Journal of International Oral Health 2015; 7(11):57-62

Received: 25th June 2015 Accepted: 24th September 2015 Conflicts of Interest: None

Source of Support: Nil

Original Research

Clinical Effectiveness of Laser Assisted New Attachment Procedure as an Adjunct to Non-surgical Periodontal Treatment: A Randomized Clinical Study

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How to cite the article:
Katuri KK, Bollepalli AC, Sunkireddy HKR, Chilakalapudi HCB, Kurapati S, Vinnakota NR. Clinical effectiveness of laser assisted new attachment procedure as an adjunct to non-surgical periodontal treatment: A randomized clinical study. J Int Oral Health 2015;7(11):57-62.

Abstract:

Background: The aim of the present study is to evaluate the clinical effects of laser-assisted new attachment procedure (LANAP) as an adjunctive to non-surgical periodontal therapy in the treatment of moderate periodontal pockets.

Materials and Methods: A total of 38 patients (22 males, 16 females; mean age 36 ± 10.1 years) diagnosed with generalized chronic periodontitis were included in this randomized, single-blind clinical study. All the sites were divided into two groups: Test group (TG) (n = 469), treated with laser along with scaling-root-planning (SRP) and control group (n = 481), treated with SRP alone. Data collected at baseline and after 6 weeks and 24 weeks included sulcus bleeding index, plaque index (PI), probing depth, and clinical attachment level (CAL). Changes in probing depth and CAL were analyzed separately for moderate (4-6 mm) and deep (≥7 mm) pockets.

Results: The results obtained in both the groups showed that approximal PI and bleeding on probing after 6 weeks and 24 weeks was superior to the baseline (P < 0.0001). At 24 weeks post-operatively, a significant (P < 0.0001) improvement was seen in moderate and deep probing depth and CAL in both the groups. In between the groups, after 24 weeks, TG showed significant gain in CAL in moderate pockets (P < 0.0001) and decreased probing depth in deep periodontal pockets (P < 0.0017).

Conclusion: The present study indicates that, LANAP using neodymium:yttrium-aluminum-garnet laser (1064 nm) with SRP as an effective non-surgical periodontal therapy in the treatment of moderate periodontal pockets.

Key Words: Chronic periodontitis, clinical attachment level, lasers, non-surgical periodontal therapy, pocket depth

Introduction

The primary goal of periodontal therapy is to control periodontal infection by the removal of supragingival and subgingival biofilms and smear layer, which contains bacteria, bacterial endotoxins and contaminated root cementum.[1,2] Removal of these pathologic substances ensures biologic compatibility between the diseased periodontal radicular surface and new connective tissue attachment (CTA).[3]

Traditional approaches like non-surgical and surgical periodontal methods using both hand instruments and ultrasonic scalers have been carried out for several years with great success. Laser therapy has been proposed as an alternative or adjunctive treatment to conventional periodontal therapy.[4] Maiman in 1960 developed the first laser prototype and later by Goldman *et al.* (1964), Stern and Sognnaes (1972) reported the effect of laser on dental tissue and on enamel and dentin.[5] Myers and Myers (1989) suggested that the neodymium:yttrium-aluminum-garnet (Nd:YAG) laser could be used for oral soft tissue surgery. Various types of LASERS like CO_2, diode lasers (gallium-aluminum-arsenide and indium-gallium-arsenide), Nd: YAG, and erbium:YAG with varying wavelengths (635-10,600 nm) have different levels of tissue penetration depending on reflection, scatter, and absorption.[6] Low-level laser therapy (LLLT) using diode laser can facilitate collagen synthesis, angiogenesis, and growth factor release, which eventually accelerate wound healing.[7]

Laser-assisted new attachment procedure (LANAP) was introduced by Dr. Robert Gregg and Delwin McCarthy in 1989. Initial reports suggest that LANAP is associated with cementum-mediated new CTA and apparent periodontal regeneration of diseased root surfaces in humans.[8] When laser irradiation is delivered cautiously, the regenerative potential of laser is high, and, undoubtedly, new fibroblastic activity in the connective tissue promotes new CTA.[9] The indications for LANAP are the same as for standard periodontal therapy that includes periodontal pocket depth (PD) ≥4 mm, radiographic evidence of bone loss, and positive laboratory test for presence of putative periodontal pathogens.

The results of recent research suggest that a free-running, pulsed Nd:YAG laser (PerioLase® MVP-7 laser, Millennium Dental Technologies) provides a viable alternative to traditional periodontal surgery. Properly applied PerioLase MVP-7 laser has been shown to produce less bleeding, swelling, discomfort, and periodontal regeneration.[10]

The use of lasers in periodontics is rapidly increasing, despite enormous clinical research and a plethora of scientific literature, controversy exists to date among clinicians regarding the application of lasers in the treatment of periodontal disease. There is limited evidence on the clinical efficacy of LANAP over conventional surgical or non-surgical periodontal and peri-implant therapies.

Consequently, the aim of the present study is to evaluate the clinical effects of LANAP therapy using 1064 nm of Nd:YAG laser with scaling-root-planning (SRP) versus the effect of SRP alone in the treatment of moderate to deep periodontal pockets.

Material and Methods

A total of 38 patients (22 males and 16 females) with a mean age of 36 ± 10.1 and diagnosed with generalized chronic periodontitis were included in the study. A randomized split-mouth method was carried out in all the patients with two quadrants as test group (TG) treated with LANAP along with SRP and other two quadrants as control group (CG) treated with SRP alone. Teeth with PD and clinical attachment level (CAL) ≥4 mm on at least one from the six surfaces were included in the study. Patients were selected according to the following inclusion criteria; history of no periodontal treatment in the last 12 months, no use of antibiotics within the previous 6 months, no systemic disease that influence the periodontal therapy, no smoking or alcohol and no pregnancy and lactation. Exclusion criteria are teeth with Grade III mobility[11] and patients using removable or fixed partial dentures. The study protocol has been approved by institutional ethical committee and informed written consent from all the recruited subjects was taken before start of the study.

Before the start of the treatment, the data of all enrolled patients including periodontal parameters like plaque index (PI),[12] bleeding on probing (BOP)[13] pocket depth (PD) and CAL were recorded at baseline, 6 weeks and 24 weeks post-operatively. Full mouth CAL and PD was measured at all the six surfaces of each tooth using UNC-15 periodontal probe. At each interval, all the clinical parameters were recorded and maintained by single examiner (AC), who was unaware of the study design. All the patients received complete supragingival scaling with an ultrasonic device in two appointments at 1-week interval by the examiner (AC). Oral hygiene instructions were given at every appointment and followed by use of 0.2% chlorhexidine mouthwash as directed twice daily for 2 weeks.

Patients were recalled after 3 weeks, and randomization was carried out using slip method with each quadrant is coded with a number, subsequently resulting in two quadrants as TG and other two quadrants as CG. To overcome the selection bias, randomization was performed by an independent instructor, who did not participate in the study.

LANAP protocol was followed along with SRP for the test quadrants, whereas SRP alone was done for the remaining two quadrants. Under local anesthesia, first application of laser is performed using Nd: YAG laser (1064 nm) at power setting of 3.0 W, 150-us pulse duration, and 20 Hz[14] into the gingival sulcus by placing the fiber optic delivery system (0.2-0.3 mm) parallel to the long axis of the tooth and moved laterally and apically 1 mm less to the clinical measurement value obtained for the pocket depth. All the six surfaces of each tooth were treated with laser. The objective of placing the laser into the sulcus is to remove the diseased epithelium toward the soft tissue wall of the periodontal pocket and also to create a trough with significant hemostasis. Full mouth SRP was performed for each patient in both groups using area specific gracey curettes until the roots were smooth and no visual or tactile evidence of calculus or altered cementum. After thorough SRP, laser fiber-optic delivery system is passed through the pocket for the second time at power setting of 4.0 W, 635-us pulse duration, and 20 Hz to achieve a stable fibrin clot and pocket seal.[14] The control teeth received all of the aforementioned treatment except for the laser therapy and suturing was not done. Full mouth SRP in both the groups and laser application in TG was carried out by the single clinician (KK). All the patients were given post-operative instructions and medication including 0.2% chlorhexidine mouthwash twice daily with supragingival brushing for 2 weeks. Antibiotics (amoxicillin 500 mg, every 8 h) and analgesics (ibuprofen 400 mg, every 8 h) were advised for 5 days. Patients were recalled at 1 week, 6 weeks, and 24 weeks for post-operative follow-up, where the clinical measurements were recorded at 6 weeks and 24 weeks respectively and oral hygiene is reinforced in all the visits. All the subjects completed the study protocol and were followed up to the end of the study. A total of 481 sites in CG and 469 sites in TG were examined.

Statistical analysis

Data were expressed as mean values of approximal PI (API), BOP, PD, and CAL (4-6 mm and >7 mm) were evaluated using a software. Comparisons were made within the group and between the groups at 6 weeks and 24 weeks using Wilcoxon matched paired *t*-test and Mann–Whitney *U*-tests.

Results

None of the 38 patients participated in the trial had reported pain or any discomfort. Healing after 24 weeks was satisfactory and uneventful as observed by the investigator and reported by the patients respectively. However, six patients in

TG compared to 4 patients in CG experienced dentinal hypersensitivity during first 4 weeks post-operatively, which has subsided. The BOP and API results (mean ± standard deviation) for LG and CG at baseline, 6 weeks and 24 weeks were presented in Table 1. Significant reduction was observed in the mean BOP and API scores from baseline to 6 weeks and 24 weeks post-intervention ($P < 0.001$). The finding held strength in both the groups. However, neither of the groups had shown significant differences in the mean BOP and API scores between 6 weeks and 24 weeks post-intervention. Similar findings were observed on comparison of mean pocket depths with significant differences observed from baseline to 6 weeks ($P < 0.0001$) and 24 weeks ($P < 0.0001$) as well in both the test and the CGs. However, no significant differences were found between the test and CGs both at baseline and post-intervention, suggesting accurate randomization and near equivalent impact of both the interventions respectively (Table 2).

The mean CAL score for teeth with CAL ≥4 mm was higher in the TG at baseline, and this difference was marginally significant ($P < 0.0493$). However, the differences lost significance after the intervention both at 6 weeks and 24 weeks. A statistically significant gain ($P < 0.0001$) of CAL (4-6 mm) is noticed in both the groups when compared from baseline to 6 weeks and 24 weeks. Inter-group comparison of CAL (4-6 mm) at 6 weeks showed that a significant gain is achieved in TG at baseline to 6 weeks ($P < 0.0244$), baseline to 24 weeks ($P < 0.0005$) and 6 weeks to 24 weeks ($P < 0.0016$) (Table 3).

The mean pocket depth of sites with PD ≥7 mm in TG was 8.38 ± 1.18 and in CG it is 8.49 ± 1.05. The difference in the mean values between the groups at baseline was not significant ($P < 0.6791$). Both the groups showed overall improvement in 6 weeks and 24 weeks post-operatively, which was statistically significant ($P < 0.0001$). However, 24 weeks post-intervention comparison revealed significant gain in the TG compared to the CG ($P < 0.0017$) (Table 4).

At baseline, there was no significant difference between the mean CAL scores of the two groups for teeth with CAL ≥7 mm. A significant gain in attachment was observed in both the groups from baseline to 6 weeks and 24 weeks ($P < 0.0001$). Unlike mean pocket depth for sites with PD ≥7 mm, mean CAL scores for teeth with CAL ≥7 mm were not significantly different between the two groups at 24 weeks post-intervention (Table 5).

Discussion

Various treatment approaches have been carried out in the treatment of periodontal pockets, and laser assisted periodontal therapy is most widely used nowadays. Laser-mediated periodontal therapy has shown significant benefits from subgingival soft tissue curettage as well as in subgingival

Table 1: Comparison of baseline, 6 weeks and 24 weeks with API and BOP scores by Wilcoxon matched pairs test.

Time	Mean	SD	Mean difference	SD difference	Percentage of change	*Z* value	*P* value
API							
Baseline	1.65	0.34	0.87	0.30	52.63	5.3731	0.00001*
6 weeks	0.78	0.29					
Baseline	1.65	0.34	0.83	0.30	50.56	5.3731	0.00001*
24 weeks	0.82	0.26					
6 weeks	0.78	0.29	−0.03	0.14	−4.38	1.2953	0.1952
24 weeks	0.82	0.26					
BOP							
Baseline	1.52	0.24	1.02	0.28	67.53	5.3731	0.00001*
6 weeks	0.49	0.13					
Baseline	1.52	0.24	1.03	0.26	67.88	5.3731	0.00001*
24 weeks	0.49	0.08					
6 weeks	0.49	0.13	0.01	0.11	1.07	0.7448	0.4564
24 weeks	0.49	0.08					

SD: Standard deviation, BOP: Bleeding on probing, API: Approximal plaque index

Table 2: Comparison TG and CGs with respect to mean PD ≥4 mm scores at baseline, 6 weeks and 24 weeks by Mann–Whitney *U*-test.

Groups	Baseline		6 weeks		24 weeks		BL-6W		BL-24W		6W-24W	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TG	4.89	0.28	3.81	0.27	3.71	0.24	1.08	0.37	1.18	0.34	0.10	0.07
CG	4.81	0.33	3.71	0.26	3.63	0.25	1.10	0.39	1.18	0.37	0.08	0.05
Total	4.85	0.31	3.76	0.27	3.67	0.25	1.09	0.38	1.18	0.36	0.09	0.06
Percentage of change in TG							22.14%#	*P*=0.0001*	24.16%#	*P*=0.0001*	2.60%#	*P*=0.000*
Percentage of change in CG							22.92%#	*P*=0.0001*	24.58%#	*P*=0.0001*	2.15%#	*P*=0.0001*
Z value	−0.9765		−1.8700		−1.7038		−0.1351		−0.0416		−1.1376	
P value	0.3288		0.0615		0.0884		0.8926		0.9669		0.2553	

*$P<0.05$, #Applied Wilcoxon matched pairs test. TG: Test group, CG: Control group, SD: Standard deviation

Table 3: Comparison TG and CGs with respect to mean CAL ≥4 mm scores at baseline, 6 weeks and 24 weeks by *t* test.

Groups	Baseline		6 weeks		24 weeks		BL-6W		BL-24W		6W-24W	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TG	5.35	0.36	3.97	0.39	3.76	0.29	1.38	0.30	1.58	0.29	0.21	0.18
CG	5.19	0.34	3.99	0.37	3.88	0.36	1.20	0.37	1.30	0.38	0.10	0.08
Total	5.27	0.36	3.98	0.38	3.82	0.33	1.29	0.35	1.44	0.36	0.16	0.15
Percentage of change in TG							25.74%#	*P*=0.0001*	29.63%#	*P*=0.0001*	5.24%#	*P*=0.0001*
Percentage of change in CG							23.09%#	*P*=0.0001*	25.11%#	*P*=0.0001*	2.63%#	*P*=0.0001*
Z value	1.9993		−0.2027		−1.6177		2.2985		3.6509		3.2848	
P value	0.0493*		0.8399		0.1100		0.0244*		0.0005*		0.0016*	

*P<0.05, #Applied paired *t* test. CAL: Clinical attachment level, TG: Test group, CG: Control group, SD: Standard deviation

Table 4: Comparison TG and CGs with respect to no of sites PD ≥7 mm scores at baseline, 6 weeks and 24 weeks by *t* test.

Groups	Baseline		6 weeks		24 weeks		Changes from					
							BL-6W		BL-24W		6W-24W	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TG	8.38	1.15	4.83	0.80	4.10	0.56	3.55	1.18	4.28	1.31	0.72	0.65
CG	8.49	1.05	5.42	0.93	5.14	0.74	3.07	0.77	3.35	0.84	0.28	0.50
Total	8.44	1.09	5.18	0.92	4.72	0.84	3.26	0.98	3.72	1.14	0.46	0.60
Percentage of change in TG							42.39%#	*P*=0.0001*	51.03%#	*P*=0.0001*	15.00%#	*P*=0.0001*
Percentage of change in CG							36.73%#	*P*=0.0001*	40.12%#	*P*=0.0001*	5.37%#	*P*=0.0014*
Z value	−0.4154		−2.7849		−6.3921		2.0983		3.6651		3.2711	
P value	0.6791		0.0069*		0.00001*		0.0395*		0.0005*		0.0017*	

*P<0.05, #Applied paired *t* test. TG: Test group, CG: Control group, SD: Standard deviation

Table 5: Comparison TG and CGs with respect to no of sites CAL ≥7 mm scores at baseline, 6 weeks and 24 weeks by *t* test.

Groups	Baseline		6 weeks		24 weeks		Changes from					
							BL-6W		BL-24W		6W-24W	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TG	8.59	1.05	5.24	0.91	4.79	0.62	3.34	1.11	3.79	1.18	0.45	0.63
CG	8.77	1.02	5.56	0.77	5.21	0.77	3.21	0.80	3.56	0.88	0.35	0.53
Total	8.69	1.03	5.43	0.84	5.04	0.74	3.26	0.93	3.65	1.01	0.39	0.57
Percentage of change in TG							38.96%#	*P*=0.0001*	44.18%#	*P*=0.0001*	8.55%#	*P*=0.0007*
Percentage of change in CG							36.61%#	*P*=0.0001*	40.18%#	*P*=0.0001*	5.63%#	*P*=0.0002*
Z value	−0.7301		−1.5933		−2.4195		0.6009		0.9685		0.7229	
P value	0.4678		0.1156		0.0181*		0.5498		0.3362		0.4722	

CAL: Clinical attachment level, TG: Test group, CG: Control group, SD: Standard deviation, #: Applied paired *t* test, *: Statistically significant

bacterial loads.[15] According to previous studies, adjunctive use of the diode laser along with conventional SRP has shown to have an additive effect in reducing subgingival bacteria in periodontal pockets measuring ≥4 mm.[16]

A study by Qadri *et al*. observed a significant reduction in inflammatory markers (interleukin-1β and matrix metalloproteinase-8 [MMP-8]) levels in gingival crevicular fluid (GCF), sites treated with SRP and Nd:YAG laser than SRP alone.[16] Another study by Aykol *et al*. observed decreased GCF levels of MMP-1, tissue inhibitor MMP-1, transforming growth factor-β1, and basic fibroblast growth factor suggesting LLLT as an adjunctive therapy to non-surgical periodontal treatment and improves periodontal healing.[7]

According to Slot *et al*., 2011, there was no significant difference in all clinical parameters between the sites treated with SRP and Nd:YAG laser than SRP alone,[17] these results are in support to his earlier systematic review.[18]

In the present study, Nd:YAG laser with wavelength of 1060 nm has been used to evaluate the clinical benefit of LANAP as an adjunct to conventional periodontal therapy for achieving new attachment. The present results indicate that non-surgical periodontal therapy using hand instruments or in combination with LANAP procedure shown significant improvements in clinical parameters (BOP, PD, and CAL) for both moderate and deep pockets at 6 weeks and 24 weeks after treatment. Similar results were presented in earlier case reports and case series, showing significant improvement in gingival inflammation during observation period from baseline to 6 weeks and 24 weeks.

Histologic evaluation of LANAP in humans for the treatment of periodontal pockets has shown new CTA and periodontal regeneration.[14] Nevins *et al*. evaluated periodontal regeneration performing LANAP procedure in humans and stated that there was a significant degree of periodontal regeneration with new cementum, periodontal ligament and alveolar bone.[10] In a

prospective study done by Nevins *et al*., evaluated the efficacy of LANAP therapy in eight patients for a period of 9 months and concluded that majority of treated sites showed improvement in all clinical parameters.[19]

The results obtained in this study using LANAP therapy have showed a significant improvement in BOP, PI, PD, and CAL, similar to the previous studies.[8,10,14,19] Sites with PD of 4-6 mm has shown significant reduction in both the groups at 24 weeks post-operatively, indicating that both the therapies were effective in treating moderate periodontal pockets. However at 24 weeks post-operatively, a significant gain in CAL at 4-6 mm in the sites treated with LANAP was observed, suggesting a new cementum and new connective tissue formation (new attachment). This data supports to the earlier study by Yukna *et al*. and Nevins *et al*., where histological examination of all six LANAP treated teeth showed formation of new CTA.

PD with ≥7 mm sites in both the groups were treated non-surgically with LANAP therapy as an adjunctive in TG. All the patients included in this study had average PD of 4-6 mm with few sites ≥7 mm. Non-surgical periodontal treatment was carried out for all the sites including sites with ≥7 mm, as they were located in isolated areas. Systematic reviews have proven that in terms of PD reduction and CAL gain in open flap debridement procedures were effective in sites with PD >6 mm.[20]

In the present study, TG showed significant reduction in PD in sites with ≥7 mm when compared with CG, but no significant gain in CAL is achieved at 24 weeks post-operatively. These results were similar to the previous study by Nevins *et al*. 2014, where initial sites of ≥7 mm had at least 2 mm of PD reduction in 91% of sites and CAL gain of 2 mm in 77% of sites. Greater retraction of periodontal tissues in deep periodontal pockets (≥7 mm) in TG led to significant reduction in PD with no significant gain in CAL.

LANAP appears to be safe procedure that resulted in new CTA formation with no significant side effects beyond dentinal hypersensitivity or gingival recession and no damage to the root surfaces.[21] Even though LANAP therapy has been introduced 15 years ago, very few case reports and case series has been reported till now with substantial clinical and histological evidence. However, controversy remains regarding the efficacy of LASERS, mainly LANAP therapy in treating the periodontal disease and periodontal regeneration. This is the first randomized controlled clinical study done to evaluate LANAP as adjunctive to SRP in the treatment of periodontal disease for a period of 24-week. LANAP therapy should be further evaluated with long-term clinical trials with larger sample size to compare the clinical results with conventional therapy.

Conclusion

Within the limits of the present study, the results indicate that LANAP therapy as an adjunct to non-surgical periodontal therapy using Nd:YAG laser offered superior results when compared with SRP alone. The present study focused mainly in the treatment of moderate periodontal pockets and achieved significant results in all the clinical parameters observed. Deeper pockets also showed promising results with LANAP therapy, suggesting that further studies are necessary to adequately test the potential benefits following the LANAP protocol in the treatment of periodontal diseases.

Acknowledgment

I thank all the patients for their support in completing the study.

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