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ORIGINAL ARTICLE

Clinical and microbiological evaluation of high intensity diode laser adjutant to non-surgical periodontal treatment: a 6-month clinical trial

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Abstract
Objectives This randomized split-mouth clinical trial was designed to evaluate the efficacy of scaling and root planing associated to the high-intensity diode laser on periodontal therapy by means of clinical parameters and microbial reduction.
Materials and methods A total of 36 chronic periodontitis subjects, of both genders, were selected. One pair of contralateral single-rooted teeth with pocket depth >5 mm was chosen from each subject. All patients received non-surgical periodontal treatment, after which the experimental teeth were designated to either test or control groups. Both teeth received scaling, root planing and coronal polishing (SRP) and teeth assigned to the test group (SRP + DL) were irradiated with the 808±5 nm diode laser, for 20 s, in two isolated appointments, 1 week apart. The laser was used in the continuous mode, with 1.5 W and power density of 1,193.7 W/cm^2. Clinical and microbiological data were collected at baseline, 6 weeks and 6 months after therapy.
Results There was a significant improvement of all the clinical parameters—clinical attachment level (CAL), probing depth (PD), plaque index (PI) and Bleeding on Probing (BOP)—for both groups ($P<0.001$), with no statistical difference between them at the 6 weeks and the 6 months examinations. As for microbiological analysis, a significant reduction after 6 weeks ($P>0.05$) was observed as far as colony forming units (CFU) is concerned, for both groups. As for black-pigmented bacteria, a significant reduction was observed in both groups after 6 months. However, the difference between test and control groups was not significant. There was no association between group and presence of *Porphyromonas gingivalis*, *Prevotella intermedia* and *Aggregatibacter actinomycetemcomitans* at any time of the study.
Conclusions After 6 months of evaluation, the high-intensity diode laser has not shown any additional benefits to the conventional periodontal treatment.
Clinical relevance The high intensity diode laser did not provide additional benefits to non-surgical periodontal treatment. More studies are necessary to prove the actual need of this type of laser in the periodontal clinical practice.

Keywords Bacterial reduction · Chronic periodontitis · High power diode laser · Non-surgical periodontal treatment

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Introduction

Periodontitis is a bacterial-related inflammatory disease which leads to the destruction of tooth-supporting tissues. Non-surgical treatment of such destructive periodontal diseases is based on the elimination of bacterial deposits adhered to tooth surfaces, primarily by means of root scaling and planning. This method, together with dental plaque control performed by the patient, is efficient in the treatment of periodontal diseases [1].

There are situations when conventional treatment fails, either because of difficulties in the scaling procedure itself [2], or because of the pathogenicity and/or resistance of the microorganisms [3], or even due to systemic conditions which may compromise host response to the treatment [4] or may contra-indicate surgical procedures. In these situations, antimicrobial treatment might be instituted, promoting bacterial reduction and additional benefits to non-surgical treatment [5]. On the other hand, antimicrobial therapy may lead to adverse reactions and promote bacterial resistance [6, 7].

For the past decades, many studies have investigated the adjunctive use of high-intensity lasers in periodontal therapy. However, these studies did not provide sufficient evidence that supports the efficacy of this additional treatment, therefore, indicating the need to carry out more clinical trials [8].

Due to its characteristics, as well to other known advantages such as low cost and practicality, the diode laser has been compared to the other lasers [9], and has been subject of a diversity of studies intended to evaluate its potential in relation to its biocompatibility [10] and to its ability in reducing bacterial counts [11]. Results have been controversial, Caruso et al. [12] and De Micheli et al. [13] did not find any additional benefits by using the diode laser during non-surgical periodontal treatment. Other studies have shown positive results both clinically as well as microbiologically using the same type of laser [11, 14].

The divergence of results may be related to the different methods used by the authors. Most studies failed to describe the fluency or the energy density used, making comparative analyses and systematic reviews difficult, if not impossible [15].

It is also important to note that, in some of the earliest studies [11, 12], a high potency (2.5 W) was used which is no longer rendered safe and may cause damage such as fusion, carbonization and necrosis, as well as excessive heating of the root surface [16].

The goal of this split-mouth randomized clinical trial was to verify, by means of bacterial reduction and changes in clinical parameters, the efficacy of the high-intensity diode laser as an adjunct to scaling and root planing (SRP), by using previously in vitro tested parameters [10, 17].

Material and methods

Study design and population

This study was a split-mouth, double-blinded randomized clinical trial. The study was conducted at the São Paulo University School of Dentistry (FOUSP), at the Special Laboratory of Lasers in Dentistry (LELO). This project was approved by the Ethics Committee of the same institution (CEP-116/05).

Subjects considered to be eligible for this research were the ones who met the following inclusion criteria: patients bearing severe chronic periodontitis [18], with at least ten teeth present, vital single-rooted teeth with contra-laterals of the same arch, with a minimum probing depth (PD) of 5 mm or more. Exclusion criteria discarded tobacco smokers or alcohol- or drug-dependent subjects, patients who had received periodontal treatment or antibiotics in the previous 6 months. Subjects who had systemic pathologies or conditions which could act as modifying factors of the periodontal condition, as well as pregnant or breastfeeding women were also excluded of this trial.

As for the sample size, 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 [SD]= 1.6 mm). The SD was based in a previous study conducted with same population [13]. Based on this information, 31 subjects would be necessary. Considering a patient dropout of 15%, a total of 36 subjects were eventually recruited.

Interventions

After signing a free informed consent, the subjects went through a complete anamnesis, impression and received radiographic and periodontal examination (Fig. 1(1)).

At the initial treatment, all subjects received oral hygiene instruction (OHI) and supra- and subgingival ultrasonic scaling of all teeth except for the experimental teeth [19] (MiniPiezon®, EMS, Electro Medical System, Le Sentier, Switzerland), under local anesthesia, when necessary. Initial treatment was performed in up to four appointments, weekly (Fig. 1(2)).

One week after the end of initial treatment, two preselected contralateral single-rooted teeth from each subject, both presenting a pocket depth ≥5 mm, were randomly assigned to test or control experimental treatment. Random assignment to test or control treatment was carried out by another examiner (C.M.P), by tossing a coin.

At the same appointment, these experimental teeth received subgingival scaling and root planning under a 2% lidocaine anesthesia, performed by one investigator (A.K.P.A) using 5/6 and 7/8 Gracey curettes (Hu-Friedy® Co., Chicagio, IL, USA), followed by tooth polishing.

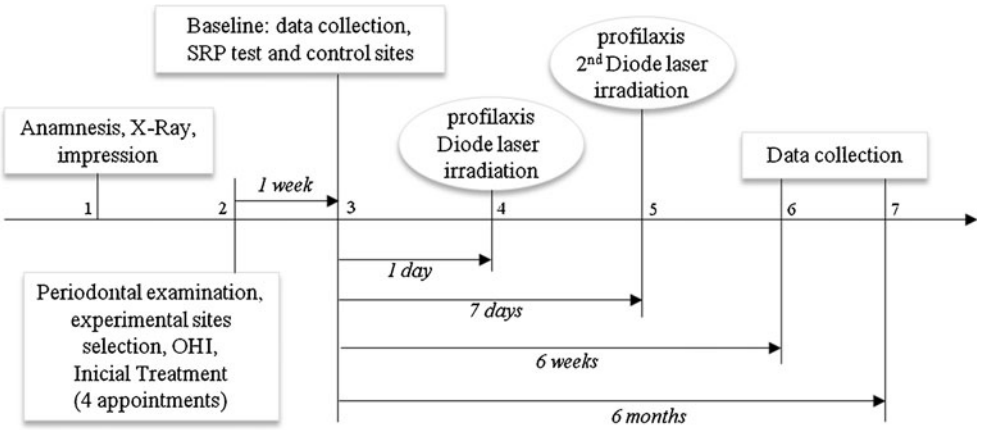

Fig. 1 Study flowchart

The clinical parameters as well as the microbiological sampling were taken at baseline, 6 weeks and 6 months after treatment conclusion, which means after the second laser irradiation (Fig. 1(3, 6, 7)).

Patients returned for periodontal maintenance 3 months after completing the active treatment, or second laser irradiation.

Laser irradiation

A diode-laser equipment (ZAP Softlase, Pleasant Hill, USA), with a wave length of 808±5 nm, delivered by a 400-μm diameter fiber optic device was used for this trial.

Before each irradiation episode, a power meter (Fieldmaster, Coeherent, Alburn, USA) was used, which allowed the adjustment and the standardization of the amount of energy used. The mean energy loss in this study was around 20%.

After coronal polishing of both teeth, the fiber optic was introduced in the periodontal pocket parallel to the long axis of the tooth, one millimeter coronal to the base of the pocket, and it was moved coronally with sweeping movements, using a power of 1.5 W, 20 s and power of density of 1,193.7 W/cm^2.

The choice of high-intensity diode laser was grounded in previous in vitro studies. Our preliminary concern was that laser could be effective and also safe. To set these parameters we based on the studies of Theodoro et al. [10] and Haypek et al. [17], that demonstrated high intensity diode laser (1.4 W/30 s) did not provide signs of thermal effects such as charring, necrosis or fusion on the root, and of Kreisler et al. [20], which inferred about the angle of laser beam, time and power irradiation on gingival fibroblasts. Other characteristics about this laser were taken into account in order to use in dental practice: it is one of the cheaper high intensity laser; furthermore the diode laser machine used in this research is small and light, therefore portable.

The test site was irradiated with the diode laser twice: 1 day and 1 week after SRP of the experimental sites (Fig. 1(4, 5)). On the contralateral control tooth, the same procedure was used, but without the activation of the laser, in a sham procedure performed to assure blinding.

Clinical and microbiological evaluation

The primary outcome of this study was CAL. The secondary outcomes were PD, bleeding on probing (BOP), the distance from the cemento-enamel junction (CEJ) to the gingival margin (CEJ–GM) and plaque index (PI) [21]. Six sites per tooth were measured with a PCPUNC 15 Periodontal Probe (Hu-Friedy® Co.) and the deepest site of each experimental tooth was defined as the experimental site. In order to attain the reproducibility of the probing, a customized acrylic stent was used for measurements of the experimental sites (Fig. 1(3)).

All examinations were performed by a single professional (V.T.E.A), trained and calibrated by means of intra-class correlation coefficient: CEJ-GM 0.997 (P, 0.001) and PD 0.990 (P, 0.001), repeated at 1-week interval.

For subgingival plaque collection, the teeth were isolated with cotton rolls and a plaque sample was obtained by the introduction of two sterile no. 40 paper cones inside the pocket for 30 s. Plaque samples were collected at baseline after 6 weeks and 6 months. The samples were placed in a vial containing 3 ml transport medium (VMGA III) [22]. These samples were processed up to 24 h after collection. The vials containing the cones in the VMGA III were incubated at 37°C for 30 min to liquefy the jelly, and then they were immediately homogenized in tube agitators (Fisher Vortex Genie 2, USA). Aliquots of 100 μl from each sample, some not diluted and some diluted to 1/10 and 1/100 in peptone water, were put into Petri dishes containing a TSBV-selective culture medium (trypticasein soy agar added to horse serum, bacitracin and vancomycin) [23]. After 3 days of incubation at 37°C in an atmosphere

containing 5–10% carbon dioxide (CO_2), the colonies were counted and a presumptive identification of *Aggregatibacter actinomycetemcomitans* was made. This identification was based on morphologic aspects of the colony through a stereoscope microscope, morphohistochemical characteristics under an optical microscope, Gram staining tests and catalase proof. Aliquots of 100 μl from each sample, diluted to 1/100, 1/1,000 and 1/10,000 in peptone water, were put into Petri dishes containing Brucella agar with 5% goat defibrinated blood, hemin (10 μg/ml, Sigma H-2250) and menadione (1 μg/ml, Sigma M-5625 L) [24]. After 7 days of incubation at 37°C in an anaerobic environment (Anaerobic Jar 2.5 L, Oxoid) the total number of bacterial colony forming units (CFU BT) and black-pigmented bacteria (CFU BPB) were counted. The CFU BPB colonies were presumptively identified based on the lactose fermentation test [25] using the 4-methylumbelliferyl-β-D-galactosidase substrate (MUG; M-1633, Sigma), at a concentration of 1% in dimethylsulfoxide (D-8799, Sigma). The trypsin activity test [26] was carried out with the fluorogenetic carbobenzoxy L-arginine-7-amino-4-methylcoumarin amine-HCL (CAAM) synthetic compound. The colonies with positive autofluorescence when subjected to a long ultraviolet light wavelength (365 nm Mineralight Lamp UVGL-58, USA) and MUG, and with negative CAAM test results [25] were identified as *Prevotella intermedia*, and the ones with negative results for autofluorescence and the MUG test and positive results for the CAAM test were identified as *Porphyromonas gingivalis* [23].

Statistical analysis

The mean and the standard deviation of the variables PD, CAL, CEJ-GM, PI, BOP, and the CFUs of BT and BPB, from the experimental sites, were considered for the statistical analysis. The presence or absence of the pathogens *P. gingivalis*, *Prevotella intermedia* and *A. actinomycetemcomitans* was also evaluated.

A repeated measures analysis of variance (ANOVA) was used to determine the differences between the averages of the groups in each experimental period and to verify changes of the means of each group, between each experimental period. Newman–Keuls test was used for multiple comparisons. A logarithmical transformation (log) of the number of CFU was performed, in order to normalize the distribution of the variables.

To verify if there was an association between experimental group and the presence of *P. gingivalis*, *Prevotella intermedia* and *A. actinomycetemcomitans*, the chi-square test was used. When the test could not be used, the Fisher exact test was applied. McNemar test was used to assess changes in the presence of residual pockets >6 mm.

The statistical analysis was performed through SPSS software for Windows (version 5.1) with a significance level of 5% in all statistical tests.

Results

Out of a total of 88 subjects examined, 37 which have fulfilled the selection criteria of this trial were selected. One of them was excluded for missing one of the appointments. The study was performed with 36 patients, whose mean age was 46.8±8.11 years (range 37–64 years), and comprising 23 (63.8%) females and 13 (36.1%) males.

Clinical evaluation

There was a significant ($p<0.001$) reduction in PD in test (2.5 mm) and control group (2.76 mm). A significant CAL gain was observed in test (1.58 mm) and control groups (2.2 mm). Both groups (test: 0.9 mm, control: 0.5 mm) presented an increase in CEJ-MG distance. There was no significant difference between groups regarding any of these variables.

As regards PI, there was a significant reduction of 0.59 in the test group and 0.87 in the control groups. Both groups (test: 57.1%, control: 60.8%) presented significant reduction in BOP. There was no difference between groups in any of the experimental times (Table 1).

At baseline, there were 14 periodontal pockets >6 mm in the control group and 16 in the test group. After 6 months, two and four periodontal pockets >6 mm were observed in control and test groups, respectively. This change was significant in both groups ($p<0.05$) (Table 2). The frequency distribution of PD reduction and CAL gain, comparing baseline and 6 months, have shown that most of the sites have gained at least 3 mm of CAL, and presented at least 3 mm of PD reduction (Table 3).

Microbiological evaluation

In both groups there was a reduction in the number of total CFUs 6 weeks after laser irradiation ($p<0.05$). However, after 6 months the CFUs levels returned to values similar to baseline. There was no significant difference between groups at any time during the study (Table 4).

Regarding dark pigmented bacteria CFUs, a significant reduction between baseline and 6 months was observed in both groups ($p<0.05$). In the test group, a difference between baseline and 6 weeks was also detected.

There was no association between group and presence of *P. gingivalis*, *Prevotella intermedia* and *A. actinomycetem-*

Table 1 Mean and standard deviation of the experimental groups test (T) and control (C) regarding the clinical attachment level (CAL), probing depth (PD), cement enamel junction gingival margin distance (CEJ-MG), plaque index (PI) and bleeding on probing (BOP) at baseline, 6 weeks and 6 months

	Baseline	6 weeks	6 months	*p* value[a]		Difference baseline × 6 months
CAL						
Test	6.91±1.94	5.72±2.51[e]	5.33±2.13[e]	<0.001[d]		1.70±1.72
Control	6.50±1.74	4.61±1.88[e]	4.30±2.08[e]	<0.001[d]		2.10±1.64
p value[b]	0.38	0.22	0.32		*p* value[c]	0.36
PD						
Test	6.13±1.35	4.05±1.49[e]	3.63±1.49[e]	<0.001[d]		2.56±1.79
Control	5.69±0.95	3.27±1.30[e]	2.93±1.33[e]	<0.001[d]		2.76±1.13
p value[b]	0.29	0.27	0.30		*p* value[c]	0.60
PI						
Test	1.25±0.99	0.16±0.37[e]	0.66±0.88[e]	<0.001 [d]		0.76±1.30
Control	1.47±0.90	0.11±0.31[e]	0.60±0.77[e]	<0.001 [d]		1.03±1.27
p value[b]	0.32	0.42	0.66			0.42
BOP						
Test	97.2±16.6	44.4±50.4[e]	40.1±49.3[e]	<0.001[d]		0.60±0.49
Control	94.4±23.2	36.1±48.7[e]	33.6±47.2[e]	<0.001[d]		0.63±0.49
p value[b]	0.32	0.47	0.89			0.79

[a]*p* value (ANOVA) over time intra-group comparison

[b]*p* value (Newman–Keuls) inter-group comparison

[c]*p* value (*t*-test) inter-group comparison, regarding changes between baseline and 6 months

[d]Statistical significance at 5%; DP = standard deviation

[e] (Newman–Keuls) intra-group difference in relation to baseline

comitans at any time of the study, or at any time of the study the presence of bacteria was significantly higher in some of the experimental groups (Table 5).

Discussion

For the past decades, adjunctive use of high-intensity lasers has been investigated in the treatment of periodontitis [8] and peri-implantitis [27], among other oral conditions [28]. The present study was designed to evaluate the efficacy of high-intensity diode laser as an adjunct in the treatment of chronic periodontitis. The results showed that diode laser irradiation did not promote additional benefits to the non-surgical treatment, as regards clinical and microbiological parameters.

The reduction of microbial load inside of the periodontal pocket was the deciding factor for the choice of the laser parameters. However, it has not been found, in the literature, any standardization of parameters such as energy and irradiation time. According to the literature, potency values already tested varies from 1 up to 2.5 W, either in the continuous or the pulsed mode [11, 12, 14, 29, 30].

Another important detail inherent to laser irradiation is related to the variation of the energy measured in the tip of the fiber optics, which must be compensated for with the aid of a power meter. In other studies using the high-intensity diode laser, there was no description of the mean energy loss or of the use of a power meter to compensate for it.

The results of this study have shown that 6 months after baseline, both SRP and the SRP + diode laser irradiation have promoted similar benefits in all aspects studied, with no statistical difference between the groups, as observed by Caruso et al. [12]. Although Moritz et al. [11] have measured PD and BOP, they did not evaluate CAL, which is considered to be the clinical gold standard parameter to investigate the previous history of destructive periodontal disease [31].

In the present study, there was a significant reduction of PI, as observed in other studies in which previous OHI was performed [29, 30]. There is no evidence that laser therapy can inhibit biofilm formation once a tooth has been irradiated.

BOP is directly associated with gingival inflammation [32] and linked to increased risk for progression of periodontitis [33]. In this study, BOP was decreased more than 50% in the experimental groups, and without

Table 2 Frequency distribution of residual pockets presenting PD ≥6 mm, at baseline and 6-month follow-up for test and control subjects (*N*=30)

Probing depth		Baseline *N* (%)	6 months *N* (%)	*p* (McNemar)
≥6 mm	Control	14 (46.7)	2 (6.7)	<0.001*
	Test	16 (53.3)	4 (13.3)	0.002*
	p (chi-square)	0.79	0.66	

*$p<0.05$, paired data

Table 3 Frequency distribution of CAL and PD changes (baseline × 6 months) for test and control groups

Group	CAL loss ≤2 mm, *N* (%)	CAL loss 1 mm, *N* (%)	No change CAL, *N* (%)	CAL gain 1 mm, *N* (%)	CAL gain 2 mm, *N* (%)	CAL gain ≥3 mm, *N* (%)
Control	1 (3.3)	1 (3.3)	4 (13.3)	2 (6.7)	8 (26.7)	14 (46.7)
Test		5 (16.7)	2 (6.7)	7 (23.3)	5 (16.7)	11 (36.7)
p	–	0.19	0.66	0.14	0.53	0.60
Group	PDi ≥2 mm, *N* (%)	PDi 1 mm, *N* (%)	No change PD, *N* (%)	PDr 1 mm, *N* (%)	PDr 2 mm, *N* (%)	PDr ≥3 mm, *N* (%)
Control	–	–	1 (3.3)	2 (6.7)	8 (26.7)	19 (63.3)
Test		1 (3.3)	2 (6.7)	5 (16.7)	9 (30.0)	13 (43.3)
p	–	–	1.00	0.42	1.00	0.19

p, chi-square test

PDi, PD increase

PDr, PD reduction

significant difference between them. Furthermore, CFUs was also significantly reduced for both groups, which means that SRP was responsible for these changes. Although Borrajo et al. [14] have found a significant difference for this parameter in favor of the group that received scaling and laser, the absence of analysis of microbiological parameters, as what had occurred in the study of Kreisler et al. [20], did not allow an equivalent analysis of these results.

Microbiological testing, especially when used in conjunction with clinical trials, complements the diagnosis and corroborates the results of the research, as the presence of certain pathogens has a positive relation with periodontal clinical parameters [34, 35].

Microbiological culture was chosen for this study because it is the gold standard method for identification and counting of the colonies [36]. Aside from enabling handlers to identify viable microorganisms, it has also a reduced cost compared to other techniques such as DNA probe and real time-PCR [37].

Culture was performed using selective means for *P. gingivalis* and *Prevotella intermedia*, which are strongly related to chronic periodontitis [38], as well as for identifying *A. actinomycetemcomitans*, another important periodontal pathogen [39].

Considering the whole bacterial CFUs, a significant reduction was observed after 6 weeks for both the test and the control groups, and a re-colonization was noted at 6 months post-treatment. Caruso et al. [12] have used the same potency as in the study performed by Moritz et al. [11], but their results, similar to this study, did not show significant differences for total bacterial count. As regards black pigmented bacteria, both groups promoted a significant reduction after 6 months. Although no difference between groups was observed at any time, only the laser irradiation group promoted a significant reduction of BPB values after 6 weeks.

According to the results of this study, the presence of *P. gingivalis*, *Prevotella intermedia* and *A. actinomycetemcomitans* was not significantly higher in any of the experimental groups, at any time after treatment.

The selection of the high-intensity diode laser was based on studies which have shown that its wavelength has a better penetration and affinity for the pigments present in some bacteria, which would act as an absorbing chromophorous, and it would, in turn, intensify its action and thus make it possible to reach black pigmented anaerobes such as *P. gingivalis* [40].

According to the in vitro study of Harris and Yessik [41], there is a "therapeutic window" which varies in a certain wave length in the infrared region, where the absorption in the tissues is minimal and the transmission is maximal, which can characterize the laser efficacy to bacteria ablation. In this present study the diode laser wavelength—which favors the high absorption by hemoglobin—could be one of the reasons why this type of laser has low selectivity towards ablation of *P. gingivalis* when compared to Nd:YAG laser. Another explanation could be attributed to pulse characteristics, e.g., the longer duration of the diode laser pulse.

The behavior of *Prevotella intermedia* was similar for both SRP and SRP + DL groups. However, none of the therapeutics applied was efficient to significantly reduce this bacterium.

Table 4 Mean and standard deviation of the experimental groups test (T) and control (C) regarding the colony forming units (CFU) of dark-pigmented bacteria of total bacteria number at different moments

CFU of total bacteria (log)	Baseline	6 weeks	6 months
Test	11.80±1.35	9.00±2.10[a]	10.84±2.13
Control	11.88±1.51	9.53±2.03[a]	10.60±2.16
p value	0.81	0.29	0.66
CFU of dark-pigmented bacteria (log)	Baseline	6 weeks	6 Months
Test	9.22±1.63[a]	7.33±1.41[a]	7.00±1.10[a]
Control	9.08±2.48[a]	8.30±1.64	7.50±1.29[a]
p value	0.83	0.18	0.75

p value (Newman–Keuls) inter-group difference

[a] Intra-group over time difference when compared to baseline (Newman–Keuls)

Both *P. gingivalis* and *Prevotella intermedia* are also known as black-pigmented bacteria because of their production of black pigments when cultivated in Brucella agar medium. When in vivo it is not possible to assure that the pigments are produced, and thus that the bacteria are in fact pigmented. According to Okamoto et al. [42], these bacteria need heme (protoporphirin IX) in order to grow, and this is the predominant pigment in *P. gingivalis* [43] and *Prevotella intermedia* [44]. The amount of free iron on the bacterial surface is photosensitive for some wavelengths [45], which would result in the ablation of these bacteria [46].

In this study, there was no significant difference, for both groups, in the reduction of *A. actinomycetemcomitans* after 6 months of treatment. Although this bacterium is related to aggressive forms of periodontitis, depending on its serotype it can be also associated with chronic periodontitis [47], and its presence—together with bacteria such as *P. gingivalis* and *T. forsythia*—acts as an indicator of disease activity [48]. Among the studies about diode laser in the treatment of periodontal diseases and the reduction of *A. actinomycetemcomitans*, those of Caruso et al. [12] and Kamma et al. [28, 49] have shown results similar to this present work.

The results of this clinical trial have shown that the high-intensity diode laser as an adjunct to conventional non-surgical treatment of chronic periodontitis have not been superior to SRP alone. Future clinical trials, properly designed and using different types of lasers, are of ultimate importance to test their efficacy and safety, as well as to permit comparisons between studies in order to obtain conclusive results which will guide the treatment of periodontal diseases in the clinical practice.

Table 5 Percentage of patients with *Porphyromonas gingivalis*, *Prevotella intermedia* and *Aggregatibacter actinomycetemcomitans* and experimental groups at different moments

	Baseline	6 weeks	6 months
P. gingivalis			
Test	27.8% (10)	16.7% (6)	3.2% (1)
Control	47.2% (17)	16.7% (6)	3.2% (1)
p value	0.08	1.00	0.75
P. intermedia			
Test	22.2% (8)	8.3% (3)	6.5% (2)
Control	22.2% (8)	8.3% (3)	–
p value	0.61	0.66	0.24
A. actinomycetemcomitans			
Test	8.3% (3)	8.3% (3)	6.5% (2)
Control	5.6% (2)	2.8% (1)	3.2% (1)
p value	1.00	0.30	0.61

Conclusions

The use of high-intensity diode laser as an adjunct to conventional periodontal treatment showed no additional benefits compared to conventional periodontal treatment.

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Conflict of interest The authors declare that they have no conflict of interest.

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