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Evaluation of the Effects of Nd:YAG Laser Compared to Scaling and Root Planing Alone on Clinical Periodontal Parameters

Reza Birang[1] • Parichehr Behfarnia[2] • Jaber Yaghini[2]* • Fatemeh Teimuri[3] • Mahsa Jamshidi[3]

[1] Associate Professor, Department of Periodontics, Dental School, Isfahan University of Medical Sciences, Isfahan, Iran
[2]Assistant Professor, Department of Periodontics, Dental School, Isfahan University of Medical Sciences, Isfahan, Iran
[3]Dentist, Private Practice, Isfahan, Iran
*Corresponding Author; E-mail: j_yaghini@dnt.mui.ac.ir

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Abstract

Background and aim. The use of certain lasers has been proposed as an adjunctive method in periodontal pocket therapies. The objective of this study was to investigate the effects of Nd:YAG laser on the clinical periodontal parameters following scaling and root planing (SRP) in comparison to SPR alone.

Materials and methods. Six adults with moderate to severe chronic periodontitis, each with at least two 4- to 7-mm pockets in single-rooted teeth, were selected. From a total of 68 sites studied, 28 were randomly allocated to the control group receiving SRP alone and 40 pockets were allocated to the test group receiving SRP assisted by Nd:YAG laser therapy (100 mJ/Pulse, 2 Hz, 2 min). Clinical parameters were recorded and compared before and three months after treatment. The data was analyzed using SPSS software.

Results. Both test and control groups revealed significant improvements in pocket probing depth, 3.2 ± 1.4 mm and 1.4 ± 1 mm respectively, $P < 0.001$), clinical attachment level (2.2 ± 1.6 mm and 0.6 ± 1.2mm respectively, $P < 0.001$), and bleeding on probing (77.5% and 46.4% respectively, $P < 0.05$). However, the improvement in the test group was significantly higher than in the control group ($P < 0.01$).

Conclusion. Nd:YAG laser can be suggested as an adjunctive method for treatment of periodontal pockets.

Key words: **Nd:YAG laser, pocket therapy, scaling & root planing.**

Introduction

Root surfaces of the teeth are areas for accumulation of dental plaque and calculus as well as bacterial endotoxins, which are infiltrated into the cementum. A thorough removal of these harmful substances is an essential part of the periodontal therapies. Debridement of the diseased root surfaces is basically accomplished by mechanical scaling and root planing (SRP) using manual or power-driven instruments.

However, the limitations of this method warrant a set of adjunctive methods in order to maximize the therapeutic effects. The use of lasers as an adjunctive method in periodontal pocket therapies has been investigated, and it is now consideredas one of the most remarkable technical modalities for non-surgical periodontal treatment because of excellent tissue ablation and strong bactericidal and detoxification effects.[1-3]

The adjunctive or alternative use of lasers with conventional methods facilitates treatment. Numerous studies have also shown the success in application of lasers such as CO_2, Diode, Nd:YAG and Er:YAG lasers for the treatment of periodontal pockets.[4-6] Nd:YAG is one of the most suitable lasers as an adjunctive therapy to the conventional mechanical debridement because of its associated ease of energy transfer via a flexible optical fiber into the pocket and its disinfection and detoxification effects within the periodontal pockets.[6] The Nd-YAG Laser has been effective in removing the smear layer after conventional root planing.[7] Fukuda et al performed Nd:YAG laser irradiation to the periodontal diseased root surface of extracted teeth and reported its inactivating ability on the endotoxins in the superficial layer of the root surface.[8]In-vivo assessment of effects of conventional scaling and Nd:YAG laser treatment with those of scaling alone has shown a significantly higher post-treatment reductionin levels of periodontopathic bacteria in the conventional scaling followed by laser treatment group.[9] Also, Nd:YAG laser irradiation into the periodontal pockets has been reported to be more effective than SRP in reducing specific bacteria and in controlling their recolonization.[10]

Despite reports that indicate Nd:YAG laser as an adjunctive method to SRP could play an important role in reducing microorganisms inside pockets and improving clinical parameters,[11,12] some investigators have reported no advantage for Nd:YAG laser over SRP alone in improving microbiological and clinical parameters.[13] American Academy of Periodontology also does not currently recommend the adjunctive use of laser for curettage following conventional mechanical root debridement.[14,15] Considering the debatable application of laser in periodontal pockets, the objective of this study was to investigate the effects of Nd:YAG laser on the clinical periodontal parameters following SRP in comparison with SRP alone.

Materials and Methods

Six healthy adults with moderate to severe chronic periodontitis, each with at least two 4- to 7-mm pockets in single-rooted teeth, were selected. Systemic diseases, taking of drugs such as antibiotics over the three months before the study, failing to cooperate appropriately, smoking, or having received periodontal treatments in the three months before the study period were considered as exclusion criteria. From a total of 68 pockets, 28 pockets wereselected randomly as the control group, receiving SRP alone and 40 pockets were allocated to the test group receiving SRP and Nd:YAG laser therapy.

Measurements of the clinical indices including clinical attachment level (CAL), pocket probing depth (PPD), and bleeding on probing (BOP) as well as plaque index (PI) were recorded before and three months after the treatments. SRP was performed using the ultrasonic dental unit (Mectron, Carasco Ge, Italy). Using curettes (Hu-Friedy, Chicago, IL, USA), root planing was also performed in zones where pocket depth was less than 5 mm. Then, explorer was applied to detect the presence of any residual calculus. After the first SPR session, all patients received oral hygiene instructions on brushing their teeth every night for two minutes using the modified Bass technique, flossing and using chlorhexidine 0.2% to be applied twice daily. A week later, patients were checked again for any remaining calculus and underwent another SRP session if itwas necessary. Inthe following week,patients in the test group were subjected to Nd:YAG laser therapy (Fidelis plus, Fotona; Ljubljana, Slovenia, 300μm fiber; 2 w/100 mg, 20 Hz, 2 min). Oral hygiene instructionswere again given after this general treatment with the exclusion of chlorhexidine mouthwash use. One week later again, laser therapy was applied for each of the study subjects, according to their individual treatment plan. This resulted in three intervals of laser therapies for each patient. Patients were called back again three months after the first treatment session for clinical measurements. Data weresubjected to paired *t*-test, oneway ANOVA, Kruskal-Wallis test, and Chi-square test using the SPSS software. $P < 0.05$ was considered the statistical significance level.

Results

58.9% of sites weretreated with the laser, and 41. 1% of sites were treated with SRP alone, as the control group. Mean probing pocket depth and mean clinical attachment level for the test and control groups before and after treatments are presented in Tables 1& 2.

According to the results of paired *t*-test, treatment in both groups significantly improved PPD and CAL compared to pretreatment conditions. However, these changes in the control group were significantly less than those in the test group.

Chi-square test revealed that the percentage of BOP sites in the laser therapy group was significantly less

Table 1. Probing pocket depth (mm) before and after treatments in the test and control groups

Group	Before treatment	After treatment	Probing pocket depth reduction
Test	5.4 ± 1.2	2.3 ± 1	3.2 ± 1.4
Control	4.7 ± 1	3.3 ± 0.7	1.4 ± 1
P value	0.08	0.001	0.001

Table 2. Clinical attachment level (mm) before and after treatments in the test and control groups

Group	Before treatment	After Treatment	Clinical attachment level improvement
Test	4.5 ± 1.9	2.3 ± 1.7	2.2 ± 1.6
Control	4.3 ± 1.8	3.7 ± 1.4	0.6 ± 1.2
P value	0.07	0.001	0.001

than the controls (P = 0.005). Figure 1shows the distribution of prevailing BOP zones before and after treatment in the two groups.

Wilcoxon test showed no significant differences between plaque-free zones in both groups before (P = 0.482) and after treatment (P = 0.186). Figure 2 shows the distribution of plaque-free zones in the two groups.

Discussion

Laser treatment is expected to take a role as an alternative or adjunctive to conventional mechanical therapy in periodontics due to various advantages, such as easy handling, short treatment time, homeostasis and decontamination and sterilization effects. Among lasers, Nd:YAG laser possesses characteristics suitable for pocket therapy, due to its bactericidal effect with elimination of lipopolysaccharides, black pigmented periopathogen bacteria and ability to remove granulation tissue of pocket easily.

However, no clear answers can yet be given as to the

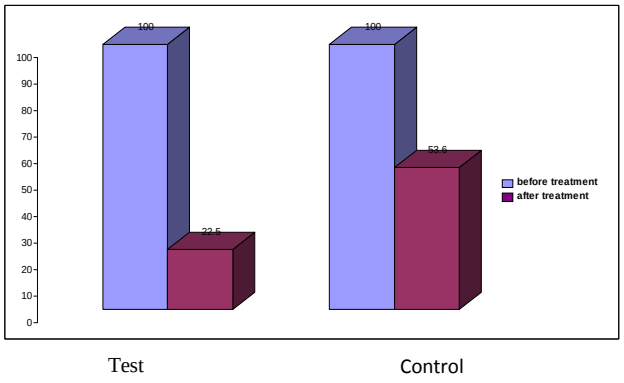

Figure 1. Prevalence of bleeding on probing before and after treatment in the test and control groups.

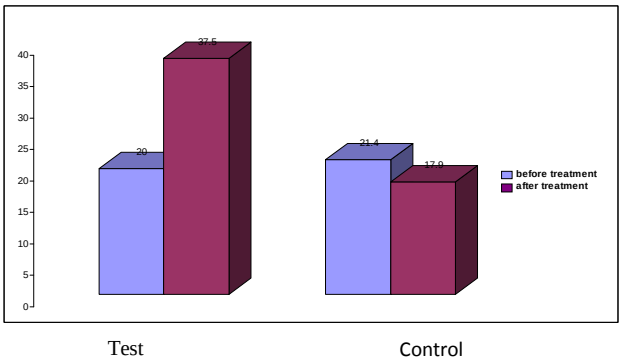

Figure 2. Prevalence of plaque-free zones before and after treatment in the test and control groups.

effectiveness of Nd:YAG laser as an adjunctive therapy following a conventional SRP treatment.[10] Therefore, in this study, we tried to evaluate efficiency and effectiveness of Nd:YAG laser as an adjunctive therapy following a conventional SRP treatment. The results revealed that Nd:YAG laser irradiation inside periodontal pockets with average depth of 4 to 7 mm following SRP had better therapeutic effects than the SRP alone, leading to higher PPD and BOP reductions and enhanced CAL (Table 2 and Figure 1).

Our findings are in agreement with those of several other studies,[7-12] despite slight differences in the application of Nd:YAG laser and the parameters used in the present study. In one study, Nd:YAG laser was used alone and compared with SPR while CO_2 laser was administered in three independent experimental groups, not as an adjunctive technique. Although in their study, Nd:YAG laser improved clinical parameters and the subgingival microflora after treatment, there was no significant difference between Nd:YAG laser and SRPcases. In our study, however, similar to other previous studies,[11,12] Nd:YAG laser was used as adjunctive treatment to SRP, which showed more improvement in clinical parameters compared to the SRP alone. The use of Nd:YAG laser in one study additionally led to a higher reduction of periopathogenic microorganisms.[12]

In contrast, the findings of our study are not in line with the studies that reported the secondary application of Nd:YAG laser after SRP was associated with no advantage over SRP alone.[17-19] The parameters used for Nd: YAG laser beam were also different. Varoius combinations of the laser beam clinically used for the treatment of periodontal pockets have been reported in different studies. White et al[20] and Coluzzi[21] used 2 w (100 mJ/Pulse 2 Hz) for different purposes such as coagulation and curettage of the pocket soft wall, bacterial reduction and hemostasis after mechanical debridement. While Gutknecth et al[12] suggested the application of Nd:YAG laser with similar parameters for

curettage before mechanical debridement in an attempt to reduce bacteremia risk associated with SRP.

Different opinions on the use of Nd:YAG lasers in periodontal disease exist. The US Food and Drug Administration (FDA)[22] and Academy of Laser Dentistry (ALD)[23] have approved the use of laser for curettage following conventional mechanical root debridement, but the American Academy of Periodontology does not recommend the use of laser curettage.[24] However, based on the results of in vitro and in vivo studies, Nd:YAG, a soft tissue laser, could be taken as an adjunct to conventional mechanical treatments rather than a primary instrument in treatment of periodontal pockets.[6]

Conclusion

According to the findings of the present study, Nd:YAG laser irradiation inside periodontal packets following SRPyields better therapeutic effect than the SRP alone, and it could be recommended for adjunctive pocket therapy.

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