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Original Research

A Comparative Study of Scaling and Root Planing Alone vs Scaling and Root Planing with Adjunctive Laser Therapy

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ABSTRACT:

Background: Chronic periodontitis is a prevalent inflammatory disease characterized by progressive destruction of periodontal tissues, leading to attachment loss and pocket formation. Scaling and root planing (SRP) remains the gold standard for non-surgical periodontal therapy; however, limitations in accessing deep periodontal pockets and eliminating pathogenic microorganisms have led to the exploration of adjunctive modalities. Diode lasers, because of their bactericidal and biostimulatory effects, have been proposed as a beneficial adjunct to SRP. This study evaluates the comparative effectiveness of SRP alone versus SRP combined with adjunctive diode laser therapy. **Aim:** To compare the clinical outcomes of scaling and root planing alone with scaling and root planing combined with adjunctive diode laser therapy in patients with chronic periodontitis. **Material and Methods:** A total of 40 systemically healthy patients diagnosed with chronic periodontitis were recruited and randomly allocated into two groups of 20 each. Group A received conventional SRP alone, while Group B received SRP followed by adjunctive diode laser therapy. Clinical parameters assessed included Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Clinical Attachment Level (CAL), Bleeding on Probing (BOP), and Gingival Recession (GR). All assessments were recorded at baseline and follow-up by a calibrated examiner using standardized periodontal probes. Data were analyzed using SPSS version 26.0, with $p < 0.05$ considered statistically significant. **Results:** Both treatment groups showed significant improvements in PI, GI, PPD, CAL, and BOP after therapy. However, Group B demonstrated significantly greater improvements in PI reduction (53.77% vs 37.14%), GI reduction (55.26% vs 38.05%), PPD reduction (38.82% vs 25.16%), and CAL gain (2.08 mm vs 1.22 mm) compared with Group A. Additionally, BOP reduction was more substantial in the laser group (62.53%) than in the SRP-only group (44.70%). Gingival recession increased slightly in both groups, with no significant intergroup difference. **Conclusion:** Diode laser therapy used as an adjunct to scaling and root planing significantly enhances periodontal healing outcomes compared with SRP alone. The combined approach offers superior improvements in plaque control, inflammation reduction, pocket depth reduction, and clinical attachment gain, making it a valuable adjunctive tool in non-surgical periodontal therapy.

Keywords: Chronic periodontitis, Scaling and root planing, Diode laser, Periodontal therapy, Clinical attachment level

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INTRODUCTION

Periodontitis is a chronic inflammatory disease of the supporting tissues of the teeth characterized by progressive destruction of the periodontal ligament and alveolar bone, ultimately leading to tooth mobility and loss if left untreated. Beyond its local effects, periodontitis has been increasingly recognized as a significant public health concern because of its high prevalence, impact on oral function and quality of life, and potential associations with systemic conditions such as diabetes and cardiovascular disease. Global burden estimates indicate that severe periodontitis is one of the most prevalent diseases worldwide, affecting a considerable proportion of adults and contributing substantially to years lived with disability, underscoring the need for effective preventive and therapeutic strategies.[1]The etiopathogenesis of periodontitis is multifactorial, involving a complex interplay between a dysbiotic subgingival biofilm and a susceptible host immune-inflammatory response. Dental plaque is a structured, multispecies biofilm in which microorganisms are

embedded in an extracellular matrix that provides protection from environmental stresses and external antimicrobial agents. Shifts in the composition and activity of this biofilm, driven by ecological changes such as poor oral hygiene or systemic risk factors, favor the overgrowth of pathogenic species and the production of virulence factors that elicit a destructive host response.[2] This culminates in the formation of periodontal pockets, clinical attachment loss, and radiographic bone defects.Non-surgical periodontal therapy, primarily in the form of scaling and root planing (SRP), remains the cornerstone and first-line approach in the treatment of chronic periodontitis. SRP aims to mechanically disrupt and remove supra- and subgingival plaque, calculus, and contaminated cementum, thereby reducing the bacterial load and creating a root surface compatible with periodontal healing. Evidence from numerous clinical trials demonstrates that thorough SRP can result in clinically meaningful reductions in probing pocket depth and gains in clinical attachment level, particularly in sites with mild to moderate baseline involvement.[3] However, despite its established effectiveness, SRP alone may not always achieve complete resolution of deep periodontal pockets or eliminate pathogenic microorganisms from anatomically complex sites.Several limitations of conventional SRP have been identified, including restricted access to deep or furcation-involved pockets, root surface irregularities, and patient-related factors such as plaque control and systemic health. In addition, residual microbial niches and rapid recolonization of treated sites can compromise long-term stability, especially in high-risk individuals. These challenges have prompted the development and evaluation of various adjunctive modalities to enhance the outcomes of non-surgical therapy, including systemic and local antimicrobials, host-modulation agents, photodynamic therapy, and laser irradiation. Evidence-based guidelines emphasize that SRP remains the foundation of care and that adjuncts should be justified by clear additional clinical benefit, as not all adjunctive therapies consistently improve outcomes beyond mechanical debridement alone.[4]Lasers have attracted considerable interest in periodontology because of their unique physical and biological properties. Depending on the wavelength and operating parameters, lasers can provide effective soft-tissue ablation, root surface decontamination, hemostasis, and biostimulatory (photobiomodulatory) effects on periodontal tissues. Experimental and clinical studies suggest that laser irradiation can reduce bacterial counts, inactivate endotoxins, and modulate inflammatory mediators, potentially promoting more favorable wound healing compared to conventional techniques alone. A variety of laser systems—including carbon dioxide (CO_2), neodymium-doped yttrium aluminum garnet (Nd:YAG), erbium-doped yttrium aluminum garnet (Er:YAG), erbium, chromium: yttrium scandium gallium garnet (Er,Cr:YSGG), and diode lasers—have been investigated for non-surgical and surgical periodontal procedures, each with specific indications and limitations.[5]Among these, diode lasers (commonly operating in the 810–980 nm wavelength range) have become popular in clinical practice owing to their relatively compact design, fiber-optic delivery systems, and affinity for pigmented tissues and chromophores present in inflamed periodontal pockets. Early clinical investigations demonstrated that diode laser irradiation of periodontal pockets could achieve greater bacterial reduction and more pronounced improvements in bleeding on probing and pocket depth compared with mechanical instrumentation alone, suggesting a potential adjunctive benefit. The ability of diode lasers to selectively target inflamed soft tissues while sparing hard tissues, combined with the potential for improved patient comfort and hemostasis, further supports their use as an adjunct to SRP in the management of chronic periodontitis.[6]More recent randomized clinical studies have continued to explore the adjunctive value of diode lasers in non-surgical periodontal therapy. These trials generally report that combining diode laser irradiation with SRP can enhance reductions in probing depth and bleeding indices and may be associated with improved clinical attachment gains compared with SRP alone, although the magnitude and durability of these effects vary across studies. For example, adjunctive diode laser therapy has been associated with superior improvements in clinical parameters and reductions in biochemical markers of inflammation and tissue breakdown when compared with mechanical instrumentation alone or even with certain surgical approaches. Nevertheless, heterogeneity in study design, laser settings, application protocols, and follow-up durations means that further well-controlled clinical trials are required to clarify the specific indications, optimal parameters, and true clinical relevance of diode laser adjuncts in routine periodontal practice.[7]

MATERIAL AND METHODS

This comparative clinical study was conducted in the Department of Periodontology at the Genesis Institute of Dental Sciences and Research, Firozpur, Punjab. The study followed a parallel-group design, evaluating the clinical outcomes of Scaling and Root Planing (SRP) alone versus SRP combined with adjunctive laser therapy. Ethical approval was obtained from the institutional ethical committee, and all participants provided written informed consent before enrolment.

A total of 40 systemically healthy patients diagnosed with chronic periodontitis were selected using purposive sampling. Patients aged between 25 and 55 years and presenting with probing pocket depths (PPD) ≥5 mm in at least two quadrants were included. Exclusion criteria were pregnancy or lactation, history

of periodontal therapy within the past six months, use of antibiotics or anti-inflammatory drugs within the last three months, smokers, individuals with systemic diseases affecting periodontal health, and those with pacemakers or contraindications to laser exposure.

Methodology
All 40 patients were randomly allocated into two equal groups, with 20 patients in each group. Group A received conventional Scaling and Root Planing alone, whereas Group B received Scaling and Root Planing followed by adjunctive diode laser therapy. Randomization was performed using a simple chit method to minimize selection bias.

Clinical Parameters Assessed
The periodontal status of each patient was evaluated using standardized clinical parameters. The primary outcome measures included Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL). The secondary parameters included Bleeding on Probing (BOP) and Gingival Recession (GR). All measurements were recorded using a UNC-15 periodontal probe by a single calibrated examiner to ensure reproducibility and reduce inter-examiner variability.

Clinical Procedure
Group A patients underwent thorough Scaling and Root Planing using both ultrasonic scalers and area-specific Gracey curettes until a smooth root surface was achieved. Group B patients received the same mechanical debridement, followed by adjunctive laser therapy using a diode laser (810–980 nm wavelength). Laser irradiation was applied in a sweeping motion along the pocket wall after SRP, with the fiber tip inserted parallel to the root surface. The laser settings, fiber diameter, and exposure were standardized to maintain uniformity. Patients were instructed to follow routine oral hygiene practices without any adjunctive chemical agents.
All clinical parameters were recorded at baseline and at subsequent follow-up visits to evaluate improvement in periodontal health. Reinforcement of oral hygiene instructions was given at each visit, but no additional periodontal interventions were performed during the evaluation phase.

Statistical Analysis
All data collected from the clinical measurements were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics, including mean and standard deviation, were calculated for all parameters. Intragroup comparisons were performed using paired t-tests, while intergroup comparisons between Group A and Group B were conducted using independent t-tests. A p-value of <0.05 was considered statistically significant for all analyses.

RESULTS

Table 1: Baseline Characteristics of the Study Population
Table 1 presents the baseline demographic characteristics of the 40 patients enrolled in the study. Both groups were comparable in terms of age and gender distribution. The mean age in Group A was 41.35 ± 7.12 years, while Group B had a mean age of 40.85 ± 6.94 years, showing no statistically significant difference between the groups ($p = 0.78$). Similarly, the distribution of males and females was proportionate, with Group A consisting of 55% males and 45% females, whereas Group B had 60% males and 40% females. The p-value of 0.75 for gender distribution indicates no statistically meaningful difference between the groups.

Table 2: Plaque Index (PI) Comparison Between Groups
Table 2 demonstrates the effect of SRP alone versus SRP combined with laser therapy on plaque accumulation. At baseline, both groups had comparable PI values (Group A: 2.10 ± 0.24; Group B: 2.12 ± 0.21), with no significant difference ($p = 0.78$). Following treatment, a notable reduction in PI was observed in both groups; however, the magnitude of reduction was significantly greater in the laser-assisted group. Group A showed a 37.14% reduction, whereas Group B exhibited a 53.77% reduction. The follow-up PI values were significantly lower in Group B (0.98 ± 0.15) compared to Group A (1.32 ± 0.18), with a p-value of 0.001, indicating a statistically significant superiority of adjunctive laser therapy in reducing plaque levels.

Table 3: Gingival Index (GI) Comparison Between Groups
Table 3 reports the changes in gingival inflammation between the two groups. Both groups showed similar baseline GI scores (Group A: 2.26 ± 0.27; Group B: 2.28 ± 0.25) with no significant difference ($p = 0.84$). After treatment, gingival inflammation decreased markedly in both groups, but Group B demonstrated a substantially higher reduction. Group A showed a 38.05% reduction in GI, while Group B achieved a 55.26% decrease. The follow-up GI value was significantly lower in the laser group (1.02 ± 0.17) compared to the SRP-only group (1.40 ± 0.20), with a p-value of 0.002.

Table 4: Probing Pocket Depth (PPD) Comparison Between Groups
Table 4 evaluates the impact of the two treatment modalities on probing pocket depth. Baseline PPD values were similar between the groups (Group A: 6.12 ± 0.51 mm; Group B: 6.08 ± 0.48 mm; $p = 0.66$), ensuring comparability before treatment. After therapy, both groups demonstrated significant reductions in PPD. However, Group B exhibited a more substantial reduction of 38.82%, compared with

25.16% in Group A. The follow-up PPD was considerably lower in Group B (3.72 ± 0.40 mm) than in Group A (4.58 ± 0.46 mm), and the difference was statistically significant (p = 0.000).

Table 5: Clinical Attachment Level (CAL) Gain Between Groups

Table 5 compares CAL gain between the two groups. Initially, there was no significant difference in CAL measurements (Group A: 7.24 ± 0.60 mm; Group B: 7.18 ± 0.58 mm; p = 0.71). Following treatment, both groups showed improvements in attachment levels, but the laser-assisted group demonstrated a greater gain. Group A achieved a CAL gain of 1.22 mm (16.85%), while Group B achieved a markedly higher gain of 2.08 mm (28.99%). The follow-up CAL values were significantly better in Group B (5.10 ± 0.46 mm) compared to Group A (6.02 ± 0.52 mm), with the difference being statistically significant (p = 0.001).

Table 6: Bleeding on Probing (BOP) and Gingival Recession (GR) Comparison

Table 6 summarizes the changes in BOP and gingival recession. At baseline, both groups had nearly identical BOP percentages (Group A: 76.50%; Group B: 75.80%). After treatment, Group A showed a reduction to 42.30%, representing a 44.70% improvement, whereas Group B demonstrated a more pronounced reduction to 28.40%, amounting to a 62.53% improvement. The difference was statistically significant (p = 0.003), indicating that adjunctive laser therapy significantly enhances bleeding control. Regarding gingival recession, both groups showed slight increases following treatment. Group A exhibited a 10.87% increase (from 0.92 mm to 1.02 mm), while Group B showed a 12.76% increase (from 0.94 mm to 1.06 mm). The difference between the groups was not statistically significant (p = 0.41).

Table 1. Baseline Characteristics of the Study Population (n = 40)

Variable	Group A (SRP Alone) n=20	Group B (SRP + Laser) n=20	p-value
Mean Age (years)	41.35 ± 7.12	40.85 ± 6.94	0.78
Male (%)	11 (55.00%)	12 (60.00%)	0.75
Female (%)	9 (45.00%)	8 (40.00%)	0.75

Table 2. Comparison of Plaque Index (PI) Between Group A (SRP) and Group B (SRP + Laser)

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	% Reduction in Group A	% Reduction in Group B	p-Value
Baseline	2.10 ± 0.24	2.12 ± 0.21	–	–	0.78
Follow-up	1.32 ± 0.18	0.98 ± 0.15	37.14%	53.77%	**0.001***

*Significant difference at p < 0.05

Table 3. Comparison of Gingival Index (GI) Between Groups

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	% Reduction in Group A	% Reduction in Group B	p-Value
Baseline	2.26 ± 0.27	2.28 ± 0.25	–	–	0.84
Follow-up	1.40 ± 0.20	1.02 ± 0.17	38.05%	55.26%	**0.002***

Table 4. Comparison of Probing Pocket Depth (PPD) Between Groups

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	% Reduction in Group A	% Reduction in Group B	p-Value
Baseline	6.12 ± 0.51	6.08 ± 0.48	–	–	0.66
Follow-up	4.58 ± 0.46	3.72 ± 0.40	25.16%	38.82%	**0.000***

Table 5. Comparison of Clinical Attachment Level (CAL) Gain

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	Gain in Group A	Gain in Group B	p-Value
Baseline	7.24 ± 0.60	7.18 ± 0.58	–	–	0.71
Follow-up	6.02 ± 0.52	5.10 ± 0.46	1.22 mm (16.85%)	2.08 mm (28.99%)	**0.001***

Table 6. Comparison of Bleeding on Probing (BOP) & Gingival Recession (GR)

Parameter	Group A Baseline	Group A Follow-up	Change (%)	Group B Baseline	Group B Follow-up	Change (%)	p-Value
BOP (%)	76.50%	42.30%	44.70%	75.80%	28.40%	62.53%	**0.003***
GR (mm)	0.92 ± 0.18	1.02 ± 0.20	↑10.87%	0.94 ± 0.16	1.06 ± 0.21	↑12.76%	0.41

DISCUSSION

In the present comparative clinical study, both treatment groups were well balanced at baseline in terms of age and gender distribution, which minimizes selection bias and allows a direct comparison of treatment effects. The mean age of our sample (Group A: 41.35 ± 7.12 years; Group B: 40.85 ± 6.94 years) is slightly younger than in many laser-assisted periodontal trials, which frequently include patients in their fifth decade of life, but still falls within the typical age range for chronic periodontitis populations. Coluzzi et al. (2020) reported that most randomized laser studies included 19–52 subjects and used SRP as the common foundational therapy, similar to our design, supporting the external validity of our findings.[8]

Overall, the present results indicate that adjunctive diode laser therapy enhances the clinical benefits of conventional SRP, particularly with respect to plaque control and inflammatory parameters. In our study, the SRP + laser group showed greater percentage reductions in PI (53.77% vs 37.14%), GI (55.26% vs 38.05%), PPD (38.82% vs 25.16%), and BOP (62.53% vs 44.70%) compared to SRP alone, with statistically significant intergroup differences for most parameters. AlZoubi et al. (2023), in an overview of 24 systematic reviews on adjunctive laser therapy, similarly concluded that lasers combined with non-surgical periodontal therapy may improve short-term clinical outcomes, although evidence for long-term superiority remains limited, which is in line with the short-term nature of our follow-up.[9]

With regard to plaque control, both groups in our study exhibited substantial PI reductions after therapy, but the laser group demonstrated a markedly greater decrease (53.77% vs 37.14%). This suggests that diode laser irradiation may facilitate better plaque control, possibly by reducing subgingival microbial load and improving patient comfort, thereby encouraging oral hygiene compliance. In contrast, Dukić et al. (2013) observed that adjunctive 980-nm diode laser therapy, applied on days 1, 3, and 7 after SRP in a split-mouth trial, did not confer additional benefit on approximal plaque index compared with SRP alone, although a significant PD gain was seen in moderate (4–6 mm) pockets.[10]

Gingival inflammation, assessed by GI, also improved in both groups, but significantly more in the SRP + laser group (55.26% vs 38.05% reduction). This finding reinforces the anti-inflammatory potential of diode laser adjuncts. Gündoğar et al. (2016) evaluated low-level laser therapy (LLLT) as an adjunct to non-surgical periodontal treatment in a randomized, split-mouth trial and reported significantly lower GI and PPD values in laser-treated sites compared with SRP alone at 3 and 6 months, along with improved CAL.[11] Although their laser type and power settings differ from the diode laser used in the present study, both studies support that appropriate laser adjuncts can enhance resolution of gingival inflammation beyond that achieved with mechanical debridement alone.

Reduction in PPD is a key indicator of successful periodontal therapy. In our study, mean PPD decreased from 6.12 ± 0.51 mm to 4.58 ± 0.46 mm (25.16% reduction) in the SRP group and from 6.08 ± 0.48 mm to 3.72 ± 0.40 mm (38.82% reduction) in the SRP + laser group, with a highly significant intergroup difference ($p = 0.000$). These findings align with the split-mouth trial by Abduljabbar et al. (2017), who found that, at 3- and 6-month follow-up, sites treated with adjunctive Nd:YAG laser exhibited significantly lower PPD, PI and BOP values than SRP-alone sites, together with reduced levels of inflammatory cytokines (IL-1β and TNF-α) in gingival crevicular fluid.[12]

Clinical attachment level gain is another critical parameter, reflecting true periodontal healing rather than mere pocket-epithelium shrinkage. In the present study, CAL improved by 1.22 mm (16.85%) in the SRP group and 2.08 mm (28.99%) in the SRP + laser group, with significantly better post-treatment CAL in the laser group ($p = 0.001$). This magnitude of attachment gain compares favorably with the network meta-analysis by Jia et al. (2020), which evaluated 25 randomized trials and ranked Er:YAG monotherapy and diode laser adjuncts among the most effective interventions for CAL gain at 3 and 6 months, with laser-assisted protocols generally outperforming SRP alone in the overall hierarchy of treatments.[13]

Bleeding on probing is a sensitive marker of active inflammation and treatment success. In our study, BOP decreased from 76.50% to 42.30% (44.70% reduction) in the SRP group and from 75.80% to 28.40% (62.53% reduction) in the SRP + laser group, with a significant between-group difference ($p = 0.003$). Ciurescu et al. (2024) reported similar trends in a randomized study where Er,Cr:YSGG laser adjuncts to SRP reduced PPD and CAL more than SRP plus chlorhexidine, and BOP in the laser group dropped from 0.587 ± 0.176 at baseline to 0.055 ± 0.048 at the first follow-up (≈90.63% reduction), compared with a reduction from 0.744 ± 0.154 to 0.334 ± 0.157 (≈55.11%) in the control group.[14]

The pattern of improvements observed in our study also fits well within the broader evidence on diode laser adjuncts. Yu et al. (2022), in a systematic review and meta-analysis of 30 randomized controlled trials involving 825 participants, found that single-session "inside-pocket" diode laser significantly improved PPD and CAL at short-term and 3-month follow-up, and improved PI at 3 and 6 months and GI at all evaluated time points compared with SRP alone; multi-session "outside-pocket" protocols also yielded notable benefits for most clinical outcomes.[15]

Although gingival recession increased slightly in both groups in our study (10.87% in SRP and 12.76% in SRP + laser) with no significant intergroup difference ($p = 0.41$), this small change likely reflects soft-tissue shrinkage following inflammation resolution and root

debridement rather than a detrimental effect of laser irradiation per se. Theoretical concerns about additional recession or tissue damage with laser use have been raised; however, the current evidence does not support a consistent harmful effect when lasers are used within recommended settings. Karlsson et al. (2008), in an early systematic review of four randomized trials, found no consistent evidence that adjunctive laser therapy improved CAL, PPD or BOP compared with SRP alone, but importantly did not report systematic adverse soft-tissue outcomes, highlighting that safety is acceptable even when efficacy is variable.[16]

CONCLUSION

The findings of this study demonstrate that adjunctive diode laser therapy significantly enhances the clinical outcomes of conventional scaling and root planing in patients with chronic periodontitis. Compared with SRP alone, the combined approach produced greater reductions in plaque index, gingival inflammation, probing pocket depth, and bleeding on probing, as well as superior gains in clinical attachment level. Both treatments were safe and well tolerated, with no significant differences in gingival recession. Overall, SRP with adjunctive laser therapy offers a more effective non-surgical option for improving periodontal health and supporting tissue healing.

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