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The Impacts of Low-Level Laser Therapy – A Complementary Treatment in the Management of Side Effects After Implant Surgery

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Abstract

Introduction: One of the most important medical applications of laser is low-level laser therapy (LLLT). In this method, laser radiation penetrates easily into the target tissue. The aim of this study was to investigate whether LLLT can reduce the side effects of advanced implant surgery.

Methods: In this triple-blind clinical trial, 30 patients aged 25 to 65 years were selected for implant insertion and divided into two groups. In the laser group, immediately after the surgery, 72 hours and 1 week after the surgery, the surgical site was irradiated with an 830 nm laser. The dose required for the laser therapy was 5 J/cm^2. The degree of pain, facial swelling and wound healing were analyzed using statistical methods.

Results: Our results showed that at 12, 24, 48, and 72 hours after the surgery, the pain level was reduced in the laser group compared with the placebo group ($P<0.05$). Swelling of the face was also significantly reduced 7 days after surgery in the laser group ($P<0.05$). The investigation on the recovery conditions of the surgical site showed that on the 3rd, 7th and 14th days after the surgery, higher levels of wound healing have been achieved ($P<0.05$).

Conclusion: Our results suggest that laser, as a complementary therapy; can be used to reduce the severity and duration of pain. Also, laser can reduce facial swelling and accelerate wound healing.

Keywords: Low-level laser therapy; Sinus lift; Wound healing; Side effects; Implant failure.

Introduction

Implant therapy has undesirable side effects. The most common side effects include tooth loosening of the teeth adjacent to the implant, bleeding, pain, swelling, ecchymosis, paresthesia, nerve damage, and implant failure.[1-3] Prevention of inflammation after surgery is critical in order to reduce pain, swelling, and infection.[4]

One of the most important laser applications is in medical sciences, in which laser works based on the interaction between laser photons and tissues.[5,6] This interaction depends on physical parameters such as laser power, laser wavelength and optical properties of the target tissue.[7,8] In low-level laser therapy (LLLT), which works based on photochemical interactions in cells or photobiostimulation, the laser irradiation easily penetrates into the target tissue due to the low power output of the laser, the selected wavelength of the laser beams being between 630-1300 nm, and other specific characteristics of the laser beams called coherence.[9-12] Previous studies have shown that LLLT can be effective to accelerate healing and pain relief through reduction of mediators and inflammatory cells and increased endorphin, respectively.[13] This modality is acceptable and cost-effective.[13,14] Many dentists use identical drugs for different treatments and there is no agreement to prescribe the drugs based on the patient's health status.[15,16] The aim of this study was to investigate the effect of LLLT using 830 nm wavelength and 120 mW power in the management of the side effects of implant surgery.

Methods

Population

In this triple-blind clinical trial (in which the subject, the person administering treatment, and the person

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evaluating the response to treatment were blinded to treatment allocation) a total of 30 patients aged 18-30 years, seeking bone grafting or sinus lift at the same session were selected for implant therapy and divided into two groups (laser and control groups). Sampling was done by simple random sampling. All patients were selected from the School of Dentistry, Azad University of Isfahan Iran, from February 2014 to May 2015. The Cochran method was used to calculate the sample volume. A consent form was signed by the patients and they were selected according to the following inclusion criteria: Patients older than 18 years and with a healthy oral mucosa, without systemic diseases, and volunteering for implant surgery. Moreover, patients with implant failure, pregnancy, light sensitivity, diabetes, prescribed antibiotics or corticosteroids in the past two weeks, smokers, and alcohol drinkers were excluded. Age, sex, jaw surgery and the type of surgery were matched.

Study Technique

After giving the written informed consent, surgery was done and the patients were guided to a room with standard conditions for laser and given protective glasses (goggles). Diode laser was used in this study with an 830 nm wavelength (Twin Laser MMOptics, Sao Carlos, Germany). This study needed continuous radiations. So, acylation wire (yellow wire) was connected to DC wire (red wire) with 33 kΩ. A key was embedded for switching the circuit on or off (Figure 1) while Sanaye Optic Iran (SA IRAN CO) confirmed the wavelength and output power of the mounted device. In the laser groups, the implant surgery area was irritated in the buccal and lingual aspects separately (Figure 2). Laser parameters were 830 nm wavelength, 12 mW power with 5 J/cm^2 energy. Exposure time was calculated for 8 seconds based on energy formula (with laser protective glasses). Common medications given to the patients after the implant surgery were as follows:

For all patients, amoxicillin 500 mg and metronidazole 250 mg every 8 hours were prescribed for 7 days.

- Analgesics were recommended for patients experiencing pain in the early weeks.
- Dexamethasone 8 mg single dose IM was used immediately after the surgery for all patients.
- Ice packs for extra-oral and surgical sites were used alternatively for 20 minutes and this procedure was repeated within 24 to 36 hours after surgery.
- Chemical plaque was controlled by chlorhexidine (12/0%) for a period of 2 weeks. One week and 3 days after surgery 5 j/cm^2 energy was radiated to this area again. This procedure was also performed for all members of the control group in the same way and at the same time (but the laser was not activated). The degree of pain was recorded after 12, 24, 48 and 72 hours based on visual analogue scale [VAS] from zero (no pain) to 10 (at death). Also, the type and number of analgesics consumed by the patients were recorded; facial swelling was recorded by using linear measurements 3 and 7 days after surgery (Figure 3). Determination of the degree of wound healing was performed on days 3, 7 and 14 after surgery as follows: 0 for complete wound healing, 1 for wound healing and the presence of a thin line of fibrin layer, 2 for wound healing and the presence of fibrin, 3 for incomplete wound closure and dehiscence, and 4 for wounds that were not closed and were necrotic (Figure 4).

Statistical Analysis

SPSS software (Statistical Package for Social Science, version 21.0, SPSS Inc., Chicago, IL, USA) was used for data analysis. *T* test was used in order to compare the duration and severity of pain, consumption of analgesics and facial swelling rate between 2 groups (control and laser). Chi-square test was used for matching between 2 groups. Also, Mann-Whitney test was used for comparison of wound healing between laser and control groups.

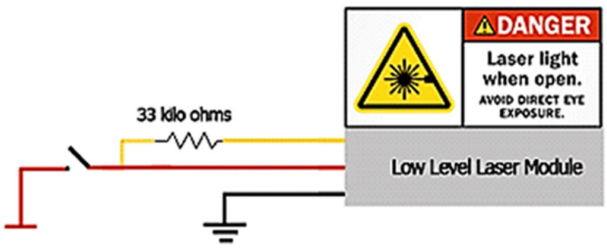

Figure 1. Laser Circuit.

Figure 2. Radiation at the Site of Surgical Implants, Buccal (Right) And Lingual (Left) Separately.

Figure 3. Clinical Approach to Measuring Swelling of Face: 1- tragus to the corner of the mouth, 2- tragus to Pogonion 3-outer corner of the eye to gonium.

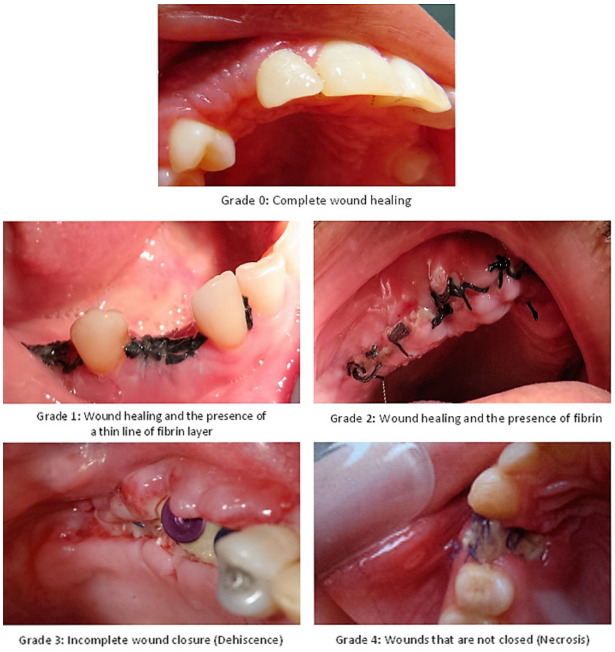

Figure 4. The Degree of Wound Healing Clinically.

Results

This study was carried out on 30 eligible patients in two groups of laser treatment and placebo groups. The age and sex of the patients in this study were matched and with no significant difference between the two groups ($P>0.05$). The frequency of surgical site (jaw irradiated) was calculated, and in accordance with the chi-square test, there was no significant difference between the 2 groups ($P=0.37$). Also, the frequency of the surgery type had no significant difference between the 2 groups ($P=0.9$).

T test showed that the degree of pain (showed with VAS) significantly reduced at 12 hours ($P<0.001$), 24 hours ($P<0.001$), 48 hours ($P=0.004$) and 72 hours ($P=0.04$) after surgery in the laser group compared with placebo (Table 1).

The average duration of painless time in the two groups was calculated and shown in Table 2. In the laser group, the pain disappeared faster than in the control group. *T* test showed that consumption of analgesics in the two groups had no significant differences ($P=0.62$). Also, the facial early index (as a baseline to check facial swelling) had no significant differences between the two groups. Facial swelling was measured at 72 hours and one week after surgery (Table 3). 72 hours after surgery the swelling of the face (Figure 3) did not differ significantly between the two groups ($P=0.09$) but was significantly reduced 1 week after surgery in the laser group ($P=0.003$).

Surgery recovery area on days 3, 7 and 14 after surgery in both groups is shown in Table 4. Mann-Whitney test showed that wound healing (area of operation) on the third day after surgery was significant between the 2 groups ($P=0.01$) that means the laser group had a better response for wound healing. Also, this index was significant on the seventh day after surgery ($P=0.04$) and 14 days after surgery ($P=0.02$).

Discussion

Side effects are an inevitable part of therapies in medicine. Edema, trismus, pain, and infections are the most common side effects of implant therapy. A relatively new strategy to control the side effects is the use of LLLT.[1,17]

Previous studies have shown that LLLT can be effective to accelerate healing and pain relief through reduction of inflammatory mediators and cells and increase the amount of endorphin, respectively.[18] The results of this study showed that laser therapy is an effective method for reducing the severity and duration of pain, reducing facial swelling and accelerating wound healing in many tissues. However, our results are similar to studies that LLLT have been used for third molar surgery.[19,20] In this study, we observed a decrease in pain intensity at 12, 24, 48, 72 hours after surgery in the laser group compared with the placebo group. Also, the results of this study indicated that laser treatment can reduce the duration of pain in the laser group compared with the placebo group. The effects of LLLT for pain relief include reduced nerve conduction velocity, action potential reduction,

Table 2. The Average Duration of Painless, Consumption of Analgesics in 2 Groups

Variables	Placebo		Laser		*P* Value
	Mean	SD	Mean	SD	
Duration of painless	57.2	5.93	24.8	7.12	<0.001
Consumption analgesics	5	1.22	4.33	0.91	0.62

Table 3. The Average Primary Facial Index, Value of Swelling in Third and Seventh Days After Surgery in 2 Groups

Variables	Placebo		Laser		*P* Value
	Mean	SD	Mean	SD	
Primary Facial Index	36.1	2.2	36.05	2.7	0.92
Value of swelling in 3rd day	1.2	0.6	0.8	0.5	0.09
Value of swelling in 7th day	0.53	0.1	0.15	0.05	0.003

Table 1. The Mean VAS at Different Times in the 2 Groups

Groups	After 12 h		After 24 h		After 48 h		After 72 h	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Placebo	4.5	2.53	2.53	1.59	2.2	0.75	0.8	1.42
Laser	1.14	0.36	0.46	0.25	0.26	0.15	0.13	0.09
P value	<0.001		<0.001		0.004		0.04	

Table 4. Distribution of the Status of Wound Healing at Different Times in 2 Groups

Wound Healing Status	Complete Wound Healing		Grade 1		Grade 2		Grade 3		Grade 4		*P* Value
	Placebo	Laser	Placebo	Laser	Placebo	Laser	Placebo	Laser	Placebo	Laser	
3rd Day	0	0	0	20	46.7	66.7	46.7	13.3	6.7	0	0.01
7th Day	0	6.7	26.7	53.3	46.7	33.3	20	6.7	6.7	0	0.04
14th Day	13.3	46.7	33.3	33.3	46.7	20	6.7	0	0	0	0.02

and selective inhibition of Aδ and C fibers and reduced painful stimuli.[21]

Positive effects of LLLT in pain reduction are frequently reported.[22-24] However, some other studies have declared that despite a minor decrease in pain, LLLT had no other effect between laser and control groups.[25,26] Therefore, an overall comparison of postoperative complications including pain is very difficult. The reasons for this difficulty can be attributed to different wavelengths of laser, a large variety of laser parameters, differences in experimental studies, sample size and study days. Laser can reduce the swelling through vasodilatation, increased circulation, lymphatic drainage, phagocytosis, and changes in the synthesis of prostaglandins.[22,27] Consistent with these findings, our results show that in the laser group, a significant reduction was seen in swelling of the face on the seventh day after surgery compared with the placebo group.

The results of the present study showed a significantly higher degree of recovery in the laser group compared with the placebo group on 3, 7 and 14 days after the surgery. These results are consistent with data from in vivo and in vitro studies which showed that LLLT facilitated mobility of fibroblasts and keratinocytes, collagen synthesis, angiogenesis, and release of growth factors.[28] They also confirm the results of studies of other researchers who demonstrated that the use of LLLT can accelerate wound healing after gingivectomy.[28,29] One of the limitations of this project was the small size of the sample, and further studies with larger sample sizes may be useful in support of these claims.

Conclusion

Despite the common use of lasers in surgery, little knowledge exists in relation to other types of lasers, including low-level lasers. Due to the wide variety of laser variables, so far optimal parameters have not been set for these purposes. One of the most important medical applications of laser is LLLT in which the laser radiation penetrates easily into the target tissue. Our results suggest that laser, as a complementary therapy; can be used to reduce the severity and duration of pain. Also, laser can reduce facial swelling and accelerate wound healing.

Conflict of Interests

The authors declare no conflict of interest.

Ethical Considerations

Our study protocol was approved by the Local Ethics Committee of Research and Clinical Center for Azad University, Isfahan, Iran.

Acknowledgments

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