EJPD 2022 CLINICAL FOCUS

Periodontology. Part 1: Gingivitis in adolescence. Review of the literature and case reports

S. Mummolo, E. Cirillo*, M. Ciribè*, R. J. Manenti, A. Galeotti*

Department of Life, Health & Environmental Sciences, Postgraduate School of Orthodontics, University of L'Aquila, L'Aquila, Italy
**Bambino Gesù Children's Hospital IRCSS, Dentistry Unit, Rome, Italy*

Email: stefano.mummolo@univaq.it

DOI: 10.23804/ejpd.2022.23.01.15

Abstract

The aim of this work was to evaluate the antiplaque effect of mouthwashes for gingivitis in adolescence.

Essential oil mouthwash is considered an effective chemical agent as an adjunct to mechanical plaque control, without adverse effects compared to chlorhexidine (pigmentation, changes of taste, and formation of supragingival calculus), which limits its continuous use. Two cases are reported showing the results obtained with the use of a chlorhexidine mouthwash followed by an ozonated olive oil-containing mouthwash as an adjunct to tooth brushing with electric round-oscillating toothbrush.

KEYWORDS Mouthwash; Plaque control; Gingivitis.

Introduction

Daily removal of supragingival dental plaque is a major factor in the prevention of caries, gingivitis and periodontitis. Proper control of bacterial plaque is obtained through the mechanical removal of the biofilm by the proper use of the toothbrush and floss. However, some studies have shown that the mean time of brushing tooth surfaces is not sufficient to obtain a proper cleaning [Beals et al., 2000] and only 2–10% of the patients use dental floss regularly and effectively [Bader, 1998]. In addition, it has been demonstrated that even after education and motivation of the patient to the proper use of toothbrush and floss, compliance is reduced with time [Stewart and Wolfe, 1989]. The result is the persistence of plaque in some areas, particularly on the interproximal surfaces of teeth. Many studies have demonstrated the effectiveness and usefulness of antiseptic mouthwashes containing active ingredients such as chlorhexidine and essential oils (EO) to prevent and control the formation of plaque and gingivitis, when used in addition to mechanical procedures [Lang et al., 1982; De Paola et al., 1989; Cortés-Dorantes et al., 2015]. Chlorhexidine is still the gold standard. The results of epidemiological studies show how gingival inflammation is a component of periodontitis and, similarly, how gingivitis precedes the onset of periodontitis [Fine et al., 2007; Paraskevas, 2005; Diamanti et al., 2021]. The latter is a chronic inflammatory disease that causes the destruction of the tissues surrounding the teeth. It is principally caused by specific anaerobic pathogens contained in the dental plaque organised on the tooth surface. Its progression leads to bone loss and is the main cause of edentulism among adults.

Recent studies have shown that contrary to what was previously thought, untreated gingivitis does not always lead to periodontitis [Charles et al., 2001; Overholser et al., 1990; Sharma et al., 2002]. The signs and symptoms of gingivitis can remain steady for years, without ever evolving into periodontal lesions that include aspects such as bone loss and epithelial attachment. The two conditions, therefore, were considered belonging to different diseases: the degree of susceptibility of the individual will determine whether periodontitis occurs. However, gingival inflammation represents a significant risk factor for periodontitis [Sharma et al., 2004; Charles et al., 2004; Pizzo et al., 2008].

Pharmacological agents

The mechanical control of the bacterial biofilm is an indispensable requirement for achieving and maintaining a state of health of the periodontal tissues.

Among the additional pharmacological agents, the gold standard is chlorhexidine-based mouthwash (CHX) [Cortelli et al., 2009]. It has broad-spectrum antimicrobial properties, which include a large number of Gram-positive and Gram-negative bacteria [Fine, 1998; Kubert et al., 1993].

The anti-plaque effect of chlorhexidine (CHX) is the result of the dicationic nature of the chlorhexidine molecule, which gives the agent the property of persisting the antimicrobial effect on the tooth surface; but for its antimicrobial action and high substantiveness, side effects, such as pigmentation, taste alteration and the formation of supragingival calculus limit its continued use. Essential oil (EO) mouthwashes have been used for years as an adjunct to brushing in oral hygiene. Their effectiveness in controlling plaque and gingivitis is well documented in literature [Sharma et al., 2004; Charles et al., 2004; Pizzo et al., 2008; Cortelli et al,. 2009]. They kill microorganisms by destroying their cell walls and inhibiting

their enzymatic activity [Fine, 1998; Kubert et al., 1993]. Furthermore, phenolic compounds like EOs are known to interfere with the inflammation process. The antibacterial action is particularly effective due to the ability of the mouthwash with EOs to penetrate the biofilm [Dewhirst, 1980; Mummolo et al., 2020]. Conventional EO mouthwashes contain ethanol, a chemical used to dissolve numerous substances in mouthwashes, including CHX. The concentration of ethanol present in the mouthwash with EOs is more than 20%, sufficient to dissolve EOs but not enough to have a direct antibacterial effect [Ouhayoun, 2003; Sissons et al., 1996].

Essential oil mouthwashes are used for many years in the prevention and treatment of periodontal disease. The effectiveness of the EO mouthwash in controlling plaque was demonstrated in many clinical trials, both long- and short-term. In short-term studies [Marchetti et al., 2009; Rosin et al., 2002], EO significantly reduced plaque accumulation in 4- and 21-days plaque regrowth models. However, when the EO rinse was compared to the CHX formulation, the latter showed better antiplaque effects. In contrast, recent studies [Riep et al., 1999; Saccomanno et al., 2021] have demonstrated that the EO rinse was as effective as the CHX rinse in inhibiting plaque regrowth. The effectiveness of the EO rinse was also demonstrated in long-term studies in which it was used as a supplement to mechanical hygiene measures. In those studies, which varied in length from 3 to 9 months, EO-containing mouthwashes significantly reduced plaque accumulation and gingivitis when compared to the placebo. Although EO formulations were less effective in reducing supragingival plaque accumulation than CHX [Overholser et al., 1990], in contrast a more recent study [Charles et al., 2004] has demonstrated that the EO mouthwash and the CHX mouthwash have comparable antiplaque and antigingivitis activity. Furthermore, several studies have demonstrated that EO and CHX rinses were equally effective in reducing gingival index scores and the number of bleeding sites [Overholser et al., 1990; Charles et al., 2004; Saccomanno et al., 2021]. Finally, in a recent systematic review, the authors concluded that although the effects of CHX ensure higher control of plaque, there are no marked differences in the control of gingival inflammation. Therefore, the EO mouthwash appears to be a reliable alternative to the CHX mouthwash in those cases where the dental professional has judged that long-term anti-inflammatory oral care may be beneficial, while for indications where plaque control is the focus, a CHX mouthwash remains the first choice [Quinzi et al., 2019; Colombo et al., 2019]. The bacterial microflora, present in the oral cavity, contributes to the health of the host and prevents infections by potentially pathogenic exogenous microorganisms, thus providing resistance to the colonisation of these parasitic species, and by regulating the inflammatory response towards the commensal bacteria that host the buccal cavity. Two literature reviews show that there is moderate-to-high evidence that the concentration of oral microbiota, causing an alteration of the quantity of Streptococcus mutans and Lactobacilli can basically affect the process of dental caries and tooth enamel demineralization, due to their acid production and tooth adhesive properties.

Professional and home protocol

The professional management of bacterial biofilm follows a minimally invasive prophylaxis protocol called Guided Biofilm Theraphy (GBT). GBT is divided into several steps which include, first of all, the assessment of the single patient and its oral health [Mummolo et al., 2020; Paduano et al., 2018].

The localization of the bacterial biofilm is then identified through the application of the plaque detector. The deposits of plaque and tartar as well as extrinsic enamel discolourations are then removed with the use of air flow. The remaining tartar is then removed with an ultrasonic scaler. Finally, the dental surfaces are polished with a brush and prophy paste [Ouhayoun, 2003; Libonati et al., 2019]. During the professional hygiene session, the patient receives instructions regarding the tools to use at home. The dental home care of the biofilm will be performed through the use of a roto-oscillating electric toothbrush with a round head 2/3 times a day and dental floss. In association with the mechanical control, patients with severe gingivitis are advised to perform two rinses a day with a mouthwash for a maximum period of ten days [Sissons et al., 1996]. The role of an antiseptic agent in these cases is considered primary: in association with the removal of plaque and tartar deposits, the chemical control of the biofilm is, in fact, aimed at reducing the bacterial load and preventing the recolonisation of the treated sites, especially in the first weeks after treatment. After this phase, referred to as "active therapy", we move on to a protocol for the maintenance of the oral health achieved: the patient will perform two rinses a day with an ozonated olive oil-based mouthwash. In this case there are no time limitations in this type of mouthwash because it is for daily use and does not have short or long-term side effects.

Case reports

Case report 1

A 14-year old male patient (Fig. 1-7) in good general health, showed the following indices.

- Visible Plaque Index (VPI): 100% at T0; 38% at T1 (after



FIG. 1 The patient at the first visit (T0).



FIG. 2 The patient at T0 after scaling and receiving instructions for home oral care.



FIG. 3 Details of signs of periodontal suffering after scaling (T0).



FIG. 4 The patient at the follow-up after 10 days (T1) of use of chlorhexidine mouthwash and electric round-oscillating toothbrush.



FIG. 5 The patient at the 3-month follow-up (T2), using the ozonated oil-containing mouthwash.



FIG. 6 The patient at T2 after scaling.



FIG. 7 The patient at the 6-month follow-up (T3), using the ozonated oil-containing mouthwash.

10 days); 65% at T2 (after 3 months); 23% at T3 (after 6 months).
- Gingival Bleeding Index (GBI): 100% at T0; 50% at T1 (after 10 days); 92% at T2 (after 3 months); 25% at T3 (after 6 months).

Case report 2

A 16-year old male patient (Fig. 8-10) in good general health, showed the following indices.

- Visible Plaque Index (VPI): 80% at T0; 0% at T1 (after 10 days); 0% at T2 (after 3 months).
- Gingival Bleeding Index (GBI): 80% at T0; 5% at T1 (after 10 days); 0% at T2 (after 3 months).

References

› Azuma Y, Ozasa N, Ueda Y, Takagi N. Pharmacological studies on the



FIG. 8 The patient at the first visit after scaling (T0).



FIG. 9 The patient at the 10-day follow-up (T1) using the chlorhexidine mouthwash and electric round-oscillating toothbrush.



FIG. 10 The patient at the 3-month follow-up (T2), using the ozonated oil-containing mouthwash.

anti- inflammatory action of phenolic compounds. J Dent Res 1986;65:53-56.
› Bader HI. Floss or die: implications for dental professionals. Dent Today 1998;17(7):76-8, 80-2.
› Barnett ML. The role of therapeutic antimicrobial mouthrinses in clinical practice. Control of supragingival plaque and gingivitis. J Am Dent Assoc 2003;134:699-704.
› Beals D, Ngo T, Feng Y, Cook D, Grau DG, Weber DA. Development and laboratory evaluation of a new toothbrush with a novel brush head design. Am J Dent 2000;13:5A-14A.
› Charles CH, Mostler KM, Bartels LL, Mankodi SM. Comparative antiplaque and antigingivitis effectiveness of a chlorhexidine and an essential oil mouthrinse: 6-month clinical trial. J Clin Periodontol 2004;31:878-884.
› Charles CH, Sharma NC, Galustians HJ, Qaqish J, McGuire JA, Vincent JW. Comparative efficacy of an antiseptic mouthrinse and an antiplaque/antigingivitis dentifrice. A six-month clinical trial. J Am Dent Assoc 2001;132:670-675.
› Colombo S, Gallus S, Beretta M, Lugo A, Scaglioni S, Colombo P, Paglia M, Gatto R, Marzo G, Caruso S, Paglia L. Prevalence and determinants of early childhood caries in Italy. Eur J Paediatr Dent 2019 Dec;20(4):267-273.
› Cortelli SC, Cortelli JR, Holzhausen M, Franco GCN, Rebelo RZ, Sonagere AS, Queiroz CS, Costa FO. Essential oils in one stage full-mouth disinfection: double- blind, randomized clinical trial of long-term clinical, microbial and salivary effects. J Clin Periodontol 2009;36:333-342.
› Cortés-Dorantes N, Ruiz-Rodríguez MS, Karakowsky-Kleiman L, Garrocho-Rangel JA, Sánchez-Vargas LO, Pozos-Guillén AJ. Probiotics and their effect on oral bacteria count in children: a pilot study. Eur J Paediatr Dent 2015;16(1):56-60.
› DePaola LG, Overholser CD, Meiller TF, Minah GE, Niehaus C. Chemotherapeutic inhibition of supragingival dental plaque and gingivitis development. J Clin Periodontol 1989;16:311-315.
› Dewhirst FE. Structure activity relationships for inhibition of prostaglandin cyclooxygenase by phenolic compounds. Prostaglandins 1980;20:209-222.
› Diamanti I, Berdouses ED, Kavvadia K, Arapostathis KN, Polychronopoulou A, Oulis CJ. Oral hygiene and periodontal condition of 12- and 15-year-old Greek adolescents. Socio-behavioural risk indicators, self- rated oral health and changes in 10 years. Eur J Paediatr Dent 2021 22(2):98–106.
› Fine DH. Mouthrinses as adjuncts for plaque and gingivitis management. A status report for the American Journal of Dentistry. Am J Dent 1998;1:259-263.
› Fine DH, Furgang D, Barnett ML. Comparative antimicrobial activities of antiseptic mouthrinses against isogenic planktonic and biofilm forms of actinobacillus actinomycetemcomitans. J Clin Periodontol 2001;28:697-700.
› Fine DH, Markowitz K, Furgang D, Goldsmith D, Charles CH, Lisante TA, Lynch MC. Effect of an essential oil-containing antimicrobial mouthrinse on specific plaque bacteria in vivo. J Clin Periodontol 2007;34:652-657.
› Gordon JM, Lamster IB, Geiger MC. Efficacy of Listerine antiseptic in inhibiting the development of plaque and gingivitis. J Clin Periodontol 1985;12:697-704.
› Kubert D, Rubin M, Barnett ML, Vincent JW. Antiseptic mouthrinse induced microbial cell surface alterations. Am J Dent 1993;6:277-279.
› Lang NP, Hotz P, Graf H, Geering AH, Saxer UP, Sturzenberger OP, Mecker AH. Effects of supervised chlorhexidine mouthrinses in children. A longitudinal clinical trial. J Periodontal Res 1982;17:101-111.
› Libonati A, Di Taranto V, Mea A, Montemurro E, Gallusi G, Angotti V, Nardi R, Paglia L, Marzo G, Campanella V. Clinical antibacterial effectiveness Healozone Technology after incomplete caries removal. Eur J Paediatr Dent 2019 Mar;20(1):73-78.
› Marchetti E, Mummulo S, Marzo G, Civisca A, Di Pietro C, Marinelli G. Effect of an essential-oil containing mouthrinse on the reduction of plaque and interproximal inflammation in comparison with an ethanol solution. Prev Assist Dent 2009;35(4):123-127.
› Moran J, Addy M, Newcombe RG, Warren P. The comparative effects on plaque regrowth of phenolic chlorhexidine and anti-adhesive mouthrinses. J Clin Periodontol 1995;22:929-934.
› Mummolo S, Sapio S, Falco A, Vittorini OL, Quinzi V. Management of pedodontic patients in moderate sedation in clinical dentistry: evaluation of behaviour before and after treatment. J Biol Regul Homeost Agents 2020 Jan-Feb;34(1 Suppl. 1):55-62.
› Mummolo S, Severino M, Campanella V, Barlattani A Jr, Quinzi V, Marchetti E. Chlorhexidine gel used as antiseptic in periodontal pockets. J Biol Regul Homeost Agents 2019 May-Jun;33(3 Suppl. 1):83-88.
› Ouhayoun JP. Penetrating the plaque biofilm: impact of essential oil mouthwash. J Clin Periodont 2003;30 (Suppl 5):10-12.
› Overholser CD, Meiller TF, DePaola LG, Minah GE, Niehaus C: Comparative effects of 2 chemotherapeu tic mouthrinses on the development of supragingival dental plaque and gingivitis. J Clin Periodontol 1990;17:575-579.
› Paduano S, Rongo R, Bucci R, Aiello D, Carvelli G, Ingenito A, Cantile T, Ferrazzano GF. Is there an association between various aspects of oral health in Southern Italy children? An epidemiological study assessing dental decays, periodontal status, malocclusions and temporomandibular joint function. Eur J Paediatr Dent 2018 19(3):176-180.
› Pan P, Barnett ML, Coelho J, Brogdon C, Finnegan MB. Determination of the in situ bactericidal activity of an essential oil mouthrinse using a vital stain method. J Clin Periodontol 2000;27:256-261.
› Paraskevas S. Randomized controlled clinical trials on agents used for chemical plaque control. Int J Dent Hyg 2005;3:162-178.
› Pizzo G, La Cara M, Licata ME, Pizzo I, D'Angelo M. The effects of an essential oil and an amine fluoride/stannous fluoride mouthrinse on supragingival plaque regrowth. J Periodontology 2008;79: 1177-1183.
› Quinzi V, Rossi O, Paglia L, Marzo G, Caprioglio A. Paediatric Orthodontics Part 2: Periodontal effects of maxillary expansion. Eur J Paediatr Dent 2019;20(2):164–166.
› Quinzi V. Catering work profession and medico-oral health: a study on 603 subjects. Healthcare 2021;9(5):582.
› Riep BG, Bernimoulin JP, Barnett ML. Comparative antiplaque effectiveness of an essential oil and an amine fluoride/stannous fluoride mouthrinse. J Clin Periodontol 1999;26:164-168.
› Rosin M, Welk A, Kocher T, Majic-Todt A, Kramer A, Pitten FA. The effect of a polyhexamethylene biguanide mouthrinse compared to an essential oil rinse and a chlorhexidine rinse on bacterial counts and 4-day plaque regrowth. J Clin Periodontol 2002;29:392-399.
› Saccomanno S, Mummolo S, Giancaspro S, Manenti RJ, Mastrapasqua RF, Marzo, G, Quinzi V. Catering work profession and medico-oral health: a study on 603 subjects. Healthcare 2021;9(5):582.
› Sharma N, Charles CH, Lynch MC, Qaqish JG, McGuire JA, Galustians HJ, Kumar LD. Adjunctive benefit of an essential oil-containing mouthrinse in reducing plaque and gingivitis in patients who brush and floss regularly. A six-month study. J Am Dent Assoc 2004;135:496-504.
› Sharma NC, Charles CH, Qaqish JG, Galustians HJ, Zhao Q, Kumar LD. Comparative effectiveness of an essential oil mouthrinse and dental floss in controlling interproximal gingivitis and plaque. Am J Dent 2002;15:351-355.
› Sissons CH, Wong L, Cutress TW. Inhibition by ethanol of the growth of biofilm and dispersed microcosm dental plaques. Arch Oral Biol 1996;41:27-34.
› Stewart JE, Wolfe GR. The retention of newly-acquired brushing and flossing skills. J Clin Periodontol 1989;16:331-332.