Comparative Evaluation of Subgingivally Delivered 2% Curcumin and 0.2% Chlorhexidine Gel Adjunctive to Scaling and Root Planing in Chronic Periodontitis

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ABSTRACT

Aim: This study aimed to compare the effects of subgingival delivery of 2% curcumin gel and 0.2% chlorhexidine gel as an adjunct to scaling and root planing (SRP) on clinical and microbiologic parameters in the management of patients with chronic periodontitis.

Materials and methods: In total, 25 systemically healthy individuals with age group ≥30 years diagnosed with chronic periodontitis were included in the study. The study was a double-blind split-mouth randomized control clinical trial. Two sites were selected in each patient and were randomly allocated to experimental and control sites. Baseline measurements of site-specific periodontal parameters and collection of subgingival plaque were done. After full-mouth SRP, subgingival delivery of 2% curcumin gel in experimental sites and 0.2% chlorhexidine gel in control sites was done. At 1 and 3 months, subgingival plaque samples were collected again and site-specific periodontal parameters were measured.

Results: The experimental group (2% curcumin gel) showed statistically significant improvements in periodontal [i.e., sulcus bleeding index (SBI), probing pocket depth (PPD), and relative attachment level (RAL)] and microbiologic parameters in the form of colony forming units (CFUs) in comparison with control group (0.2% chlorhexidine gel).

Conclusion: Subgingival delivery of curcumin has shown effective anti-inflammatory and antibacterial properties. Since it is biologically accepted by the patients and its delivery in periodontal pockets can be recommended as an adjunct to SRP therapy for the treatment of patients with localized, moderate chronic periodontitis and in patients under the periodontal maintenance phase.

Clinical significance: Curcumin being a herbal agent may be excellent alternative to chlorhexidine. It is biologically accepted by the patients and can be recommended as an adjunct to SRP in the treatment of localized moderate chronic periodontitis and periodontal maintenance patients.

Keywords: Chlorhexidine gel, Chronic periodontitis, Curcumin gel, Local drug delivery.

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INTRODUCTION

Chronic periodontitis is an infectious disease resulting in inflammation within the supporting tissues of the teeth, progressive attachment loss, and bone loss and is characterized by periodontal pocket formation and/or recession of the gingiva.1 The primary etiologic factor of periodontitis is dental plaque and the microorganism that are present in it.2

The aim of periodontal therapy is to remove the bacterial plaque and all the factors that favor its accumulation.3 Surgical and nonsurgical therapy are applicable in the treatment of periodontal diseases. Scaling and root planing (SRP) remains the “gold standard” treatment for periodontal disease against which other treatments are compared. Scaling and root planing involves the removal of supra- and subgingival plaque and calculus thereby returning the tissues to a state of health.4

Systemic administration of drugs has been useful in treating periodontal pockets, but it has various disadvantages such as the development of resistant bacteria and drug toxicity and requires higher dosage to attain required gingival crevicular fluid concentration at the target site.5,6

Therefore, to override these shortcomings, local delivery of antibacterial agents into periodontal pockets have been extensively studied. Dr Max Goodson in 1979 of Forsyth Dental Research Centre developed the concept of local drug delivery (LDD).7 The common agents used as LDD include subgingival chlorhexidine, tetracycline fibers, minocycline, doxycycline, and metronidazole.8–10

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treatment of chronic periodontitis. Hence, the present study aimed at comparing the clinical and microbiological effect of subgingivally delivered 2% curcumin gel and 0.2% chlorhexidine gel in periodontal pockets in patients with chronic periodontitis.

**Materials and Methods**

Formulation of 2% curcumin gel: 100 g of curcumin powder (SV Agro product) was mixed with pure alcohol and placed in the water bath for 2 hours to get the pure curcumin (99%) by the method of evaporation. After preparation of pure curcumin, 2 g of pure curcumin was mixed with 100 mL of glycerol to get a final gel preparation. The prepared gel was tested for microbial growth by incubation for 24 hours. No microbial growth was observed. The final preparation was then transferred into glass containers and was stored in the refrigerator (temperature ranging from 2–10°C and 80–85% humidity).

The patients were recruited from the outpatient department, Department of Periodontology, School of Dental Sciences, Sharda University, Greater Noida. The nature and outcome of the study were explained to the patients following which a written consent form was obtained. The study was approved by Institutional Ethics Committee. A total of 25 systemically healthy individuals diagnosed with chronic periodontitis, age group ≥30 years, were included in the study. Patients with chronic periodontitis having ≥20 teeth, PPD ≥5 mm, and radiographic evidence of bone loss in at least one site each in two quadrants of the same arch were included in the study. Patients who had undergone periodontal therapy in last 6 months or with history of antibiotic therapy within 6 months prior to study were excluded. Pregnant, lactating women, users of tobacco in any form, and patients not willing to give a written consent form were also excluded from the study. The study was conducted from August 2017 to October 2018.

Two sites were selected in each patient and were randomly allocated to experimental and control sites by the method of flip of coin. The study design can be described as a split-mouth randomized control clinical trial. Each patient was presented in four visits. At baseline, measurements of periodontal parameters such as gingival index (GI),17 plaque index (PI),17 sulcus bleeding index (SBI),18 probing pocket depth (PPD), and relative attachment level (RAL) were done. Using a Gracey’s curette, plaque samples were collected from the deepest part of the periodontal pockets in both experimental and control sites to assess total viable anaerobic count (TVAC; CFUs). After SRP, subgingival delivery of 2% curcumin gel in experimental sites and 0.2% chlorhexidine gel (Cervitec gel; Ivoclar) in control sites was done with the help of tuberculin syringe (Figs 1 and 2). Routine oral hygiene instructions were given. At the second visit (seventh day), removal of periodontal pack and assessment for adverse effects (if any) was done. Routine oral hygiene instructions were reinforced. At 1 and 3 months, site-specific periodontal parameters were measured again. Subgingival plaque samples were also collected again to assess the microbiological parameter in the form of CFUs.

The subgingival plaque samples were inoculated onto the brain heart infusion agar plates supplemented with hemin and vitamin K. The four-quadrant streak method was used to spread the inoculums across the plate. A sterile inoculation loop was used for the purpose with repeated flaming time and again to maintain its sterility. A gap of 5 seconds was given for the loop to cool down after each flaming before streaking. The inoculated brain heart infusion agar plates supplemented with hemin and vitamin K were then placed in a cylindrical container (anaerobic jar) along with one AnaeroGas Pack Sachet. The AnaeroGas Pack sachet is a disposable oxygen-absorbing and carbon dioxide-generating agents used in anaerobic jars for the preparation of anaerobic media. The container was then sealed and placed in the incubator. After 7 days of incubation at 37°C, the TVAC was determined. All the microbiology data were transformed into CFUs/plate using a manual colony counter (Fig. 3).

**Statistical analysis**

Data were entered into Microsoft Excel spreadsheet and then checked for any missing entries. It was analyzed using Statistical Package for Social Sciences (SPSS) version 21. Categorical variables were summarized as frequencies, and continuous variables were summarized as mean and standard deviation. Graphs were prepared on Microsoft Excel. Normality of the data was checked by Shapiro–Wilk test. Data were found to be normal. Keeping in view the nature (continuous) and distribution (normal) of data, inferential statistics were performed using parametric tests of significance. Inferential statistics were performed using independent t test and repeated measures of analysis of variance (ANOVA) test. Independent t test was used for intergroup comparison. Repeated measures of ANOVA test is used for an intragroup comparison. The level of statistical significance was set at 0.05.

**Results**

The study included 25 patients (20 males and 5 females) with mean age of 38 years with 50 sites, diagnosed with moderate to severe chronic generalized periodontitis, fulfilling the inclusion and exclusion criteria. Intragroup comparisons of the experimental sites (2% curcumin gel) and control sites (0.2% chlorhexidine gel) showed a statistically significant reduction in all the periodontal parameters and microbiological counts from baseline to 1 month and 3 months intervals (Tables 1 to 5). The intergroup comparison of experimental sites (2% curcumin gel) and control sites (0.2% chlorhexidine gel) showed a higher statistically significant reduction in periodontal parameters such as SBI (p < 0.0001) (Table 3), PPD (p < 0.0001) (Table 4), RAL (p < 0.0001) (Table 5) (Fig. 4), in the experimental sites (2% curcumin gel) at 1 month and 3 months intervals when compared with control sites (0.2% chlorhexidine gel). However, the other periodontal parameters such as PI and GI did not show a statistically significant reduction difference between both the groups (Tables 1 to 5).
The intergroup comparison of the experimental sites (2% curcumin gel) and control sites (0.2% chlorhexidine gel) showed a statistically significant reduction in microbiological parameters in the form of CFUs in the experimental sites at 3 months interval when compared with control sites \( (p < 0.0001) \) (Fig. 5 and Table 6).

**Discussion**

Traditional therapies for periodontal disease have included mechanical debridement to disrupt the subgingival flora and provide clean, smooth, and biologically compatible root surfaces. Unfortunately, in some instances, the complex anatomy of the root and the contours of the lesion may hamper the treatment and prevent sufficient reduction of the bacterial load to make the tooth surface biologically acceptable.\(^{19}\)

Topical administration of antibacterial agents in the form of mouthwashes, dentifrices, or gels can be used effectively in controlling supragingival plaque. Irrigation systems or devices can deliver agents into deep pockets but clinically not effective in halting the progression of periodontal attachment loss. Chlorhexidine has long been the gold standard for chemical plaque control. The effectiveness of chlorhexidine gel when used along with phase 1 therapy is proved since many years. Its action relates to reduction in pellicle formation, alteration of bacterial adherence to teeth, and an alteration of bacterial cell walls. It has been proven to be an effective plaque inhibiting agent. However, the disadvantages of chlorhexidine such as staining of teeth, taste disturbances, and an increase in calculus accumulation preclude its long-term use.\(^{20}\)

Hence, to overcome these problems, age-old solution but currently receiving the focus of wide interest of both medical and dental fraternity due to their natural and nonchemical property is herbal therapy/phytotherapy.

Herbal medicines are drug of plant origin used to treat diseases and to attain or maintain a condition of improved health. Herbs with medicinal properties are a useful and effective source of treatment for various diseases.\(^{21}\)

Turmeric is a spice that has received much interest from both the medicinal/scientific worlds and the culinary world. Turmeric is a rhizomatous herbaceous perennial plant (Curcuma longa) of the ginger family. Curcumin is the active ingredient in the herbal remedy and dietary spice turmeric. Curcumin exhibits anti-inflammatory, antioxidant, antiseptic, and antimutagenic activities. Curcumin modulates the inflammatory response by downregulating the activity of cyclooxygenase-2, lipoygenase,

![Fig. 2: Tuberculin syringe loaded with curcumin gel and chlorhexidine gel](image)

**Table 1: Intergroup and intragroup comparison of plaque index (PU)**

|                  | (a) At baseline |          | (b) At 1 month |          | (c) At 3 months |          | p value of intragroup comparison | Post hoc pairwise comparison |
|------------------|----------------|----------|----------------|----------|----------------|----------|----------------------------------|-----------------------------|
|                  | Mean           | Standard deviation | Mean           | Standard deviation | Mean           | Standard deviation |                                |                             |
| Experimental sites | 2.0340         | 0.15324  | 1.1200         | 0.22546  | 1.0000         | 0.00000  | <0.0001, S                  | a > b > c                   |
| Control sites    | 2.0580         | 0.12390  | 1.1200         | 0.22546  | 1.0000         | 0.00000  | <0.0001, S                  | a > b > c                   |
| p value of intergroup comparison | 0.247, NS | –               | –               | –               | –               | –                   | –                             |                             |

NS, nonsignificant; S, significant
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Behal et al. conducted a split-mouth study involving 30 subjects to evaluate the effect of 2% whole turmeric gel on periodontal parameters and trypsin-like enzyme activities of red complex microorganisms namely Treponema denticola and Bacteroides forsythus in patients with chronic localized and generalized periodontitis. The results of the study concluded that 2% gel is more effective when used along with SRP than SRP alone in the treatment of periodontal pockets. The results of the above study are comparable with our study; however in our present study, there was no assessment of any enzymatic activity of any specific periodontal pathogens.

The results of our study can be also compared with the study conducted by Jaswal et al. where the clinical effects of topical subgingival application of 2% whole turmeric gel and 1% chlorhexidine gel were assessed. Fifteen patients diagnosed with chronic periodontitis with probing depth of 5–7 mm were selected. Group receiving 2% turmeric gel showed comparable improvement in all the clinical parameters compared with other group where 1% chlorhexidine gel was delivered.

Anitha et al. conducted a clinical trial in 30 chronic periodontitis patients with PPD of 4–6 mm. Curcumin and chlorhexidine gel was applied in the contra lateral diseased sites at baseline and day 15. Probing pocket depth, RAL, GI, and PI were recorded, and CFUs were assessed microbiologically. The results of this study are comparable

| Table 2: Intergroup and intragroup comparison of gingival index (GI) |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | (a) At baseline          | (b) At 1 month           | (c) At 3 months          | p value of intragroup comparison |
|                         | Mean Standard deviation  | Mean Standard deviation  | Mean Standard deviation  | Post hoc pairwise comparison |
| Experimental sites      | 2.1060 0.20429           | 1.0640 0.16553           | 0.9200 0.18708           | <0.0001, S a > b > c       |
| Control sites           | 2.1140 0.20388           | 1.0640 0.16553           | 0.9200 0.18708           | <0.0001, S a > b > c       |
| p value of intergroup comparison | 0.327, NS               | –                        | –                        | 0.068, S                   |
| NS, nonsignificant; S, significant |

| Table 3: Intergroup and intragroup comparison of sulcus bleeding index (SBI) |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | (a) At baseline          | (b) At 1 month           | (c) At 3 months          | p value of intragroup comparison |
|                         | Mean Standard deviation  | Mean Standard deviation  | Mean Standard deviation  | Post hoc pairwise comparison |
| Experimental sites      | 1.7200 0.45826           | 0.9020 0.2489           | 0.5000 0.25000           | <0.0001, S a > b > c       |
| Control sites           | 1.7600 0.43589           | 0.9420 0.27145          | 0.5800 0.32048           | <0.0001, S a > b > c       |
| p value of intergroup comparison | 0.327, NS               | 0.046, S                | 0.038, S                 | 0.068, S                   |
| NS, nonsignificant; S, significant |

| Table 4: Intergroup and intragroup comparison of probing pocket depth (PPD) |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | (a) At baseline          | (b) At 1 month           | (c) At 3 months          | p value of intragroup comparison |
|                         | Mean Standard deviation  | Mean Standard deviation  | Mean Standard deviation  | Post hoc pairwise comparison |
| Experimental sites      | 6.2400 0.72342           | 4.040 0.67577           | 3.1200 0.3316           | <0.0001, S a > b > c       |
| Control sites           | 5.6000 0.50000           | 4.3200 0.55678          | 3.2800 0.45826           | <0.0001, S a > b > c       |
| p value of intergroup comparison | <0.0001, S               | 0.020, S                | 0.031, S                 | 0.068, S                   |
| NS, nonsignificant; S, significant |

| Table 5: Intergroup and intragroup comparison of relative attachment level (RAL) |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | (a) At baseline          | (b) At 1 month           | (c) At 3 months          | p value of intragroup comparison |
|                         | Mean Standard deviation  | Mean Standard deviation  | Mean Standard deviation  | Post hoc pairwise comparison |
| Experimental sites      | 8.4800 0.87178           | 6.040 0.61101           | 5.0000 0.5000           | <0.0001, S a > b > c       |
| Control sites           | 7.8400 0.80000           | 6.3200 0.55678          | 5.3600 0.48990          | <0.0001, S a > b > c       |
| p value of intergroup comparison | <0.0001, S               | 0.020, S                | 0.004, S                 | 0.068, S                   |
| NS, nonsignificant; S, significant |

and inducible nitric oxide synthase enzymes and inhibits the production of inflammatory cytokines.

The results of our study can be also compared with the study conducted by Jaswal et al. where the clinical effects of topical subgingival application of 2% whole turmeric gel and 1% chlorhexidine gel were assessed. Fifteen patients diagnosed with chronic periodontitis with probing depth of 5–7 mm were selected. Group receiving 2% turmeric gel showed comparable improvement in all the clinical parameters compared with other group where 1% chlorhexidine gel was delivered.

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with our study which revealed a significant reduction of clinical parameters in both groups, but curcumin group showed greater reduction when compared with the chlorhexidine group.

The reduction in periodontal parameters of the experimental sites (2% curcumin gel) may be explained due to anti-inflammatory action of curcumin. It reduces inflammation by lowering histamine levels and possibly by increasing the production of natural cortisone by the adrenal glands. Its anti-inflammatory properties may be attributed to its ability to inhibit both biosynthesis of inflammatory prostaglandins from arachidonic acid and neutrophil function during inflammatory states. The reduction in microbiological parameters, i.e., TVAC in the experimental sites (2% curcumin gel) may be explained due to antimicrobial action of curcumin as it has an ability to inhibit the growth of various microorganisms.

To the best of our knowledge, very few studies in the scientific literature have been conducted which have compared the efficacy of 2% curcumin gel and 0.2% chlorhexidine gel when subgingivally delivered along with SRP on the periodontal and microbiological parameters at both 1 month and 3 months in chronic periodontitis patients.

Although the aim and objectives of the present study were met, however few limitations were also noted. Our study had a small sample size. Also the effect of 2% curcumin gel and 0.2% chlorhexidine gel was not assessed on specific periodontopathogens. The bioavailability of the gels used (2% curcumin gel and 0.2% chlorhexidine gel) may be limited due to their usage in the gel form.

Future perspectives could be aimed at conducting studies with larger sample size including studies of 6-month follow-ups or more to assess the long-term effectiveness of subgingivally delivered curcumin gel as an adjunct in nonsurgical periodontal therapy, longer bioavailability of curcumin in the periodontal pocket, and they may be incorporated into a biodegradable matrix of cross-linked hydrolyzed gelatin and made into a chip. Curcumin could be compared with other herbal agents such as aloe vera, neem, tulsi, propolis, cocoa husk, pomegranate, and cranberry to assess clinical advantage and side effect of the agent used as an adjunct for conventional periodontal treatment procedures. Further studies can be performed to evaluate the efficacy of 2% curcumin gel on different periodontopathogens using a polymerase chain reaction in chronic periodontitis patients.

**Conclusion**

Curcumin showed effective anti-inflammatory and antibacterial properties when subgingivally delivered in periodontal pockets...
in chronic periodontitis patients. It is biologically accepted by the patients and can be recommended as an adjunct to SRP in the treatment of localized moderate chronic periodontitis and periodontal maintenance patients.

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