Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 13, (2024)
https://www.jneonatalsurg.com

OPEN ACCESS

Comparative Evaluation of the Efficacy of Herbal and Chlorhexidine Mouthwash on Gingival Health: A Randomized Clinical Trial

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Cite this paper as: Sanchiti Nandeshwar , Mangesh Andhare , Himanshu Shrivastava , Aditi Sarda , Mayur Awchar , Saurabh Sonawane , Krutika Bidkar, (2024) Comparative Evaluation of the Efficacy of Herbal and Chlorhexidine Mouthwash on Gingival Health: A Randomized Clinical Trial.*Journal of Neonatal Surgery*, 13, 1641-1646.

ABSTRACT

Background: Chlorhexidine (CHX) gluconate has long been considered the “gold standard” chemical plaque control agent due to its broad antimicrobial spectrum and high substantivity. However, its use is often limited by adverse effects such as tooth staining, mucosal irritation, and taste alteration. Herbal mouthwashes, containing plant-based bioactive agents with antimicrobial and anti-inflammatory properties, are gaining attention as safer and more biocompatible alternatives.

Objective: This randomized clinical trial aimed to compare the clinical efficacy of a standardized herbal mouthwash and 0.12% chlorhexidine gluconate in improving gingival health among patients with plaque-induced gingivitis.

Methods: Ninety participants aged 18–45 years with plaque-induced gingivitis were randomly allocated into three equal groups: Group I – 0.12% chlorhexidine gluconate, Group II – herbal mouthwash (green tea + aloe vera + triphala formulation), and Group III – placebo (distilled water). All participants were instructed to rinse twice daily for 30 days. Clinical parameters including Plaque Index (PI), Gingival Index (GI), and Bleeding on Probing (BOP) were recorded at baseline, Day 7, Day 14, and Day 30. Adverse effects and patient acceptability were also assessed. Data were analyzed using repeated-measures ANOVA with $p < 0.05$ considered significant.

Results: Both CHX and the herbal mouthwash demonstrated significant reductions in PI, GI, and BOP from baseline to Day 30 ($p < 0.001$). Mean reduction in GI for CHX was 0.95 ± 0.30, for the herbal rinse 0.88 ± 0.29, while placebo achieved 0.30 ± 0.25. No statistically significant difference was observed between CHX and the herbal rinse for either PI or GI ($p > 0.05$). However, the herbal group exhibited superior taste acceptability and minimal staining or mucosal irritation compared to CHX ($p < 0.01$).

Conclusions: The herbal mouthwash demonstrated comparable clinical efficacy to chlorhexidine in reducing plaque and gingival inflammation, with better tolerance and fewer side effects. Herbal formulations thus represent a promising adjunct

in gingivitis management and may serve as effective long-term alternatives to CHX

Keywords: Chlorhexidine gluconate; Herbal mouthwash; Gingivitis; Plaque control; Green tea; Aloe vera; Triphala; Clinical trial

1. INTRODUCTION

Gingivitis is the most prevalent form of periodontal disease worldwide and represents an early, reversible stage of inflammation induced by dental plaque biofilm [1]. Effective mechanical plaque control through toothbrushing and interdental cleaning remains the foundation of prevention, but complete removal of plaque deposits is often unachievable due to technique limitations and poor compliance [2]. Chemical plaque control using antimicrobial mouthrinses has therefore become an important adjunctive measure [3].

Among chemical agents, chlorhexidine gluconate (CHX) stands as the gold standard because of its broad-spectrum antibacterial activity, high substantivity, and proven clinical efficacy in reducing gingival inflammation [4]. Despite its effectiveness, CHX is associated with a range of side effects including brown discoloration of teeth, altered taste perception, increased calculus formation, and mucosal irritation, making it unsuitable for long-term daily use [5] [6].

To overcome these drawbacks, natural and herbal mouthwashes have emerged as alternative agents. Plant-derived bioactive compounds such as polyphenols, flavonoids, tannins, and terpenoids possess antimicrobial, antioxidant, and anti-inflammatory effects [7] [8]. Ingredients such as *Camellia sinensis* (green tea), *Aloe vera*, *Terminalia chebula* (Triphala), *Punica granatum* (pomegranate), and propolis have been incorporated into formulations that exhibit plaque-inhibitory and gingival-soothing actions [9] [10].

Previous trials have demonstrated that green tea and aloe vera mouthwashes can achieve reductions in plaque and gingival indices similar to CHX when used for 2–4 weeks [11] [12]. Similarly, Triphala and neem-based mouthwashes have shown promising antimicrobial and anti-inflammatory efficacy without notable side effects [13] [14]. However, the literature shows variability in herbal composition, concentration, and trial methodology, making direct comparisons difficult [15].

Hence, this randomized clinical trial was designed to evaluate and compare the clinical efficacy and patient acceptability of a standardized multi-herbal mouthwash and 0.12% chlorhexidine gluconate in improving gingival health among individuals with plaque-induced gingivitis.

2. MATERIALS AND METHODS

Study design and ethics

A single-blind, randomized, parallel-arm clinical trial was conducted at the Department of Periodontology. All procedures followed the Declaration of Helsinki, and written informed consent was obtained from each participant.

Sample size and randomization

Based on previous studies showing a mean GI difference of 0.3 ± 0.45 between groups [16], with 80% power and $\alpha = 0.05$, a minimum of 25 subjects per group was required. To compensate for dropouts, 30 subjects were enrolled in each group (total = 90). Randomization was performed using a computer-generated sequence and allocation concealed in opaque envelopes. The examiner remained blinded to group allocation.

Inclusion and exclusion criteria

Inclusion: Adults aged 18–45 years with plaque-induced gingivitis (GI ≥ 1), at least 20 natural teeth, and no recent antimicrobial therapy.
Exclusion: Systemic diseases affecting the periodontium, history of periodontal therapy within 6 months, pregnancy or lactation, allergies to CHX or herbal components, and tobacco or alcohol use.

Intervention

Participants were allocated into three groups:

Group I (CHX): 0.12% chlorhexidine gluconate (15 mL rinse, twice daily for 30 seconds, after brushing).

Group II (HERB): Standardized herbal mouthwash containing green tea extract 0.5%, *Aloe vera* 1%, and *Triphala* 0.8% (15 mL rinse, twice daily).

Group III (Placebo): Distilled water with inert coloring and flavoring.

All participants were instructed to avoid any other oral rinses or antibiotics and to maintain their usual brushing technique.

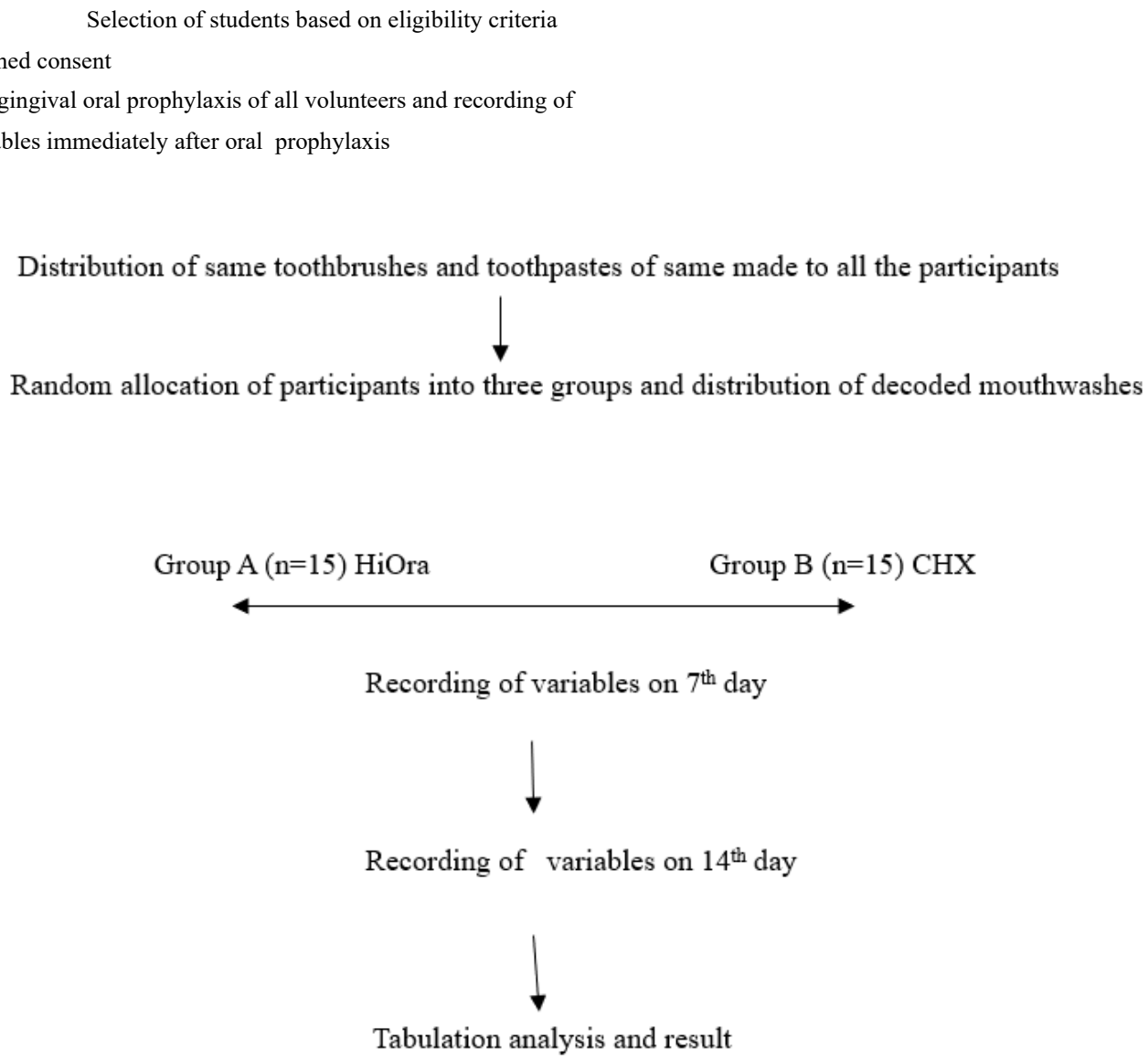
Clinical examination

A calibrated examiner recorded Plaque Index (Silness & Löe 1964) and Gingival Index (Löe & Silness 1963) at baseline, Day 7, Day 14, and Day 30 [17] [18]. Bleeding on Probing (BOP) was assessed using a UNC-15 periodontal probe. Examiner calibration yielded an intra-examiner reliability coefficient (ICC) > 0.85.

Adverse effects such as staining, burning, or mucosal irritation were recorded at each visit. Participants rated the rinse for taste and freshness on a 5-point Likert scale.

Statistical analysis

Data were analyzed using SPSS v26.0. Descriptive statistics (mean ± SD) were computed. Repeated-measures ANOVA was applied to compare mean PI and GI across groups and time points. Inter-group comparisons were performed using post-hoc Bonferroni tests. A p-value < 0.05 was considered significant.



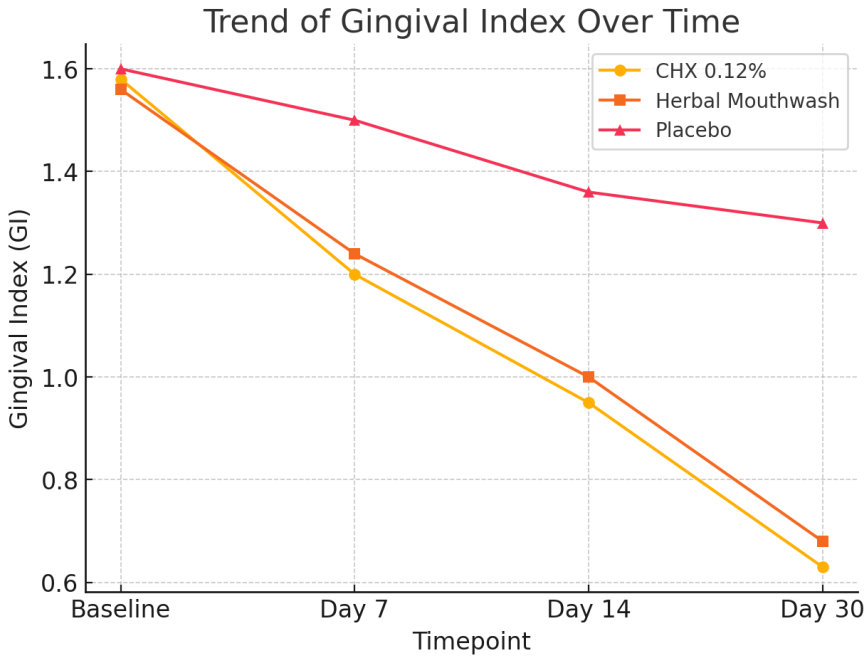
3. RESULTS

Out of the 90 participants randomized, 84 completed the study (CHX = 28, HERB = 29, Placebo = 27). Baseline characteristics including age, gender, and initial PI/GI scores did not differ significantly among groups ($p > 0.05$).

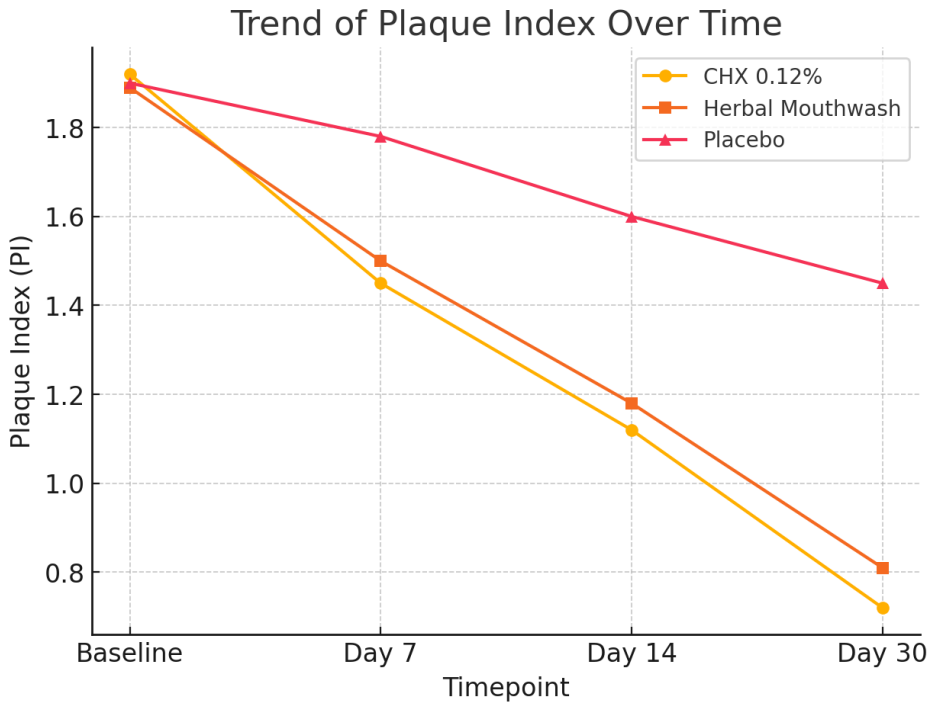
From baseline to Day 30, both CHX and HERB groups exhibited significant reductions in Plaque Index and Gingival Index ($p < 0.001$), while the placebo group showed only marginal improvement ($p > 0.05$). Mean PI reduction was 1.20 ± 0.35 in the CHX group, 1.08 ± 0.32 in the herbal group, and 0.45 ± 0.28 in placebo. Similarly, mean GI reduction was 0.95 ± 0.30 in CHX, 0.88 ± 0.29 in HERB, and 0.30 ± 0.25 in placebo. No significant difference existed between CHX and HERB at

any follow-up point ($p > 0.05$).

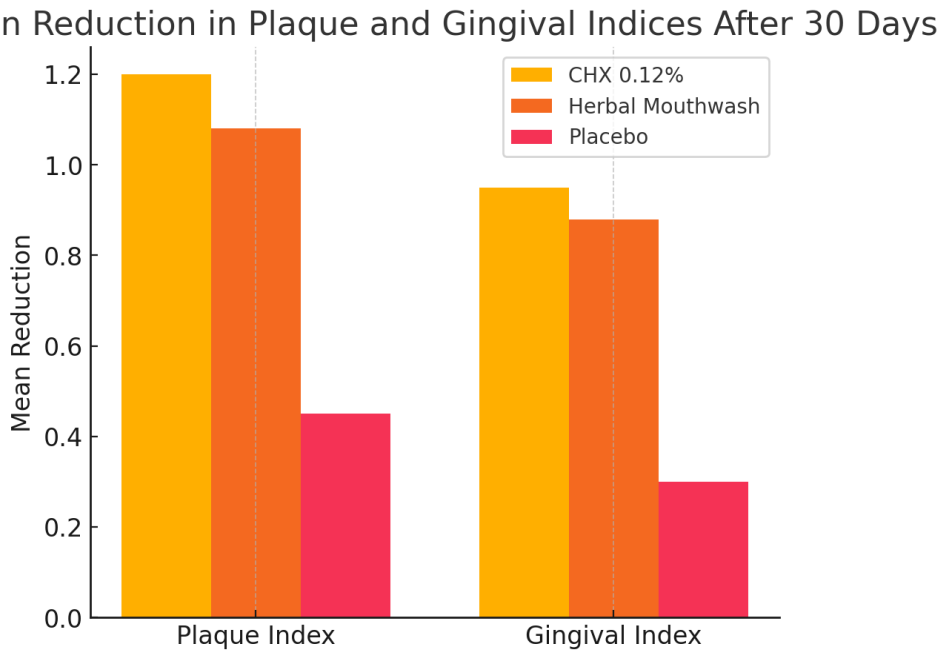
Bleeding on Probing decreased from 52% to 18% in CHX and 50% to 22% in HERB, while the placebo showed 51% to 40% reduction. CHX caused visible tooth staining in 73% of users and mild taste alteration in 60%, whereas HERB users reported minimal side effects and higher acceptability scores (mean 4.5/5 vs 3.1/5 for CHX). No serious adverse reactions were observed.



Graph 1: Trends of Gingival Index over time



Graph. 2: Trends of Plaque Index over time



Graph 3:Mean reduction in plaque and gingival index after 30 days

4. DISCUSSION

The present clinical trial demonstrated that the tested herbal mouthwash was comparable in efficacy to 0.12% chlorhexidine in reducing plaque accumulation and gingival inflammation over 30 days, while being significantly better tolerated.

These findings corroborate earlier reports. Priya et al. (2015) compared a green-tea mouthwash with 0.2% CHX and observed similar reductions in GI and PI after 21 days, attributing this effect to catechins that inhibit bacterial adhesion and suppress inflammatory mediators [19]. Likewise, Al-Maweri et al. (2020) conducted a systematic review concluding that aloe vera mouthwashes were nearly as effective as CHX in improving gingival parameters, with a superior safety profile [20].

Deshpande et al. (2021) tested green tea + ginger formulations versus CHX and reported comparable results, emphasizing the synergistic anti-inflammatory and antioxidant properties of combined herbal extracts [21]. In another randomized trial, Chatterjee et al. (2019) showed that Triphala mouthwash reduced gingival scores significantly without side effects [22], while Pannuti et al. (2003) observed equivalent gingival improvement with propolis mouthrinse compared to CHX over 15 days [23].

The anti-plaque effects of herbal rinses may be attributed to polyphenols that interfere with bacterial glucosyltransferase activity and reduce biofilm adherence [24]. Aloe vera polysaccharides exert anti-inflammatory effects by inhibiting prostaglandin E_2 synthesis and reactive oxygen species [25], while Triphala's gallic acid and ellagic acid components possess potent antimicrobial and antioxidant capacities [26].

While chlorhexidine's mechanism involves cationic binding to bacterial cell walls and sustained release (substantivity), herbal agents may achieve similar plaque control via multi-target biochemical pathways [27] [28]. The absence of staining and taste disturbance in the herbal group enhances patient compliance, particularly for long-term maintenance [29].

Strengths of the present study include randomized design, examiner blinding, and assessment at multiple intervals. Limitations include short-term follow-up, single-center setting, and the absence of microbiological or biochemical assays. Variability in herbal product composition may also limit generalization [30].

Nevertheless, the results indicate that herbal mouthrinses, when standardized and quality-controlled, can serve as effective, well-tolerated adjuncts to mechanical plaque control in gingivitis management.

5. CONCLUSION

The herbal mouthwash tested in this randomized trial produced clinical improvements in plaque and gingival indices statistically comparable to those obtained with chlorhexidine, while demonstrating superior patient acceptability and fewer adverse effects. Herbal mouthwashes may thus serve as a viable alternative for individuals requiring long-term oral antiseptic use. Future research should focus on multicenter trials with extended duration and microbial analysis to confirm these outcomes

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