CRITICAL REVIEW

Mouthwashes for the control of supragingival biofilm and gingivitis in orthodontic patients: evidence-based recommendations for clinicians*

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Abstract: Properly performed daily mechanical biofilm control is the most important prevention strategy for periodontal diseases. However, proper mechanical biofilm control is not performed effectively by the majority of the population, mainly due to lack of motivation and of manual dexterity. Local biofilm retention factors may aggravate home oral hygiene quality. For this reason, patients wearing fixed orthodontic appliances comprise a group that may benefit from the daily use of mouthwashes. The purpose of this review was to perform a systematic search in the literature on antiseptics used to control supragingival biofilm and gingivitis in orthodontic patients. Six studies investigating the effect of chlorhexidine and 5 studies evaluating the effect of the daily use of antiseptics were found. Chlorhexidine showed better results in reducing plaque and gingivitis. However, because of its adverse effects after continuous use, it should not be indicated for long-term periods. Among the agents considered for daily use, the fixed combination of essential oils was the only one evaluated in a clinical trial, in which a comparative group presented a statistically significant clinical impact. There is no direct evidence supporting the indication of antiseptic agents for orthodontic patients other than chlorhexidine and essential oils. It can be concluded that, for patients undergoing orthodontic treatment, chlorhexidine should be considered for treating acute gingival inflammation, whereas essential oils should be indicated for long-term daily use in controlling supragingival biofilm.

Keywords: Mouthwashes; Biofilms; Gingivitis; Orthodontic Appliances.

Introduction

Properly performed mechanical home biofilm control is the most important prevention strategy for periodontal diseases.[1,2,3,4] However, studies show that proper mechanical control is not performed effectively by the majority of the population, mainly due to lack of motivation and of manual dexterity.[5,6] These findings are supported by several epidemiological studies that reported a high prevalence of gingivitis and poor oral hygiene in both developed[7,8] and developing countries.[9,10] In Brazil, a study with a representative urban population sample showed that the average of tooth surfaces with visible biofilm was 60%, and only 5% of subjects

had visible plaque on less than 20% of their tooth surfaces.[11,12]

Difficulties to achieve ideal mechanical plaque control have led many researchers to search for other methods, such as chemical agents, which could contribute to daily biofilm control, removal, or inhibition of plaque formation on tooth surfaces. Current evidence shows that when chemical agents are used as adjuvants to brushing and flossing, they can promote additional advantages compared to mechanical control alone, as regards both plaque and gingivitis reduction.[13,14] Several clinical trials have been conducted in order to test the efficacy and safety of these products. Systematic reviews of these clinical trials have demonstrated the efficacy of mouthwashes containing chlorhexidine gluconate,[15] essential oils[15,16] and cetylpyridinium chloride.[17] A recent review of systematic reviews compared these three active principles, showing that mouthwashes containing chlorhexidine present higher anti-plaque and anti-gingivitis efficacy (mean reduction of 40% and 28%, respectively) followed by essential oils (mean reduction of 27% and 18%, respectively) and cetylpyridinium chloride (mean reduction of 15% and 13%, respectively).[18] However, it is important to note that chlorhexidine-containing mouthwashes are associated with a higher incidence of adverse events, such as tooth and soft tissue staining, which limit their long-term use.[15]

The presence of local biofilm retention factors aggravates home oral hygiene quality. For this reason, individuals with fixed orthodontic appliances comprise a group of patients that may benefit from the use of chemical agents used in association with daily mechanical biofilm control. However, the evidence on plaque and gingivitis reduction by chemical agents in these patients is limited, and there are no systematic search reviews on this topic. The objective of this paper was, thus, to perform a systematic review of the literature regarding the use of antiseptics to control supragingival biofilm and gingivitis in orthodontic patients.

Periodontal disease in orthodontic patients

High gingivitis prevalence is commonly found in orthodontic patients.[19] The presence of brackets, bands and other accessories, as well as composite resin restorations and cements used to bond them, facilitate biofilm build up and hinder its removal by patients, favoring enamel demineralization and gingivitis,[20,21] and promoting quantitative and qualitative changes in the oral microbiota.[19,22] Several studies have shown an association between placement of braces and an increase in biofilm.[23,24] Corroborating the damage done by orthodontic appliances to the periodontium, Sallum *et al.*[25] observed significant reductions in plaque, gingivitis, probing pocket depth and the presence of periodontopathogenic microorganisms after 30 days of appliance removal and professional prophylaxis.

Huser *et al.*[26] conducted a split-mouth study, which evaluated the clinical and microbiological effects of installing orthodontic bands in 10 patients. They evaluated four sites per patient; two of them comprised the test (banded teeth) and the other two comprised the control (unbanded teeth) groups. The parameters were assessed at baseline, 5, 7, 47, 72 and 90 days after placement of orthodontic appliances. The results showed increases in plaque, gingival inflammation and spirochetes, and decreases in cocci levels in test sites compared to control sites, while probing depth remained unchanged for both groups.

Narranjo *et al.*[24] evaluated the clinical and microbiological changes in 30 patients before and 3 months after orthodontic bracket placement (test), and 30 patients without braces (control). The results showed that probing depth and clinical attachment level remained unchanged after 3 months, but there was an increase in the amount of plaque and in the clinical signs of gingival inflammation, in addition to an increase in superinfecting microorganisms and periodontal pathogens (*Porphyromonas gingivalis, Prevotella intermedia / Prevotella nigrescens, Tannerella forsythia,* and *Fusobacterium* species).

Similar results were found by Kim *et al.,*[27] who evaluated the subgingival microbiota before bracket placement, and 3 and 6 months after it, as well as during the orthodontic leveling and alignment phase by polymerase chain reaction (PCR) in 30 patients. The results showed a significant increase in

the frequency of *Tannerella forsythia*, *Prevotella nigrescens* and *Campylobactor rectus* after placement of braces, especially in the molar region.

Risk factors for periodontal changes in adult patients during orthodontic treatment were assessed in a cross-sectional study[28] evaluating the periodontal status of banded second molars using the gingival index (GI). One hundred patients were divided into test (with braces) and control (without braces) groups. The results showed that the gingival index was higher in the test group, and that the main risk factors for gingival inflammation were, in decreasing order of importance, plaque, subgingival encroachment of the cervical margin of bands, probing depth, and length of orthodontic treatment.

As can be seen, orthodontic patients experience increases in supragingival biofilm accumulation resulting in the worst periodontal status after the installation of braces.[29,30] Clearly, this is the result of limited efficacy of mechanical biofilm control, due to the retention effects of the orthodontic appliances. Therefore, the use of chemical biofilm control as a third step in one's oral hygiene routine becomes a valuable option for these patients.

Scientific evidence of antiseptic use in orthodontic patients

Literature search systematization

The scientific literature on the use of antiseptics for supragingival plaque control and gingivitis in orthodontic patients was reviewed using a systematic search strategy. The Medline database was accessed through PubMed. The search strategy included a combination of the following keywords:

- mouthwash,
- orthodontics,
- plaque,
- gingivitis,
- essential oils,
- chlorhexidine,
- cetylpyridinium chloride and
- triclosan.

The search was performed by one of the authors who selected the articles in stages starting from title evaluation, followed by the abstract and then full article assessment.

Table 1 - Search results for articles eligible for the review.

Strategy	Search results	Papers included
mouthwash AND orthodontics AND plaque	78	4
mouthwash AND orthodontics AND gingivitis	31	1
mouthwash AND chlorhexidine AND orthodontics	126	6
essential oils OR cetylpyridinium chloride OR triclosan OR chlorhexidine AND orthodontics	145	1
Total	380	11

The inclusion criteria applied for selecting articles were controlled trials or randomized controlled trials comparing mouthwashes, published in English between 1990 and 2012, and including patients of any age undergoing orthodontic treatment with fixed appliances only. For studies to be included in the review, they had to evaluate plaque and/or gingivitis as clinical outcomes.

General search results

Table 1 shows the search results for papers dealing with the use of mouthwashes in orthodontic patients. In comparison to the overall literature on mouthwash efficacy in reducing supragingival plaque and gingivitis, there were few studies evaluating chemical agents in the supragingival environment, specifically for orthodontic patients. It was observed that the literature mostly had articles evaluating outcomes related to dental caries, such as cariogenic bacteria reduction and reduction of caries lesions. Moreover, chlorhexidine was the most studied antiseptic, appearing in several forms such as chewing gum, toothpaste, varnish, gel and mouthwash.

Of the 380 citations found, 36 (9.5%) were selected by title, 21 (5.5%) remained eligible after abstract evaluation, and the search was finished after reading the full paper, yielding 11 (2.9%) studies that were included for review.

Chlorhexidine use in orthodontic patients

Six studies evaluating chlorhexidine met the in-

Table 2 - Summary of the main methodological characteristics and results of studies evaluating chlorhexidine mouthwashes in orthodontic patients.

Study	Age (years)	Groups	N	Randomization	Time	Results	Difference %*
Brightman *et al.*,[23] 1991	11–17	C: brush + placebo T: brush + 0.12% CHX solution	34	Yes	12 weeks	Significant plaque and gingivitis reduction higher in test group	Plaque: –64% Gingivitis: –60%
Morrow *et al.*,[31] 1992	12–17	C: SI saline solution T: SI 0.12% CHX solution	23	Yes	4 weeks	No significant plaque and gingivitis reduction in either group. No significant differences between them	Descriptive data not provided
Babay and Al Jansse,[32] 1996	12–18	C: SI saline solution T1: SI 0.2% CHX solution T2: SI 0.3% sanguinarine extract + ZnCl	18	No	4 weeks	Improvement of plaque and gingivitis levels in the 3 groups. No significant differences among them	Descriptive data not provided
Anderson *et al.*,[33] 1997	11–15	C: brush + placebo solution T: brush + 0.12% CHX solution	28	Yes	12 weeks	Significant plaque and gingivitis increase in control group and significant reduction of plaque and gingivitis in test group	Plaque: –63% Gingivitis: –61.8%
Gehlen *et al.*,[34] 2000	14.1 (mean age)	C: brush + fluoride solution T: brush + 0.2% CHX solution	12	Yes	9 days	T: Significant gingivitis reduction and plaque regrowth	Descriptive data not provided
Ousehal *et al.*,[35] 2011	19.41 (mean age)	C: manual brush T1: electric brush T2: manual brush + 0.12% CHX alcohol-free solution	84	Yes	4 weeks	Plaque reduction in the 3 groups, being higher in groups T1 and T2. Significant gingivitis reduction only in group T2	Plaque 1: –32% Plaque 2: –30.8% Gingivitis 1: –13.1% Gingivitis 2: –24.6%

*Difference between test and control groups (negative sign indicates better result for the test group). C: control, T: test, SI: subgingival irrigation, CHX: chlorhexidine gluconate, ZnCl: Zinc chloride.

clusion criteria for this review. Two studies assessed the effects of subgingival irrigation with chlorhexidine solution. Four studies evaluated the effects of chlorhexidine mouthwash as an adjuvant to tooth brushing. Table 2 describes the methodological characteristics and the main findings of these studies. In order to determine the extent of the clinically relevant benefit of chlorhexidine mouthwashes in orthodontic patients, we calculated the percentage difference between test and control groups for plaque and gingivitis. This difference was calculated by subtracting the final test group value from the control group value, and then dividing the result by the control group value. Hence, negative values indicated that the test group was superior to the control group, and vice versa.

Subgingival chlorhexidine irrigation was evaluated in two studies. The first study[31] was a randomized split-mouth trial conducted in adolescents with gingivitis and banded first molars. The clinical effects of a 0.12% chlorhexidine digluconate single irrigation were evaluated compared to saline irrigation on 4 sites per tooth without root instrumentation. The results showed gingivitis reduction after 4 weeks for both groups with no differences between them, but with no change in the plaque index throughout the study, probably due to the absence of mechanical removal of supragingival plaque. Babay and Al Jasser[32] also evaluated the effect of subgingival irrigation in adolescents with gingivitis and orthodontic appliances, using 3 solutions:

- saline solution,
- chlorhexidine (0.2% chlorhexidine gluconate) and
- 0.3% sanguinarine extract and zinc chloride.

The results showed a significant reduction in plaque and gingivitis in the three groups, with no significant difference among them.

Chlorhexidine mouthwashes were found in 4 studies, in two concentrations of 0.12% and 0.2%. Brightman *et al.*[23] assessed the efficacy of 0.12% chlorhexidine rinses in 34 orthodontic patients with gingivitis in a randomized clinical trial. Both test and control groups showed a reduction in plaque and gingivitis at the end of the study; however, this reduction was significantly greater in the test group after 12 weeks (64% less plaque and 60% less gingivitis). Similar results after the same observation period (63% reduction in plaque and 61.8% in gingivitis) were found in a randomized clinical trial conducted by Anderson *et al.*[33]

In another randomized clinical trial, Gehlen *et al.*[34] observed the short-term effect of 0.2% chlorhexidine in plaque regrowth in orthodontic patients. The control group used only a fluoride solution. The study was conducted in four phases with a 5-day washout. The results demonstrated that the test group showed significantly higher plaque and gingivitis reduction than the control group, corroborating findings by Anderson *et al.*[33] and Brightman *et al.*[23]

In a randomized controlled trial, Ousehal *et al.*[35] compared the efficacy of electric toothbrushes with that of manual tooth brushing, using 0.12% chlorhexidine solution without alcohol, designating manual tooth brushing alone as the control group. After 4 weeks, all groups showed plaque reduction, which was found to be higher in the test group (32.8% for the electric toothbrush and 30% for the manual toothbrush plus chlorhexidine) compared to the control group. Although all groups showed gingivitis reduction, this was only significant in the group where the mouthwash was used followed by manual toothbrushing.

Daily use of mouthwashes for orthodontic patients

Five studies evaluating daily-use antiseptics met the inclusion criteria for this review. Two studies evaluated amino stannous fluoride solution (Meridol, Gaba, Basel, Switzerland), two studies evaluated an essential oil mouthwash (Listerine®, Johnson & Johnson, São Paulo, Brazil), and another study evaluated a sodium benzoate mouthwash (Plax pre-brushing rinse, Pfizer, New York, USA). Table 3 summarizes the methodological characteristics and the main findings of these studies. The percentage difference between test and control groups was also calculated, as described above for chlorhexidine mouthwashes.

Pontier *et al.*[36] investigated the efficacy of a pre-brushing sodium benzoate rinse in a randomized crossover placebo-controlled trial with 16 orthodontic patients (ages 11–18 years). Plaque and gingivitis were recorded after 5 weeks of mouthwash use, in addition to non-supervised mechanical plaque control. There were no significant differences between test and placebo regarding plaque and gingivitis at the end of the 5-week period.

Two studies assessed the effect of the combined use of toothpaste and mouthwash, containing an association of amino fluoride and stannous fluoride. The first study[37] compared the efficacy of a combination of amino fluoride and stannous fluoride (test group) with that of sodium fluoride (control), both in dentifrice and mouthwash formulations. Participants used the products from the placement of the fixed appliance (bonding) until the end of the orthodontic treatment (debonding), with a mean follow-up of 18 months. Plaque and gingivitis were measured only in the upper anterior teeth. A significant increase in plaque and gingivitis was observed between bonding and debonding in the control group, whereas no significant change was observed in the test group. The other study[38] assessed whether or not using mouthwash in addition to toothpaste would promote additional benefits to plaque and gingivitis reduction. No significant differences were observed between the groups after one month.

The greatest effect of daily use of antiseptics in orthodontic patients was observed in two studies that tested essential oils. Tufekci *et al.*[39] evaluated the efficacy of the adjunctive use of an antiseptic containing essential oils in reducing plaque and gingivitis. All subjects received oral hygiene instructions (brushing and flossing) at baseline. A significant increase in plaque and gingivitis was observed in the control group after six months, whereas plaque and gingivitis remained low in the test group throughout the study. After 6 months, plaque and

Table 3 - Summary of the main methodological characteristics and results of studies evaluating daily use of antiseptics in orthodontic patients.

Study	Age (years)	Groups	N	Randomization	Time	Results	Difference %*
Pontier *et al.*,[36] 1990	11–18	C: brush + placebo solution T: brush + sodium benzoate solution	16 16	Yes	5 weeks	Improvement of plaque and gingivitis levels in both groups with no significant differences between them	Plaque: 4.0% Gingivitis: 1.9%
Ogaard *et al.*,[37] 2006	14 (mean age)	C: brush + NaF dentifrice + NaF solution T: brush + AmF/SnF dentifrice + AmF/SnF solution	47 50	Yes	1.5 years (mean)	Significant plaque and gingivitis increase in control group	Plaque: –29.4% Gingivitis: 0%
Tufekci *et al.*,[39] 2008	10–64	C: brush + floss T: brush + floss + essential oils	25 25	No (Matched for sex / age)	6 months	Significant plaque and gingivitis increase in control group. Lower plaque and gingivitis levels in test group during the study. Significantly less plaque and gingivitis in test group at the end of the study	Plaque: –53.2% Gingivitis: –50.9%
Alves *et al.*,[40] 2010	12–21	C1: OHI C2: OHI + placebo solution T: OHI + essential oils	10 10 10	No	2 months	Significantly less plaque and gingivitis using essential oils	Descriptive data not provided
Madlena *et al.*,[38] 2012	14–32	C: brush + AmF/SnF dentifrice T: brush + AmF/SnF dentifrice + AmF/SnF solution	20 20	Yes	1 month	Significant reduction in plaque and gingivitis for both groups. AmF/SnF solution did not provide any additional benefits	Plaque: 3.9% Gingivitis: –14.7%

* Difference between test and control groups (negative sign indicates better result for the test group). C: control; T: test; OHI: oral hygiene instruction; AmF/SnF: amino-stannous fluoride, NaF: sodium fluoride.

gingivitis were 50% lower in orthodontic patients who used mouthwash containing essential oils associated to brushing and flossing, compared with using mechanical plaque control alone.

Alves *et al.*[40] conducted a randomized clinical trial with 30 subjects between 12 and 21 years of age who used fixed orthodontic appliances. The results are in agreement with the Tufekci *et al.*[39] study, and provide further evidence about the additional benefit of daily use of mouthrinses containing essential oils in reducing plaque and gingivitis. However, these authors did not provide descriptive data to compare results.

Final considerations

Six studies included in this review investigated the effect of the short-term use of an agent (chlorhexidine), and 5 studies investigated the effect of the daily use of antiseptics. Among these 5 studies, only two assessed the effect of a mouthrinse containing essential oils, which are considered the daily-use antiseptic with greatest anti-plaque and anti-gingivitis efficacy.[14,18] Among these, only the Tufeki *et al.*[39] study followed up the subjects for 6 months, according to the American Dental Association Guidelines.[41]

The few number of studies retrieved in this review indicate a lack of information regarding the efficacy of antiseptics in orthodontic patients. The majority of the studies that were included, evaluating daily use of antiseptics, showed methodological limitations, such as small sample sizes, absence of randomization, inadequate comparison groups and short follow-up periods.

Although few clinical trials were found that assessed the effect of oral antiseptics in orthodontic patients, it is important to remember that studies with subjects having gingivitis but not using fixed

orthodontic appliances clearly show the additional benefit of essential-oil-containing mouthwashes in reducing plaque and gingivitis.[15,16] It is possible to generalize this evidence indirectly from clinical trials with subjects not using fixed appliances to those using them. However, it is very important that well-designed clinical trials be conducted to provide evidence regarding the efficacy of oral antiseptics in reducing plaque and gingivitis in orthodontic patients.

The results of this review suggest that the use of oral antiseptics by orthodontic subjects may be beneficial in controlling plaque and gingivitis. Thus, professionals who provide orthodontic treatment or who maintain the periodontal health of orthodontic subjects should recommend mouthwashes. Chlorhexidine showed the best results in reducing plaque and gingivitis, but because of its adverse effects associated with long-term use, it should be indicated only for short periods of time, especially in cases of acute periodontal disease. Among the daily-use agents, essential oils are recommended as the first option, because of their significant efficacy. Further evidence is warranted regarding the effectiveness of other chemical agents.

References

1. Loe H, Theilade E, Jensen SB. Experimental gingivitis in man. J Periodontol. 1965 May-Jun;36(3):177-87.
2. Ximénez-Fyvie LA, Haffajee AD, Som S, Thompson M, Torresyap G, Socransky SS. The effect of repeated professional supragingival plaque removal on the composition of the supra- and subgingival microbiota. J Clin Periodontol. 2000 Sep;27(9):637-47.
3. Axelsson P, Albandar JM, Rams TE. Prevention and control of periodontal diseases in developing and industrialized nations. Periodontol 2000. 2002 Apr;29(1):235-46.4. Van der Weijden F, Slot DE. Oral hygiene in the prevention of periodontal diseases: the evidence. Periodontol 2000. 2011 Feb;55(1):104-23.
5. Addo-Yobo C, Williams SA, Curzon ME. Oral hygiene practices, oral cleanliness and periodontal treatment needs in 12-year old urban and rural school children in Ghana. Community Dent Health. 1991 Jul;8(2):155-62.
6. Teles RP, Teles FR. Antimicrobial agents used in the control of periodontal biofilms: effective adjuncts to mechanical plaque control?. Braz Oral Res. 2009 Jun;23 Suppl 1:39-48.
7. Morris AJ, Steele J, White DA. The oral cleanliness and periodontal health of UK adults in 1998. Br Dent J. 2001 Aug 25;191(4):186-92.
8. Li Y, Lee S, Hujoel P, Su M, Zhang W, Kim J, et al. Prevalence and severity of gingivitis in American adults. Am J Dent. 2010 Feb;23(1):9-13.
9. Gjermo P, Rösing CK, Susin C, Oppermann R. Periodontal diseases in Central and South America. Periodontol 2000. 2002 Apr;29(1):70-8.
10. Albandar JM, Tinoco EM. Global epidemiology of periodontal diseases in children and young persons. Periodontol 2000. 2002 Apr; 29(1):153-76.
11. Susin C, Dalla Vecchia CF, Oppermann RV, Haugejorden O, Albandar JM. Periodontal attachment loss in an urban population of Brazilian adults: effect of demographic, behavioral, and environmental risk indicators. J Periodontol. 2004 Jul;75(7):1033-41.
12. Haas AN, Gaio EJ, Oppermann RV, Rösing CK, Albandar JM, Susin C. Pattern and rate of progression of periodontal attachment loss in an urban population of South Brazil: a 5-years population-based prospective study. J Clin Periodontol. 2012 Jan;39(1):1-9.
13. Gunsolley JC. A meta-analysis of six-month studies of antiplaque and antigingivitis agents. J Am Dent Assoc. 2006 Dec;137(12):1649-57.
14. Haas AN, Reis A, Lemos CA, Pannuti CM, Escobar EC, Almeida ER, et al. Daily biofilm control and oral health: an epidemiological challenge consensus – Brazilian Advisory Panel in Oral Health. Braz J Periodontol. 2012 Sep;22(3):40-6.
15. Van Leeuwen MP, Slot DE, Van der Weijden GA. Essential oils compared to chlorhexidine with respect to plaque and parameters of gingival inflammation: a systematic review. J Periodontol. 2011 Feb;82(2):174-94.
16. Stoeken JE, Paraskevas S, van der Weijden GA. The long term effect of a mouthrinse containing essential oils on dental plaque and gingivitis: a systematic review. J Periodontol. 2007 Jul;78(7):1218-28.
17. Haps S, Slot DE, Berchier CE, Van der Weijden GA. The effect of cetylpyridinium chloride-containing mouth rinses as adjuncts to toothbrushing on plaque and parameters of gingival inflammation: a systematic review. Int J Dent Hyg. 2008 Nov;6(4):290-303.
18. Gunsolley JC. Clinical efficacy of antimicrobial mouthrinses. J Dent. 2010 Jun;38 Suppl 1:S6-10.
19. Davies TM, Shaw WC, Worthington HV, Addy M, Dummer P, Kingdon A. The effect of orthodontic treatment on plaque and gingivitis. Am J Orthod Dentofacial Orthop. 1991 Feb;99(2):155-6.
20. Ristic M, Vlahovic Svabic M, Sasic M, Zelic O. Clinical and microbiological effects of fixed orthodontic appliances on periodontal tissues in adolescents. Orthod Craniofac Res. 2007 Nov;10(4):187-195.

21. Zachrisson BU, Zachrisson S. Gingival condition associated with partial orthodontic treatment. Acta Odontol Scand. 1972 Mar;30(1):127-36.
22. Paolantonio M, Di Girolamo G, Pedrazzoli V, Di Murro C, Catamo G, Cattabriga M, et al. Occurrence of Actinobacillus actinomycetemcomitans in patients wearing orthodontic appliances. J Clin Periodontol. 1996 Feb;23(2):112-8.
23. Brightman LJ, Terezhalmy GT, Greenwell H, Jacobs M, Enlow DH. The effects of a 0.12% chlorhexidine gluconate mouthrinse on orthodontic patients aged 11 through 17 with established gingivitis. Am J Orthod Dentofacial Orthop. 1991 Oct;100(4):324-9.
24. Naranjo AA, Trivino ML, Jaramillo A, Betancourth M, Botero JE. Changes in the subgingival microbiota and periodontal parameters before and 3 months after bracket placement. Am J Orthod Dentofacial Orthop. 2006 Sep;130(3):275.e17-22.
25. Sallum EJ, Nouer DF, Klein MI, Gonçalves RB, Machion L, Sallum AW, et al. Clinical and microbiologic changes after removal of orthodontic appliances. Am J Orthod Dentofacial Orthop. 2004 Sep;126(3):363-6.
26. Huser MC, Baehni PC, Lang R. Effects of orthodontic bands on microbiologic and clinical parameters. Am J Orthod Dentofacial Orthop. 1990 Mar;97(3):213-8.
27. Kim SH, Choi DS, Jang I, Cha BK, Jost-Brinkmann PG, Song JS. Microbiologic changes in subgingival plaque before and during the early period of orthodontic treatment. Angle Orthod. 2012 Mar;82(2):254-60.
28. Melo MMC, Cardoso MG, Faber J, Sobral A. Risk factors for periodontal changes in adult patients with banded second molars during orthodontic treatment. Angle Orthod. 2012 Mar;82(2):224-8.
29. Rego RO, Oliveira CA, Santos-Pinto A, Jordan SF, Zambon JJ, Cirelli JA, et al. Clinical and microbiological studies of children and adolescents receiving orthodontic treatment. Am J Dent. 2010 Dec;23(6):317-23.
30. Lundstrom F, Hamp SE. Effect of oral hygiene education on children with and without subsequent orthodontic treatment. Scand J Dent Res. 1980 Feb;88(1):53-9.
31. Morrow D, Wood DP, Speechley M. Clinical effect of subgingival chlorhexidine irrigation on gingivitis in adolescent orthodontic patients. Am J Orthod Dentofacial Orthop. 1992 May;101(5):408-13.
32. Babay N, Al Jasser N. Subgingival irrigation effects of chlorhexidine or sanguinarine on gingivitis in orthodontic patients. J Clin Pediatr Dent. 1996 Spring;20(3):225-8.
33. Anderson GB, Bowden J, Morrison EC, Caffesse RG. Clinical effects of chlorhexidine mouthwashes on patients undergoing orthodontic treatment. Am J Orthod Dentofacial Orthop. 1997 Jun;111(6):606-12.
34. Gehlen I, Netuschil L, Berg R, Reich E, Katsaros C. The influence of a 0.2% chlorhexidine mouthrinse on plaque regrowth in orthodontic patients. A randomized prospective study. Part I: clinical parameters. J Orofac Orthop. 2000;61(1):54-62.
35. Ousehal L, Es-Said R, Hamdoune H, Elquars F, Khadija A. Evaluation of dental plaque control in patients wearing fixed orthodontic appliances: a clinical study. Int Orthod. 2011 Mar;9(1):140-55.
36. Pontier JP, Pine C, Jackson DL, DiDonato AK, Close J, Moore PA. Efficacy of a prebrushing rinse for orthodontic patients. Clin Prev Dent. 1990 Aug-Sep;12(3):12-7.
37. Ogaard B, Alm AA, Larsson E, Adolfsson U. A prospective, randomized clinical study on the effects of an amine fluoride/stannous fluoride toothpaste/mouthrinse on plaque, gingivitis and initial caries lesion development in orthodontic patients. Eur J Orthod. 2006 Feb;28(1):8-12.
38. Madlena M, Banoczy J, Gotz G, Marton S, Kaan M Jr, Nagy G. Effects of amine and stannous fluorides on plaque accumulation and gingival health in orthodontic patients treated with fixed appliances: a pilot study. Oral Health Dent Manag. 2012 Jun;11(2):57-61.
39. Tufekci E, Casagrande ZA, Lindauer SJ, Fowler CE, Williams KT. Effectiveness of an essential oil mouthrinse in improving oral health in orthodontic patients. Angle Orthod. 2008 Mar;78(2):294-8.
40. Alves KM, Goursand D, Zenobio EG, Cruz RA. Effectiveness of procedures for the chemical-mechanical control of dental biofilm in orthodontic patients. J Contemp Dent Pract. 2010 Mar 1;11(2):41-8.
41. American Dental Association. Council on Dental Therapeutics. Guidelines for acceptance of chemotherapeutic products for the control of supragingival dental plaque and gingivitis. J Am Dent Assoc. 1986 Apr;112(4):529-32.

ERRATUM

In article “Mouthwashes for the control of supragingival biofilm and gingivitis in orthodontic patients: evidence-based recommendations for clinicians”, DOI: 10.1590/1807-3107-BOR-2014.vol28.0021; Braz Oral Res., (São Paulo) 2014;28(Spec Iss 1), where it reads:

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It should read:

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