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Research Article

Comparative evaluation between chlorhexidine, povidone iodine and turmeric mouthwashes post phase 1 periodontal therapy

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Abstract

Background: Periodontal disease remains a significant global health burden, with phase 1 therapy serving as the cornerstone of initial treatment. Adjunctive antimicrobial mouthwashes are commonly employed to enhance therapeutic outcomes. This study aimed to compare the clinical efficacy of three different mouthwashes—chlorhexidine (0.12%), povidone iodine (1%), and turmeric (2% curcumin extract)—as adjuncts to phase 1 periodontal therapy.

Methods: A randomized, double-blind, controlled clinical trial was conducted with 120 patients (40 per group) diagnosed with chronic periodontitis. Following phase 1 therapy (scaling and root planing), participants were randomly assigned to use one of the three mouthwashes twice daily for 21 days. Clinical parameters including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were recorded at baseline, 14 days, and 21 days. Microbiological analysis of subgingival plaque samples was also performed.

Results: All three mouthwashes demonstrated significant improvements in clinical parameters compared to baseline ($p < 0.001$). The chlorhexidine group showed the greatest reduction in PI (2.15 ± 0.32 to 0.82 ± 0.18) and GI (1.98 ± 0.28 to 0.75 ± 0.15). The turmeric group exhibited comparable results in PPD reduction (4.32 ± 0.87 mm to 2.87 ± 0.65 mm) and CAL gain (3.45 ± 0.92 mm to 2.18 ± 0.71 mm). Povidone iodine demonstrated significant antimicrobial activity with a 78.3% reduction in total bacterial count. Inter-group analysis revealed chlorhexidine was superior for plaque control ($p = 0.023$), while turmeric showed better anti-inflammatory effects ($p = 0.018$).

Conclusion: All three mouthwashes proved effective as adjuncts to phase 1 periodontal therapy. Chlorhexidine remains the gold standard for plaque control, turmeric demonstrates promising anti-inflammatory properties, and povidone iodine offers potent antimicrobial activity. The choice of mouthwash should be tailored to individual patient needs and specific clinical presentations.

Keywords: periodontal therapy, chlorhexidine, povidone iodine, turmeric, mouthwash, clinical parameters, antimicrobial

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1. Introduction

Periodontal diseases represent a major public health challenge worldwide, affecting approximately 50% of the global population and being the leading cause of tooth loss in adults [1]. The pathogenesis of periodontal disease involves complex interactions between microbial biofilms and the host immune response, leading to inflammation and destruction of periodontal tissues [2]. Phase 1 periodontal therapy, also known as initial or cause-related therapy, forms the foundation of periodontal treatment and aims to eliminate etiologic factors, reduce inflammation, and establish a healthy oral environment [3].

The primary objectives of phase 1 therapy include removal of dental plaque and calculus through scaling and root planing (SRP), elimination of factors that retain plaque, and establishment of proper oral hygiene practices [4]. However, despite thorough mechanical debridement, complete elimination of pathogenic microorganisms

from periodontal pockets remains challenging due to their ability to invade dentinal tubules and reside in areas inaccessible to mechanical instrumentation [5]. This limitation has led to the widespread use of adjunctive antimicrobial agents to enhance the therapeutic outcomes of phase 1 therapy [6].

Chlorhexidine gluconate (CHX) has long been considered the gold standard among antimicrobial mouthwashes due to its broad-spectrum antimicrobial activity and substantivity [7]. At 0.12% concentration, CHX demonstrates excellent efficacy against both gram-positive and gram-negative bacteria, as well as fungi and viruses [8]. However, its use is associated with several side effects including tooth staining, taste alteration, and mucosal irritation, which may affect patient compliance [9].

Povidone iodine (PVP-I), a complex of polyvinylpyrrolidone and iodine, has emerged as a promising alternative with broad-spectrum antimicrobial activity [10]. The 1% PVP-I solution has shown bactericidal effects against most periodontal pathogens, including Porphyromonasgingivalis and Aggregatibacteractinomycetemcomitans [11]. Unlike chlorhexidine, PVP-I does not cause tooth staining and has minimal side effects, making it a suitable option for long-term use [12].

In recent years, there has been growing interest in natural alternatives for periodontal therapy, with turmeric (Curcuma longa) gaining significant attention [13]. The active compound curcumin possesses potent anti-inflammatory, antioxidant, and antimicrobial properties [14]. Studies have demonstrated that turmeric-based mouthwashes can effectively reduce gingival inflammation and plaque accumulation while being free from the side effects associated with synthetic antimicrobials [15].

Recent systematic reviews and meta-analyses have compared various mouthwashes, but most studies have focused on pairwise comparisons rather than comprehensive evaluations of multiple agents [16,17]. Furthermore, limited research has directly compared the efficacy of conventional antimicrobials with natural alternatives like turmeric in the context of phase 1 periodontal therapy [18].

The existing literature reveals several gaps: (1) insufficient head-to-head comparisons between chlorhexidine, povidone iodine, and turmeric mouthwashes; (2) limited evaluation of their effects on both clinical and microbiological parameters; and (3) inadequate assessment of their long-term efficacy and patient acceptance [19]. Addressing these gaps is crucial for evidence-based clinical decision-making and personalized treatment planning.

Therefore, this study aimed to conduct a comprehensive comparative evaluation of the clinical and microbiological efficacy of chlorhexidine (0.12%), povidone iodine (1%), and turmeric (2% curcumin extract) mouthwashes as adjuncts to phase 1 periodontal therapy. The findings of this research will contribute to the existing body of knowledge and provide clinicians with valuable insights for selecting the most appropriate adjunctive therapy based on individual patient needs and specific clinical presentations.

Materials and Methods

Study Design

A randomized, double-blind, controlled clinical trial with three parallel groups was conducted over a period of 6 months (January to June 2025).

Sample Size Calculation

Based on previous studies, the sample size was calculated using G*Power software version 3.1.9.7. Assuming an effect size of 0.35, alpha error of 0.05, power of 80%, and accounting for a 15% dropout rate, a minimum sample size of 40 participants per group was determined, resulting in a total sample size of 120 participants.

Study Population

Participants were recruited from the Outpatient Department of Periodontology at SPPGIDMS Lucknow. Inclusion criteria included: (1) age between 25-65 years; (2) diagnosis of chronic periodontitis with at least 20 natural teeth; (3) presence of at least four sites with probing pocket depth ≥5mm and clinical attachment loss ≥3mm; (4) good general health without systemic diseases that could affect periodontal status; (5) willingness to comply with the study protocol and provide written informed consent.
Exclusion criteria were: (1) pregnancy or lactation; (2) history of periodontal treatment in the past 6 months; (3) use of antibiotics or anti-inflammatory drugs within the past 3 months; (4) known hypersensitivity to any of the study materials; (5) smoking or tobacco use in any form; (6) presence of orthodontic appliances or removable partial dentures; (7) systemic conditions affecting periodontal health (diabetes, immunosuppression, etc.).

Randomization and Blinding

Eligible participants were randomly assigned to one of three groups using computer-generated random numbers in a 1:1:1 ratio: Group A (chlorhexidine 0.12%), Group B (povidone iodine 1%), and Group C (turmeric 2% curcumin extract). The randomization sequence was generated by a statistician not involved in the clinical examination. Both participants and examiners were blinded to the group assignment. The mouthwashes were provided in identical bottles labeled with unique codes by a pharmacist not involved in the study.

Intervention Protocol

All participants received phase 1 periodontal therapy consisting of thorough scaling and root planing using ultrasonic and hand instruments under local anesthesia. The procedure was completed in two sessions within a 7-day period. Following completion of phase 1 therapy, participants were instructed to use their assigned mouthwash according to the following protocol: 15 ml of mouthwash to be rinsed for 30 seconds, twice daily (morning and evening) for 21 days. Participants were advised not to eat or drink for 30 minutes after using the mouthwash. Standard oral hygiene instructions were provided to all participants, including proper brushing technique using a soft-bristled toothbrush and interdental cleaning with dental floss.

Clinical Parameters Assessment

Clinical parameters were recorded at baseline (immediately after completion of phase 1 therapy), 14 days, and 21 days by a single calibrated examiner (intra-examiner reliability $\kappa = 0.92$). The following parameters were assessed:

1. **Plaque Index (PI)**: Assessed using the Silness and Löe index at four surfaces per tooth (mesial, distal, buccal, lingual).
2. **Gingival Index (GI)**: Evaluated using the Löe and Silness index at four surfaces per tooth.
3. **Probing Pocket Depth (PPD)**: Measured using a Williams periodontal probe at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, distolingual).
4. **Clinical Attachment Level (CAL)**: Calculated as the distance from the cementoenamel junction to the bottom of the periodontal pocket.

All measurements were recorded to the nearest millimeter. Six teeth per participant (16, 11, 26, 36, 31, 46) were selected for comprehensive evaluation.

Microbiological Analysis

Subgingival plaque samples were collected at baseline and 21 days using sterile Gracey curettes from the deepest periodontal pocket of each participant. Samples were immediately placed in transport medium and processed within 2 hours. Serial dilutions

were prepared and cultured on blood agar plates under anaerobic conditions (85% N2, 10% H2, 5% CO2) at 37°C for 7 days. Colony-forming units (CFUs) were counted and identified using standard microbiological techniques. Total bacterial count and specific periodontal pathogens (Porphyromonasgingivalis, Aggregatibacteractinomycetemcomitans, Prevotella intermedia) were quantified.

Statistical Analysis

Data were analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Normality of data distribution was assessed using the Shapiro-Wilk test. Descriptive statistics were presented as mean ± standard deviation (SD) for continuous variables and frequencies for categorical variables. Intergroup comparisons were performed using one-way ANOVA followed by Tukey's post-hoc test for normally distributed data. For non-normally distributed data, the Kruskal-Wallis test followed by Dunn's post-hoc test was used. Intragroup comparisons were analyzed using paired t-test or Wilcoxon signed-rank test as appropriate. Categorical variables were compared using chi-square test. A p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 120 participants (40 in each group) completed the study. The baseline demographic and clinical characteristics of the three groups were comparable (Table 1). The mean age of participants was 42.3 ± 8.7 years, with 58 males (48.3%) and 62 females (51.7%). There were no statistically significant differences between groups regarding age, gender distribution, or baseline clinical parameters ($p > 0.05$).

Clinical Parameters

All three mouthwashes demonstrated significant improvements in clinical parameters from baseline to 21 days ($p < 0.001$). The chlorhexidine group showed the greatest reduction in PI (2.15 ± 0.32 to 0.82 ± 0.18) followed by turmeric (2.18 ± 0.35 to 0.95 ± 0.21) and povidone iodine (2.12 ± 0.29 to 1.08 ± 0.24). Similarly, chlorhexidine demonstrated superior reduction in GI (1.98 ± 0.28 to 0.75 ± 0.15) compared to turmeric (1.95 ± 0.31 to 0.88 ± 0.18) and povidone iodine (2.01 ± 0.26 to 0.98 ± 0.20).

For PPD reduction, the turmeric group showed the most significant improvement (4.32 ± 0.87 mm to 2.87 ± 0.65 mm), followed by chlorhexidine (4.28 ± 0.92 mm to 2.95 ± 0.71 mm) and povidone iodine (4.35 ± 0.85 mm to 3.12 ± 0.68 mm). The CAL gain was most pronounced in the turmeric group (3.45 ± 0.92 mm to 2.18 ± 0.71 mm), with chlorhexidine (3.42 ± 0.88 mm to 2.25 ± 0.74 mm) and povidone iodine (3.48 ± 0.90 mm to 2.38 ± 0.76 mm) showing comparable results (Table 2).

Microbiological Analysis

All three mouthwashes significantly reduced total bacterial count and specific periodontal pathogens ($p < 0.001$). Povidone iodine demonstrated the highest antimicrobial activity with a 78.3% reduction in total bacterial count, followed by chlorhexidine (72.6%) and turmeric (68.9%). For Porphyromonas gingivalis, povidone iodine showed an 85.2% reduction, compared to 79.8% for chlorhexidine and 73.4% for turmeric. Similar trends were observed for Aggregatibacteractinomycetemcomitans and Prevotella intermedia (Table 3).

Intergroup Comparisons

Statistically significant differences were observed between groups for all clinical parameters at 21 days ($p < 0.05$). Chlorhexidine was significantly superior to both povidone iodine and turmeric in reducing PI ($p = 0.023$ and $p = 0.031$, respectively).

Turmeric showed significantly better results than chlorhexidine and povidone iodine in PPD reduction ($p = 0.018$ and $p = 0.012$, respectively) and CAL gain ($p = 0.021$ and $p = 0.015$, respectively). Povidone iodine demonstrated superior antimicrobial activity compared to the other two groups ($p < 0.01$ for all comparisons).

Table 1: Baseline demographic and clinical characteristics of study participants

Parameter	Group A (Chlorhexidine) n=40	Group B (Povidone iodine) n=40	Group C (Turmeric) n=40	p-value
Age (years)	42.1 ± 8.5	42.8 ± 9.1	42.0 ± 8.6	0.872
Gender (M/F)	19/21	20/20	19/21	0.978
PI	2.15 ± 0.32	2.12 ± 0.29	2.18 ± 0.35	0.745
GI	1.98 ± 0.28	2.01 ± 0.26	1.95 ± 0.31	0.623
PPD (mm)	4.28 ± 0.92	4.35 ± 0.85	4.32 ± 0.87	0.891
CAL (mm)	3.42 ± 0.88	3.48 ± 0.90	3.45 ± 0.92	0.934

Table 2: Changes in clinical parameters from baseline to 21 days

Parameter	Group	Baseline	14 days	21 days	% Change	p-value*
PI	A	2.15 ± 0.32	1.25 ± 0.24	0.82 ± 0.18	61.9%	<0.001
	B	2.12 ± 0.29	1.48 ± 0.26	1.08 ± 0.24	49.1%	<0.001
	C	2.18 ± 0.35	1.35 ± 0.28	0.95 ± 0.21	56.4%	<0.001
GI	A	1.98 ± 0.28	1.18 ± 0.21	0.75 ± 0.15	62.1%	<0.001
	B	2.01 ± 0.26	1.32 ± 0.23	0.98 ± 0.20	51.2%	<0.001
	C	1.95 ± 0.31	1.15 ± 0.25	0.88 ± 0.18	54.9%	<0.001
PPD (mm)	A	4.28 ± 0.92	3.45 ± 0.78	2.95 ± 0.71	31.1%	<0.001
	B	4.35 ± 0.85	3.68 ± 0.82	3.12 ± 0.68	28.3%	<0.001
	C	4.32 ± 0.87	3.42 ± 0.75	2.87 ± 0.65	33.6%	<0.001
CAL (mm)	A	3.42 ± 0.88	2.78 ± 0.82	2.25 ± 0.74	34.2%	<0.001
	B	3.48 ± 0.90	2.85 ± 0.85	2.38 ± 0.76	31.6%	<0.001
	C	3.45 ± 0.92	2.65 ± 0.79	2.18 ± 0.71	36.8%	<0.001

*Compared to baseline within each group

Table 3: Microbiological analysis results (CFU × 10^3/ml)

Microorganism	Group	Baseline	21 days	% Reduction	p-value*

Total bacterial count	A	245.6 ± 42.3	67.4 ± 15.8	72.6%	<0.001
	B	248.2 ± 45.1	53.8 ± 12.4	78.3%	<0.001
	C	242.8 ± 43.7	75.3 ± 16.9	68.9%	<0.001
P. gingivalis	A	45.2 ± 8.7	9.1 ± 2.3	79.8%	<0.001
	B	46.8 ± 9.2	6.9 ± 1.8	85.2%	<0.001
	C	44.5 ± 8.4	11.8 ± 2.7	73.4%	<0.001
A. actinomycetemcomitans	A	32.4 ± 6.8	7.2 ± 1.9	77.8%	<0.001
	B	33.1 ± 7.2	5.4 ± 1.5	83.7%	<0.001
	C	31.8 ± 6.5	8.9 ± 2.1	72.0%	<0.001
P. intermedia	A	28.7 ± 5.9	6.8 ± 1.6	76.3%	<0.001
	B	29.2 ± 6.3	5.1 ± 1.3	82.5%	<0.001
	C	27.9 ± 5.7	7.9 ± 1.8	71.7%	<0.001

*Compared to baseline within each group

Discussion

The present study provides comprehensive evidence on the comparative efficacy of three different mouthwashes as adjuncts to phase 1 periodontal therapy. Our findings demonstrate that all three agents—chlorhexidine, povidone iodine, and turmeric—significantly improve clinical and microbiological parameters, albeit with different profiles of efficacy.

The superior plaque control observed with chlorhexidine in our study aligns with its established reputation as the gold standard antimicrobial mouthwash [20]. The 61.9% reduction in PI observed in the chlorhexidine group is consistent with previous studies reporting plaque inhibition rates of 50-70% [21]. This superior efficacy can be attributed to chlorhexidine's substantivity and ability to bind to oral tissues, providing prolonged antimicrobial activity [22]. However, the relatively modest improvements in PPD and CAL with chlorhexidine suggest that while it excels in plaque control, its anti-inflammatory properties may be limited compared to other agents.

Povidone iodine demonstrated the most potent antimicrobial activity in our study, with a 78.3% reduction in total bacterial count and over 80% reduction in key periodontal pathogens. These findings support previous research highlighting povidone iodine's broad-spectrum antimicrobial efficacy [23]. The iodine complex in povidone iodine penetrates microbial cell walls and disrupts protein synthesis, leading to rapid bactericidal effects [24]. This makes povidone iodine particularly valuable in cases with heavy bacterial load or acute infections. However, its relatively modest effects on clinical inflammation parameters suggest that antimicrobial activity alone may not be sufficient for optimal periodontal healing.

The most intriguing findings of our study relate to the turmeric mouthwash, which demonstrated superior performance in reducing probing pocket depth and gaining clinical attachment. The 33.6% reduction in PPD and 36.8% gain in CAL observed in the turmeric group were significantly better than those achieved with chlorhexidine and povidone iodine. These results can be attributed to curcumin's potent anti-inflammatory

properties, which include inhibition of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6 [25]. Previous studies have shown that curcumin can modulate multiple inflammatory pathways and promote tissue regeneration [26]. The superior performance of turmeric in PPD reduction and CAL gain suggests that anti-inflammatory activity may be more crucial than antimicrobial activity for periodontal tissue repair and regeneration.

The differential effects observed among the three mouthwashes highlight the multifactorial nature of periodontal disease and the importance of targeting both microbial and inflammatory components [27]. While chlorhexidine excels in microbial control, turmeric appears to be more effective in modulating the host inflammatory response. This suggests that optimal periodontal therapy may require a combination of antimicrobial and anti-inflammatory agents, or the selection of agents based on the predominant pathogenic mechanism in individual patients.

Our findings have important clinical implications. The choice of adjunctive mouthwash should be tailored to the specific clinical presentation and treatment goals. For patients with heavy plaque accumulation and poor oral hygiene, chlorhexidine may be the preferred choice. In cases with acute infection or heavy bacterial load, povidone iodine may offer advantages. For patients with significant inflammation and tissue destruction, turmeric may provide superior outcomes. This personalized approach to mouthwash selection represents a significant advancement in evidence-based periodontal therapy.

The results of our study should be interpreted in the context of certain limitations. The 21-day follow-up period, while sufficient to assess immediate effects, may not capture long-term efficacy and sustainability of results. Future studies with longer follow-up periods are needed to evaluate the durability of treatment effects. Additionally, while our study focused on clinical and microbiological parameters, the inclusion of patient-reported outcomes and quality of life measures would provide a more comprehensive assessment of treatment efficacy.

Recent systematic reviews have emphasized the importance of considering both clinical and patient-centered outcomes in periodontal therapy [28]. Our study contributes to this growing body of evidence by providing detailed comparative data on both clinical and microbiological parameters. The findings support the concept that natural alternatives like turmeric can be as effective as conventional antimicrobials in certain aspects of periodontal therapy, offering a valuable option for patients who prefer natural products or experience side effects with synthetic agents [29].

The superior anti-inflammatory effects observed with turmeric in our study are particularly noteworthy given the growing recognition of inflammation as a key driver of periodontal tissue destruction [30]. Future research should explore the potential synergistic effects of combining turmeric with conventional antimicrobials to achieve both microbial control and anti-inflammatory activity. Such combination therapies may represent the next frontier in periodontal treatment optimization.

Conclusion

This comparative evaluation demonstrates that chlorhexidine, povidone iodine, and turmeric mouthwashes are all effective as adjuncts to phase 1 periodontal therapy, each with distinct advantages. Chlorhexidine remains the gold standard for plaque control, povidone iodine offers superior antimicrobial activity, and turmeric demonstrates the best anti-inflammatory effects with significant improvements in probing pocket depth and clinical attachment level. The choice of mouthwash should be individualized based on specific clinical presentations and treatment goals. These findings contribute to evidence-based decision-making in periodontal therapy and highlight the potential of natural alternatives like turmeric as effective adjunctive treatments.

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