https://doi.org/10.26682/sjuod.2023.26.2.19
Journal of University of Duhok., Vol. 26, No.2 (Pure and Engineering Sciences),Pp 228-235, 2023

CLINICAL EFFECT OF DIODE LASER THERAPY AND CHLORHEXIDINE GEL 0.2% AS ADJUNCTS TO NON-SURGICAL PERIODONTAL THERAPY IN CASES OF CHRONIC PERIODONTITIS

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(Received: July 2, 2023; Accepted for Publication: September 11, 2023)

1. ABSTRACT

Objectives: The aim of the current study is to compare the efficacy of a diode laser (940 nm) and chlorhexidine -gel 0.2% with that of conventional non-surgical mechanical treatment.

Materials and methods: A group of patients with chronic periodontal disease are the subject of the current split-mouth -clinical trial Periodontal pocket- depth (PPD) of than 5 mm and more were used to categorize 180 tooth surfaces with moderate to severe periodontal disease into three categories. The entire mouth underwent periodontal treatment, which included scrubbing and root surface debridement. Using a split mouth design, (scaling and) root surface debridement alone were applied randomly to each quadrant while SRP with diode laser (Biolase) and SRP with 0.2% chlorhexidine- gel (perio Kin gel) were the test- groups.

Results: As Compared to baseline, both of the study's treatment modalities resulted in statistically -significant improvements in the assessed clinical parameters at one and three months. After three months there was statistically significant difference in PD, CAL, and BOP between/ the diode laser and the control- groups as well as between the diode laser group and the chlorhexidine- gel group.

Conclusions: After 1 month of evaluation, the high intensity diode laser and chlorhexidine gel have not shown any additional benefits to the conventional periodontal treatment. Clinical relevance of diode laser therapy in conjunction with conventional scaling and root surface debridement seem to be superior in reducing probing depth, Clinical attachment level and bleeding on probing than SRP alone or SRP with Chlorhexidine gel 3 months after treatment.

KEYWORDS: Chronic Periodontitis. Diode laser. Chlorhexidine gel

2. INTRODUCTION

Chronic periodontitis is a multifactorial inflammatory disease. It is predominantly caused by pathogenic bacteria in the dental plaque biofilm that causes gingival inflammation, tooth mobility, and edentulism if left untreated (Mopur *et al*, 2013). The purpose of periodontal therapy is to remove bacterial plaque and other conditions that encourage its buildup (Greenstein, 2006). The "gold standard" treatment for periodontal-disease is still scaling and root surface debridement, to which all other therapies are measured. By removing supra- and subgingival plaque and calculus. Scaling and root surface -debridement restores the tissues to a healthy state (Sidharth *et al*, 2020). The idea that dental cementum is penetrated and infected by bacterial plaque (dental biofilm) has historically served as the foundation for non-surgical periodontal treatment. Scaling and root surface debridement were thought to be necessary for removing this diseased cementum and then restoring periodontal health (Ciantar, 2014). Non-surgical therapy with a diode laser does not replace traditional treatment, but it can be included and help make therapy more effective (Caruso *et al*, 2008). In the field of non-surgical periodontology , laser technology is still in its infancy. Its wavelength ranges from (800 to 980) nanometers. used in accordance with standards established by worldwide scientific literature, Blood components and tissue pigments specifically absorb the neon infrared (800–1100 nm) photonic energy from Diode lasers in sites of inflammation . This laser is used for early periodontal therapy to destroy

germs and remove inflamed soft tissue from the periodontal pocket, which is often less aggressive than surgery (Mathew *et al*, 2018), It deactivates bacterial toxins and has a bactericidal and detoxifying action on the root surface (Loredana et al, 2020). International scientific literature procedures , state that laser therapy has a bactericidal and detoxifying impact on the root surface because it renders bacterial toxins inactive, induces hemostasis and prevents the formation of smear layers (Chambrone *et al*, 2018).

For the local treatment of periodontitis, chlorhexidine (CHX) is still one of the most potent local antibacterial agents (Lecic et al, 2016). Chlorhexidine is a safe, non-toxic antiseptic with a wide range of antibacterial action (Pietruska *et al*, 2006). Chlorhexidine is ineffective for treating periodontitis when gingival washing is used because it cannot be kept at an effective concentration in a periodontal pocket for long time enough. Devices were created to gradually deliver chlorhexidine inside the periodontal pocket to solve this issue (Hugar *et al*, 2016).

However, the high clearance of CHX from the periodontal pocket leads to sub-therapeutic CHX concentrations in the local environment after only a short time of sub-gingival CHX application, which results in an insufficient treatment effectiveness (Verma *et al*, 2012). In order to overcome this constraint, CHX Gel with a CHX concentration up to 15 times higher than liquid carriers was created. The effectiveness of adjunctive CHX to nonsurgical periodontal therapy (NSPT) has been shown in various research in recent years. Gingival crevicular fluid (GCF) flows 40 times more frequently at the location of periodontal disease than it does in a healthy tissue (Greenstein, 2006). The GCF provides a leaching medium for the release of a drug from the dosage form and for its distribution throughout the pocket. These features, together with the fact that the periodontal diseases are localized to the immediate environment of the pocket, make the periodontal pocket a natural site for treatment with local delivery systems (Tariq *et al*, 2012).

MATERIALS AND METHODS

The present study was conducted in Duhok city, Periodontics Department /College of Dentistry/ University of Duhok. The patients were attending the Department of Periodontics The patients were attending the. The study was performed by a single dentist and data were also collected by the same dentist. The study population consisted of 180 of teeth surfaces. The patients were selected according to

inclusion criteria:

1. Patients between 20-50 years.
2. Patients with chronic periodontitis with pocket depth of 5 mm and more.
3. Medically healthy patients.

The exclusion criteria:

1. Smokers
2. Pregnant women.

All the participants of the procedures were informed, duration, and outlines purpose, of the study, and they signed a written informed consent form before the study which has been approved by the Research ethics General Directorate of Health committee of Duhok. Each patient was educated about the causes of periodontal diseases, and oral hygiene instructions were given, Brushing technique and the use of appropriate interdental cleaning aids were explained . Acrylic stent was prepared for each patient to permit and guide the entry of periodontal probe into probing locations (Singh & Vandana, 2019). The stent was used at the baseline for the examination of the clinical periodontal parameters (PPD and CAL) and after one and three months for reevaluation of these parameters.

Experimental design:

The study population of 180 tooth surfaces were divided randomly into three groups, group one (Control group) 60 teeth surfaces received only mechanical therapy of scaling and root surface debridement that is made possible by two fundamental procedures

- Scaling, which consisted in removing mucobacterial plaque and calculus from supra and subgingival root surfaces, generally through the use of an ultrasonic scaler. Followed by polishing the crown of all teeth with polishing brush and paste.
- Root surface debridement, which consisted in removal of deposits of subgingival calculus,

granulation tissue and softened, infected or necrotic cementum, typically through the use of manual instrument such as the universal curettes With the use of normal saline as irrigation material for removal of debris throughout the procedure.

The process has been achieved under Local Anesthesia 2% Lidocaine HCL with 1:100,000 (0.01mg/ml) Epinephrine. Full mouth scaling and root surface debridement was performed for each patient after that clinical periodontal parameters were measured. Then the patients were called for follow up visits after on and three months.

Group two (test group) 60 teeth surfaces underwent mechanical therapy of scaling and root surface debridement with 940- nm wavelength (Epic-X) soft tissue diode laser application (Biolase) technique through the following dosimetric values:

- Peak- power: 1.6 W
- average -power: 0.8 W
- pulse-frequency: 50/60 Hz
- Emission- mode of laser light: continuous - pulsating (CP2)
- Pulse- duration (time-on): 1.0 ms
- Pulse- interval (time- off): 1.0 ms
- Duty-cycle (time-on/time-off): 50%
- Fiber tip - diameter: 300-400 μm

Prior to start treatment, make sure everyone in the room has put on safety glasses. Follow joining all the components (pedal and optical fiber), It is crucial to utilize an initiating block to turn on the tip, and to ensure that the light guide's point designs a complete circle and does not have a star-like look; the activated tip shows a black-end and, at this point, the laser is ready for the use. The tips contain a core of metal that enables them to be inclined to meet the operator's demands. The tip was placed into the pocket and moved in a sweep motion, apically to coronally along to the tooth's longitudinal axis, and by tactile sensation; It was confirmed that the inside sulcus for 30 seconds will receive irradiation. Laser- irradiation of test groups was conducted in three sessions, at the first session following SRP, and the second was after 48 hours and the third at day 7.

Group three (test group) 60 teeth surfaces received mechanical therapy of scaling and root surface debridement with sub-gingival application of Chlorhexidine-gel 0.2% (perio kin) was carried out using a 1ml insulin syringe. A stopper made of rubber was used to mark the needle's length, which was measured using an endodontic ruler to determine the precise length of the pocket depth. The method of injection was Walking and Fill Over, by inserting the gel into the depth of the periodontal pocket with the insulin syringe and inserting the gel from the bottom of the pocket upwards to allow the depth of the pocket to be filled with gel. For an hour, the patients received instructions not to eat or brush their teeth.

Clinical measurements: For all research participants, all clinical periodontal parameters were evaluated at baseline, one month and three months following therapy. Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment loss (CAL) are clinical periodontal parameters measured by through the use of UNC-15 probe and acrylic stent.

STATISTICAL ANALYSIS

The level of clinical parameters was presented in mean and sta. deviation. The three groups (control, diode laser and chlorhexidine) were compared statistically with each other in regard to the four clinical parameters (PD, CAL, BOP and PI). This comparison was done by statistical ANOVA test with post hoc Tukey HSD test. Relationships with a p value (p) $\leq$ 0.05 were considered as statistically significant. The mean value of the clinical parameters was recorded in three different times, baseline, after one month and after three months.

4.RESULTS

Comparisons between control and the test groups at baseline, one month and three months of treatment.

Pocket Depth (PD) parameter shows that the difference in the mean and standard deviation among the three groups was statistically not significant in the baseline and one-month readings. However, at three months the difference was significant with a p-value of <0.001. The post hoc test showed that the difference in 3 month was significant between the control and diode laser groups and also between diode laser and chlorhexidine groups but not between control and chlorhexidine groups as shown in table (1).

Table(1):- the difference in the mean score of PD at different times among the three groups

Pocket Depth PD	A Control group Mean (SD)	B Diode laser group Mean (SD)	C Chlorhexidine gel group Mean (SD)	p-value	Post hoc results	
					Compared groups	p-value
Baseline	5.63 (0.879)	5.81 (0.930)	5.70 (0.774)	**0.545 (NS)**		
One month	5.34 (0.704)	5.23 (1.078)	5.26 (0.684)	**0.765 (NS)**		
Three months	5.03 (0.772)	4.0 (0.985)	4.94 (0.745)	**< 0.001**	**A with B**	**< 0.001**
					A with C	**0.840 (NS)**
					B with C	**< 0.001**

Regarding CAL parameter, at the baseline a slight significant difference was only seen between the control group mean (4.5) and diode laser group (5.21). The difference was statistically not significant at one month but was highly significant at 3 months reading with a p-value of 0.003. The post hoc test showed that the difference in 3 month was significant between the control and diode laser groups and also between diode laser and chlorhexidine groups but not between control and chlorhexidine groups. These analyses are shown in table (2).

Table (2):- the difference in the mean score of CAL at different times among the three groups

Clinical attachment loss CAL	A Control group Mean (SD)	B Diode laser group Mean (SD)	C Chlorhexidine gel group Mean (SD)	p-value	Post hoc results	
					Compared groups	p-value
Baseline	4.50 (1.714)	5.21 (1.411)	4.75 (1.693)	**0.043**	**A with B**	**0.033**
					A with C	**0.639 (NS)**
					B with C	**0.294 (NS)**
One month	4.21 (1.628)	4.63 (1.519)	4.60 (1.510)	**0.213 (NS)**		
Three months	4.09 (1.561)	3.42 (1.130)	4.32 (1.441)	**0.003**	**A with B**	**0.023**
					A with C	**0.620 (NS)**
					B with C	**0.003**

Bleeding on probing was the third parameter to compare among the three groups. In table (3) we can see that no significant difference was seen among the groups at baseline and one month reading. After 3 months the difference shown to be highly significant with a p-value of 0.005. However, the post hoc test explained that this significant difference at 3 months was only between diode laser group mean score (1.36) and chlorhexidine group meant score (1.89). This means that the control group mean score (1.64) was statistically not different significantly with the other two groups.

Table(3): -the difference in the mean score of BOP at different times among the three groups

Bleeding on probing BOP	A Control group Mean (SD)	B Diode laser group Mean (SD)	C Chlorhexidine gel group Mean (SD)	p-value	Post hoc results Compared groups	p-value
Baseline	2.23 (0.523)	2.21 (0.629)	2.39 (0.423)	**0.434 (NS)**		
One month	1.91 (0.520)	1.80 (0.569)	1.94 (0.607)	**0.701 (NS)**		
Three months	1.64 (0.477)	1.36 (0.516)	1.89 (0.557)	**0.005**	**A with B**	**0.11 (NS)**
					A with C	**0.152 (NS)**
					B with C	**0.003**

Finally, regarding the PI parameter, a significant difference was seen at baseline and by post hoc it was shown that the significance was between the mean score of the diode laser group (1.32) with that of the chlorhexidine group (1.79) but not with the control group. At one-month readings the differences were not significant statistically. After 3 months the difference was significant and the post hoc test explained that the difference was significant again between diode laser and chlorhexidine groups and not with the control group. The differences among the three groups regarding PI are shown in table (4).

Table (4):- the difference in the mean score of PI at different times among the three groups

Plaque index PI	A Control group Mean (SD)	B Diode laser group Mean (SD)	C Chlorhexidine gel group Mean (SD)	p-value	Post hoc results Compared groups	p-value
Baseline	1.51 (0.514)	1.32 (0.424)	1.79 (0.564)	**0.017**	**A with B**	**0.356 (NS)**
					A with C	**0.133 (NS)**
					B with C	**0.013**
One month	1.36 (0.406)	1.20 (0.359)	1.41 (0.408)	**0.210 (NS)**		
Three months	1.25 (0.363)	1.05 (0.197)	1.34 (0.337)	**0.022**	**A with B**	**0.084 (NS)**
					A with C	**0.594 (NS)**
					B with C	**0.02**

5.DISCUSSION

The treatment of periodontitis with scaling and root surface debridement has a substantial clinical efficacy; however, it does not always eradicate the pathogenic bacteria species due to their location within the periodontal tissue or other areas inaccessible by periodontal instruments (Samulac et al, 2021). Anti-infective strategies that try to get rid of or reduce pathogenic micro organisms in dental plaque located on tooth surfaces and in various crevices throughout the oral cavity are essential for effective periodontal therapy. Recently, attention has been drawn to laser-assisted periodontal treatment as a prospective complement or alternative to traditional manual debridement (Shetty et al, 2020).

The current findings demonstrate that non-surgical periodontal therapy employing hand instruments, a sonic- device, and a diode laser yields in, significant improvements in clinical parameters (BOP, 0 PD, and CAL) at 1 and 3 months following treatment. In contrast to 980 nm diode lasers, a 940-nm diode - laser was used in

this study due to its durable absorption- in pigments and hemoglobin and its low absorption in water. (Katsikani et al, 2019).

Our findings are consistent with a number of studies by Roncati et al. from that of 2017, which had found that the use of diode lasers diminished PD and resulted in negative BOP scores surrounding implants. Bansal et al 2019 also had found that that the the use of laser might assures an anti-inflammatory and anti-microbial outcome that will lead to reduction in bacterial counts and enhance healing also reducing the need for periodontal surgical-interventions.

Another crucial feature of laser irradiation is the alteration in energy measured at the fiber optics' tip, which needs to be taken into account with the use of a power meter (Euzebio et al, 2013).

The epithelial surface is relieved, and the periodontal pocket is disinfected, as the major purposes of laser therapy. Diode laser therapy was found to be effective in eradicating A.actinomycetemcomitans from the periodontal pocket, based on studies and this could be because the lipopolysaccharide and proteases, which are essential to the bacteria's pathogenicity, were eliminated (Gupta et al, 2016).

The efficacy of utilizing and the diode laser as an a supplement to scaling and root surface debridement was questioned in a comprehensive review and meta-analysis based on 9 studies. For changes in PPD and CAL, the adjunctive use of diode laser is deemed to be moderate. Better outcomes were observed in the laser group in terms of bleeding ratings, but the clinical importance of this difference is still debatable. (Slot et al 2014).

In fact, combining the laser therapy and with that of traditional methods results in a more efficient cleansing of the pocket and a slower rate of recolonization than areas merely treated mechanically. this phenomenon may be in the attributed to clot formation in the pocket, that would act as a seal to it (Crispino et al, 2015). According to that of Kreisler (2005), the killing of bacteria in periodontal pockets is not primarily responsible for the biggest decrease in the degree of tooth mobility and probing depth in the group of patients who underwent SRP + laser; therapy but rather to the whole elimination of the diseased sulcular epithelium, which promotes a stronger adhesion of the connective tissue. which promotes a stronger adhesion of the connective tissue Additionally, the elimination of diseased granulation tissue facilitates the healing of connective tissue with a decreasing in probing depth, gingival index, and tooth movement (Giannelli et al, 2012).

Antimicrobial drugs delivered locally have been looked into as a crucial solution to the weaknesses of the traditional SRP treatment. Recently, the use of continual statement formulations to deliver antimicrobial agents to the of infection area in periodontal pockets has become effective therapy (Pragati et al, 2009). Long recognized as a potent anti-inflammatory, antibacterial, and an antiseptic agent, chlorhexidine has also shown numerous additional advantageous qualities (Hugar et al, 2016).

The high concentration of chlorhexidine gel prevents it from being washed out of the pocket, and if it is washed, it will not increase the antibacterial properties. The GCF, which is 20 µl per hour, justifies the 1minute half-life of the chlorhexidine gel in the periodontal pocket. In addition, the lack of adhesion of chlorhexidine to the levels of the root and its high prevalence of blood and serum proteins can justify its lower durability by gingival sulcus (Birang et al, 2011).

Therefore, methods for preserving further effect of chlorhexidine gel in the area under the gingiva are suggested (Kranti et al, 2010). As reported by Gautam et al in 2021the addition of xanthan to chlorhexidine is increasing the adhesion property, and the cationic load of chlorhexidine combines with the anionic charge of xanthan to increase the gel structure and stability.

6. CONCLUSION

After 1 month of evaluation, the high intensity diode laser and chlorhexidine gel have not shown any additional benefits to the conventional periodontal treatment. Clinical relevance of diode laser therapy in conjunction with conventional scaling and root surface debridement seem to be superior in reducing probing depth, Clinical attachment level and bleeding on probing than SRP alone or SRP with Chlorhexidine gel 3 months after treatment.

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