Efficacy of Subgingival Irrigation with 10% Povidone-iodine as an Adjunct to Scaling and Root Planing: A Clinical and Microbiological Study

Abstract

Background: To evaluate the effectiveness of subgingival irrigation with 10% povidone-iodine as an adjunct to scaling and root planning (SRP) and to assess the effectiveness of 10% povidone-iodine in reducing periodontal pathogens mainly Porphyromonas gingivalis (Pg) and Aggregatibacter actinomycetemcomitans (Aa). Methodology: Sixty patients with chronic periodontitis of mild to moderate type with periodontal pocket depths (PDs) of 4–6 mm were recruited. At baseline, plaque index, gingival index, and bleeding index were assessed. The PD and clinical attachment level were assessed using the Florida probe®. Pooled subgingival plaque samples were collected. Each participant was allocated into 2 arches, maxillary arch received SRP alone and mandibular arch received SRP with 10% of povidone-iodine irrigation at baseline. After 3 months, same clinical parameters were assessed and plaque samples were collected from both arches. The collected plaque samples were evaluated using polymerase chain reaction. Data were analyzed using SPSS software, version 10 and through independent-samples t-test, paired-samples t-test, and repeated measures ANOVA. Results: At 3 months posttreatment, subgingival irrigation with povidone-iodine together with SRP showed a statistically significant reduction in all the clinical parameters and in levels of Pg and Aa. Conclusion: In the present study, 10% povidone-iodine irrigation as an adjunct to SRP favored the nonsurgical periodontal therapy, due to its broad-spectrum antimicrobial activity. Hence, it could be considered as an adjunctive treatment approach in the treatment of chronic periodontitis.

Keywords: Periodontitis, povidone-iodine, scaling and root planing

Introduction

Periodontitis is a disease of multiple etiologies but is primarily mediated by periodontopathic bacteria mainly by Aggregatibacter actinomycetemcomitans (Aa) and Porphyromonas gingivalis (Pg), leading to the inflammation and destruction of periodontium.[1]

Nonsurgical periodontal therapy aims to eliminate pathogenic bacteria in the biofilms. However, a complete elimination of such pathogenic microorganisms remains an enigma. The periodontist often faces a dilemma with the choice of treatment rather than a treatment of choice. In light of this, more research has been directed at developing methods for enhancing plaque removal efforts.

The traditional treatment modality of scaling and root planing (SRP) remains the “gold standard” for the nonsurgical management of periodontal disease.[2,3] However, SRP does have certain limitations which include the inability to instrument the deeper periodontal pockets, bifurcations, and inability to remove the microorganisms within the tissue lining of the periodontal pockets. Hence, antimicrobial therapy targets the susceptible microorganisms in various ecological niches of the oral cavity.

Thus, chemical substituents could alter the environment of the pockets to prevent the growth of pathogens. These have shown greater efficacy when used with SRP. Many different agents have been utilized for irrigation; the most widely studied agent is chlorhexidine and various percentages of povidone-iodine solution.

Elemental iodine or its derivatives polyvinylpyrrolidone-iodine complex (Povidone-I) is the most broad-spectrum and potent antiseptics available. This Povidone-I has a bactericidal effect against most bacteria including putative periodontal pathogens, fungi, mycobacteria, viruses, and protozoa.[4] Povidone-iodine remains an effective antibacterial agent when...
used directly into the periodontal pocket even at low concentrations.

Various methods have evolved to detect the periodontal pathogens. The investigation of specific bacteria in oral microflora of patients with disease determines which periodontal sites are at a high risk for active destruction.[5,6] Nevertheless, new technology is always exciting with many products and device which is still under development.

Recently, molecular-based detection methods, particularly polymerase chain reaction (PCR), have greatly facilitated the investigations of specific microorganisms in oral diseases. PCR is a nucleic acid-based assay which can detect a single microorganism and has the highest sensitivity compared to any other microbiological method.[7]

Objectives of the study
To evaluate the effectiveness of subgingival irrigation with 10% of povidone-iodine as an adjunct to SRP and to evaluate the effectiveness of 10% povidone-iodine in reducing periodontal pathogens Aa and Pg.

Methodology
Systemically healthy controls presenting to the Department of Periodontics, fulfilling the following criteria were selected and recruited for the study. Sixty patients with an age range of 20–60 years who were diagnosed with chronic periodontitis, mild to moderate type[8] were recruited [Figures 1 and 2]. Each study participant with a minimum of 20 teeth exhibiting at least one periodontal pocket, with probing depth of 4–6 mm in each quadrant of the dentition were included.

Exclusion criteria included allergy to iodine, thyroid dysfunction, SRP or systemic antibiotic treatment within the preceding 3 months, pregnancy, requirement of antibiotic prophylaxis before dental treatment, and any medical condition comprising a contraindication for routine dental treatment.

All patients were, on an individual basis, informed about the nature and scope of the proposed treatment and informed consent forms were signed. The study protocols were presented to and approved by the ethical committee of the institution.

At the baseline visit, the clinical parameters such as plaque index (PI), gingival index (GI), and bleeding index (BI) were recorded by using a Williams periodontal probe. The pocket depth (PD) and clinical attachment level (CAL) were recorded by Florida probe* [Figure 3]. The selected site before sampling was isolated by placement of cotton rolls and then gently dried with compressed air to prevent contamination from saliva. At baseline, subgingival pooled plaque samples were collected with sterile Gracey curettes from the teeth with PDs of 4–6 mm from each quadrant.

At the baseline visit, maxillary quadrant (control arch) received SRP alone and subsequently, mandibular quadrant (i.e. experiment arch) received SRP and one posterior tooth of mandibular quadrant was randomly chosen and irrigated with 1 ml of 10% povidone-iodine using endodontic double side-vented syringe [Figure 4]. The syringe was gently inserted into the depth of periodontal pockets to assure delivery of irrigant solutions. Repeated irrigation ensured that irrigant solution filled up pockets for a period of 5 min and oral hygiene instructions were reinforced. Patients were recalled after 3 months, and clinical parameters and plaque samples were reassessed [Figure 5].

PCR protocol was carried by extracting DNA from the plaque samples using highly purified Invitrogen DNA isolation kit [Figure 6] (pure link™ DNA extraction kit). The standard “proteinase K” method was followed by adding 20 µl of proteinase K to a sterile microcentrifuge tube, and 200
µl of plaque sample was transferred to the tube containing proteinase K and incubated at 55°C for 30 min. 20 µl of RNase A was added to the lysate and mixed well by briefly vortexing and incubated at room temperature for 2 min. Two hundred microliter of Purelink™ Genomic Lysis/ Binding buffer was added and mixed well by vortexing to obtain a homogeneous solution. Two hundred µl of 96%–100% ethanol was mixed well by vortexing for 5 s to obtain a homogeneous solution and preceded to purification protocol immediately. The purification procedure is designed by using purifying genomic DNA [Figure 7]. A Purelink™ spin-column centrifugation was carried out for 10–15 min. The column was centrifuged at 10000 rpm for 1 min at room temperature. Custom SYBR® Green assay reagents (Applied Biosystems, India) were used in this study.

Based on the Ct values (i.e., the number of PCR cycles that obtained the threshold signals of fluorescence was taken into consideration). All the calculations were done using Applied Biosystems Software.

Statistical analysis data were analyzed using SPSS software, version 10 (Windows 8, Mysore, Karnataka) and through independent-samples t-test, paired-samples t-test, and repeated measures ANOVA.

**Results**

A total number of 60 chronic periodontitis patients were included, of which 60% were males and 40% were females with a mean age group of 39.87 ± 9.83 years. The clinical examination revealed a statistically significant reduction in a PI, GI, and BI in mandibular arch after receiving 10% povidone-iodine subgingival irrigation along with SRP arch when compared to the maxillary arch with SRP alone. Probing PD reduction was 1.5 mm following povidone-iodine subgingival irrigation along with SRP in mandibular arch, 2.6 mm for the SRP alone in maxillary arch [Table 1].

Hence, significant differences in PD reduction were established between the two arches (P < 0.01) whereas considering reduction of the CAL, there was no significant difference between maxillary and mandibular arch.

The microbial examination revealed the reduction in periodontal pathogen counts differed among maxillary and mandibular quadrants (P < 0.001), with the largest reduction found in the mandibular arch of povidone-iodine with SRP. Major pathogen counts Aa and Pg were reduced by at least 40%–30% of sites in the SRP arch and by 10% of sites in the povidone-iodine with SRP arch with a significant difference in the mandibular arch [Table 2].
The present clinical study was designed to evaluate the clinical effects of adjunctive use of 10% povidone-iodine with SRP in the treatment of slight to moderate chronic periodontitis. In each participant, the mouth was split into 2 arches to eliminate inter-subject variables. However, split-mouth design employed in the present study might carry the risk of transferring povidone-iodine through saliva and affecting the microbiota in control sites.\(^9\)

The multifaceted approaches have been developed to control periodontal diseases along both mechanical and pharmaceutical lines. SRP combined with subgingival antiseptics are useful in treating periodontitis. Hence, in this study, povidone-iodine was used as an adjunct to SRP because of its broad-spectrum antimicrobial activity, low potential for developing resistance and adverse reactions, wide availability, ease of use, and low financial cost.\(^{10}\)

In the present study, 10% concentration of povidone-iodine was used as it remains more effective in the sulcus even after further being diluted in the presence of biological fluids such as gingival crevicular fluid and blood as shown in various studies by Berkelman \textit{et al}. and Hoang \textit{et al}.\(^{11}\)

In this study, mandibular arch received SRP along with 10% povidone-iodine irrigation because studies have shown that plaque accumulation is more in mandibular arch when compared to the maxillary arch, which could compromise the patient’s self-care and also, the retention of POVIDONE iodine solution is better in the mandibular arch.\(^{12}\)

The present study showed a significant reduction in PI, BI, and GI in mandibular arch after (SRP + adjunctive use of 10% povidone-iodine irrigation). This could be due to the adjunctive use of 10% povidone-iodine irrigation along with SRP, as povidone-iodine sustains the effect of antimicrobial activity for a longer duration of time. The result of this study was in line with the previous reports of Pandya \textit{et al}., Nagakawa \textit{et al}.., and Kotsilikov \textit{et al}.\(^{13}\) A predictable reduction in the levels of inflammation and absence of bleeding were also noticed. This is in accordance with study by Marunaik \textit{et al}. and Cigana \textit{et al}.\(^{14}\) Slow release of iodine in the subgingival area induce the fresh influx of macrophages and T-helper cells, which helps in modulating the wound healing and further reduces the inflammation as show in the studies by Cigana \textit{et al}. and Selvaggi G.\(^{15}\)

There is a large body of evidence that supports the fact that \textit{Pg} and \textit{Aa} play an important role in the pathogenesis of periodontitis as shown in various studies by Van Steenbergen \textit{et al}. 1991 and Haffajee \textit{et al}. 1998. Hence, in the present study, we tried to quantitatively analyze the levels of \textit{Pg} and \textit{Aa} in the periodontitis patients and they were found to be positive for these periodontal pathogens.\(^{16}\)

There was a statistically significant reduction in levels of \textit{Pg} and \textit{Aa}. This could be due to the presence of iodine which is able to penetrate the cell walls of microorganisms causing damage to the cell wall leading to the loss of the intracellular material and thereby reducing the activity of periodontal pathogens as shown in studies by Leohardt \textit{et al}. and Hoang \textit{et al}.\(^{17}\)

Therefore, in lieu of all the above-mentioned facts, the present study showed that SRP along with 10% of povidone-iodine irrigation could be considered as an adjunctive treatment approach in the treatment of chronic periodontitis.

### Table 1: Comparison of clinical parameters in chronic periodontitis group at baseline and after 3 months in both control maxillary arch after scaling and root planing and experiment mandibular arch after scaling and root planing with povidone-iodine irrigation

| Clinical parameters | Duration | Mean±SD | \( P \) |
|---------------------|----------|---------|--------|
| Plaque index        | Baseline | 2.52±0.31 | 0.001* |
|                     | Maxillary after 3 months | 2.07±0.24 |        |
|                     | Mandibular after 3 months | 0.81±0.44 |        |
| Gingival index      | Baseline | 2.61±0.23 | 0.001* |
|                     | Maxillary after 3 months | 2.14±0.33 |        |
|                     | Mandibular after 3 months | 0.81±0.44 |        |
| Bleeding index      | Baseline | 99.7±0.94 | 0.000* |
|                     | Maxillary after 3 months | 36.8±7.33 |        |
|                     | Mandibular after 3 months | 18.6±8.55 |        |
| Periodontal probing depths | Baseline | 3.26±0.33 | 0.001* |
|                     | Maxillary after 3 months | 2.61±0.31 |        |
|                     | Mandibular after 3 months | 1.58±0.45 |        |
| CAL                 | Baseline | 3.54±0.73 | 0.028  |
|                     | Maxillary after 3 months | 3.07±0.50 |        |
|                     | Mandibular after 3 months | 2.37±0.77 |        |

SRP=Scaling and root planing, SD=Standard deviation, CAL=Clinical attachment level, *statistically highly significant as \( P < 0.001 \)

### Table 2: Interarch comparison of levels of \textit{Aggregatibacter actinomycetemcomitans} and \textit{Porphyromonas gingivalis} in maxillary control and experiment mandibular arch in chronic periodontitis group at baseline and after 3 months

| Microbial count | Levels of \textit{Pg} (%) | Levels of \textit{Aa} (%) |
|----------------|--------------------------|--------------------------|
| Baseline       | 80                        | 60                        |
| Percentage of maxillary sites showing reduction in microbial count following SRP after 3 months | 40 | 30 |
| Percentage of mandibular sites showing reduction in microbial count following Povidone-iodine/SRP after 3 months | 10 | 10 |
| \( P \)        | 0.001*                   | 0.001*                   |

\textit{Pg}=\textit{Porphyromonas gingivalis}, \textit{Aa}=\textit{Aggregatibacter actinomycetemcomitans}, SRP=Scaling and root planing, *statistically highly significant as \( P < 0.001 \)

### Discussion

The multifaceted approaches have been developed to control periodontal diseases along both mechanical and pharmaceutical lines. SRP combined with subgingival antiseptics are useful in treating periodontitis. Hence, in this study, povidone-iodine was used as an adjunct to SRP because of its broad-spectrum antimicrobial activity, low potential for developing resistance and adverse reactions, wide availability, ease of use, and low financial cost.\(^{10}\)

In the present study, 10% concentration of povidone-iodine was used as it remains more effective in the sulcus even after further being diluted in the presence of biological fluids such as gingival crevicular fluid and blood as shown in various studies by Berkelman \textit{et al}. and Hoang \textit{et al}.\(^{11}\)

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Therefore, in lieu of all the above-mentioned facts, the present study showed that SRP along with 10% of povidone-iodine irrigation could be considered as an adjunctive treatment approach in the treatment of chronic periodontitis.
Limitations of the study

The split-mouth design carries the risk of transferring povidone-iodine from the assigned quadrants to the others.

Conclusion

However, a few scientific data exist on its utility in periodontal treatment. Considering its potent and broad-spectrum antimicrobial activity, and low financial cost. The current study aimed to determine the context of 10% PVP-iodine as sub gingival irrigation that can provide microbiological as well as clinical benefits in the treatment of periodontitis as an adjunct to nonsurgical periodontal therapy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Umeda M, Takeuchi Y, Noguchi K, Huang Y, Koshy G, Ishikawa I. Effects of nonsurgical periodontal therapy on the microbiota. Periodontol 2000 2004;36:98-120.
2. Cobb CM. Clinical significance of non-surgical periodontal therapy: An evidence-based perspective of scaling and root planing. J Clin Periodontol 2002;29 Suppl 2:6-16.
3. Cobb CM. Microbes, inflammation, scaling and root planing, and the periodontal condition. J Dent Hyg 2008;82 Suppl 3:4-9.
4. Schreier H, Erdos G, Reimer K, König B, König W, Fleischer W. Molecular effects of povidone-iodine on relevant microorganisms: An electron-microscopic and biochemical study. Dermatology 1997;195 Suppl 2:111-6.
5. Sanz M, Lau L, Herrera D, Morillo JM, Silva A. Methods of detection of Actinobacillus actinomycetemcomitans, Porphyromonas gingivalis and Tannerella forsythensis in periodontal microbiology, with special emphasis on advanced molecular techniques: A review. J Clin Periodontol 2004;31:1034-47.
6. Zambon JJ, Haraszthy VI. The laboratory diagnosis of periodontal infections. Periodontol 2000 1995;7:69-82.
7. Kubista M, Andrade JM, Bengtsson M, Forootan A, Jonák J, Lind K, et al. The real-time polymerase chain reaction. Mol Aspects Med 2006;27:95-125.
8. Armitage GC. Development of a classification system for periodontal diseases and conditions. Ann Periodontol 1999;4:1-6.
9. Quirynen M, Mongardi C, de Soete M, Pauwels M, Coucke W, van Eldere J, et al. The rôle of chlorhexidine in the one-stage full-mouth disinfection treatment of patients with advanced adult periodontitis. Long-term clinical and microbiological observations. J Clin Periodontol 2000;27:578-89.
10. Ferguson AW, Scott JA, McGavigan J, Elton RA, McLean J, Schmidt U, et al. Comparison of 5% povidone-iodine solution against 1% povidone-iodine solution in preoperative cataract surgery antisepsis: A prospective randomised double blind study. Br J Ophthalmol 2003;87:163-7.
11. Berkelman RL, Holland BW, Anderson RL. Increased bactericidal activity of dilute preparations of povidone-iodine solutions. J Clin Microbiol 1982;15:635-9.
12. Sharma U, Jain RL, Pathak A. A clinical assessment of the effectiveness of mouthwashes in comparison to toothbrushing in children. J Indian Soc Pedod Prev Dent 2004;22:38-44.
13. Pandya D, Manohan B, Darshan V, Shrimankar N, Pathak N. Povidone iodine – An adjunct to periodontal therapy. NJIRM 2012;3:148-51.
14. CiganA, Kerebel B, David J, Doumenjou F, Da Costa Noble R. A clinical and histological study of the efficacy of betadine on gingival inflammation. J Biol Buccale 1991;19:173-84.
15. Selvaggi G, Monstrey S, Van Landuyt K, Hamdi M, Blondeel P. The role of iodine in antisepsis and wound management: A reappraisal. Acta Chir Belg 2003;103:241-7.
16. Yang HW, Asikainen S, Dogan B, Suda R, Lai CH. Relationship of Actinobacillus actinomycetemcomitans serotype b to aggressive periodontitis: Frequency in pure cultured isolates. J Periodontol 2004;75:592-9.
17. Hoang T, Jorgensen MG, Keim RG, Pattison AM, Slots J. Povidone-iodine as a periodontal pocket disinfectant. J Periodontal Res 2003;38:311-7.