

Evaluation of the effect of hydrogen peroxide as a mouthwash in comparison with chlorhexidine in chronic periodontitis patients: A clinical study

Hazem Tarek Rashed

Department of Periodontology, College of Dentistry, Al Jouf University, Sakaka, Saudi Arabia

Corresponding author (email: <hazemtarek81@hotmail.com>)

Dr. Hazem Tarek Rashed, Department of Periodontology, College of Dentistry, Al Jouf University, Sakaka, Saudi Arabia.

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Abstract

Aims and Objective: This study was conducted to evaluate the effect of hydrogen peroxide (H_2O_2) as a mouthwash in comparison with chlorhexidine (CHX) in chronic periodontitis patients. **Materials and Methods:** A total of 45 patients suffering from localized mild to moderate chronic periodontitis were chosen. The subjects were divided equally into three groups. Group A patients were treated only with scaling and root planning (SRP). Group B were treated with SRP in combination with 0.2% CHX gluconate mouthwash twice daily for 10 days. Group C were treated with SRP in combination with 1.5% H_2O_2 mouthwash twice daily for 10 days. Gingival index, plaque index, pocket depth, and clinical attachment level were recorded for patients of all groups on day 0 (Baseline), 15, 30, and 90, respectively. Statistical analysis was done using the Statistical Package for the Social Sciences version 22.0. Repeated measures analysis of variance was used to assess the differences in the abovementioned indices because of time and groups. **Results:** Both CHX gluconate and H_2O_2 mouthwashes significantly reduced the gingival index more than that observed in the control group, but similar to each other. There were no significant differences in the clinical attachment loss, plaque index, and pocket depth among the study groups, but improvement was seen within the CHX group participants. In participants with chronic periodontitis, SRP in combination with 0.2% CHX gluconate mouthwash was an effective treatment in reducing the gingival index and the pocket depth, as well as improving the clinical attachment level. **Conclusion:** The use of CHX gluconate was observed to be higher than H_2O_2 for the reduction in the gingival index and the pocket depth, as well as for the improvement of the clinical attachment level.

Key words: Chlorhexidine gluconate, chronic periodontitis, hydrogen peroxide.

INTRODUCTION

Periodontal problems have been considered to be major health issues in different populations for a long time.^[1] Chronic periodontitis has a slow to moderate rate disease progression, which can be associated with local predisposing factors such as dental plaque, calculus deposits, and iatrogenic factors, and systemic diseases

such as diabetes mellitus.^[2] The severity and extent of damage vary between individuals and over time, mainly affected by individual's immune and inflammatory responses to microbial challenge.^[3,4]

At present, an efficacious and widely accepted modality of treatment for periodontal disease is the mechanical removal of the bacterial biofilm and their toxins from

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the tooth surface by scaling and root planning (SRP), making it convenient with biologic reattachment, which is the basis of any ultimate adjunctive therapy.^[5] An acceptable therapeutic measure is usually gained when personal plaque control is achieved in conjunction with professional removal of plaque, calculus, and other local factors.^[6]

Dental calculus removal is complemented by SRP procedures using hand, sonic, or ultrasonic equipments. The therapeutic aim of SRP is the removal of plaque and calculus to minimize subgingival bacteria below a threshold level which is capable of inducing clinical inflammation. The prosperity of instrumentation is determined by the evaluation of the periodontal tissues after treatment and during the maintenance phase of the therapy.^[7] Using topical antibacterial agents to reduce bacterial plaque may be advantageous for the prevention and treatment of gingivitis in some patients. A number of these agents in oral rinses and dentifrices have been examined in clinical trials.^[8,9]

Chlorhexidine (CHX) digluconate is considered to be one of the most frequently used compounds; since 1950, it has been used as a potent broad-spectrum antiseptic agent in medicine with a pronounced antimicrobial effect on both Gram-negative and Gram-positive bacteria, as well as on fungi and some viruses. Moreover, the ability of CHX to inhibit the formation and development of bacterial plaque for several hours was demonstrated in 1970's because of its high affinity for oral surfaces.^[10,11]

In addition, CHX is a positively charged cationic bisbiguanide that can be adsorbed to a variety of negatively charged sites, including mucous membranes, salivary pellicle on teeth, as well as several components of the biofilm on the tooth surfaces, e.g., bacteria, extracellular polysaccharides, and glycoproteins.^[12,13] *In vitro* studies showed that, in low concentrations, CHX causes destruction to the cell membrane and low molecular weight molecules escape from the microorganisms. On the other hand, a higher concentration of CHX causes precipitation and coagulation of the proteins in the cytoplasm of the exposed microbes. These properties interfere with biofilm formation and prevent its growth.^[14-16]

Hydrogen peroxide (H₂O₂) has been used in dentistry in combination with salts or alone for more than 70 years.^[17] Therapeutic delivery of H₂O₂ to prevent periodontal disease requires mechanical access to subgingival pockets. Furthermore, wound healing

following gingival surgery is enhanced because of the antimicrobial effects of topically administered H₂O₂. For most subjects, beneficial effects have been seen with H₂O₂ levels above 1%. H₂O₂ has been shown to possess a wide spectrum of antimicrobial activity because it is active against bacteria, yeasts, fungi, viruses, and spores.^[18]

Moreover, H₂O₂ is an oxidizer that has been employed in plaque control. Applications of oxygenating agents include the control of supragingival plaque and the treatment of acuteulcerative gingivitis with no side effects to the tissues.^[19]

In 1982, Wolff *et al.*, studied the effect of 3% H₂O₂ on gingival inflammation and concluded its effectiveness in reducing pocket depth of more than 4 mm, however, it showed no effect on bleeding and other gingival indices.^[20]

Considering the side effects of CHX that include brown discoloration of the teeth, restorative materials and dorsum of tongue,^[21,22] as well as the role of anaerobic bacteria in periodontal diseases and the ecosystem in periodontal pockets that allows microbial growth, it was decided to evaluate the effect of H₂O₂ as a mouthwash in comparison with CHX in chronic periodontitis patients.

MATERIAL AND METHODS

Patients' selection

Forty-five patients participated in this study. The participants were suffering from localized mild to moderate chronic periodontitis and were selected from the outpatient clinic of the Faculty of Dentistry, Al Jouf University. An informed consent was signed before starting the treatment for all patients. Clearance was obtained from the institutional ethical clearance committee. The patients were chosen on the basis of inclusion criteria.

Inclusion criteria

- Localized mild to moderate chronic periodontitis patients with a minimum of 20 permanent teeth and having clinical attachment loss ≤4 mm in less than 30% of the sites were included.
- Age range of patients: 30–50 years of age.
- Gender: Only male patients were selected (Because of the restriction of the conservative society, it was difficult to enroll the female sample).

Exclusion criteria

- Patients suffering from systemic diseases, which may have an impact on the periodontium, such as diabetes mellitus and osteoporosis.
- Uncooperative patients who failed to preserve proper oral hygiene during and after phase I therapy.
- Patients on antibiotics and/or antiinflammatory drugs.
- Patients allergic to CHX or H₂O₂.
- Smokers.

The following assumptions were used for sample size estimation: Alpha error = 5%, study power = 80%, estimated mean pocket depth in CHX group at the end of the study = 3.5 mm and in the H₂O₂ group = 4 mm, and common standard deviation = 0.4. The required sample size per group was calculated to be 11, which was increased to 15 to allow for probable loss to follow up.

Grouping

The subjects were divided equally into three groups:

- Group A: Fifteen patients were treated only with SRP.
- Group B: Fifteen patients were treated with SRP in combination with 0.2% CHX gluconate mouthwash (AVOHEX[®] mouth wash).
- Group C: Fifteen patients were treated with SRP in combination with 1.5% H₂O₂ mouthwash (Colgate[®] Peroxyl[®] Mouth Sore Rinse).

Methods

- A. Comprehensive personal, medical, and dental history was taken for all patients.
- B. Intraoral clinical assessment was done including the following: Evaluation of the gingival status through Gingival Index (GI) according to Löe H,^[23] evaluation of the amount of dental plaque through Plaque Index (PLI) by applying the (O'Leary Index),^[24] and measurement of the periodontal probing depth (PD)^[25] and the clinical attachment level (CAL).^[26]
- C. Phase I therapy included:
 - i. Patient's education and motivation was done for all cases.
 - ii. Plaque control and oral hygiene instructions were given.
 - iii. Proper scaling, polishing, and root planning was assured.

Appendix 1 shows the consort flow diagram of the study.

Study design

Gingival index, plaque index, pocket depth, and clinical attachment level were recorded. SRP was performed for all patients. In group A, SRP only was performed; in group B, 0.2% CHX gluconate mouthwash was prescribed as an adjunct to SRP. In group C, 1.5% H₂O₂ mouthwash was used after SRP. Patients of groups B and C were instructed to use the prescribed mouthwash concentrate twice daily for 10 days. The abovementioned indices were recorded on day 0 (Baseline), 15, 30, and 90.

Statistical analysis

For evaluation of the effect of H₂O₂ as a mouthwash compared with CHX in chronic periodontitis patients, the data were collected and statistically analyzed. Repeated measures analysis of variance was used to assess the differences in gingival index, plaque index, pocket depth, and clinical attachment level because of time and groups. Percent reduction in gingival index, plaque index, and pocket depth was calculated as follows:

$$[(\text{values after 90 days} - \text{values at baseline}) / \text{values at baseline}] \times 100.$$

Percent reduction in pocket depth was used as an outcome in a regression model with the following variables used as independent variables: Percent change in gingival index and percent change in plaque index and group. Adjusted means and 95% confidence intervals were calculated. Significance level was set at 5%. Statistical analysis was performed using the Statistical Package for the Social Sciences, version 22.0. IBM Corp., Armonk, NY, USA.

RESULTS

Gingival index

Figure 1 shows the change in the gingival index across time in the 3 study groups. A significant improvement in gingival index was noted over time ($P < 0.0001$). There was a significant reduction in gingival index from baseline to after 15 days, after 30 days, and after 90 days ($P < 0.0001$ for all). The highest gingival index was observed in the control group whereas the gingival index in the CHX and H₂O₂ were significantly lowered, but similar to each other.

Plaque index

Figure 2 shows the change in the plaque index across time in the 3 study groups. Time had a significant effect

on plaque index ($P < 0.0001$). There was a significant reduction in plaque index from baseline to after 15 days, after 30 days, and after 90 days ($P < 0.0001$ for all). There were no significant differences in plaque index among the study groups ($P = 0.11$).

Pocket depth

Figure 3 shows the change in pocket depth across time in the 3 study groups. Time had a significant effect on pocket depth ($P < 0.0001$). There was a significant reduction in pocket depth from baseline to after 15 days, after 30 days, and after 90 days ($P < 0.0001$ for all). There were no significant differences in pocket depth among the study groups ($P = 0.06$).

Table 1 shows the adjusted mean reduction in pocket depth in the 3 study groups. By the end of the study, there were statistically significant differences

in reduction in pocket depth from baseline values ($P < 0.0001$). The pocket depth reduction within the CHX group was significantly greater than in the H_2O_2 and the control groups, which were statistically similar. The regression model accounted for 55% of the variation in pocket depth reduction.

Clinical attachment level

Figure 4 shows the change in clinical attachment level across time in the 3 study groups. Time had no

Table 1: Percent reduction in pocket depth in the three study groups

Adjusted mean percent reduction in pocket depth (95% confidence interval)		
Hydrogen peroxide	Chlorhexidine	Control
24.77 (20.80, 28.74) ^a	38.09 (33.37, 42.82) ^b	21.30 (15.33, 27.28) ^a

Adjusted in regression analysis for change in plaque and gingival indices.
^{a,b}Different letters denoting significant differences between groups;
 Adjusted $r^2=0.55$

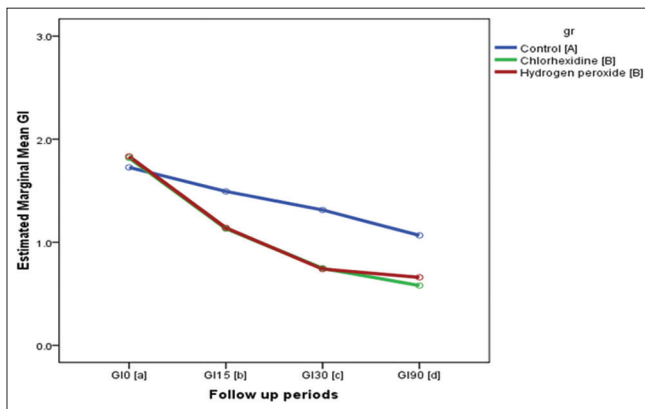


Figure 1: Change in gingival index across time in the study groups. Effect of time [$F = 430.28, P < 0.0001$; a, b, c, and d: Different letters denoting significant difference between follow up period]. Effect of groups [$F = 10.12, P < 0.0001$; A and B: Different letters denoting significant difference between the follow-up period]

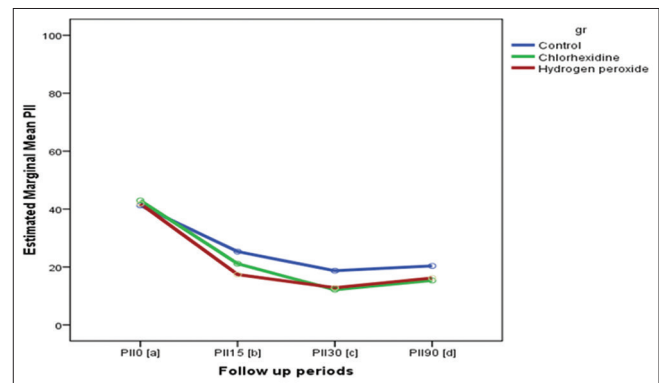


Figure 2: Change in plaque index across time in the study groups. Effect of time [$F = 291.73, P < 0.0001$; a, b, c, and d: Different letters denoting significant difference between the follow-up period]. Effect of groups [$F = 2.33, P = 0.11$]

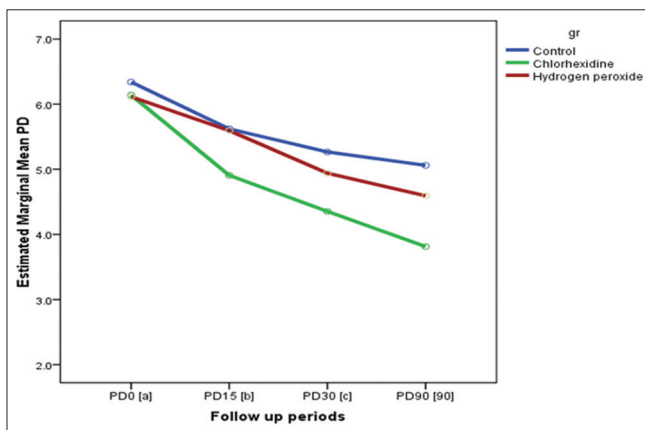


Figure 3: Change in pocket depth across time in the study groups. Effect of time [$F = 596.36, P < 0.0001$; a, b, c, and d: Different letters denoting significant difference between follow-up period]; effect of groups [$F = 2.95, P = 0.06$]

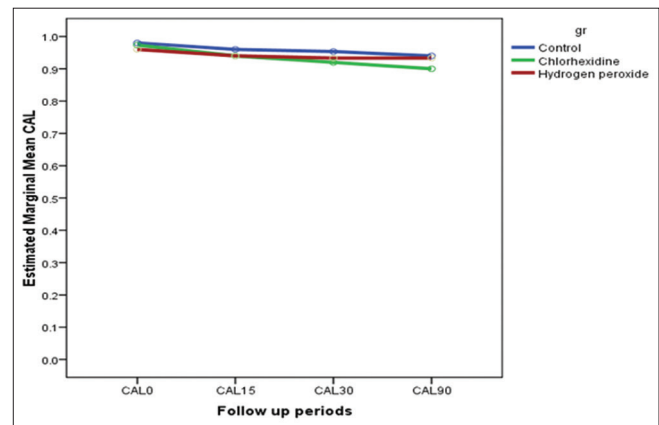


Figure 4: Change in the clinical attachment level across time in the study groups. Effect of time [$F = 1.60, P = 0.21$]; effect of groups [$F = 0.02, P = 0.98$]

significant effect on clinical attachment level ($P = 0.21$). There were no significant differences in clinical attachment level among the study groups ($P = 0.98$).

DISCUSSION

Till date, mechanical plaque removal with assorted devices remains the primary and most widely accepted means of controlling plaque and preserving good oral hygiene. As an adjunct to mechanical techniques, chemical plaque control comprising of a variety of chemotherapeutic agents, have been beneficial and advisable.^[19,27]

The greatest success has been with CHX, which is now considered the gold standard, against which other potential antiplaque agents are measured.^[28] However, the local side effects of CHX, particularly extrinsic staining and taste aberrations, may limit its long-term use in oral hygiene products.^[29]

The present study was initiated to evaluate the effect of H_2O_2 as a mouthwash in comparison with CHX in chronic periodontitis patients. The findings of the present study show that rinsing using CHX as an adjunct to SRP can help in achieving desirable clinical outcomes in the treatment of chronic periodontitis.

The results of the present study show a significant reduction in gingival index when using the CHX or H_2O_2 as adjunct to SRP as is evident from Figure 1. Similarly, this finding has been confirmed in the study done by Hasturk *et al.*, which indicated that H_2O_2 mouthwashes reduce the signs of gingival inflammation.^[30]

The study of Sahebjam *et al.* indicated that subgingival irrigation with 3% H_2O_2 plays a potential role in inflammation control and reduction of gingival bleeding.^[18]

In a double blind parallel group study, the efficacy of CHX mouth rinses with and without alcohol was evaluated, and it was found that the alcohol-free rinse was as effective as one containing alcohol in controlling plaque and reducing gingival inflammation.^[31]

Furthermore, all study groups showed a significant reduction in plaque index with time from baseline to after 15 days, after 30 days, and after 90 days ($P < 0.0001$ for all). There were no significant differences in plaque index among the study groups

as patient's education and motivation was done for all cases. Plaque control and oral hygiene instructions were also given to all groups.

Regarding the pocket depth, the study results showed a significant reduction in pocket depth with time from baseline to after 15 days, after 30 days, and after 90 days ($P < 0.0001$ for all). This study failed to reveal a significant difference in pocket depth among the study groups. This is in line with Sahebjam *et al.* who studied the effect of periodontal pocket irrigation with 3% H_2O_2 and reported that there was no significant effect on probing depth compared to saline or to nonirrigation groups.^[18]

Time had no significant effect on clinical attachment level ($P = 0.21$). There were no significant differences in clinical attachment level among the study groups ($P = 0.98$).

According to Sahebjam *et al.*^[18] irrigation with H_2O_2 resulted in a significant reduction of attachment levels between the 3 groups on day 21.

This is in agreement with Pietruska *et al.*^[21] who demonstrated the efficacy of local treatment with H_2O_2 drugs on the clinical status of periodontium in chronic periodontitis patients. Plaque and gingival indices were significantly reduced after treatment. Pocket depths after treatment were markedly reduced, on other hand, no significant changes were observed after 3 months in the attachment level as compared to the baseline.

Strength of the study

CHX proved to be more effective than H_2O_2 regarding the reduction in the gingival index and the pocket depth, as well as in the improvement of the clinical attachment level, this aspect may be considered as the positive aspect of this study.

Limitations of the study

Limited time duration and the small and nonprobability sample of convenience were the limitations of this study. The size, convenience, and homogeneity of the sample limit the generalizability of this study, and hence further studies are recommended.

CONCLUSION

Within the limitations of this study, it can be concluded that CHX is more effective than H_2O_2 in reducing

gingival index, pocket depth, and improving the clinical attachment level. CHX is the most effective agent as an adjunct to routine oral hygiene procedures. Rinsing with CHX twice daily can be recommended as an adjunct to SRP to treat chronic periodontitis. Further studies to clarify the effect of CHX, as well as H₂O₂, mouthwashes in chronic periodontitis patients are recommended.

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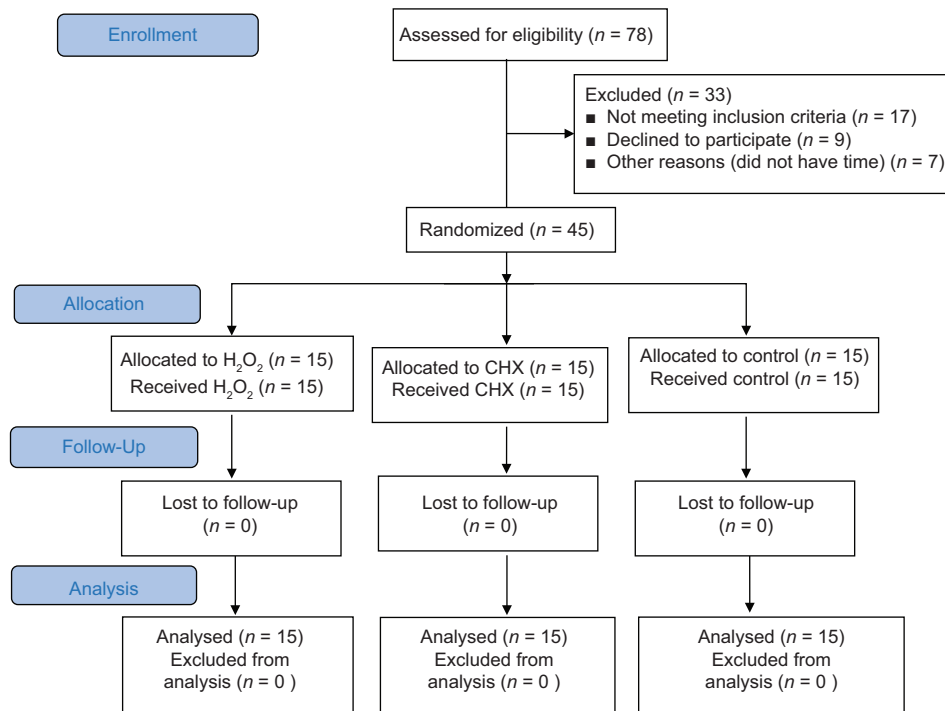
Conflicts of interest

There are no conflicts of interest.

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Appendix 1: Consort flow diagram