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Comparison of Er:YAG Laser and Ultrasonic Scaler in the Treatment of Moderate Chronic Periodontitis: A Randomized Clinical Trial

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Abstract

Introduction: Periodontitis is an inflammatory periodontal disease that leads to tooth loss. Recently laser has been introduced as an alternative treatment for periodontitis. The aim of the present study was to compare the effect of Erbium-doped Yttrium Aluminum Garnet (Er:YAG) laser with ultrasonic scaler in patients with moderate chronic periodontitis.

Methods: In this randomized single-blind clinical trial, 27 patients with moderate chronic periodontitis were selected. One quadrant of the patients was treated by Er:YAG laser and the other one by ultrasonic scaler. Clinical parameters, including periodontal pocket depth (PPD), papillary bleeding index (PBI) and clinical attachment level (CAL) were measured before, as well as 6 and 12 weeks after treatment. Data were analyzed by SPSS 20 software using Friedman test, paired *t* test, independent *t* test and Mann-Whitney test. The significance level was set at 0.05.

Results: The means of clinical parameters in both groups were significantly improved in the first and second follow-ups ($P<0.001$). Although the means of PPD, PBI and CAL were slightly higher in the laser group than in the ultrasonic group, the differences were not statistically significant between these two groups ($P>0.05$).

Conclusion: Although both ultrasonic scaler and Er:YAG laser could effectively improve clinical periodontal parameters, the results did not reveal the superiority of Er:YAG laser over ultrasonic scaler or vice versa.

Keywords: Ultrasonic; Er:YAG lasers; Root planings; Scaling.

Introduction

Periodontitis is an inflammatory bacterial disease that leads to the destruction of supporting tissues and tooth loss.[1] Periodontal diseases are treated by surgical and non-surgical procedures. The non-surgical procedures include scaling and root planing (SRP) and dental plaque control by the patient.[2]

Recently, laser has been introduced as an adjunct way for periodontal treatment. The benefits of laser therapy include antimicrobial properties, removal of calculus and endotoxins from root surface, smear layer elimination, wound healing and bleeding control.[3-7] Dental lasers are classified based on the difference in wavelength, lasing medium and clinical applications. A wide range of lasers are available for clinical use.[5,8] It seems that Erbium-doped Yttrium Aluminum Garnet (Er:YAG) affects both soft and hard tissues with no serious thermal damage, and can remove the bacteria biofilm and calculus from root surface, which makes it an appropriate technique for periodontal treatment.[9-13] Er:YAG laser has a wavelength of 2940 nm with bactericidal effects. Also, due to high its ability to absorb water during the removal of bacterial endotoxin and calculus, this laser has less thermal risk for mineralized tooth surfaces.[9,10,13-16]

Crespi et al[17] reported that the clinical parameters in the patients with chronic periodontitis treated by Er:YAG laser had significant improvement compared to the conventional scaling method. In their clinical study,

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Schwarz et al[18] evaluated the effect of conventional scaling and Er:YAG laser therapy on patients with moderate to advanced periodontitis. They reported significant reduction of bleeding during probing and significant improvement of clinical attachment level (CAL) in the Er:YAG laser group. Further, in clinical and microbiological analysis of Er:YAG laser among patients with persistent periodontitis, Lopes et al[19] concluded that Er:YAG laser could be a substitute treatment to reduce proliferation of microorganisms in persistent periodontitis. Although some studies have shown the improvement of clinical parameters in periodontal patients,[3,18,20-22] other studies have presented different results.[17,19,23-26] The results of a clinical trial which evaluated the clinical and microbiological parameters indicated that Er:YAG laser was as effective as conventional scaling or ultrasonic tools for the treatment of chronic subgingival periodontitis.[1] In a 6-month study, Schwarz et al[18] reported no increase of CAL or reduction of packet depth in Er:YAG laser group in comparison with conventional SRP. In a review article, Schwarz et al[16] reported that Er:YAG laser therapy was able to yield similar clinical results than conventional treatments in the long- and short-term periods.

Poor study design, lack of proper control group and high variation of laser parameters in different studies are some of the reasons for uncertain findings of laser compared to conventional scaling technique.[18,24,27] Hence, the current study was an attempt to compare the therapeutical effect of Er:YAG laser with ultrasonic scaler among patients with moderate chronic periodontitis, via split-mouth method.

Methods

Patient Recruitment

A total of 27 patients with moderate chronic periodontitis were included in this study. The patients were selected from the Department of Periodontics, Isfahan University of Medical Sciences. The exclusion criteria were: presence of systemic disease, pregnancy, periodontal treatment within the last 12 months, use of antibiotics over the past 6 months and smoking.

Study Design

In this randomized split-mouse clinical trial, a total of 54 quadrants and 648 sites were selected from 27 patients, and were equally divided into left and right sides. While the teeth of one side were treated by ultrasonic scaler, the teeth of contralateral side underwent laser therapy. Moreover, all patients received oral hygiene instructions.

Data Collection

The following clinical parameters were measured and recorded at baseline, 6 and 12 weeks after the intervention, by the calibrated and blinded researcher. The parameters included periodontal pocket depth (PPD by calibrated Michigan 'o' probe with standard pressure), CAL and papillary bleeding index (PBI by Saxer and Muhlemunn). The parameters were evaluated at four levels for each tooth, mesiobuccal, midbuccal, distobuccal and midlingual. Further, visual analogue scale (VAS) for each patient was recorded between 0 and 10 immediately after interventions.

Interventions

In the control group, UDS-K ultrasonic scaler (Guilin Woodpecker Medical Instrument Co. Ltd, Guilin, China) with an output half-excursion force of 2 N, output tip vibration frequency of 28 ± 3 kHZ and water pressure of 0.1-5 bar was used. For SRP, the G1×2 and G2 tips were used with to-and-fro motion on the tooth under constant water irrigation.

In the case group, Er:YAG laser (Fotona, Fidelis plus, Ljubljana, Slovenia) with a wavelength of 2490 nm, energy level of 160 mJ/pulse and pulse frequency rate of 10 Hz was used. The laser beams were radiated on the packet by R14-C hand-piece. The optical fiber tip (chisel shape, Product code: 72561) was used in apicocoronal movements with a 15-20′ angle with respect to the root surface, until it reached the end of packet. While the tip was in contact with the tooth, sites were irrigated with water spray. Both interventions were continued until the operator felt a smooth surface on the root. Both interventions were carried out by one operator.

Examiner Reliability

Ten patients with two teeth presenting > 4 mm probing depth were used in two different quadrants, for calibration by the examiner. The examiner examined the patients twice with an interval of seven days. If the data in the first and seventh days were similar more than 90%, the calibration was accepted.

Statistical Analysis

The results were analyzed by SPSS 20 software (IBM Corp, Armonk, NY). CAL, PPB and PBI before treatment, 6 and 12 weeks after interventions were compared in both groups. Paired *t* test and Friedman test were used for intra-group comparison of parameters at different intervals. Independent *t* test was applied to perform inter-group comparisons of parameters. Furthermore, Mann-Whitney test was used to compare the mean VAS immediately after interventions. The significance level was set at 0.05. Considering 1 mm as the significant difference between groups, the power of study was calculated to be 0.99. Data were expressed as mean ± standard deviation (SD).

Results

The PPD, CAL and PBI were measured at three times: before, 6 and 12 weeks after treatment. The paired *t* test revealed no significant difference between the groups in terms of the means of parameters before treatment (Table 1).

The means of PPD, CAL and PBI are presented in Table 1. The inter-group comparisons 6 and 12 weeks after interventions showed no significant difference ($P \geq 0.05$, independent *t* test). However, the intra-group difference

Table 1. Means and Differences of Parameters Before and 6 and 12 Weeks After Intervention

	Before Treatment	6 Weeks After Treatment	1Δ	12 Weeks After Treatment	2Δ	3Δ	*P* Value[b]	*P* Value[c]
Packet depth (mm)								
Ultrasonic	2.50±0.13	1.68±0.11	0.81±0.08	1.32±0.06	0.36±0.09	1.18±0.09	<0.001[a]	<0.001[a]
Laser	2.44±0.13	1.57±0.09	0.87±0.07	1.19±0.07	0.37±0.09	1.25±0.12	<0.001[a]	<0.001[a]
P value[d]	0.741		0.618		0.937	0.668		
Attachment level (mm)								
Ultrasonic	2.67±0.21	1.63±0.21	1.03±0.15	1.21±0.16	0.42±0.12	1.45±0.11	<0.001[a]	<0.001[a]
Laser	2.64±0.24	1.75±0.22	0.88±0.15	1.18±0.21	0.56±0.11	1.45±0.14	<0.001[a]	<0.001[a]
P value[d]	0.923		0.492		0.392	0.987		
Papillary bleeding								
Ultrasonic	1.54±0.09	0.62±0.08	0.91±0.09	0.32±0.05	0.29±0.06	1.21±0.08	<0.001[a]	<0.001[a]
Laser	1.51±0.09	0.58±0.07	0.92±0.10	0.27±0.05	0.31±0.06	1.24±0.09	<0.001[a]	<0.001[a]
P value[d]	0.857		0.914		0.898	0.830		

Δ1 Difference before and 6 weeks after treatment; Δ2 Difference 6 and 12 weeks after treatment; Δ 3 Difference before and 12 weeks after treatment.
[a] Significant difference ($P<0.05$).
[b] Paired *t* test (Intra-group comparison of Δ).
[c] Friedman test (Intra-group comparison of mean).
[d] Independent *t* test (Inter-groups comparison of Δ or mean).

of parameters mean was statistically significant over time ($P<0.000$, paired *t* test and Friedman).

In addition, the means of VAS immediately after intervention in ultrasonic and laser groups were 2.67 ± 0.46 and 3.58 ± 0.50, respectively, indicating no significant difference between the groups ($P=0.169$, Mann-Whitney test).

Discussion

The aim of periodontal treatment is biological restoration and reattachment of periodontal tissues to the root surface. So, in the first phase of periodontal treatments, mechanical debridement and root surface planing are performed by manual or ultrasonic tools. Due to the inefficiency of the abovementioned instruments, new systems like the use of laser have been introduced.[5]

In the current study, the clinical parameters of PPD, CAL and PBL were measured before, 6 and 12 weeks after treatment. The findings indicated significant improvement of these indices in both ultrasonic and laser groups. Although improvements were more evident in the laser group, the difference was not statistically significant, which is in agreement with the results of some of the previous studies.[14,18,23,28] Rotundo et al[23] showed that CAL in the Er:YAG laser group was similar to the conventional group. In a clinical trial, Soo et al[28] argued that PBI and PPD reduction and CAL increase were higher in the conventional method than Er:YAG laser in the short term. On the other hand, some studies[13,17,18,24,26] stated that laser improved clinical periodontal parameters compared with conventional method. These controversial results may be attributed to different laser radiation parameters (density, wavelength and energy level), different devices manufacturers, shape of laser tips, expertise of operator and different cut-points. Given the increased connection of fibroblasts and periodontal ligaments to the tooth surface following the creation of more surface roughness after laser therapy,[29] and the antibacterial effects on periodontal microorganisms, laser can be considered an adjunct therapy to other conventional treatment methods.[30,31] However, in our study there was no significant difference between laser and ultrasonic scaler, in term of clinical parameters.

In the present study, VAS was assessed immediately after intervention. Although the mean level of this parameter was a little higher in the laser group, the difference was not statistically significant. Studies have shown different results in this regard. However, Rotundo et al[23] and Derdilopoulou et al[1] reported less pain in the laser group, Tomasi et al[24] and Soo et al[28] reported less comfort in the laser group. Different target population and their response to pain, laser parameters like different laser tips and therapist's performance can be some of the factors for these conflicting results.[28]

Conclusion

According to the results of this study, the use of Er:YAG laser for SRP, causes more improvement of clinical parameters compared to ultrasonic scaler. However, these differences were not significant. So, Er:YAG laser can be used as an appropriate device for periodontal treatments.

Ethical Considerations

This randomized clinical trial was approved by the ethical committee of Isfahan University of Medical Sciences (#392408) and clinical trial site (IRCT201402164877N18). Also, following a detailed explanation of the study to the patients, informed consent was taken from them.

Conflict of Interests

The authors declare no conflict of interest, financial or other exists.

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