BIOFILMS

Therapeutic mouthwashes

BACKGROUND

The control of dental biofilms is essential to reducing the incidence of dental caries, gingivitis, and periodontitis. Mechanical approaches such as tooth brushing and flossing are the major approaches to this control, but are limited by their ability to adequately clean hard-to-reach areas and the gingival margin. In addition, elderly patients with compromised physical or mental abilities, malpositioned or isolated teeth, bridgework, or orthodontic appliances can have difficulty achieving effective cleaning. To supplement these mechanical approaches, various antimicrobial agents are now included in oral care products such as toothpaste and mouthwash (MW). Agents are designed to address each stage of biofilm formation. Therapeutic MWs act as anti-plaque and anti-gingivitis measures to prevent the initial biofilm formation. Fluoride MWs offer cariostatic abilities that support remineralization and increased acid resistance for dental hard tissues. The current evidence regarding the efficacy of MWs to manage biofilms and provide cariostatic effects was reviewed.

METHODS

The search in MEDLINE was focused on systematic reviews of randomized clinical trials (RCTs) related to MWs. Follow-up had to be at least 4 weeks and involve daily use of the MW. The agents studied included chlorhexidine gluconate MW (CHX), essential oils–containing MW (EO), cetylpyridinium chloride MW (CPC), delmopinol MW (Del), amine fluoride MW (AmF), and stannous fluoride MW (SnF). Six systematic reviews focused on the anti-biofilm properties of MWs (Figure 2), 5 on the anti-gingivitis properties, and 2 on the cariostatic properties. The adverse effects of the various agents were also considered.

RESULTS

Anti-biofilm Effect

The most commonly studied MWs were CHX, EO, and CPC, in that order. Strong evidence supported the efficacy of MWs that contain CHX and EO as anti-biofilm agents. EO provided a significant improvement in the plaque index after 6 months. A comparison of CHX and EO was unable to detect which agent was superior in terms of dental biofilm inhibition.

CPC MW produced a significant reduction in dental biofilm accumulation, but to a lesser degree than those created by CHX and EO MWs. The effect of Del MW was small to nonexistent compared to placebo. Both AmF and SnF MWs were less effective in preventing the accumulation of dental biofilm.

Anti-gingivitis Effect

Strong evidence supported the efficacy of both CHX and EO as anti-gingivitis agents. The effect of CHX was slightly different in more recent reviews than in those performed earlier, but the results for EO were similar to those reported in the past. It was hypothesized that the differences for CHX may result from the availability of more concentrations of CHX, specifically, 0.05%, 0.6%, 0.1%, 0.12%, and 0.2%. Most of the studies reviewed used concentrations higher than 0.1% as the same group. The latest clinical study showed that 0.2% CHX has a statistically significant greater effect in preventing dental biofilm than 0.12% and 0.06% solutions. The difference in clinical efficacy of the various concentrations of CHX requires further study.

CPC MWs with concentrations exceeding 0.05% significantly improved the modified gingival index and gingival index, but the impact was not necessarily meaningful clinically. The use of EO for 6 months proved more efficacious than the use of CPC.

CHX and EO were not compared for anti-gingivitis efficacy. However, CHX, EO, and EO without alcohol were compared. No statistically significant differences were found between CHX and EO without alcohol or between EO and EO without alcohol. Future studies are needed to determine if the alcohol vehicle enhances the agent's anti-biofilm properties.

Del MWs had no significant effect on gingival measures. Both AmF and SnF showed significant effects.

Cariostatic Effect

MWs that contain fluoride have been recommended for caries prevention in patients at high risk for caries. Fluoride MWs contain various fluoride compounds, including SnF, sodium monofluorophosphate, and AmF. The supervised regular use of a fluoride MW by children and adolescents greatly reduces the caries increment in permanent teeth. However, since most people already use a fluoridated dentifrice daily, the additional effect of a fluoride MW on dental caries is difficult to determine.

One systematic review evaluated the effect of fluoride MWs on root caries prevention. Rinsing the mouth with a fluoride MW was found to significantly reduce the number of decayed, missing, or filled root surfaces compared to use of a placebo, but the effect was much less than was achieved with 38% silver diamine fluoride. The authors concluded that the regular use of dentifrices containing 5000 ppm fluoride and silver diamine fluoride or CHX varnishes applied quarterly by professionals was most efficacious in decreasing the initiation and progression of root

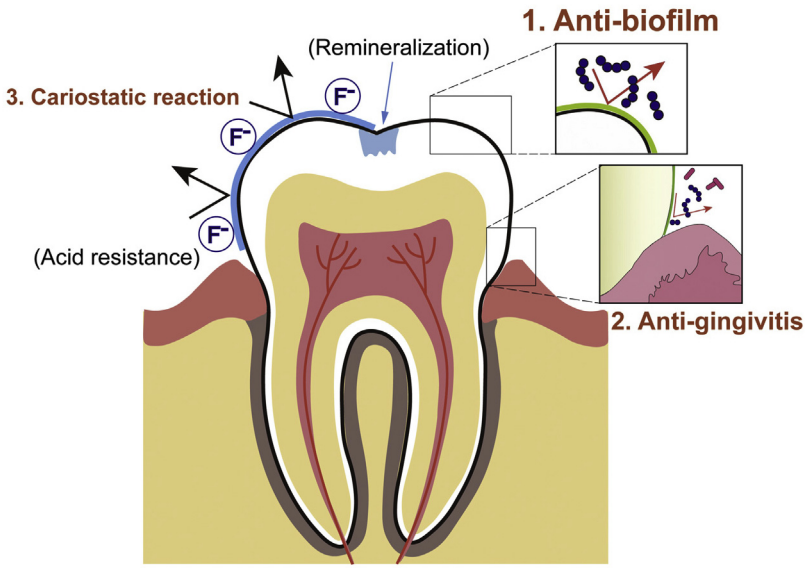

Figure 2. Schematic diagram showing clinical effects of MWs. Anti-biofilm property *(1)* has been proven to be effective with strong evidence, followed by anti-gingivitis *(2)* and cariostatic reaction *(3)*. (Courtesy of Takenaka S, Ohsumi T, Noiri Y: Evidence-based strategy for dental biofilms: Current evidence of mouthwashes on dental biofilm and gingivitis. *Jpn Dent Sci Rev* 55;33-40, 2019.)

caries, respectively. The quality of the evidence is low, so further studies are needed to recommend the use of fluoride MW for all patients.

Adverse Events

When considering which MW to recommend, clinicians should consider the possible side effects or adverse events that may accompany the use of a particular agent. CHX MW was found to cause extrinsic tooth staining when used for 4 weeks or more. Other adverse effects that have been reported are calculus build-up, transient disturbance of taste sensation, and various effects on the oral mucosa. Less frequently, patients reported a burning sensation, hypersensitivity, mucosal lesions, and a sensation of being anesthetized. The recommendation for the use of CHX is to limit use to specific clinical situations for short periods of time.

EO MWs that contain alcohol have led to complaints about poor taste and oral irritation. In addition, alcohol-free MWs are recommended for patients at high risk for side effects, including children, alcohol addicts, patients with genetic deficiencies in ethanol metabolism, those with oral cancer, and smokers.

DISCUSSION

MWs containing CHX or EO have well-proven efficacy as anti-biofilm and anti-gingivitis agents. Both provide significant reductions in dental biofilm and gingivitis measures. Fluoride MWs can improve oral health in children and adults, but current evidence is of low quality. Mechanical elimination of dental biofilms is still the major approach to dental caries prevention, but MWs can be used adjunctively when mechanical methods are insufficient to achieve sufficient cleaning.

Clinical Significance

The use of chemical agents is designed to be an alternative approach to achieving biofilm disruption and to improving gingival health. Both CHX and EO MWs have provided good results in these roles. Most patients use a fluoridated toothpaste, and many receive fluoride varnish to protect teeth from caries development. The combination of tooth brushing and a therapeutic MW for daily cleansing of the teeth will serve most patients well.

Takenaka S, Ohsumi T, Noiri Y: Evidence-based strategy for dental biofilms: Current evidence of mouthwashes on dental biofilm and gingivitis. *Jpn Dent Sci Rev* 55;33-40, 2019

Reprints available from Y Noiri, Div of Cariology, Operative Dentistry and Endodontics, Niigata Univ Graduate School of Medical and Dental Sciences, 2-5274, Gakkocho-dori, Chuo-ku, Niigata 951-8514, Japan; e-mail: noiri@dent.niigata-u.ac.jp