

Efficacy of 0.5% Hydrogen Peroxide Mouth Rinse as an Adjunct to Scaling in Chronic Gingivitis: A Randomised Controlled Trial

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ABSTRACT

Background. Chronic gingivitis is a plaque-induced inflammatory condition of the gingiva. While scaling and polishing are standard treatments, adjunctive antimicrobial mouth rinses may enhance clinical outcomes. Hydrogen peroxide, an oxygen-releasing bactericidal agent, is a safe and accessible adjunct.

Aim. To evaluate the effectiveness of daily 0.5% hydrogen peroxide rinsing as an adjunct to scaling in improving gingival health and reducing plaque in chronic gingivitis patients.

Subjects and methods. Forty systemically healthy adults were randomly assigned to two groups. The control group received scaling and polishing plus oral hygiene instructions, while the test group received scaling and polishing plus twice-daily rinsing with 10 ml of 0.5% hydrogen peroxide for 14 days. Gingival Index (GI) and Plaque Index (PI) were recorded at baseline and post-intervention by the same examiner. Data were analysed using paired and independent t-tests ($p < 0.05$).

Results. Both groups showed significant reductions in GI and PI scores after 14 days ($p < 0.001$). In the control group, mean GI decreased from 2.04 ± 0.31 to 1.28 ± 0.27 , while in the test group, it decreased from 2.06 ± 0.34 to 0.88 ± 0.19 , with a significant difference between groups ($p < 0.001$). Similarly, the mean PI decreased from 1.93 ± 0.26 to 1.21 ± 0.24 in the control group and from 1.91 ± 0.29 to 0.83 ± 0.21 in the test group, showing significantly greater improvement in the hydrogen peroxide group ($p < 0.001$). No serious adverse effects were reported.

Conclusions. Daily use of 0.5% hydrogen peroxide as an adjunct to scaling significantly improves gingival health and reduces plaque compared to scaling alone. It is a safe, effective, and low-cost adjunctive therapy for chronic gingivitis.

1. Introduction

Chronic gingivitis is a common oral disease worldwide, characterised by inflammation of the gingival tissues primarily due to bacterial plaque. If untreated, it can progress to periodontitis, causing permanent deterioration of periodontal attachment and alveolar bone [1]. Mechanical plaque control methods, including professional scaling and polishing, are the primary management strategy for plaque-induced gingivitis, effectively removing dental plaque and calculus and promoting gingival health. Nevertheless, mechanical debridement alone may not eliminate all microorganisms in difficult-to-access areas; therefore, antimicrobial mouth rinses are often used as adjunctive therapies [2,3].

Recent advances in periodontal research have shifted the understanding of gingivitis from a simple plaque-associated condition to a microbiota-associated inflammatory disease characterised by dysbiosis within the oral biofilm. Rather than the mere presence of dental plaque, alterations in microbial composition and ecological balance promote a host inflammatory response that contributes to gingival tissue inflammation [4]. Consequently, contemporary preventive approaches increasingly focus not only on mechanical plaque removal but also on modulating the oral microbiota and restoring biofilm homeostasis. Strategies such as interdental cleaning, adjunctive antimicrobial agents, and biofilm-targeted preventive therapies have demonstrated benefits in reducing plaque accumulation and gingival inflammation while supporting a healthier oral microbial ecosystem [5–7].

Within this framework, hydrogen peroxide may exert beneficial effects by reducing microbial burden, disrupting dysbiotic biofilms, and improving local oxygenation, thereby contributing to the restoration of a more balanced oral environment.

Hydrogen peroxide (H_2O_2) has gained attention for its antimicrobial, anti-inflammatory, and oxygenating effects. Its action involves releasing reactive oxygen species that disrupt microbial cell walls and biofilm, reducing the microbial load in the gingival sulcus [8]. It also facilitates wound healing by supplying oxygen to inflamed tissues, improving repair, and decreasing bleeding [9]. According to recent studies, low concentrations (0.2–1.5%) of hydrogen peroxide can achieve

effective plaque control and reduction of gingival inflammation without significant irritation or cytotoxic effects when used appropriately [8,10,11]. Hydrogen peroxide exerts its antimicrobial effect through the generation of reactive oxygen species that disrupt bacterial cell membranes, proteins, and biofilm structure. A concentration of 0.5% was selected because it has been shown to provide sufficient oxidative antimicrobial activity while remaining below concentrations commonly associated with epithelial irritation or tissue toxicity. Previous clinical studies have demonstrated significant reductions in plaque and gingival inflammation with 0.5% hydrogen peroxide, supporting its use as a safe and effective adjunct to mechanical plaque control [8,10,11].

Clinical trials support the efficacy of hydrogen peroxide rinses. Boccalari et al. [2,12] reported that mouth rinses containing hydrogen peroxide and hyaluronic acid decreased gingival inflammation and enhanced post-extraction healing. Khudhair and Ahmed [9] observed clinical and immunological improvements in gingivitis patients using the same rinse. Hydrogen peroxide also reduces bacterial aerosol contamination during scaling by over 80%, comparable to chlorhexidine [13], and nanosilver-stabilised formulations aid healing and decrease postoperative pain [14]. Long-term benefits are reported: six months of weekly 0.5% hydrogen peroxide irrigation significantly reduced plaque and gingival inflammation without tissue side effects [11], and topical oxygen therapy improved gingivitis and periodontitis outcomes [15].

Comparisons with other antimicrobials show similar efficacy. Chlorhexidine/hydrogen peroxide combinations effectively reduce plaque while minimising staining [10], and sodium hypochlorite (0.25%) is also effective as a subgingival irrigant [16]. Despite this evidence, low-concentration hydrogen peroxide (0.5%) as a daily adjunct to scaling in chronic gingivitis remains underinvestigated [2,10]. Alternative oxidising rinses, such as povidone-iodine or sodium hypochlorite, are less favourable due to irritation or taste [16,17]. This study aimed to assess the effectiveness of 0.5% hydrogen peroxide as a daily mouth rinse with scaling in patients with chronic gingivitis. This study contributes to the growing evidence regarding the role of hydrogen peroxide as part of periodontal maintenance programs by evaluating

its effects on clinical parameters such as the Gingival Index (GI) and Plaque Index (PI) [18,19]. The study hypothesis was that the adjunctive use of a 0.5% hydrogen peroxide mouth rinse following professional scaling would result in significantly greater reductions in GI and PI scores compared with scaling and oral hygiene instructions alone in patients with chronic gingivitis.

2. Subjects and methods

2.1 Eligibility Criteria

Inclusion criteria:

- Adults aged 18–50 years.
- Systemically healthy individuals.
- Presence of at least 20 natural teeth.
- Clinical diagnosis of plaque-induced gingivitis characterised by gingival redness, swelling, and bleeding on probing without clinical attachment loss or radiographic evidence of alveolar bone loss.
- Willingness to participate and provide written informed consent.

Exclusion criteria:

- Current smokers or tobacco users.
- Use of systemic antibiotics, anti-inflammatory drugs, or antimicrobial mouth rinses within the previous 3 months.
- Pregnancy or lactation.
- Presence of periodontitis, defined by clinical attachment loss and/or radiographic bone loss.
- History of systemic diseases known to affect periodontal health (e.g., uncontrolled diabetes mellitus, immunocompromising conditions).
- Known allergy or hypersensitivity to hydrogen peroxide.
- Inability or unwillingness to comply with the study protocol.

2.2 Data Collection

A periodontist selected participants from patients attending the outpatient clinic of the Department of Periodontology during the study period. Recruitment began in the outpatient department (OPD), where consecutive patients presenting with clinical signs of plaque-induced gingivitis were screened for eligibility according to the predefined inclusion and exclusion criteria. Eli-

gible patients were informed about the study and invited to participate; those who agreed provided written informed consent before enrollment and randomisation. No advertisements, public announcements, or external recruitment strategies were used. A total of 40 participants were randomised in a 1:1 allocation ratio to either the test group or the control group using a computer-generated randomisation sequence prepared by an independent investigator who was not involved in participant recruitment, enrollment, treatment administration, or outcome assessment. Allocation concealment was ensured through sequentially numbered, sealed opaque envelopes. The investigator responsible for enrolling participants did not have access to the randomisation sequence, and group assignments were revealed only after participant enrollment had been completed. Plaque-induced gingivitis was diagnosed based on the criteria of the American Academy of Periodontology (AAP), characterised by gingival inflammation with redness, swelling, and bleeding on probing in the absence of clinical attachment loss or radiographic evidence of alveolar bone loss [20]. All participants were fully informed about the study objectives and signed an informed consent form before enrollment. The study was approved by the Institutional Review Board of the Libyan International Medical University (Approval No. DG-2025–14).

Sample size calculation

Sample size was calculated using G*Power software based on an expected difference in Gingival Index of 0.4, power of 80%, and alpha of 0.05. The minimum sample size required was 18 participants per group. To compensate for potential dropouts, 20 participants per group were included.

A total of 52 patients were screened for eligibility. Twelve patients were excluded because they did not meet the inclusion criteria or declined participation. Consequently, 40 participants were enrolled and randomised into two equal groups ($n = 20$ per group). Randomisation was performed using a computer-generated random allocation sequence prepared by an independent investigator. Allocation concealment was maintained using sequentially numbered, sealed opaque envelopes. Blinding of participants was not feasible because of the nature of the intervention. However, the

examiner responsible for recording the Gingival Index and Plaque Index was blinded to treatment allocation throughout the study. To maintain blinding, participants were instructed not to reveal their group assignment during follow-up examinations. Therefore, outcome assessment was performed under a single-masked design.

This randomised controlled trial was conducted in accordance with CONSORT guidelines. Group A (control group) received professional scaling and polishing only. Group B (test group) received the same scaling and polishing, in addition to daily rinsing with 0.5% hydrogen peroxide mouthwash for 14 days (Figure 1).

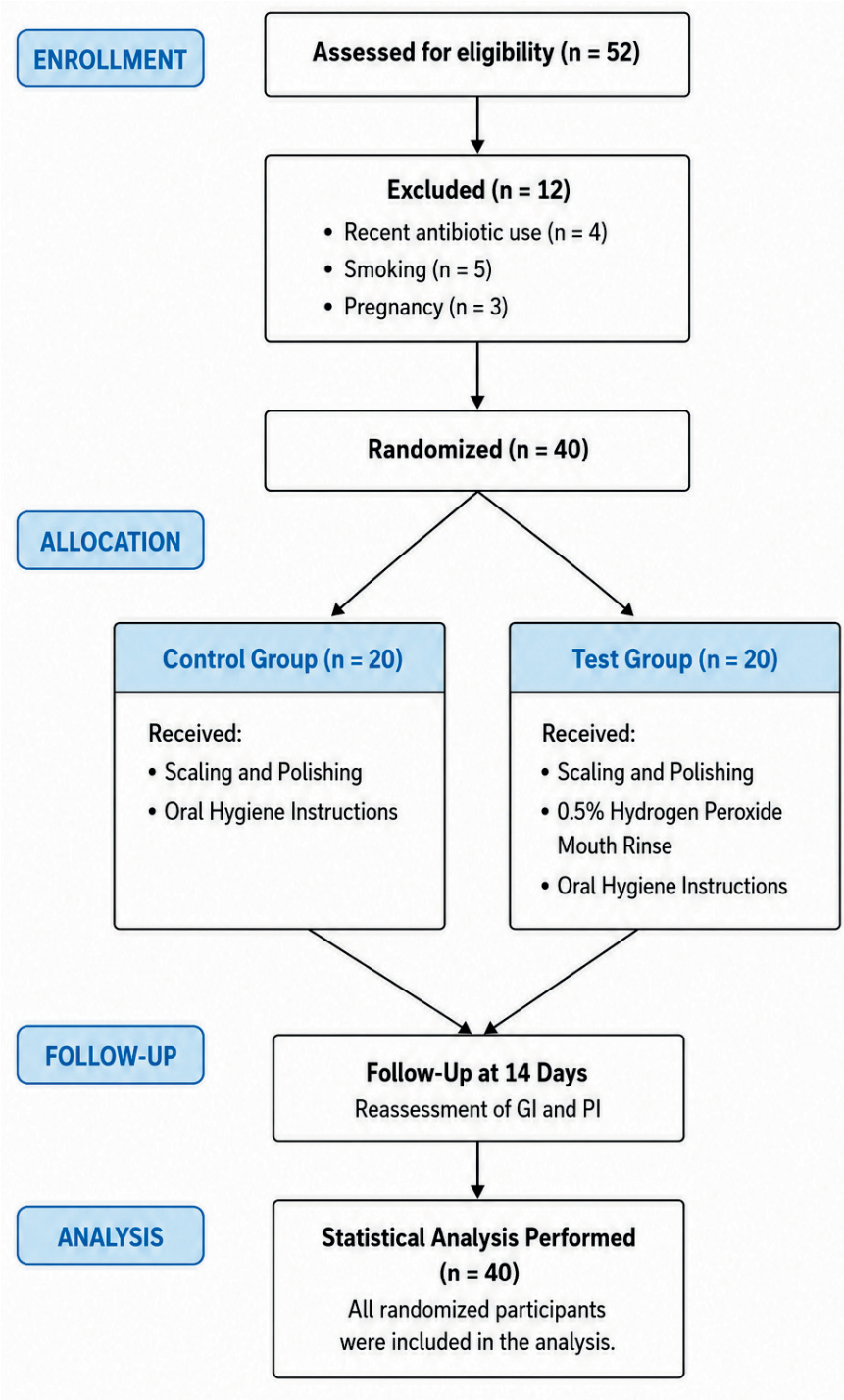


Figure 1. CONSORT flow diagram depicting the enrollment, allocation, follow-up, and analysis of patients with chronic gingivitis. GI: Gingival Index; PI: Plaque Index

2.3 Process

The initial stage of the study involved a comprehensive oral examination and professional scaling and polishing of all participants using an ultrasonic scaler and rubber cup polishing with non-fluoridated paste. This was performed to standardise baseline conditions across groups. Personalised oral hygiene instructions, including proper tooth-brushing technique (modified Bass method) and interdental cleaning, were provided to patients immediately after scaling and baseline measurements were conducted, and randomisation was completed.

Group A (control) was instructed not to receive any intervention other than routine oral hygiene advice. In contrast, Group B (test) was instructed to use a 0.5% hydrogen peroxide mouth rinse solution prepared by diluting 10 ml of 3% hydrogen peroxide with 50 ml sterile distilled water to obtain a 0.5% solution. The freshly prepared solution was dispensed to participants each day to ensure consistent concentration and minimise degradation. Participants were instructed to use the solution on the day of dispensing. Test group participants were instructed to rinse with 10 mL of the 0.5% solution for 30 seconds twice daily (after breakfast and before bedtime) and were advised not to eat or drink for 30 minutes after rinsing.

Adherence was monitored using a daily self-report checklist and confirmed during follow-up visits. During the 14-day intervention period, 18 out of 20 subjects (90%) in the test group reported complete adherence, while 2 subjects (10%) missed one or two rinsing sessions. All clinical measurements were performed by a single trained examiner using standardised assessment criteria for the Gingival Index and Plaque Index. The same examiner conducted

baseline and follow-up assessments to minimise inter-examiner variability.

The two principal indices measured were the Gingival Index (GI), as described by Löe and Silness (18), and the Plaque Index (PI), as described by Silness and Löe (19). The entire procedure was performed under normal lighting using a UNC-15 periodontal probe.

Clinical re-evaluation was conducted 14 days after the initiation of the intervention. The GI and PI were recorded again for all participants using the same standardised criteria and examination protocol employed at baseline to ensure consistency. Any adverse effects related to the use of the mouth rinse were recorded at the follow-up visit, and participants were specifically asked about symptoms such as a burning sensation, irritation, or discomfort (**Table 1**).

2.4 Data Analysis

The data obtained were entered and analysed using the Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). The data were screened for completeness and accuracy before analysis, and no missing values were observed. The data were summarised using descriptive statistics, with results presented as mean $\pm$ standard deviation (SD) for continuous variables and frequency (n) and percentage (%) for categorical variables.

The Shapiro-Wilk test was applied to assess the normality of the data distribution. The results indicated that all quantitative data (Gingival Index and Plaque Index scores) were normally distributed ($p > 0.05$). Therefore, inferential analysis was performed using parametric tests.

The mean scores of both the GI and PI at baseline and post-treatment (Day 14) were com-

Table 1. Summarises the flow of clinical activities and the follow-up schedule

Step	Description	Time point	Examiner	Compliance rate Percentage (%)
Initial scaling and polishing	Standard ultrasonic scaling and polishing performed for all participants	Day 0	Trained periodontist	100%
Oral hygiene instruction	Education on toothbrushing and interdental cleaning	Day 0	Same examiner	100%
Hydrogen peroxide rinsing (Group B only)	10 ml of 0.5% solution twice daily for 14 days	Days 1–14	Self-administered	90%
Clinical re-evaluation (GI and PI)	Post-treatment assessment and compliance verification	Day 14	Same examiner	100%

GI: Gingival Index; PI: Plaque Index

pared using paired-sample t-tests to evaluate differences between baseline and post-treatment mean scores. Independent-sample t-tests were used to compare the mean changes in these indices between groups.

All analyses were conducted at a statistical significance level of $p < 0.05$, and highly significant results were considered those with $p < 0.001$.

3. Results

At baseline, all participants (100%) presented with signs of gingivitis, including bleeding on probing, and 90% exhibited visible plaque accumulation. The mean baseline GI score for the total sample was 2.05 ± 0.32 , while the mean PI was 1.92 ± 0.28 . Baseline values were comparable between the two groups, with no statistically significant differences observed (Table 2).

All 40 randomised participants (20 men and 20 women; mean age 31.8 ± 6.4 years) completed the study and were included in the final analysis (20 per group). No participants were lost to follow-up, withdrew, or were excluded after randomisation, yielding a 100% completion rate. No protocol deviations occurred. Adherence to the hydrogen peroxide rinsing regimen was high, with 90% of participants reporting full compliance

and the remaining 10% missing only one or two rinsing sessions. No withdrawals due to adverse effects were reported.

3.1. Gingival Index (GI) Outcomes

Similar levels of gingival inflammation were observed at baseline, where the GI scores of the test and control groups were 2.06 and 2.04, respectively, with no statistically significant difference between them ($p > 0.05$). Significant improvement in GI scores was observed in both groups after 14 days.

In the control group (scaling and polishing), the mean GI decreased to 1.28 ± 0.27 , representing a 37.3% reduction from baseline. In the test group (scaling + hydrogen peroxide), the mean GI decreased more markedly to 0.88 ± 0.19 , representing a 57.3% reduction ($p < 0.001$) (Table 3).

At day 14, the Gingival Index was significantly lower in the test group than in the control group (mean difference = 0.40; 95% CI: 0.25–0.55; $p < 0.001$), with a very large between-group effect size (Cohen's $d = 1.71$) demonstrating lower inflammation scores. This indicates that adjunctive use of a 0.5% hydrogen peroxide rinse was more effective than scaling and polishing alone in promoting gingival healing and reducing bleeding on probing.

Figure 2 presents representative intraoral photographs illustrating the condition of the gin-

Table 2. Baseline characteristics of the participants

Variable	Group A (n = 20)	Group B (n = 20)	Total (n = 40)	Percentage (%)
Mean age (years)	32.1 ± 6.7	31.5 ± 6.2	31.8 ± 6.4	–
Male	10	10	20	50%
Female	10	10	20	50%
Baseline GI (mean $\pm$ SD)	2.04 ± 0.31	2.06 ± 0.34	2.05 ± 0.32	–
Baseline PI (mean $\pm$ SD)	1.93 ± 0.26	1.91 ± 0.29	1.92 ± 0.28	–
Gingival bleeding on probing	20	20	40	100%
Visible plaque accumulation	18	18	36	90%

GI: Gingival Index; PI: Plaque Index; SD: Standard Deviation

Table 3. Summarises the statistical outcomes

Variable	Group A (Control) Mean $\pm$ SD	Group B (Test) Mean $\pm$ SD	% Reduction	p-value	Significance
Gingival Index (Baseline)	2.04 ± 0.31	2.06 ± 0.34	–	–	–
Gingival Index (Day 14)	1.28 ± 0.27	0.88 ± 0.19	37.3% vs. 57.3%	$< 0.001^{**}$	Highly significant
Plaque Index (Baseline)	1.93 ± 0.26	1.91 ± 0.29	–	–	–
Plaque Index (Day 14)	1.21 ± 0.24	0.83 ± 0.21	37.3% vs. 56.6%	$< 0.001^{**}$	Highly significant

SD: Standard Deviation; **: denotes statistical significance ($p < 0.001$)



Figure 2. Representative intraoral images illustrating the condition of the gingiva before and after 14 days of 0.5% hydrogen peroxide rinsing as an adjunct to scaling. Improvements in redness, oedema, and marginal bleeding were observed, consistent with the improvement in the Gingival Index

gingiva before and after the 14-day intervention. The clinical photographs show noticeable improvement in gingival colour, reduction in swelling, and decreased bleeding in a patient from the hydrogen peroxide group, consistent with the quantitative changes in the Gingival Index described above. Notably, 95% of participants in the test group showed a clinically evident reduction in gingival redness and bleeding, compared to 70% in the control group.

3.2. Plaque Index (PI) Outcomes

The baseline mean PI in the control and test groups was 1.93 ± 0.26 and 1.91 ± 0.29 , respectively ($p = 0.74$), confirming similarity in plaque levels between the groups. After 14 days, the PI decreased to 1.21 ± 0.24 in the control group, representing a 37.3% reduction, and to 0.83 ± 0.21 in the test group, representing a 56.6% reduction (**Table 3**).

Statistical comparison between the groups showed a highly significant difference ($t = 6.54$, $p < 0.001$). In the test group, 90% of patients had a PI score lower than 1.0, indicating good plaque control, whereas only 55% of patients in the control group achieved a PI score lower than 1.0. Similarly, at day 14, the Plaque Index was significantly lower in the test group than in the control group (mean difference = 0.38; 95% CI: 0.24–0.52; $p < 0.001$), with a very large between-group effect size (Cohen's $d = 1.69$). These findings support the conclusion that daily use of a 0.5% hydrogen

peroxide rinse was highly effective in reducing plaque and maintaining oral hygiene following scaling.

3.3. Side Effects and Patient Tolerance

No serious adverse effects were reported during the study. However, two participants (10%) in the hydrogen peroxide group reported mild and transient burning sensations during the first two days of rinsing. The symptoms resolved spontaneously, and no participant discontinued the intervention because of these effects. No mucosal irritation, ulceration, or taste alterations were observed. All patients expressed satisfaction with the mouth rinse and reported improved gingival comfort and freshness.

3.4. Clinical Improvement Summary

The mean percentage improvement in both indices (GI and PI) was 47.3% in the control group and 56.9% in the hydrogen peroxide group, as shown in **Table 4**. The combined reduction in inflammatory and plaque parameters further supports the adjunctive effect of 0.5% hydrogen peroxide in the management of chronic gingivitis.

Figure 3 presents a visual representation of the overall differences in mean GI and PI values between the control and test groups. The bar graph highlights the greater percentage change observed in the hydrogen peroxide group compared to the control group, which is statistically significant.

Table 4. Presents a summary of the results

Parameter	Group A (Control) Mean $\pm$ SD	% Change	Group B (Test) Mean $\pm$ SD	% Change	Mean Difference	95% CI	p-value
Gingival Index (Baseline)	2.04 $\pm$ 0.31	—	2.06 $\pm$ 0.34	—	—	—	> 0.05
Gingival Index (Day 14)	1.28 $\pm$ 0.27	37.3%	0.88 $\pm$ 0.19	57.3%	0.40	0.25 to 0.55	< 0.001**
Plaque Index (Baseline)	1.93 $\pm$ 0.26	—	1.91 $\pm$ 0.29	—	—	—	> 0.05
Plaque Index (Day 14)	1.21 $\pm$ 0.24	37.3%	0.83 $\pm$ 0.21	56.6%	0.38	0.24 to 0.52	< 0.001**
Combined GI + PI improvement	—	47.3%	—	56.9%	—	—	< 0.001**

** denotes statistical significance ($p < 0.001$); CI: Confidence Interval; GI: Gingival Index; PI: Plaque Index

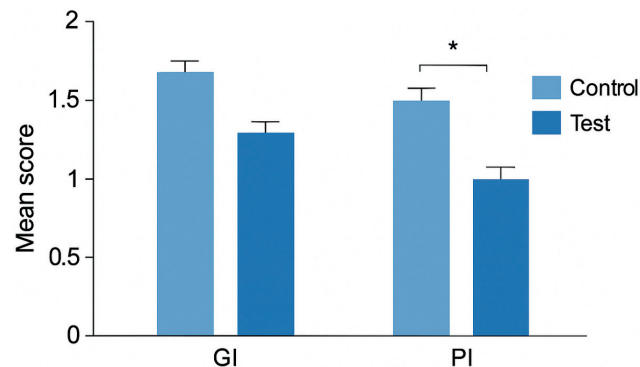


Figure 3. Comparative reductions in mean Gingival Index (GI) and Plaque Index (PI) scores over 14 days in the control and test groups. The statistics illustrate the higher clinical response observed with adjunctive 0.5% hydrogen peroxide rinsing (*: $p < 0.001$)

4. Discussion

The results of the current study indicated that daily use of a 0.5% hydrogen peroxide solution as an adjunct to scaling had a significant impact on the gingival and plaque indices of patients with chronic gingivitis compared to scaling alone. The 14 days were selected to evaluate short-term clinical response during the initial gingival healing phase. The observed decreases in the Gingival Index (57.3%) and Plaque Index (56.6%) after 14 days indicate a substantial improvement in gingival condition and overall oral health, suggesting that hydrogen peroxide is an effective adjunctive antimicrobial agent in non-surgical periodontal therapy. The biological mechanism underlying these effects is related to the broad-spectrum antimicrobial activity of hydrogen peroxide and the generation of reactive oxygen species, which disrupt bacterial cell membranes and biofilm organisation [21].

The findings are consistent with previous evidence regarding the antimicrobial and oxygenating effects of hydrogen peroxide in periodontal

therapy [2,8,9]. Furthermore, the 0.5% concentration was effective and well tolerated, with no reported side effects such as mucosal irritation or tooth sensitivity, reinforcing its short-term clinical safety. Low-concentration hydrogen peroxide formulations have previously been shown to provide therapeutic benefits with minimal adverse effects [6,10].

Hydrogen peroxide also exerts mild oxygenating effects that inhibit the growth of anaerobic bacteria and promote gingival recovery by increasing local oxygen tension [22]. The present findings align with those of Hrishi et al. [23], who reported significant improvements in periodontal parameters following adjunctive ozone irrigation due to oxidative antimicrobial effects, suggesting that both ozone- and peroxide-based oxygen therapies may be beneficial in clinical practice.

The positive outcomes in this study are also consistent with Alassy et al. [24], who reported that chemical adjuncts enhance the effects of mechanical debridement, particularly in areas difficult to access during scaling. Similarly, Vergara-Buenaventura and Castro-Ruiz [25] high-

lighted the virucidal and bactericidal properties of peroxide-based rinses, which were even recommended during the COVID-19 pandemic to reduce oral microbial load. These findings support the conclusion that a low-concentration hydrogen peroxide rinse, used daily over a short period, is both effective and safe.

The adjunctive benefits of hydrogen peroxide in this study are comparable to other phototherapeutic and antimicrobial modalities. Siddiqui et al. [26] and Niazi et al. [27] demonstrated the bactericidal effects of photochemotherapy and photodynamic therapy, respectively, in acute and necrotising gingival infections, both of which rely on reactive oxygen species similar to hydrogen peroxide. Likewise, Al-Kheraif et al. [28] reported that photodynamic therapy combined with oral debridement significantly reduced microbial load and pain, supporting the clinical usefulness of oxidative adjuncts in managing periodontal inflammation. Similarly, Garg et al. [29] found that antimicrobial mouthwashes, including chlorhexidine, significantly reduced bacterial adherence following periodontal surgery.

Although chlorhexidine is widely regarded as the gold standard antimicrobial mouth rinse, it is associated with adverse effects such as tooth staining and taste alteration. In the present study, adjunctive use of a 0.5% hydrogen peroxide mouth rinse resulted in significantly greater reductions in plaque accumulation and gingival inflammation compared with the control group. However, because chlorhexidine was not evaluated in this trial, no direct comparison between the two agents can be made. Emerging evidence also supports the use of oral rinses with similar mechanisms. Ahmed et al. [30] summarised the effects of nanoparticle-based oral rinses, which interfere with microbial biofilms and reduce plaque formation by 40–60%, consistent with the reductions observed in the current study.

Furthermore, Meykadeh [31] demonstrated that antimicrobial agents on contaminated implant surfaces effectively reduced *Staphylococcus aureus* biofilms, supporting the idea that oxidising agents, such as hydrogen peroxide, can manage oral biofilms beyond natural dentition. Maintaining periodontal health has systemic implications. Herrera et al. [32] emphasised that the oral cavity can serve as a reservoir for systemic pathogens, particularly during viral

outbreaks such as SARS-CoV-2, where peroxide rinses were shown to reduce viral load. These findings confirm the clinical relevance of the current study, suggesting that regular plaque control with hydrogen peroxide not only reduces gingivitis but may also help maintain overall oral microbial balance.

Other adjunctive therapies, such as probiotic mouth rinses, are also being investigated. Tapa-shetti et al. [33] found that probiotics reduced red-complex bacteria in chronic periodontitis by an average of 45%, although the mechanism differs from that of oxidative agents. Hydrogen peroxide provides a faster-acting antibacterial effect, which may explain the higher reduction rates in plaque and gingival scores observed over the short 14-day period in this study.

These results add to the evidence supporting adjunctive treatments in periodontal care. Alassy et al. [24] and Dumitrel et al. [22] found that using chemical agents like hydrogen peroxide daily can greatly improve clinical outcomes after scaling. Overall, the findings demonstrate that consistent adjunctive use of 0.5% hydrogen peroxide rinse produces statistically significant, clinically meaningful, and biologically plausible improvements in non-surgical periodontal therapy outcomes.

The findings of the present study should also be interpreted within the contemporary understanding of gingivitis as a dysbiosis-driven inflammatory condition. Current evidence suggests that gingival inflammation results not merely from the accumulation of dental plaque but from ecological shifts within the oral biofilm that promote a pathogenic microbial community and an exaggerated host inflammatory response. Systematic reviews of the periodontal microbiome have highlighted the importance of microbial dysbiosis and biofilm composition in periodontal disease development, emphasising the need for preventive strategies that target both biofilm quantity and quality [4]. Consequently, modern periodontal prevention emphasises both mechanical disruption of the biofilm and approaches aimed at modulating the oral microbiota and restoring microbial homeostasis.

Interdental cleaning, professional plaque removal, antimicrobial mouth rinses, and other adjunctive preventive therapies have all been shown to contribute to improved gingival health and reduction of biofilm-associated inflamma-

tion. Recent clinical studies demonstrated that calibrated interdental brushing significantly improves plaque-induced gingivitis and enhances oral hygiene outcomes [5]. At the same time, interdental cleaning has also been shown to reduce gingival inflammation in specific populations such as pregnant women [6]. Furthermore, growing interest in biofilm-modulating agents, including ozonated olive oil mouthwashes, ozonated water, and natural compounds such as green tea extracts, reflects the increasing focus on adjunctive therapies that support oral microbial balance and periodontal health [7,34,35].

Within this context, hydrogen peroxide may provide additional benefits through its oxidising activity, disruption of biofilm structure, reduction of microbial load, and improvement of local oxygenation. These effects may contribute to the favourable reductions in plaque accumulation and gingival inflammation observed in the present study. Nevertheless, hydrogen peroxide should be considered an adjunct rather than a substitute for effective daily mechanical plaque control, interdental hygiene measures, and professional periodontal maintenance.

5. Limitations

This study has several limitations that should be considered when interpreting the findings. First, the sample size was relatively small and drawn from a single clinical centre, which may limit the generalizability of the results. Second, the follow-up period was limited to 14 days; therefore, the long-term sustainability of the observed improvements in gingival and plaque indices could not be assessed. Third, the study relied solely on clinical parameters (Gingival Index and Plaque Index) without microbiological or biochemical assessments, which could have provided deeper insight into the antimicrobial and anti-inflammatory effects of hydrogen peroxide. Additionally, although adherence was monitored using self-reported checklists, this method may be subject to reporting bias. Future multicenter trials with larger sample sizes, longer follow-up periods, and microbiological analyses are recommended to confirm the long-term efficacy and safety of 0.5% hydrogen peroxide as an adjunct in periodontal therapy.

5. Conclusion

Daily use of a 0.5% hydrogen peroxide rinse as an adjunct to professional scaling significantly improves gingival health and reduces plaque in patients with chronic gingivitis compared to scaling alone. The rinse was well tolerated, safe, and provided a rapid antimicrobial effect, highlighting its potential as a simple, cost-effective addition to routine oral hygiene. These findings support the use of low-concentration hydrogen peroxide to enhance non-surgical periodontal therapy. However, further long-term studies are recommended to assess sustained effects and comparative efficacy with other adjunctive rinses such as chlorhexidine, sodium hypochlorite, or povidone-iodine, and explore potential synergistic effects with anti-inflammatory or healing agents such as hyaluronic acid.

Statements

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Conflict of interests

The authors declare no conflict of interest.

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Author contributions

Omar A. Huni contributed to the conception and design of the study, performed the research and wrote the first draft of the manuscript. Muna S. Elburki analysed the data and contributed to writing, manuscript editing, formatting, and final revision. Malek A. Abdulmatlob collected the data, performed material preparation and analysis and coordinated the study. Ayman. S.Najem collected the data. Marei H. Mugrabi collected the data. All authors reviewed the manuscript and approved the submitted version.

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