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Original Article

The Effect of Preoperative Low-Level Laser Therapy on Pain, Swelling, and Trismus Associated With Extraction of The Lower Third Molar: A Case Series at The Clinics of The Faculty of Dentistry, Sana'a University, Sana'a City

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Abstract

Background and objectives: *Particularly, the most frequent postoperative consequences are thought to be discomfort, edema, and restricted mouth opening. As a biostimulant in the wound healing process, light amplification by stimulated emission of radiation (LASER) has been shown in several studies to be therapeutically helpful. It can also speed up cell and tissue regeneration and reduce postoperative discomfort. The purpose of this study was to assess the impact of low-level laser treatment (LLLT) on postoperative pain, swelling (MPS), MMO, and trismus prior to the extraction of mandibular third molars.*

Materials and methods: *Fifteen patients between the ages of 18 and 45 who had impacted mandibular third molars in comparable locations and were recommended for extraction based on radiographic and clinical evaluations were included in the research. There were two groups of patients: Ten minutes before to surgery, Group 1 had LLLT, while Group 2 (control group) had a standard extraction of an impacted tooth following the application of blue LED light. To evaluate the impact of LLLT on pain, edema, and trismus, measurements were made before surgery as well as 24 hours, 48 hours, and 7 days after surgery. The statistical analysis was conducted using Epi-info version 7. The normality of the distributions was assessed. A t-test was used to compare the control group and the laser treatment group. The criterion for significance was set at $p < 0.05$.*

Results: *The study consist of 23 female (82.14%) and 5 males (17.86%) patients, their mean age equal to 21.34±4.37 years. The results showed no significant difference in visual anisotropy scale (VAS) scores (3.2±4.4 for the laser group versus 3.2±3.9 (p>NS) for the control group) or MMO scores (28.6±2.1 cm for laser group versus 28.8±5.05 cm for the control group). However, a significant difference was observed in oral edema scores (MPS), with an MPS difference score of 25, and the difference was statistically significant at $p<0.0001$.*

Conclusion: *The study found no significant differences in pain perception contrast VAS and MMO between the laser-treated and control groups, nor did it observe superiority in trismus. However, it did have a significant effect in reducing edema. Further clinical research is required to estimate the long-term efficiency of LLLT in the surgery of maxillofacial.*

Introduction

One issue that has a detrimental effect on people's quality of life is dental impaction. The lower third molars (MTMs) are the most affected of all the teeth [1]. One of the most popular surgical techniques in dentistry is the extraction of MTMs in order to stop the issues they frequently or probably will create. Chronic pericoronitis, idiopathic face discomfort, caries of neighboring teeth, denture-related, periodontal, and orthodontic causes, as well as the development of cysts and tumors, are the most frequent reasons for MTM extraction [2,3]. Although extraction of infected lower third molars caused by infection or other pathology is recommended, there is a difference of opinion regarding the asymptomatic lower third molars prophylactic extraction [1]. Prophylactic extraction of lower third molars (MTMs) is not recommended according to the recommendations of the NICE [4]. According to Kandasamy et al. [5], "there is considerable individual variation and multiple beliefs and

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biases among practitioners, especially concerning the removal of asymptomatic or pathological lower 3rd molars, with priority given to evidence-based decision-making." The uneven and deceptive use of nomenclature creates uncertainty regarding the removal of MTMs that are asymptomatic or pathology-free [6,7]. Some research use the term "asymptomatic" to mean that there is no tooth-related disease, whereas other studies use it to mean that there are no symptoms [7]. Being asymptomatic does not always equal being disease-free, therefore there is a crucial difference between the two. Since it has been proposed that pathology always comes before symptoms, doctors would be wise to presume that pathology has developed if teeth start to show symptoms [6]. Clinical research language must precisely characterize the situation being illustrated (e.g., whether pathology is present or not); otherwise, inconsistent results would unavoidably be published. With surgical damage, the inflammatory reaction leads to the development of discomfort, edema, and trismus when affected MTMs are extracted [8]. Paraesthesia, infection, alveolitis, temporomandibular joint (TMJ) discomfort and prolonged bleeding are among the other postoperative problems that might occur [9]. The development of problems in MTM surgery is greatly influenced by a number of parameters, including the patient's age, gender, systemic health, smoking, dental hygiene status, usage of contraceptive tablets, presence of pericoronitis, and degree of impaction difficulties [10]. The occurrence of problems may also be influenced by a number of practitioner-related factors, including as the surgical technique, operation length, socket irrigation, and anesthesia techniques [10–12].

It has been recommended that nonsteroidal anti-inflammatory medicines and systemic or local corticosteroids be used to lessen discomfort and inflammation after impacted MTM surgery. Nevertheless, adverse effects include allergic responses, systemic bleeding, and gastrointestinal problems are possible with these drugs [13]. To reduce postoperative problems and promote mucosal wound healing, several approaches might be taken into account. Because it speeds up tissue restoration and wound curing at the same time as lowering swelling and pain throughout anti-inflammatory processes, low-level laser treatment (LLLT) is being utilized more and more to lessen postoperative problems after various oral cavity surgical operations [14]. It is well known that laser treatment reduces postoperative pain and speeds up tissue and cell regeneration [13]. According to research, laser treatment has biostimulator, analgesic, and anti-inflammatory properties; it also improves connective tissue flexibility and tissue nutrition; it decreases edema; it encourages lymphatic drainage; and it helps the regeneration of synovial membranes [15]. In particular, by decreasing swelling, pain; and hastening the healing of injured tissues, LLLT can regulate the inflammatory process [16]. LLLT rapidly and dramatically reduces a number of pain and inflammatory mediators, including cyclooxygenase-2 (COX-2), prostaglandin E2 (PGE2), interleukin 1 (IL-1), and tumor necrosis factor (TNF) [13].The purpose of the work is to assess how preoperative LLLT affects trismus, mouth opening, edema, and discomfort in individuals having their mandibular third tooth extracted.

Material and Methods

Study approval

Every patient gave their informed permission. The Ethics Committee at Sana'a University in Sana'a, Yemen, gave its approval to this study.

Study population

In 2023, the Faculty of Dentistry at Sana'a University reported that 27 patients, 24 of whom were female (88.9%) and 3 of whom were male (11.1%), had impacted mandibular third molars that were advised for extraction based on radiological and clinical testing.

Sample size

Establishment of study groups The necessary sample size was found to be 27 patients based on the final power analysis (95% CI level (1-α), test power 95% (1-β), effect size d=0.717).

Clinical works and parameters measuring

Both the research and control groups of our study comprised individuals who were scheduled for surgery on their impacted mandibular third molar. Ten minutes prior to surgery, the 27 patients were split into two groups. The first group got low-level laser treatment (LLLT), while the second group, known as the control group, had their impacted teeth extracted routinely following the application of blue LED light. In order to measure the facial distance and maximum mouth opening, particular anatomical locations on the face were measured both before and after surgery in order to evaluate edema and trismus. A visual analogue scale (VAS) was also used to measure pain. Preoperative, postoperative, and postoperative measurements were obtained, and the discrepancies between these time periods were evaluated by statistical analysis.

Inclusion criteria

The study included healthy patients aged 17 to 27 years, free of systemic diseases. The most common impaction among the participants was class IIB impaction, accounting for 12 cases (44.4%), followed by class IIA impaction, accounting for 9 cases (33.3%), and class IIC and IA impactions, each accounting for 3 cases (11.1%) (according to the Bell and Gregory classification), with comparable degrees of bone retention. Subsequent to acquire the patients' dental and medical records , radiographic and oral assessment were performed using routine panoramic bone imaging.

Exclusion criteria

Participants were excluded if they had systemic diseases that hindered wound healing or surgery, had been taking anti-inflammatory drugs nonsteroidal (NSAIDs) for a long time, were receiving steroid or antihistamine therapy, had allergies to every of the drugs or materials utilized in the study, were active smokers, had acute oral or extra-oral infections, were pregnant or nursing, were contraindicated for laser treatment, or were unable to attend follow-up exams.

Laser therapy (LLLT) treatment

After reading and signing an informed consent form that had been authorized by the Committee of the Ethics, all participants were initially briefed about the risks associated with the operation and therapy. Measurements required to evaluate edema and trismus preoperatively were made prior to the surgery and documented in the report form of the case.

In addition, a diode laser (indium gallium arsenide phosphor, or InGaAsP), Biolase Epic, with a wavelength of 940±10 nm, a power output of 0.1 W, a continuous mode of 35 J/cm², a fiber tip diameter of 300 μm, a frequency of 50/60 Hz, and a biostimulation head with a spot mass of 1×3 cm, was used to administer low-level laser therapy. There was one intraoral phase and one extraoral phase in each patient's low-level laser

treatment session. In particular, the laser was delivered intra-orally for 60 seconds to the buccal area of the alveolar socket of the teeth to be removed, extra-orally for 60 seconds to the chewing region, 1 cm from the skin, and lingually for 60 seconds. The laser was administered in circular motions while staying one centimeter away from the gums and chewing region.

Surgical procedure

All patients received buccal anesthetic and block the inferior alveolar nerve prior to the removal of the impacted third molar. Following anesthesia, a No. 15 scalpel was used to make a horizontal incision and a buccal relaxation incision. A mucoperiosteal full-thickness flap was then raised. A microsurgical motor and circular burs made of steel or tungsten carbide were applied to amputate the buccal bone and, if required, segment the teeth while being irrigated with saline. After removing the bone around the impacted tooth on the right and left sides, a cleavage point was created between the tooth and the cortical bone in the buccal and medial regions. A bone elevator was then used to extract the tooth from the alveolar cavity. The alveolar cavity was cleared of any leftover debris, bone, and epithelium following tooth extraction. To guarantee hemostatic bleeding, the cavity was irrigated by means of 0.9% isotonic sodium chloride saline, and the wound margins were mostly sutured with silk using 3/0, 18 mm, 75 cm, and 3/8 gauge needles. One surgeon, Dr. Ahmed Al-Ashwal, carried out all of the procedures in order to reduce the disparities in expertise amongst the many doctors. With one assessor not knowing the group assignment, a double-blind, randomized design was used to exclude any possibility of bias in the current study outcomes. Patients received information on how to take care of themselves after surgery.

Postoperative Prescriptions and Recommendations

All patients were given the following prescription drugs to take for a week following surgery in order to assess how successfully laser therapy reduced facial swelling: 500 mg of paracetamol twice a day; 120 mg (0.12%) chlorhexidine gluconate + 150 mg (0.15%) benzydamine hydrochloride, three times a day from the first surgical day to the removal of the sutures (7 days); and 875 mg amoxicillin + 125 mg clavulanic acid, twice a day at 12-hour intervals. Measurements of pain, edema, and muscular spasm were taken again on the second and seventh postoperative days, and any variations were examined. Measures of pain, edema, and muscle spasm were taken before and after surgery on two groups of patients. After then, the data were aggregated for statistical examination.

Evaluation of postoperative complications Visual analog scale (VAS) pain assessment

Subjective characteristics that cannot be measured scientifically can be measured using the visual analogue scale (VAS).The two endpoints of the 10-cm scale are labeled to indicate the maximum values of the parameter being estimated. The patient is asked to mark a point on the scale to represent their level of pain. Postoperative pain was measured using a 10-cm VAS, which has a range of 0 (no pain or discomfort) to 10 (highest pain or discomfort). After teaching the patient how to use the scale to gauge their level of discomfort, assessments were carried out on the second and seventh postoperative days.

Evaluation of swelling

The face distance was calculated to evaluate the postoperative swelling by comparing the lengths between certain anatomical reference points (Tragus-Labial Commissure, Gonion-Lateral Cantus, and Gonion-Labial Commissure) before and after surgery. The face distance was then calculated by adding together these measurements and dividing the result by three. A tape measure was used to measure the separations between the locations. Prior to surgery and on the second and seventh postoperative days, measurements were made. The percentage increase in facial breadth was used to represent the postoperative swelling. The percentage of cheek swelling on the first and seventh days following surgery was calculated using the preoperative measurements as a reference.

Evaluation of trismus

To assess postoperative trismus, the distance between the incisal edges of the mandibular and maxillary central incisors was measured with a scalpel handle both before to surgery and on the second and seventh postoperative days. The greatest amount of mouth opening was noted.

Statistical analysis

Epi-info version 7 was used for the statistical analysis. The distributions' normality was evaluated. The laser treatment and control groups were compared using the using a t-test . A significant threshold of $p < 0.05$ was established.

Results

Table 1: *Age and gender distribution of patients whom under take preoperative low-level laser therapy on mandibular third molar extraction Sana'a city, Yemen.*

Characters	N (%)
Sex	
Male	3 (11.1)
Female	24 (88.9)
Age groups (years)	
Less than 20 years	6 (22.2)
20 -24 years	12 (44.4)
≥25 years	9 (33.3)
Total	27 (100)
Mean age	23.25 years
SD	3.9 years
Median	24 years
Mode	27 years
Min - Max	17 years - 27 years

Table 2: *Distribution of Pell and Gregory classifications (tooth impaction) of patients who underwent preoperative low-level laser treatment for lower third molar extraction in Sana'a City, Yemen*

Classification	N (%)
IA	3 (11.1)
IIA	9 (33.3)
IIB	12 (44.4)
IIC	3 (11.1)
Total	27 (100)

Table 3: *The extraction difficulty index of mandibular third molar extraction Sana'a city, Yemen*

Extraction difficulty degree	N (%)
Minimally difficult (3-4)	6 (22.2)
Moderately difficult (5-6)	12(44.4)
Very difficult (7-10)	9 (33.3)
Mean	5.4
SD	1.4
Median	5
Mode	5
Min to Max	3- 7
Total	27 (100)

Table 4: *The pain degree by visual analogue scale (VAS) for mandibular third molar extraction patients, Sana'a city, Yemen*

The pain degree (VAS)	N (%)
0 degree	15 (55.6)
5	3 (11.1)
7	3 (11.1)
8	3 (11.1)
9	3 (11.1)
Mean	3.2
SD	3.9
Median	0.0
Mode	0.0
Min to Max	0.0 - 9
Total	27 (100)

Table 5: *The maximum mouth opening (MMO) for mandibular third molar extraction patients, Sana'a city, Yemen*

The maximum mouth opening (MMO)	N (%)
≤25	6 (22.2)
26-28	6 (22.2)
29 -31	12 (44.4)
≥ 32	3 (11.1)
Mean	28.7 cm
SD	3.4 cm
Median	30 cm
Mode	30 cm
Min to Max	23- 35 cm
Total	27 (100)

Table 1 shows the age and gender distribution of patients receiving low-level laser therapy prior to extraction surgery. The study included 3 males (11.1%) and 24 females (88.9%). The mean age ± standard deviation was 23.25 ± 3.9 years, with a range of 17–27 years. Table 2 shows the distribution of Bell and Gregory impaction classifications in patients who underwent preoperative low-level laser treatment for mandibular third molar extraction in Sana'a, Yemen. The most common impaction was Class II B, accounting for 12 cases (44.4%), followed by Class II A, accounting for 9 cases (33.3%), and Class IIC and Class I A, accounting for 3 cases (11.1%) each.

Table 3 shows the Pedersen Difficulty Index (PDI) for the surgery of impacted third molar (ITM) for patients in Sana'a, Yemen. The mean ± standard deviation of the PDI for ITM extraction was 5.4 ± 1.4, with a range of 3–7. Slight difficulty was found in 6 cases (22.2%), moderate difficulty in 12 cases (44.4%), and severe difficulty (7–10) in 9 cases (33.3%) of the total. Table 4 shows the visual analogue scale (VAS) pain scores

Table 6: *The mouth edema degree (MPS) for mandibular third molar extraction patients, Sana'a city, Yemen*

The mouth edema degree (MPS)	N (%)
< 10	9 (33.3)
10 - 12	9 (33.3)
≥ 12.1	9 (33.3)
Mean	10.75
SD	1.8
Median	10.5
Mode	10
Min to Max	8 - 13
Total	27 (100)

Table 7: *The trismus occurring before, immediately, 2nd day and 7th day after extraction of the mandibular third molar, Sana'a city, Yemen*

The trismus	N (%)
Before extraction	6 (22.2)
Immediately after extraction	3 (11.1)
2nd day after extraction	21 (77.7)
In 7th day after extraction	0 (0.0)

Table 8: *Comparison of pain scores (VAS) for patients who underwent laser treatment and the control group for lower third molar extraction, Sana'a City, Yemen*

The pain degree (VAS)	Laser group	Control group
	N (%)	N (%)
0 degree	9 (60)	6 (50)
5	0 (0)	3 (25)
7	3 (20)	0 (0)
8	0 (0)	3 (25)
9	3 (20)	0 (0)
Mean	3.2	3.2
SD	4.4	3.9
Median	0	2.5
Mode	0	0
Min to Max	0-9	0-8
Total	15 (55.6)	12 (44.4)

of patients with lower ITM extraction in Sana'a, Yemen. The mean ± standard deviation of the VAS scores was 3.2 ± 3.9, with a range of 0.0–9. Most patients (15 patients, 55.5%) did not experience any pain. Severe pain was present in 9 patients (33.3%), while moderate pain was present in 3 patients (11.1%).

Table 5 shows the maximum mouth opening (MMO) of patients with MITM extractions. The mean ± standard deviation of MMO was 28.7 ± 3.4 cm, with a range of 23–35 cm. Most patients had MMOs of 29–31 cm, with 12 cases (44.4%), followed by 26–28 cm, and ≤25 cm, with 6 cases (22.2%) in both groups. Only three cases (11.1%) had MMOs of 32 cm or greater. Table 6 shows the oral edema score (MPS) for patients with lower ITM extractions. The mean ± standard deviation of the MPS was 10.75 ± 1.8, with a range of 8 to 13. Nine (33.3%) patients had an MPS of <10, and similar numbers occurred in the 10-12 and ≥12.1 groups.

Table 7 shows the incidence of mandibular spasm before, immediately after, on the second day, and on the seventh day after lower third molar extraction in our patients. Most patients experienced mandibular spasm on the second day after extraction (21 patients (77.7%)), while no case developed mandibular spasm (trismus) on the seventh day after extraction.

Table 8 shows a comparison of the pain scores (VAS) of patients who undertaken laser treatment and the control group for lower ITM extraction. The mean ± standard deviation of the VAS scores was 3.2 ± 4.4, with a range of 0.0–9 for the laser group, and similar scores for the control group (3.2 ± 3.9, with a range of 0.0–8). The differences were not significant, indicating that preoperative laser treatment had no effect on pain relief.

Table 9 shows a comparison of the MMO of the laser-treated and control group of lower ITM extraction patients. The mean ± standard deviation of the MMO scores was 28.6 ± 2.1 cm, with a range of 25–30 cm, for the laser group and almost identical to the scores for the control group (28.8 ± 5.05 cm, with a range of 23–35 cm). The differences were not statistically significant, indicating that preoperative laser treatment had no effect on increasing MMO.

Table 11 shows a comparison of the oral edema score (MPS) for patients who underwent laser treatment and the group of comparative control for extraction of lower ITMs, using a t-test. A significant difference was observed between the case and control groups, with the MPS difference score reaching 25 and the difference being statistically significant at $p < 0.0001$, indicating a positive effect of preoperative laser treatment on lysis edema in the laser group compared to the control group.

Table 12 shows a comparison of jaw trismus in patients who underwent laser treatment and the control group for extraction of lower ITMs. Immediately after extraction, 3 (20%) of the laser-treated group developed trismus, while none of the control group experienced trismus. On the next day following extraction, 9 (60%) of the laser-treated group developed trismus, while all 12 of the control group experienced trismus. On the seventh day after extraction, no trismus was recorded in either group.

Table 9: *Comparison of the maximum mouth opening (MMO) for patients who underwent laser treatment and the control group for lower third molar extraction, Sana'a City, Yemen*

The maximum mouth opening (MMO)	Laser group	Control group
	N (%)	Control group
N (%)	9 (60)	6 (50)
≤25	3 (20)	3 (25)
26-28	3 (20)	3 (25)
29 -31	9 (60)	3 (25)
≥ 32	0 (0)	3 (25)
Mean	28.6	28.8
SD	2.1	5.05
Median	30	28.5
Mode	30	23
Min to Max	25-30	23-35
Total	15	12

Table 10: *Comparison of the mouth edema degree (MPS) for patients who underwent laser treatment and the control group for lower third molar extraction, Sana'a City, Yemen*

The mouth edema degree (MPS)	Laser group	Control group
	N (%)	Control group
N (%)	9 (60)	6 (50)
< 10	8 (53.3)	1 (8.3)
10 - 12	7 (46.7)	2 (16.6)
≥ 12.1	0 (0.0)	9 (75)
Mean	9.2	12.3
SD	0.95	0.86
Median	9.5	12.5
Mode	10	12.5
Min to Max	8 - 10	11-13
Total	15	12

Table 11: *Comparison of the mouth edema degree (MPS) for patients who underwent laser treatment and the control group for lower third molar extraction, Comparison of two independent means (t-test).*

Difference	3.100
Standard error	0.353
95% CI	2.3729 to 3.8271
t-statistic	8.781
DF	25
Significance level	P < 0.000

Table 12: *Comparison of the trismus in patients who underwent laser treatment and the control group of the lower third molar extraction, Sana'a City, Yemen(t-test).*

The trismus	Laser group N (%)	Control group N (%)
Before extraction	6 (40)	0 (0)
Immediately after extraction	3 (20)	0 (0)
2nd day after extraction	9 (60)	12 (100)
In 7th day after extraction	0 (0)	0 (0)

Discussion

Of all impacted third molars, MITM are reported to have the greatest impaction rate. Third molar surgery is among the most frequent procedures performed by oral and maxillofacial surgeons. Certain inevitable difficulties may still arise even with the proper use of postoperative patient preparation concepts, the use of novel surgical procedures, and careful management of both hard and soft tissues to minimize postoperative complications. Specifically, the most frequent postoperative consequences are thought to be discomfort, edema, and restricted mouth opening [2]. After surgery, pain peaks three to five hours after the procedure, lasts for two to three days, and then progressively subsides seven days later. Furthermore, edema peaks 12 to 48 hours after surgery and then progressively subsides until the seventh day. It has been recommended that non-steroidal anti-inflammatory medicines and systemic or local steroids be used to lessen pain and inflammation after surgery of third molar; on the other hand, these treatments have a number of adverse effects, including as allergic responses, systemic bleeding, and gastrointestinal problems. Since a biostimulant in the injury curative process, light magnification by stimulated emission of radiation (LASER) has been shown in several studies to be therapeutically helpful [2,17]. Studies have demonstrated that laser therapy can reduce postoperative pain and hasten tissue and cell regeneration [18, 19]. Early in the 1970s, LLLT was first used in oral surgery and dentistry [18]. The effectiveness of LLLT in treating edema and trismus after ITM extractions has been the subject of multiple research, although the results are still mixed; some claim positive outcomes, while others do not [20]. Numerous factors for low-level laser treatment have been discussed in the literature [20, 21].

The current study compared pain scores (VAS) and MMO of patients who undertaken laser treatment and a control group for lower TM extraction. The results showed no significant difference in VAS scores or MMO between the laser and control groups. However, a significant difference was observed in oral edema scores (MPS) between the laser and control groups, indicating a positive effect of preoperative laser treatment on lyses edema. Additionally, jaw trismus was observed in the laser-treated group, and control group in similar level. The use of an 810 nm wavelength laser (100 mW, 4 J/cm2) intraorally and extraorally following the surgical excision of MTMs did not have a statistically significant impact on postoperative discomfort, edema, or trismus, according to Amarillas Escobar et al. [27]. Our findings for trismus, MMO, and VAS are similar to theirs.

Eshghpour et al. [21] evaluated the impact of LLLT on reducing postoperative pain and edema after MTM extraction in a split-mouth randomized controlled trial (RCT). The study comprised forty participants with comparable bilateral impacted wisdom teeth.

The experimental group was assigned at random to one side, and the control group was assigned to the other side. On the experimental side, low-level laser treatment was administered intraorally at a wavelength of 660 nm (200 mW, 6 J per point at 4 sites) and extraorally at a wavelength of 810 nm (200 mW, 6 J per point at 3 locations). The 810 nm irradiation was repeated on the second and fourth postoperative days. The control group did not get laser treatment, however they did receive the same normal postoperative care as the experimental group. Patients were advised to take 500 mg of amoxicillin every 8 hours for seven days, 400 mg of ibuprofen every eight hours, and a mouthwash containing 0.12% chlorhexidine twice a day for ten days as part of their postoperative regimen. According to the results, the experimental group's pain and edema were noticeably lower than those of the control group.

In our investigation, low-level laser treatment (LLLT) (parameters: wavelength 940±10 nm, power output 0.1 W, 35 J/cm^2) was carried out as a single preoperative session during the extraction of impacted mandibular third molars, which is different from the work by Eshgbour et al., [21]. Additionally, NSAIDs were replaced with paracetamol-containing analgesics (PAROL). When compared to the control group, the laser-treated group showed no discernible change in discomfort or trismus, although there were noticeable impacts on edema. In a research including 100 patients, Martinez et al. [23] investigated the efficacy of helium-neon laser therapy for the prevention of discomfort, edema, and trismus after the surgery of third molar. Three groups of participants were assigned to receive ibuprofen, neon laser therapy, or a placebo. Both the neon laser and ibuprofen groups showed a substantial decrease in trismus, according to their findings. But compared to the placebo and laser groups, the ibuprofen group experienced less discomfort. All groups had similar levels of edema, trismus, and inflammation, which is in line with our findings for pain and trismus alone but not swelling.

Kazancioglu et al. [24] investigated the effectiveness of LLLT and ozone therapy in treating trismus, discomfort, and edema after third molar surgery (TMS) in 60 patients with asymptomatic ITMs. Three groups of twenty patients each were randomly assigned to undergo low-level laser treatment (wavelength 810 nm, 200 mW) for 30 seconds, ozone therapy for another group, and a control group for their third group. Comparing of controls, the ozone and LLLT patients both experienced less discomfort and used analgesics less often. Trismus was much reduced in the LLLT patients than in the ozone therapy and controls. These results are not consistent with our study, and there is no clear explanation for this difference.

In our study, a significant diversity was found between the cases and controls, with the MPS difference score reaching 25 and the difference being statistically significant at $p < 0.0001$, indicating a positive effect of preoperative laser treatment on hemolytic edema in the laser group compared to the control group. This result is similarly comparable to that of Kazancioglu et al. [24], who found that ozone therapy did not significantly improve edema management whereas LLLT successfully decreased swelling. These findings imply that ozone therapy and LLLT might enhance patient comfort and reduce postoperative discomfort. 1000 mg of amoxicillin and 550 mg of naproxen sodium were administered orally as part of the postoperative treatment, along with a mouthwash containing 0.2% chlorhexidine (applied for one minute, three times a day for seven days). Additionally, patients were told to place an ice pack on the surgery site for half an hour.

Following lower third molar surgery, Goran Patingan et al.'s study [25] sought to examine the combined anti-inflammatory benefits of photodynamic therapy and low-level laser treatment on wound healing, pain, edema, halitosis, and the usage of analgesics. According to the findings, using a 660 nm laser with 3 kW of power and 4 J of intensity throughout the study period considerably decreased the need for postoperative analgesics. The results showed that laser therapy dramatically decreased postoperative problems in lower third molar surgery, with the laser-treated group showing outstanding outcomes.

In order to treat IMTM extractions, Ferranti et al. [20] studied two groups that received treatment with a 980 nm diode laser, administering 54 J of energy intraorally and extraorally within 24 hours following surgery. Following surgery, they noted the number of days and degree of discomfort. There was no discernible difference in pain levels between the LLLT patients and the controls, according to statistical analysis, but there were notable changes in muscular spasm and edema. They observed that extraoral application of LLLT was more successful than intraoral application.

Mixed findings have been found in systematic reviews and meta-analyses on the advantages of LLLT following surgery for an ITM. Brignardello-Petersen et al. [26] shown in their meta-analysis that LLLT had no impact on pain or edema and had a moderate effect on lowering mandibular spasm. Similarly, Dawdy et al. [27] reported no significant effects of LLLT in avoiding postoperative complications in their 2017 comprehensive review and meta-analysis. The impact of LLLT on pain and edema following bilateral MTM extractions was examined by Cloki et al. [24], Fernando et al. [28], and Taube et al. [29]. Similarly, after bilateral MTM extractions carried out in two different surgical sessions, Roynesdal et al. [30] assessed the impact of LLLT on edema, discomfort, and mandibular spasm. All investigations found that LLLT did not significantly reduce edema or muscle spasm following extraction, even when different laser settings were used. This is comparable to the present study's findings. A statistically significant decrease in pain was observed on the day of surgery and the first postoperative day, according to Cloki et al. [31]. While there was no change in the proportion of edema or discomfort between the laser and placebo groups, Carillo et al. [23] reported a statistically significant decrease in trismus in the laser group up to seven days after surgery. Neckel and Kukizl [32] examined two patient groups who had their MTM extracted using a diode laser that administered 11 J/cm2 of energy intraorally at 810 nm. The duration and severity of postoperative discomfort were noted. Significant variation were found by statistical analysis, indicating that the tested group incident less discomfort and for a shorter period of time than the controls.

Variation in laser factors, such as pre- and/or post-operative protocols, energy levels, wavelength, energy density, power output, radiation duration and frequency, intraoral in opposition to extraoral treatment, irradiated area, and medical treatments administered, may be responsible for the discrepancies between the results of our study and those of previous studies.

Limitations

Our study had a rather small sample size. Therefore, in order to assess the advantages of LLLT in the surgery of maxillofacial oral surgery, more clinical research with bigger populations is required. Additionally, we think that evaluating postoperative swelling brought on by edema utilizing 3D pictures may yield more objective swelling measurement findings than existing techniques.

Conclusion

TIn conclusion, no statistically significant variations in visual anisotropy scale (VAS) ratings between the laser-treated group and the control group were found over the two periods of our study. Statistical analysis did not establish that the laser-treated group was superior in terms of trismus, despite the fact that they had a decrease in edema. More extensive clinical study is needed to assess the long-term efficacy of low-level laser treatment in oral and maxillofacial surgery. Additionally, we think a more thorough investigation is required to look at how laser settings affect research results.

Data availability

The accompanying author can provide the empirical data that were utilized to support the study's conclusions upon request.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Ahmed Abdulah Al-Ashwal: writing original draft, methodology, investigation, formal analysis, data curation, conceptualization. Al-Shamahy H: writing, review and editing, methodology.

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