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Comparison Between Efficacy of LASER Assisted & Conventional Non-surgical Periodontal Therapy: An experimental study

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ABSTRACT

Background:

Scaling and root planing (SRP) is the cornerstone of nonsurgical periodontal therapy; however, adjunctive approaches may enhance clinical and microbiological outcomes. Low-level laser therapy (LLLT) has been proposed as an adjunct to SRP because of its potential anti-inflammatory and antimicrobial effects.

Aim: To compare the clinical and microbiological efficacy of SRP alone with SRP supplemented by LLLT in patients with generalized chronic periodontitis.

Materials and Methods: An experimental clinical trial with a split-mouth design was conducted among 30 patients with generalized chronic periodontitis, contributing 60 study sites. Contralateral sites were randomly allocated to receive either SRP with adjunctive LLLT (test group) or SRP alone (control group). Clinical parameters, including sulcus bleeding index (SBI), probing pocket depth (PPD), and clinical attachment level (CAL), and subgingival Porphyromonas gingivalis counts were assessed at baseline and after 3 months. Data were analyzed using IBM SPSS Statistics version 26.0. Paired Student's t-test or Wilcoxon signed-rank test was applied according to data distribution, with $p < 0.05$ considered statistically significant.

Results: Baseline clinical and microbiological parameters were comparable between the two groups. At 3 months, SBI decreased to 0.92 ± 0.31 in the SRP + LLLT group compared with 1.28 ± 0.35 in the SRP-alone group ($p < 0.001$). PPD decreased to 2.78 ± 0.39 mm and 3.18 ± 0.42 mm, respectively ($p < 0.001$), with significantly greater PPD reduction in the test group (1.54 ± 0.41 mm vs. 1.11 ± 0.38 mm; $p < 0.001$). Although the 3-month CAL values did not differ significantly between groups ($p = 0.061$), CAL gain was significantly greater with adjunctive LLLT (0.89 ± 0.31 mm vs. 0.62 ± 0.28 mm; $p = 0.002$). The mean P. gingivalis count decreased from 5.82 ± 0.54 to 3.21 ± 0.48 in the SRP + LLLT group and from 5.79 ± 0.51 to 4.18 ± 0.52 in the SRP-alone group, with a significantly greater reduction in the test group ($p < 0.001$)..

Conclusion: Both treatment modalities produced significant clinical and microbiological improvements after 3 months. However, SRP supplemented with LLLT demonstrated significantly greater reductions in gingival bleeding, probing pocket depth, and subgingival P. gingivalis, along with greater CAL gain. These findings suggest that LLLT may provide additional clinical and microbiological benefits when used as an adjunct to conventional SRP in the management of chronic periodontitis..

Keywords: Clinical attachment level, Chronic periodontitis, Low-level laser therapy, Porphyromonas gingivalis, Probing pocket depth, Scaling and root planing, Sulcus bleeding index

INTRODUCTION

Periodontitis is a biofilm-associated inflammatory condition that affects the supporting structures of the teeth and may result in periodontal tissue destruction and attachment loss when left untreated. Effective disruption of subgingival biofilm and reduction of pathogenic microorganisms are essential components of periodontal treatment [1]. Scaling and root planing (SRP) is widely recognized as a fundamental nonsurgical periodontal procedure and can produce substantial improvements in gingival inflammation, probing pocket depth, and clinical attachment. However, mechanical instrumentation may have limitations in accessing complex root surfaces and completely eliminating pathogenic microorganisms from periodontal pockets [2].

In recent years, laser-based approaches have been investigated as potential adjuncts to conventional periodontal therapy. Low-level laser therapy (LLLT), also known as photobiomodulation therapy, has been proposed to influence cellular activity, inflammatory responses, tissue repair, and microbial levels. When used in conjunction with conventional mechanical debridement, these effects may contribute to improved periodontal healing and clinical outcomes [3].

The subgingival microbiota plays a central role in the initiation and progression of periodontal inflammation. *Porphyromonas (P. gingivalis),* a member of the red-complex group of periodontal bacteria, has been strongly associated with periodontal disease and is considered an important contributor to the dysbiotic microbial environment observed in periodontitis [4]. Therefore, monitoring changes in subgingival *P. gingivalis* levels can provide additional microbiological evidence regarding the effectiveness of periodontal interventions [5].

Considering the potential benefits of laser-assisted therapy, the present experimental study was undertaken using a split-mouth design to compare conventional SRP with SRP supplemented by LLLT in patients with generalized chronic periodontitis. Changes in Sulcus Bleeding Index (SBI), probing pocket depth (PPD), clinical attachment level (CAL), and subgingival *P. gingivalis* counts were assessed at baseline and three months after treatment. The study aimed to determine whether the addition of LLLT could provide superior clinical and microbiological outcomes compared with conventional mechanical plaque debridement alone.

Materials & Methods

Aim

The study aimed to compare the clinical and microbiological efficacy of SRP alone with SRP supplemented by LLLT in patients with chronic periodontitis.

Study Design and Study Population

An experimental clinical trial with a split-mouth design was conducted among patients diagnosed with generalized chronic periodontitis. A total of 30 patients providing 60 study sites were included. Each participant contributed contralateral sites, with one site receiving SRP + LLLT (test) and the corresponding contralateral site receiving SRP alone (control).

Inclusion Criteria

Participants were eligible if they met the following criteria:

Diagnosed with generalized chronic periodontitis, with periodontal pockets measuring less than 5 mm in the posterior sextants

Age between 20 and 60 years

Willingness to participate and provide informed consent

Exclusion Criteria

Patients were excluded if they had:

PPD greater than 5 mm

Local plaque-retentive factors, including malocclusion, Class II restorations, fixed prostheses, proximal caries, or gingival recession

Systemic diseases or conditions that could influence periodontal status or treatment response, including diabetes mellitus and pregnancy

A history of smoking or other deleterious oral habits

Antibiotic use within the preceding 6 months

Periodontal treatment within the preceding 6 months

Clinical and Microbiological Assessment

Clinical and microbiological parameters were evaluated at baseline (T0) and after 3 months (T3). The clinical parameters included SBI, PPD, and CAL. Subgingival plaque samples were also evaluated for *P. gingivalis*, a recognized periodontal pathogen associated with the periodontal red complex.

Periodontal Treatment

All selected sites underwent scaling and root planing. In the test sites, SRP was supplemented with LLLT, whereas the contralateral control sites received SRP alone. This split-mouth approach allowed comparison of the two treatment modalities within the same patient while reducing the influence of interindividual variability.

Participants were recalled monthly during the study period for reinforcement of oral-hygiene instructions and maintenance of plaque-control measures. Clinical and microbiological outcomes were reassessed at the 3-month follow-up.

Outcome Measures

The primary clinical outcomes were changes in SBI, PPD, and CAL from baseline to 3 months. The microbiological outcome was the change in subgingival *P. gingivalis* count over the same period. Between-group comparisons focused on the changes produced by SRP + LLLT versus SRP alone.

Statistical Analysis

The data were entered into Microsoft Excel and statistically analyzed using Statistical Package for the Social Sciences IBM SPSS Statistics, version 26.0. Continuous variables, including SBI, PPD, CAL, and subgingival *P. gingivalis* counts, were presented as mean ± standard deviation (SD). The Shapiro–Wilk test was used to assess the normality of continuous variables. Given the split-mouth study design, intergroup comparisons between SRP + LLLT and SRP-alone sites were performed using the paired Student's t-test for normally distributed data. Changes in clinical and microbiological parameters from baseline to 3 months within each group were also evaluated using the paired t-test. For non-normally distributed variables, the Wilcoxon signed-rank test was applied. Between-group differences in the mean reductions of SBI, PPD, and *P. gingivalis* counts, as well as CAL gain, were assessed. All statistical tests were two-tailed, with $p < 0.05$ considered statistically significant and $p < 0.001$ considered highly statistically significant.

Results

Table 1 & Figure 1 present a comparison of the SBI between the study groups. At baseline, the mean SBI was comparable between the SRP + LLLT group (2.21 ± 0.41) and the SRP-alone group (2.19 ± 0.39), with no statistically significant intergroup difference ($p = 0.842$). After 3 months, the mean SBI decreased to 0.92 ± 0.31 in the SRP + LLLT group and 1.28 ± 0.35 in the SRP-alone group, with the difference between the groups being statistically significant ($p < 0.001$). The mean reduction in SBI was also significantly greater in the SRP + LLLT group (1.29 ± 0.36) than in the SRP-alone group (0.91 ± 0.32; $p < 0.001$), demonstrating greater improvement in gingival bleeding with adjunctive LLLT.

Table 1: Comparison of SBI between the two groups

Time interval	SRP + LLLT (Test) Mean ± SD	SRP alone (Control) Mean ± SD	p-value
Baseline	2.21 ± 0.41	2.19 ± 0.39	0.842
3 months	0.92 ± 0.31	1.28 ± 0.35	<0.001*

Mean reduction	1.29 ± 0.36	0.91 ± 0.32	<0.001*

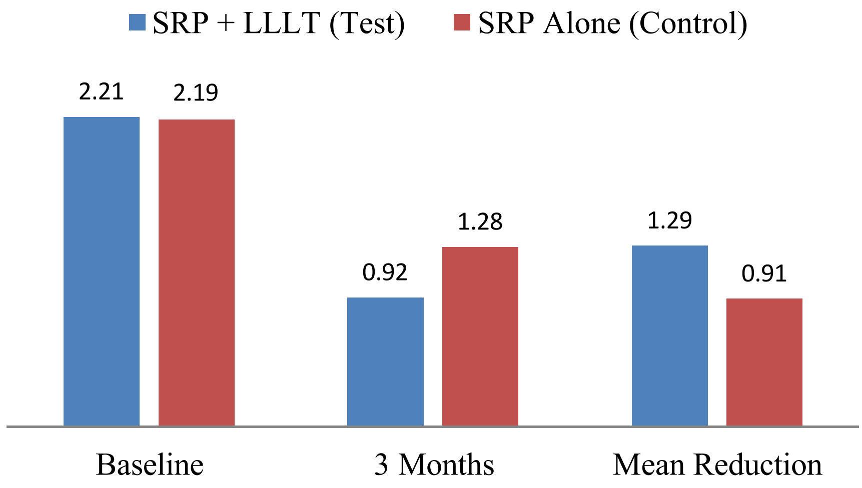

Figure 1: Comparison of mean SBI at baseline and 3 months between the SRP + LLLT and SRP-alone groups.

Table 2 & Figure 2 present a comparison of PPD between the study groups. At baseline, the mean PPD was comparable between the SRP + LLLT group (4.32 ± 0.48 mm) and the SRP-alone group (4.29 ± 0.46 mm), with no statistically significant intergroup difference ($p = 0.812$). After 3 months of treatment, the mean PPD decreased to 2.78 ± 0.39 mm in the SRP + LLLT group and 3.18 ± 0.42 mm in the SRP-alone group, with a significant difference between the groups ($p < 0.001$). The mean reduction in PPD was significantly greater in the SRP + LLLT group (1.54 ± 0.41 mm) than in the SRP-alone group (1.11 ± 0.38 mm; $p < 0.001$), indicating a greater reduction in PPD with adjunctive LLLT.

Table 2: Comparison of PPD between the two groups

Time interval	SRP + LLLT (Test) Mean ± SD (mm)	SRP alone (Control) Mean ± SD (mm)	p-value
Baseline	4.32 ± 0.48	4.29 ± 0.46	0.812
3 months	2.78 ± 0.39	3.18 ± 0.42	<0.001*
Mean reduction	1.54 ± 0.41	1.11 ± 0.38	<0.001*

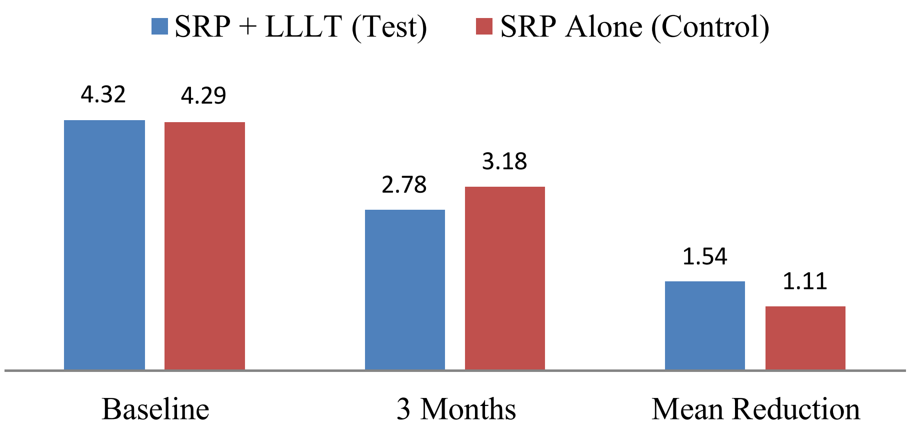

Figure 2: Comparison of mean PPD at baseline and 3 months between the SRP + LLLT and SRP-alone groups.

Table 3 & Figure 3 present a comparison of CAL between the study groups. At baseline, the mean CAL was comparable between the SRP + LLLT group (4.78 ± 0.52 mm) and the SRP-alone group (4.74 ± 0.50 mm), with no statistically significant intergroup difference (p = 0.765). After 3 months, the mean CAL was 3.89 ± 0.46 mm in the SRP + LLLT group and 4.12 ± 0.48 mm in the SRP-alone group; however, this intergroup difference did not reach statistical significance (p = 0.061). Nevertheless, the mean CAL gain was significantly greater in the SRP + LLLT group (0.89 ± 0.31 mm) than in the SRP-alone group (0.62 ± 0.28 mm; p = 0.002), indicating a greater improvement in periodontal attachment with adjunctive LLLT.

Table 3: Comparison of CAL between the two groups

Time interval	**SRP + LLLT (Test) Mean ± SD (mm)**	**SRP alone (Control) Mean ± SD (mm)**	**p-value**
Baseline	4.78 ± 0.52	4.74 ± 0.50	0.765
3 months	3.89 ± 0.46	4.12 ± 0.48	0.061
Mean attachment gain	0.89 ± 0.31	0.62 ± 0.28	0.002*

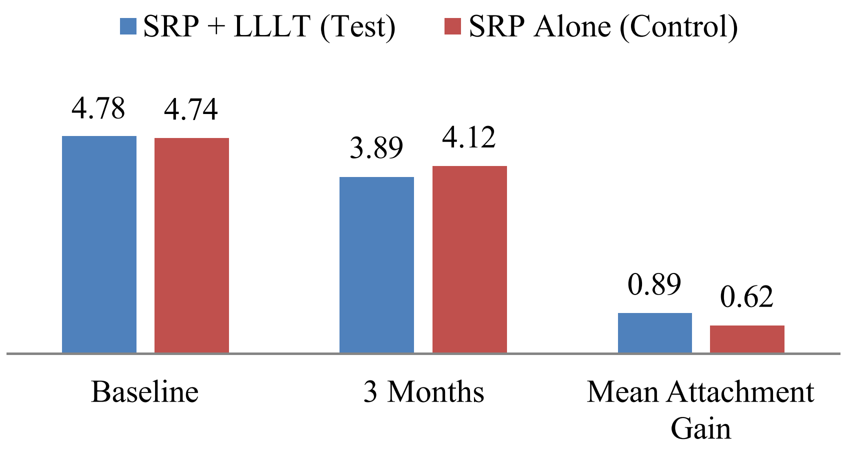

Figure 3: Comparison of mean CAL at baseline and 3 months and CAL gain between the SRP + LLLT and SRP-alone groups.

Table 4 & Figure 4 present a comparison of subgingival *P. gingivalis* counts between the study groups. At baseline, the mean subgingival *P. gingivalis* count was comparable between the SRP + LLLT group (5.82 ± 0.54) and the SRP-alone group (5.79 ± 0.51), with no statistically significant intergroup difference (p = 0.826). After 3 months, the bacterial count decreased to 3.21 ± 0.48 in the SRP + LLLT group and 4.18 ± 0.52 in the SRP-alone group, with a statistically significant difference between the groups (p < 0.001). Furthermore, the mean reduction in *P. gingivalis* count was significantly greater in the SRP + LLLT group (2.61 ± 0.51) than in the SRP-alone group (1.61 ± 0.47; p < 0.001), demonstrating a greater microbiological response with adjunctive LLLT.

Table 4: Comparison of subgingival *P. gingivalis* count between the two groups

Time interval	**SRP + LLLT (Test) Mean ± SD**	**SRP alone (Control) Mean ± SD**	**p-value**
Baseline	5.82 ± 0.54	5.79 ± 0.51	0.826
3 months	3.21 ± 0.48	4.18 ± 0.52	<0.001*
Mean reduction	2.61 ± 0.51	1.61 ± 0.47	<0.001*

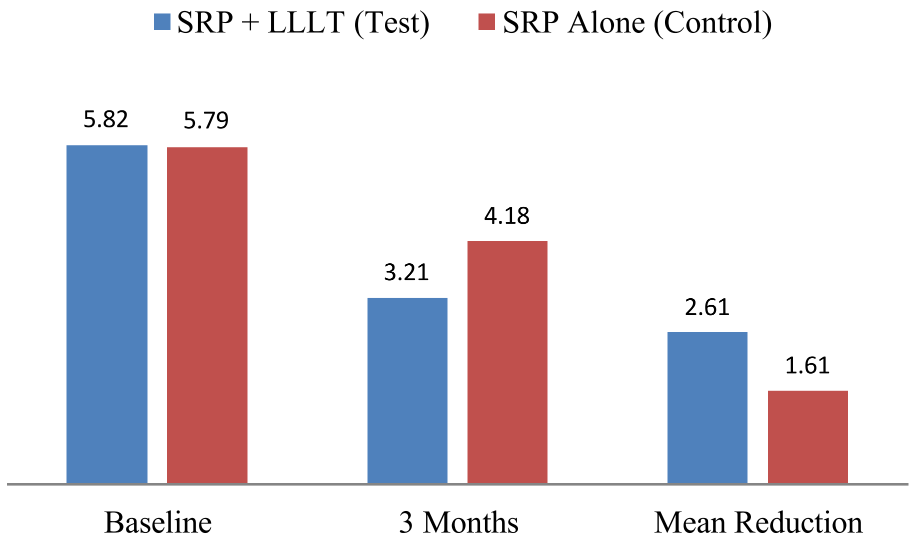

Figure 4: Comparison of mean subgingival *P. gingivalis* counts at baseline and 3 months between the SRP + LLLT and SRP-alone groups

Table 5 & Figure 5 present a within-group comparison of clinical and microbiological parameters in the SRP + LLLT group. The within-group analysis demonstrated significant improvements in all evaluated clinical and microbiological parameters following 3 months of treatment with adjunctive LLLT. The mean SBI decreased from 2.21 ± 0.41 at baseline to 0.92 ± 0.31 at 3 months, while mean PPD reduced from 4.32 ± 0.48 mm to 2.78 ± 0.39 mm. Similarly, mean CAL improved from 4.78 ± 0.52 mm to 3.89 ± 0.46 mm. The mean subgingival *P. gingivalis* count also showed a marked reduction, from 5.82 ± 0.54 to 3.21 ± 0.48. All observed changes were highly statistically significant ($p < 0.001$), indicating substantial clinical and microbiological improvement following SRP with adjunctive LLLT.

Table 5: Within-group comparison of clinical and microbiological parameters from baseline to 3 months in the SRP + LLLT group

Parameter	**Baseline Mean ± SD**	**3 Months Mean ± SD**	**p-value**
SBI	2.21 ± 0.41	0.92 ± 0.31	<0.001*
PPD (mm)	4.32 ± 0.48	2.78 ± 0.39	<0.001*
CAL (mm)	4.78 ± 0.52	3.89 ± 0.46	<0.001*
P. gingivalis count	5.82 ± 0.54	3.21 ± 0.48	<0.001*

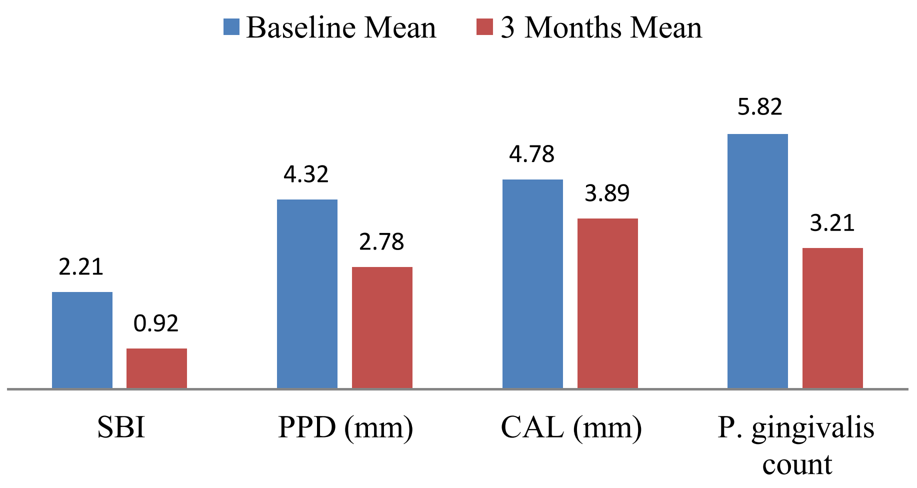

Figure 5: Within-group comparison of clinical and microbiological parameters at baseline and 3 months in the SRP + LLLT group

Table 6 & Figure 6 present a within-group comparison of clinical and microbiological parameters in the SRP-alone group. The within-group analysis revealed significant improvements across all assessed clinical and microbiological parameters following 3 months of SRP alone. The mean SBI decreased from 2.19 ± 0.39 at baseline to 1.28 ± 0.35 at 3 months, while mean PPD declined from 4.29 ± 0.46 mm to 3.18 ± 0.42 mm. Mean CAL also improved from 4.74 ± 0.50 mm to 4.12 ± 0.48 mm. Additionally, the mean subgingival *P. gingivalis* count decreased from 5.79 ± 0.51 to 4.18 ± 0.52. All changes were statistically significant ($p < 0.001$), demonstrating significant clinical and microbiological improvement following conventional SRP therapy.

Table 6: Within-group comparison of clinical and microbiological parameters from baseline to 3 months in the SRP-alone group

Parameter	Baseline Mean ± SD	3 Months Mean ± SD	p-value
SBI	2.19 ± 0.39	1.28 ± 0.35	<0.001*
PPD (mm)	4.29 ± 0.46	3.18 ± 0.42	<0.001*
CAL (mm)	4.74 ± 0.50	4.12 ± 0.48	<0.001*
P. gingivalis count	5.79 ± 0.51	4.18 ± 0.52	<0.001*

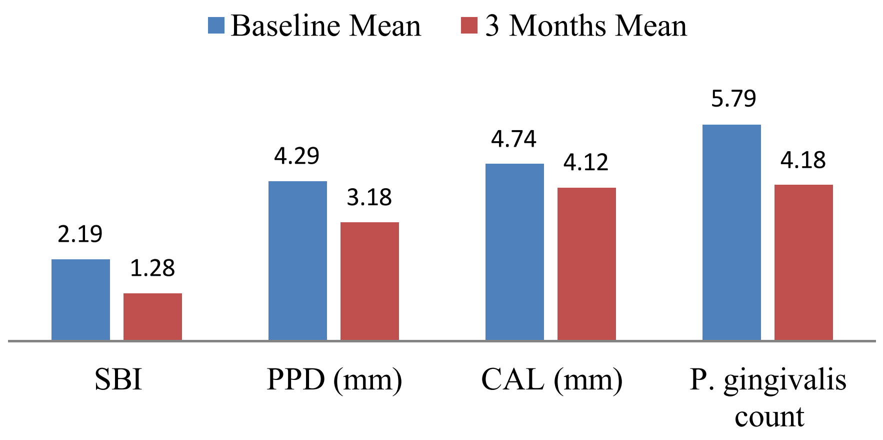

Figure 6: Within-group comparison of clinical and microbiological parameters at baseline and 3 months in the SRP-alone group.

Limitations

The present study has several limitations that should be considered when interpreting the findings. First, the follow-up period was limited to 3 months, which does not allow assessment of the long-term stability of the clinical and microbiological improvements observed with adjunctive LLLT. Periodontal healing and changes in the subgingival microbiota may continue beyond this period, and longer follow-up is required to determine whether the benefits of LLLT are sustained.

Second, the study evaluated a relatively limited number of clinical and microbiological parameters. Although SBI, PPD, CAL, and *P. gingivalis* counts provided useful information regarding periodontal response, other parameters such as plaque levels, gingival inflammation, alveolar bone changes, broader microbial profiles, and inflammatory biomarkers were not assessed. Evaluation of these factors could provide a more comprehensive understanding of the mechanisms underlying the additional benefits of LLLT.

Third, microbiological assessment was restricted primarily to *P. gingivalis*. Periodontal disease involves a complex polymicrobial community, and changes in a single periodontal pathogen may not fully represent alterations in the overall subgingival microbial environment. Future studies incorporating comprehensive microbial profiling may provide greater insight into the antimicrobial effects of LLLT.

Finally, although the split-mouth design reduces interindividual variability by allowing each participant to serve as their own control, treatment effects may potentially be influenced by cross-over or carry-over effects between sites. Therefore, larger multicenter randomized clinical trials with longer observation periods, standardized laser protocols, and broader microbiological and inflammatory assessments are warranted to confirm the present findings.

Discussion

The present study demonstrated that adjunctive LLLT combined with SRP produced greater clinical and microbiological improvements than SRP alone. Significant reductions in SBI, PPD, and *P. gingivalis* counts, together with greater CAL gain, indicate that LLLT may enhance the response to conventional nonsurgical periodontal therapy.

Kamma et al. (2009) [6] evaluated 980-nm diode laser therapy in patients with aggressive periodontitis and reported improvements in clinical and microbiological parameters following laser treatment. These findings support the present observation that adjunctive laser therapy may improve periodontal inflammation and microbial control when combined with conventional periodontal treatment.

Alzoman and Diab (2016) [7] investigated the effect of gallium-aluminium-arsenide diode laser therapy on *P. gingivalis* and demonstrated a significant reduction in bacterial levels following laser treatment. This finding is consistent with the present study, in which the SRP + LLLT group showed a significantly greater reduction in *P. gingivalis* counts than the SRP-alone group, suggesting an additional antimicrobial effect of LLLT.

Yadwad et al. (2017) [8] conducted a clinico-microbiological study of diode laser therapy in chronic periodontitis and reported favorable changes in periodontal clinical and microbiological parameters. These findings correspond with the present reductions in SBI, PPD, and *P. gingivalis*, supporting the potential benefit of diode laser therapy as an adjunct to mechanical periodontal debridement.

Dervisbegovic et al. (2025) [9] evaluated adjunctive LLLT using a randomized clinical split-mouth design and reported additional periodontal benefits following laser-assisted treatment. Their findings are particularly relevant to the present study because of the comparable split-mouth methodology and support the use of LLLT as an adjunct rather than a replacement for SRP.

Holt and Ebersole (2005) [10] described *P. gingivalis, Treponema denticola, and Tannerella forsythia* as important members of the periodontal "red complex" and emphasized their contribution to periodontal disease. The significant reduction in *P. gingivalis* observed in the present study may therefore be clinically relevant, as improved microbial control could contribute to reduced periodontal inflammation and improved tissue health.

Kamma et al. (2009) [11] further demonstrated that 980-nm diode laser therapy could influence both clinical and microbial parameters in periodontal disease. Their observations reinforce the present finding that laser-assisted periodontal treatment may provide additional benefits beyond mechanical debridement alone.

Alzoman and Diab (2016) [12] reported that diode laser therapy was effective in reducing *P. gingivalis* levels in chronic periodontitis. The greater bacterial reduction observed in the present SRP + LLLT group is in agreement with their findings and suggests that LLLT may contribute to enhanced suppression of periodontal pathogens.

Yadwad et al. (2017) [13] observed significant clinical and microbiological improvements following diode laser therapy in chronic periodontitis. Their results further support the present findings of improved SBI, PPD, and microbial status following adjunctive LLLT.

Dervisbegovic et al. (2025) [14] reported beneficial periodontal effects of adjunctive LLLT in a randomized split-mouth clinical trial. The consistency between their findings and the present results strengthens the evidence that LLLT may enhance the clinical response to conventional periodontal therapy.

Holt and Ebersole (2005) [15] highlighted the pathogenic significance of the periodontal red complex, particularly the interaction of *P. gingivalis*, T. *denticola*, and *T. forsythia* in periodontal disease. The reduction of *P. gingivalis* observed with adjunctive LLLT in the present study may therefore represent an important microbiological component of the improved periodontal outcomes.

Overall, the present findings support LLLT as a useful adjunct to SRP, with additional benefits in periodontal inflammation, PPD reduction, CAL gain, and *P. gingivalis* suppression. However, variations in laser wavelength, energy parameters, treatment frequency, and follow-up periods among studies indicate the need for standardized protocols and longer-term clinical investigations.

Conclusion

Within the limitations of this study, adjunctive LLLT with SRP produced significantly greater clinical and microbiological improvements than SRP alone over 3 months. The SRP + LLLT group showed greater reductions in SBI, PPD, and subgingival *P. gingivalis*, along with greater CAL gain. These findings indicate that LLLT may enhance the effectiveness of nonsurgical periodontal therapy. However, longer-term studies with larger samples are required to confirm the sustainability of these benefits and establish optimal LLLT protocols.

Conflicts of Interest: Nil

Financial Support: None

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