Original Article

Efficacy of low-level laser therapy in the management of postoperative surgical sequelae after surgical removal of impacted mandibular third molars

ABSTRACT

Introduction: The study is aimed to evaluate the effectiveness of low-level laser therapy (LLLT) in the control of pain, swelling, and trismus after the surgical removal of impacted mandibular third molars.

Materials and Methods: A prospective study was conducted on thirty patients requiring surgical removal of the impacted mandibular third molar. Mesioangular impacted third molar with class I level B position (according to the Pell and Gregory classification) were included in the study. The study group ($n = 15$) received LLLT using diode laser of wavelength 980 nm and the control group ($n = 15$) received routine postoperative care without LLLT. The parameters evaluated were intensity of pain, maximum mouth opening, postoperative swelling, healing at the surgical site, and presence of dry socket.

Results: The mean score of pain, swelling, and trismus in the study group were statistically lower as compared to the control groups. Healing assessment using Laury and Turnbull healing index inferred that the healing at the seventh postoperative day was superior in the study group as compared to the control group.

Conclusions: LLLT with a diode laser of wavelength 980 nm can effectively reduce pain, swelling, and trismus in the postoperative phase after surgical extraction of the mandibular impacted third molar and promote healing at the operative site.

Keywords: Impacted third molar, laser dentistry, pain, swelling, trismus

INTRODUCTION

Surgical extraction of the impacted third molar is one of the most frequently performed surgery in routine dental practice. The common sequelae after surgical extraction of third molars includes pain, swelling, reduced mouth opening (trismus), and alveolar osteitis (dry socket).[1] Pain reaches its maximum intensity 3–5 h after surgery, continuing for 2–3 days, and diminishing gradually by the 7th day. Whereas, swelling reaches its peak after 12–48 h and resolves by the 5th–7th day.[1] There has been a constant search for methods by which these complications can be controlled and include; local or systemic corticosteroids,[2] nonsteroidal anti-inflammatory drugs,[3] inserting tube drain,[4] using socket dressing,[5] cryotherapy, ice application[6] and modified suture technique.[7] With advancing dental techniques intended to deliver better patient care, there has been a constant search for newer and modern alternative methods to manage the postoperative sequel after the surgical extraction of third molars. The use of low-level laser therapy (LLLT) is one such technological advancement that can be harnessed for the same.

The term "LASER" stands for Light Amplification by Stimulated Emissions of Radiation and was invented in 1960 by American physicist Maiman.[8] Conventionally laser has been used in

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surgery for placement of incision and excision of the lesion with minimal bleeding. Recently low wavelength laser has been applied in the field of surgery and medicine due to its property of photobiomodulation, which promotes tissues healing, and reduces pain and inflammation.[9] However, a study done by Mulcahy *et al*. has shown conflicting results on the postoperative sequel and healing.[10] LLLT has been used in the field of maxillofacial surgery to reduce swelling, and pain after the orthognathic surgery,[11] promote healing after the marsupilization of ranulas and mucoceles,[12] accelerate bone healing at the extraction sites, bony fracture defects, and distraction osteogenesis. It has been very recently used in the treatment of temporomandibular joint disorders, myo-facial pain syndrome, and arthritis[13] LLLT has been applied for the regeneration of nerve fiber after traumatic denervation, enhance osseointegration of dental implant and promote healing of skin defects by accelerating epithelization and increasing collagen synthesis by fibroblasts.[13] Its also been reportedly used to relieve the pain of trigeminal neuralgia, herpes labialis, and post-herpetic ulcers.[13,14]

The present study aimed to evaluate and compare the efficacy of LLLT in the management of postoperative surgical sequelae of pain, swelling, and trismus after the surgical removal of impacted mandibular third molars. The quality of extraction socket healing with LLLT was assessed and compared with the control site.

MATERIALS AND METHODS

A randomized prospective study was conducted on 30 patients who required surgical removal of impacted mandibular third molar in the Department of Oral and Maxillofacial Surgery, School of Dental Sciences, after due approval from the institutional ethical committee (KIMSDU/IEC/03/2015 dated December 10, 2015). All the patients were informed about the nature of the study, and a written informed consent was obtained. The patients in the age group of 18–35 years having mesioangular impacted mandibular third molars with class I level B position (according to Pell and Gregory's classification) were included in the study. Patients on immunosuppressive drugs and those with hematological parameters not within normal limits were excluded from the study. All the surgical procedure was carried out by the same operating surgeon. All the patients were randomly divided into two groups of 15 each. Group A received LLLT immediately after surgical extraction, whereas Group B received the routine postoperative protocol without LLLT. The laser used in the study was diode laser of 10 Watts intensity and 980 nm wavelength (Zolar Tech Mfg Co. Inc, Mississauga, Canada).

All the patients were assessed preoperatively for facial dimensions (measured from the tip of the chin to the lower part of the auricular lobe, using flexible measuring tape) and maximal mouth opening (distance measured between the incisal edges of the maxillary right and mandibular right central incisor teeth using Vernier caliper) [Figure 1a and b]. Surgical extraction was performed under local anesthesia. Patients in Group A received LLLT, after surgery within 10 min. The laser was applied both intraorally and extraorally. Intraorally, the laser probe was applied for 1 min each in the vestibular and lingual area (approximately 1 cm away from the tissues) at the operated site [Figure 2a]. Similarly, the extraoral application of the laser was performed for 1 min over the masseter muscle from origin to insertion [Figure 2b]. The laser was applied immediately after surgery and after an interval of 24 h along with the routine postoperative protocol (that included antibiotic, analgesic, and antacid). In the control group, patients only received the routine postoperative protocol, without LLLT.

All the patients were postoperatively assessed for parameters that included intensity of the pain (recorded using Visual Analogue Scale), maximum mouth opening and swelling on 1st, 3rd, and 7th postoperative day. Healing at the extraction site was determined using the Laundry and Turn Bull method on 1st, 3rd, and 7th postoperative day. Assessment for a dry socket at the operated site was noted in the postoperative follow-up period. Collected data were statistically analyzed.

RESULTS

Pain, swelling, and mouth opening scores were compared between the two groups at different time intervals using independent *t*-test. There was statistically significant difference in the mean pain score between the two groups on day 1 ($P = 0.007$), 3 ($P = 0.001$), and 7 ($P = 0.002$). On the 1st day, the mean pain score was 2.6667 ± 0.97590 for Group A, which was comparatively lower than Group B (4.0000 ± 0.84515), with a difference of 0.73333. Similarly, the mean pain score difference between Group A and Group B was 1.26667 and 0.93333 on the 3rd and 7th day, respectively [Table 1].

In comparison to the preoperative facial dimension, swelling was present in both groups at all time intervals. The intra-group comparison showed insignificant difference in the mean swelling score values on 1st and 3rd day. However, there was a gradual decrease in the swelling from the 3rd to 7th postoperative day. The mean swelling scores on 3rd day in Group A (16.4800 ± 1.12770) were less compared to Group B (17.9400 ± 0.63897), with a difference of 1.46000 which was statistically significant ($P = 0.000$). Similarly, on

the 7th day, the difference in mean swelling scores of Group A (15.8880 ± 1.04793) and Group B (16.8600 ± 0.58895) was. 97200, which was statistically significant ($P = 0.004$) [Table 2].

Reduction in mouth opening was similar in both groups with no statistical difference on the 1st postoperative day. The mouth opening increased on the 3rd day in Group A (33.9267 ± 3.79746), with a statistically significant difference of 1.46000 compared to Group B (33.6067 ± 2.70277) ($P = 0.792$). Mouth opening score on the 7th day in Group A (35.5800 ± 3.90022) increased nearly to the baseline values as compared to Group B (36.5333 ± 1.99523) with a difference of 0.95333 ($P = 0.406$) [Table 3].

Healing Index consisted of three parameters that were compared among the groups using Mann–Whitney U-test. All the statistical data was plotted on bar diagrams. The first parameter in the index was gingival redness (an indicator of inflamed oral mucosa). Gingival redness decreased rapidly from 1st to 3rd to 7th postoperative day in Group A when compared to group B. The difference on the 7th postoperative day between the scores of both groups was statistically significant ($P = 0.001$) with less incidence of redness in Group A [Graph 1]. Bleeding on probing was similar on the first postoperative day in both the study and control group. While it was totally absent in the study group on both the 3rd and 7th days. Bleeding was less in the study group as compared to both the groups at all intervals of time [Graph 2]. The incidence of granulation tissue in the study group as compared to the control group was equal on the 1st postoperative day. Granulation tissue incidence reduced rapidly in the study group as compared to that in the control group on the 3rd and 7th days [Graph 3].

The presence and absence of dry socket in the study group and control group were compared by Mann –Whitney U-test. Dry socket was totally absent in the study group as compared to the control group ($n = 3$, 20% [Graph 4].

DISCUSSION

The biological effects of laser were first studied in 1967 by Inyushin.[15] The concept of low-wavelength laser therapy for bio-stimulation was reported in 1970 when Endre Mester in Budapest first applied it over chronic ulcers to accelerate healing.[15] This stimulation of biologic tissues by laser was termed as photobiomodulation.[16] Literature describes many claims of therapeutic effects of LLLT on a broad range of disorders, including; acceleration of wound healing enhanced remodeling and repair of bone,[17] restoration of

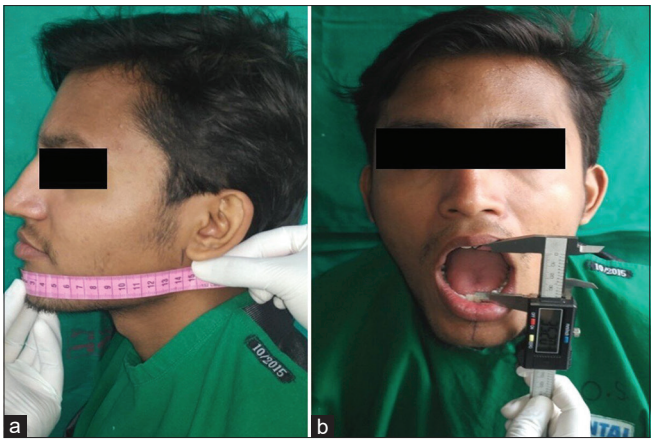


Figure 1: Preoperative measurement of facial dimension (a) and mouth opening (b)

Figure 2: Application of low level laser therapy intraorally (a) and extraorally (b)

Table 1: Comparison of pain Scores at various interval

	Pain score (mean±SD)	*P* (two tailed)	Mean difference	SE difference
Immediate postoperative	Study group (2.0667±0.70373)	0.007	−0.73333	0.25198
	Control group (2.800±0.67612)			
1st day	Study group (2.6667±0.97590)	0.000	−1.33333	0.33333
	Control group (4.0000±0.84515)			
3rd day	Study group (2.4667±1.06010)	0.001	−1.26667	0.34272
	Control group (3.7333±0.79881)			
7th day	Study group (0.6667±0.48795)	0.002	−0.93333	0.26667
	Control group (1.6000±0.91026)			

SD: Standard deviation, SE: Standard error

Table 2: Comparison of swelling scores at various interval

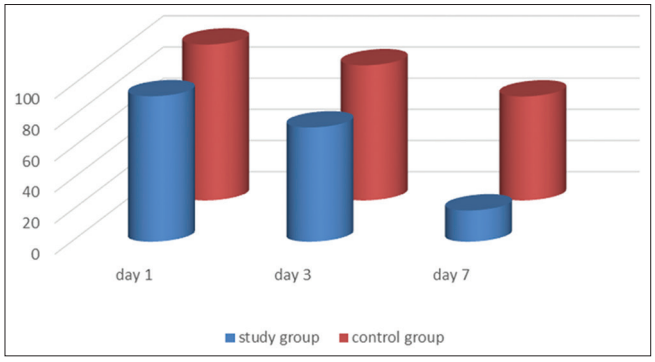
	Swelling score (mean±SD)	*P* (two tailed)	Mean difference	Standard error difference
Immediate postoperative	Study group (15.3667±0.95294)	0.313	−0.30000	0.29201
	Control group (15.6667±0.60906)			
1st day	Study group (16.5400±1.09922)	0.000	−1.31333	0.32815
	Control group (17.8533±0.63793)			
3rd day	Study group (16.4800±1.12770)	0.000	−1.46000	0.33466
	Control group (17.9400±0.63897)			
7th day	Study group (15.8880±1.04793)	0.004	−0.97200	0.31038
	Control group (16.8600±0.58895)			

SD: Standard deviation

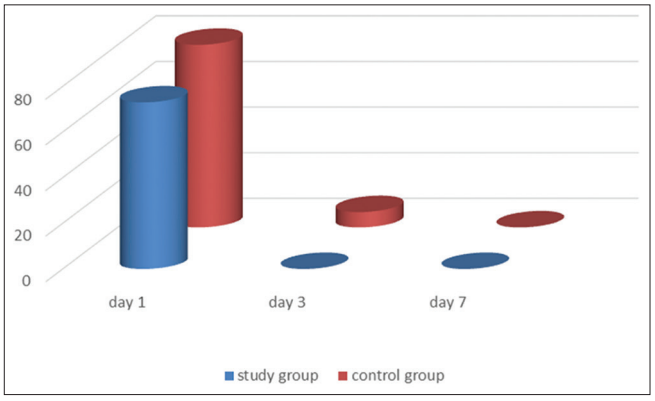
Table 3: Comparison of mouth opening scores at various interval

	Mouth opening score (mean±SD)	*P* (two tailed)	Mean difference	SE difference
Immediate postoperative	Study group (36.4200±4.21548)	0.077	−2.13333	1.16071
	Control group (38.5533±1.56153)			
1st day	Study group (34.1467±4.14692)	0.760	0.38000	1.23286
	Control group (33.7667±2.36693)			
3rd day	Study group (33.9267±3.79746)	0.792	0.32000	1.20348
	Control group (33.6067±2.70277)			
7th day	Study group (35.5800±3.90022)	0.406	−0.95333	1.13115
	Control group (36.5333±1.99523)			

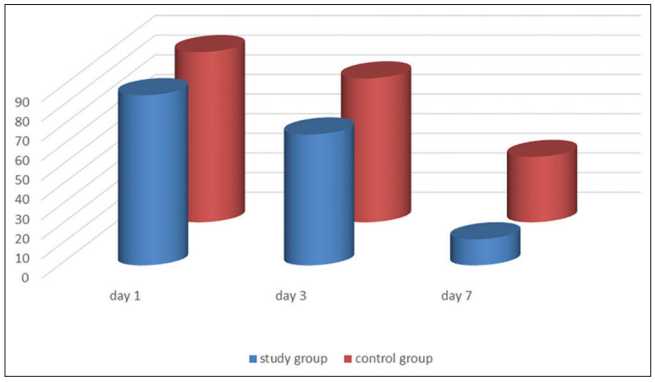
SD: Standard deviation



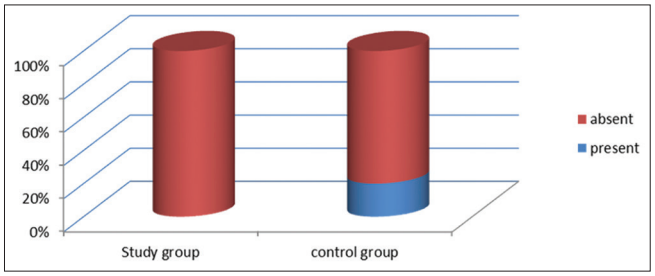
Graph 1: Healing index scores (gingival color) among two groups



Graph 2: Healing index scores (bleeding) among two groups



Graph 3: Healing index scores (granulation tissue) among two groups



Graph 4: Incidence of dry socket (%) among two groups

normal neural functions in nerve injuries,[18] pain modulation with stimulation of endorphin release and regulation of the immune system.[19] At the molecular level, LLLT modulates cellular metabolic processes, leading to enhanced regenerative potential for biological tissues that improves the cellular abilities of proliferation, migration, and adhesion at low-levels of red/near-infrared light illumination.[20] LLLT improves microcirculation that reduces the edema by changing capillary hydrostatic pressure.[21] An optimum dose of LLLT promotes the formation of new endothelium and new

blood vessels that stimulate the formation of granulation tissue, which accelerates the healing process.[21]

In maxillofacial surgery, LLLT has been used to treat temporomandibular joint pain,[13] pain of trigeminal neuralgia.[13,14] It has been used to promote healing of facial fracture, extraction socket, and post marsupialization of ranulas and mucoceles.[12] In the present study, LLLT was efficient in reducing postoperative sequalae of pain, swelling, and trismus after the 3rd molar surgery. The result was consistent with previous findings of Ferrante *et al*.,[22] Mohammadi *et al*.[23] and Landucci *et al*.[24] However, Raiesian *et al*. found that LLLT reduces postoperative pain and swelling, but had no significant effect on trismus.[25] The study of extraction socket healing in addition to controlling the postoperative complication was evaluated in the study. The healing was better in the patients who had LLLT after surgery. LLLT also reduced postoperative complications of dry socket. Dry socket was totally absent in the study group, whereas 20% of patients in the control group presented dry socket.

CONCLUSIONS

Use of LLLT is an effective tool to reduce the postoperative sequelae after the 3rd molar surgery and should be more commonly included in clinical practice. However, future studies with larger sample size and with the grading of the level of difficulty of impacted teeth can be undertaken to evaluate the role of LLLT in the 3rd molar surgery.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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