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Comparative Evaluation of Curcumin Gel With Diode Laser (970 nm) Versus Diode Laser Alone For Pocket Depth Reduction in Chronic Localised Periodontitis – A Split-Mouth Randomized Clinical Trial

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Abstract

Introduction: The fusion of curcumin gel and laser technology offers a promising solution for periodontal pocket reduction. Harnessing the anti-inflammatory prowess of curcumin and the precision of laser, this approach enhances periodontal therapy efficacy, fostering improved oral health outcomes.

Methods: This split-mouth study was conducted on nine patients. After scaling and root planing (SRP), curcumin gel with a diode laser and a diode laser alone were used in the test and control groups, respectively. The plaque index (PI), modified sulcus bleeding index (SBI), probing pocket depth (PPD), and clinical attachment loss (CAL) were recorded at baseline and three months.

Results: The results revealed that both the diode laser and curcumin gel reduced periodontal pocket depths, but a greater reduction was observed in the test group than in the control group.

Conclusion: It can be concluded that both control and experimental gel can be used as an adjunct to SRP, but curcumin gel was more effective when used with Diode laser therapy (970nm) in the treatment of periodontal pockets with a significant reduction in the scores of the indices when compared to the baseline values.

Keywords: Pocket depth reduction; Chronic localised periodontitis; Diode laser; Curcumin gel; Periodontal therapy.

Introduction

Chronic periodontitis is a bacterial disease which triggers swelling of gum tissues, erodes the jawbone, and results in the loss of teeth. The key bacteria involved in moderate to severe long-term periodontitis can be identified through bacterial culture techniques, including *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia*, *Treponema denticola*, and *Aggregatibacter actinomycetemcomitans*. The latest hypothesis suggests that certain bacteria like *P. gingivalis*, *P. intermedia*, *T. forsythia*, and *T. denticola* are thoroughly linked to elevation in the probing pocket depth (PPD) and the presence of bleeding on probing (BOP).[1]

A widely accepted approach for the first step in treating gum disease involves cleaning below the gum line by scaling and root planing (SRP), using tools like an ultrasonic machine. Research has indicated positive results and improvements in bacteria levels. These benefits encompass stopping the growth of bacteria below the gum line, lowering the amount of bacteria, and getting free of plaque, tartar, and toxins. Successful treatment of gum disease is measured by oral hygiene scores, plaque index (PI), modified sulcus bleeding index (SBI), PPD, and clinical attachment loss (CAL).[2]

There are two methods for addressing the advancement of gum disease: surgical and non-surgical treatments. Surgical methods include curettage or flap surgery. Over the previous ten years, non-surgical treatments have concentrated on eradicating bacteria. Various treatment strategies have been explored, including mouthwash, doxycycline, metronidazole, topical tetracycline and minocycline applied to gum tissue, and low-dose tetracycline taken two times daily for 3 months or further. Additionally, the topical application of curcumin gel, Tulsi gel, and aloe vera gel has been utilized.[3]

Indian herbal medicine systems have long utilized turmeric. An Assyrian herbal book from approximately 600 BC contains a list of it. The Zingiberaceae family includes the perennial herbaceous plant, turmeric. Turmeric is utilized in culinary and preservation and has

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been utilized in customary Indian and Chinese medicine since the seventh century AD. Curcumin, which makes up 2-4 percent of the spice, is the most active ingredient in turmeric.[4]

The primary yellow bioactive ingredient in turmeric, curcumin (diferuloylmethane), has been demonstrated in the literature to have a variety of biological benefits. Among them are its effects on healing, myogenetic, hypotensive, antiulcer, antibacterial, antifungal, antiprotozoal, antiviral, anticoagulant, anticarcinogenic, antiallergic, antimutagenic, and antidiabetic. Humans can tolerate up to 8 g/day without experiencing any negative side effects, according to clinical investigations.[5]

Infectious and inflammatory disorders are associated with periodontal disease. Consequently, in order to assist the manual debridement of the surfaces of the tooth through the systemic and local injection of chemical agents, deeper periodontal pockets necessitate additional antimicrobial treatment. One benefit of local medication administration into periodontal pockets is that it minimizes drug exposure throughout the body while preserving a sufficient concentration of the drug at the target site. Herbal remedies are utilized in place of systemic medications. Many herbal items and their constituents are employed in periodontology for topical medicine administration since herbal extracts are generally safe. Many herbal extracts with active ingredients, such as those from *Aloe vera, Glycyrrhiza glabra*, *Curcuma longa, Acacia catechu, Azadirachta indica*, *Matricaria chamomile*, and *Ocimum sanctum*, presented to have strong anti-inflammatory, antibacterial, antioxidant, astringent properties and to significantly improve gum health when used as a subgingival rinse. This is in light of the unfavorable repercussions and drawbacks of many artificial agents.[6]

Since photobiomodulation is simple to use by dentists for the upkeep and treatment of oral health, it is currently being explored as a means of eliminating germs in patients with periodontal disease. Some researchers are exploring low-dose laser therapy as an alternative treatment to reduce the reliance on antibiotics and other chemicals for treating periodontitis.[7]

Since bacterial infections are widely recognized as the primary cause of periodontal disease, eradicating periodontal pathogenic microorganisms will have a favorable impact. Laser light eliminates the toxins that these microorganisms release. It has been demonstrated that using SRP in addition to laser therapy can lessen pocket depth and enhance dental health. Periodontitis can be treated with a variety of lasers, including diode lasers, erbium lasers, Nd:YAG lasers, and

CO2 lasers. When compared to curettage, lasers are a more therapeutic choice since they require fewer specialist skills, have a shorter application time, improve visualization, cause less discomfort, and increase patient comfort. The diode laser, operating at wavelengths of 810 nm or 910-980 nm, is designed for use on soft tissues.

The laser beam has a bactericidal effect, does not interact with the hard dental tissue, and helps the curettage of soft tissue and sulcus debridement. A portion of laser energy is diffused during irradiation and enters the periodontal pockets, activating the cells of the surrounding tissue. This results in a decrease in inflammatory conditions, an increase in lymph flow, an increase in cell proliferation, better adherence of periodontal tissue, and a notable decrease in post-operative pain.[8]

It is well known that using curcumin gel causes the depth of the pocket to decrease. Thus, this investigation was conducted to evaluate how well curcumin gel and laser (970 nm) work together to reduce pocket depth.[7]

Objective

This study aimed to evaluate the potential of curcumin gel and SRP with or without diode laser therapy (970 nm) for pocket depth reduction in chronic localised periodontitis.

Methods

Study Design

Participants in this three-month prospective, double-blinded, split-mouth design, randomized controlled study were chosen from patients who were seen at the outpatient periodontology department at Manipal College of Dental Sciences, Mangalore. Informed consent was obtained from all participants, and after receiving institutional ethical committee approval from Manipal College of Dental Sciences (CTRI REF NO. REF/2023/11/075628), the study was carried out.

Study Population

This study involved nine patients in total, all of whom were between the ages of 20 and 55. Using the coin toss procedure, the individuals were arbitrarily allotted to one of the two treatment sites. The test site was subjected to diode laser therapy (970 nm) in combination with curcumin gel, and the control group was subjected to diode laser therapy (970 nm) alone. All study-related procedures were carried out by the lead investigator. All the clinical measures were performed by one investigator (not the operator), who was blind to the research groups.

Sample Size

The sample size was calculated using the following:

In order to maintain a 5% alpha error, 95% research power, and a clinically meaningful difference of 1 unit, 9 samples are needed in each group.

N is the number of samples, d = the minimum difference in the values which will make a clinically relevant impact, and s = the average standard deviation

Z (1- a/2): Z score for the alpha error chosen

Z (1- b): Z score for the power chosen.

Inclusion Criteria

1. Patients aged 20-55 years, irrespective of gender
2. Patients who approve to partake in the research by signing the informed consent form
3. Patients diagnosed with stage II periodontitis
4. Patients with no prior history of periodontal therapy or antibiotic therapy in past 6 months were included.
5. Systemically healthy individuals
6. Full Mouth plaque Score – less than 25%
7. CAL ≤ 5 mm
8. ≥ two teeth surfaces on interproximal area with loss of CAL ≤ 5 mm (not for the same tooth)
9. ≥ two teeth surfaces in the interproximal area with PD ≤ 5 mm
10. Full mouth SBI less than 20%.

Exclusion Criteria

The present study excluded: 1. individuals with a history of known systemic illnesses and blood disorders, allergies, and medications, 2. Individuals with any nonvital or carious teeth, 3. Individuals who use chronic medication, 4. Pregnant women, 5. Lactating women, and 6. Individuals who smoke more than 20 cigarettes/day.

Clinical Measurements

Primary Outcomes

The following clinical parameters of all study teeth are assessed at baseline and 30 days after the treatment.

1. PPD: Assessed from the margin of gingiva to gingival sulcus.
2. CAL: Measured by subtracting the distance between the CEJ and the free gingival margin from the PPD value

Secondary Outcomes

1. PI
2. Modified SBI

Methodology

Treatment

The patients with the identified locations were arbitrarily allotted to one of the two treatment groups because this was a split-mouth experiment. Before the operation, each patient received advice on proper oral hygiene and Phase I therapy was concluded.

Control Group: Diode Laser Therapy

The control group had root planing with Gracey curettes (Hu-Friedy, USA) and supra- and subgingival scaling using the ultrasonic tip PIEZON 250® (EMS, Switzerland) at intervals of 5-7 days. The control group received pocket laser therapy with a 970 nm diode laser (SiroLaser Blue – Dentsply Sirona), and the periodontal pockets were irrigated with saline solution. After scaling, root planing, and pocket cleaning with saline solution, the patient and the dentist put on safety eyewear. An optical fiber (EasyTip 320 μm) received 1.5 W of continuous wave power in order to facilitate laser therapy. Subsequently, this was inserted into the periodontal pockets created by the last tooth in the upper right quadrant of the oral cavity.

The fiber tip was introduced into the periodontal pocket floor in a parallel position with the root surface after laser light-emitting equipment was turned on. Next, the fiber was swept slowly (1 mm/s) from the apical to the coronal direction, ensuring that no more than 40 seconds or 20 seconds were spent on each tooth or tooth surface. To preserve its physical properties, the fiber tip was severed before each radiation. All deposits and carbonization that may have accumulated on the tip were eradicated. Following every laser disinfection, the pockets were cleaned using saline solution. Every patient received advice on oral hygiene (roll technique, dental floss, & interproximal brush depending on the status of periodontium) (Figures 1 and 2).

Test Group: Curcumin Gel + Diode Laser

Following curettage, the periodontal pocket was treated with curcumin gel (*C. longa* extract,10 mg, Curenext, Abbott, Healthcare Limited, Mumbai, India). A blunted, pre-bent non-reusable cannula was placed into the periodontal pocket in order to inject the gel.

The gel was applied into the periodontal pocket until it overflowed through the gingival margin, followed by diode laser therapy (970 nm) as described in the control group. The affected region was covered with a periodontal dressing. The patient was not allowed to eat or drink for one hour. Clinical evaluation was done 3 months after the treatment (Figures 3-6).

Post-treatment Evaluation

The assessment of PPD was done on baseline (prior to the treatment) and post-treatment, and 3 months after the treatment. The patients were instructed not to brush the site of treatment until the pack was removed and they could continue their normal oral hygiene practices (Figures 7-10).

Statistical Analysis

The results obtained were subjected to statistical analysis. The statistical analysis was achieved by means of the paired *t* test and the unpaired t-test using commercially available software SPSS 20.0 (IBM, Chicago).

Results

Nine individuals, four men and five women, with a combined diagnosis of chronic periodontitis were involved in the investigation. Every patient who was part

Figure 1. Probing Depth of 5mm Between 24 And 25

Figure 2. Application of 970nm Diode Laser Therapy Between 24 and 25

Figure 3. Application of 970nm Diode Laser Between 24 And 25

Figure 4. Application of 970nm Diode Laser Therapy Between 14 And 15

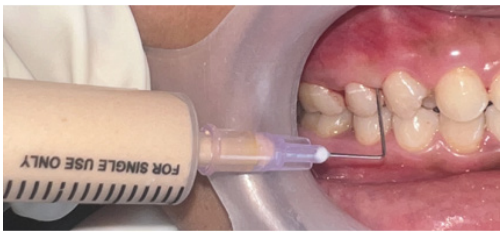

Figure 5. Application of Curcumin Gel Using Pre-blunt Syringe

Figure 6. Periodontal Pack Placed

Figure 7. Probing Depth of 5mm Between 14 and 15

Figure 8. Probing depth of 2 mm

Figure 9. Pre Op Probing Depth of 5mm

Figure 10. Post Op Probing Depth of 3mm

of the review finished the three-month trial term. Every patient had a smooth healing process. There have been no reports of any negative side effects, like burning or soreness, from using the curcumin gel and laser light.

When the mean PI levels of the test and control groups were compared at baseline and after three months, the baseline mean value was higher (difference = 0.64875), which was statistically significant ($P < 0.001$; Table 1). Similarly, both the test and control groups had higher

mean SBI values at baseline and after three months, with a difference of 0.69625 that was statistically significant ($P=0.002$; Table 2).

The mean PPD values of the test and control groups were compared at the beginning of the trial and after three months. Over the course of three months, the mean PPD value of the test group considerably dropped by 1.625 ($P<0.001$). Additionally, the control group experienced a substantial drop of 0.235 ($P<0.001$). When comparing the PPD baseline values between the groups, the test group had a 0.375 higher mean value; however, this difference was not statistically significant ($P=0.08$). Following three months, the mean PPD score of the control group stood considerably greater than the test site, at 0.875 ($P=0.006$; Table 3).

The mean CAL values of the test and control groups were compared at the beginning of the trial and after three months. Over the course of three months, the mean CAL value of the test group dramatically dropped by 1.625 ($P<0.001$). The mean CAL value dropped by 0.375 in the control site, though the change was not statistically significant ($P=0.08$). The mean score of 0.5 in the test group ($P=0.033$) was considerably greater than the baseline CAL values in the other groups. The control site outperformed the test site with a significantly greater mean CAL score of 0.75 ($P=0.003$) at the 3-month mark (Table 4).

Discussion

Further laser therapy may be helpful in this era of growing antibiotic resistance in microorganisms and high risk of antibiotic adverse effects.

- After a three-month PPD follow-up, there was a statistically significant difference of 1.63 group.
- After a three-month CAL follow-up, there was a statistically significant difference of 1.67 group.
- At three months, a statistically significant decline was observed in both the test and control groups' full mouth plaque and modified sulcular bleeding index.
- A statistically significant difference of 0.65 ± 0.27 was seen for PI in the test group at a three-month follow-up, and a statistically significant difference of 0.7 ± 0.39 for SBI at a 3-month follow-up.

These findings indicate that the intervention or treatment was successful in significantly reducing both plaque and bleeding indices over the 3-month period. Additionally, the patient demonstrated effective oral hygiene maintenance throughout this time.

According to our research, the mean difference of the test group in PD, PI, and SBI values has improved much more than that of the control group. Qadri et al[9] discovered in their paper that added remedy using diode lasers reduced periodontal gingivitis and PD; the results of our investigation are similar to their study, which only documented short-term effects of the diode laser. However, the methodology of the two studies was different.

The most significant systematic reviews and meta-analyses, however, have not produced any conclusive results. In a cautious meta-analysis based on four trials, Sgolastra et al[10] in their study concluded that no added benefit via a diode laser as an adjuvant treatment for traditional Non Surgical Periodontal Therapy (NSPT). However, the meta-analysis included research from various treatment stages (maintenance therapy and beginning therapy) as well as from two different kinds of laser therapy: low-level laser therapy and high-power laser therapy. Slot et al[11] examined the validity of utilizing a diode laser as an added technique to help SRP in comprehensive meta-analysis and built on nine research studies. Regarding changes in CAL and PPD, concurrent usage in Diode Laser (DL) is classified as mild. Although the laser group achieved better results in terms of bleeding ratings, the clinical significance of this difference is still debatable.

In a study by Anwar et al in 2024,[12] the efficacy of diode laser therapy was evaluated using systemic antibiotic treatment in patients with stage III grade C periodontitis. Results showed significant improvements in clinical and microbiological parameters with diode laser therapy.

A 2020 study by Sopi et al[13] explored the consequences of diode laser therapy on periodontal parameters and concluded that it is further effectual in reducing clinical parameters, when equaled to scaling and root planning or surgical approaches.

In a study by Zingale et al in 2023,[14] the added use of a diode laser, together with scaling root planing, was significantly useful in decreasing periodontal pocket

Table 1. Comparison of PI Between Two Groups

	Baseline	3 Months	Difference	*P* Value
Test	1.84 ± 0.18	1.19 ± 0.29	0.65 ± 0.27	<0.001
Control	1.84 ± 0.18	1.19 ± 0.29	0.65 ± 0.27	<0.001

Table 2. Comparison of SBI Between Two Groups

	Baseline	3 Months	Difference	*P* Value
Test	1.79 ± 0.27	1.09 ± 0.44	0.7 ± 0.39	<0.001
Control	1.79 ± 0.27	1.09 ± 0.44	0.7 ± 0.39	<0.001

Table 3. Comparison of PPD Between Two Groups

	Baseline	3 Months	Difference	*P* Value
Test	4.5 ± 0.54	2.88 ± 0.64	1.63 ± 0.52	<0.001
Control	4.13 ± 0.84	3.75 ± 0.46	0.38 ± 0.52	<0.001

Table 4. Comparison of CAL Between Two Groups

	Baseline	3 Months	Difference	*P* Value
Test	4.7 ± 0.6	3.11 ± 0.6	1.67 ± 0.5	<0.001
Control	4.3 ± 1	3.89 ± 0.6	0.44 ± 0.5	<0.001

depth and BOP associated with only SRP.

In 1998, Moritz et al [15] found that diode laser therapy led to better bacterial reduction and improved bleeding indices during probing compared to the control group.

In their 2009 study, Lin et al[16] evaluated the success of diode laser treatment in comparison with standard gingival curettage with manual instruments in chronic periodontitis individuals.

At present, the application of herbal inventions in dentistry is constantly growing. This is due to the fact that they are readily available and inexpensive and have few side effects. One of the products is turmeric (*C. longa*). Commercially accessible preparations of "CU" include about 77% CU, 17% demethoxycurcumin, and 3% bisdemethoxycurcumin.

Through molecular mechanisms involving anti-inflammatory actions and phosphorylase kinase inhibition mediated by downstream Nuclear Factor Kappa B (NF-KBB), the topical use of curcumin has good efficacy. Studies on dermatology demonstrate that using curcumin topically produces long-lasting, acceptable effects. Three molecular targets linked to inflammation are interacting with curcumin: chemokines, IL-6, tumor necrosis factor, and IL-1. Additionally, curcumin interacts with transcription factors which contain activator protein 1 (AP-1), nuclear factor kappa beta (NF-κB), peroxisome proliferator-activated receptors gamma, β-catenin, hypoxia inducible factor-1, nuclear factor-erythroid factor 2, and early growth response protein-1. Additionally, curcumin interacts with the enzymes heme oxygenase-1, inducible nitric oxide synthase, 5-lipoxygenase, cyclooxygenase-1 (COX-1), and COX-2. In addition, curcumin suppresses the expression of several other inflammatory mediators that control immune cell activity and inflammatory responses, such as matrix metallopreoteinase-2 (MMP-2), Inducible Protein 10, stromal cell derived factor 1, interferon, and MMP-9. Numerous signaling pathways are involved in this process, but NF-κB is the most significant one. Curcumin continued to effectively adapt NF-κB signaling through a number of different methods.

The diode laser and curcumin gel significantly reduced PI, SBI, and PD in the current trial, with SRP following suit. While there was a small but not statistically significant decrease from baseline to 90 days, there was important enhancement in both sites according to within-group assessments of mean PPD, PI, and SBI scores. This is consistent with a study by Nagasri et al[17] which investigated the efficacy of CU in addition to SRP for the management of chronic periodontitis using single-blinded, split-mouth, randomized design.

Clinical and microbiological indicators significantly improved with the usage of curcumin, adjuvant to periodontal treatment, according to Anitha et al.[18]Curcumin functions similarly to non-steroidal anti-inflammatory medications like aspirin, but it has the advantage of selectively blocking prostaglandin and thromboxane synthesis while leaving prostacyclin synthesis unhindered. All things considered, CU 10 mg (Curenext®) produces a clinically meaningful decrease and may be used as a herbal supplement with supporting periodontal care.

Limitations

However, there were some limitations of this study due to short follow-up period and small size so further studies with long duration and larger sample size are required.

Conclusion

Based on the comparative evaluation of curcumin gel with diode laser (970 nm) versus diode laser alone for pocket depth reduction in chronic localized periodontitis, the study concludes that the combination of curcumin gel with diode laser therapy significantly improves pocket depth reduction compared to diode laser therapy alone. This improvement is likely due to the anti-inflammatory and antimicrobial properties of curcumin, which, when combined with the diode laser, allow for more effective treatment of chronic localized periodontitis. These results suggest that the inclusion of curcumin gel in periodontal treatment protocols could lead to improved clinical outcomes. Larger sample numbers and longer follow-up times are advised for future research in order to validate these findings and set new benchmarks for non-surgical periodontal care.

Authors' Contribution

Conceptualization: Sanidhya Sharath.
Data curation: Sanidhya Sharath.
Formal analysis: Deepa G Kamath.
Investigation: Sanidhya Sharath.
Methodology: Sanidhya Sharath.
Project administration: Sanidhya Sharath, Deepa G Kamath.
Resources: Sanidhya Sharath.
Software: Sanidhya Sharath, Deepa G Kamath.
Supervision: Deepa G Kamath, Nina Shenoy.
Validation: Deepa G Kamath, Nina Shenoy.
Visualization: Sanidhya Sharath, Deepa G Kamath, Nina Shenoy.
Writing-original draft: Sanidhya Sharath.
Writing-review & editing: Sanidhya Sharath, Deepa G Kamath.

Competing Interests

The authors have no conflicts of interest to declare

Ethical Approval

This study was conducted following guidelines regulating research work on human subjects of the Department of Periodontology, Manipal College of Dental Sciences Mangalore and after receiving institutional ethical committee approval from Manipal College of Dental Sciences (CTRI REF NO. REF/2023/11/075628), the study was carried out. (Clinical trials registry- India (ICMR-NIMS) Ref number: REF/2023/11/075628, dated November 15, 2023).

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