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EFFECT OF LOW LEVEL LASER THERAPY ON MANDIBULAR EDEMA - A REVIEW STUDY

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Abstract:
Mandibular third molars surgery and removal is one of the most common outpatient surgical procedure, which causes degree of pain, swelling, and trismus after the surgery. The recommended local or systemic drugs may manifest side effects .i. e GIT irritations, bleeding, gastric problems. Non medication methods i. e Low level laser therapy (LLLT) is also known as 'soft laser therapy' and bio-stimulation. LLLT may have significant neuropharmacological effects in the synthesis, release, and metabolism of a series of biochemical substances, such as the increase in serotonin and acetylcholine production at a central level, and by modulating key mediators of inflammation at a peripheral level, such as histamine and prostaglandins. It has also been demonstrated that the LLLT induces analgesia by stimulating the synthesis of endogenous endorphins (β-endorphin), decreasing the activity of C-fibers and bradykinin, and altering the pain threshold. This method is highly useful for treatment of such surgical removed teeth conditions.
Key words: Mandibular third molars surgery, mandibular edema, Low level laser therapy (LLLT)

Introduction

Surgical removal of impacted mandibular third molars is one of the most common outpatient surgical procedures. It is also the most commonly performed procedure in oral and maxillofacial surgery around the world.[1-3] Nearly all patients undergoing surgical removal of mandibular third molars develop some degree of pain, swelling, and trismus after the surgery[3-7]. After local anesthesia wears off, pain usually reaches to maximum intensity 3 to 5 hours after surgery, continuing for 2 to 3 days, and gradually diminishing until the seventh day.[8,9] Swelling reaches peak intensity in 12 to 48 hours, influencing facial esthetics and social interactions. It usually resolves between the fifth and seventh days. As the pain and swelling subside, trismus decreases.[9] The use of local or systemic corticosteroids and nonsteroidal anti-inflammatory drugs are often recommended, but the majority of them may manifest side effects such as a tendency to systemic bleeding, gastrointestinal irritation, and allergic reactions.[10-13] These observations justify efforts to find a new method of postoperative pain control that does not induce side effects.[13] Nonmedication methods used to minimize tissue injury after third-molar extraction include compression, cryotherapy, and laser application.[12-14] Low-level laser therapy (LLLT) seems to offer many benefits in controlling the inflammatory process by reducing swelling, pain, and by promoting the healing of the tissues, without having adverse effects in patients.[13,15]

Low level laser therapy (LLLT) is also known as 'soft laser therapy' and bio-stimulation. The use of LLLT in health care has been documented in the literature for more than three decades.[16] The use of laser as a therapy was first described by Mester et al[17] in 1971, who concluded that low-level laser energy irradiation (LLEI) stimulates wound regeneration. Since then, laser therapy has been used for treating different syndromes and diseases, including dentin hypersensitivity,[18-22] temporomandibular joint disorders,[23-25] oral mucositis,[26,27] injury to the inferior alveolar nerve,[28] and sagittal ramus osteotomy.[29] For more than 40years, low-level laser therapy (LLLT) has been employed in medicine and dentistry because of its analgesic, biostimulative, and anti-inflammatory effects and its great benefits in accelerating the healing process.[30]

The exact biological mechanism of the analgesic effect produced by the LLLT still remains unclear. There is evidence to suggest that the LLLT may have significant neuropharmacological effects in the

synthesis, release, and metabolism of a series of biochemical substances, such as the increase in serotonin and acetylcholine production at a central level, and by modulating key mediators of inflammation at a peripheral level, such as histamine and prostaglandins. It has also been demonstrated that the LLLT induces analgesia by stimulating the synthesis of endogenous endorphins (β-endorphin), decreasing the activity of C-fibers and bradykinin, and altering the pain threshold.[15,31,32] The anti-inflammatory effect of the LLLT could be due to an increase of the phagocytic activity, the number and diameter of lymphatic vessels, a decrease in the permeability of blood vessels and a restoration of microcapillary circulation, normalizing the permeability of vascular walls, and decreasing edema. Recently, it has been shown that LLLT induce morphological neurons changes, reduce the mitochondrial membrane potential, and block the fast axonal flow, leading to neural conduction blockage.[15,33] To the best of our knowledge till date no studies have been conducted on the effect of LLLT after mandibular third molar surgery on Indian population. Therefore, the rationale of this study was to evaluate the effect low power laser therapy in reducing the post operative complications after mandibular third molar surgery.

Literature review

E. Mester, T. Spiry, B. Szende, Jolan G. Tota (1971) conducted the study to evaluate the effect of laser rays on wound healing. Low doses of laser were found to stimulate the regeneration not only of mechanically induced wounds but also of burns. The wound-healing stimulated by laser radiation involved an increased rate of epithelial growth, which may eventually be the starting point of neoplastic growth.[17] The effect of helium-neon (He-Ne) laser on the prevention of pain, swelling and trismus following the removal of an impacted third molar was studied in 100 patients randomly allocated to receive He-Ne laser, ibuprofen or placebo in a prospective double-blind parallel clinical trial conducted by Carrillo JS , Calatayud J, Manso FJ, Barberia E, Martinez JM, Donado M. (1990). Trismus was significantly reduced in the He-Ne laser and ibuprofen treatment groups. Pain was significantly less in the ibuprofen group with regard to He-Ne laser and placebo groups. Swelling was the same in the three treatment groups.[34]

Troullos ES, Hargreaves KM, Butler DP, Dionne RA (1990) compared two nonsteroidal anti-inflammatory drugs (NSAIDs), flurbiprofen and ibuprofen, with a prototype glucocorticoid, methylprednisolone, in two replicate placebo-controlled studies for suppression of inflammation due to the surgical removal of impacted third molars. The results indicated that NSAIDs produce greater initial analgesia than did steroids, whereas steroids resulted in greater suppression of swelling and less loss of function. Examination of the pooled data from the two studies indicated that NSAID pretreatment resulted in a modest suppression of swelling in comparison with placebo. The data suggested that the acute analgesic effects of NSAIDs in the oral surgery model were due to suppression of a nociceptive process, presumably prostaglandin formation, rather than a generalized anti-inflammatory effect.[35]

Røynesdal AK, Björnland T, Barkvoll P, Haanaes HR (1993) conducted a double-blind, crossover study to evaluate the effect of soft-laser application on postoperative pain and swelling . Twenty-five healthy adults with bilateral identically impacted lower third molars were selected for this study. The teeth were removed in two separate operations. Laser treatment was tested in comparison with placebo laser, with a 40-mW, 830-nm Biophoton laser (Roenvig Dental, Denmark). All surgical procedures and measurements were done by the same surgeon. The following features were statistically analyzed: swelling, trismus, and subjective registration of pain on a visual analog scale. No statistically significant differences were observed in comparison of the experimental side with the placebo side. It was concluded that soft-laser treatment had no beneficial effect on swelling, trismus, and pain after third molar surgery.[36]

Fernando S, Hill CM, Walker R. (1993) conducted a randomised, double blind comparative study to assess the efficacy of low level laser therapy in the reduction of postoperative pain and swelling in patients undergoing the extraction of bilaterally impacted mandibular third molar teeth. Healing of the sockets was also compared after 1 week. A group of 64 patients had one randomly-selected operation side treated with a semi-conductor laser and the other side with an apparently identical but non-operating model. Complete data were obtained from 52 of the 64 patients. The results showed that there was no evidence of a difference in pain and swelling on the third day after operation between laser and placebo sides. There was no difference between the

two sides when they were assessed for healing 7 days after surgery.[37]

Iijima K, Shimoyama N, Shimoyama M, Mizuguchi T (1993) conducted a study to investigate the effect of the He-Ne laser (continuous wave, lambda = 632.8 nm, 8.5 mW in power) irradiation on human erythrocyte deformability. Blood samples were obtained from hematologically normal adult donors by venipuncture. Red cells were washed and adjusted to 30% Ht with 0.9% NaCl solution (pH 7.00). Red cell solution samples were assigned to three groups. Each sample was divided into seven 3-ml working aliquots. The aliquots in Group I were irradiated for 0 (control), 1, 3, 5, 10, 15, and 30 min within 2 hr after sampling. The aliquots in Group 2 and Group 3 were stored at 5 degrees C for 24 and 36 hr, respectively, and received similar irradiations after 12 hr (in both groups), 24 hr (in Group 2), and 36 hr (in Group 3) from sampling. Red cell deformability was measured by the Nuclepore filter filtration and presented as the filter filtration rate (FFR). The deformability shown as FFR was unchanged in Group 1 (fresh cell group) from the control value, but improved significantly in Groups 2 and 3 (damaged cell groups) after the irradiation. The results suggested that the irradiation of low-powered He-Ne lasers improved cytoskeletal protein activities in damaged erythrocytes.[38]

Marković AB, Todorović L. (2006) conducted a study (1) to evaluate he postoperative analgesic efficacy, comparing long-acting and intermediate-acting local anesthetics; and (2) to compare the use of low-power laser irradiation and the nonsteroid anti-inflammatory drug diclofenac, which were claimed to be among the most successful aids in postoperative pain control. A twofold study of 102 patients of both sexes undergoing surgical extraction of LTM was conducted. In the first part of the study, 12 patients with bilaterally impacted LTMs were treated in a double-blind crossover fashion; local anesthesia was achieved with 0.5% bupivacaine plain or 2% lidocaine with 1:80.000 epinephrine. In the second part of the study, 90 patients undergoing LTM surgical extraction with local anesthesia received postoperative low-power laser irradiation (30 patients) and a preoperative single dose of 100 mg diclofenac (30 patients), or only regular postoperative recommendations (30 patients). The results of the first part of the study showed a strikingly better postoperative analgesic effect of bupivacaine than lidocaine/epinephrine (11 out of 12; 4 out of 12, respectively, patients without postoperative pain). In the second part of the study, low-powerlaser irradiation significantly reduced postoperative pain intensity in patients premedicated with diclofenac, compared with the controls. Provided that basic principles of surgical practice have been achieved, the use of long-acting local anesthetics and low-powerlaser irradiation enabled the best postoperative analgesic effect and the most comfortable postoperative course after surgical extra ction of LTMs.[39]

Lucía Lago-Méndez, Márcio Diniz-Freitas, Carmen Senra-Rivera, Francisco Gude-Sampedro, José Manuel Gándara Rey, and Abel García-García (2007) investigated the influence of surgical difficulty on postoperative pain after extraction of mandibular third molars. A prospective study was performed of 139 patients who underwent a total of 157 mandibular third molar extractions. For evaluation of surgical difficulty, a 4-class scale was completed after surgery: I, extraction with forceps only; II, extraction requiring osteotomy; III, extraction requiring osteotomy and coronal section; IV, complex extraction (root section). The duration of surgery was also recorded. Postoperative pain was evaluated using a visual analog scale that each patient completed daily until day 6 post surgery, at which time the sutures were removed. A statistically significant relationship was observed between surgical difficulty (as rated on the scale) and postoperative pain. Longer interventions generally produced more pain. They concluded that pain after extraction of a mandibular third molar increased with increased surgical difficulty and duration of the intervention.[7]

Mutan Hamdi Aras and Metin Güngörmüs (2009) conducted a study in thirty two patients who were to undergo surgical removal of lower third molars. The purpose of this study was to evaluate the effect of low-level laser therapy (LLLT) on postoperative trismus and edema after the removal of mandibular third molars. Patients were randomly allocated to two groups, LLLT and placebo. Patients in the LLLT group received 12 J (4 J/cm2) low-level laser irradiation to the operative side intraorally 1 cm from the target tissue, and to the masseter muscle extraorally immediately after surgery. In the placebo group the handpiece was inserted into the operative side intraorally and was applied to the masseter

muscle extraorally each for 1 min, but laser power was not activated. Interincisal opening and facial swelling were evaluated on postoperative days 2 and 7. Student's *t*-test used to analyze the data. It was determined that the trismus and the swelling in LLLT group were significantly less than in the placebo group on postoperative days 2 and 7. Within the limitations of this study it was concluded that LLLT was beneficial for the reduction of postoperative trismus and swelling after third molar surgery.[40]

Mutan Hamdi Aras & Metin Güngörmüş (2009) conducted a Placebo-controlled randomized clinical trial of the effect two different low-level laser therapies (LLLT)—intraoral and extraoral—on trismus and facial swelling following surgical extraction of the lower third molar.The purpose of this study was to compare the effects of extraoral and intraoral low-level laser therapies (LLLT) on postoperative trismus and oedema following the removal of mandibular third molars. Forty-eight patients who were to undergo surgical removal of their lower third molars were studied. Patients were randomly allocated to one of three groups: extraoral LLLT, intraoral LLLT, or placebo. In the study, a Ga-Al-As diode laser device with a continuous wavelength of 808 nm was used, and the laser therapy was applied by using a 1×3-cm handpiece. The flat-top laser beam profile was used in this therapy. For both of the LLLT groups, laser energy was applied at 100 mW (0.1 W) for a total of 120 s (0.1 W×120 s=12 J). Patients in the extraoral-LLLT group (n=16) received 12-J (4 J/cm2) low-level laser irradiation, and the laser was applied at the insertion point of the masseter muscle immediately after the operation. Patients in the intraoral-LLLT group (n=16) received 12-J (4 J/cm2) low-level laser irradiation intraorally at the operation site 1 cm from the target tissue. In the placebo group (n=16), the handpiece was inserted intraorally at the operation site and then was touched extraorally to the masseter muscle for 1 min at each site (120 s total), but the laser was not activated. The size of the interincisal opening and facial swelling were evaluated on the second and seventh postoperative days. At the second postoperative day, trismus (29.0± 7.6 mm [p=0.010]) and swelling (105.3±5.0 mm [p=0.047]) in the extraoral-LLLT group were significantly less than in the placebo group (trismus: 21.1±7.6 mm, swelling: 109.1± 4.4 mm). Trismus (39.6±9.0 mm [p=0.002]) in the extraoral-LLLT group at the seventh postoperative day was also significantly less than in the placebo group (29.0± 6.2 mm). However, at the seventh postoperative day in the intraoral-LLLT group, only trismus (35.6±8.5 [p=0.002]) was significantly less than in the placebo group (29.0± 6.2 mm). This study demonstrated that extraoral LLLT was more effective than intraoral LLLT for the reduction of postoperative trismus and swelling after extraction of the lower third molar.[41]

Hanaa El Shenawy, Neveen Helmy Aboelsoud, Ahmed Abbass Zaki, Mohamed El Zawahry, Amr Shaibeta (2010) conducted a study to compare the use of low-power laser irradiation and the non-steroidal anti-inflammatory drug diclofenac sodium, as dental analgesic postoperative tools. Ninety patients undergoing non- surgical extraction of lower third molar with local anaesthesia (2% lidocaine with epinephrine 1:80.000) were enrolled in this study. Sixty received a preoperative single dose of 100 mg diclofenac sodium; thirty patients of them had postoperative low power laser irradiation in addition. They were compared to a third group with only regular postoperative recommendations (30 patients). Results showed that low-power laser irradiation significantly reduced postoperative pain intensity than in patients pre-medicated with diclofenac alone, or depend only on regular recommendations (controls). They suggested that the use of low-power laser irradiation enabled the best postoperative analgesic effect and the most comfortable postoperative course after non surgical extraction of lower third molar than non-steroidal anti-inflammatory drugs or regular postoperative treatment.[42]

Ana Pejcic, Draginja Kojovic, Ljiljana Kesic and Radmila Obradovic (2010) evaluated the effects of low level laser irradiation treatment and conservative treatment on gingival inflammation in 60 patients. Based on the analysis, the following conclusions were made:

1. Upon application of laser therapy, a decrease in plaque values can be noted, but the decrease is not statistically significant.

2. There is a statistically significant improvement in values of gingival index and bleeding index obtained after laser application, especially over a longer period of time, which was revealed by the controls three and six months after irradiation.

3. This study clearly shows that the number of laser applications is important for obtaining better results with the irradiated tissue. Namely, after the fifth application, a considerable anti-inflammatory effect was achieved.

4. Based on the reported results, we can reach a general conclusion that low level laser therapy (semiconductor, 670nm) can be used as a successful adjuvant, physical method of treatment which, combined with traditional periodontal therapy, ensures better treatment results and longer-lasting therapeutic results.[43]

E. Darío Amarillas-Escobar, J. Martin Toranzo-Fernández, Ricardo Martínez-Rider, Miguel A. Noyola-Frías, J. Antonio Hidalgo-Hurtado, Víctor M. Fierro Serna, Antonio Gordillo-Moscoso, and Amaury J. Pozos-Guillén (2010) conducted a double-blind, randomized, controlled clinical trial in 2 groups of 15 patients each to evaluate the effectiveness of a therapeutic laser in the control of postoperative pain, swelling, and trismus associated with the surgical removal of impacted third molars. The experimental group received 4 J/cm2 of energy density intraorally and extraorally, with a laser with a diode wavelength of 810 nm and output power of 100 mW in a continuous wave. The control group received only standard management. The degree of postoperative pain, swelling, and trismus was registered for both groups.The experimental group exhibited a lower intensity of postoperative pain, swelling, and

trismus than the control group, without significant statistical differences. Patients of both groups

required rescue medication; however, the time lapse between the end of the surgery and the administration of the medication was shorter for the control group. They concluded that the use of therapeutic laser in the postoperative management of patients having surgical removal of impacted third molars decreased the postoperative pain, swelling, and trismus, without statistically significant differences.[44]

Ana Pejcic, Dimitrije Mirkovic (2011) evaluated the anti-inflammatory effects on gingiva by combined therapy (conservative therapy complemented with laser therapy) in 34 patients. Based on the results obtained, it can be concluded that the use of LLLT as an adjunct procedure in the conservative treatment of periodontitis is very successful in reducing gingival tissue inflammation. [45]

Khalid M. AlGhamdi & Ashok Kumar & Noura A. Moussa (2011) conducted a study to review the available literature on the details of low-level laser therapy (LLLT) use for the enhancement of the proliferation of various cultured cell lines including stem cells. Literature was reviewed from 1923 to 2010. By investigating the outcome of LLLT on cell cultures, many articles reported that it produced higher rates of ATP, RNA, and DNA synthesis in stem cells and other cell lines. Thus, LLLT improved the proliferation of the cells without causing any cytotoxic effects. Mainly, helium neon and gallium-aluminum-arsenide (Ga-Al-As) lasers were used for LLLT on cultured cells. The results of LLLT also varyied according to the applied energy density and wavelengths to which the target cells were subjected. The review suggested that an energy density value of 0.5 to 4.0 J/cm2 and a visible spectrum ranging from 600 to 700 nm of LLLT were very helpful in enhancing the proliferation rate of various cell lines. With the appropriate use of LLLT, the proliferation rate of cultured cells, including stem cells, could be increased, which would be very useful in tissue engineering and regenerative medicine.[46]

Marta López-Ramírez & Miguel Ángel Vílchez-Pérez & Jordi Gargallo-Albiol & Josep Arnabat-Domínguez & Cosme Gay-Escoda (2012) conducted a prospective, randomized and double-blind study in 20 healthy patients with two symmetrically impacted lower third molars. The aim of this study was to evaluate the analgesic and anti-inflammatory effects of a low-level laser therapy (Laser Smile™, Biolase®, San Clemente, USA) applied to the wound appeared after the surgical removal of impacted lower third molars.The application of a low-level laser was made randomly on one of the two sides after surgery. The experimental side received 5 J/cm2 of energy density, a wavelength of 810 nm, and an output power of 0.5 W. On the control side, a handpiece was applied intraorally, but the laser was not activated. Evaluations of postoperative pain, trismus, and swelling were made. The sample consisted of 11 women and nine men, and mean age was 23.35 years (18–37). The pain level in the first hours after surgery was lower in the experimental side than in the placebo side, although without statistically significant differences (p= 0.258). Swelling and trismus at the 2nd and 7th postoperative days were slightly higher in the control side, although not statistically significant differences were detected (p> 0.05). The application of a low-level laser with the parameters used in this study did not show beneficial affects in reducing pain, swelling, and trismus after removal of impacted lower third molars.

Romina Brignardello-Petersen, Alonso Carrasco-Labra, Ignacio Araya, Nicolas Yanine, Joseph Beyene and Prakesh S. Shah (2012) conducted a systematic

review and meta-analysis to assess the efficacy and safety of low-level laser energy irradiation (LLEI) for decreasing pain, swelling, and trismus after surgical removal of impacted mandibular third molars (IMTMs).

MEDLINE, EMBASE, and the Central Register of Controlled Trials of the Cochrane Library were searched from their inception, and conference proceedings, cross-references and gray literature were searched for the last 5 years for randomized and quasi-randomized controlled trials that evaluated the effects of any type of LLEI, compared with active or inactive treatments, in patients undergoing surgical removal of IMTMs. Risk of bias in included studies was assessed by 2 independent evaluators using the Cochrane Risk of Bias tool. A random-effects model meta-analysis was used to estimate the mean difference of trismus between the groups. Heterogeneity was assessed using Cochran _2 and I2. Ten eligible trials were included in this systematic review. The included studies overall had a moderate risk of bias. Because of heterogeneity in the intervention and outcomes assessments, pain and swelling outcomes were only qualitatively summarized and indicated no beneficial effects of LLEI over placebo. Patients receiving LLEI had an average of 4.2 mm (95% confidence interval, 1.2 to 7.2) and 5.2 mm (95% confidence interval, 1.8 to 8.2) less trismus than patients receiving no active treatment on the second and seventh day after the surgery, respectively. They concluded that there was no benefit of LLEI on pain or swelling and a moderate benefit on trismus after removal of IMTMs.

Maurizio Ferrante, Morena Petrini, Paolo Trentini, Giuseppe Spoto (2012) conducted a study to evaluate the effectiveness of the low-level laser therapy (LLLT) in the control of pain, swelling, and trismus associated with surgical removal of impacted lower third molars. Thirty patients were randomized into two treatment groups, each with 15 patients-group test (LLLT) and a group control (no-LLLT)-and were told to avoid any analgesics 12 h before the procedure. In group test, the 980-nm diode-laser (G-Laser 25 Galbiati, Italy) was applied, using a 600-µm handpiece, intraorally (lingual and vestibular) at 1 cm from the involved area and extraoral at the insertion point of the masseter muscle immediately after surgery and at 24 h. The group control received only routine management. Parameters used for LLLT were: continuous mode, at 300 mW (0.3 W) for a total of 180 s (60 s × 3) (0.3 W × 180 s = 54 J). Group test showed improvement in the interincisal opening and remarkable reduction of trismus, swelling and intensity of pain on the first and the seventh postoperative days. The study demonstrated that LLLT, with these parameters, was useful for the reduction of postoperative discomfort after third-molar surgery.[12]

Saber K, Chiniforush N, Shahabi S (2012) conducted a study to evaluate the effects of low level laser on the postoperative pain of patients who had to undergo third molar surgery. In a randomized clinical setting, 100 patients were assigned to two groups of 50 in each. Every patient underwent surgical removal of one mandibular third molar (with osteotomy). After suturing the flap, the soft laser was applied to every patient. In group I laser radiation was applied by the dental assistant with output power of 100 mW, in continuous mode with sweeping motion, in group II, the laser hand piece was only brought into position without releasing energy, so that no patient knew which group he belonged to. The patient was given a pain evaluation form where they could determine their individual pain level and duration. The statistical tests showed significant difference in pain level between laser and control group (P<0.001) but no significant difference found in pain duration in two groups (P=0.019). The result of the study verified the positive effect of the soft-laser therapy in the postoperative complication after third molar extraction.[47]

Kazancioglu HO, Ezirganli S, Demirtas N (2014) conducted a study to evaluate the efficacy of the ozone and laser application in the management of pain, swelling, and trismus after third-molar surgery. Sixty consecutive patients with asymptomatic impacted mandibular third molars were recruited into the study. Patients were randomized into three treatment groups of 20 patients each: two study groups (group 1 = low-level laser therapy (LLLT), group 2 = ozonetherapy) and a control group (no-LLLT or ozone therapy). Twenty teeth extractions were performed in each group. Evaluations of postoperative pain, the number of analgesics tablets taken, trismus, swelling, and quality of life (Oral Health Impact Profile-14 questionnaire) were made. The sample consisted of 28 female and 32 male patients, whose total mean age was 23.5 ± 3.4 (range, 18-25) years. The pain level and the number of analgesics tablets taken were lower in the ozonated and LLLT applied groups than in the control group. This study showed

that ozone and low power laser therapies had a positive effect on the patients' quality of life. Trismus in the LLLT group was significantly less than in the ozonated and control groups ($p = 0.033$). Ozone application showed no superiority in regards of postoperative swelling; however, LLLT group had significantly lower postoperative swelling. This study demonstrated that ozone and laser therapies were useful for the reduction of postoperative pain and they increased quality of life after third-molar surgery. Although the ozone therapy had no effect on postoperative swelling and trismus after surgical removal of impacted lower third molars LLLT had a positive effect.[13]

Majid Eshghpour , Farzaneh Ahrari , Navab-Teymour Najjarkar , Mohammad-Amin Khajavi (2015) investigated the efficacy of low level laser therapy (LLLT) for managing alveolar osteitis in 60 patients. LLLT displayed good results in this study for treatment of alveolar osteitis and should be further investigated as an alternative to alvogyl for AO management. [48]

A systematic review and meta analysis on the efficacy of low level laser therapy in the management of complication after mandibular third molar surgery by He W.L., Yu F.Y., Li .J. et al. (2015) evaluated the efficacy of lowlevel laser therapy (LLLT) for the reduction of complication caused by impacted mandibular third molars extraction. An extensive literature search up to October 2013 for randomized controlled trials (RCTs) was performed through CENTRAL, PubMed, Embase, Medline, and CNKI. Six RCTs in which involves 193 participants are included in the metaanalysis. Among them, three RCTs exhibited a moderate risk of bias, while the other three showed a high bias risk. Compared with placebo laser/control group, pain was significantly reduced with LLLT on the first . The superiority of LLLT in pain control persisted on the second and the third day . Moreover, LLLT reduced an average of 4.94 mm of trismus compared with placebo laser irradiation in the first 3 days. On the seventh day, the superiority of LLLT also persisted. In the first 3 days after surgery, extraoral irradiation and intraoral combined with extraoral reduced facial swelling significantly. On the seventh day, the intraoral combined with extraoral irradiation still showed benefit in relieving facial swelling. However, because of the heterogeneity of intervention and outcomes assessment and risk of bias of included trials, the efficacy was proved with limited evidence.[9]

A. Landucci, A. C. Wosny, L. C. Uetanabaro, A. Moro, M. R. Araujo (2016) evaluated the clinical efficacy of a single dose of low-level laser therapy (LLLT) for the reduction of pain, swelling, and trismus following the surgical extraction of third molars. Mandibular third molars, with similar radiographic positions on two distinct sections, were extracted from 22 patients. Immediately after extraction from the randomly selected right or left side, LLLT was applied (study group). The same extraction procedure was performed 21 days later on the other third molar, without the application of LLLT (control group). LLLT was applied at 10 points: four intraoral in close proximity to the socket and six extraoral along the masseter muscle. Pain intensity was assessed using a visual analogue scale, swelling was measured as the distance from the tragus to the median base of the mentum, and trismus was assessed by the extent of mouth opening. Data were collected at four time points: before surgery, immediately after surgery, 48 h postoperatively, and 7 days postoperatively. Compared with the control group, the study group showed significant reductions in pain, swelling, and trismus at 48 h and 7 days postoperatively. In conclusion, a single dose of LLLT was effective at reducing the postoperative discomforts (pain, swelling, and trismus) associated with third molar extraction surgery.[49]

Majid Eshghpour, Farzaneh Ahrari and Mohammad Takallu (2016) conducted a study to evaluate the effect of low-level laser therapy (LLLT) on decreasing pain and swelling after removal of impacted third molars. It was a randomized, double-blinded, split-mouth study including 40 patients presenting with 2 symmetrically impacted mandibular third molars. In each participant, one side was randomly assigned to laser treatment and the other side received placebo. LLLT was performed by intraoral application of a 660-nm laser (200 mW, 6 J per point at 4 points) followed by extraoral application of an 810-nm laser (200 mW, 6 J per point at 3 points). Irradiation at the 810-nm wavelength was repeated on days 2 and 4 after surgery. On the control side, the treatment protocol was similar to the experimental side, but with laser simulation. The main outcomes were the degree of pain during the next 7 days and the edema coefficients on days 2, 4, and 7 after surgery. Data were analyzed using generalized linear models to determine the effect of group and time on pain level and edema coefficients. Pain level was significantly lower in the laser than in the placebo side at all time points during the experiment ($P < .05$). Swelling was

significantly lower in the laser than in the placebo group on days 2, 4, and 7 after surgery ($P < .05$). They concluded that LLLT proved effective in decreasing the intensity of pain and swelling after removal of impacted third molars and can be recommended to alleviate patients' symptoms after surgery.[50]

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