

Comparative Evaluation of the Efficacy of Curcumin Gel and Laser Pocket Irradiation as Adjuncts to Scaling and Root Planning in the Treatment of Chronic Periodontitis: A Randomized Clinical Study

Dr. Lisa Chacko¹, Dr. Shivani Karmalkar²

¹Professor & PG Guide- Department of Periodontology, SMBT Dental College and Hospital Sangamner, Maharashtra, India

²PG Student- Department of Periodontology, SMBT Dental College and Hospital Sangamner, Maharashtra, India

Corresponding Author Email: [karmalkarshivani2\[at\]gmail.com](mailto:karmalkarshivani2[at]gmail.com)

Abstract: *This randomized clinical trial compared scaling and root planing (SRP) alone, SRP with diode laser therapy, and SRP combined with diode laser therapy and 2% curcumin gel in patients with chronic periodontitis. Thirty systemically healthy patients aged 30 to 70 years were allocated to three treatment groups and evaluated at baseline, 6 weeks, and 3 months. Clinical assessment included Plaque Index, Gingival Index, bleeding on probing, probing pocket depth, and clinical attachment level. All three treatment approaches produced improvement during follow-up. The combination of SRP, diode laser, and curcumin gel produced the greatest reductions in plaque, gingival inflammation, bleeding on probing, and pocket depth, together with the highest clinical attachment gain at 3 months. Differences among the groups were statistically significant at both follow-up periods. The combined antibacterial action of diode laser therapy and the anti-inflammatory and wound-healing properties of curcumin may provide added clinical benefit in periodontal care. Within the limitations of the small sample and short follow-up period, 2% curcumin gel used with diode laser therapy may serve as a useful adjunct to conventional non-surgical treatment for chronic periodontitis.*

Keywords: Chronic Periodontitis, Curcumin Gel, Diode Laser, Scaling and Root Planing, Periodontal Healing

1. Introduction

Periodontitis is a chronic multifactorial inflammatory disease characterized by progressive destruction of the periodontal supporting tissues due to a dysregulated host immune response to periodontopathogenic bacteria.¹ Owing to its high prevalence and impact on oral health, continuous advancements in periodontal therapy are essential.² The primary goal of periodontal therapy is to control inflammation, eliminate periodontal pathogens, and promote healing of the periodontal tissues.³

Scaling and root planing (SRP) is considered the gold standard non-surgical treatment for periodontal disease and is widely used for both therapy and maintenance.⁴ However, SRP alone may not always achieve complete regeneration of periodontal tissues.^{5,6} Healing following SRP commonly results in the formation of a long junctional epithelium, which may contribute to recurrence of periodontal pockets.⁷ Therefore, several adjunctive therapies such as antimicrobial agents, local drug delivery, gingival irrigation, and photodynamic therapy have been introduced to improve periodontal healing outcomes.^{3,8,9,10,11}

Recently, laser-assisted periodontal therapy has gained attention as an adjunct to conventional mechanical debridement because of its bactericidal and detoxification effects, along with its ability to access areas inaccessible to conventional instruments.^{12,13,14} Laser therapy also promotes reduction of inflammation, enhances cell proliferation, and

improves periodontal tissue healing.¹³ Among the various laser systems available, diode lasers are widely preferred due to their compact size, affordability, and effectiveness in soft tissue procedures.¹⁴ Diode lasers exhibit significant antibacterial effects and aid in periodontal pocket healing when used along with SRP.¹⁵

Various chemical antiplaque agents such as chlorhexidine, triclosan, and povidone-iodine have also been used as adjuncts to periodontal therapy. However, their prolonged use may result in side effects including allergic reactions, tooth staining, and unpleasant taste.¹⁶ This has increased interest in herbal alternatives with fewer adverse effects.

Herbal agents such as turmeric have been extensively used in traditional medicine and have gained attention in dentistry because of their therapeutic properties.¹⁷ Curcumin, the principal active component of turmeric, possesses anti-inflammatory, antioxidant, antibacterial, antifungal, and wound-healing properties.^{18,19} Studies have shown that curcumin enhances collagen synthesis, fibroblast proliferation, angiogenesis, and granulation tissue formation, thereby improving periodontal healing and regeneration.^{20,21,22}

Considering the beneficial effects of diode laser therapy and curcumin, the present study was undertaken to evaluate the effects of curcumin gel and laser pocket irradiation as adjuncts to scaling and root planing in patients with chronic periodontitis.

2. Materials and Methods

Study Design

The present study was designed as a parallel arm randomized clinical trial conducted to evaluate and compare the efficacy of scaling and root planing (SRP) alone, SRP with diode laser therapy, and SRP with diode laser and curcumin gel in the treatment of chronic periodontitis. The study protocol was approved by the Institutional Ethics Committee, and the trial was registered under the Clinical Trial Registry of India (CTRI No. CTRI/2026/02/103303). The study was conducted in the Department of Periodontology and Oral Implantology SMBT Dental college and hospital, Sangamner.

Study Population and sample size

A total of 30 systemically healthy patients aged between 30–70 years, diagnosed with chronic periodontitis were recruited for the study. Sample size estimation was performed using G*Power software version 3.1.9.2, with a confidence interval of 95%, alpha error of 5%, and study power of 80%. The calculated sample size was 30 patients, with 10 sites allocated to each treatment group.

The selected sites were randomly allocated into three groups: Group I (control group) received SRP alone, Group II received SRP with diode laser therapy, and Group III received SRP combined with diode laser and curcumin gel application. The study was designed as a single-blinded clinical trial. Systemically healthy male and female patients aged 30–70 years diagnosed with chronic periodontitis, having probing pocket depth ≥ 5 mm and < 7 mm with at least one periodontal pocket and no furcation involvement, were included after obtaining informed consent. Patients with major systemic illness, known intolerance to test products, recent antibiotic therapy, heavy smoking habits, immunosuppressive chemotherapy, pregnancy, debilitating diseases, or previous periodontal therapy were excluded. Subjects developing exclusion criteria during the study, experiencing adverse effects, unwilling to continue, or unable to comply with follow-up visits were withdrawn from the study.

Presurgical Therapy

All enrolled patients underwent full mouth supragingival and subgingival scaling and root planing using ultrasonic scalers and hand instruments. Oral hygiene instructions were reinforced before initiation of the study. After confirming the

suitability of sites based on inclusion criteria, periodontal pockets with probing depth ≥ 5 mm and < 7 mm were selected. The selected sites were randomly allocated into three groups using the lottery method.

Preparation of 2% Curcumin gel

500mg finely powdered carbopol-934 was accurately weighed and dispersed in 10 ml of deionized water using a vortex mixer. The volume of dispersion was raised to 50 ml, accurately weighed quantity of curcumin was dispersed and sonicated for 90 seconds until clear transparent dispersion was obtained. The dispersion was neutralized to attain the desired pH by adding triethanolamine until a clear transparent gel loaded with curcumin was obtained. The gel was refrigerated for 24 hours to achieve full deaeration and hydration.

3. Clinical Procedure

Group I – SRP Alone

The selected sites received supragingival and subgingival scaling and root planing using hand and ultrasonic instruments.

Group II – SRP + Diode Laser

Following SRP, diode laser irradiation was performed under relative isolation according to standard laser safety protocols. A diode laser of 940 nm wavelength with 0.8 W power output in continuous mode was used. A 300 μ m fiber tip was inserted into the periodontal pocket and moved in an apico-coronal sweeping motion for 30 seconds at each site. The entire periodontal pocket lining was irradiated at six sites around the tooth: mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual areas.

Group III – SRP + Diode Laser + Curcumin Gel

Following SRP and diode laser irradiation as described for Group II, curcumin gel was delivered into the periodontal pockets.

Postoperative Care

Patients were instructed to avoid hot and spicy foods for 24 hours, maintain gentle tooth brushing, and follow proper oral hygiene measures throughout the study period. Clinical evaluation was carried out at baseline, 6 weeks, and 3 months.

Group I – SRP Alone (FIG 1)



Figure 1: a) Pocket Probing Depth at baseline b) Scaling c) Pocket Probing Depth after 6 weeks d) Pocket Probing Depth after 3 months

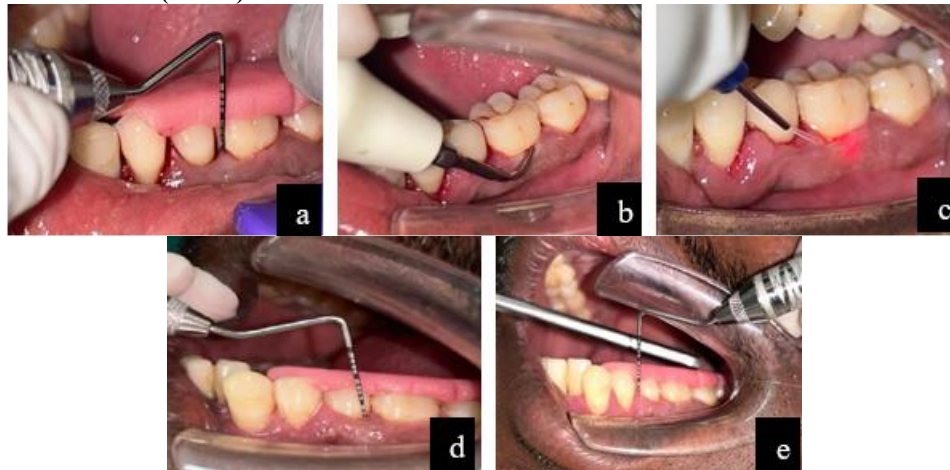
Group II – SRP + Diode Laser (FIG 2)

Figure 2: a) Pocket Probing Depth at baseline b) Scaling c) Application of Diode laser after Scaling d) Pocket Probing Depth after 6 weeks e) Pocket Probing Depth after 3 months

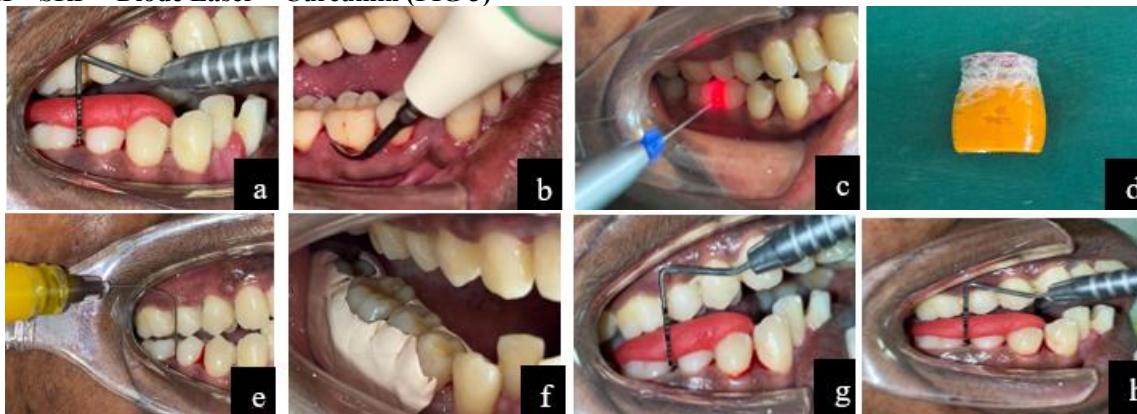
Group III – SRP + Diode Laser + Curcumin (FIG 3)

Figure 3: a) Pocket Probing Depth at baseline b) Scaling c) Application of Diode laser after Scaling d) 2% Curcumin gel prepared e) Curcumin gel application f)Coe-pack application g) Pocket Probing Depth after 6 weeks h) Pocket Probing Depth after 3 months

4. Results**Table 1:** Comparison of Plaque Index (PI)

Time Interval	Group I (SRP) Mean $\pm$ SD	Group II (SRP + Laser) Mean $\pm$ SD	Group III (SRP + Laser + Curcumin) Mean $\pm$ SD	p-value
Baseline	2.32 $\pm$ 0.24	2.35 $\pm$ 0.28	2.31 $\pm$ 0.26	0.91
6 Weeks	1.45 $\pm$ 0.20	1.20 $\pm$ 0.18	0.86 $\pm$ 0.15	<0.001*
3 Months	1.10 $\pm$ 0.16	0.82 $\pm$ 0.14	0.48 $\pm$ 0.12	<0.001*

At baseline, PI scores were comparable among all groups ($p = 0.91$). At 3 months, Group III showed the greatest reduction in PI (2.31 ± 0.26 to 0.48 ± 0.12), followed by Group II (2.35 ± 0.28 to 0.82 ± 0.14) and Group I (2.32 ± 0.24 to 1.10 ± 0.16). The intergroup difference was statistically significant ($p < 0.001$). All groups demonstrated reduction in plaque accumulation from baseline to 3 months. However, Group III showed significantly greater reduction in PI compared to Groups I and II at both follow-up intervals.

Table 2: Comparison of Gingival Index (GI)

Time Interval	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Group III Mean $\pm$ SD	p-value
Baseline	2.28 $\pm$ 0.21	2.30 $\pm$ 0.25	2.29 $\pm$ 0.23	0.88
6 Weeks	1.42 $\pm$ 0.18	1.08 $\pm$ 0.17	0.72 $\pm$ 0.14	<0.001*
3 Months	1.05 $\pm$ 0.15	0.78 $\pm$ 0.13	0.40 $\pm$ 0.10	<0.001*

All groups demonstrated significant reduction in GI scores from baseline to 3 months. Group III showed maximum improvement, with GI decreasing from 2.29 ± 0.23 to 0.40 ± 0.10 , compared to Group II (2.30 ± 0.25 to 0.78 ± 0.13) and Group I (2.28 ± 0.21 to 1.05 ± 0.15) ($p < 0.001$). A statistically significant reduction in gingival inflammation was observed in all groups. The greatest improvement was seen in Group III, suggesting enhanced anti-inflammatory effects of curcumin gel.

Table 3: Comparison of Bleeding on Probing (BOP)

Time Interval	Group I (%)	Group II (%)	Group III (%)	p-value
Baseline	92.0 $\pm$ 8.4	90.5 $\pm$ 7.8	91.2 $\pm$ 8.1	0.84
6 Weeks	48.3 $\pm$ 6.5	34.2 $\pm$ 5.8	18.4 $\pm$ 4.6	<0.001*
3 Months	32.1 $\pm$ 5.2	20.5 $\pm$ 4.1	8.2 $\pm$ 2.4	<0.001*

Bleeding on probing significantly decreased in all groups over time. BOP scores significantly reduced in all groups over the study period. Group III demonstrated the greatest reduction from $91.2 \pm 8.1\%$ at baseline to $8.2 \pm 2.4\%$ at 3 months, while Group II reduced to $20.5 \pm 4.1\%$ and Group I to $32.1 \pm 5.2\%$ ($p < 0.001$). Group III exhibited the maximum reduction in bleeding scores, indicating superior control of periodontal inflammation.

Table 4: Comparison of Probing Pocket Depth (PPD)

Time Interval	Group I Mean $\pm$ SD (mm)	Group II Mean $\pm$ SD (mm)	Group III Mean $\pm$ SD (mm)	p-value
Baseline	6.12 $\pm$ 0.44	6.08 $\pm$ 0.40	6.15 $\pm$ 0.46	0.79
6 Weeks	4.82 $\pm$ 0.36	4.20 $\pm$ 0.34	3.62 $\pm$ 0.30	<0.001*
3 Months	4.20 $\pm$ 0.32	3.52 $\pm$ 0.28	2.84 $\pm$ 0.24	<0.001*

All treatment groups showed significant reduction in probing pocket depth from baseline to 3 months. PPD reduction was observed in all groups from baseline to 3 months. Group III showed the greatest reduction from 6.15 $\pm$ 0.46 mm to 2.84 $\pm$

0.24 mm, followed by Group II (6.08 $\pm$ 0.40 mm to 3.52 $\pm$ 0.28 mm) and Group I (6.12 $\pm$ 0.44 mm to 4.20 $\pm$ 0.32 mm) ($p < 0.001$).

Table 5: Comparison of Clinical Attachment Level (CAL)

Time Interval	Group I Mean $\pm$ SD (mm)	Group II Mean $\pm$ SD (mm)	Group III Mean $\pm$ SD (mm)	p-value
Baseline	6.80 $\pm$ 0.52	6.75 $\pm$ 0.48	6.82 $\pm$ 0.50	0.87
6 Weeks	5.62 $\pm$ 0.40	4.95 $\pm$ 0.36	4.20 $\pm$ 0.32	<0.001*
3 Months	5.02 $\pm$ 0.34	4.12 $\pm$ 0.30	3.20 $\pm$ 0.28	<0.001*

Significant CAL gain was observed in all groups during the study period. Group III exhibited the highest improvement, with CAL reducing from 6.82 $\pm$ 0.50 mm at baseline to 3.20 $\pm$ 0.28 mm at 3 months, compared to Group II (6.75 $\pm$ 0.48 mm to 4.12 $\pm$ 0.30 mm) and Group I (6.80 $\pm$ 0.52 mm to 5.02 $\pm$ 0.34 mm) ($p < 0.001$). Group III demonstrated significantly greater CAL gain compared to Groups I and II at 3 months.

5. Discussion

Periodontal disease comprises a group of inflammatory conditions affecting the supporting structures of the teeth, with bacterial plaque recognized as the primary etiological factor.²³ Conventional periodontal therapy primarily involves mechanical debridement through scaling and root planing (SRP), aimed at disrupting and reducing the subgingival microbial flora, which generally results in clinical improvement.²³ However, complete elimination of pathogenic microorganisms may not always be achieved, particularly in deep periodontal pockets and anatomically inaccessible areas, thereby increasing the risk of persistent infection and disease recurrence.²⁴

In addition, SRP is a highly technique-sensitive procedure, and its effectiveness depends on factors such as the clinician's expertise, time devoted to instrumentation, and the number of sites requiring treatment.²⁵ Certain periodontal pathogens may also remain unaffected by mechanical therapy alone, highlighting the need for adjunctive antimicrobial approaches to enhance periodontal treatment outcomes.²⁶ The concept of locally delivering chemotherapeutic agents to the periodontal pocket as a method to treat periodontal disease has been studied for over few decades. Several herbal drugs have been an area of interest in the treatment of periodontal diseases.²⁷ Adjunctive therapeutic modalities such as laser therapy and local drug delivery systems have gained considerable attention in contemporary periodontal therapy.

In the present study the greatest clinical improvement was observed in Group III (SRP + diode laser + curcumin gel), which demonstrated maximum reduction in plaque accumulation, gingival inflammation, bleeding on probing, and probing pocket depth, along with the highest clinical attachment gain at 3 months. Group II (SRP + diode laser) also showed better outcomes compared to SRP alone, indicating the beneficial effects of adjunctive laser therapy. In

contrast, Group I (SRP alone) exhibited the least improvement among the three groups, although significant clinical improvement was still observed from baseline values.

Plaque scores significantly decreased in all groups, with Group III demonstrating maximum reduction at 3 months. This improvement may be attributed to the antibacterial and anti-inflammatory properties of curcumin along with the bactericidal effect of diode laser irradiation. Similar findings were reported by **Dave et al.**¹⁷ who observed significant reduction in plaque accumulation when curcumin gel was used as an adjunct to SRP in chronic periodontitis patients. **Nilofer et al.**¹⁸ also demonstrated the effectiveness of curcumin gel in reducing plaque-induced gingival inflammation.

Curcumin exerts its anti-inflammatory effects by inhibiting nuclear factor kappa-B (NF- κ B), thereby suppressing tumor necrosis factor- α (TNF- α), an important mediator of inflammation.^{28,29} It also downregulates cyclooxygenase-2 (COX-2), which is involved in prostaglandin synthesis and periodontal inflammation.³⁰ In the present study, the curcumin group showed significant improvement in GI, PI, and PPD, with results comparable to chlorhexidine, suggesting its effectiveness as an alternative local drug delivery agent in periodontal therapy. Curcumin offers additional advantages such as minimal side effects, acceptable taste, affordability, and absence of adverse effects like tooth staining or taste alteration commonly associated with chlorhexidine. Similar findings were reported by **Jaswal et al.** and **Behal et al.**^{26,31}

Greater CAL gain in Group III may be due to the combined anti-inflammatory, antimicrobial, and wound-healing effects of curcumin along with the biostimulatory action of diode laser therapy, which together enhance periodontal healing and regeneration.^{18,21} **Sidhu et al.**²² demonstrated enhanced wound healing and tissue repair with curcumin application in experimental studies. The findings of the present study are also in agreement with those of **Sgolastra et al.**¹², whose meta-analysis reported significant clinical benefits of diode laser therapy as an adjunct to SRP in chronic periodontitis.

Singh et al.³² compared turmeric chips and chlorhexidine chips as local drug delivery agents in chronic periodontitis and found both modalities to be equally effective. Similarly, **Madaan et al.**³³ reported significant improvement in clinical parameters with both green tea and turmeric-based local drug

delivery systems used adjunctively with SRP. **Kandwal et al.**³⁴ also observed comparable reductions in Plaque Index and Gingival Index between turmeric gel and 2% chlorhexidine gel in plaque-induced gingivitis; however, turmeric gel showed better patient acceptance due to its pleasant odor and absence of tooth staining.

The superior clinical outcomes observed in Group III suggest that the combined use of diode laser and curcumin gel may provide additional therapeutic benefits beyond conventional SRP alone. The antimicrobial effects of laser irradiation together with the anti-inflammatory and healing properties of curcumin appear to contribute synergistically toward improved periodontal healing.

However, the present study has certain limitations, including a relatively small sample size and short follow-up duration of 3 months. Long-term randomized controlled clinical trials with larger sample sizes and microbiological as well as radiographic evaluation are required to further validate the efficacy of curcumin gel and diode laser therapy as adjuncts to non-surgical periodontal treatment.

6. Conclusion

Within the limitations of the present study, all treatment modalities resulted in significant clinical improvement in chronic periodontitis patients. However, the adjunctive use of diode laser and curcumin gel with SRP demonstrated superior reductions in plaque accumulation, gingival inflammation, bleeding on probing, and probing pocket depth, along with greater clinical attachment gain when compared to SRP alone and SRP with diode laser. The results suggest that 2% curcumin gel, owing to its potent anti-inflammatory and wound-healing properties, can serve as an effective adjunct in non-surgical periodontal therapy.

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