Original Article

Evaluation of the Effects of Diode (980 Nm) Laser on Gingival Inflammation after Nonsurgical Periodontal Therapy

Davoud Zare[1], Ahmad Haerian[1], Reza Molla[2], Farzane Vaziri[1]

[1]Periodontology Department, Faculty of Dentistry, Shahid Sadughi University of Medical Science, Yazd, Iran.
[2]Specialist in Periodontics, Yazd, Iran.

Abstract:

Introduction: Periodontitis is an inflammatory disease, for which, scaling and root planning (SRP) is the common approach for non-surgical control of inflammation. Using lasers is another approach in the first phase of periodontal treatment for control of inflammation. Diode laser has some beneficial effects such as acceleration of wound healing, promotion of angiogenesis and augmentation of growth factor release. Thus the aim of this study is the evaluation of diode laser (980 nm) effect on gingival inflammation when it is used between the first and second phase of periodontal treatment, in comparison with common treatment (SRP) modality alone.
Methods: In this study, 21 patients with moderate to severe chronic periodontitis were selected and divided in to control group (SRP) and test group (SRP + laser). Two months after the last scaling and laser radiation, indexes including gingival level (GL), bleeding on probing (BOP) and modified gingival index (MGI) were recorded and compared with baseline.
Results: Two months after the beginning of the study, all indices improved in both groups. The indices were not different between two groups except for BOP which was lower in laser group.
Conclusion: Based on overall improvement in parameters such as superiority of laser application in some indices, lack of thermal damage and gingival recession with the specific settings used in this study, the application of laser as an adjunctive treatment together with common methods is preferable.
Keywords: periodontitis; diode Laser; gingival

Please cite this article as follows:
Zare D, Haerian A, Molla R, Vaziri F. Evaluation of the Effects of Diode (980 Nm) Laser on Gingival Inflammation after Nonsurgical Periodontal Therapy J Lasers Med Sci 2014;5(1):27-31

Corresponding Author: Farzane Vaziri,DDS; Periodontology Department, Faculty of Dentistry, Shahid Sadughi University of Medical Science, Yazd, Iran. Tel:+98-3518248683; Fax;+98-3516225802; E-Mail:farzane.vaziri@gmail.com

Introduction

Periodontitis is an inflammatory disease involving tooth supporting structures[1]. The main principle of periodontal therapy is elimination of bacterial deposits and niches by removing supragingival and subgingival biofilm[2].

Scaling and root planning is the common approach in the control of inflammation in non-surgical treatment modality[3]. But, conventional treatment fails in many situations especially in severe cases[4]. Several adjunctive treatment modalities have been developed to overcome these limitations[5].

Using lasers is one of these modalities[6]. Many studies have shown that in addition to common mechanical therapy or even in replacement of it, laser therapy can cause resolution of inflammation in gingival tissue[7,8,9]. This approach has some advantages including bactericidal and detoxification effects as well as the capacity to reach deeper sites where conventional mechanical

instrumentation cannot[6].

Diode laser with a wavelength between 655 and 980 nm, is able to accelerate wound healing, to promote angiogenesis, to augment growth factor release and to prevent root surface ablation. Smaller units in size as well as lower financial costs are other beneficial characteristics of diode laser[10]. However some studies did not find any additional benefit in non-surgical treatment modality by using diode laser[4]. The aim of this study was to evaluate the effects of Diode laser with the wavelength of 980 nm in gingival sulcus between the first and second phase of periodontal therapy in resolution of gingival inflammation.

Method

In this single blind clinical trial study all participants provided informed written consent, and 21 patients with moderate to severe chronic periodontitis participated. Having moderate to severe chronic periodontitis, at least 4 teeth in each quadrant, at least 4 sites with probing depth more than 4 mm and bleeding on probing as well as radiographic signs of alveolar bone loss were the inclusion criteria of this study. Exclusion criteria were systemic disease like bleeding disorders, epilepsy, mental deficiency, smoking and pregnancy.

Oral health condition in all participants based on gingival level (GL), modified gingival index (MGI) and bleeding on probing (BOP) were recorded.

Full mouth GL was recorded using Williams's periodontal probes. For determination of gingival inflammation, MGI was used, in which according to the severity of inflammation 5 scores from 0 to 4 around each tooth. The mean of these scores was used for each tooth. BOP was measured one minute after probing along gingival sulcus and recorded in percent of surfaces.

At the end all the sites were randomly divided into two groups; Control group which only received SRP and Case group which received SRP with laser therapy. Oral hygiene instructions which included tooth brushing and flossing were given to all patients. At the last visit of scaling when the first phase of therapy was completed, laser therapy was randomly carried out in two quadrants (one of them in upper jaw and the other in the lower jaw) of the case group. Characteristics of the laser were 980 nm Diode laser with one watt power and a speed of 2 mm/s by a 400 μm fiber which was used in continuous mode. Laser beam was projected from the distal site of the selected quadrants while fiber was inserted into the depth of the sulcus. Lightening was from depth to the surface of sulcus with spiral movements. To prevent from excess heat production on the soft tissue surface, a 10s discontinuation was considered in the site where the duration of lightening was more than 30s.

This procedure continued for both buccal and lingual surfaces to the anterior tooth in each quadrant. In the remaining quadrants as control sites, there was only pilot lightening of laser in the same way, but laser lightening was inactivated.

After collecting all the data from patients who participated in all recall programs, Mann Whitney and Wilcoxon tests were exploited to analyze the data.

Results

Among 26 patients who participated in the study at the beginning, 21 patients attended all recall programs from which 11 were male and 10 were female with a mean age of 42.2 years. In overall 207 sites from these patients in both case and control groups were evaluated.

Regarding GL, the result of the study showed a significant reduction in both case and control groups after treatment (P< 0.001). In other words, patients experienced gingival recession. Comparing GL between two groups after treatment, there was no significant difference. (P=0.903) (Table 1).

Two months after treatment both groups showed significant reduction in MGI (P< 0.001), while the difference between two groups was not statistically significant (p-value= 0.379) (Table 2).

This study showed that BOP in both groups had significant reduction after 2 months. Reduction of BI in test group was more than control group, also differences in treatment modality was statistically significant (P-value=0.033) (Table 3).

Table 1. Mean gingival level before and after treatment in mm.

group	Before			After			P-value
	median	mean	S.D	median	mean	S.D	
Control	-0.5	-0.88	1.1	-1	-1.09	1.26	<0.001
Test	-1	-0.91	1.12	-1	-1.07	1.18	<0.001
P-value		0.853			0.903		

MannWhitney and Wilcoxon Tests

Table 2. Mean MGI score before and after treatment

group	baseline			2 month			P-value
	Median	mean	S.D	Median	mean	S.D	
control	2	1.49	0.82	1	0.66	0.71	<0.001
case	2	1.49	0.74	1	0.71	0.68	<0.001
P-value		0.951			0.379		

MannWhitny and Wilcoxon Tests

Table 3. Mean BOP before and after treatment in percent.

Group	Baseline			2 month			P-value
	Median	mean	S.D	Median	mean	S.D	
Control	66	61.14	39.92		33.33	39.48	<0.001
Case	66	65.51	39.07		25.07	35.88	<0.001
P-value		0.258			0.033		

MannWhitney and Wilcoxon Tests

Discussion

Due to the 8 weeks healing time after the first phase of therapy, 2 months duration of follow up in this study was considered, so our decision about the surgical phase was based on outcome of treatment.

Although one watt continuous power by 400 μm fiber that was used in this study is a setting that has the least side effects on periodontal tissues but positive effects on removal of pocket epithelium and subgingival flora proves the effectiveness of diode laser on reduction of inflammation after periodontal surgery. According to Kreisler et al in 2005 810 nm diode laser with the characteristic of one watt power by a 600μm fiber during 3 months is a safe method which can be used as an adjunctive treatment along SRP[11]. Using a 400 μm fiber with the power of one watt in the present study is in contrast to 600 μm fiber and has higher density per surface unit; However 980nm diode laser in the present study is in contrast to 810nm diode laser and has less pigmentation absorbtion, thus risk of heat production will be low.

Kreisler et al in 2000 showed that 1w power has no or little effects on root surface and attachment level of periodontal tissue among different power of 1, 1.5, 2 and 2.5w diode laser, while 1.5w and higher power cause thermal damage and attachment loss[12].

However, the presence of blood in gingival sulcus acts as an interventional factor which can elevate risk of thermal damage. This thin biofilm of blood products which cover root surfaces of periodontal pocket can considerably elevate absorbtion of energy and may lead to thermal damage to the dental pulp. Thus laser therapy is not recommended in the first session of scaling. Based on this condition Borrajo[13] recommended laser therapy should be started 2 days after scaling or accompanied by normal saline irrigation. To minimize the risk of periodontal damage, in the present study diode laser therapy was carried out in the last session of the first phase of periodontal therapy because in this phase inflammation and bleeding has reduced to a degree which minimizes the risk of damage.

The basic question in the present study will be whether this recommended protocol removes sulcular epithelium and inflammatory tissue of periodontal pocket? As we know positive effects of laser therapy on improvement of attachment depends on the characteristic of laser.

Romanos et al in 2004 showed the effectiveness of 980 nm diode laser with the power of 2 and 4w in continuous mode with duration of 15s for each site on animals in removal of lining periodontal pocket. In a microscopic evaluation, they demonstrated that there is remnant of epithelial tissue in treated sites with hand instrument while in site treated with laser, the removal of sulcular epithelium and connective tissue was complete. However sites which were treated with 4w power showed signs of necrosis which could delay healing[14].

Kreisler et al evaluated laser therapy in invivo conditions with the power of 1w in continuous mode in duration of 10s for each site for the treatment of periodontitis. Results of their study indicated the safety of laser therapy as an adjunctive treatment to SRP. In this study, there was also more reduction in tooth mobility and probing depth in the case group which could be attributed to the removal of lining epithelium of periodontal pocket and improvement of connective tissue attachment[11].

Microbiologic evaluation of periodontal pocket after laser therapy demonstrated that antimicrobial effects of laser directly depend on antimicrobial effects of diode, Er-

YAG and Nd- YAG lasers. However, these effects about diode and Nd-YAG laser are mainly based on thermal effects and related to energy absorbtion by pigmented agents.

Not having microbiologic evaluation is the limitation of the present study; although many studies proved the effectiveness of recommended protocol in current study in reduction of microorganisms load in dental plaque.

Mortiz et al in 1998 demonstrated bacterial reduction by the use of laser therapy with the wave length of 805 nm by a 400 μm fiber with the power of 2.5^{w} and the frequency of 50 Hz in pulse mode; Sites which received laser demonstrated significant reduction in bacteria specially A.a[15].

Fontana et al in 2004, reported positive effect of diode laser therapy in reduction of prevotella and fusobacterium species[16, 17].

According to the above contents in the present study, effects of diode 980 nm laser therapy as a laser assisted periodontal therapy, its antimicrobial effects and closed curettage in de-epithelialization of lining periodontal pocket as an adjunctive treatment after the first phase of periodontal therapy on gingival inflammation were evaluated.

Gingival Level (GL):

The results of the present study showed significant reduction in gingival level in both groups. In fact we expected it because of removal of local stimulating factors and reduction of the severity of inflammation. Also, we don't have statistically significant differences between the two groups which confirm no harmless effect of recommended protocol on gingival tissue.

Borajo et al in 2004 in the evaluation of adjunctive laser therapy with wavelength 980nm and the power of 2^{w} using 200μm fiber in pulsed mode showed a significant reduction on gingival level, however according to the present study there wasn't any significant difference between case and control groups in gingival recession[13].

Bleeding on Probing (BOP):

In periodontal studies repeated BOP in one site represents continuous pattern of periodontal destruction. Also, it can be attributed to periodontopathogens in subgingival microflora. So, not having BOP is an appropriate indicator for healthy periodontal tissue[18]. Conventionally, after the first phase of therapy we expected to have the elimination of BOP and improvement of clinical sign of inflammation. What is important in this study is the significant differences between case and control groups. In fact, we have more reduction in BOP in the case group in contrast to the control group which indicates the effect of laser therapy on subgingival microflora.

Antimicrobial effects of laser with 1^{w} power have been proved; these effects cause changes in subgingival microflora composition and reduce number of gram negative microorganisms.

However this hypothesis needs microbiologic evaluation of subgingival plaque samples after laser therapy, but the recommended dose in the present study did not cause gingival recession and reduced BOP in comparison to control group. We can use this recommended protocol for improvement of gingival inflammation in maintenance session. For the anterior region in which surgical treatment can cause uneven gingival recession, laser therapy with the characteristic of this study is recommended as an alternative method for surgical treatment.

Borajo et al in 2004 have studied on 980 nm diode laser with the power of 2^{w} as an adjunctive treatment to SRP in 6 weeks periods. Their results were in accordance with the present study in which BOP reduced in both groups but this reduction was more in the case group than the control group[13].

In contrast to the present study, Kreisler in 2005 and Kelbauskiene in 2007 didn't show any statistical significant differences between two groups of laser and conventional therapy. However, Kelbauskiene used Er.Cr:YAG and Kreisler used diode laser with the wavelength 890 nm with 2^{w} power[11,19].

Jensen in 2010 and Birang in 2010 studied the effects of Nd.YAG laser as an adjunctive therapy to SRP. They showed a BOP reduction in both groups, while there weren't any significant differences between two groups in these studies[18, 20].

Modified gingival index (MGI):

MGI represents the severity of gingival inflammation such as redness and edema of gingival tissue. Patients in this study showed mild inflammation before treatment, involving the entire marginal and papillary unit. This inflammation reduced, to some part, in both groups after treatment. Although in the comparison between groups there weren't any statistically significant differences.

Considering this point that it is in contrast to BOP which represents inflammation of internal lining of periodontal pocket, MGI displays inflammation of gingival margin and external lining of periodontal pocket; thus laser therapy causes reduction of inflammation in

internal lining of periodontal pocket in deep sites and reduction of BOP in the case group in contrast to the control group. This study showed that laser therapy has no effect on manifestation of inflammation in marginal external surface of gingiva.

The result of Kreisler et al in 2005 regarding MGI by the use of 890 nm diode laser with the power of 2^{w} was in accordance to the present study in which there wasn't any differences between the case and control groups[11]. Also, the results of Yilmaz et al in 2002 in using diode laser with a wave length of 685 nm and 30^{mw} power in low level laser therapy were similar to the present study[5].

Conclusion

Diode laser can affect the reduction of BOP and have no negative effect on root surfaces and gingival recession.

Reference

1. Armitage GC. Development of a classification system for periodontal diseases and conditions. Ann Periodontol 1999;4:1–6.
2. Schwarz F, Sculean A, Beakdar M, Georg T, Reich E, Becker J. Periodontal treatment with an Er:YAG laser or scaling and root planning. A 2-year follow up split-mouth study. J Periodontal 2003;74:509-96
3. Yukna RA, Scott JB, Aichelmann-Reidy ME, LeBlanc DM, Mayer ET. Clinical evaluation of the speed and effectiveness of subgingival calculus removal on single rooted teeth with diamond-coated ultrasonic tips. J Periodontol 1997;68:436-42.
4. Euzebio Alves VT, de Andrade AK, Toaliar JM, Conde MC, Zezell DM, Cai S, et al. Clinical and microbiological evaluation of high intensity diode laser adjutant to non-surgical periodontal treatment: a 6-month clinical trial. Clin Oral Investig 2013;17(1):87-95.
5. Yilmaz S, Kuru B, Kuru L, Noyan U, Arguan D, Kadir T. Effect of Galium Arsenide Diode Laser on Human Periodontal Disease: A Microbiological and Clinical Study. Lasers Surg Med 2002;30:60-6.
6. Sgolastra F, Severino M, Gatto R, Monaco A. Effectiveness of diode laser as adjunctive therapy to scaling root planning in the treatment of chronic periodontitis: a meta-analysis. Lasers Med Sci;2013;28(5):1393-402.
7. Van der Weijden GA, Timmerman MF. A systematic review on the clinical efficacy of subgingival debridement in the treatment of chronic periodontitis. J Clin Periodontol 2002;29 Suppl 3:55-71;
8. Schwarz F, Aoki A, Becker J, Sculean A. Laser application in non-surgical periodontal therapy: a systematic review. J Clin Periodontol 2008;35(8 Suppl):29-44.
9. Karlsson MR, Diogo Löfgren CI, Jansson HM. The effect of laser therapy as an adjunct to non-surgical periodontal treatment in subjects with chronic periodontitis: a systematic review. J Periodontol 2008;79(11):2021-8.
10. Aoki A, Sasaki K M, Watanabe H, Ishikawa I. Laser in nonsurgical periodontal therapy. Periodontology 2000 2004;36:59–97.
11. Kreisler M, Al Haj H, d'Hoedt B. Clinical efficacy of semiconductor laser application as an adjunct to conventional scaling and root planing. Lasers Surg Med 2005;37(5):350-5.
12. Kreisler M, Al Haj H, Daubländer M, Götz H, Duschner H, Willershausen B, et al . Effect of diode laser irradiation on root surfaces in vitro. J Clin Laser Med Surg 2002;20(2):63-9.
13. Borrajo JL, Varela LG, Castro GL, Rodríguez-Nuñez I, Torreira MG. Diode laser (980 nm) as adjunct to scaling and root planing. Photomed Laser Surg 2004;22(6):509-12.
14. Romanos GE, Henze M, Banihashemi S, Parsanejad HR, Winckler J, Nentwig GH. Removal of epithelium in periodontal pockets following diode (980 nm) laser application in the animal model: an in vitro study. Photomed Laser Surg 2004;22(3):177-83.
15. Moritz A, Schoop U, Goharkhay K, Schauer P, Doertbudak O, Wernisch J, et al. Treatment of periodontal pockets with a diode laser. Lasers Surg Med 1998;22(5):302-11.
16. Fontana CR, Kurachi C, Mendonça CR, Bagnato VS. Microbial reduction in periodontal pockets under exposition of a medium power diode laser: an experimental study in rats. Lasers Surg Med 2004;35(4):263-8.
17. Fontana CR, Kurachi C, Mendonça CR, Bagnato VS. Temperature variation at soft periodontal and rat bone tissues during a medium-power diode laser exposure. Photomed Laser Surg 2004;22(6):519-22.
18. Jensen J, Lulic M, Heitz-Mayfield LJA, Joss A, Lang NP. Nd:YAG (1064 nm) laser for the treatment of chronic periodontitis: a pilot study. J Invest Clin Dent 2010;1:16–22.
19. Kelbauskiene S, Maciulskiene V. A pilot study of Er,Cr:YSGG laser therapy used as an adjunct to scaling and root planing in patients with early and moderate periodontitis. Stomatologija 2007;9(1):21-6.
20. Birang R , Behfarnia P, Yaghini J, Teimuri F, Jamshidi M. Evaluation of the Effects of Nd:YAG Laser Compared to Scaling and Root Planning Alone on Clinical Periodontal Parameters. J Periodontal Implant Dent 2010;1(2):25-8.