



## THE EFFECT OF DIODE LASER AS AN ADJUNCT TO PERIODONTAL TREATMENT ON CLINICAL PERIODONTAL PARAMETERS AND HALITOSIS: A RANDOMIZED CONTROLLED CLINICAL TRIAL

*Periodontal Tedaviye Destek Olarak Kullanılan Diyot Lazerin Periodontal Klinik Parametrelere Ve Halitozis Üzerine Etkileri: Randomize Kontrollü Klinik Çalışma*

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### ABSTRACT

**Aim:** The aim of this study is to examine the clinical efficiency of diode laser periodontal pocket irradiation as an adjunct to conventional scaling and root planning (SRP) on periodontal parameters and halitosis.

**Material and Methods:** In our randomized, controlled clinical trial, 40 patients with untreated chronic periodontitis were randomly separated into two group to receive SRP with laser (laser group n=20) or SRP solely (control group n=20). Plaque index (PI), gingival index (GI), probing pocket depth (PD), clinic attachment loss (CAL), bleeding on probing (BOP) and halitosis were recorded at baseline and 1st ,3rd and6th months after treatment by a periodontist.

**Results:** Both treatment methods showed significant reductions in clinical parameters and halitosis levels compared to baseline.

**Conclusion:** The present study indicates that compared to SRP solely, adjunctive applications of a 940-nm diode laser with SRP showed lower bleeding on probing and halitosis levels.

**Key Words:** Periodontitis, Diode Laser, Halitosis.

### ÖZ

**Amaç:** Bu çalışmanın amacı geleneksel diş yüzeyi temizliği ve kök yüzeyi düzleştirmesine (SRP) ek olarak periodontal cep içerisine diyot lazer uygulamasının periodontal parametreler ve ağız kokusu üzerine klinik etkinliğini incelemektir.

**Materyal Metot:** Randomize kontrollü klinik çalışmamızda, tedavi edilmemiş kronik periodontitisli 40 hasta rastgele SRP ve lazer uygulananlar (lazer grubu n = 20) veya sadece SRP uygulananlar (kontrol grubu n = 20) olmak üzere iki gruba ayrıldı. Başlangıçta ve 1. 3. ve 6. aylarda plak indeksi (PI), gingival indeks (GI), cep derinliği (PD), klinik ataşman kaybı (CAL), sondalamada kanama (BOP) ve halitozis kaydedildi.

**Bulgular:** Her iki tedavi metodunda da klinik parametreler ve halitozis seviyeleri başlangıca göre anlamlı derecede azalma gösterdi.

**Sonuç:** Bu çalışma, yalnızca SRP'ye kıyasla SRP'ye ek olarak 940 nm diyot lazer uygulamasında sondalamada kanama ve halitozis seviyelerinin daha düşük olduğunu göstermiştir.

**Anahtar Kelimeler:** Periodontitis, Diyot Lazer, Halitozis

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## INTRODUCTION

Chronic periodontitis is an inflammatory disease which develops against the microbial plaque on tooth surface and ends in loss of periodontal tissues.<sup>1</sup> The prime target in periodontal treatment is the elimination of all factors which cause formation and cumulation of the plaque.<sup>2</sup>

In nonsurgical periodontal treatment, infection is aimed to be controlled by mechanically removing supragingival and subgingival calculus.<sup>3</sup> The success of periodontal treatment depends on totally removing subgingival and supragingival pathogens and enabling oral hygiene by the patient after the treatment.<sup>4,5</sup>

Tooth surface (SRP) is the most important procedure in the treatment of periodontitis and its clinical benefits were proved by many studies.<sup>4, 6, 7</sup> However, microbial component may not be removed totally by mechanical treatment in the presence of deep pockets.<sup>8</sup> Therefore, many methods such as antibiotics, antiseptics and lasers have been used in addition to periodontal treatment.<sup>9-12</sup>

Dental laser usage has been commonly used recently. Different laser types are used for dental purposes such as Er:YAG laser, Er,Cr:YSGG laser, Nd:YAG laser, CO2 laser and diode laser.<sup>13, 14</sup>

Diode laser is a semiconductor laser, which uses combinations of elements such as gallium (Ga), arsenide (Ar), aluminum (Al) and indium (In) for the transformation of electric energy into luminous energy.<sup>15,16</sup> Diode laser, which can be used in soft tissue implementations successfully, do not penetrate into hard tissues.<sup>13</sup> Many studies showed that diode laser has an antibacterial activity when it is used to support periodontal treatment.<sup>17-19</sup>

Moritz *et al.* suggest that diode laser as an adjunct to SRP will decrease bacteria amount and inflammation.<sup>17</sup> They achieved positive results in clinical parameters but irradiation

procedure caused morphological changes on root surface.<sup>17, 19</sup>

The term 'halitosis' means bad breath which can have local or systemic origins.<sup>20, 21</sup> 10 per cent of halitosis cases develop because of extra-oral reasons.<sup>22</sup> Halitosis can be observed in people of different ages and negatively affect social interaction of the person.<sup>23</sup> Findings which belong to epidemiological studies in different countries cannot be compared because there are not standart protocols for treatment and diagnosis of halitosis.<sup>24</sup>

Most of extra oral factors which cause halitosis are generated from respiratory tract or otorhinolaryngologic diseases such as tonsillitis, sinusitis and post-nasal drip. Bad breath can occur rarely because of renal, hepatic, endocrinological or gastrointestinal reasons.<sup>22, 24-27</sup> The cumulated materials can be smelt by the breath within some certain systemic diseases such as acetone smell within diabetic patients or ammonia smell within urea or cirrhotic patients.<sup>28</sup> Periodontal diseases, caries, bacteria plaque on the tongue, insufficient salivation, stomatitis, in-mouth neoplasm, extraction socket which is being treated and smelly food consumption are amongst in-mouth reasons of halitosis.<sup>22, 24, 29</sup>

Volatile sulphur compounds (VSC) are formed as oral microorganisms which exist in saliva, periodontal pockets, tongue and other parts of the mouth proteolysate free amino aside substrates, such as cysteine, sistine and methionine which include sulphur.<sup>30</sup> VSC is mainly composed of hydrogen sulfide, methyl mercaptan and dimethyl sulfide components which are the main reasons of bad breath.<sup>31, 32</sup>

Two methods are implemented in the evaluation of halitosis; the first one is organoleptic method which is subjective. In this method, breath of the patient is graded through smelling by an educated and experienced person. The method can give variable values because it is a sense method

besides it is not a good experience both for the patient and the implementer.<sup>38, 39</sup> The second method is measuring VSC amount by gas chromatography or halimeter which is an objective method.<sup>40</sup> When halitosis is measured by a halimeter, nano VSC amount can be defined.<sup>41-45</sup> VSC amount within the people with periodontal diseases are more than healthy people because of the high rate of bacteria plaque covering the tongue. Therefore, there is a positive relation between the severity of periodontal disease and VSC content.<sup>31</sup>

The main principle in the treatment of halitosis is eliminating oral pathogens and restraining bacterial bio film. Many methods are adopted in order to treat halitosis such as using mouthwash solutions with CHX, hydrogen peroxide and essential oil, tongue scraper or tongue brush. 70 per cent of oral sulfides will be eliminated by tongue cleaning.<sup>46</sup> Chewing gum with mint and mouth sprays is also used in order to cover the smell.<sup>21, 24, 47-51</sup>

Our study aims at evaluating the effectiveness of diode laser usage as an adjunct to SPR both on periodontal parameters and halitosis.

## **MATERIAL AND METHOD**

### *Selection of the Participators and Design of the Study*

This study is a randomized controlled clinical study. 40 adults (20 females, 20 males), who were selected from the patients without periodontal treatment in the last 6 months, who consulted to Akdeniz University Faculty of Dentistry Periodontology clinic between September 2014 and March 2015 for periodontal complaints or controls, were included in the study. All patient provided written permissions. The protocol of the study was approved by Antalya Training Research Hospital Non-pharmaceutical Clinic Researches Ethical Commission (2014 decision no:46/10).

The people who have systemic diseases, require regular medicine, are pregnant, smoke and people with fixed partial denture were not included in the study. The people have minimum 14 teeth and at least 2 teeth that have 5mm pocket in each quadrant. The people were only divided into 2 random groups as the ones who have SRP treatment (control group KG n=20) and who are implemented diode laser as an adjunct to SRP (Laser group LG n=20)

### *Halitosis measurement*

In our study halitosis measurements are done by Halimeter (InterscanCorp., Chatsworth, Ca, USA). People were asked not to consume onion, garlic and spicy food and use mouthwash before the implementation day. People were also asked to breathe through the nose without opening their mouths for a minute then halimeter was placed into the mouth as not to touch the patient's tongue and palate.

### *Clinical Procedure*

Plaque index (PI), gingival index (GI), clinical attachment level (CAL), probing pocket depth (PD), bleeding on probing (BOP) and halitosis measurements were carried out in 6 sections for each tooth after treatment prior to treatment of the patients.

SRP was implemented via hand pieces (Gracey Curettes, Hu-Friedy, Chicago, IL, USA) and ultrasonic equipment (EMS SA CH 1260 Nyon, SWITZERLAND). 940 nm indium-gallium-aluminum-phosphate diode lasers (Epic, Biolase, Irvine, CA, USA) were implemented in the same session under local anesthesia. Total 15 J/cm<sup>2</sup> power of laser in 1.5 W power with 20 ms frequency during 20 ms shots was implemented to periodontal pocket. Laser irradiation was realized with fiber optic ends which are of 300 µm diameter. Fiber is implemented by parallelly locating on root surface level inside the periodontal pocket. Fiber laser is directed from apical to coronal during light emission. It was implemented in total 20 seconds as 10 second

lingual to 10 seconds to each tooth in mezio-distal direction in buccal angle.<sup>12</sup>

The patients were provided with detailed oral hygiene training at the end of the session. The training includes the usage of materials such as dental floss and interdental brush which are used for interdental cleaning and how to clean dorsum and lateral of tongue with brush and tongue cleaner.

Clinical index scores and halitosis levels were measured after 1, 3 and 6 months after the treatment. The patients were not informed about their categories in the groups during the treatment.

Whether they correlate normal distribution or not is decided via Shapiro-Wilks test for statistical assessment of datum. Variance analysis, Tukey multiple comparison tests and independent sample t-test were carried out via an appropriate software for the assessment of datum which are defined to present normal distribution. (SPSS v20.0, IBM, Chicago, IL, USA).

**RESULTS**

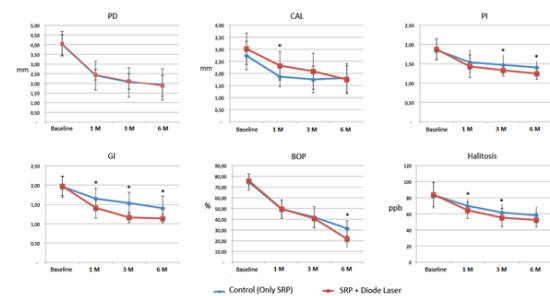
Average and standard deviation values for datum of control group of clinical assessment criteria, the group which was implemented SRP solely and Diode laser group with combined SRP are presented in Table 1.

**Table 1:** Average and standard deviation results of datum of clinical evaluation criteria

	SRP (Control)				SRP + Diode Laser			
	Beginning	1 <sup>st</sup> month	3 <sup>rd</sup> month	6 <sup>th</sup> month	Beginning	1 <sup>st</sup> month	3 <sup>rd</sup> month	6 <sup>th</sup> month
PD (mm)	4,00±0,53	2,40±0,75	2,05±0,76	1,95±0,81	4,05±0,64	2,44±0,27	2,11±0,41	1,88±0,55
CAL (mm)	2,74±0,59	1,87±0,41	1,76±0,55	1,81±0,60	3,03±0,65	2,32±0,59	2,09±0,74	1,75±0,58
PI	1,86±0,28	1,54±0,33	1,47±0,26	1,41±0,16	1,88±0,27	1,44±0,29	1,33±0,15	1,25±0,15
GI	1,96±0,28	1,65±0,27	1,54±0,28	1,41±0,31	1,98±0,25	1,42±0,27	1,17±0,13	1,14±0,11
BOP (%)	74,8±7,59	49,4±8,56	42,1±9,73	31,5±7,23	75,9±6,79	49,6±8,93	40,1±9,80	21,7±8,16
Halitosis	83,4±17,2	70,1±8,56	61,8±10,2	58,2±10,8	83,9±14,9	64,5±10,1	55,4±11,4	52,4±8,69

It was found out that both groups decreased pocket depth in time in the pocket depth (PD) measurement in clinical probing. However, in the statistical assessments a significant difference was not found between groups (p>0.05). There was a decrease in both

groups in the comparison of clinical attachment levels in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months. The difference between groups was found statistically significant especially in the 1<sup>st</sup> month's measurement. It was shown in plaque index scores that both methods are effective related to time and plaque index values were decreased via the measurements in the beginning. It was found that the difference between SRP solely and diode laser combined with diode laser implementation were statistically significant in plaque index data in 3<sup>rd</sup> and 6<sup>th</sup> month periods. Both treatment methods were found effective in gingival index scores and statistically significant difference was found in the date which were held in the measurements in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months periods (p<0.05). As a result of data held with bleeding on probing, it was found that significant decrease was held especially at the end of 6<sup>th</sup> month and the difference between groups in the data of these periods were significant. In halitosis measurements, it was discovered that both treatment methods decreased bad smell and there is a significant difference between treatment methods in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> month's periods.



**Figure 1:** Datum of clinical evaluation criteria and statistical differences between groups. (\*:p<0.05)

**DISCUSSION**

There is much evidence on the benefits of non-surgical treatment in the treatment of periodontal diseases.<sup>53 54</sup> It is argued that laser can be used as a support for non-surgical periodontal treatment.<sup>55</sup> However, on the contrary, some authors decided that diode laser implementation combined with SRP has no

supremacy over SRP implementation solely in terms of microbial parameters and gingival inflammation.<sup>56, 57</sup> In our study, it was presented that both treatment procedures caused significant recovery in clinical parameters.

Dukic and colleagues expressed that statistically significant recovery was held in clinical parameters in the group which they implemented SRP solely and the group implemented with diode laser combined with SRP in 6th and 18th weeks in a study, which was carried out on people with chronic periodontitis.<sup>2</sup>

Aykol and colleagues achieved progress in periodontal pocket depth and bleeding on probing per cent in the group they implemented gallium-aluminum-arsenide after periodontal treatment in 1st, 2nd and 7th day through a similar study which they carried out with chronic periodontitis patients.<sup>58</sup>

Kreisler and colleagues implemented diode laser of 810 nm wave length to 2 random quadrants of the patients after they treated 22 patients with chronic periodontitis via routine SRP during their study. They presented that more statistically significant decrease was held in teeth mobility, pocket depth and clinical attachment loss in the tooth which were implemented laser when compared to control group.<sup>59</sup>

In our study CAL, BOP and PI datum were compared and decrease was found in both groups in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months. However, a statistically significant recovery was achieved in LG when compared to CG in the 1<sup>st</sup> month's measurements. A statistically significant decrease was held in BOP measurements in LG when compared to CG in 6<sup>th</sup> month.

Whilst probing pocket depth decreased in time in both groups in PD measurements a statistically significant difference cannot be found between groups.

Qadri and colleagues had better results in periodontal pocket depth, plaque index and

gingival index in the areas where they implemented laser when they carried out a similar study design.<sup>60</sup>

Ustun and colleagues implemented diode laser of 810 nm wave length to 2 random quadrants of the patients after they treated 21 patients with chronic periodontitis via routine SRP during their study. CAL, BOP and PI datum were compared and decrease was found in both groups in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months. More decrease was achieved in LG when compared to CG in terms of PD levels in 1st, 3rd and 6th months. Better results were found in LG when compared to CG in terms of CAL and GI levels in 3<sup>rd</sup> and 6<sup>th</sup> months. They could not have found a statistically significant difference between two groups in terms of PI.<sup>61</sup>

PI and GI datum were compared and a decrease in both groups were found in our study. However, in all of 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months' measurements in GI levels of LG had a statistically significantly decrease when compared to CG. Whilst decrease was observed in both groups within PI measurements, a statistically significant decrease was achieved in LG when compared to CG in 3<sup>rd</sup> and 6<sup>th</sup> months.

Many authors reported that periodontal disease is a significant reason of halitosis.<sup>62-65</sup> Periodontal pathogens generate endotoxine, proteinase and VSC. Persson and colleagues stated that *Bacteroides melaninogenicus*, *Treponema denticola*, *Porphyromonas gingivalis* and *Prevotella intermedia* types produce VSC.<sup>66</sup> VSC molecules, which are produced by gram negative bacteria on tongue and periodontal pocket, cause smell formation.<sup>67</sup>

A number of studies showed the positive relation between progression of periodontal disease and VSC amount.<sup>35, 36</sup> Morita and Wang<sup>68</sup> found a significant relation between the severity of periodontal disease and VSC amount in breath. They discovered that VSC value was measured lower within people who

are provided with periodontal treatment than the ones who are not treated. They also asserted that there is a correlation between VSC level and bleeding on probing and periodontal pocket depth. Coil and Tonzetich<sup>69</sup> also found higher VSC levels in the people with deep pockets which bleed during probing than the people with shallow pockets with low bleeding rate during probing.

A similar relation between periodontitis and halitosis was also determined in our study. VSC level in 1<sup>st</sup>, 3<sup>rd</sup> and 6<sup>th</sup> months were found to be lower than the first measured level in both groups which have periodontal treatment. Dissimilarly, VSC level which is measured in LG is found to be statistically significantly lower than CG in the 1<sup>st</sup> and 3<sup>rd</sup> months.

In the light of this information, we can state that laser treatment which is implemented as an adjunct to SRP has a statistically significant positive effect on clinical parameters and halitosis. In addition to that there is a need for new studies to discover in which mechanisms does laser effect these parameters.

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