Original Article

The Effects of Low Level 660nm Laser Irradiation on Pain and Teeth Hypersensitivity after Periodontal Surgery

Ardavan Etemadi[1], Mostafa Sadeghi[2], Mohamad Hossein Dadjou[3]

[1]Laser Research Center of Dentistry, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
[2]Associate Professor, Department of Restorative Dentistry, School of Dentistry, Rafsanjan University of Medical Sciences, Rafsanjan, Iran.
[3]DDS, Rafsanjan, Iran.

Abstract:

Introduction: Tooth pain and sensitization are the two main causes of discomfort after periodontal flap surgery. Effects of low level laser therapy for reducing pain have already been established; these kinds of lasers have been used for tooth desensitization as well. This controlled blind study sought to compare tooth pain and sensitization after 660nm laser irradiation in a split mouth and also in a control group after periodontal flap surgery.

Methods: Forty patients were enrolled in this study. In these entire patients periodontal flap surgery was done in the upper anterior segment. In the test group, by tossing of a coin the left or right side was determined for laser irradiation, so central incisor, lateral incisor and canine were irradiated by swiping motion of 660nm laser (AZOR, Russia) 25mW, 4.5 J, and 3 min every other day starting one day after surgery; and in collateral segment a placebo probe was put to blind the patients. In the control group, dressing was used after surgery. One, 3, 5 and 7 days after surgery for both groups visual analog score (VAS) for tooth pain and sensitization were recorded for both sides in each patient.

Results: In the laser group, both sides had lower VAS for pain than the control group ($P< 0.05$) after the first day. There was no statistical difference in the laser group between laser irradiated, or non-irradiated segment and for sensitization between groups.

Conclusion: Pain can be reduced after periodontal surgery by using low level 660nm laser therapy. Lower pain in both sides in the laser group may be the result of the spread of mediators and neurotransmitters secreted after laser irradiation, or may be because of scattered radiation in the collateral part.

Keywords: dentine hypersensitivity; low level 660nm laser; periodontal surgery

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***Corresponding Author:** Mostafa Sadeghi, DDS, MS; Department of Restorative Dentistry, School of Dentistry, Rafsanjan University of Medical Sciences, Rafsanjan, Iran.Tel: +98-3918220031-4; Fax: +98-3918220008; Email:mostafa.sadeghi@rums.ac.ir

Introduction

After introduction of Ruby laser by Maiman, in 1960, it has been more than 50 years which different lasers have been used in dentistry. Application of CO2, neodymium-doped yttrium aluminium garnet(Nd:YAG), erbium substituted: yttrium aluminium garnet(Er:YAG) and diode lasers

in periodontology as a treatment modality for soft and hard tissue surgery, as well as nonsurgical treatment have been proven by a wide range of researches (1-4).

Low power lasers and lasers with 400-900 nm wave-lengths have some biostimulation and biomodulation effects (5, 6). These types of lasers mainly act on cellular mitochondrial respiratory chain and membrane calcium channels (7, 8).

Tooth pain and sensitization are the two main causes of discomfort after periodontal surgery. The Effects of low level laser therapy in reducing tooth pain and desensitization after periodontal surgery has been well established (6, 9-11). But to the best of our knowledge, there is lack of studies on the effects of low level 660nm laser irradiation after periodontal surgery.

Methods

Forty patients (26 female and 14 male) with moderate to severe chronic periodontitis (38 subjects) or cosmetic crown lengthening (2 subjects) were enrolled in the study. All patients were healthy and had not received any medication before the study. Patients with periodontal treatment or antibiotic therapies within six months, as well as missing or hopeless teeth in upper anterior segment were excluded.

Written informed consent was obtained from all patients. The study protocol was approved by the ethics committee of Rafsanjan University of Medical Sciences, Rafsanjan, Iran.

Treatment was started by scaling, polishing and oral hygiene instruction which was followed by periodontal flap surgery on upper anterior sextant (canine to canine) by one periodontist in all procedures.

20 patients were selected randomly as the study group, and 20 patients as the controls. In the study group, by tossing of a coin the left or right side was determined for laser irradiation (Azor-Russia) 660nm, 25mW, 4.5J, so a band of gingiva just beneath the marginal gingiva of the central incisor, lateral incisor and canine were irradiated by swiping motion for 3 minutes every other day starting the day after surgery and continuing for 4 times. A placebo probe was put in the collateral segment to blind the patients. The control group just received surgical dressing after surgery. Amoxicillin 500mg (three times a day) for seven days was prescribed for both groups.

On the 1st, 3rd, 5th and 7th days post surgery, visual analog score (VAS) for pain and dentin hypersensitivity (DH) was recorded in both sides of each patient.

Data were analyzed using SPSS 17 and Mann-Whitney U test and Wilcoxon signed-ranked test. Statistical significance was set at 95% confidence level.

Results

All patients in the study group attended to the four sessions of treatment according to their schedules. The mean and standard deviation of VAS index for DH obtained from thermal-evaporative stimuli for the three groups are presented in Table 1.

Kruskall Wallis Analysis of the Variance was used to evaluate the difference in VAS index for DH among the study groups which revealed statistically significant difference ($p>0.05$). The Mann-Whitney test was applied to compare the difference between the mean of VAS for DH between the three groups; and there was no statistically significant difference between laser irradiated and placebo; as well as between placebo and control groups; however difference between placebo and control groups on the 1st ($P=0.049$) and the 3rd ($P=0.036$) days were significant, that was not continued to the 5th and 7th days ($p>0.05$). A Wilcoxon signed rank test showed a significant difference in VAS index for DH between the 1st day of treatment with the 3rd, 5th and 7th days in all groups ($p<0.05$). The statistical analysis of data revealed that sensitivity level significantly dropped in the period of examination (Figure 1).

Table 2 shows the mean and standard deviation of VAS index for pain in the three groups at different times.

Analysis of data showed statistically significant differences in VAS index for pain among the study groups on the 3rd ($P=0.007$), the 5th ($P=0.008$), and

Table 1. Mean and standard deviation of VAS for DH in the three groups at different times (N=20).

Evaluation Group	1st day	3rd day	5th day	7th day
Laser Irradiated	4.35±1.98	2.95±1.64	1.80±1.51	1.00±1.08
Placebo	3.85±1.81	2.60±1.43	1.70±1.34	1.05±1.15
Control	5.25±2.22	4.25±2.43	2.15±1.84	0.55±0.83

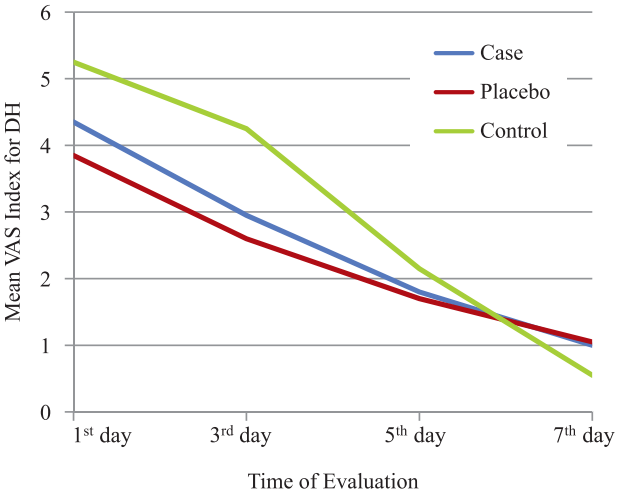

Figure 1. VAS index changes for DH in the three groups at different times (N=20).

Table 2. Mean and standard deviation of VAS for pain in the three groups at different times (N=20).

Evaluation Group	1st day	3rd day	5th day	7th day
Laser Irradiated	5.90±2.22	4.05±2.19	2.65±2.11	1.05±1.10
Placebo	6.70±1.22	5.30±1.72	3.00±2.25	1.50±1.28
Control	6.65±1.63	5.90±1.33	4.50±1.50	2.10±1.02

the 7th (P=0.012) days of treatment; while, on the 1st day it was not observed. When comparing the groups, no statistically significant difference was found between laser irradiated and placebo groups; the difference between laser irradiated and control groups on the 3rd (P=0.003), the 5th (P=0.005), and the 7th (P=0.004) days were significant, but not on the 1st day of treatment (p>0.05). Statistically

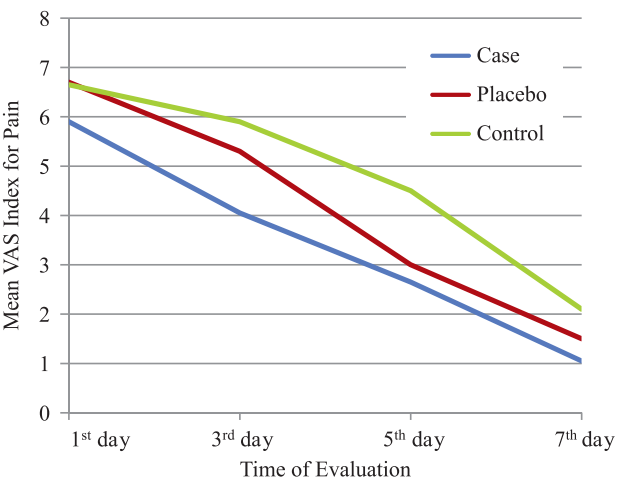

Figure 2. VAS index changes for pain sensation in the three groups at different times (N=20).

significant difference between placebo and control groups on the 5th (P=0.013) day was found, but on the 1st, 3rd and 7th days of treatment no significant difference were observed (p>0.05). The internal analysis of the item in each group showed (Figure 2). A significant reduction was observed in the pain condition from the 1st day until the end of treatment in the study groups (p<0.05).

Discussion

Low level laser is mostly recommended in periodontology to reduce patient's complaint and discomfort due to dentinal hypersensitivity (DH), or pain after surgical procedures. These two conditions are usually difficult to quantify. In this study, VAS was used to determine the amount of DH and pain following the treatments. There are many studies in the literature that have applied VAS as reliable criteria for presence and / or severity of pain after surgical procedures. This criterion is easily recognized by patients, and is sensitive and appropriate for evaluating the pain (2, 12, 13).

The results of this study indicated that 660nm low level laser therapy reduces pain after periodontal surgery, but does not have any effects on DH. Reduction of pain following application of laser may be interpreted that laser can help in faster wound healing which is due to the result of an increase in movement of keratinocytes and accelerates in epithelialization by increasing fibroblast proliferation and neovascularization (14).

Tuby, et al had also demonstrated that the secretion of fibroblast growth factor by macrophage and fibroblasts is increased following low level laser therapy (15). It seems that growth factors together with the scattered beam of laser help to reduce pain in the collateral segment in patients who receive laser therapy after surgery.

Dentin hypersensitivity is one of the most frequent complaints in the daily clinic (16-20). It has multifactorial etiology, and generally more than one factor is found to be associated with and active in this painful manifestation (21). The exposure of the dentinal tubules present throughout the full extent of the dentin is the main cause (22-24) Therefore; more than one treatment method should be associated to desensitize the dentin to satisfactory levels (21).After periodontal therapy a higher number and width of dentinal tubules are

exposed so DH is experienced (25). Despite the great variety of available therapeutic methods, DH still remains a chronic dental problem with a difficult treatment conduct and an uncertain prognostic process (26). The present study tried to verify the effectiveness of the low level laser irradiation for reduction, or remission of dentin hypersensitivity and pain following periodontal surgeries.

Low level lasers are widely used in dentistry due to their effectiveness to improve the healing process, lowering pain after surgery, treatment of parasthesia, treatment of sensitive teeth, and many other painful conditions, besides promoting a faster dentin formation; and they are mostly recommended in periodontology to reduce patients' complaints and discomfort due to DH or pain after surgical procedures(2,12,13).However, the advent of dental lasers has raised another option for the treatment of DH and painful sensation after periodontal surgeries, and it has become a research interest in the last decades(27, 28).

In the present study, low level laser therapy is not effective in decreasing the DH following periodontal surgeries, and there was no statistically significant difference among the study groups. Also, there was no statistically significant difference between laser irradiated and placebo; and between laser irradiated and control groups. There are many reports of low level laser use in the treatment of DH. Vieira et al found no significant difference between the low level laser and placebo groups for reducing DH (29). Birang et al compared the effects of Nd:YAG, Er:YAG and placebo lasers, reporting a statistically significant reduction of painful sensation after each laser application and between the beginning and the end of the treatment, although there was no statistically significant difference between the laser treated and the placebo groups at the end of treatment (2). In contrast, Corona SA et al concluded that the low-level GaAlAs laser may be effective in decreasing cervical DH (26). The morphological analysis of dentin surface using scanning electron microscopy revealed that Nd:YAG laser irradiation causes melting and fusion of dentin; and therefore the closure of exposed dentinal tubules (30). Nevertheless, Walsh et al believed that the low-level laser affected on DH upon depressed nerve transmission in the neural transmission networks within the dental (5). Also, histological studies have reported that hard tissue formation is enhanced as a reaction of dental pulp to laser light (31, 32).

Although in the present study, a clinical and statistically significant reduction was observed over time in dentin sensitivity for the laser treated group, a significant reduction was also observed for the placebo and control groups. It is generally accepted that teeth sensitivity may decrease with time due to the natural occlusion of tubules (33).In the literature, there are lots of contradictory studies for treatment of DH using low level lasers (10, 11, 17-19). These differences are due to various types of lasers and variety in laser parameters. In our study, laser beam was aimed and focused on the keratinized gingiva of each tooth and not to the exposed dentin. Lack of any differences in DH may indicate that reducing DH does not relate to a systemic effect. It should be kept in mind that due to the controversies in information regarding the mechanism of effects of low level lasers in the treatment of DH and the fact that the treatment procedure is not simple because of the interference of placebo effect, natural desensitization of teeth, mechanical occlusion of the exposed dentinal tubules by smear layer or creationofsecondary dentin, we still need more study for investigation in this field .

Clinically, the patients demonstrated a statistically significant reduction in painful sensation to the thermal-evaporative stimulus after periodontal surgeries in all study groups. Tuner and Hode concluded that laser effects on endorphin release could be the reason for the immediate pain relief in patients, but biostimulative effects happen gradually in probably a few days. Besides the immediate analgesic effect, the laser therapy used with correct parameters, may stimulate the normal physiological cellular functions. Stimulation of odontoblasts, production of reparatory irregular dentin and obliteration of dentinal tubules provoked by laser are reasons for the prolonged suppression of pain in DH (34). Although information on the neurophysiologic mechanism is not conclusive, it is postulated that a low level laser mediates an analgesic effect related to the depolarization of C-fiber afferents. This interference in the polarity of cell membranes by increasing the amplitude of the action potential of cell membranes can block the transmission of pain stimuli in hypersensitive dentin (35).

Conclusion

Low level 660nm laser irradiation can reduce pain after periodontal surgery. Lower pain in collateral side in the laser group may be the result of spreading mediators and neurotransmeters secreted after laser irradiation.

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