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Clinical and Radiographic Investigation of the Adjunctive Effects of a Low-Power He-Ne Laser in the Treatment of Moderate to Advanced Periodontal Disease: A Pilot Study

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Abstract

Objective: To evaluate the adjunctive effect of a low-power He-Ne laser in the non-surgical periodontal treatment of patients with moderate to advanced chronic periodontitis. ***Background Data:*** Laser applications in dental treatment are now more common in the literature. However, limited data are available on the potential effects of the low-power laser as an adjunct to non-surgical periodontal therapy for managing patients with moderate to advanced periodontal disease. ***Materials and Methods:*** Sixteen patients with probing pocket depth (PPD) ≥5 mm and comparable bone defects on both sides of the mouth were recruited. Supragingival plaque (PL), bleeding on probing (BOP), PPD, and probing attachment level (PAL) were recorded at baseline and at 3, 6, 9, and 12 mo, while gingival crevicular fluid (GCF) samples and standardized intra-oral radiographs for digital subtraction radiography were taken at baseline and at 1, 3, 6, 9, and 12 mo. After non-surgical mechanical periodontal treatment, the test sites were selected randomly and irradiated with a low-power He-Ne laser (output power 0.2 mW) for 10 min for a total of eight times in the first 3-mo period, while the control sites received no additional treatment. ***Results:*** PL percentage (83–16%) and BOP percentage (95–34%) decreased significantly after 12 mo. Statistically significant changes in reductions of PPD and GCF volume, gain in PAL, and increase in recession were seen in both test and control sites when compared to baseline ($p < 0.05$). No statistically significant differences in any clinical parameters or radiographic findings were found between the test and control sites. Changes in GCF volume were significant only at 3 mo in the test sites. ***Conclusion:*** Within the limits of this pilot study, the use of the low-power He-Ne laser as an adjunct to non-surgical periodontal therapy in patients with moderate to advanced chronic periodontitis did not seem to provide additional clinical benefit.

Introduction

Periodontal disease is an oral infectious disease involving inflammatory reactions that cause tissue destruction in tooth-supporting structures (i.e., gingiva, cementum, periodontal ligament, and alveolar bone).[1] Currently, non-surgical periodontal therapy remains the standard of care to treat periodontal disease. Numerous studies have reported successful outcomes in treating periodontal disease with non-surgical periodontal therapy.[2–8] However, non-surgical periodontal therapy is not always successful.[6,7] Therefore attempts have been made to incorporate various adjunctive therapies using antimicrobials, either locally as controlled-release agents[9–12] or systemically,[13,14] to further enhance the outcomes of non-surgical therapy.

Very few studies have targeted the host response as an adjunctive therapeutic approach, except for those using host-modulating drugs.[15] Low-power lasers have been the focus of basic research in the past decade on their stimulatory effects on various cells in vitro[16–20] and in animals.[21,22] Many therapeutic claims for the use of low-power lasers in dentistry have also been reported, including management of aphthous ulcers,[23] reduction of pain and discomfort,[24,25] treatment of dentine hypersensitivity,[26] and neurosensory recovery after surgical procedures in the head and neck region,[27–29] where positive results have been reported.

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Masse et al.[30] found no effect of low-power laser therapy on healing after periodontal surgery, while Neiburger[31] found a biostimulatory effect on the rate of gingival wound healing following application of helium-neon (He-Ne) diode laser energy. Recently, Qadri et al.[32] found greater reductions in gingival inflammation with use of a low-power laser, and Amorim et al.[33] also found better healing after gingivectomy with the use of a low-power laser than without. Yet few data are available on the potential effects of low-power laser energy as an adjunct to non-surgical periodontal therapy in managing periodontal disease. Hence, the aim of this pilot study was to investigate the possible effects of low-power He-Ne laser energy as an adjunct to non-surgical periodontal therapy in a randomized controlled clinical protocol in bringing about resolution of inflammation and in reducing periodontal probing pocket depth in patients with moderate to advanced periodontal disease.

Materials and Methods

Study population

Sixteen patients were selected from the pool of patients awaiting treatment in the Periodontology Clinic of the Prince Philip Dental Hospital, the Faculty of Dentistry, The University of Hong Kong. Inclusion criteria were: Chinese patients, aged from 30–60 y, diagnosed with moderate to advanced chronic periodontitis, presenting with at least two teeth in each quadrant having a probing pocket depth (PPD) >5 mm, having more than 20 remaining teeth, and having received no periodontal treatment except oral hygiene instructions in the previous 6 mo. Patients were excluded if they were smokers, if they had systemic medical conditions known to be associated with periodontitis, if they were pregnant, if they had received immunosuppressive drugs, and if they had undergone antibiotic treatment within the preceding 3 mo. Patients wearing removable partial prostheses or receiving orthodontic treatment were also excluded. The study was approved by the Ethics Committee of the Faculty of Dentistry, The University of Hong Kong.

Study design

This was a randomized longitudinal split-mouth study lasting for 12 mo. All patients were given detailed explanations about the study after screening for meeting inclusion criteria and being free of exclusion criteria. Written consent was obtained from all participants. Impressions were taken pre-baseline at screening for fabrication of occlusal stents for clinical data collection. Two matched sites, preferably one site from the anterior region (i.e., canine to canine), and the other site from the premolars, having PPD ≥5 mm and comparable angular bone defects (determined initially from a panoramic oral radiograph taken as part of the hospital's admission screening procedure), were selected for control and test (laser irradiation) sites. Assignment of the selected site as test or control was made on the basis of a coin toss. Molar teeth were excluded from this study. The teeth selected were responsive to electric pulp testing and were free from unrestorable carious lesions or obvious cracks involving the roots. Non-surgical periodontal treatment including oral hygiene instructions, and supra-gingival and sub-gingival debridement under local anesthesia, was delivered half-mouth by half-mouth over two appointments within a 2-wk time period by one operator (S.L.). The oral hygiene level was constantly reassessed and reinforcement was provided as necessary during recall appointments. Sub-gingival debridement of any remaining pockets ≥5 mm deep was also performed during the recall appointments. All clinical parameters were recorded and radiographs, treatment procedures (except for laser application), and reviews were made according to the clinical protocol, and were carried out by the same operator (S.L.), who was blinded to the assignment of the test and control sites.

Laser irradiation

A low-power laser (JGZ-3 He-Ne Laser Acupuncture; China Electronics, Jiang Su, Peoples' Republic of China) operating at a wavelength of 632 nm with an output power of 0.2 mW was used in this study. Laser energy was applied to two test sites through an optical fiber. Laser irradiation was performed by another trained operator, who was not involved in the data analysis. The laser was applied directly to the buccal gingival surface at the two test sites. The optical fiber was placed perpendicularly to the interdental papilla and kept in place touching the outer gingival surface. The procedure was performed for test sites immediately after non-surgical therapy, for a total of 10 min, and the treatment was repeated at each review appointment over the following 3 mo. A total of eight laser irradiation sessions were performed on the test sites. The dose delivered at each application was 1.7 J/cm^2 (2.83 mW/cm^2), and the total dosage for the entire course of treatment was 13.6 J/cm^2.

Data collection

Clinical parameters. Clinical parameters were recorded at baseline, and at 3, 6, 9, and 12 mo after completion of the non-surgical periodontal treatment. At test and control sites standardized intra-oral radiographs for evaluation of alveolar bone changes were made, and gingival crevicular fluid (GCF) samples were also taken at baseline and at 1, 3, 6, 9, and 12 mo. Full-mouth clinical data were obtained to monitor overall treatment response to the full-mouth non-surgical therapy, using a manual probe (PCP-UNC 15; HuFriedy Manufacturing Co., Chicago, IL, USA) at six sites (mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual, and disto-lingual aspects) of each tooth except the third molars. The presence or absence of plaque (PL) was determined by running the tip of the probe around the gingival margin of each site, and are presented here as the percentage of sites with detectable plaque (PL%). A custom-made polyethylene occlusal stent was then used for full-mouth measurements as a reference guide for PPD (i.e., the distance from the base of pocket to the gingival margin, presented here in millimeters), and probing attachment level (PAL), which was the distance from the base of the pocket to the lower border of the occlusal stent, also presented here in millimeters. We also noted the change in recession (Rec), as measured by change in position of the gingival margin relative to the lower border of the occlusal stent. Bleeding on probing (BOP) was designated as positive if bleeding occurred within 10 sec after probing, and is presented here as the percentage of sites with BOP (BOP%).

GCF samples were collected from the test and control sites, after recording the presence or absence of supragingival plaque and careful removal of any plaque, using standard filter-paper GCF strips (Periopaper® GCF strips; IDE Inter-

atate, Amityville, NY, USA) inserted into the sites and left in place for 30 sec. GCF volumes were determined immediately using a GCF meter (Periotron 8000; IDE Interatate).

Alveolar bone change observed by digital subtraction radiography (DSR) Standardized. periapical radiographs were taken of each test and control site. All periapical radiographs were taken using the paralleling technique with the same x-ray machine (GE 700; General Electric Co., Milwaukee, WI, USA) at the same setting (70 kV and 15 mA). Size 1 radiographic films were used for the anterior regions, while size 2 radiographic films were used for the premolars (Kodak Ektaspeed Plus; Eastman Kodak Co., Rochester, NY, USA). All the films were developed with an automatic developing machine (Periomat; Dürr Dental GmbH & Co., Bietigheim-Bissingen, Germany). The radiographs were then scanned into a computer at 600 dpi using a flatbed scanner (Agfa Studiostar; Agfa Gevaert, Mortsel, Antwerp, Belgium), and the resulting images were stored on the hard disk of a personal computer.

The images were imported into subtraction software running on the Linux operating system. The analysis of the alveolar bone changes was performed using a DSR system developed locally.[34] Selected sites were defined as regions of interest (ROI) on the radiographs, and the computer-assisted densitometric image analysis (CADIA) value was calculated for each ROI according to a formula described by Brägger et al.[35] The CADIA value was used to quantify alveolar bone changes and is presented as a net value between two standardized radiographic images made at different time points.

Intra-examiner reproducibility

A total of 480 sites for both PPD and PAL measurements were examined and recorded for investigating intra-examiner reproducibility; 95% and 94% of PPD and PAL measurements were within 1 mm of each other, and the weighted kappa scores for PPD and PAL measurements were both 0.7.

Statistical analysis

The full-mouth clinical data were analyzed to assess the effect of the non-surgical periodontal treatment. Means and standard deviations (SDs) of PPD, PAL gain, and Rec increase (in millimeters) were calculated separately for two groups of probing depth ranges categorized by a baseline probing pocket depth of 4–6 mm and ≥7 mm. The differences in measurements across the different time points within each group were tested using Wilcoxon signed-rank tests.

For the evaluation of the adjunctive effects of the laser, only teeth treated by the laser and the paired controls were included in the analyses. The effects of the laser were tested by Wilcoxon signed-rank tests on PPD, PAL gain, and Rec increase (in millimeters), GCF volume, and CADIA values between teeth with adjunctive laser treatment and paired controls at baseline and at 3, 6, 9, and 12 mo (and also at 1 mo for GCF and CADIA). Due to the non-independent nature of the tooth data within each patient's mouth, the effect of laser treatment on PPD, PAL gain, Rec increase, GCF, and CADIA were tested using generalized estimate equation (GEE`) analysis. An exchangeable working correlation matrix was assumed.

All statistical analyses were conducted using SPSS 11.5 (SPSS, Inc., Chicago, IL, USA), except for the GEE analysis, which was conducted using STATA 8.0 (Stata Corp LP, College Station, TX).

Results

A total of 16 patients (2 men and 14 women) were recruited; however, two of them withdrew from the study for personal reasons. As a result, 14 patients (13 women and 1 man) completed the study, and their ages ranged from 33–57 y (mean 43.6 y). Altogether, a total of 56 sites were selected at baseline for testing the effects of low-power laser irradiation, with 28 sites serving as test sites and 28 as control sites. Half of the sites were chosen from the anterior regions while the other half were chosen from premolars. During the study period, one control site was lost due to the selected tooth being traumatized in an accident, and it required extraction after 6 mo. Therefore, only 27 control sites were analyzed at the end of the study. No adverse effects were associated with the laser therapy and none were reported during the entire study period.

Initially, the full-mouth PL% and BOP% were 83% and 95%, respectively. After periodontal treatment, both parameters showed statistically significant improvements ($p < 0.05$) compared to baseline at all subsequent examinations (16% and 34% for PI% and BOP%, respectively, at 12 mo).

The changes in PPD, PAL, and Rec for sites with initial PPDs of 4 mm or more during the study period in all patients are presented in Fig. 1, with the data grouped into two categories of periodontal pockets according to the initial

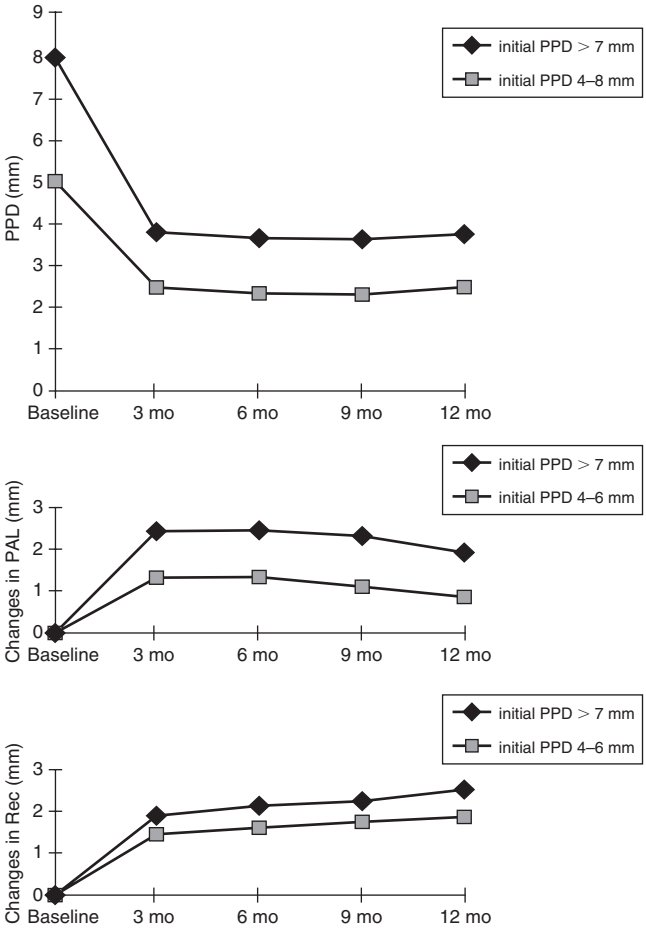

FIG. 1. Overall changes in probing pocket depth (PPD), probing attachment level (PAL), and recession (Rec) from baseline to 12 mo.

Table 1. Mean PPD, PAL Gain, Rec Increase, GCF Volume and CADIA Value Changes from Baseline for the Test and Control Sites

	Paired control mean (± SD)	*Laser-treated mean (± SD)*	p *Value*[a]
PPD (mm)			
Baseline	6.29 (± 1.24)	6.32 (± 1.22)	0.82
3 mo	232 (± 1.33)	2.43 (± 0.63)	0.35
6 mo	2.39 (± 1.17)	2.46 (± 1.04)	0.56
9 mo	2.59 (± 0.97)	2.46 (± 1.00)	0.60
12 mo	2.44 (± 0.89)	2.46 (± 0.84)	0.53
PAL gain (mm)			
3 mo	2.29 (± 1.65)	2.04 (± 1.57)	0.83
6 mo	2.25 (± 1.73)	2.21 (± 1.55)	0.96
9 mo	2.07 (± 1.62)	2.07 (± 1.51)	0.68
12 mo	2.11 (± 1.55)	1.86 (± 1.41)	0.72
Rec increase			
3 mo	1.68 (± 1.09)	1.86 (± 1.27)	0.64
6 mo	1.64 (± 1.34)	1.64 (± 1.28)	0.73
9 mo	1.67 (± 1.21)	1.79 (± 1.20)	0.95
12 mo	1.78 (± 1.09)	2.00 (± 1.33)	0.73
GCF (μL)			
Baseline	0.38 (± 0.23)	0.40 (± 0.24)	0.82
1 mo	0.11 (± 0.11)	0.20 (± 0.27)	0.10
3 mo	0.08 (± 0.06)	0.05 (± 0.04)	0.04
6 mo	0.08 (± 0.06)	0.08 (± 0.07)	0.73
9 mo	0.10 (± 0.12)	0.10 (± 0.21)	0.94
12 mo	0.10 (± 0.10)	0.15 (± 0.22)	0.31
CADIA			
1 mo	213.11 (± 213.70)	243.38 (± 207.20)	0.34
3 mo	284.29 (± 238.46)	288.33 (± 276.64)	0.87
6 mo	322.44 (± 240.09)	309.29 (± 261.88)	0.78
9 mo	379.37 (± 313.93)	318.18 (± 239.97)	0.95
12 mo	319.29 (± 230.66)	302.68 (± 289.04)	0.72

[a]Significance value by Wilcoxon signed-rank test.

PPD. The non-surgical periodontal treatment led to statistically significant changes in these three parameters when compared to baseline at all time points ($p < 0.05$) for both categories of periodontal pockets. At 12 mo the overall mean PPD reduction was 2.0 mm, the mean PAL gain was 0.6 mm, and the mean increase in Rec was 1.3 mm. Pockets with the deepest initial PPDs (i.e., ≥7 mm) showed a mean PPD reduction of 4.5 mm, mean PAL gain of 1.9 mm, and increase in Rec of 2.5 mm. Those pockets with initial PPDs of 4–6 mm showed only moderate changes.

The baseline characteristics of the test sites and control sites showed no statistically significant differences by Wilcoxon signed-rank testing. Table 1 summarizes the mean changes in PPD, PAL, Rec, GCF volume, and CADIA values at all time points. Both test and control sites showed significant reductions in PPD and GCF volume, gains in PAL, and increases in Rec, at all time points ($p < 0.05$) compared to baseline. Evaluation of the low-power laser's effects revealed no statistically significant differences between test and control sites, except for GCF volume at 3 mo, which showed statistically significantly lower volumes in the laser-treated sites ($p < 0.05$), and a generally lower percentage of test sites presented with BOP than did control sites at 3 mo (29% versus 36%), 6 mo (36% versus 46%), and 9 mo (36% versus 52%).

Simple GEE models with treatment using laser as the predictor and the various periodontal measurements as outcome were estimated. The effect of the laser treatment on the outcome was estimated and is presented in Table 2, together with the 95% confidence intervals and significance values. All models showed that there were no significant effects of laser treatment on outcome measurements (p values ranged from 0.455–0.959). This finding is consistent with the results presented in Table 1.

Discussion

The results of the present study indicate that the treatment of patients with moderate to advanced chronic periodontitis with both non-surgical periodontal therapy and with adjunctive low-power laser lead to clinically significant PAL

Table 2. GEE Regression Estimated Parameters for the Effect of Laser Treatment on All Clinical Parameters

Variable	*Estimated parameter*	*95% Confidence interval*	p *Value*
PPD	0.01	−0.41, 0.43	0.959
ΔPAL	−0.11	−0.72, 0.51	0.737
ΔRec	0.12	−0.34, 0.58	0.608
GCF	0.02	−0.04, 0.08	0.455
CADIA	−11.33	−118.11, 95.46	0.835

gains and PPD reductions, with radiographic bone gain. The improvements here are similar to those reported in other clinical studies.[2,3,5] However, the increase in recession (Rec) we found in this study was greater than that seen in a previous study (2.5 mm versus 1.8 mm), in the group with initial PPDs ≥7 mm.[3] The exact reason is not known, but it may be because of the thinner gingival tissue found in Chinese people compared to that seen in Caucasians. Recession in some Asian populations is quite prevalent, as demonstrated by the difference between the modest prevalence of pockets and the widespread prevalence of attachment loss seen in Southern Chinese people.[36] Recession has also been reported to be extensive in the elderly Northern Chinese.[37] Greater recession and shallower pockets are seen in the Chinese than in other populations, the data for which were detailed in one overview.[38] Greater recession is seen in those receiving non-surgical treatment in Southern Chinese patients,[39] compared to that seen in studies of treatment response to non-surgical therapy in Caucasians.[3]

The low-power laser we used in this study was a He-Ne laser with a wavelength of 632 nm. It was manufactured in China, and this type of machine is usually used for laser acupuncture. As detailed in the literature, the He-Ne laser is one of best known low-power lasers for use in bringing about biostimulatory effects. The He-Ne laser is the most coherent of all the different types of therapeutic lasers, which is an important factor contributing to its biological results, and positive effects have been shown in several studies, such as those at the cellular level,[19,40] in animal studies,[21,22] and in one human study.[31] Other therapeutic low-power lasers such as diode, indium-gallium-aluminum-phosphide (InGaAlP), gallium-aluminum-arsenide (GaAlAs), and gallium-arsenide (GaAs) lasers have also demonstrated positive effects.[26–29,32] The popularity of these lasers can be explained in part by the fact that they are inexpensive, small, and sturdy. The present clinical trial showed that the adjunctive use of a He-Ne low-power laser when used as an adjunct to non-surgical periodontal therapy in patients with moderate to advanced chronic periodontitis did not enhance the healing response as assessed by both clinical and radiographic parameters, although there was a statistically significant difference in GCF volume between test and control sites at 3 mo. Recently, a short-term clinical study using a low-power laser as an adjunct to the treatment of periodontal inflammation showed a positive influence on healing.[32] That study found reductions in probing pocket depth, plaque and gingival indices, and gingival crevicular volume, that were significantly greater in the laser-treated sites. Direct comparison cannot be made with the present study because different laser systems and laser parameters were used in the two studies. However, that study did demonstrate some biological effects of low-power lasers on initial periodontal therapy. The lack of positive results in this study may be due to the smaller sample size, with only two test and two control teeth in each patient, while in the study by Qadri et al.,[32] five teeth per patient were tested. However, it was not practical in our study to use that many teeth for analysis, since the laser treatment took 10 min for each tooth to deliver an effective dosage, compared with 90 sec and 25 sec, depending on wavelength, in the study by Qadri et al.[32] Amorim et al.[33] used a low-power laser with 635-nm wavelength to enhance gingival healing after gingivectomy. The laser used had a similar wavelength to the laser we used in this study (632 nm). Clinical evaluation in that other study found better healing in laser-irradiated sites from 7 to 35 d post-treatment. However, the power used, which was 50 mW with an exposure time of 80 sec, was higher than we used here. Masse et al.[30] studied the post-surgical analgesic, anti-inflammatory, and healing effects of low-power laser energy when used as an adjunct after periodontal mucogingival surgery, and they found no significant differences between the laser-treated group and the placebo group. The output power of the laser used in that study was rather low (0.042 J/cm^2), and the parameters they evaluated were: pain as assessed with a modified McGill pain scale questionnaire, edema, and the gingival and healing indices. Rydén et al.[41] investigated the effect of low-power laser energy on gingival inflammation using a stereophotographic technique and reported no beneficial effects.

The output power of the laser used in our study after passing through the optical fiber was about 0.2 mW, which is <10% of the original (3 mW) output. Therefore, we used a treatment time of 10 min for each site in an attempt to deliver a biostimulatory exposure. In addition, multiple laser irradiation sessions, rather than a single treatment session, were conducted so that cumulative effects could be obtained, and the total dosage applied to the test sites could be maximal. Each test site was irradiated for 80 min in total. The dosage used for each test site in this study was about 1.7 J/cm^2 for each treatment session, and the total dosage for the entire course of treatment was 13.6 J/cm^2. After reviewing the available literature and using clinical experience as a reference, it has been suggested that the optimal dosage of low-power laser energy to achieve favorable biostimulatory effects is 0.5–1 J/cm^2 for open areas, and 2–4 J/cm^2 for tissues beneath the skin.[42] The target tissues in our study were underneath the gingival epithelium, which was lased directly, and thus the dosage we used should have been within the "therapeutic window," but from the results we obtained, it appears that the dosage we delivered had no clinical effect. Since there are few data on the optimal dosage of low-power laser energy to bring about a biostimulatory effect, it is not known whether increasing the dosage might have produced better results. However, two recently published studies[32,33] of periodontal treatment showed positive results from using power levels of 10 mW and 50 mW. This suggests that more energy from the low-power laser should be delivered to achieve positive results, even if this requires increased exposure times. Thus, we used eight sessions of 10 min each on the test sites during the treatment and review appointments. However, it appears that the main drawback of the laser system tested here is that it could not be used on several sites in any given patient, due to the time-consuming nature of the treatment. In a recent comprehensive review of lasers in periodontics,[43] it was noted that few published studies using low-power lasers for managing periodontal disease have been conducted using an evidence-based approach employing clinical periodontal parameters such as PAL gains as the outcome variables. Thus, the data and clinical design of our pilot study may be used as a guide for further clinical trials of adjunctive low-power laser therapy for advanced periodontitis. In addition, the dosage used, 1.7 J/cm^2 per site, may be insufficient to yield positive effects. Since the output is fixed for this particular laser, longer laser exposure could

be attempted, but this would further reduce the practicality of this approach.

Alveolar bone gain is another important parameter for assessing favorable responses to periodontal treatment, and no studies of low-power laser energy have yet reported about this parameter, since most low-power laser studies have targeted gingival inflammation. Some positive results have been seen in the literature for the low-power laser when used for bone regeneration and to hasten fracture healing in animals.[21,22] Thus, DSR was used in the present study as a sensitive method of assessing the bone changes seen following non-surgical periodontal therapy with or without low-power laser therapy. Results from this study showed that there was no difference between test and control sites in terms of CADIA values, but bone gains were seen with in both treatment approaches. CADIA has been proven to be a valid means of quantifying alveolar bone changes in periodontal research.[35] Calibration procedures showed that when the threshold was set $\geq$12, the noise level was $<$3%, and therefore 12 was chosen as the optimal threshold value. As the noise level was quite low at this threshold, the CADIA values obtained should include few false-positive or false-negative results. A smaller but comparable threshold value ($\sim$11.6) was chosen by Steffensen et al.[44] for their study, to achieve 99% specificity.

Conclusion

In conclusion, favorable clinical responses were obtained with both types of treatment in our group of Chinese patients with moderate to advanced chronic periodontitis who were treated non-surgically. Comparable results and no statistically significant differences were found in the clinical and radiographic parameters between the test and control sites. It appears that no additional clinical benefit was obtained by the use of a low-power He-Ne laser with the protocol we used, and therefore the possibility of combining laser therapy with non-surgical periodontal therapy in an effort to achieve better healing remains questionable. Since this was a pilot study, a definitive conclusion about the use of laser therapy in this context cannot be drawn. Further studies involving larger numbers of patients, incorporating cellular level parameters, and using different laser systems, should be carried out to further investigate the potential for the use of low-power laser therapy in periodontal treatment.

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