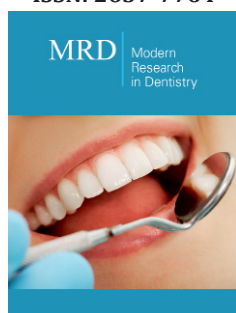


# Effect of Low-Level Laser Therapy after Dental Extraction on Post-Operative Complications in Controlled Diabetic Patients

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## Abstract

**Objective:** The aim of this study is to evaluate the Effect of Low-Level Laser therapy after dental extraction on post-operative complications in controlled diabetic patients.

**Material and Method:** Prospective study was conducted in Oral Maxillofacial Surgery Clinic, Faculty of Dentistry, Umm Al-Qura University, Makkah, KSA. Thirty controlled diabetic patients with non-restorable teeth indicated for extraction were included in the study. The exclusion criteria; uncontrolled systemic disease, poor oral hygiene, smoker patient, blood disorders, any contraindications for laser therapy and patients whom taking analgesics in the past 24 hours before surgery.

**Methods of assessments:** Size of the alveolus was measured after extraction bucco-lingually and mesio-distally in millimeters immediately after laser application in study side, and for the controlled side we measured it after extraction only using periodontal prob. The pain was evaluated by visual analog scale (VAS). The scores extended between 0 (no pain) and 10 (the greatest pain). The pain was evaluated 8 hours after extraction and on the 7<sup>th</sup> day. The swelling and redness were evaluated both the study and controlled sides by palpation and inspection respectively on 7<sup>th</sup> day. The data was collected, tabulated and analyzed statistically using Statistical Package of social sciences software (SPSS).

A total of 30 patients participated in this study (M=47.20y). Table 1 shows the descriptive data for the participants. For swelling and redness, there was no significant difference between the two groups after the 7<sup>th</sup> postoperatively ( $p > 0.05$ ; Table 2).

**Table 1:** Descriptive Statistics.

Age (years)	N	Mean	Std. Deviation	Minimum	Maximum
	30	47.2	13.12	25	70
Blood glucose (mg/dL)	30	157.13	20.38	114	198
HbA1c	30	6.6	0.71	5	7.5

**Table 2:** Comparison of Swelling and Redness between Laser Treated and Control.

Groups	Swelling and Redness			Pearson Chi-Square	P value
	Present	Absent	Total		
Laser Treated	3(10%)	27(90%)	30(100%)	4.812	0.028
Control	10(33%)	20(67%)	30(100%)		

Extraction site treated with LLLt showed decrease in the B-L width of the alveolus on the 7<sup>th</sup> day after extraction; however, it was a statistically non-significant ( $p > 0.05$ ; Table 3). And for the M-D width of the alveolus there was no significant difference between the 1<sup>st</sup> day and the 7<sup>th</sup> day ( $p > 0.05$ ; Table 3). There was no significant difference in pain intensity in both sides after 8 hours from the extraction ( $p > 0.05$ ; Table 3). However, pain intensity in study side on the 7<sup>th</sup> day was statistically non-significant ( $p > 0.05$ ; Table 3).

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**Table 3:** Comparison of effect of low-level laser therapy on healing after dental extraction between two groups.

Variables	Groups	Mean	SD	Std. Error Mean	Differences Without Controlling for Covariates		Differences After Controlling for Covariates	
					T value	P value	F	P value
Baseline B-L width	Laser Treated	6.89	1.88	0.343	0.513	0.61	0.518	0.723
	Control	6.63	2.09	0.382				
Baseline M-D width	Laser Treated	6.01	1.72	0.314	0.889	0.378	0.355	0.84
	Control	5.59	1.96	0.358				
B-L width after 7 days	Laser Treated	3.23	1.98	0.361	0.203	0.84	0.946	0.444
	Control	3.13	1.83	0.335				
M-D width after 7 days	Laser Treated	2.97	1.71	0.313	0.304	0.762	0.53	0.714
	Control	2.83	1.68	0.307				
Pain after 8 hours	Laser Treated	4.5	2.1	0.383	0.625	0.535	0.866	0.49
	Control	4.17	2.04	0.372				
Pain after 7 days	Laser Treated	1.4	1.65	0.302	-0.711	0.48	1.112	0.36
	Control	1.73	1.96	0.359				

**Conclusion:** In conclusion, the LLLT showed no significant differences in the mean of controlling the post-operative complications after extraction between the study and controlled sides. So, using LLLT has no clinical significance after extraction among the controlled diabetic patient.

**Keywords:** Low level laser therapy; Dental extraction; Diabetic patients; Wound healing; Pain

## Introduction

Within the field of medicine, surgical lasers have been used to manage several diseases such as rheumatoid arthritis, osteoarthritis, carpal tunnel syndrome, non-healing ulcers, epicondylitis and lumbago [1,2] (Silveira et al. 2011). Laser can be classified according to the energy level that is produced by the laser, which results in very different therapeutic actions. There are two primary levels: high-level laser therapy (HLLt), which is used mostly for surgical procedures; and low-level laser therapy (LLLt), which improves wound healing [3].

LLLt was discovered by the physician Mester when he accidentally noticed an increase and improvement in the healing process when attempting to stop cancer growth in mice [2]. Since then, the laser has also been introduced to dentistry as a treatment modality. Several examples include: frenectomy, temporomandibular diseases and to decrease postoperative complications after lower 3<sup>rd</sup> molar extractions [4] (Peimani et al. 2018) (Sampaio-Filho et al. 2018). LLLt with a wavelength range between 300-400mw-cm<sup>2</sup> improves healing by fibroblast proliferation especially in diabetic patients [5]. On the other hand, the exact analgesic effect of LLLt is still unclear. However, there is an evidence suggested that LLLt plays a role in the synthesis, release, and metabolism of some neurotransmitters, such as an increase

in serotonin and acetylcholine production in the central nervous system. In the peripheral nervous system, LLLt acts on some mediators of inflammation such as histamine and prostaglandin [6] (Sun & Tunér 2004).

The effect of LLLt on postoperative pain is controversial, studies showed a significant relief of postoperative pain with a gallium aluminum arsenide diode laser (GaAlAs) of 810nm, 0.1W used intraorally with a dose of 23.86J/cm<sup>2</sup> [7]. Moreover, the use of LLLt at 810nm with a 4j/cm<sup>2</sup> energy density with 0.30W output power showed a significant reduction of pain on the 7<sup>th</sup> day postoperatively [8]. In comparison, there was no significance in the use of LLLt at 810nm WL, 0.5W output power, and 5j/cm<sup>2</sup> of energy density for 32 seconds intraorally 1 cm away from the target area [9].

Data regarding pain control and management of postoperative complications after routine dental extraction in diabetic patients after the application of the LLLt not clear. Hence this study aimed to evaluate the effect of low-level laser therapy after dental extraction on postoperative complications in controlled diabetic patients.

## Material and Methods

A Quasi-Experimental split-mouth study conducted at the Oral Maxillofacial Surgery Clinic, Faculty of Dentistry, Umm Al-Qura University, Makkah, KSA. Ethical approval was obtained from

the Research Committee of Faculty of Dentistry, Umm Al-Qura University with Institutional Review Board (IRB code: study no-114-18). Thirty controlled diabetic patients with hopeless teeth were included in the study. Informed consent was discussed and signed. Uncontrolled diabetic patients, poor oral hygiene, smoker, blood disorders, any contraindications for laser therapy, and patients taking analgesics in the past 24 hours before surgery was excluded.

Local anesthesia with 1.7ml of 4% articaine hydrochloride with epinephrine 1/100,000 (Septanest SP® Novocol Pharmaceutical of Canada, Ontario, Canada) were used for anesthesia. Twenty minutes after extraction, a single application of 660nm aluminum gallium arsenide (GaAlAs) diode laser (Laser HF® "Comfor Hager Weken, Germany) was applied for 80 seconds using a 200mm in diameter fiber tip with continuous mode, 100mW output power intraorally at a distance of 1cm from the surgical area.

### Clinical assessments

The size of the alveolus was measured after extraction Bucco-lingually (B-L) and Mesio-distally (M-D). Evaluation of pain was done on a visual analog scale (VAS) by asking the patient to report their pain threshold. The scores ranged between 0 (no pain) and 10 (greatest pain) (Figures 1 & 2). Patients instructed how to measure the pain by themselves with VAS. Pain was evaluated 8 hours after extraction and one week after extraction and laser application. Swelling and redness were evaluated both during the study and on the controlled sides by palpation and inspection respectively on the 7<sup>th</sup> day (Figures 3 & 4).



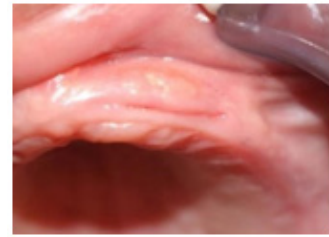
**Figure 1:** Controlled side on 1st day.



**Figure 2:** After laser application.



**Figure 3:** Controlled side on 7<sup>th</sup> day.



**Figure 4:** Study side in 7<sup>th</sup> day.

### Statistical analysis and data management

All data recorded on Microsoft Excel sheet and transferred to SPSS version 23 for statistical analysis. An independent biostatistician, who was not aware of the group allocation carried out the analysis. Data were normally distributed (Shapiro-Wilk Test,  $p=0.299$ ). Descriptive statistics were used in the form of means and standard deviation. Independent t-test used to compare the differences in the values between two groups. We used ANCOVA to determine the effect of covariates in the intervention. Pearson's Chi-square test was used to see the association of any categorical variables. A significance value,  $p<0.05$  was considered statistically significant.

### Result

Study consisted of 30 patients who had undergone extraction of hopeless teeth at two sites. The mean age of our study participants was  $47.2\pm 3.12$  years. In each patient, one extraction site was treated with a single application of laser (LT), while the other site was left as a control group (C). The mean Bucco-lingual (BL) width of the LT site after 7 days was found to be  $3.23\pm 1.98$ mm and there were no statistically significant differences observed with that of the control site ( $p=0.840$ ).

The mean M-D width of the alveolus at the LT extraction site after 7 days was found to be  $2.97\pm 1.71$ mm and that of the control site was  $2.83\pm 1.68$ mm, which also showed no statistically significant difference ( $p=0.762$ ). Prior to laser therapy treatment, there was no significant difference in all the patient variables between the two groups. The mean change in B-L width after 7 days in the LT group was  $3.66\pm 1.36$ mm and in the control group it was  $3.50\pm 1.50$ mm. The M-D width in the LT group was  $3.50\pm 1.50$ mm and in the control group it was  $2.75\pm 1.44$ mm.

In the clinical examination for pain, the patient was asked to score on a visual analogue scale (VAS), starting with 0 cm (no pain) to 10cm (worst pain). Pain was also evaluated after 8 hours and 7 days for both the LT and control sites, respectively. In the LT group the mean VAS score after 8 hours was  $4.50\pm 2.10$ cm, whereas in the control group it was  $4.17\pm 2.04$ cm, indicating no statistically significant difference ( $p=0.535$ ). After 7 days the mean score of pain in the LT group was less ( $1.40\pm 1.65$ cm) compared to the control group ( $1.73\pm 1.96$ cm), but there was no statistically significant difference noted ( $p=0.480$ ).

Analysis of covariance (ANCOVA) was used to see the effect of three covariates such as age ( $\leq 45$  years/ $>45$  years), blood sugar

levels ( $\leq 140\text{mg/dL}$ / $>140\text{mg/dL}$ ) and HbA1c value ( $\leq 6.5\%$ / $>6.5\%$ ). Even after controlling for covariates there were no significant differences seen in B-L, M-D widths and pain scores (Table 3).

## Discussion

This study utilized a split-mouth design in controlled diabetic patients to study the effect of laser treatment on alveolus healing and pain at the extraction site. After extraction, the tooth socket undergoes resorption and remodeling, and this process results in changes in height and width of the alveolar ridge (Zhao et al. 2011). In the field of surgery, gallium-arsenide (GaAs) and helium-neon (HeNe) lasers are the commonly used to enhance wound healing (Silveira et al. 2011). In dentistry, CO<sub>2</sub>, Nd:YAG, GaAlAs, and HF have been used to promote socket healing and pain modulation in tooth extraction sites [10,11]. Our study found no significant differences in B-L and M-D width of the alveolar socket between LT and control sites.

A study conducted by Batinjan et al. [12] showed that LLLT produced a significant reduction in postoperative wound swelling and decrease in wound temperature after surgical removal of third molars. The exact mechanism of how LLLt acts on biological tissues to promote wound healing, bone remineralization and pain control is not clearly identified. This could be due to the contradictory findings obtained from research conducted in animals [13] and humans [3,14,15]. A possible explanation for this healing process could be that laser may have an enhancing effect on proliferation of fibroblasts, osteoblasts and epithelial cells [13,16,17].

This Study included controlled type 2DM patients to observe the effect of LLLt in wound healing and pain modulation. Type 2 DM patients often have macrovascular and microvascular complications, in which the later type is found to have a dramatic role in wound healing following tooth extraction [18,19]. In DM patients, the normal functioning of this microvasculature is compromised and this could have an effect in wound healing [19]. In our study, the LLLt applied may not have produced an additional stimulating effect on wound healing from the normal methods due to the underlying micro and macro vascular complications in these DM patients even though it was controlled. Research shows that inhibiting Interleukin-1 $\beta$  (IL-1 $\beta$ ) in the pro-inflammatory pathway increased wound healing in diabetic patients [20], Pradhan et al. 2011. Another split-mouth study reported that LLLt therapy had an inhibitory effect on IL-1 $\beta$  and IL-6 after seven days of tooth extraction compared to the control site [14].

Our study found that pain after tooth extraction didn't show a statistically significant difference between LT and control group after 8 hours and 7 days. A study conducted in the United Arab Emirates, reported that there was significant reduction in pain after tooth extraction in a laser group (GaAlAs /810nm) compared to control group [7]. A study conducted by Kucerova et al. [15] reported that even though there was no difference observed in wound healing between laser treated group (helium-neon/638nm) and control group, there was a significant improvement in pain relief. Although numerous studies [1,21-23] have shown LLLt reduced postoperative pain after tooth extraction, it should be well

noted that none of the studies used a split-mouth design as in our study. Also, a systematic review and meta-analysis conducted by Brignardello-Petersen et al. [24] reported that adjuvant LLLt didn't have a beneficial effect on pain and swelling after surgical removal of third molars.

The strength of our study was that this was the first split-mouth study done among controlled diabetic patients to determine the effect of LLLt in wound healing and pain relief. Accordingly, each patient served as their own control, eliminating the possibility of any bias in interventional effect and increasing the power of the study. We also analyzed the effect of covariates such as age, blood glucose levels and HbA1c values, which also showed no statistically significant effect on all the variables tested. Even though the findings of our study show that LLLt didn't produce a beneficial effect in wound healing and pain relief among diabetic patients, it is necessary to do a wider study with larger samples and use multiple wavelengths of LLLt with a multicenter design. In conclusion our study found that there was no significant difference in the size of alveolus between laser-treated and control sites in controlled diabetic patients. LLLt therapy may or may not have an effect on wound healing and pain relief in diabetic patients and the current evidence is insufficient to arrive at a conclusive statement. A well-designed randomized control trial on a larger sample in a multicenter environment is warranted.

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