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(REVIEW ARTICLE)

The ability of chlorhexidine oral rinse in prohibiting gingivitis in orthodontic patients: A literature review

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Abstract

Periodontal conditions, known as plaque-induced gingivitis, are one that dentists frequently deal with daily. One condition that often faces challenges in plaque control is fixed orthodontic treatment. Plaque control is generally carried out by mechanical methods, such as using dental floss, brushing teeth, oral irrigation, cleaning teeth with an interdental cleaner and professional tartar cleaning and polishing to remove plaque mechanically. However, the success of this method is highly dependent on the techniques used by each individual. As a complement, Chlorhexidine (CHX) mouthwash is often used to support plaque control. This study purposed to analyze the role of chlorhexidine (CHX) on the gingivitis index in orthodontic patients as a control for plaque-induced gingivitis. This research method uses a literature review of nine articles using Google Scholar, PubMed and Elsevier databases from 2014-2024. CHX was proven to significantly reduce gingival index (GI), plaque index (PI) and inhibit the accumulation of microbial biofilm on the surface of orthodontic appliances. The conclusion is that CHX mouthwash effectively reduces gingivitis and plaque in patients with fixed orthodontic appliance, even though it has adverse effect such as tooth staining and irritation. Alternatives such as probiotics, propolis, and herbal mouthwash show similar potential with less severe side effects, so further research is needed to optimize formulations and evaluate their long-term effectiveness.

Keywords: Chlorhexidine mouthwash; Gingivitis; Orthodontic patients; Control plaque; Gingivitis prevention

1. Introduction

Fixed orthodontic appliances can pose a risk to dental health as they may promote the buildup of microorganisms, leading to enamel demineralization characterized by white spot lesions. In patients with fixed orthodontic appliances, malocclusion and crowded teeth associated with these appliances contribute to hygiene challenges.[1] In addition, brackets, wires, rubber bands, and other components of orthodontic devices in the oral cavity can affect the mouth's pH and bacterial balance, resulting in the buildup of dental plaque that is difficult to eliminate. The design and surface characteristics of orthodontic attachments, along with the roughness of composites, also play a role in retaining plaque, which can increase the risk of caries.[2]

In addition to caries, plaque-induced gingivitis is a common periodontal condition often encountered in dental practice. This condition develops due to microbial biofilm on tooth surfaces, mainly caused by insufficient oral hygiene practices. Gingivitis is characterized by redness, swelling, and gums that bleed easily during flossing or brushing. When untreated, this early form of periodontal disease can progress, damaging the supporting structures of the teeth, such as the gums and bone, and potentially causing tooth loss.[3] Plaque control is typically achieved through mechanical methods, including tooth brushing, flossing, using interdental cleaners, oral irrigation, and professional procedures like scaling and polishing to eliminate plaque physically.

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However, the success of this method is highly dependent on the techniques used by each individual. Today, various mechanical and chemical treatment options exist to treat periodontal problems. Therefore, it is recommended to utilize chemical methods to maintain oral hygiene, such as gargling with antimicrobial drugs every day, especially for those at risk of periodontitis. *Chlorhexidine* (CHX) is a mouthwash widely used to prevent plaque formation.[4] It has been reported that CHX mouthwash, followed by manual tooth brushing, significantly reduces the Gingival Index (GI) and Plaque Index (PI) of patients with fixed orthodontic appliances. Therefore, this review aims to analyze the effect of chlorhexidine (CHX) on the gingivitis index in orthodontic patients as a control for plaque-induced gingivitis

2. uses the literature review method to compare, analyze, and summarize previously existing theories. It also functions Material and methods

This research to look for references that can support theories relevant to the problem being researched.[5] According to Winoto, the process of doing a literature review involves finding relevant textual sources linked to the issue or subject under review, including books and journals.[6]

Data sources come from scientific articles from various journal databases, such as Google Scholar, PubMed, and Elsevier. Article searches were carried out using keywords such as "Chlorhexidine mouthwash," "Gingivitis," "Orthodontic patients," "Control plaque," and "Gingivitis prevention." Additionally, a few chosen article references were manually searched to locate any more relevant articles that might have passed through the database search.

The selected articles are articles that meet the inclusion criteria: 1) Articles published between 2014–2024 or a maximum of the last 10 years, 2) Articles with a Randomized Controlled Trial (RCT) research method, 3) Articles in English, and are the results of research with subjects of patients using fixed orthodontic appliances of various ages.

3. Results

There are 9 articles regarding the ability of chlorhexidine mouthwash to decrease gingivitis among patients with fixed orthodontic appliances from 2014-2024. The outcome of the review are written in table form which includes the title of the article/author, subject, research objectives and research results.

Table 1 Summary of Journal Contents

No.	Article Title/ Writer	Subject	Research purposes	Research methods	Research result
1.	Comparison of antiplaque and anti-gingivitis effects of aloe vera mouthwash with chlorhexidine in fixed orthodontic patients—A randomized controlled trial (Kamath et al., 2023)	30 patients with fixed orthodontic appliances	This research intends to compare the efficacy of 0.2% chlorhexidine mouthwash and aloe vera mouthwash in lowering dental plaque and gingivitis in patients with fixed orthodontic appliance.	Randomized Controlled Trial (RCT)	In both groups (aloe vera and chlorhexidine), the gingival index (GI) presented a statistically significant difference between starting point and visits on days 21 and 35. While there were no significant changes between the second and third visits, the two groups plaque index and bleeding during inspection also exhibited statistically significant differences when compared between baseline and visits on days 21 and 35.
2.	Comparative Evaluation of 0.25% Lemongrass Oil	60 patients with fixed orthodontic appliances	This research intends to compare how efficiently	Randomized Controlled Trial (RCT)	On days 14 and 21, the group using lemongrass oil mouthwash had lower plaque index (PI) and gingival index

	Mouthwash and 0.2% Chlorhexidine Mouthwash in Fixed Orthodontic Patients Suffering from Gingivitis (Wasey et al., 2023)	had mild to moderate gingivitis	mouthwash containing 0.2% chlorhexidine and 0.25% lemongrass oil reduce gingivitis and plaque in individuals under fixed orthodontic treatment.		(GI) , with statistically significant differences ($p < 0.001$) when compared to the group using the Use of chlorhexidine mouthwash.
3.	Effect of chlorhexidine mouthwashes on periodontal parameters and extrinsic tooth staining in orthodontic patients (Andrucioli et al., 2023)	33 patients aged 11–33 years, of both sexes, who underwent orthodontic treatment with a fixed orthodontic appliance for less than 16 months.	This research intends to evaluate how individuals under orthodontic treatment are affected by extrinsic tooth discolouration and periodontal diseases when using mouthwash containing chlorhexidine (CHX).	Randomized Controlled Trial (RCT)	Gingival index, plaque index, and gingival bleeding all decreased in the experimental group during each of the evaluation periods ($P < 0.05$). Additionally, the color change index after 60 days was significantly different from the first following the hygiene protocol's execution ($P < 0.05$). The control group, on the other hand, never displayed any appreciable changes in gingiva, gingival bleeding, plaque index, or color alterations ($P > 0.05$).
4.	Comparison of the Antimicrobial Activity of Aloevera Mouthwash with Chlorhexidine Mouthwash in Fixed Orthodontic Patients (Ayesha et al., 2022)	90 patients with fixed orthodontic appliances	This study examines the antibacterial activity of mouthwash made with aloe vera and chlorhexidine in individuals receiving fixed orthodontic treatment.	Randomized Controlled Trial (RCT)	Plaque Index (PI) score decreased by an average of 0.43 ± 0.49 for group chlorhexidine, 0.03 ± 0.18 for group aloe vera, and 1.65 ± 0.88 for the control group on day 20. On day 20, the gingival index (GI) scores decreased by an average of 0.83 ± 0.40 in the aloe vera group, 0.93 ± 0.55 in the chlorhexidine group, and 1.85 ± 0.77 in the control group. Aloe vera and chlorhexidine groups saw a more substantial reduction than the control group, according to the results of an analysis of the differences between days 1 and 20 in each group using the Student's t-test.
5..	Comparative Evaluation of Plaque Inhibitory and Antimicrobial	30 patients with fixed orthodontic treatment,	This research intends to evaluate the efficacy of	Randomized Controlled Trial (RCT)	The plaque index of the chlorhexidine and probiotic groups significantly decreased compared to the

	Efficacy of Probiotic and Chlorhexidine Oral Rinses in Orthodontic Patients: A Randomized Clinical Trial (Shah et al., 2019)	healthy condition	chlorhexidine and probiotic mouthwash in orthodontic patients.		control group. However, the probiotic group outperformed the chlorhexidine group, and the gingival index improved more than the plaque index. After the intervention period, there were no significant differences in the quantity of streptococci between the probiotic and chlorhexidine groups.
6.	Effect of Propolis mouthwash on plaque and gingival indices over fixed orthodontic patients (Dehghani et al., 2019)	Patients aged 15-35 years, using fixed orthodontic appliances, good health condition and mild to moderate gingivitis	This research intends to assess how mouthwash containing propolis and chlorhexidine affected gingival and plaque indices in patients receiving orthodontic treatment.	Randomized Controlled Trial (RCT)	There was a statistically significant difference between the plaque index (P<0.001), gingival index (P=0.006), and periodontal index (P=0.005) before and after propolis was administered. The three indicators of plaque (P<0.001) , gingiva (P=0.001), and periodontal (P=0.003) showed similar substantial differences before and after using chlorhexidine mouthwash. As a result, no statistically significant change was observed between the two mouthwash groups after use.
7.	Efficacy of Three Types of Plaque Control Methods During Fixed Orthodontic Treatment: A Randomized Controlled Trial (Shilpa et al., 2019)	Patients aged 13-35 years with fixed orthodontic treatment	This research intends to assess and contrast the efficacy of three plaque management techniques in patients receiving fixed orthodontic treatment at the Coorg Institute of Dental Sciences in Virajpet, Coorg district, Karnataka, India, who were between the ages of 13 and 35.	Randomized Controlled Trial (RCT)	The three groups' difference in plaque levels was statistically significant (P = 0.001). The group that used a manual toothbrush and mouthwash containing chlorhexidine (Group C) had the lowest average plaque index (PI), measuring 0.5 ± 0.39. When the groups' mean gingival index (GI) scores were compared after two months, there was likewise an extremely significant difference (P = 0.001). Furthermore, at the end of two months, the mean MPBI scores for the three groups differed statistically significantly (P = 0.001), with group C having the lowest MPBI score (0.3 ± 0.3).

. 8.	Impact of Mouthwashes on Antibacterial Activity of Subjects with Fixed Orthodontic Appliances: A Randomized Clinical Trial (Nishad et al., 2017)	Patients aged 18-35 years, using fixed orthodontic appliances.	This research intends to assess how mouthwash affects antibacterial activity in people who use fixed orthodontic appliances.	Randomized Controlled Trial (RCT)	The amount of Streptococcus mutans (SM) colonies, average plaque index (PI), and gingival index (GI) score did not differ statistically significantly across groups. Following the intervention, there were significant differences between the CHX and Neem mouthwash groups in terms of the number of SM colonies that decreased and a substantial drop in GI and PI scores (p =0.032, p =0.002, respectively).
9.	Clinical efficacy of a 1% Matricaria chamomile L. mouthwash and 0.12% chlorhexidine for gingivitis control in patients undergoing orthodontic treatment with fixed appliances. (Goes et al., 2016)	Subjects were over 10 years old, used fixed orthodontic appliances, had at least 20 natural teeth, were in healthy condition, and had an average plaque index of more than 1.5.	This research intends to evaluate if a mouthwash with 1% Matricaria chamomilla L. (MTC) extract reduces plaque and gum inflammation in individuals receiving orthodontic treatment with fixed treatment.	Randomized Controlled Trial (RCT)	On days 1 and 15, the gingival bleeding index (GBI) and visible plaque index (VPI) data (mean ± SD) were recorded. Over the period, the VPI by 10.2% and the GBI increased by 23.1% in the placebo group. GBI and VPI , on the other hand, dropped considerably in the CHX group (-32.0% and -39.9%, respectively) and the MTC group (-29.9% and-25.6%, respectively) when compared to the placebo group.

4. Discussion

The primary purpose of this literature review is to assess the effect of chlorhexidine (CHX) on the gingival index in orthodontic patients. Dental caries are caused by acid-producing bacteria like *Lactobacillus* and *Streptococcus mutans*, which convert sucrose into lactic acid and other organic acids, leading to enamel demineralization. Moreover, using fixed orthodontic appliances alters the oral environment, promoting increased plaque accumulation and the proliferation of *S. mutans* and *Lactobacillus*, which can lead to dental caries. Orthodontic appliances can also cause colonization of periodontal pathogenic bacteria associated with gum inflammation and periodontal disease. Antibiotics are commonly administered before invasive procedures to reduce the risk of infection and prevent bacteremia and endocarditis caused by *Streptococcus mutans*. Mouthwashes like chlorhexidine, sodium hypochlorite, and similar agents are frequently used; however, they may lead to side effects such as hypersensitivity reactions, toxicity, and tooth staining.[7]

Most research indicates chlorhexidine is a highly effective antimicrobial agent for minimizing plaque and gingivitis in patients with fixed orthodontic treatment. CHX consistently shows a notable reduction in both plaque index (PI) and gingival index (GI) when compared to control groups. For instance, a study by Andrucioli observed a significant reduction in PI and GI following the use of CHX in orthodontic patients, highlighting CHX's effectiveness in preventing the buildup of microbial biofilm on orthodontic appliance surfaces.[8] In their research, Wasey also proved that CHX can reduce the periodontal index and the number of pathogenic microbes, including bacteria that cause caries and gum disease. Using mouthwash twice weekly for 60 days is effective, with 30 days considered optimal to avoid side effects such as staining.[9]

Kamath discovered that CHX effectively reduced plaque, gum inflammation, and *Streptococcus mutans* (SM) levels. However, it also causes side effects like tooth staining, altered taste, and local irritation.[10] Shah also support these findings, stating that CHX has strong antimicrobial capabilities in controlling plaque and gingivitis, although braces can impair effectiveness.[1] Nishad confirmed that CHX could reduce microbial plaque and colonization of *Streptococcus mutans*, even under challenging conditions such as fixed orthodontic treatment.[11] A manual toothbrush with chlorhexidine mouthwash can also significantly reduce plaque, gingivitis, and bleeding after 1 and 2 months. This is proven by research conducted by Shilpa. [12]

CHX continues to be the preferred treatment for managing plaque and gingivitis. However, because of the side effects, alternatives such as probiotics, propolis, and herbal mouthwash may be an option, especially for long-term use. Dehghani show that propolis is similar to CHX in reducing the gum health index, with the added advantage of not having side effects such as a spicy taste or tooth staining.[2] Meanwhile, Goes compared 1% MTC (Matricaria chamomilla) with CHX. The findings indicated that MTC was equally effective in reducing gingivitis without causing the side effects associated with CHX..[13] Therefore, additional research is required to establish the ideal dosage, suitable formulation, and long-term efficacy of alternatives like probiotics and propolis.[2]

5. Conclusion

A review of nine journal articles showed that most studies identified chlorhexidine (CHX) as an effective antimicrobial agent for decreasing plaque and gingivitis in patients with fixed orthodontic appliances. CHX was proven to significantly reduce plaque index (PI) and gingival index (GI) and inhibit the accumulation of microbial biofilm on the surface of orthodontic appliances. However, its use has limitations, such as tooth staining, taste changes, and local irritation. Therefore, while CHX remains the gold standard for controlling plaque and gingivitis, alternatives like probiotics, propolis, and herbal-based mouthwashes such as Matricaria chamomilla (MTC) are beginning to demonstrate similar effectiveness with the added benefit of fewer side effects. Therefore, further research is needed to develop optimal formulations and evaluate the long-term effectiveness of these alternatives.

Compliance with ethical standards

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Disclosure of conflict of interest

I declare no conflict of interest.

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