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Research Article

The Efficacy of Diode Laser (810-980 nm) as an Adjunct to Non-Surgical Treatment of Periodontitis on Porphyromonas gingivalis: A Randomized Split-Mouth Study

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Abstract: Periodontitis is a chronic, complex inflammatory condition linked to dysbiotic plaque biofilms and marked by the progressive deterioration of the tooth-supporting structures. Porphyromonas gingivalis, a critical periodontal infection, is known to significantly contribute to the onset and advancement of periodontal illnesses by inducing a dysbiotic alteration in the overall, particularly sub-gingival, gram-positive and gram-negative periodontal microbiota. Conventional therapies, including scaling and root planing (SRP), seek to eliminate plaque and tartar from the surfaces of teeth and subgingival areas. Nonetheless, these treatments are accompanied by certain limitations.The advent of diode lasers has demonstrated potential as an adjuvant therapy, possibly improving the results of traditional treatments.
Aim of the study: This study aimed to compare the effectiveness of the diode laser as an adjunctive treatment modality for nonsurgical treatment versus SRP only on the colony-forming unit (CFU) of the Porphyromonas gingivalis in patients with periodontitis.
Material and methods: This research was structured as a singular, randomized controlled, split-mouth clinical experiment. Twenty-five persons (11 females and 14 men aged 20 to 56 years) diagnosed with periodontitis, participated in this research. Following primary periodontal treatment, which included dental hygiene guidelines and scaling procedures, each patient underwent two separate treatments on opposing sides of the mouth. The left side was designated as the test group, while the right side was allocated to the control group. Randomization was accomplished by a coin toss to guarantee impartial allocation.In the test group(left side) patients underwent scaling and root planing (SRP) in conjunction with diode laser therapy; in the opposing control group (right side) they received scaling and root planing (SRP) treatment exclusively. The laser was set at a 1.5 W, continuous wave, 400 µm tip, contact, and sweeping technique. 50 Subgingival plaque samples were taken after recording periodontal parameters, plaque index(PI), bleeding on probing(BOP), periodontal pocket depth(PPD), and clinical attachment loss (CAL) at baseline before, immediately after 3 days, 1 week, and 12 weeks post-treatment. Microbiological assessments focused on the colony-forming unit of Porphyromonas gingivalis (P.G). Colony-forming units (CFU) were enumerated for each group for 48-72 hours on a suitable culture medium following serial dilution. Clinically isolated bacteria were confirmed by using the biochemical test, microscopic examination,viteck II system, and finally by PCR technique (16S rRNA).
Result: Colony-forming units (CFU) reduced with both forms of treatment and did not return to the initial concentrations three months after therapy. The SRP plus the diode laser group exhibited significantly higher reductions in bacterial levels of P. gingivalis at 3 days, 1 week, and 3 months after treatment in comparison to SRP treatments alone.

Conclusion: A notable disparity in the colony-forming units of p,g was detected between the control and test groups. The dual wavelength diode laser can be utilized as an adjunct to non-surgical treatment for those with periodontitis

Keywords: periodontitis, diode laser, SRP, Colony forming unit, Porphyromonas gingivalis.

1. Introduction

Microbial plaques have been established as the principal etiological factor of inflammatory periodontal disease[1-3]. The subgingival oral biofilm contains various periodontopathogenic bacteria, including Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, Treponema denticola, and Prevotella intermedia [4]. P. gingivalis, an anaerobic Gram-negative member of the Cytophaga-Bacteroidetes family, belongs to a “red complex” of species associated with chronic periodontal infections [5, 6] . These bacteria secrete toxins that compromise the integrity of periodontal soft and hard tissues and promote the production of deleterious inflammatory cytokines that contribute to the prognosis of periodontal illnesses [7].The primary objective of periodontal therapy has been to eradicate all bacterial deposits from the tooth surface[1, 8] Mechanical debridement refers to a professional scaling and root planing (SRP) procedure. that is designed to remove supra and subgingival biofilms and calculus from colonized root surfaces in order to halt and regulate inflammatory processes[9-13]. SRP is unable to eradicate pathogenic bacteria in inaccessible periodontal areas, including deep periodontal pockets, root concavities, and furcation involvement.[14-16] Therefore, it was found that local and systemic antibiotics were essential for the removal of pathogenic microorganisms from tissues[17].
On the other hand, the development of bacterial resistance and adverse effects may result from antimicrobial treatment[1, 18]. Researchers suggested the utilization of lasers in periodontal therapy as a solution to these inconveniences.[19] In periodontal therapy, lasers are beneficial for control of bacteremia, reduction of bacteria, and improvement of periodontal healing in both humans and animals without harming the neighbouring bone and pulp tissues [20]. Lasers were introduced to periodontics as a monotherapy alternative to traditional nonsurgical periodontal therapy, or as an adjunct to traditional scaling and root planing [14, 15]. A pilot study demonstrated that diode laser with an (805)nm wavelength achieved superior bacterial elimination in periodontal pockets compared to scaling and root planing (SRP) alone [21]. Moritz et al. showed that diode laser, when used alongside SRP, enhanced the repair of periodontal pockets through its bactericidal properties. Reports indicate that DL + SRP resulted in a substantial decrease in total bacterial load, specifically P. gingivalis and T. denticola, at six months post-treatment compared to SRP alone[22]. diode laser incorporates a solid-state semiconductor composed of aluminum, gallium, arsenide, and occasionally indium, enabling it to generate laser wavelengths spanning from 810 nm to 980 nm .With its antibacterial characteristics[23], the diode laser system possesses photothermal properties that facilitate the simultaneous removal of granulation tissue and inflamed periodontal tissue (sulcular debridement). This process involves coagulation at a temperature of 60°C, leading to protein denaturation and a decrease in proinflammatory cytokines [24-26]

The aim of this study was to to compare the effectiveness of the diode laser as an adjunctive treatment modality for nonsurgical treatment versus SRP alone on bacterial count of the pathogen Porphyromonas gingivalis in patient with periodontitis.

2. Materials and methods

This study comprised 25 adult patients with periodontitis, aged between 20 and 56 years, who attended the Specialist Centre of Dentistry's periodontology division and dental clinics in Al-Muthanna, Iraq, from January 2024 to September 2024. Approval for this work was secured by the Ethical and Scientific Committee of Baghdad University,Institute of Laser for Postgraduate Studies (approval number464 in 10-10-2023). Written informed consent was obtained from all of the participants.
The inclusion criteria included Patients of both sexes who were systemically healthy, with Periodontitis (interdental clinical attachment loss [CAL] of ≥2 nonadjacent teeth, or buccal or oral CAL of ≥3 mm with

pocketing of ≥4 mm observable at ≥2 nonadjacent teeth) [27, 28] . The additional eligibility criteria included patients who had not received any antibiotic therapy within the previous three months , , each Patients should possess a minimum of one pocket from the same tooth on every side, and these teeth should exhibit a periodontal clinical attachment loss and pocket depth ≥**5**mm.
The exclusion criteria encompassed pregnant or lactating patients and persons with chronic diseases, immunocompromised patients, and those who used antimicrobial mouthwash or had a history of smoking.

3. Calculation of Sample size

With a pooled standard deviation of 1.2 units, the study requires a sample size of 22 per group (yielding a total of 44, assuming equal group sizes) to achieve a power of 80% and a significance level of 5% (two-sided) for detecting a true mean difference of -1.027 (i.e., 1.2 - 2.227) BC between the test and control groups based on (Nammour et al., 2021) study [9]. The sample size was increased to 25 for each group to account for the loss of follow-up.

4. Clinical examinations and plaque sampling

Periodontitis Patients received clinical diagnoses, underwent comprehensive oral examinations, and periodontal samples were obtained. Microbial samples were obtained randomly from pockets in the periodontal tissue of both the control and test groups. The two deepest interproximal periodontal sites with probing depths (PD ≥ 5mm) were selected from the same tooth on each side for subgingival plaque sampling. Subsequently, samples were aggregated for either the group treated just with SRP or the group treated with both SRP and a diode laser. Designated sites were sampled at pretreatment, 3 days post-treatment, 1 week post-treatment, and 3 months post-treatment. The sampling area was isolated using cotton rolls, meticulously scaled supragingivally with a sterile scaler, and cleansed with sterile cotton pellets to avert contamination of the samples by saliva or supragingival plaque [29]. then, the samples were taken with fine sterile Gracey curette[30]. The curette was introduced as deeply as feasible into the pocket without exerting pressure on the tooth surface to prevent the displacement of subgingival plaque into the depths of the pocket. Upon encountering tissue resistance in the apical region of the pocket, subgingival sampling was executed with a singular vertical stroke [31] Figure 1. The bacterial sample was suspended in 1 ml of P. gingivalis broth media within a 5 ml screw-capped bottle by vigorously agitating the instrument's tip in the solution. It was then incubated for 24 hours until growth was indicated by turbidity in the broth. Subsequently, it was taken to a lab for the cultivation of bacteria and molecular analysis. The microbiological study included the identification of Porphyromonas gingivalis (Pg).

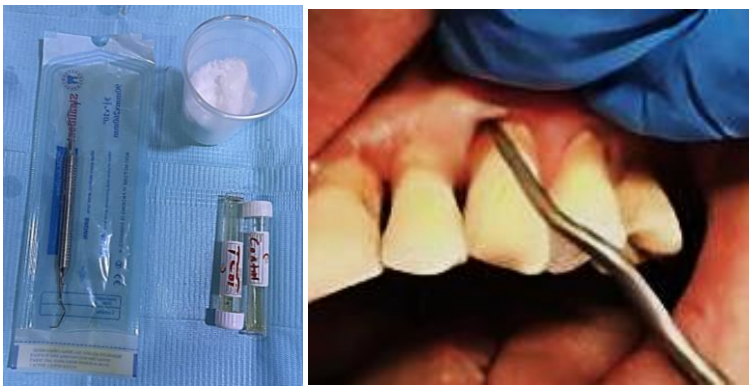

Figure.1: Curette sampling

5. Treatment protocol

Initial appointment (0 days): Comprehensive medical and dental histories were obtained from each participant, and panoramic Radiographs were performed on all participants after their study enrollment. Clinical periodontal measures, including full mouth plaque index (PI)[32], bleeding on probing (BOP)[33], probing pocket depth (PPD)[34], and clinical attachment level (CAL)[34], were assessed utilizing a Willium periodontal probe. Supragingival scaling was conducted by the same examiner for all patients using ultrasonic equipment (Woodpecker UDS-K, India). All patients received dental hygiene and motivational teaching, reiterated at each appointment.

Baseline appointment (seven days post-initial appointment): assessment of clinical periodontal parameters (Plaque Index, Bleeding on Probing, Pocket Probing Depth, and Clinical Attachment Level), After evaluating periodontal parameters, collection of plaque sample were done.

Afterward, each participant was assigned to one of two treatments: the test group(left side) underwent SRP combined with diode laser therapy. The contralateral control group (right side) received only SRP therapy .Both groups underwent the identical scaling and root planing (SRP) operation for the periodontal pockets as a component of the conventional treatment protocol. Local anesthetic was utilized to provide treatment to all patients. In the designated side for diode laser plus SRP, diode laser treatment was conducted in a single session following instrumentation with an ultrasonic scaler and gracy curette, utilizing a continuous contact-focused mode (810-980 nm) diode laser (Quicklase, Dentalase, U.K.) operating at 1.5W power and employing a 400-µm flexible glass fiber optic. The insertion of the laser fiber optics required a decrease of 1 mm from the documented pocket depths. The 1 mm reduction improved the penetration of the laser's energy at its apex and the irradiation of damaged tissue in the periodontal pocket.

Nevertheless, it did not cause heat injury to healthy tissues[35]. The laser started working after the fibre reached the calibrated depth and the tip was engaged. The fibre was then placed in gentle contact aligned with the root's area to excise the infected soft tissue lining the compartment. The instrument was thereafter advanced in an apico-coronal direction with a sweeping motion at a constant velocity of 2.5 mm/sec, commencing at the base of the pocket and progressing upward while ensuring contact with the soft tissue within the pocket. The technique was reiterated until the full circumference of the root was irradiated, resulting in renewed bleeding. Each location underwent an irradiation duration of approximately 10 seconds.

Furthermore, this enabled the removal of delicate tissue during laser-assisted curettage. To prevent thermal injury to the root surface, we thoroughly cleaned the root surface with a saline solution after the laser irradiation was complete[36]. The fiber tip was cleansed with moist gauze between treatments of each tooth to avoid the accumulation of debris, and ethanol was applied to the wiping surface for 5 seconds. The tip's termination was tested and cut before and after each subsequent treatment to ensure optimal beam emission.

The contralateral side was treated exclusively with SRP only. The periodontal gracy curettes and an ultrasonic piezoelectric scaler (Woodpecker, UDS-K, India) were employed to conduct the SRP. The entire pocket cementum was treated, and the pockets were manually root-planed from the apical to the coronal direction. This was done with great care. The instrumentation was accomplished until the operator felt the root surfaces were adequately scaled and planned. Conventional periodontal therapy aims to eradicate all local allergens, including calculus, plaque, debris, and toxins. A single practitioner administered the SRP treatments to each patient during a single appointment[35]. The patient, the surgeon, and the dental assistant were required to wear safety glasses during the treatments to prevent the potential ocular harm that could result from laser irradiation. Upon completion of both treatments, patients were instructed to abstain from dental brushing on the day of the therapy. An oral hygiene protocol was subsequently implemented. X-rays were obtained at the baseline and the end of the three-month study period.
Third appointment(Follow-up) immediately 3 days after baseline appointment: collection of plaque sample.
Fourth appointment (follow-up) one week after baseline appointment: collection of plaque sample.

Five appointments (follow-up) 12 weeks after baseline appointment: Assessment of clinical periodontal parameters (Plaque Index, Bleeding on Probing, Probing Pocket Depth, and Clinical Attachment Level), collection of plaque sample.

6. Cultivation of Porpyromonas gingivalis

The dental tube samples were thereafter incubated vertically at 37°C for 48 hours, after which a 100 µl aliquot from each sample was streaked over P. gingivalis agar (P.GING), an enriched selective medium for the isolation and presumptive identification of P. gingivalis[37, 38].. The (P.GING) medium is locally prepared. The formulation consists of Columbia Agar Base, supplemented with 5% sheep blood, 5 µg/ml haemin, and 1 µg/ml vitamin K1 (Himedia), which function as selective agents for the isolation of the fastidious, strictly anaerobic P. gingivalis from other periodontopathogens. The chosen media plates were incubated in a hermetically sealed anaerobic jar at 37°C using a gas pack (Oxoid) for a duration of 7 to 14 days [37].

7. Identification and colony counting of porpyromonas gingivalis

The preliminary identification of P. gingivalis was conducted using standard procedures, encompassing biochemical testing and microscopic examination, as shown in Figure 2. [39], and Vitek II system(bioMérieux, France) [40]. In contrast, the definitive identification was conducted with the polymerase chain reaction (PCR) method[41]. Bacterial enumeration was performed using CFU/ml. A portion of the bacterial suspension (100 microlitres) was disseminated over P.GING agar and grown for 48-72 hours following serial dilutions of 10^1,10^2, 10^3, and 10^4 in peptone water, and the number of colonies that have between 30 and 300 colonies is counted by using the following equation: Number of CFU/ml = number of CFU x dilution factor[42].

The colonies of *porphyry monas gingivalis* on the P.GING agar were in Black and surrounded by a transparent halo, as shown in Figure 3.

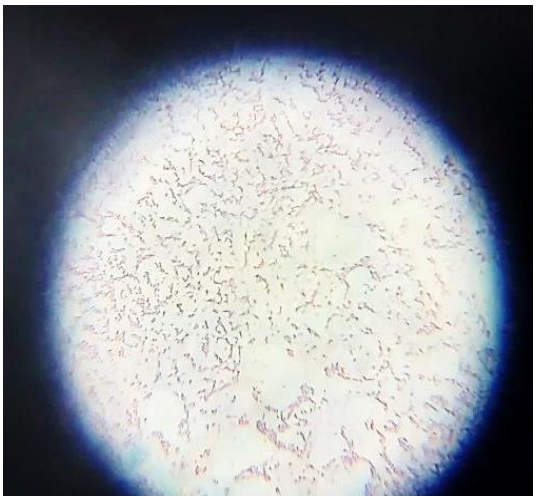

Figure 2: Microscopic examination of *porphyry monas gingivalis* after performing the dying process with gram stain.

Figure 3: Colonies of *porphyromonas gingivalis* Black colony grown on P.GING at 37°C for 48-72 hrs.

8. Identification of p.gingivalis using the Vitek II system

This system was used according to the manufacturing company (bioMérieux, France) by inoculating bacteria on the agar plate. Incubation at (37 ºC /48-72 hours) shown in Table (1).

Table.1: Identification of p.gingivalis using the Vitek II system

Bionumber: 7537739485441
Organism Quantity: **Selected Organism: Porphyromonas gingivalis**

Comments:	

Identification Information	**Card:**	ANC	**Lot Number:**	2442240403	**Expires:**	Jan 14, 2025 12:00 AST
	Status:	Final	**Analysis Time:**	8.10 hours	**Completed:**	July 20, 2024 16:24 AST
Organism Origin	VITEK 2					
Selected Organism	99% Probability		**Porphyromonas gingivalis**			
	Bionumber: 7537739485441			Confidence: excellent identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages:						
Contraindicating Typical Biopattern(s)						

Biochemical Details																	
4	dGAL	+	5	LeuA	+	6	ELLM	(+)	7	PheA	+	8	ProA	-	10	PyrA	-
11	dCEL	-	13	TyrA	+	15	APPA	-	18	dGLU	+	20	dMNE	+	22	dMAL	+
28	SAC	+	30	ARB	-	33	NAG	+	34	BGLUi	+	36	URE	-	37	BGURi	-
39	BGALi	-	41	AARA	-	42	AGALi	-	43	BMAN	-	44	ARG	+	45	PVATE	-
51	MTE	+	53	ESC	+	54	BdFUC	-	55	BNAGi	-	56	AMANi	-	57	AlFUC	-
59	PHOS	-	60	lARA	-	61	dRIB2	+	62	OPS	-	63	AARAF	-	64	dXYL	+
	GRAM	-		MORPH	-		AERO	-									

9. Molecular Detection of P. gingivalis

9.1 DNA extraction

The Genomic DNA Mini Kit (Geneaid, Korea) was employed to isolate DNA from periodontal samples in accordance with the manufacturer's instructions. Immediately after extraction, the DNA samples were stored at -20°C for molecular detection of P. gingivalis; for the molecular identification of P. gingivalis, a monoplex PCR targeting the 16S rRNA gene amplification was implemented in accordance with [43] using the amplification primers listed in Table 2 and the cycling parameters listed in Table 3.

Table.2: The primer set was employed for the molecular detection of P. gingivalis.

	Prime		Primer sequence 5'- - 3'	PCR product
Porphyromonas gingivalis	**16S ribosomal RNA gene**	**F**	**ACGGGAATAACGGGCGATAC**	**766 bp**
		R	**TGTAAGGGCCGTGCTGATTT**	

9.2 Amplification Reaction Protocols

Table .3: Cycling parameters for monoplex PCR of 16S rRNA gene amplification

No.	Phase	Tm (°C)	Time	No. of cycle
1-	Initial Denaturation	95°C	3min	1 cycle
2-	Denaturation-2	95°C	45sec	35cycle
3-	Annealing	60°C	45sec	
4-	Extension-1	72°C	45sec	
5-	Extension-2	72°C	7Min	1 cycle

9.2 Agarose gel electrophoresis

The PCR products were subjected to agarose gel electrophoresis (1.5%) using the following lanes: M (M: 100bp ladder), Figure 4.

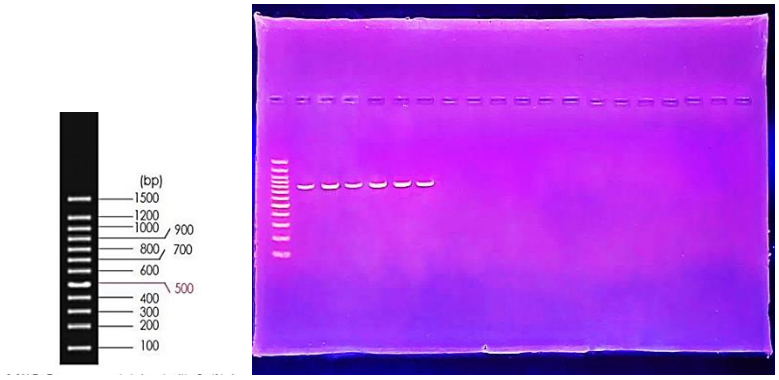

Figure .4: Gene electrophoresis using agarose gels. After staining with red stain, bands were visualized under ultraviolet light after being fractionated by electrophoresis on a 1% agarose gel. Lane: M (M: 100-1500bp ladder).

10. Statistical analysis

Depending on whether the distribution was normal or skewed, the continuous variables were represented as means and standard deviations. Frequency and percentages were employed to represent categorical variables. In order to evaluate the mean differences, the Welch's t-test was implemented for variables that were normally distributed.The differences between serial measurements of periodontal indices were calculated based on repeated measure ANOVA test and post-hoc analysis with holm adjustments. A P-value less than 0.05 was considered statistically significant. The sample size was calculated using G-power software. R software packages (dplyr, gt_summery, and ggplot) were used for data processing, visualization, and statistical analysis ("R version 4.2.2, R Foundation for Statistical Computing, Vienna, Austria").

11. Result

The patient had an average age of 35.3 years and a standard deviation of 10.7 years. This indicates a median age of 32 within 20 to 56 years. The sex distribution revealed that 56.0% of the participants were male (14 individuals), while 44.0% were female (11 individuals), as was detailed in Table(4).

Table .4: Description of the demographic profile of the patients with Periodontitis (N=25).

Characteristic	**N = 25[1]**
Age (years)	35.3 ± 10.7
Median (range)	32 (20 - 56)
Sex	
Male	14 (56.0%)
Female	11 (44.0%)
[1]Mean ± SD; n (%)	

The colony forming unit (CFU) of Porphyromonas gingivalis was measured in both the control group, which received scaling and root planing (SRP) only, and the test group, which received SRP plus diode laser treatment, over several follow-up periods. At baseline, the CFU was similar between the groups, with the control group showing a count of 2.56e+06 ± 9.75e+04 and the test group at 2.51e+06 ± 7.14e+04, with no significant difference (p=0.066). By the 3rd day, the test group showed a significantly lower CFU (1.51e+06 ± 4.61e+04) compared to the control group (1.70e+06 ± 5.30e+04), with a p-value of <0.001. This trend continued in the 1st week, where the CFU in the test group decreased further to 4.94e+05 ± 5.69e+04, significantly lower than the control group's 6.81e+05 ± 5.93e+04 (p<0.001). By the 3rd month, the test group CFU declined to 2.99e+05 ± 5.48e+04, again significantly lower than the control group's 4.86e+05 ± 5.89e+04, with a p-value of <0.001, indicating the efficacy of diode laser treatment in reducing CFU over time, as was detailed in Table 5.

The CFU of Porphyromonas gingivalis showed significant reductions over the follow-up period in both the SRP group and the SRP plus diode laser group. In the SRP group, the baseline CFU was 2.56e+06 ± 9.75e+04, which decreased significantly to 1.70e+06 ± 5.30e+04 on the 3rd day, 6.81e+05 ± 5.93e+04 by the 1st week, and to 4.86e+05 ± 5.89e+04 by the 3rd month (p<0.001). Similarly, in the SRP plus diode laser group, the CFU started at 2.51e+06 ± 7.14e+04 and significantly declined to 1.51e+06 ± 4.61e+04 by the 3rd day, 4.94e+05 ± 5.69e+04 by the 1st week, and 2.99e+05 ± 5.48e+04 by the 3rd month (p<0.001). Post-hoc analysis using Tukey's test showed that the differences between all the measurements in each group were statistically significant, as was shown in Table 6 and Figures 3 and 4.

Table 5: Description of CFU/ml of Porphyromonas gingivalis in both control and test groups over the follow-up time.

CFU/ML	SRP only, N = 25[1]	SRP + Diode Laser, N = 25[1]	P-value[2]
At baseline	2.56e+06 ± 9.75e+04	2.51e+06 ± 7.14e+04	0.066
At 3rd day	1.70e+06 ± 5.30e+04	1.51e+06 ± 4.61e+04	**<0.001**
At 1st week	6.81e+05 ± 5.93e+04	4.94e+05 ± 5.69e+04	**<0.001**
At 3rd month	4.86e+05 ± 5.89e+04	2.99e+05 ± 5.48e+04	**<0.001**

[1]Mean ± SD
[2]Welch Two Sample t-test

Table 6: The statistical differences between the CFU/ml over the follow-up time.

Parameter	Baseline[1]	3rd day[1]	1st week[1]	3rd month[1]	P-value[2]
SRP Group	2.56e+06 ± 9.75e+04	1.70e+06 ± 5.30e+04	6.81e+05 ± 5.93e+04	4.86e+05 ± 5.89e+04	**<0.001**
SRP + Diode laser group	2.51e+06 ± 7.14e+04	1.51e+06 ± 4.61e+04	4.94e+05 ± 5.69e+04	2.99e+05 ± 5.48e+04	**<0.001**

[1]Mean ± SD
[2]Repeated measure ANOVA

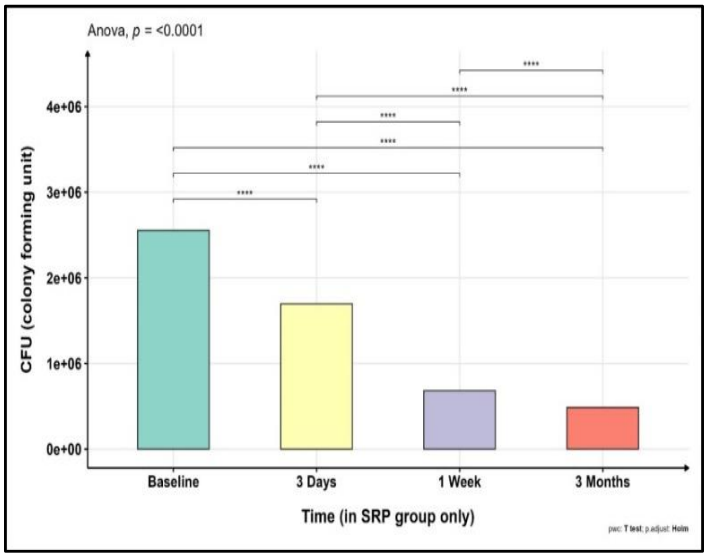

Figure.5: post-hoc analysis showing the mean CFU/ml in the different follow-up time in the SRPgroups (****: p-value <0.0001).

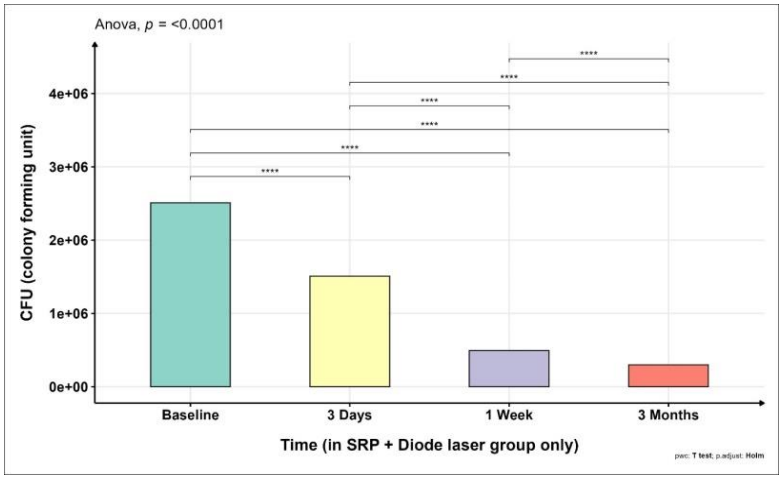

Figure 6*: post-hoc analysis showing the mean CFU /ml in the different follow-up times in the SRP with diode laser groups (****: p-value <0.0001).*

12. Discussion

This is the first study that assesses the impact of an 810-980nm diode laser as an addition to periodontal therapy on the colony-forming units of P. gingivalis in individuals with periodontitis. The current literature indicates that microorganisms play a substantial role in developing periodontal disease [44]. The efficacy of periodontal therapy is widely acknowledged to rely on the diminishment of periodontal pathogens in the subgingival region. Research indicates that scaling and root planing (SRP) in individuals with periodontitis significantly alters the composition of subgingival microbiota, like that of healthy areas [45]. Nonetheless, these alterations are temporary, particularly in remaining deep sites following periodontal therapy [46]. Recent research indicates that bacteria can infiltrate epithelial cells not only in the periodontal pocket but also in the outer gingiva, so establishing a microbial reservoir may promote post-treatment relapses and the chronicity of periodontitis [47]. Rhemrev et al. illustrate that subgingival mechanical washing alone has a restricted efficacy in eliminating microorganisms[45]. Periodontopathogens remain inside cells outside the pocket epithelium, irrespective of standard periodontal therapy [12]. Numerous studies have demonstrated positive results from this medication regarding clinical and microbiological attributes. The clinical benefits arise from the removal of subgingival plaque and the disruption of the subgingival biofilm, leading to a decrease in bacterial populations. The results of the current investigation demonstrated that the counts of the bacterial species under investigation, particularly P. gingivalis, were significantly reduced by SRP alone. These data substantiate the beneficial effects of SRP in reducing the levels of P. gingivalis and T. denticola that were previously observed[26, 31]. Lasers are integral to periodontal therapy. They aid in eliminating both intra- and extracellular microorganisms[48]. Numerous literature papers reveal that laser irradiation possesses significant bactericidal characteristics [49, 50]. Our microbiologic examination results indicate that Applying a diode laser in combination with the SRP resulted in a substantial drop in bacterial presence.The effectiveness may stem from the thorough elimination of subgingival biofilm and eradication of pathogens from the root pocket[51]. Arisan et al. discovered that scaling and root planing (SRP) with adjunctive laser therapy decreased the total bacterial count in the compromised peri-implant region [52]. Arisan et al. observed an insignificant decrease in A. a, P. g, T.d, and T.f species after one month of follow-up relative to the control group [52] . In our current investigation, the CFU in the test group assessed after 3 days, 1 week, and 3 months was considerably lower compared to SRP alone. Furthermore, we observed a substantial reduction in the quantity of P. gingivalis at all follow-up intervals. The decrease in bacterial CFU may be attributed to the superior penetration and affinity of the diode laser's wavelength for the chromophores or pigments in P. gingivalis, perhaps leading to rupture of the bacterial cell wall[53]. Chan and Chien: [54] It was proved that the in vivo bactericidal effect of the Nd:YAG laser was the result of the interaction between this wavelength and pigmentation. This suggests that black-pigmented infectious

periodontal bacteria will absorb this energy, as the dark pigment functions as a laser-absorbing chromophore.
The haemoglobin in the soft tissue of periodontal pockets serves as an absorptive chromophore for the high-power diode laser, functioning as an endogenous dye that amplifies the laser's efficacy at this location [55]. These findings align with prior research, demonstrating that short-term decreases in bacterial numbers transpired within three months following medication [9, 56], and bacterial re-colonization occurred after three mo[35]. Additional research employing the same treatment procedure and laser parameters, with a greater patient cohort and extended follow-up durations, is essential to validate the efficacy of the therapy suggested in this study. Future research should optimise the session number for each group session to yield sufficient results. A more extensive sample should be analysed to validate the importance and efficacy of the treatment on bacterial CFU.

13. Conclusions

A notable disparity in the colony-forming units of p,g was detected between the control and test groups. The dual wavelength diode laser can be an adjuvant to non-surgical treatment for those with periodontitis.

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فاعلية الليزر الثنائي (810-980 نانومتر) كمساعد للعلاج غير الجراحي لالتهاب اللثة على بكتيريا بورفيروموناس جينيفاليس: دراسة عشوائية مقسمة على الفم

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الملخص: التهاب اللثة هو حالة التهابية مزمنة ومعقدة ترتبط بالأغشية الحيوية للبلاك المختل وتتميز بالتدهور التدريجي للهياكل الداعمة للأسنان. يُعرف أن بكتيرياPorphyromonas gingivalis ، وهي عدوى حيوية حرجة في اللثة، تساهم بشكل كبير في بداية وتقدم أمراض اللثة عن طريق إحداث تغيير اختلالي في الميكروبيوتا اللثوية، خاصة تحت اللثة، من البكتيريا الموجبة والسالبة الجرام. تسعى العلاجات التقليدية مثل تنظيف الجذور وتخطيط الجذور (SRP) إلى إزالة البلاك والجير من أسطح الأسنان والمناطق تحت اللثة. ومع ذلك، فإن هذه العلاجات تصاحبها بعض القيود. لقد أظهرت الليزرات الثنائيات إمكانية كعلاج مساعد، مما قد يحسن نتائج العلاجات التقليدية

الهدف من الدراسة: تهدف هذه الدراسة إلى مقارنة فعالية ليزر الصمام الثنائي كطريقة علاجية مساعدة للعلاج غير الجراحي مقابل SRP فقط على CFU للبورفيروموناس اللثوية في المرضى الذين يعانون من التهاب اللثة.

المواد والطرق

تم تنظيم هذا البحث كتجربة سريرية عشوائية محكمة، مقسمة الفم. شارك في هذا البحث خمسة وعشرون شخصًا (11 أنثى و14 ذكرًا تتراوح أعمارهم بين 20 و56 عامًا) تم تشخيصهم بالتهاب اللثة. بعد العلاج الأولي للثة، والذي شمل إرشادات نظافة الفم وإجراءات التنظيف، خضع كل مريض لعلاجين منفصلين على جانبي الفم المتقابلين. تم تعيين الجانب الأيسر كمجموعة اختبار، بينما تم تخصيص الجانب الأيمن كمجموعة تحكم. تم تحقيق العشوائية عن طريق رمي العملة لضمان التوزيع العادل. في مجموعة الاختبار (الجانب الأيسر) خضع المرضى (SRP) بالتزامن مع علاج الليزر الثنائي؛ في مجموعة التحكم المقابلة (الجانب الأيمن) تلقوا علاج (SRP) فقط. تم ضبط الليزر على موجة مستمرة بقدرة 1.5 واط، طرف 400 ميكرومتر، تقنية التلامس والمسح. تم أخذ 50 عينة من اللويحة تحت اللثة بعد تسجيل معايير اللثة، مؤشر اللويحة (PI)، النزيف عند الفحص (BOP)، عمق جيب اللثة (PPD)، وفقدان التعلق السريري (CAL) في البداية قبل، وبعد 3 أيام، أسبوع واحد، و12 أسبوعًا من العلاج. ركزت التقييمات الميكروبيولوجية على الوحدات المكونة للمستعمرات من (P.G Porphyromonas gingivalis). تم تعداد الوحدات المكونة للمستعمرات (CFU) لكل مجموعة لمدة 48-72 ساعة على وسط زراعي مناسب بعد التخفيف التسلسلي. تم تأكيد البكتيريا المعزولة سريريًا باستخدام الاختبار البيوكيميائي، الفحص المجهري، نظام Vitek II، وأخيرًا بواسطة تقنية PCR

النتيجة: تم تخفيض وحدات تشكيل المستعمرة (CFU) من خلال طريقتي العلاج ولم تعود إلى مستويات خط الأساس بعد ثلاثة أشهر من العلاج. أظهرت مجموعة ليزر SRP +ليزر دايود انخفاضًا ملحوظًا إحصائيًا في المستويات البكتيرية لـ P. gingivalis بعد 3 أيام وأسبوع و3 أشهر بعد العلاج مقارنةً بمعالجات SRP وحدها.

الاستنتاج: تم الكشف عن تباين ملحوظ في وحدات تشكيل مستعمرة p.g بين المجموعتين الضابطة والاختبارية. يمكن استخدام ليزر الصمام الثنائي ذو الطول الموجي المزدوج كمساعد لعلاج اللثة غير الجراحي للمرضى الذين يعانون من التهاب اللثة.