Original Article

Effect of Diode Laser as an Adjunct to Open Flap Debridement in Treatment of Periodontitis

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Abstract

Introduction: Periodontitis could possibly be defined as a chronic inflammatory disease that probably affecting the supporting structures of the teeth which is characterized by progressive destruction of periodontium associated with apical migration of the epithelial attachment that eventually result in pocket formation and destruction of the alveolar bone.[1] The aim of this study is to compare and evaluate the adjunctive benefits of a diode laser to conventional surgical debridement in the treatment of periodontitis and comparing the outcomes of the surgical therapy. **Materials and Methods:** The study began with 18 patients who had fulfilled the inclusion criteria that were followed in this study. All the patients were treated with full mouth scaling and root planing, followed with laser decontamination procedure. The various inclusion criteria that were followed in this study were seemed to be those patients with mild-to-moderate periodontitis, patient within the age range of 25–50 years. **Results:** In Group A, PPD, RAL, and mSBI from baseline to 3 months and baseline to 6 months showed a statistical significant difference, but there was no statistically significant difference observed from 3 months to 6 months. **Conclusion:** In the present study, the use of laser as an adjunct to flap surgery showed promising results. Further studies are required to provide an insight into the healing and possible role of diode laser in the formation of new attachment.

Keywords: Bone density, flap debridement, Diode laser.

Introduction

Periodontitis could possibly be defined as a chronic inflammatory disease that probably affecting the supporting structures of the teeth which is characterized by progressive destruction of periodontium associated with apical migration of the epithelial attachment that eventually result in pocket formation and destruction of the alveolar bone.[1] It is a multifactorial disease, with microbial plaque and calculus being the prime factors. As the dental plaque biofilm continues to accumulate, different bacterial species may colonize and develop into a biofilm. The subgingival plaque comprises of a complex microbiota that mainly consists of Gram-negative anaerobic bacteria.

The goals of periodontal treatment include the arrest and control of infection, removal of plaque and calculus, reduction in the amount of bioburden within the pocket, and providing an environment in which the tissue can return to health. The treatment for this disease entity is staged and multifaceted. The initial phase of treatment is scaling and root planing, which is considered as gold standard. Some microorganisms remain on the root surface even after root planing and scaling procedures. Deep periodontal pocket, furcation involvement various anatomic factors, etc., make it difficult to accomplish complete elimination of bacterial toxins by non-surgical therapy. These limitations of the conventional mechanical therapy lead to the use of other adjunct modalities for treating chronic periodontitis.[2]

"Laser" is an acronym for "Light Amplification by Stimulated Emission of Radiation." The properties of monochromaticity, directionality, and coherence make lasers unique and suitable for use in medical and dental fields. The laser types used for non-surgical periodontal therapy includes the diode, Nd: YAG, CO_2, and erbium lasers. The diode laser does not interact with dental hard tissues making it convenient for use for soft tissue operations; cutting and coagulation of gingiva, soft-tissue curettage, or sulcular debridement. Using diode laser combined with scaling and root planing, it has been proved

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that there is a significant decrease in bacteria and reduction in inflammation.[3-5] The bactericidal and detoxifying effect of laser treatment is advantageous in periodontal therapy.

Recently, the use of lasers adjunct to conventional mechanical procedures commonly employed in the treatment of periodontal diseases. Adequate sterilization, hemostasis, and less post-operative pain have been found in surgical procedures performed with diode laser compared to conventional surgical techniques.[6] Diode laser has a wavelength of 810 nm or 910–980 nm, mainly target the diseased soft tissues without interacting with dental hard tissues. The aim of this study is to compare and evaluate the adjunctive benefits of a diode laser to conventional surgical debridement in the treatment of periodontitis and comparing the outcomes of the surgical therapy.

Materials And Methods

After obtaining the prior permission from the institutional ethical committee, the study began with 18 patients who had fulfilled the inclusion criteria that were followed in this study. All the patients were treated with full mouth scaling and root planing, followed with laser decontamination procedure. The various inclusion criteria that were followed in this study were seemed to be those patients with mild-to-moderate periodontitis, patient within the age range of 25–50 years, periodontal pocket with 4–7 mm, clinical attachment level (CAL) of <4 mm, and those with radiographic evidence of bone loss. Exclusion criteria include those patients with uncontrolled systemic illnesses, patients who had undergone periodontal therapy within 6 months, those patients under antibiotic or anti-inflammatory drugs in the previous 6 months, those pregnant and lactating women, and those with Grade III mobile teeth.

Before surgery, all the study participants received Phase I therapy comprising of oral hygiene instructions, scaling, and root planing. Four weeks after following the Phase I therapy, periodontal pockets are measured to confirm suitable sites for open flap debridement (OFD). An acrylic stent was fabricated to standardize the measurements of clinical parameters at different time intervals. One site from each sextant (two sites in each patient) was selected randomly and was allocated into two groups with the help of a computer by auto-generated random table.

1. Group A (Control group) – Conventional OFD alone
2. Group B (Test group) – Laser-assisted OFD (LA-OFD).

The various clinical parameters that were assessed include probing pocket depth (PPD), modified sulcular bleeding index (mSBI),[7] CAL/relative attachment level (RAL), wound healing index (WHI),[8] visual analog scale (VAS). PPD, mSBI, and RAL were assessed at baseline, 3 months, and 6 months after the surgical procedure; WHI assessed at 3rd and 7th day post-surgery; VAS scores were assessed immediately after surgery, 1st day, and 7th day post-surgery.

Table 1: Demographic data

Variables	Participants
n	18
Mean age (SD)	39.2 (7.63)
Minimum age	26
Maximum age	50
Male (%)	12 (66.7)
Female (%)	6 (33.3)

Table 2: Comparison of PPD, RAL, and mSBI in each study group at baseline, 3 months, and 6 month

Groups	Variables	*n*	Mean difference	T	*P*-value
A	PPD				<0.0001
	Baseline–3 months	18	1.81	8.11	<0.001
	Baseline–6 months	18	1.81	5.29	1.02
	3–6 months	18	0.01	0.00	
	RAL				
	Baseline–3 months	18	1.81	8.11	<0.00`
	Baseline–6 months	18	1.80	5.32	<0.00`
	3–6 months	18	0.01	0.00	1.23
	mSBI				
	Baseline–3 months	18	0.62	0.62	<0.002
	Baseline–6 months	18	0.38	0.38	0.099
	3–6 months	18	−0.52	−0.02	0.264
B	PPD				
	Baseline–3 months	18	2.35	1.5	<0.001
	Baseline–6 months	18	3.12	9.74	<0.001
	3–6 months	18	0.68	2.89	0.013
	RAL				
	Baseline–3 months	18	2.35	2.35	<0.001
	Baseline–6 months	18	3.12	3	<0.001
	3–6 months	18	0.68	0.69	0.014
	mSBI				
	Baseline–3 months	18	0.62	0.82	<0.001
	Baseline–6 months	18	0.89	0.96	<0.001
	3–6 months	18	0.07	0.06	0.69

PPD: Probing pocket depth, mSBI: Modified sulcular bleeding index, RAL: Relative attachment level

Results

The demographic details of the study participants are shown in Table 1, 15 participants of which 10 were male and five were female with a mean age of 38.9. Table 2 shows the intragroup comparison of PPD, RAL, and mSBI in Group A and B. In Group A, PPD, RAL, and mSBI from baseline to 3 months and baseline to 6 months showed a statistical significant difference, but there was no statistically significant difference observed from 3 months to 6 months. Whereas in Group B, PPD and RAL showed significant differences from baseline to 3 months, baseline to 6 months, and from 3 months to 6 months. The mean difference of mSBI from baseline to 3 months and baseline to 6 months showed significant difference, but there was no significant difference observed from 3 months to 6 months [Table 3].

Table 3: Tabulated that Comparison of PPD, RAL, mSBI, WHI, and visual analogue scale scores between the study groups at different time intervals

Variables	*n*	Mean difference	T	*P*-value
PPD				
Baseline				
A	18	7.2	−1.16	0.272
B	18	7.43		
3-months			−0.55	0.610
A	18	5.24		
B	18	4.53		
6-months			3.31	0.005
A	18	5.24		
B	18	4.5		
RAL				
Baseline				
A	18	9.32	−0.86	0.415
B	18	9.55		
3-months				
A	18	7.48	1.02	0.337
B	18	0.55		
6-months				
A	18	7.48	4.11	0.001
B	18	6.60		
mSBI				
Baseline				
A	18	1.42	0.00	1.02
B	18	1.42		
3-months				0.191
A	18	0.82	1.42	
B	18	0.83		
6-months				0.004
A	18	1.2	3.52	
B	18	0.55		
WHI				
Day-3				
A	18	0.42	0.42	<0.001
B	18	0.06		
Day-7				
A	18	4.84	0.006	0.021
B	18	4.95		

PPD: Probing pocket depth, mSBI: Modified sulcular bleeding index, RAL: Relative attachment level, WHI: Wound healing index

Discussion

This present study probably compared the clinical parameters, patient response with the adjunctive use of diode laser to conventional flap surgery in patients with periodontitis. A randomized, controlled, parallel-arm, split-mouth, triple masked, and monocentric trial was undertaken to assess the adjunctive benefits of a diode laser to conventional mechanical debridement in the treatment of periodontitis. Eighteen participants were recruited, for the same and two sites in each participant (bilateral/contralateral), that is, a total of 36 sites were selected and included in the study. The two sites in each patient were randomly allocated into control and test groups based on a computer-generated random table.

Intragroup analysis in the present study demonstrated a statistically significant reduction of PPD, mSBI and gain in RAL from baseline to 3-month and 6-month post-treatment, in the sites which were treated with OFD alone (Group A) and LA-OFD (Group B). Various results that were obtained in this study with OFD alone that include reduction in values of clinical parameters PPD, mSBI, and gain in RAL, from baseline to 3 months and 6 months and these values were in accordance with the earlier studies.[9-11] This could only happening due to the elimination of local factors (plaque and calculus) and pocket lining thereby reduction of overall inflammation.

Clinical outcomes of sites treated with LA-OFD showed a significant reduction in values of PPD, mSBI, and gain in RAL at 3 months and 6 months compared to baseline, and also significance was observed from 3 months to 6 months. In intergroup analysis, LA-OFD showed more reduction in PPD compared with OFD alone group at 6 months, and it was statistically significant ($P = 0.005$), whereas no significance was observed at 3 months. This more significant decrease in PPD in LAOFD group could be due to increased levels of antiinflammatory cytokines and enhanced microcirculation by laser irradiation.[12] On comparison of mean change in RAL between the two groups, the LA-OFD group showed more gain in RAL compared with OFD alone group at 6 months, and it was statistically significant ($P = 0.001$). In addition to curettes, laser therapy assists in complete removal of the epithelium, suggesting the formation of new connective tissue attachment. Laser-induced thermal necrosis of wound margin seals small vasculature, lymphatics, and blocks release of chemical mediators thereby delays the epithelial migration.[13]

In the present study, the LA-OFD group showed a significant reduction in bleeding on probing compared with OFD alone group at 6 months. These findings correlate well with the results obtained from the study done by Aena *et al*.[14] In our study, the LA-OFD group showed clinically acceptable values of PPD, RAL, I than OFD alone group, and the improvement was sustained for 6 months. These results are in accordance with study.[15] Is that a in contrast with few studies, reported that there are no additional benefits on clinical parameters using diode laser compared to conventional mechanical debridement in the treatment of periodontitis.[2,16,17] On comparison of mean change in the WHI between the two groups, LAOFD showed significant improvement in wound healing at 3rd and 7th day post-surgery compared to OFD alone group. This could be due to less degradation of collagen after laser irradiation, described in terms of inhibition of plasminogen activator plasmin proteolytic system using lasers.[18] Kreisler *et al*.[19] reported that sites treated with 809 nm laser showed higher fibroblast proliferation and increased production of basic fibroblast growth factor (bFGF). Saygun *et al*.[20] have shown in their study that laser irradiation increases bFGF release from gingival fibroblasts. "bFGF" is a chemoattractant for fibroblasts and endothelial cells and a potent

mitogen which stimulates an angiogenic response in the wound and in epithelial cells and fibroblasts, it activates the neutral proteases.[15] This enhances wound contraction and reduces inflammatory mediators. Pain scale used in this study is highly subjective and dependent on the individual experience. Patient discomfort and pain perception were recorded immediately, 1 day, and 1 week after surgery using VAS. On comparing the mean change in VAS scores between the groups, patients experienced less pain in sites treated with the laser than other sites. This could be due to the prevention of pain signal transmission by laser therapy from the injured site to the brain. This reduces pain perception and increases the production and release of endorphins and enkephalins (natural pain-relieving chemicals) by decreasing nerve sensitivity significantly.[21]

Conclusion

In the present study, the use of laser as a supplement to flap surgery showed quite promising results. Moreover further studies are required to provide an insight into the healing and possible role of diode laser in the formation of new attachment. Bone density changes and understanding the exact mechanism of the biostimulatory effect are required with the use of techniques like computer assisted densitometric image analysis or cone-beam computed tomography.

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