Original Article

The adjunct effectiveness of diode laser gingivectomy in maintaining periodontal health during orthodontic treatment
A randomized controlled clinical trial

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ABSTRACT

Objective: To evaluate the effectiveness of diode laser gingivectomy as an adjunct to nonsurgical periodontal treatment in the management of periodontal health among patients receiving fixed orthodontic appliance therapy (FOAT).

Materials and Methods: Thirty patients undergoing FOAT with gingival enlargement were block randomized into two treatment groups. The test group received diode laser gingivectomy (940-nm diode laser, ezlase, Biolase Technology Inc) as an adjunct to nonsurgical periodontal treatment. The control group received nonsurgical periodontal treatment only. For both groups, five periodontal parameters were assessed at baseline, 1 month, 3 months, and 6 months: Plaque Index, Gingival Index, bleeding on probing, probing pocket depth, and Gingival Overgrowth Index. Intra- and intergroup variations in the periodontal parameters were determined over time.

Results: Both groups showed statistically significant improvements in periodontal health over the study period ($P < .05$). However, significant improvements in periodontal health were evident earlier among the test group subjects ($P < .05$). The magnitude of improvement in periodontal health compared to baseline was greater in the test group than in the control group for Gingival Overgrowth Index at 1 month ($P < .001$) and 3 months ($P < .05$), Gingival Index at 3 months ($P < .05$) and 6 months ($P < .05$), and probing pocket depth at 1 month ($P < .05$).

Conclusions: Nonsurgical periodontal management with or without the adjunct use of lasers can be effective in the management of gingival health problems among patients receiving FOAT. The adjunctive use of lasers can produce an earlier and greater improvement in gingival health. (*Angle Orthod.* 2013;83:43–47.)

KEY WORDS: Randomized controlled trial; Lasers; Periodontal treatment; Gingival enlargement; Orthodontics

INTRODUCTION

Fixed orthodontic appliance therapy (FOAT) is frequently associated with pathological changes in the periodontal tissues.[1–4] The presence of fixed appliances can increase plaque stagnation, impede oral hygiene, and cause a shift in the oral microbial ecosystem to more periodontopathogenic oral biofilms.[5] Clinical studies have frequently reported on the development of chronic periodontal inflammation, loss of clinical attachment, and gingival enlargement among orthodontic patients.[6,7]

Gingival enlargement is one of the most common soft tissue problems associated with FOAT, with a reported prevalence of almost 10%.[7] Gingival enlargement further impedes the maintenance of oral hygiene (thereby resulting in further damage to periodontal tissues), causes aesthetic and functional problems, and has been reported to compromise orthodontic tooth movement.[8,9]

In the management of gingival enlargement, meticulous (self-care) oral hygiene is the first line of

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defense, but motivation to maintain oral hygiene can be inadequate in some patients; thus, this approach has limited success.[10] The use of mouth rinses is a useful adjunctive self-care approach to the management of gingival enlargement, but it, too, relies on patient compliance; in addition, there can be some side effects with long-term use.[11] Nonsurgical periodontal treatment (including oral hygiene instruction, scaling, root planing, and prophylaxis) is the conventional management approach for gingival enlargement but is not always effective when gingival enlargement is extensive and self-care is compromised.[12]

This in turn has led to surgical approaches to the management of gingival enlargement. However, this is considered by many as very invasive and may not be effective if self-care oral hygiene practices remain poor.[13] In recent decades, considerable attention has focused on the use of lasers (diode, erbium:yttrium-aluminum-garnet, neodymium:yttrium-aluminum-garnet, carbon dioxide, and erbium,chromium–doped yttrium-scandium-gallium-garnet lasers of varying wavelengths) as adjunct management approaches to enhance nonsurgical periodontal treatment, as they offer a less invasive surgical approach.[14–19] The diode laser has been used for gingivectomy procedures and involved the removal of gingival soft tissues only. Evidence of the effectiveness of lasers as an adjunct measure to nonsurgical periodontal treatment in the management of gingival enlargement among patients receiving FOAT remains uncertain.[20–23]

The aim of this randomized controlled clinical trial was to evaluate the effectiveness of diode laser gingivectomy as an adjunct to nonsurgical periodontal treatment in the management of periodontal health among patients receiving FOAT.

MATERIALS AND METHODS

This study was a randomized controlled parallel clinical trial. Subjects were recruited from among patients undergoing FOAT who had received ongoing nonsurgical periodontal treatment and instructions on oral hygiene but had persistent gingival enlargement. Participating patients had to be fit, healthy nonsmokers undergoing active FOAT who were between 10 and 40 years of age (inclusive) and who displayed gingival enlargement on the labial side of the anterior teeth. Patients taking medications that may cause drug-associated gingival enlargement (eg, calcium channel blockers, anticonvulsants, or immunosuppressants) or who were currently pregnant or lactating were excluded.

Subjects were block randomized (in groups of four) to two treatment groups (test and control groups). The test group received diode laser gingivectomy (940-nm diode laser, ezlase, Biolase Technology Inc, Irvine, Calif) as an adjunct to nonsurgical periodontal treatment on sites with gingival enlargement. The diode laser gingivectomy was performed under topical anesthetic gel (a mixture of lidocaine 20%, phenylephrine 2%, and tetracycline 4% [TAC 20% Alternate, Professional Arts Pharmacy, Baltimore, Md] applied 5 minutes prior to operation). No infiltration anesthesia was given. The laser fiber tip (300 μm in diameter) was held at 1 mm from the gingival tissue, and the gingivectomy was performed with gentle, sweeping brush strokes with a power output of 1 W in pulsed mode (pulse length of 0.05 ms, pulse interval of 0.2 ms). High-volume suction was used to evacuate the laser plume and charred odor. Patients were checked for hemostasis and were given postoperative instructions. Acetaminophen (500-mg tablet qid prn × 3/7) was given to patients for pain control. The control group received nonsurgical periodontal treatment only. Five periodontal parameters were assessed at baseline, 1 month, 3 months, and 6 months: Silness and Löe Plaque Index (PI),[24] Löe and Silness Gingival Index (GI),[25] bleeding on probing (BOP),[26] probing pocket depth (PPD),[25] and Gingival Overgrowth Index (GOI).[27]

The key outcome measure was GOI. Nonsurgical periodontal treatment has been shown to produce an 18.2% reduction in GOI.[28] In estimating the sample size, it was hypothesized that the adjunctive use of lasers would produce a further improvement of at least 10%. A sample size of 13 was estimated to have 80% power to identify a significant difference between the test (adjunct use of lasers) and control groups (nonsurgical periodontal treatment). To account for potential dropouts, 30 subjects were recruited.

Data were analyzed using SPSS Statistics software, version 19.0.0 (SPSS Inc, Chicago, Ill). Reliability of the five periodontal assessments was conducted among 10 patients throughout the study. Variations in the periodontal parameters over time were assessed using repeated-measures analysis of variance. Intragroup comparisons at 1 month, 3 months, and 6 months with baseline assessments were conducted using the paired *t*-test. Intergroup comparisons of the magnitude of change in the periodontal parameters compared to baseline were conducted at each examination using Student's *t*-test. The significance level was set at $P < .05$.

The study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (UW 10-396). The methodology followed the CONSORT 2010 guidelines[29] and was registered at the US Clinical Trials Registry (www.clinicaltrials.gov, NCT01286298). The research was carried out in accordance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human

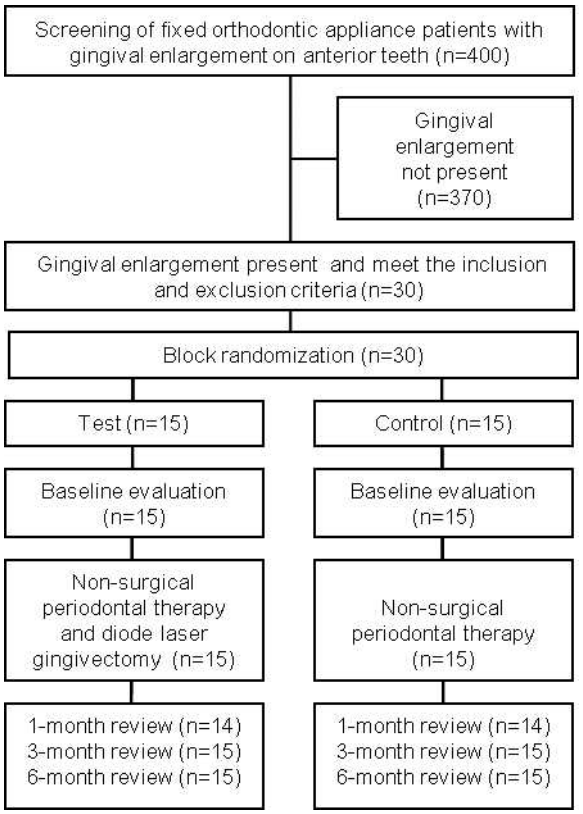

Figure 1. Flow diagram of the study process.

Subjects, and subjects provided informed written consent.

RESULTS

A flow chart of the recruitment protocol for this study is presented in Figure 1. The mean age of the 30 participating subjects was 18.03 ± 4.2 years, and 50.0% were female. There were significant changes in all five periodontal parameters over the study period (Table 1) ($P < .05$). Intragroup comparisons within the test group identified significant changes in several of the periodontal parameters compared to baseline (Table 2): percentage of sites with plaque at 1 month ($P < .05$), 3 months ($P < .01$), and 6 months ($P < .01$); percentage of sites with BOP at 1 month ($P < .01$), 3 months ($P < .01$), and 6 months ($P < .05$); percentage of sites with gingival inflammation at 3 months ($P < .01$) and 6 months ($P < .01$); mean PPD at 1 month ($P < .01$), 3 months ($P < .01$), and 6 months ($P < .01$); and percentage of sites with gingival overgrowth at 1 month ($P < .001$), 3 months ($P < .001$), and 6 months ($P < .001$). There were also significant intragroup variations in the control group in the clinical parameters compared to baseline: percentage of sites with plaque at 3 months ($P < .05$) and 6 months ($P < .05$); percentage of sites with BOP at 1 month ($P < .05$) and 6 months ($P < .01$); percentage of sites with gingival inflammation at 6 months ($P < .05$); mean PPD at 6 months ($P < .01$); and percentage of sites with gingival overgrowth at 3 months ($P < .05$) and 6 months ($P < .01$).

Intergroup comparisons identified significant differences in the magnitude of change in some periodontal parameters between the test and control groups (Table 3). Significant differences in the change in the percentage of sites with gingival enlargement (with respect to baseline) between the test and control groups were evident at 1 month ($P < .001$) and 3 months ($P < .01$). The magnitude of change in the percentage of sites with gingival inflammation was greater in the test group compared to the control group at 3 months ($P < .05$) and 6 months ($P < .05$). The magnitude of changes in mean PPD was greater in the test group than in the control group at 1 month ($P < .05$).

DISCUSSION

The response rate to the study was high; this most likely relates to the fact that participants were receiving ongoing FOAT and therefore were available for follow-up assessments. Thus, patients undergoing FOAT can be a useful group in which to conduct high-quality clinical trials to address existing research gaps, not only for orthodontic patients but for dental patients in general. Of note, 7.5% of the patients screened had evidence of gingival overgrowth, and this provides further evidence of the high prevalence of this problem among orthodontic patients. It has been suggested that FOAT may increase the risk of periodontal disease through increased plaque retention.[30]

Intragroup comparisons identified significant changes in clinical parameters over time in both the test and control groups. By 6 months there were significant changes across all parameters compared to baseline

Table 1. Variations in Periodontal Parameters Over the Study Period

Variable	Baseline Mean (SD)	1-mo Mean (SD)	3-mo Mean (SD)	6-mo Mean (SD)	P*
PI (% of sites)	96.9 (7.7)	83.0 (27.8)	78.8 (24.3)	78.3 (23.3)	.004
BOP (% of sites)	59.0 (24.6)	38.9 (25.8)	42.0 (26.3)	42.0 (26.3)	<.001
GI (% of sites)	98.0 (5.5)	86.8 (27.9)	82.7 (24.9)	81.7 (24.9)	.015
PPD (mm)	0.77 (0.8)	0.32 (0.6)	0.19 (0.4)	0.18 (0.4)	<.001
GOI (% of sites)	40.2 (21.0)	23.9 (25.7)	22.3 (22.7)	20.4 (18.3)	<.001

* Repeated-measures analysis of variance.

Table 2. Intragroup Comparisons of Periodontal Parameters Over Time

Group/Variable	Baseline Mean (SD)	1-mo Mean (SD)	3-mo Mean (SD)	6-mo Mean (SD)
Test group				
PI (% of sites)	95.4 (9.7)	77.6 (29.3)*	70.5 (28.5)**	71.6 (26.5)**
BOP (% of sites)	51.9 (25.4)	26.5 (19.7)**	30.3 (23.5)**	34.9 (23.3)*
GI (% of sites)	97.3 (6.0)	81.5 (29.7)	73.3 (30.7)**	72.1 (26.5)**
PPD (mm)	0.91 (1.0)	0.21 (0.5)**	0.12 (0.3)**	0.22 (0.5)**
GOI (% of sites)	32.6 (22.9)	3.5 (5.4)***	3.8 (5.8)***	8.7 (10.9)***
Control group				
PI (% of sites)	98.3 (5.1)	88.4 (26.1)	87.2 (16.4)*	84.9 (18.1)*
BOP (% of sites)	66.2 (9.2)	51.4 (25.7)*	53.7 (24.2)	44.7 (20.1)**
GI (% of sites)	98.7 (5.0)	92.0 (25.9)	92.1 (12.4)	91.2 (11.8)*
PPD (mm)	0.73 (0.7)	0.43 (0.7)	0.38 (0.6)	0.21 (0.4)**
GOI (% of sites)	47.7 (16.4)	44.3 (21.1)	40.8 (17.3)*	31.2 (16.7)**

* $P < .05$; ** $P < .01$; *** $P < .001$ (paired *t*-test statistics).

in both groups, suggesting that nonsurgical periodontal treatment with or without the adjunct use of laser therapy can be effective in the management of gingival health problems among patients receiving FOAT. However, in the test group, significant changes in the periodontal parameters were observed earlier—in some instances within a month. Furthermore, the degree of significant changes in periodontal health was larger and more frequent among the test group patients.

Intergroup comparisons identified significant differences in the magnitude of change in some of the clinical parameters between the test and control groups. For example, change in the percentage of sites with gingival overgrowth was significantly greater in the test group compared to the control group after 1 and 3 months. This indicates that the use of a laser can quickly resolve gingival overgrowth, although its long-term effectiveness was not evident. In addition, the adjunct use of diode laser gingivectomy was more effective in controlling gingival inflammation than nonsurgical periodontal treatment alone at 3 and 6 months. The change in the mean PPD was greater in the test group than in the control group at 1 month, again suggesting that diode laser gingivectomy can quickly resolve and control this periodontal problem. The early and sustained ability of diode laser gingivectomy to maintain periodontal health has considerable clinical relevance for orthodontic patients, since appliances in themselves can be iatrogenic to periodontal health, particularly if treatment periods are lengthy.

Table 3. Intergroup Comparisons of the Magnitude of Changes in Periodontal Parameters Over Time With Respect to Baseline

	Mean (SD)		
Variable	1-mo	3-mo	6-mo
PI (% of sites)			
Control	9.9 (26.5)	11.1 (16.4)	13.4 (18.5)
Test	17.8 (30.7)	25.0 (30.1)	23.8 (25.0)
P	.455	.131	.205
BOP (% of sites)			
Control	14.8 (24.5)	12.5 (25.7)	21.5 (23.2)
Test	25.4 (32.6)	21.7 (24.1)	17.1 (28.3)
P	.324	.322	.645
GI (% of sites)			
Control	6.7 (25.8)	6.6 (12.8)	6.8 (11.9)
Test	15.8 (30.3)	24.0 (29.4)	25.3 (25.1)
P	.382	.049	.018
PPD (mm)			
Control	0.16 (0.40)	0.30 (0.61)	0.48 (0.63)
Test	0.73 (0.88)	0.80 (0.83)	0.69 (0.71)
P	.036	.073	.390
GOI (% of sites)			
Control	3.4 (10.3)	6.9 (10.1)	15.6 (19.5)
Test	29.1 (22.2)	28.9 (22.6)	24.0 (18.3)
P	.001	.003	.236

Given the limited studies evaluating the effectiveness of diode laser gingivectomy as an adjunct measure for maintaining periodontal health among orthodontic patients, further studies are required to support or refute our claim that diode laser gingivectomy improves gingival health beyond what can be obtained from nonsurgical periodontal treatment.

CONCLUSIONS

- Nonsurgical periodontal management with or without the adjunct use of diode laser gingivectomy can be effective over time in the management of gingival health problems.
- However, the adjunct use of diode laser gingivectomy can produce a greater improvement in gingival health more quickly, suggesting that the adjunct use of diode laser gingivectomy has potential benefits for orthodontic patients.

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