Comparison of an essential-oil-based oral rinse and chlorhexidine as adjuncts to scaling and root planing in the treatment of periodontal inflammation

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Abstract: Objective: The aim of the present short-term follow-up study was to compare the effects of an essential oil (EO)-based oral rinse and chlorhexidine as adjuncts to scaling and root planing (SRP) in the treatment of periodontal inflammation. Methods: In Group-1, SRP was performed and participants were instructed to rinse with EO-based oral rinse; in Group-2, SRP was performed and participants were instructed to rinse with chlorhexidine; and in Group-3, SRP was performed and participants were instructed to rinse with water. Periodontal parameters (plaque index [PI], bleeding-on-probing [BOP], and probing pocket depth [PPD] ≥ 4 mm) were assessed at baseline and after 7 and 30 days. Results: In all groups, periodontal parameters (PI, BOP, and PPD ≥ 4 mm) were comparable at baseline. In Groups-1 and -2, there was a significant reduction in PI (P < 0.01), BOP (P < 0.01), and PD ≥ 4 mm after 7 days and 30 days of follow-up than baseline. In Group-3, there was a significant reduction in PI (P < 0.01) and BOP (P < 0.01) after 7 days of follow-up compared to baseline. There was no difference in periodontal parameters after 7 days and 30 days of follow-up in Groups-1 and -2. Conclusion: EO-based oral rinses and chlorhexidine digluconate (CHX) are acceptable adjuncts to SRP in the treatment of periodontal inflammation. Keywords: chlorhexidine, essential oil, oral rinse, periodontal, scaling and root planing

Introduction

Periodontal inflammatory conditions (such as chronic periodontitis [CP]) affect 5% to 20% of the adult population [1]. In addition to the host susceptibility, the presence of periodontopathogenic microbes (particularly those in the dental plaque) plays an essential role in its etiopathogenesis of CP in susceptible individuals [1]. A major goal of scaling and root planing (SRP) is to eliminate supra- and subgingival deposits of dental plaque and calculus in order to maintain a healthy periodontal status. However, it is pertinent to mention that the overall efficacy of SRP is compromised especially if there is presence of deep pockets and/or furcation areas where complete eradication of plaque and calculus deposits is difficult [2]. Moreover, results of a systematic review demonstrated that the quality of the mechanical plaque control is not sufficiently effective in reducing periodontal inflammation [3]. In this regard, therapeutic regimes such as use of oral rinses, photodynamic therapy, and antibiotic therapy as adjunct to conventional mechanical debridement (SRP) have been proposed in an attempt to eradicate periodontal inflammatory conditions [4–8].

Chemical plaque control using oral rinses has been recommended as part of an oral hygiene regimen, and the effectiveness of oral antisepic mouth rinses is usually attributed to their antibacterial activity. Chlorhexidine is a diphenyl compound that is active mainly against bacteria and exhibits limited activity against viruses. Traditionally, 0.12–0.2% chlorhexidine digluconate (CHX) is used as an adjunct to SRP in an attempt to control
periodontal inflammatory conditions. In a systematic review that assessed the effect of subgingival irrigation with CHX, no additional benefit to mechanical debridement was found [9]. Studies [10–12] have reported that 0.2% CHX shows little or no antibacterial activity against various enteric Gram-negative rods and microorganisms of the oral biofilm. Furthermore, CHX has been reported to jeopardize the cell morphology of fibroblasts [13]. On the other hand, essential oil (EO)-based oral rinses have a broad antimicrobial spectrum, affecting Gram-positive and Gram-negative microbes. EO-based oral rinses have been reported to reduce bacterial colonization and multiplication on the tooth surfaces. In addition, EO-based oral rinses have been shown to retard bacterial multiplication [14]. This causes a reduced bacterial load, slow plaque maturation, and decreased plaque mass and pathogenicity [14]. The antibacterial mechanisms through which EO-based oral rinses reduce the counts of pathogenic microbes involves the rupture of the cell wall and enzymatic inhibition [14].

In the present clinical study, it was hypothesized that EO-based oral rinse when used as an adjunct to SRP is more effective in the treatment of CP as compared to when SRP is performed with adjunct CHX use. With this background, the aim of the present short-term follow-up study was to compare the effects of an EO-based oral rinse and CHX as adjuncts to SRP in the treatment of CP.

Materials and Methods

Ethical guidelines

The study was approved by the Research Ethics Review Committee of the College of Dentistry, King Saud University, Riyadh, Saudi Arabia (NF2286). A consent form was presented to all study participants. It was mandatory for all study participants to have read and signed the consent form before being included in the present investigation.

Study participants

The study participants were recruited from an oral healthcare center situated in Riyadh, Saudi Arabia. Baseline and follow-up periodontal examinations were performed at the same oral healthcare center.

Eligibility criteria

The eligibility criteria were as follows: a) patients with bleeding on probing (BOP) in at least 30% sites; and b) patients with a probing depth of at least 4 mm in 30% sites. Smokers; alcohol users; patients who were currently using or had a history of antibiotic and/or steroid intake; pregnancy and/or lactation; and patients with systemic diseases such as poorly controlled diabetes mellitus, renal disorders, cardiovascular diseases, and acquired immune deficiency syndrome were excluded.

Study grouping

All individuals were divided into three groups. Among patients in all groups, SRP was performed by one trained and calibrated operator (MA). The k value for the intraexaminer reliability was 0.95. Based on the type of oral rinse allocated, participants were divided into three groups. Randomization was done by picking a paper from an opaque bag marked either “Group-1,” “Group-2,” or “Group-3.” In Group-1, participants were instructed to rinse with an EO-based oral rinse (Listerine, Johnson & Johnson Middle East FZ – LLC) twice daily for 2 weeks; in Group-2, participants were instructed to rinse with CHX (Peridex, 3M ESPE, St. Paul, MN, USA) twice daily for 2 weeks; and in Group-3, participants were instructed to rinse with water twice daily for 2 weeks. In all groups, participants were instructed to rinse twice daily with 10 mL of the allocated oral rinse (undiluted) for 60 s, after which they could spit.

Periodontal parameters

Among patients in Groups-1, -2, and -3, periodontal parameters (plaque index [PI] [15], bleeding on probing [BOP] [16], and probing pocket depth [PPD] ≥ 4 mm) [17] were assessed at baseline and 7 and 30 days after treatment.

Statistical analysis

Statistical analysis was performed using a software program (SPSS Version 18, Chicago, IL, USA). Group comparisons were assessed using one-way analysis of variance. For multiple comparisons, the Bonferroni post hoc test was used. P values less than 0.05 were considered statistically significant.

Results

General characteristics

In total, 90 patients with CP patients were included with 30 participants in each group. Mean ages of the
participants in Groups -1, -2, and -3 were 42 ± 4.8 years, 44.8 ± 2.6 years, and 43.5 ± 4.3 years, respectively. Gender of the study participants was comparable in all study groups. There was no significant difference in periodontal parameters (PI, BOP, and PD ≥ 4 mm) among participants in Groups -1, -2, and -3 at baseline (Table I).

**Group-1: Periodontal parameters at baseline and after 7 days and 30 days of follow-up**

There was a significant reduction in PI (P < 0.01), BOP (P < 0.01), and PD ≥ 4 mm after 7 days and 30 days of follow-up compared to baseline. At 30 days of follow-up, PI (P < 0.01), BOP (P < 0.01), and PD ≥ 4 mm had significantly reduced compared to those at 7 days of follow-up. These results are summarized in Fig. 1.

**Group-2: Periodontal parameters at baseline and after 7 days and 30 days of follow-up**

There was a significant reduction in PI (P < 0.01), BOP (P < 0.01), and PD ≥ 4 mm after 7 days and 30 days of follow-up compared to baseline. At 30 days of follow-up, PI (P < 0.01), BOP (P < 0.01), and PD ≥ 4 mm had significantly reduced compared to those at 7 days of follow-up. These results are summarized in Fig. 2.

**Group-3: Periodontal parameters at baseline and after 7 days and 30 days of follow-up**

There was a significant reduction in PI (P < 0.01) and BOP (P < 0.01) after 7 days of follow-up compared to baseline. There was no significant reduction in PD ≥ 4 mm after 7 days of follow-up compared to baseline. At 30 days of follow-up, PI, BOP, and PD ≥ 4 mm had significantly reduced compared to those at 7 days of follow-up. These results are summarized in Table I.

| Group-1 (SRP + EO) | Group-2 (SRP + CHX) | Group-3 (SRP + water) |
|-------------------|---------------------|-----------------------|
| Number of participants (n) | 30 | 30 | 30 |
| Age in years (mean ± SD) | 42 ± 4.8 | 44.8 ± 2.6 | 43.5 ± 4.3 |
| Gender (male:female) | 20:15 | 18:17 | 18:17 |
| PI (%) | 60.4 ± 12.2 | 66.3 ± 6.6 | 62.8 ± 4.8 |
| BOP (%) | 70.1 ± 5.1 | 64.8 ± 6.7 | 62.7 ± 8.1 |
| PD ≥ 4 mm (%) | 40.7 ± 10.2 | 38.1 ± 12.2 | 33.5 ± 4.8 |

Fig. 1. Periodontal parameters at baseline and after 7 days and 30 days of follow-up in Group-1. Red bars represent plaque index, blue bars represent bleeding on probing, and green bars represent probing depth ≥ 4 mm. *P < 0.01, †P < 0.01, ‡P < 0.01, §P < 0.01, ¶P < 0.01, ††P < 0.01
4 mm were comparable to baseline values as shown in Fig. 3.

**Discussion**

The present study was based on the hypothesis that EO-based oral rinse when used as an adjunct to SRP is more effective in the treatment of CP as compared to when SRP is performed with adjunct CHX use. The present results showed that, as compared to the placebo group (Group-3), there was a significant reduction in PI, BOP, and PD ≥ 4 mm at 7 days and 30 days of follow-up. CHX has been mainly used to control plaque in situations when achieving ordinary plaque control by mechanical measures is impractical. CHX binds to bacterial...
cell membranes and causes increased permeability with leakage of intracellular components. On the other hand, EO-based antiseptic is a combination of the phenol-related essential oils, including thymol (0.060%), eucalyptol (0.091%), menthol (0.042%), and methylsalicylate (0.064%) in a 26.9% hydroalcoholic vehicle [13]. The mode of action of EO-based oral rinses is through bacterial membrane protein denaturation and successive bacterial membrane damage, as well as inhibiting bacterial enzyme action [13]. EO-based oral rinses present anti-inflammatory and prostaglandin synthetase inhibitor activity, which can occur at concentrations lower than that needed for antibacterial activity [13]. When we compared to periodontal inflammatory parameters at 1 week and month of follow-up among patients treated using EO-based oral rinse (Group-1) and Group-2 (CHX), we found no significant difference in the severity of periodontal parameters among the two groups. This suggests that the antimicrobial activity of both forms of oral rinses (EO-based oral rinse as well as CHX) is effective pathogenic microbes, which makes both forms of oral rinses useful adjuncts in the treatment of periodontal inflammation the authors of the present clinical study support the in vitro study by Eick et al. [18] which assessed the action of CHX and an EO-based oral rinse on periodontopathogenic microbes including Streptococci, Enterobacteria, Porphyromonas gingivalis, Aggregatibacter actinomycetemcomitans, and Fusobacterium nucleatum. The results demonstrated that CHX as well as EO-based oral rinses is active against oral microbes [18]. Similar results were reported by Fine et al. [19].

In the present study, both CHX and EO-based oral rinses mouthwashes have proven their efficacy on the reduction of plaque accumulation and gingival inflammation after SRP. However, it is pertinent to mention that these oral rinses have not been proven to enhance the healing of gingival tissues after periodontal surgery. In the study by Sanz et al. [20]. CHX displayed no statistically significant difference in the healing rate of gingival tissues following periodontal surgery compared with placebo, as measured by epithelialization of the surgical area for up to 1.5 months. Likewise, in another clinical trial, the healing rate of the operated sites in patients treated with EO-based oral rinse was either equal to or slower than the controls. To our knowledge, there are no studies that have directly compared the effectiveness of CHX and EO-based oral rinses as adjuncts in periodontal flap surgical interventions. Hence, additional studies are needed in this context [21].

There are a few limitations of the present study. It is well known that periodontal inflammatory conditions are worse in immunocompromised individuals, cigarette smokers, and individuals chewing smokeless tobacco products [15, 17, 22–28]. Moreover, it has also been reported that the outcomes of periodontal surgical interventions are compromised in tobacco smokers [29, 30]. It is therefore tempting to speculate that the outcomes of SRP (regardless of the type of oral rinse used as adjunct) are compromised in individuals using tobacco products and immunocompromised patients, such as those with poorly controlled diabetes and acquired immune deficiency syndrome. Further prospective studies are warranted to assess the effect of EO-based oral rinses when used as adjunct to SRP in the treatment of periodontal inflammation among immunocompromised patients and tobacco product users. In addition, it is also worth mentioning that the results presented in the present study were based on a short-term follow-up (1 month). It is hypothesized that had these patients been followed-up for longer durations.

Fig. 4. Comparison of periodontal parameters at baseline and after 7 days and 30 days of follow-up in Group-1 and Group-2.
(at last months), the results regarding comparisons between Groups-1 and -2 would have been similar. However, additional long-term follow-up studies are warranted in this regard.

Within the limits of the present study, it is concluded that EO-based oral rinses and CHX are equally acceptable adjuncts to SRP in the treatment of periodontal inflammation. However, further studies are needed to assess the effect of EO-based oral rinses in the long-term management of periodontal inflammatory conditions.

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**Authors’ contribution:** MS wrote the manuscript and designed and supervised the research study. FA performed the statistical analysis and wrote the methodology. KMA revised the manuscript. AAA arranged references as per the journals’ style.

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