ผลของไดโอดเลเซอร์ในการรักษาโรคปริทันต์อักเสบร่วมกับการขูดใต้เหงือกด้วยเครื่องขูดอัลตราโซนิคเสร็จในคราวเดียว

EFFECT OF DIODE LASER ON PERIODONTITIS TREATMENT WITH ONE-VISIT ULTRAZONIC SUBGINGIVAL DEBRIDEMENT

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บทคัดย่อ

วัตถุประสงค์เพื่อเปรียบเทียบผลทางคลินิกระหว่างการใช้ไดโอดเลเซอร์ร่วมกับการขูดใต้เหงือกด้วยเครื่องขูดหินน้ำลายอัลตราโซนิคชนิดเพียโซอิเล็กทริกเสร็จในคราวเดียว ในการรักษาโรคปริทันต์อักเสบระดับปานกลางถึงรุนแรงโดยใช้อาสาสมัคร 30 คน เป็นผู้ป่วยโรคปริทันต์อักเสบระดับปานกลางถึงรุนแรง แบ่งเป็น 2 กลุ่ม ด้วยวิธีการแบบสุ่ม ได้แก่ กลุ่มควบคุมและกลุ่มทดลอง ทั้ง 2 กลุ่มได้รับการขูดหินน้ำลายและเกลารากฟันทั้งปากในคราวเดียวเสร็จด้วยเครื่องขูดหินน้ำลายอัลตราโซนิคชนิดเพียโซอิเล็กทริก โดยในกลุ่มทดลองมีการใช้ไดโอดเลเซอร์ร่วมด้วย เฉพาะตำแหน่งร่องลึกปริทันต์ที่ ≥ 5 มม. ขึ้นไป ติดตามผลการรักษาที่เวลา 1, 3 และ 6 เดือน พบว่าที่เวลา 6 เดือน ผลทางคลินิกของทั้ง 2 กลุ่ม ดีขึ้นอย่างมีนัยสำคัญทางสถิติเมื่อเปรียบเทียบกับที่เวลาเริ่มต้น ผลที่ดีกว่าพบได้จากกลุ่มทดลอง โดยพบว่าที่เวลา 3 และ 6 เดือน ตำแหน่งร่องลึกปริทันต์ขนาดเริ่มต้น ≥ 5 มม. มีการลดลงของร้อยละค่าดัชนีการเลือดออกของเหงือกแตกต่างอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) เมื่อเปรียบเทียบกับกลุ่มควบคุม และพบว่าในตำแหน่งร่องลึกปริทันต์ที่มีขนาดเริ่มต้น ≥ 7 มิลลิเมตรนั้น กลุ่มทดลองมีการลดลงของร่องลึกปริทันต์ และการมีเพิ่มขึ้นของระดับการยึดเกาะอวัยวะปริทันต์อย่างมีนัยสำคัญทางสถิติ ($p<0.05$) เมื่อเปรียบเทียบกับกลุ่มควบคุมที่เวลา 6 เดือน สรุปผลได้ว่าการใช้ไดโอดเลเซอร์ร่วมกับเครื่องขูดหินน้ำลายอัลตราโซนิคในการรักษาโรคปริทันต์อักเสบระดับปานกลางถึงรุนแรง สามารถลดขนาดร่องลึกปริทันต์และเพิ่มระดับการยึดเกาะของอวัยวะปริทันต์ได้ในร่องลึกปริทันต์ขนาด ≥ 7 มม. ขึ้นไปได้

คำสำคัญ: ไดโอดเลเซอร์ การขูดใต้เหงือกด้วยเครื่องขูดอัลตราโซนิคเสร็จในคราวเดียว การรักษาโรคปริทันต์ การขูดหินน้ำลายใต้เหงือกด้วยเครื่องขูดอัลตราโซนิคชนิดเพียโซอิเล็กทริก

Abstract

This study aimed to evaluate the clinical outcome of one-visit periodontal treatment using ultrasonic piezoelectric device in combination with diode laser. Thirty patients were randomized into two groups. In both groups, sub-gingival full mouth SRP in a single visit was performed using piezoelectric ultrasonic device. In test group, after sub-gingival debridement, a 970 nm diode laser was applied to all periodontal pockets of ≥5 mm. The clinical parameters were evaluated at 1,3 and 6 months after treatment. At 6 months, each clinical parameter was significantly improved compared to baseline, better results were in favor of the test group. At 3 and 6 months, statistical significant difference between control and test group were found in bleeding on probing (BOP) at site with ≥5 mm. pocket depth and pocket reduction ($p<0.05$). Nevertheless, the significant difference in clinical attachment gain at site with ≥ 7 mm. pocket depth was only found after 6 months ($p<0.05$). The use of diode laser following subgingival SRP could shallow periodontal pocket depth and improved clinical attachment level, especially at site with ≥ 7 mm. depth of periodontal pockets.

Keywords: Diode laser, One-visit ultrasonic subgingival debridement, Periodontal treatment, Piezoelectric ultrasonic debridement

Introduction

Chronic periodontitis is a slow inflammatory condition of periodontal tissue in response to bacterial plaque and calculus at the gingival margin and root surface. This chronic inflammation cause periodontal tissue breakdown and eventually leads to tooth mortality. The goal of periodontal therapy is to arrest the inflammation by removing a local bacterial plaque and calculus and maintain a healthy periodontium [1]. Scaling and root planing (SRP) is an important part of periodontal treatment focusing on supra- and subgingival removal of bacterial plaque and calculus using hand instruments and ultrasonic scalers. Traditionally, one quadrant SRP is performed in one visit. This resulting in a long period of treatment time until a full mouth is done [2]. Though hand instrumentation have been the gold standard [3] for SRP, it required high hand-skill level and takes longer treatment time than ultrasonic scalers. Numerous clinical and microbiological studies have revealed that there were no significant differences in clinical efficacy and/or microbiology effect between using hand instruments or ultrasonic scaler in periodontal treatment [4-5], moreover, ultrasonic scaler could save 20-50% of treatment time and more comfort to patients [6].

Full mouth SRP in one visit was first introduced by Quirynen et al. [7] since the quadrant-wise treatment may provide an opportunity for periodontal pathogen (periopathogen) in untreated sites to reinfect the already treated sites. Many clinical outcomes and microbiological studies reported that one-stage full mouth disinfection using ultrasonic scaler demonstrates not only similar results to

quadrant-wise treatment [2] but also shorter treatment time [8].

Rather total elimination of periopathogens, clinical success of SRP depend on the amount of residual plaque and calculus and the ability to decrease tooth surfaces infected by periopathogens [1]. Evidently, complete removal of bacterial plaque and their toxins from the root surface cannot be achieved through mechanical debridement alone [9]. Moreover, regardless of the treatment modality or protocol, complete removal of subgingival plaque and calculus especially from site with deep pockets and complicated area such as furcation, remained difficult to achieve [4]. Thus, the use of antibiotic as an adjunct therapy for bacterial reduction has been introduced, nevertheless, the increasing risk for developing antibiotic resistance cannot be overlooked.

At present, diode laser is used as an adjunct to periodontal therapy [9-10]. Many studies suggested that diode laser might have bactericidal effects, promote wound healing, and did not interact with bone and dental hard tissue, making it safe for soft tissue operation [4], [9-10]. An in vitro study, showed that 980 nm. diode laser can remove epithelium in periodontal pocket more completely without damaging the surrounding tissue when compared to using a hand instrument alone [11]. Mortiz et al. found that the used of diode laser in combination with SRP did promote healing of the periodontal pockets through more thorough bacterial elimination [12]. However, there are many studies that did not find any additional benefits of diode laser as an adjunct to SRP in periodontal treatment [13-14]. Due to the difference in treatment protocol and wavelength of diode laser in each study, the results of diode laser use in combination with SRP have been difficult to interpret.

Objectives

The objective of the present study is to evaluate and compare the clinical outcomes between two periodontal treatment modalities: one-visit full mouth sub-gingival ultrasonic debridement alone and one visit full-mouth sub-gingival ultrasonic debridement together with the use of 970 nm diode laser.

Methods

The present study was a randomized controlled trial involving thirty patients with moderate to severe chronic periodontitis at the Faculty of Dentistry, Srinakharinwirot University. A total of thirty patients were randomized into control group (n=15) and test group (n=15). Written informed consents were obtained from all subjects. The study protocol was approved by the Ethics Commission of Srinakharinwirot University [Bangkok] (SWUEC/F-150/2562). The sample size was calculated considering a statistical power of 80% was used in order to detect a significant difference of 1.0 mm for clinical attachment level (CAL) (α = 0.05,

standard deviation S.D. = 1.6 mm). The SD was base in a previous study conduct with the same population [14]. Base on this, 28 subjects were enrolled in this study. Considering a patient dropout of 10%, a total of 30 subjects were recruited.

Inclusion criteria: patients must have at least 15 teeth with at least 4 positions have probing depth of 5 mm. or more and clinical attachment loss of 3 mm. or more. Exclusion criteria: patients presented with a systemic disease affecting periodontal tissue, pregnancy, mental disorder, tobacco smoking or alcoholism; patients who had undergo periodontal treatment within 6 months; patients who has been taken systemic antibiotics in the previous 6 months before the commencement of the study.

The clinical parameters assessed were PI (plaque index Silness and LÖe) [15], GI (gingival index LÖe and Sillness) [15], BOP (bleeding on probing) according to the method of Ainamo and Bay [16], PD (probing pocket depth) using a PC-UNC 15 periodontal probe, CAL (clinical attachment level), pocket reduction (changes in PD: mm) and clinical attachment gain (change in CAL: mm). All clinical parameters were evaluated at 1,3 and 6 months.

All patients received oral hygiene instruction on every appointment. Full mouth SRP in a single visit was performed using a piezoelectric ultrasonic scaler device (ACTEON® Satelec P5 Newtron Scaler., France) and specific periodontal insert (NEWTRON® Perio tips., France) in both groups. In the test group, diode laser therapy was performed in the periodontal pockets of 5 mm. or more concomitantly with SRP at the same appointment. Diode laser therapy was performed by using a 970 nm Indium-Gallium-Arsenide (SiroLaserBlue, Dentsply Sirona., Germany). The laser device was set at 1.5 watts, 10 Hz. and 50%pulse duty cycle. Laser fiber (a diameter of 320 μm.) was inserted into the periodontal pocket. Activated by the finger switch, the laser fiber was slowly sweeped apically to coronally from mesial to distal to palatal/lingual and finished at buccal for about 20s per periodontal pocket.

The Shapiro-Wilk test was used to verify normality of the data and Levene's test used to assess the equality of variances. If the data were normally distributed, parametric test was used for intragroup comparison is one-way repeated measurements ANOVA and two-way repeated measurements ANOVA for intergroup comparison. Adjusting p-value for pairwise comparison with Sidek's method. All statistical test were performed at a significant level of 0.05 (p-value<0.05)

Results

Thirty subjects successfully completed the entire study. At 6 months follow-up period treatments were uneventful in all cases. No adverse effects and complications reported by any of the subjects. The demographic data was shown in table 1.

Table 1 Demographic characteristics.

	Control group	Test group	p-value
Number of participants	15	15	
Age (Years)	52.80 ± 11.74	51.20 ± 10.08	0.69
Sex (male : female)	5 : 10	6 : 9	0.71
Number of sites with PD (probing pocket depth) ≥ 5 mm. (n)	240	324	

No differences between groups for any parameter.

Results demonstrated that there were no significant differences between the groups in all of the clinical parameters (PI, GI, BOP, PD, CAL) at baseline and the data were normally distributed (Table 2).

Table 2 Periodontal clinical parameters at baseline.

Clinical parameters	Control group	Test group	p-value
Plaque index (PI)#	2.04 ± 0.56	2.06 ± 0.57	0.89
Gingival index (GI)#	1.99 ± 0.43	2.09 ± 0.42	0.54
Bleeding on probing (BOP%)	70.06 ± 23.04	75.49 ± 23.71	0.57
Probing pocket depth (PD ; mm.)	2.98 ± 0.38	3.06 ± 0.52	0.62
Clinical attachment level (CAL ; mm.)	4.05 ± 0.66	3.69 ± 0.52	0.19

PI# and GI# were mean value calculated from index teeth (16, 11, 24, 36, 32, 44)

No differences between groups for any parameter.

The clinical outcomes (BOP, PD, CAL) of the sites with PD of 5 mm. or more at all time points have shown in Table 3. All of the clinical outcomes improved significantly in both group when compared to baseline (p-value < 0.001). There were no significant differences in clinical outcomes between group. However, a significant difference in BOP was observed between the two groups at both 3 and 6 months (p-value<0.05)

Clinical outcome measures for pocket reduction (ΔPD) and clinical attachment gain (CAL gain) of the sites with initiate probing pocket depth ≥ 5 mm. (PD ≥ 5 mm.) have shown in Table 4. ΔPD and CAL gain were analyzed separately for initially moderate (PD 5-6 mm.) and deep periodontal pocket depth (PD ≥ 7 mm.) The difference of CAL gain was significant in PD ≥ 5 mm. after 6 months between group. No significant difference in a ΔPD for PD ≥ 5 mm, PD 5-6 mm. and CAL gain for PD 5-6 mm. was observed between group at any time point. Nevertheless, a significant difference between group was found in ΔPD and CAL gain for site with initiate probing pocket depth ≥ 7 mm. (PD ≥ 7 mm.) after 6 months (p-value<0.05)

Table 3 Clinical outcome of site with probing pocket depth ≥ 5 mm. at baseline.

Clinical parameters	Baseline	1 month	3 months	6 months	p-value
BOP[1] of initiate pocket depth ≥ 5 mm.					
Control	97.81±4.50	68.90±20.30	64.68±20.07	63.91±18.82	<0.001*
Test	93.36±10.16	62.39±24.52	45.30±25.55	47.39±18.20	<0.001*
p-value	0.13	0.44	0.03**	0.02**	
PD[2] of initiate pocket depth ≥ 5 mm.					
Control	5.46 ± 0.30	4.38 ± 0.70	4.07 ± 0.68	4.10 ± 0.68	<0.001*
Test	5.59 ± 0.43	4.27 ± 0.68	4.01 ± 0.78	3.89 ± 0.86	<0.001*
p-value	0.35	0.66	0.82	0.45	
CAL[3] of initiate pocket depth ≥ 5 mm.					
Control	6.44 ± 0.78	5.36 ± 1.03	4.99 ± 1.07	5.03 ± 1.08	<0.001*
Test	6.29 ± 0.99	4.91 ± 0.68	4.62 ± 1.21	4.45 ± 1.21	<0.001*
p-value	0.65	0.27	0.38	0.17	
PD of initiate pocket depth 5-6 mm.					
Control	5.28 ± 0.18	4.23 ± 0.61	3.91 ± 0.56	3.95 ± 0.58	<0.001*
Test	5.27 ± 0.14	3.97 ± 0.47	3.79 ± 0.49	3.66 ± 0.62	<0.001*
p-value	0.79	0.21	0.51	0.22	
CAL of initiate pocket depth 5-6 mm.					
Control	6.28 ± 0.72	5.22 ± 0.93	4.87 ± 0.98	4.90 ± 0.99	<0.001*
Test	5.94 ± 0.78	4.59 ± 1.02	4.36 ± 0.99	4.20 ± 0.97	<0.001*
p-value	0.22	0.08	0.17	0.06	
PD of initiate pocket depth ≥ 7 mm.					
Control	7.29 ± 0.42	6.23 ± 0.62	5.86 ± 1.18	5.90 ± 0.88	0.008*
Test	7.27 ± 0.44	5.82 ± 0.92	5.29 ± 1.10	5.11 ± 1.11	<0.001*
p-value	0.92	0.27	0.26	0.09	
CAL of initiate pocket depth ≥ 7 mm.					
Control	8.29 ± 0.71	7.25 ± 1.16	6.79 ± 1.47	6.87 ± 1.29	0.013*
Test	8.00 ± 1.05	6.61 ± 1.25	5.98 ± 1.44	5.74 ± 1.43	<0.001*
p-value	0.48	0.24	0.21	0.07	

* Statistically significant difference from baseline within group by One-way repeated ANOVA (p-value<0.05).

** Statistically significant difference between group by Two-way repeated ANOVA (p-value<0.05).

[1]BOP: Bleeding on probing

[2]PD: Probing pocket depth

[3]CAL: Clinical attachment level

Table 4 Clinical outcome measures for pocket depth reduction (ΔPD) and clinical attachment gain (CAL gain).

Clinical Parameter	0-1 month (1)	0-3 month (3)	0-6 month (6)	p-value 1month versus 3 months	p-value 1 month versus 6 months	p-value 3 months versus 6 months
Δ PD[4] of initiate pocket depth ≥ 5 mm.						
Control	1.07 ± 0.54	1.39 ± 0.55	1.36 ± 0.54	0.001*	0.001*	0.87
Test	1.32 ± 0.32	1.58 ± 0.42	1.70 ± 0.54	0.001*	0.001*	0.13
p-value	0.13	0.31	0.09			
Clinical attachment gain of initiate pocket depth ≥ 5 mm.						
Control	1.08 ± 0.45	1.45 ± 0.54	1.41 ± 0.53	p<0.001*	0.001*	0.85
Test	1.37 ± 0.36	1.67 ± 0.42	1.84 ± 0.47	p<0.001*	p<0.001*	0.004*
p-value	0.06	0.22	0.02**			
Δ PD of initiate pocket depth 5-6 mm.						
Control	1.09 ± 0.57	1.41 ± 0.54	1.38 ± 0.56	0.002*	0.003*	0.91
Test	1.29 ± 0.37	1.50 ± 0.43	1.60 ± 0.56	0.012*	0.026*	0.32
p-value	0.28	0.63	0.29			
Clinical attachment gain of initiate pocket depth 5-6 mm.						
Control	1.06 ± 0.46	1.42 ± 0.53	1.37 ± 0.53	0.001*	0.002*	0.85
Test	1.34 ± 0.42	1.58 ± 0.47	1.74 ± 0.52	0.01*	0.003*	0.006*
p-value	0.09	0.39	0.07			
Δ PD of initiate pocket depth ≥ 7 mm.						
Control	1.07 ± 0.67	1.38 ± 1.12	1.36 ± 0.84	0.50	0.12	0.99
Test	1.45 ± 0.70	1.98 ± 0.84	2.16 ± 0.85	0.02*	0.009*	0.14
p-value	0.22	0.17	0.04**			
Clinical attachment gain of initiate pocket depth ≥ 7 mm.						
Control	1.05 ± 0.71	1.50 ± 1.26	1.43 ± 0.97	0.34	0.13	0.93
Test	1.39 ± 0.70	2.02 ± 0.76	2.39 ± 1.04	0.002*	0.002*	0.19
p-value	0.27	0.24	0.04**			

* Statistically significant difference from baseline within group by One-way repeated ANOVA (p-value<0.05).

** Statistically significant difference between group by Two-way repeated ANOVA (p-value<0.05).

[4] ΔPD: pocket depth reduction

Conclusions and Discussion

The diode laser is an excellent soft tissue surgical laser. It was used for cutting and coagulating gingiva and oral tissue at the same time, which makes it suitable for soft tissue curettage or sulcular debridement [9]. Many studies have demonstrated that diode laser had a bactericidal effect which might allows better healing of periodontal tissue, accordingly, making diode laser a good option as an adjunct to non-surgical periodontal treatment [12], [17-19].

The higher reduction in periodontal pocket depth was possibly not related to the bactericidal effect of diode laser, but its effect on reduction of inflammatory substances, and the de-epithelization, and enhancement in the proliferation of soft tissue in the periodontal pocket [20]. Previous studies demonstrated the properties of diode laser with wavelength between 810-980 nm which comprises activation of cell proliferation [21], increase the expression of collagen type I mRNA [22], and reduce MMP-8 (matrix metalloproteinase-8) [23] which facilitates periodontal wound healing and regeneration. Clinical improvement from the use of diode laser also evident [23]. The bactericidal effect of diode laser is nonetheless still the advantage of its role as an adjunct to non-surgical periodontal treatment, through its use as a local disinfectant [24].

Bleeding on probing (BOP) is a clinical parameter for tissue evaluation. It was used as an indicator for disease progression or stability of periodontal tissue [25]. A high BOP prevalence represent a higher risk for further attachment loss at a single sites, especially during a maintenance period of periodontal treatment. This study demonstrated that the use diode laser in conjunction with SRP can significantly reduce BOP higher than SRP alone. This study showed that using the 970 nm diode laser with ultrasonic scaler in periodontal treatment for full mouth SRP in one visit resulted in a significantly higher reduction of BOP on site with PD $\geq$ 5 mm. at 3 and 6 months. The success in decreasing BOP in this study was in consistent with other studies [26-27] which showed that the use of diode laser did improve the result of mechanical instrumentation.

The results also demonstrated the improvement in other clinical parameters, PD and CAL. Although PD and CAL were improved significantly when compared to baseline in both test and control group, our results failed to reveal the differences between groups. However, this finding was in agreement with DeMichelli et al. [13] and Saglum et al. [23] In our present study, the PD and CAL of control group at 6 months were higher compared to the results at 3 months, whereas, the PD and CAL parameters in the test group continued to reduce along the 6 months of the observation period. This result, may be explained by the decrease in inflammatory mediator in periodontal disease of the laser site [28].

However, the significant difference between group in this study was found in terms of pocket reduction and clincal attachment gain (change in PD, CAL compared to baseline) at the site with $\geq$ 7 mm. pocket depth while the difference at a site with 5-6 mm. periodontal pocket depth was not found. In contrast to Dukić et al., [29] who found that, using 980 nm diode laser could significantly improve pocket reduction in 4-6 mm periodontal pocket depth better than SRP alone, but not in deep pocket sites with 7-10 mm periodontal pockets. These results may differ due to the difference in treatment protocol used in each study. Dukić et al., performed diode laser three times (on day 1,3 and 7) after SRP and the fiber tip of

diode laser was inserted at 1 mm. less than the value from clinical measurements, whereas the use of diode laser in this study was performed just once after full mouth SRP was completed in the same visit, and the fiber tip of diode laser was inserted to the bottom of the periodontal pockets.

Diode laser with wavelength between 810-980 nm can penetrate the tissue generally well. The estimated depth of penetration is approximately 0.5-3 mm [30]. These wavelengths are poorly absorbed in water, but highly absorbed in hemoglobin and pigmented tissue [9]. Additional benefit of diode laser is the result of de-epithelization of the periodontal pocket epithelium and antimicrobial effect, leading to an enhanced connective tissue attachment [20]. These properties of diode laser made it a suitable laser for soft tissue curettage, that also provides excellent result in deep periodontal pockets.

The treatment protocol of this study is more simple than many existing studies that investigate the use of diode laser in periodontal treatment. This study uses diode laser after scaling and root planing by ultrasonic scaler only (no curettes) in the same visit, and used diode laser for sulcular debridement at the sites with $\geq$ 5 mm. of periodontal pocket depth only. Hence, this protocol is easier to adapt to the daily clinical practice in periodontal treatment.

In conclusion, the present study demonstrated that the use of 970 nm diode laser as an adjunct to one-visit full mouth SRP by ultrasonic scaler only, produces significant improvement in clinical parameters compared to SRP alone. Even though the results from this study demonstrated that diode laser add a minimal clinical benefit in moderate periodontal pocket depth (5-6 mm.), the use of diode laser as an adjunct to SRP is an effective method in non-surgical periodontal treatment, especially in the deep periodontal pocket site ($\geq$ 7 mm.). This traeatment modality also set-aside the problem of antibiotic resistance. Nevertheless, further investigations are needed to clarify the effect of diode laser, especially in the deep periodontal pocket depth or in patients with severe chronic periodontitis.

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