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Effectiveness of Clove Extract-Dental Flossing in Reduction of Supragingival Biofilm

Dhuha Malek Hasan, Mukhaled Louay Ali, Israa Hussein Ali

[1]College of Dentistry,University of Babylon, Al-Hilla, Babylon, Iraq

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Email: den129.duha.malik@uobabylon.edu.iq

Abstract

Objective: Dental biofilm in interproximal locations is difficult to manage with a toothbrush. Consequently, some products, such as dental floss, may be in benefit for these specific locations, with natural ingredients that can be used as a long-term substitute for mouthwashes with chemical-based bacterial resistance. The aim of this study was to compare the effectiveness of dental floss impregnated with clove extract versus, using a dental floss impregnated with 5% chlorhexidine gluconate in terms for reducing a supragingival biofilm. **Materials and Methods:** Eighty children, aged 12 to 15, from undergraduate clinics in Babylon University's Faculty of Dentistry in Iraq, were sampled for this study and split equally into four groups. Group 1 (negative control) did not use waxed floss without mouthwash; Group 2 (positive control) flossed without impregnation with mouthwash twice daily; Group 3 (positive control) flossed with chlorhexidine gluconate twice daily; and Test Group 4 (G4) used the same dental floss twice daily with clove extract impregnation. Every group was assessed in this study after two and four weeks, respectively. Using the (Quigley-Hein Index) in which was modified by Turesky et al, the presence of a biofilm was assessed to the four surfaces (mesiobuccal, distobuccal, mesiolingual, and distolingual), giving each tooth four scores. **Results:** Between and within groups, there was a highly significant difference ($P < 0.001$) at two and four weeks. In group 4, the mean dental plaque value was the lowest. **Conclusion**: In comparison to dental floss impregnated with chlorhexidine gluconate, and traditional waxed floss, it was determined, that the use of dental floss impregnated with clove extract produced further decreases in the supragingival biofilm on the anterior teeth.

Introduction

Dental plaque, a complex mass of highly viscous microorganisms adhered to the tooth surface, is the primary cause of dental caries and periodontal disorders, the two conditions that most frequently result in tooth extraction [1]. Periodically, dental plaque that has formed on tooth surfaces should be completely removed to prevent oral diseases. Using a toothbrush to mechanically manage the biofilm is the most effective method of preventing this illness [2]. Nevertheless, because toothbrushes are not very effective at eliminating the dental biofilm that builds up on interproximal surfaces, they should be used in conjunction with other cleaning tools. Furthermore, not every tooth location is necessarily equally affected by periodontal disorders [3,4]. Interproximal surfaces had higher concentrations of dental biofilm formation than non-proximal areas, indicating that interdental cleaning is frequently not done properly. Several interproximal cleaning tools, like as dental floss, toothpicks, and single-tufted brushes, are frequently available to remedy this problem [5,6]. Chemical control is an additional method of controlling

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dental biofilms in addition to mechanical management. Although the most widely used antimicrobial agent, chlorhexidine gluconate, is effective at preventing the formation of dental plaque, it can cause side effects like extrinsic dental staining or dry mouth. Chemical methods are useful for removing interdental plaque that cannot be removed by brushing your teeth. Furthermore, antibiotic resistance may reduce its efficacy to prevent dental plaque production when administered consistently [7]. Plant extract has many advantages over chemical and physical methods; it is safe for medicinal purposes in humans, economical, and environmentally beneficial [8]. One such natural element that can be utilized in place of mouthwashes made with chemicals is clove, a naturally occurring product that is easily and affordably collected. This curcuminoid chemical has antioxidant, anti-tumor in addition to anti-cancer, anti-microbial, antiseptic, and anti-inflammatory qualities. It is valuable for the prevention, treatment, and care of a variety of disorders [9]. The cytoplasmic membranes of cells can be denatured and destroyed by the essential oils that were demonstrated. Due to unstable bacterial cell walls and cytoplasmic membranes in which, interfere with permeability in addition to active transport, and protein regulation. If the cytoplasmic integrity of bacterial cells is disturbed, the cells will lyse. Flavonoids have the potential to damage bacterial cell walls. Because broken cell walls increase the permeability of the cell membrane, enabling fluid from the outside to enter the cell, bacterial cell rupture results [10,11].**Error! Reference source not found.**

Material and Methods

Eighty children, from undergraduate clinics in Babylon University's College of Dentistry, aged 12 to 15, of both sexes, were chosen for the study. It took place between the middle of September 2025 and the middle of January 2026.

They were equally divided into four groups. The negative control, group 1 (G1) (n = 20) did not use any kind of interproximal cleaning device, and only used a toothbrush to eliminate the supragingival plaque; group 2 (G2) (n = 20), used the same toothbrush and a waxed dental floss without any impregnation twice a day; group 3 (G3) (n = 20) also used a toothbrush, and the same dental floss impregnated with chlorhexidine gluconate twice a day as a positive control and group 4 (G4) (n = 20) also used a toothbrush and the same dental floss impregnated with clove extract twice a day as a test group.

The following criteria were met by the subjects who were included: All recruited children had to be in good general health and exhibit interproximal gaps free of gingival recession or diastema. Except for dental calculus, participants in this study were not allowed to smoke or have any type of dental prosthesis, caries, or other biofilm retentive factors. Exclusions were also made for people who had taken systemic antibiotics within three months before the trial began and those who had systemic diseases like diabetes that affected periodontal health. The researcher gave each participant verbal and individual tooth brushing and flossing techniques instructions. Only the anterior teeth, a total of twelve interproximal gaps on the upper arch, and twelve on the lower arch, were chosen for evaluation in this study. To make flossing easier for the volunteers and to make it easier for the examiner to see the dental biofilm, it was decided to use only anterior teeth.

The American Dental Association (ADA) recommended the usage of dental floss. Three buccal–lingual motions were to be made, against the mesial surfaces and three more against the distal surfaces after the dental floss was introduced into each interproximal area. Daily oral hygiene practices were not observed, except during the first visit. The participants were encouraged by the researcher to carry out this treatment twice daily at 12-hour intervals. For the lower and upper arches, each subjects used a single piece of dental floss. Only four surfaces were examined for the presence of dental biofilm, at two and four weeks following the baseline examinations, yielding four scores for each tooth (mesiobuccal, distobuccal, mesiolingual, and distolingual). Turesky et al.'s modified Quigley–Hein Index [12] was used to evaluate the four surfaces [13].

To make clove extract, 25g of clove buds were weighed and ground into a fine powder using a mortar and pestle that was provided. In a beaker, it was combined with 250 milliliters of distilled water and heated to 80 degrees Celsius while being constantly stirred for one to two hours. Whatman's filter paper No. 1 was used to filter the mixture, which was then stored at 4°C for later use [14].

This study according to Ethical Committee, University of Babylon, College of Dentistry with Reference Number 92.
For statistical analysis, ANOVA and Post Hoc tests were employed (P-value = 0.05).

Results

There were no remarkable differences between or among groups prior to flossing, using mouthwashes containing chlorhexidine and cloves (p=0.052). Figure 1 shows distribution of dental biofilm mean value between buccal and lingual.

It was found a significant difference between groups and within groups after two weeks of treatment with flossing, chlorhexidine, and clove mouthwashes with flossing (p <0.001). Figure 2 shows that the mean value of dental biofilm was the lowest for Group 4.

It was found a significant difference between groups and within groups after four weeks of treatment with flossing, chlorhexidine, and clove mouthwashes with flossing (p<0.001). Figure 3 shows that the mean value of dental biofilm was the lowest for group 4 for both buccal and lingual.

Discussion

The two most prevalent oral diseases that cause tooth loss and eventually lower a patient's quality of life worldwide are periodontitis and dental caries. Oral diseases of infectious origin, including periodontitis and dental caries, are mostly caused by microbial biofilm that is adhered to the tooth surface. Since the interproximal areas are the difficult for patients to maintain and clean, plaque biofilm can readily form there [15].

One important component of mechanical plaque control is using dental floss to clean the interproximal areas. Several antimicrobial treatments have been investigated as a supplement to mechanical plaque to eradicate harmful bacterial biofilm. To avoid gum disease, tooth decay, and foul breath, flossing eliminates dental plaque, a bacterial biofilm that accumulates on teeth [16].

The most popular application of mouthwash is as a supplement to mechanical plaque control, and it has been shown to be successful in removing all plaque [17]. Dental floss that has been impregnated with antimicrobials exhibits strong antimicrobial activity. antibacterial-coated dental floss has demonstrated significant antibacterial activity, according to previous work [18].

Alcoholic mouthwash, with essential oils and non-alcoholic mouthwash, with chlorhexidine, as the active ingredient had similar plaque efficacy. Innovations pertaining to natural or herbal mouthwash products must be commercialized to capitalize on the growing market for these products. Despite its substantivity

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and antibacterial properties, chlorohexidine mouthwash has several negative side effects. In contrast, a novel herbal mouthwash has fewer side effects and better patient compliance. Clove extracts are one type of herbal agent that has antibacterial, anti-inflammatory, and antioxidant qualities [19].

Dental floss can remove some interproximal plaque, and regular flossing will lower the risk of interproximal caries and periodontal disease. However, a high level of evidence suggests that floss may not be the best way to clean between teeth, particularly for people who are not very skilled or compliant [20-22].

By eliminating microbes, the antimicrobial chemical chlorhexidine successfully reduces gingivitis and dental plaque. Although it greatly reduces plaque accumulation, particularly when combined with mechanical cleaning, it has adverse effects and does not stop plaque or tartar from forming, necessitating ongoing oral hygiene [23].

Because of their antibacterial qualities, extracts from clove plants can successfully lower oral microorganisms like Streptococcus mutans, which cause cavities and dental plaque. Additionally, these extracts decrease the synthesis of glucosyltransferase, an enzyme involved in the creation of plaque, prevent bacterial adherence to teeth, and may have an anti-inflammatory effect on the gums, making them a viable natural solution for enhancing dental hygiene and treating gingivitis [24,25].

While eugenol in clove oil shows antibacterial activity against P. gingivalis, S. mutans, Fusobacterium, and Prevotella intermedia, Marchese et al. (2017) discovered that clove oil primarily works against S. mutans and A. actinomycetemocomitans [26]. Chlorhexidine is also the gold standard for chemical plaque control, as demonstrated by Muniz et al. (2018), who found that an unwaxed dental floss impregnated with 2% chlorhexidine was effective in controlling supragingival biofilm in a randomized clinical experiment [27].

Clove extract inhibits the correct production of DNA and proteins and destroys the cellular membrane and wall of microorganisms [28]. Clove oil was shown to have a greater zone of inhibition against oral infections in comparison to chlorhexidine [29]. Clove oil has antimicrobial qualities linked to its primary constituents, eugenol, carophyllene, eugenol acetate, and alpha-humulene, which also have antimicrobial and antifungal characteristics [30-32].

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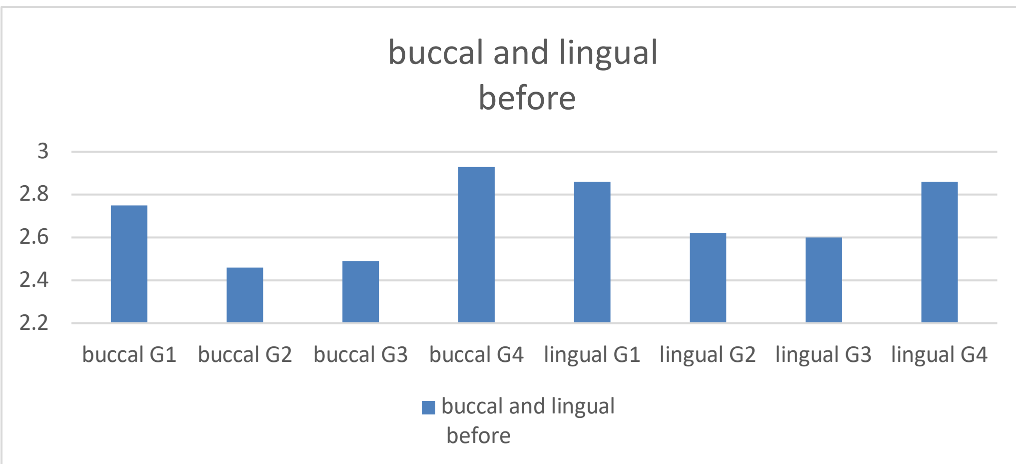

Figure 1. Dental biofilm mean values to buccal and lingual for all groups before flossing, chlorhexidine, and clove mouthwashes with flossing.

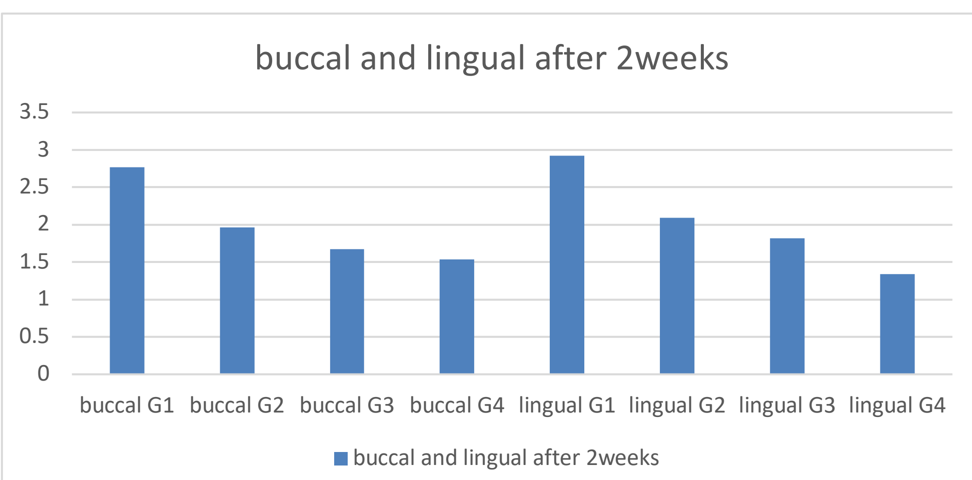

Figure 2. Dental biofilm mean values to buccal and lingual for all groups after two weeks with flossing, chlorhexidine and clove mouthwashes with flossing.

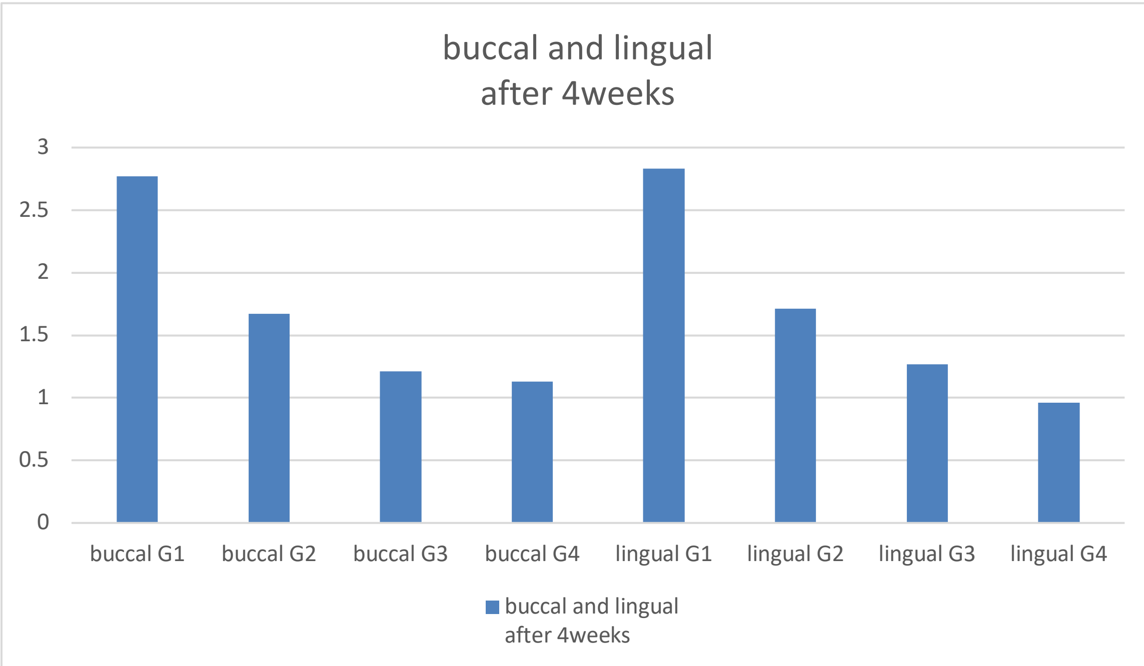

Figure 3. Dental biofilm mean values to buccal and lingual for all groups after four weeks with flossing, chlorhexidine, and clove mouthwashes with flossing.