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Original Article

Dentistry Section

Efficacy of Low Level Laser Therapy in Reducing Pain, Swelling and Trismus following Impacted Third Molar Extraction Surgery: A Split-mouth Randomised Controlled Trial

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ABSTRACT

Introduction: The use of local or systemic corticosteroids and non steroidal anti-inflammatory drugs are often recommended after surgical extraction of impacted lower third molars to abolish postoperative pain, but some of them may manifest adverse effects such as gastrointestinal irritation, systemic bleeding tendency, and allergic reactions.

Aim: To evaluate the efficacy of low level laser therapy in reducing pain, swelling, and trismus following impacted third molar extraction surgery.

Materials and Methods: The present split-mouth randomised controlled clinical trial was carried out in the Department of Oral and Maxillofacial Surgery, Yenepoya Dental College, Mangalore, Karnataka, India. The study sample consisted of nine clinically and radiologically confirmed cases of bilateral symmetrical impacted mandibular third molars indicated for extraction. After extraction surgery, low level laser therapy was administered intraorally and extraorally (low level laser group). On the contralateral side (non laser group), extraction was carried out 15 days prior in the same manner except that patient was not subjected to laser therapy. Trismus, pain, swelling and healing were evaluated on 2nd, 3rd, 4th and 7th day; and were subjected to statistical analysis using Independent t-test and Mann-Whitney U test.

Results: The study consisted of nine patients, among which six were males and three were females with mean age of 25.89±6.79 years. Pain intensity was lower in the laser group than in the non laser group at all-time points assessed and was non significant (p-value >0.05). Swelling when assessed was less for laser group than non laser group at all-time points and were statistically significant (p-value <0.05) except on the 7th day. The extent of mouth opening was greater in the laser group than in the non laser group at all-time points which was statistically significant only on 2nd day (p-value=0.048). Both laser and non laser group had no statistically significant difference in healing (p-value >0.05).

Conclusion: The use of therapeutic laser in the postoperative management of patients undergoing surgical removal of impacted third molars decreases postoperative pain, swelling, and trismus.

Keywords: Anti-inflammatory, Healing, Photobiomodulation, Reduced mouth opening

INTRODUCTION

Oral and maxillofacial surgeons perform third molar surgery regularly. Postoperative pain, oedema, and reduced jaw function are common, following surgical removal of an impacted third tooth. The numerous elements that contribute to these complicated conditions, stem from an inflammatory response triggered by surgical trauma [1]. The pain is most intense 3 to 5 hours after surgery, lasts 2 to 3 days, and then lessens by the 7th day [2,3]. Swelling occurs for 12 to 48 hours before subsiding between the 5th and 7th days [4]. After surgical extraction of impacted lower third molars, the use of local or systemic corticosteroids and non steroidal anti-inflammatory drugs is frequently recommended to alleviate postoperative pain but some of them can cause gastrointestinal irritation, systemic bleeding, and allergic reactions [5-7]. These observations justify efforts to find a way of postoperative pain control that doesn't induce side effects. In this regard, the use of Low Level Laser Therapy (LLLT) has a good prospect.

Many analgesic effects (Altered pain threshold, increased production of endogenous endorphins, lowered mitochondrial membrane potential, decreased production of inflammatory cytokines and inflammatory enzymes and morphological modification of neurons) and other beneficial attributes (increased phagocytic activity, decreased oedema, increase in number of lymphatic vessels as well as increase in the diameter of the same and restoration of micro-capillary blood circulation) of LLLT have been documented in the scientific literature [8,9]. The effectiveness of LLLT for the avoidance of discomfort, postoperative oedema, and trismus following surgery is debatable [10]. This could be due to methodological discrepancies in the research, which vary based on the laser type and application.

The present split-mouth randomised controlled clinical trial was aimed to evaluate the efficacy of a low level diode laser in reducing pain, trismus and swelling after third molar extraction surgery and was based on the null hypothesis that there is no effect of low level diode laser in reducing pain, trismus and swelling after third molar extraction surgery.

MATERIALS AND METHODS

The present split-mouth randomised controlled clinical trial was carried out in the Department of Oral and Maxillofacial Surgery, Yenepoya Dental College, Mangalore, Karnataka, India, after obtaining clearance from the Ethical Committee of the University (YEC2/503) and registering for Clinical Trial Registry- India (CTRI/2021/02/031180). The study was conducted in accordance with the criteria set by the Declaration of Helsinki. All participants in the study were required to sign an informed consent form. The study sample comprised of nine patients with bilateral

symmetrical impacted lower third molars indicated for extraction, who visited to the Department between November 30, 2020 to November 30, 2021.

Sample size calculation: Sample size was calculated using nMaster 2.0 (Department of Biostatistics, CMC; Vellore, India) based on estimating the mean difference with power of 80% and confidence interval set at 95% according to pervious study [8]. Random sequencing was done using Coin Toss method (Simple Randomisation) with equal allocation to the both groups. Random sequencing and allocation concealment was done by a staff who was not involved in the study.

Inclusion and Exclusion criteria: Patient under American Society of Anaesthesia- 1 category [10] and patients between age group of 18 to 45 years [11] were included. Patient with uncontrolled systemic disease, who have undergone chemotherapy or radiotherapy, who are on long term antibiotics, steroids or antiplatelet, active local or systemic infection, those who are on oral contraceptives were all excluded from the study.

Study Procedure

For each patient, the same Oral Surgeon performed both surgical extractions at a 2 week interval. The study included patients with bilateral symmetrical impacted mandibular third molars indicated for extraction that were clinically and radiologically (Oral Pantomography-OPG) confirmed [Table/Fig-1]. Lignocaine (2%) and 1:80000 adrenaline were used to administer inferior alveolar and buccal nerve blocks. In both groups, local anesthetic was provided. Ward's incision was used to reflect the mucoperiosteal flap [Table/Fig-2]. With a circular bur and continuous irrigation, enough bone was removed around the impacted tooth, and the tooth was extracted [Table/Fig-3]; and 3-0 silk sutures were used for flap closure.

After surgery, laser therapy was delivered intraorally and extraorally at a density of 4 J/cm^2 using a laser with a diode wavelength of 810 nm and an output power of 100 milli-watt. For 30 seconds, laser therapy was delivered intraorally (0.3 cm tip) around the extraction site [Table/Fig-4], and extraorally (1×3 cm handpiece) along the masseter muscle origin and insertion [Table/Fig-5], as well as along the length. The experiment was performed with an AMD LASER Picasso Lite Dental Diode Laser (ID: 16674351733, West Jordan). The laser therapy was given on the 2nd, 3rd, and 4th days.

Contralateral extraction was performed in the same way 15 days prior, with the exception that laser therapy was not used. All of the patients were given postoperative advice. Patients were given Amoxicillin/Erythromycin 500 mg t.i.d. for 5 days and Diclofenac sodium 50 mg t.i.d. for 3 days. If the pain became severe, the patient was given Tablet Ultracet (Paracetamol/Acetaminophen and Tramadol) and was discontinued from the trial. The patients were followed-up on the 2nd, 3rd, 4th, and 7th day to assess the procedure's efficacy in terms of postoperative pain [12], postoperative healing [13], postoperative swelling [14] and postoperative mouth opening [15] for the measure of trismus.

Clinical Assessment

The following parameters were taken into consideration for the assessment of the procedure:

- **Pain intensity:** It was evaluated by 10 level Visual Analogue Scale (VAS) [12]. [Table/Fig-6] with the patient placing a mark on the scale was used to indicate an intensity range from no pain '0' to severe/unbearable pain '10'. This was recorded after 24 hrs, 48 hrs, 72 hrs and 7th day.
- **Soft tissue healing:** This was assessed after 24 hrs (T0), 48 hrs (T1), 72 hrs (T2) and 7th (T3) day by healing index of Landry R et al., [13] which is as follows:-

  Healing index 1- Very poor: Two or more signs are present from below:

  (1) tissue colour: 50% of red gingiva

  (2) bleeding on palpation

  (3) granulation tissue: present

  (4) incision margin: not epithelialised, with loss of epithelium beyond incision margin

  (5) suppuration present

  Healing index 2- Poor:

  (1) tissue colour: 50% of red gingiva

[Table/Fig-1]: Oral pantomography of bilateral symmetrical impacted mandibular third molar; **[Table/Fig-2]:** Ward's incision; **[Table/Fig-3]:** Third molar extraction. (Images from left to right)

[Table/Fig-4]: Intraoral laser application.
[Table/Fig-5]: Extraoral laser application. (Images from left to right)

[Table/Fig-6]: Visual analogue scale.

(2) bleeding on palpation: yes

(3) granulation tissue: present

(4) incision margin: not epithelialised, with exposed connective tissue

Healing index 3- Good:

(1) tissue colour: 20-50% of red gingiva
(2) bleeding on palpation: yes
(3) granulation tissue: none
(4) incision margin: no exposed connective tissue

Healing index 4- Very good:

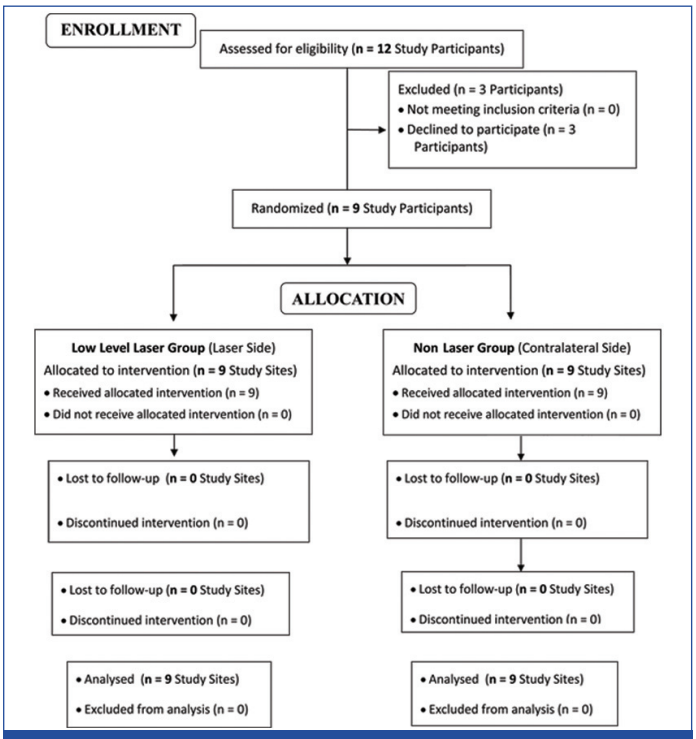
(1) tissue colour: <25% of red gingiva
(2) bleeding on palpation: yes
(3) granulation tissue: none
(4) incision margin: no exposed connective tissue

Healing index 5- Excellent:

(1) tissue colour: all tissues pink
(2) bleeding on palpation: yes
(3) granulation tissue: none
(4) incision margin: no exposed connective tissue.

- **Swelling:** It was evaluated by measuring the distance of Line A from Tragus to soft tissue pogonion, Line B from Tragus to corner of mouth, Line C from Lateral corner of the eye to angle of mandible, using 3-0 silk thread and then transferred on scale, facial swelling was calculated by the sum of three measurements divided by three (A+B+C/3). It was recorded at T0, T1, T2, T3 [14].
- **Mouth opening:** Trismus was evaluated at T0, T1, T2, and T3 by measuring the maximum mouth opening between the incisal edges of the upper and lower central incisors with a ruler [15].

The protocol of study is depicted in [Table/Fig-7].



[Table/Fig-7]: Diagrammatic Representation of Study Protocol.

STATISTICAL ANALYSIS

The results obtained were documented, tabulated, and statistically assessed. Statistical analysis was performed using Statistical Package of Social Sciences (SPSS) software version 21.0 (SPSS IBM Statistics, USA). Descriptive statistics (mean, mean rank, standard deviation) were obtained. To compare clinical parameters such as pain, healing, swelling and trismus for laser and non laser group; Independent t-test and Mann-Whitney U test was used where p-value <0.05 was considered as statistically significant.

RESULTS

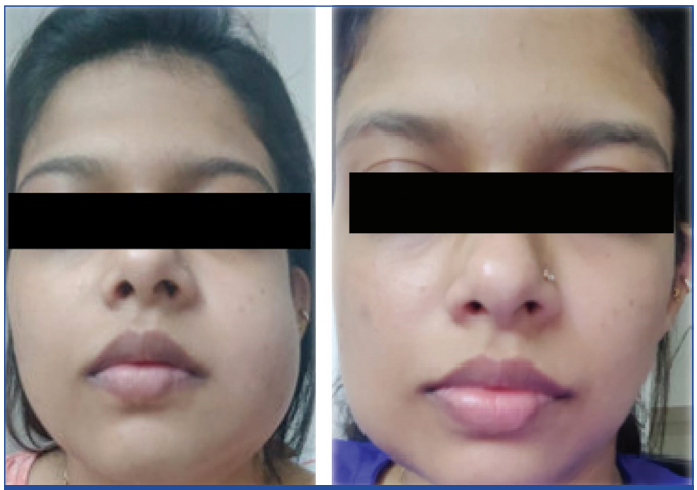
The participants consisted of nine patients, among which six were males and three were females with mean age 25.89±6.79 years diagnosed with bilateral symmetrical mandibular impacted third molar. Pain intensity [Table/Fig-8] was lower in the laser group than in the non laser group at all-time points assessed but was non significant (p-value >0.05). Swelling [Table/Fig-9-11] when assessed was less for laser group than non laser group at all-time points and were statistically significant (p-value <0.05) at all-time points except on the 7th day. The extent of mouth opening [Table/Fig-12-14] was greater in the laser group than in the non laser group at all-time points; which was statistically significant only on 2nd day (p-value=0.048). Both laser and non laser group had no difference (p-value >0.05) in healing [Table/Fig-15-17]. No adverse events were reported in the presently conducted clinical trial.

Pain assessment	Groups	N	Mean rank	p-value
On 2nd day	Non laser group	9	11.06	0.222
	Laser group	9	7.94	
On 3rd day	Non laser group	9	10.94	0.258
	Laser group	9	8.06	
On 4th day	Non laser group	9	11.00	0.258
	Laser group	9	8.00	
On 7th day	Non laser group	9	8.50	0.436
	Laser group	9	10.50	

[Table/Fig-8]: Pain intergroup comparison.
p-value based on Mann-Whitney U test

Swelling	Groups	N	Mean (mm)	SD (mm)	p-value
On 2nd day	Non laser group	9	14.55	1.66	0.029*
	Laser group	9	12.77	1.48	
On 3rd day	Non laser group	9	14.55	2.06	0.010*
	Laser group	9	12.11	1.45	
On 4th day	Non laser group	9	12.11	1.76	0.047*
	Laser group	9	10.44	1.50	
On 7th day	Non laser group	9	10.22	1.39	0.064
	Laser group	9	9.11	0.92	

[Table/Fig-9]: Swelling intergroup comparison.
p-value based on Independent t-test; *Statistically Significant (p<0.05)



[Table/Fig-10]: Swelling non laser side (day 2).
[Table/Fig-11]: Swelling laser side (day 2). (Images from left to right)

Mouth opening assessment	Groups	N	Mean (mm)	SD (mm)	p-value
On 2nd day	Non laser group	9	22.11	4.04	0.048*
	Laser group	9	26.11	3.88	

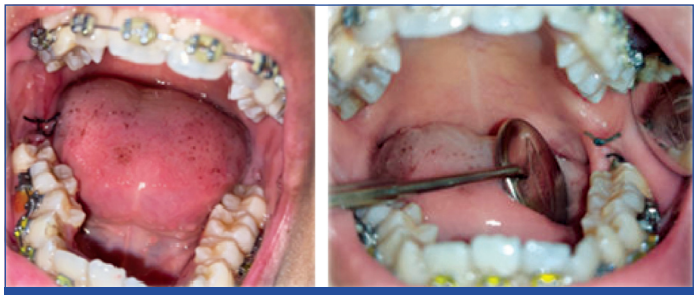
On 3rd day	Non laser group	9	25.77	3.07	0.067
	Laser group	9	28.88	3.62	
On 4th day	Non laser group	9	30.55	3.16	0.141
	Laser group	9	33.22	4.08	
On 7th day	Non laser group	9	35.44	2.78	0.076
	Laser group	9	38.00	2.91	

[Table/Fig-12]: Mouth opening intergroup comparison.
p-value based on Independent t-test; *Statistically Significant (p<0.05)

[Table/Fig-13]: Mouth opening non laser side (day 2).
[Table/Fig-14]: Mouth opening laser side (day 2). (Images from left to right)

Healing assessment	Groups	N	Mean rank	p-value
On 2nd day	Non laser group	9	8.00	0.258
	Laser group	9	11.00	
On 3rd day	Non laser group	9	9.50	1.000
	Laser group	9	9.50	
On 4th day	Non laser group	9	9.00	0.730
	Laser group	9	10.00	
On 7th day	Non laser group	9	9.50	1.000
	Laser group	9	9.50	

[Table/Fig-15]: Healing intergroup comparison.
p-value based on Mann-Whitney U test



[Table/Fig-16]: Healing non laser Side (day 7).
[Table/Fig-17]: Healing laser side (day 7). (Images from left to right)

DISCUSSION

Low level Laser Therapy (LLLT) has been used to prevent postoperative oedema and trismus after third molar surgery in earlier trials, however the outcomes are mixed. While some research found that laser energy has a favourable effect, others found that it has no effect. Variations in study design and inconsistencies in evaluating factors associated to postoperative sequelae after third molar surgery, as well as the use of different lasers and handpiece types and irradiation parameters, could explain these contradictory results [Table/Fig-18] [16-19].

The ability of LLLT to modulate several signal transduction and physiologic mechanisms involved in analgesia, such as the increase of endorphin levels and the modulation of biochemicals related to pain, such as substance P (SP), Tumour Necrosis Factor (TNF), and cyclooxygenase-2, could explain its analgesic effect [20]. According to animal research, preoperative LLLT can reduce the activity of creatine-kinase and the re-release of reactive oxidative species while boosting antioxidants and heat shock proteins, hence, preventing ischaemic muscle injury [21].

Author	Place	Study design	Wave-length	Dose	Parameters assessed	Conclu-sion (effective group)
Present study	India	Split-Mouth Randomised Control Trial	810 nm	4 J/cm^2	Pain, Swelling, Trismus, Healing	Laser group
Mozzati M et al., (2011) [16]	Italy	Split-Mouth Study	904 nm	180 J/cm^2	Interleukin (IL), Cyclooxygenase-2 (COX-2), Collagen, Pain	Laser group
Hamid MA (2017) [17]	Dubai	Randomised, Controlled, Double-Blind, Prospective Split-Mouth Clinical Trial	810 nm	9 J/cm^2	Pain	Laser group
Asutay F et al., (2018) [18]	Turkey	Randomised, Placebo-Controlled Study	810 nm	4 J/cm^2	Pain	Laser group
John SS et al., (2020) [19]	India	Double-Blind, Prospective Clinical Trial	980 nm	7.5 J/cm^2	Pain, Wound Healing	Laser group

[Table/Fig-18]: Comparative analysis of review of literature on the effect of Low Level Laser Therapy (LLLT) on postextraction pain [16-19].

The current study found that the pain intensity and swelling when assessed was less for laser group than non laser group, the extent of mouth opening was greater in the laser group than in the non laser group at all-time points, and hence, rejecting the null hypothesis. There was no difference in healing among both the groups. These findings were in accordance with those of Ferrante M et al., (2013) [8], who found that laser therapy can help reduce discomfort after third molar surgery. Aras MH and Güngörmüş M (2009) examined the efficacy of intraoral and extraoral laser administration. According to the researchers, extraoral laser therapy had a better effect on reducing pain severity and trismus after third molar surgery. LLLT has been found to alleviate acute pain and modify the inflammatory process in a short period of time. The absorption of LLLT energy by tissues and the interaction of its photons with cellular structures cause the partial production of LLLT biological effects. This interaction is expected to have therapeutic effects. Increased cellular energy and changes in cell membrane permeability result in pain relief, wound healing, and muscle relaxation [20].

Finally, based on our findings and previous research, it appears that other effective factors, complications, and the type and method of laser therapy should all be considered before reaching a conclusion. The results of the present study can be generalised as the design of study protocol followed a strict adherence.

Limitation(s)

Present study was limited by the small sample size. Future studies to be aimed at larger sample sizes, use of different wavelength lasers and more clinical parameters to be incorporated in the same study to obtain better scientific knowledge regarding the same.

CONCLUSION(S)

Low level laser therapy following third molar surgery has been employed in prior research at various doses intraorally, with various types of laser devices, and with handpieces of various diameters. In the present study, laser energy was administered intraorally with a 0.3 cm tip and extraorally with a 1×3 cm handpiece at 4 J/cm^2, and observed that the LLLT group had considerably less trismus and oedema than the non laser group. The results of the presently conducted study showed that LLLT is effective in lowering postoperative trismus and oedema after third molar surgery.

REFERENCES

[1] Grossi GB, Maiorana C, Garramone RA, Borgonovo A, Creminelli L, Santoro F. Assessing postoperative discomfort after third molar surgery: A prospective study. J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg. 2007;65(5):901-17.

[2] Marković AB, Todorović L. Postoperative analgesia after lower third molar surgery: Contribution of the use of long-acting local anesthetics, low-power laser, and diclofenac. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;102(5):e4-8.

[3] Lago-Méndez L, Diniz-Freitas M, Senra-Rivera C, Gude-Sampedro F, Gándara Rey JM, García-García A. Relationships between surgical difficulty and postoperative pain in lower third molar extractions. J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg. 2007;65(5):979-83.

[4] Markovic A, Todorovic L. Effectiveness of dexamethasone and low-power laser in minimizing oedema after third molar surgery: A clinical trial. Int J Oral Maxillofac Surg. 2007;36(3):226-29.

[5] Mocan A, Kişnişci R, Uçok C. Stereophotogrammetric and clinical evaluation of morbidity after removal of lower third molars by two different surgical techniques. J Oral Maxillofac Surg. 1996;54(2):171-75.

[6] Walsh LJ. The current status of low level laser therapy in dentistry. Part 1. Soft tissue applications. Aust Dent J. 1997;42(4):247-54.

[7] Amin MM, Laskin DM. Prophylactic use of indomethacin for prevention of postsurgical complications after removal of impacted third molars. Oral Surg Oral Med Oral Pathol. 1983;55(5):448-51.

[8] Ferrante M, Petrini M, Trentini P, Perfetti G, Spoto G. Effect of low-level laser therapy after extraction of impacted lower third molars. Lasers Med Sci. 2013;28(3):845-49.

[9] Oliveira Sierra S, Melo Deana A, Mesquita Ferrari RA, Maia Albarello P, Bussadori SK, Santos Fernandes KP. Effect of low-level laser therapy on the post-surgical inflammatory process after third molar removal: Study protocol for a double-blind randomized controlled trial. Trials. 2013;14:373.

[10] Doyle DJ, Goyal A, Garmon EH. American Society of Anesthesiologists Classification. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 [cited 2022 Feb 25]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK441940/.

[11] Hounsome J, Pilkington G, Mahon J, Boland A, Beale S, Kotas E, et al. Prophylactic removal of impacted mandibular third molars: A systematic review and economic evaluation. Health Technol Assess Winch Engl. 2020;24(30):01-116.

[12] Garra G, Singer AJ, Domingo A, Thode HC. The Wong-Baker pain FACES scale measures pain, not fear. Pediatr Emerg Care. 2013;29(1):17-20.

[13] Landry R, Turnbull R, Howley T. Effectiveness of benzydamyne HCl in the treatment of periodontal post-surgical patients. Res Clin Forums. 1988;10:105-18.

[14] de Santana-Santos T, de Souza-Santos JA, Martins-Filho PR, da Silva LC, de Oliveira e Silva ED, Gomes AC. Prediction of postoperative facial swelling, pain and trismus following third molar surgery based on preoperative variables. Med Oral Patol Oral Cir Bucal. 2013;18(1):e65-70.

[15] Khare N, Patil SB, Kale SM, Sumeet J, Sonali I, Sumeet B. Normal mouth opening in an adult Indian population. J Maxillofac Oral Surg. 2012;11(3):309-13.

[16] Mozzati M, Martinasso G, Cocero N, Pol R, Maggiora M, Muzio G, et al. Influence of superpulsed laser therapy on healing processes following tooth extraction. Photomed Laser Surg. 2011;29(8):565-71.

[17] Hamid MA. Low-level laser therapy on postoperative pain after mandibular third molar surgery. Ann Maxillofac Surg. 2017;7(2):207-16.

[18] Asutay F, Ozcan-Kucuk A, Alan H, Koparal M. Three-dimensional evaluation of the effect of low-level laser therapy on facial swelling after lower third molar surgery: A randomized, placebo-controlled study. Niger J Clin Pract. 2018;21(9):1107-13.

[19] John SS, Mohanty S, Chaudhary Z, Sharma P, Kumari S, Verma A. Comparative evaluation of low level laser therapy and cryotherapy in pain control and wound healing following orthodontic tooth extraction: A double blind study. J Cranio-Maxillo-fac Surg. 2020;48(3):251-60.

[20] Aras MH, Güngörmüş M. The effect of low-level laser therapy on trismus and facial swelling following surgical extraction of a lower third molar. Photomed Laser Surg. 2009;27(1):21-24.

[21] Silveira PCL, da Silva LA, Pinho CA, De Souza PS, Ronsani MM, Scheffer D da L, et al. Effects of low-level laser therapy (GaAs) in an animal model of muscular damage induced by trauma. Lasers Med Sci. 2013;28(2):431-36.

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