Original Research Article

Efficacy of curcumin as an adjunct to scaling and root planning in chronic periodontitis patients

Syed Saima[1*], Sabita Sambyal[2], Suhail Majid Jan[3], Roobal Behal[4], Ishrat Parveen[5]

[1]Lecturer, [2,5]PG IIIrd year, [3]HOD, [4]Associate Professor
Dept. of Periodontics & Oral Implantology, Govt. Dental College & Hospital, Srinagar, India
[*]Corresponding author email: **somsaliah52@rediffmail.com**

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Abstract

Introduction: Gingival inflammation, periodontal pocket formation, destruction of the periodontal ligament and alveolar bone resulting in mobile teeth accompanied with apical migration of the junctional epithelium onto the root surface are the main characteristics of periodontitis. The aim of periodontal therapy is to remove the bacterial plaque and all the factors that favor its accumulation. Scaling and root planning (SRP) is one of the most commonly utilized procedures in the treatment of periodontal diseases but it cannot eradicate subgingival bacteria and good periodontal health cannot be achieved. Therefore, local drug delivery agents like curcumin into the pockets via a syringe or irrigating device has been shown to be effective against subgingival flora.

Materials and methods: The present study was a randomized split-mouth study including 10 subjects aged 25–40 years. After meeting the inclusion and exclusion criteria the subjects were divided into two groups. Group 1(Test): Participants receiving SRP were followed by local delivery of curcumin into the pocket at the baseline visit. Group II (Control): Participants receiving only SRP. The parameters were recorded at baseline and 6 weeks.

Results: Statistically significant ($p < 0.01$) results were obtained in both the groups between baseline and 6 weeks and between the groups at 6 weeks.

Conclusion: From the present study it can be concluded that although SRP reduced the periodontal parameters and has a beneficial effect in patients but using curcumin as an adjunct to SRP resulted in better clinical outcomes as it has anti-inflammatory, antioxidant, and anti-microbial properties.

Key words

Chronic Periodontitis, Curcumin, PPD > 5 mm, Local drug delivery.

Introduction

Diseases that affects the surrounding and supporting tissues of the teeth constitutes the periodontal disease formerly called as gingival disease as it is confined to the gingiva and later as the supporting structures gets involved, it is called periodontal disease or periodontitis [1]. Gingival inflammation, periodontal pocket formation, destruction of the periodontal ligament and alveolar bone resulting in mobile teeth accompanied with apical migration of the junctional epithelium onto the root surface are the main characteristics of periodontitis [2]. It is considered as one of the major causes of tooth loss [3]. The aim of periodontal therapy is to remove the bacterial plaque and all the factors that favour its accumulation [4]. Scaling and root planning (SRP) is one of the most commonly utilized procedures in the treatment of periodontal diseases and has been used as the "gold standard" for mechanical therapy [5]. Scaling and root planning alone cannot eradicate subgingival bacteria and good periodontal health cannot be achieved. This may be due to the fact that some of these species reside in soft tissues, dentinal tubules, or in root surface irregularities, thereby contributing to treatment failure [6]. To overcome the limitations of this conventional treatment only, antibiotics and antiseptics have been used successfully to treat periodontal disease by systemic and local administration [7]. However, systemic antibiotics require the administration of large dosages, which could potentially promote the development of antibiotic resistance and patient compliance, so to avoid all of these complications local drug delivery is preferred [8].

Local delivery of chemotherapeutic agents into the pockets via a syringe or irrigating device has been shown to be effective against subgingival flora [9] local application of pharmacological agents must fulfil three criteria:

- The medication must reach the intended site of action
- Remain at an adequate concentration; and
- Last for a sufficient duration of time [10].

Many chemical agents have been tested as adjuncts to mechanical methods which can reduce plaque-associated gingivitis. Chlorhexidine, triclosan, povidone-iodine and various phenolic compounds have been used successfully as anti-plaque agents [11]. However, side effects such as allergy, discolouration of teeth and unpleasant taste can occur when these chemicals are used for an extended period of time [12]. Herbal medicines like Turmeric, neem, aloe vera, clove and cinnamon have been used for thousands of years for healthcare needs. Turmeric is one of the common herbal products used in dentistry, it's a dietary spice, with curcuma as its most active ingredient. It is widely used as a traditional medicine in Asian countries. Curcuminoids are components of turmeric, which include a large number of studies in both animals and humans and havereported that curcumin has antioxidant, anti-inflammatory, anti-carcinogenic, anti-microbial and anti-parasitic properties [13]. *Curcuma* longa also used externally for inflammation of oral mucosa [14]. To overcome the adverse effects caused by the chemical agents, curcumin can be employed in the management of gingivitis and periodontitis [15]. Hence, we designed a clinical study to compare the efficacy of SRP with or without the application of oral curcumin gel on mild to moderate chronic periodontitis.

Aim and objectives

- To evaluate the efficacy of curcumin gel as local drug delivery post-scaling and root planning.
- To evaluate the effects of curcumin gel on clinical parameters like plaque, gingival scores, pocket depth, and clinical attachment level (CAL)

Materials and methods

The present study was a randomized split-mouth study including 10 subjects aged 25–40 years reporting at the Department of Periodontology and Implantology, Govt. Dental College and Hospital, Srinagar, after obtaining institutional ethics committee approval. Verbal and written informed consent will be obtained from every participant.

Participants were randomly allocated into two groups:

Group I (Test): Participants receiving SRP were followed by local delivery of curcumin into the pocket at the baseline visit.

Group II (Control): Participants receiving only SRP.

Clinical parameters were measured on the baseline, after 6 weeks follow-up in either site.

Clinical parameters

The parameters recorded were:

PI (Silness and Loe, 1964)

GI (Loe and Silness, 1963)

Periodontal pocket depth (measured from the crest of gingival margin to base of the sulcus)

Relative attachment level (measured from a fixed reference point on the acrylic stent to the base of the pocket).

Inclusion criteria

- Patients willing to take part in the study.
- Subjects of age group between 25 and 40 years without any systemic disease.
- Patient with more than 20 natural teeth.
- Patient with chronic periodontitis having a PPD of ≥ 5 mm.
- Patients with no history of allergies.

Exclusion criteria

- Participants who had any adverse habits, such as smoking or tobacco chewing, and who were not willing for participation and further follow-up were excluded.
- Pregnant women and lactating mothers
- Patients with known hypersensitivity to curcumin.

Procedure

The test and control sites were selected on a random basis and, after full-mouth SRP, saline irrigation was done in both test and control sites and placement of medication was done only after complete bleeding was halted.

The test site was completely isolated with cotton rolls (not to contaminate the medication with saliva) undiluted curcumin gel through a 3 mL disposable syringe was placed in the test site and later the area was covered by Coe pack (for retaining the medicine in the pocket) (**Photo – 1 to 8**).

I. Pre-operative measurements

Photo – 1: Plaque Index.

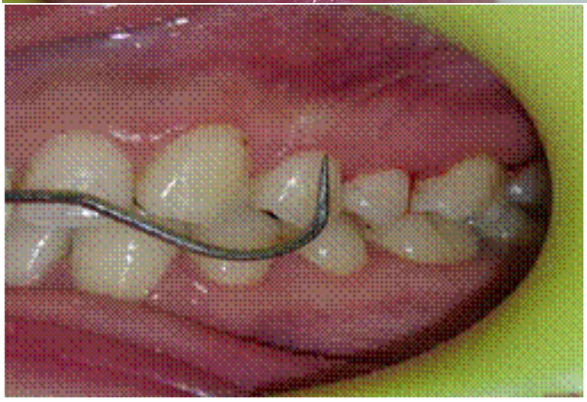


Photo – 2: Gingival index.

Photo – 3: Probing depth.

Photo – 4: Relative attachment level.

Photo – 5: Placement of Curcumin and periodontal pack.

Photo – 6: Curenext oral gel.

II. Post-operative measurements

Photo – 7: Probing depth.

Photo – 8: Relative attachment level.

Subjects were instructed not to touch the area till the removal of the pack. Patients were recalled after a week for Coe pack removal and refrained from using any other oral hygiene measures in the observation period, recalled after a month for follow-up.

Statistical analysis

We summarized numeric variables as mean and standard deviation. We used a GEE model with exchangeable correlation structure to model PPD and RAL across the two groups adjusting for the baseline values. 95% Confidence Interval for the regression coefficients was reported using robust standard errors. Paired t-test was used to analyze the difference in paired means. We considered a p-value <0.05 as statistically significant. Data was analyzed using Stata 18.

Results

A split mouth study in 10 patients was conducted over a period of 6 weeks. A statistically significant reduction in mean PPD and RAL was seen between baseline and 6 weeks in both test and control group (**Table - 1**, **Graph - 1 and 2**).The difference in mean PPD and RAL was highly statistically significant at the test site when compared to control site at 6 weeks (**Table - 2**, **Graph – 1 and 2**). Also there was a statistically significant reduction in mean plaque and gingival index when evaluated at 6 weeks (**Table - 3**, **Graph - 3 and 4**).

Discussion

Chronic periodontitis being the most common type of periodontitis is accompanied by plaque and calculus deposits and has a slow to moderate rate of disease progression [2].

Slowly progressive periodontitis is constantly accompanied by the presence of plaque [2]. Thus poor oral hygiene is associated with slowly progressive periodontitis. Periodontitis is the consequence of a complex, multifactorial collaboration between host and infective agent and is due to imbalance between the microbial insult to the attachment apparatus and the competency of the host's defence mechanisms. Local host defence factors seem to be playing a significant role in the specific pattern and severity of disease at the local site [16]. In slowly progressive periodontitis, there are no pathologic changes because of systemic disease.

Chronic periodontitis occurs as a localized disease wherein 30% of evaluated sites demonstrate attachment and bone loss or occurs as a more generalized disease.

Curcumin, a polyphenol, has been shown to target multiple signalling molecules while also demonstrating activity at the cellular level, which has helped to support its multiple health benefits. It has been shown to benefit inflammatory conditions [17], metabolic syndrome [18], pain [19], and to help in the management of inflammatory and degenerative eye conditions [20, 21]. Antioxidant and anti-inflammatory properties are the two primary mechanisms that explain most of the effects of curcumin on the various conditions discussed in this review [22, 23]. Curcumin has been shown to improve systemic markers of oxidative stress [24].

Table - 1: Mean values of PPD and RAL of case and control at baseline and 6 weeks.

	Group 1			Group 2		
	BASELINE MEAN (SD)	**6 WEEKS MEAN (SD)**	**P-VALUE**	**BASELINE MEAN (SD)**	**6 WEEKS MEAN (SD)**	**P-VALUE**
PPD	6.6 (0.84)	3.7 (0.67)	P <0.001	6.8 (1.03)	5.1 (0.88)	P<0.001
RAL	11.6 (0.84)	8.7 (0.67)	P <0.001	11.6 (1.17)	10.0 (0.94)	P <0.001

Table - 2: Intergroup comparison of PPD and RAL between the case and control group.

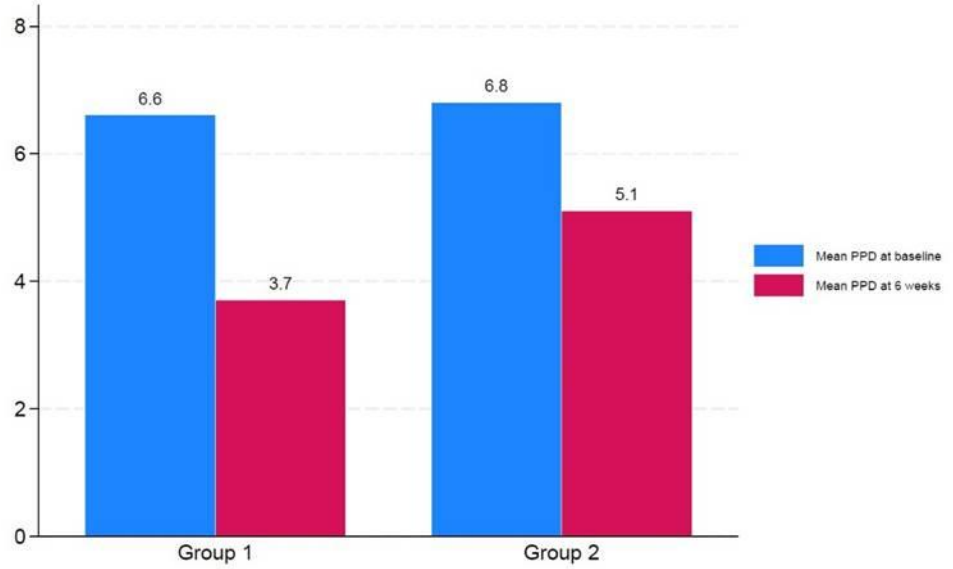
	REGRESSION COEFFICIENT*	**95% CI**	**P-VALUE**
PPD	1.29	1.020 to 1.57	P <0.001
RAL	1.30	1.04 to 1.56	P <0.001

*Difference in 6-week values adjusted for the baseline value

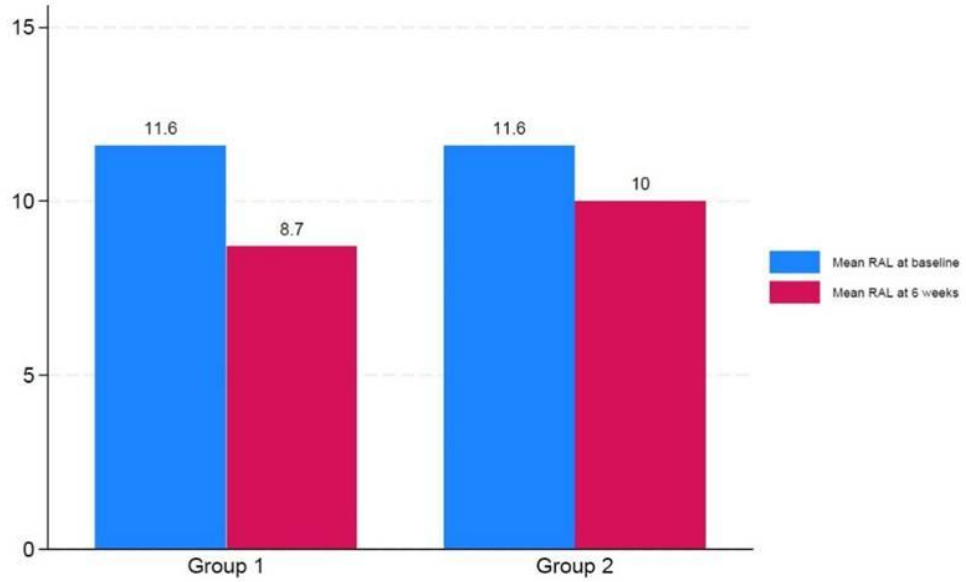
Table - 3: Mean values of PI and GI at baseline and 6 weeks.

	BASELINE MEAN (SD)	**6 WEEKS MEAN (SD)**	**P-VALUE**
PI	1.87 (0.56)	0.66 (0.42)	P <0.001
GI	1.82 (0.54)	0.56 (0.32)	P <0.001

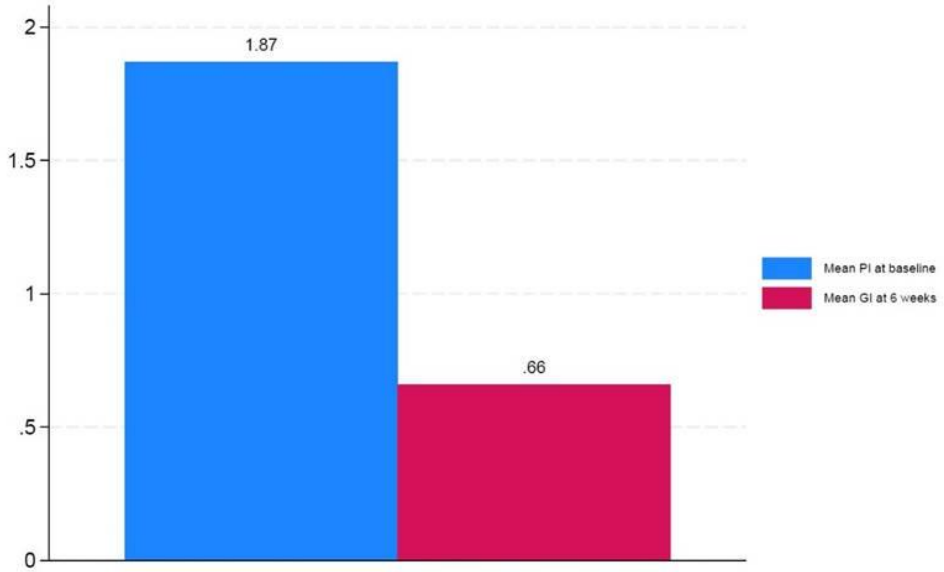
Graph – 1: Probing Pocket Depth (PPD).



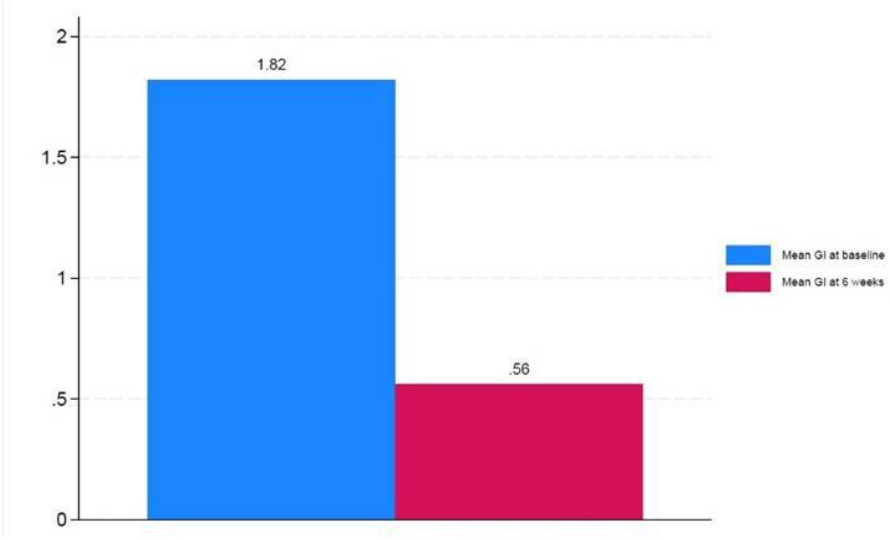
Graph – 2: Relative Attachment Level (RAL).



Graph – 3: Plaque Index (PI).



Graph – 4: Gingival Index (GI).



There is evidence that it can increase serum activities of antioxidants such as superoxide dismutase (SOD) [25, 26, 27]. Curcumin's effect on free radicals is carried out by several different mechanisms. It can scavenge different forms of free radicals, such as reactive oxygen and nitrogen species (ROS and RNS, respectively) [26]; it can modulate the activity of GSH, catalase, and SOD enzymes active in the neutralization of free radicals [22, 23] also, it can inhibit ROS-generating enzymes such as lipoxygenase/ cyclooxygenase and xanthine hydrogenase/ oxidase [22]. In addition, curcumin is a lipophilic compound, which makes it an efficient scavenger of peroxyl radicals, therefore, like vitamin E, curcumin is also considered as a chain-breaking antioxidant [28]. Oxidative stress has been implicated in many chronic diseases, and its pathological processes are closely related to those of inflammation, in that one can be easily induced by another. In fact, it is known that inflammatory cells liberate a number of reactive species at the site of inflammation leading to oxidative stress, which demonstrates the relationship between oxidative stress and inflammation [29].

In addition, a number of reactive oxygen/nitrogen species can initiate an intracellular signalling cascade that enhances pro-inflammatory gene expression. Tumor necrosis factor α (TNF-α) is a major mediator of inflammation in most diseases, and this effect is regulated by the activation of a transcription factor, nuclear factor (NF)-κB. Whereas TNF-α is said to be the most potent NF-κB activator, the expression of TNF-α is also regulated by NF-κB. In addition to TNF-α, NF-κB is also activated by most inflammatory cytokines; gram-negative bacteria; various disease-causing viruses; environmental pollutants; chemical, physical, mechanical, and psychological stress; high glucose; fatty acids; ultraviolet radiation; cigarette smoke; and other disease-causing factors. Therefore, agents that downregulate NF-κB and NF-κB–regulated gene products have potential efficacy against several of these diseases. Curcumin has been shown to block NF-κB activation increased by several different inflammatory stimuli [18].

In this study there was a statistically significant reduction in the mean PPD in both the test group and the control group when evaluated at the 6 weeks. These results were in accordance with the study conducted by Behal, et al. [30]. The reduction in the PPD in the test group can be attributed to the anti-inflammatory property of curcumin which modulates the inflammatory response, inhibits the production of pro-inflammatory cytokines, represses the activation of AP-1 and NF-κβ, inhibits the biosynthesis of inflammatory prostaglandins and enhances neutrophil function during inflammatory response. The reduction in PPD in control sites can be attributed to SRP and oral hygiene instructions given at follow-up periods which resulted in decrease in gingival inflammation and biofilm formation.

Also a statistically significant gain in RAL was seen in both the test and control group. These results were in accordance with the study conducted by Behal et al. [30], Hugar, et al. [31].

The statistically significant reduction was seen in both the PI and GI between the baseline and 6 weeks. This can be attributed to the effect of SRP and regular oral hygiene instructions given to the patients. This is in accordance to the study conducted by Nagasri, et al. [32].

Conclusion

From the present study it can be concluded that although SRP reduced the periodontal parameters and has a beneficial effect in patients but using curcumin as an adjunct to SRP resulted in better clinical outcomes as it has anti-inflammatory, antioxidant, and anti-microbial properties.

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