

An update on mouthwashes: advice for dental practitioners

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Key points

Explains which mouthwashes are most appropriate for different oral diseases, namely caries and periodontal diseases.

Updates practitioners, by using the highest-level evidence and recent guidelines, to support any firm advice on mouthwash use.

Increases awareness about best current techniques – that mouthwashes can be used after brushing.

Suggests some potential risks to oral and systemic health with mouthwash use which may involve the oral microbiome, but this remains uncertain and more research is needed.

Abstract

Due to their antimicrobial constituents, mouthwashes are well-known to be clinically effective for reducing plaque biofilms containing bacteria and reducing gingival inflammation. However, with a variety of products now available (often containing more than one active ingredient), it is important to consider which chemical constituents are most suitable for different types of oral disease and how mouthwashes should be best used. This article thus updates professionals on techniques for use and which agent to select, using current professional guidelines and the highest level of evidence available. As examples, clinicians need to be aware of adjunctive approaches for mouthwash use and 'spit don't rinse with water' instructions. However, there is currently insufficient evidence on mouthwashes and the oral microbiome (including systemic health) to support microbiome testing to guide a choice. After consulting the literature, this article reiterates that adjunctive fluoride mouthwashes, alongside effective toothbrushing and interdental cleaning, are effective for preventing dental caries. Adjunctive chlorhexidine, essential oils and/or cetylpyridinium chloride mouthwashes may also be effective for managing plaque-induced periodontal diseases at early stages. Some possible risks to mouthwash use are highlighted, including allergies, tooth staining and oral microbiome dysbiosis. Until more evidence is available, clinicians should ensure that benefits outweigh risks and refer to current mouthwash guidelines to support personalised preventive care advice.

Background

In recent years, mouthwashes have gained increasing attention from researchers, healthcare providers and the media, and similarly, the number of mouthwash products available over the counter (OTC) has continued to grow. There are a plethora of antimicrobial agents that exist within mouthwashes, some of which are clinically effective for the management of dental caries involving hard tissues, and others that are more effective for periodontal diseases affecting soft tissues.¹ High levels of collective evidence, obtained during systematic reviews, suggest that chemicals found in commercial

mouthwashes, such as fluoride, chlorhexidine (CHX), essential oils (EOs) and cetylpyridinium chloride (CPC), can effectively reduce the amounts of bacterial plaque biofilms on teeth and gingival inflammation.^{2,3,4,5} However, evidence is still emerging and incomplete as to the most clinically effective mouthwashes for different oral diseases, particularly in the context of the oral microbiome. Clinicians should thus heed caution using oral microbiome analysis to target their use. Information about the techniques and approaches to use also need further promotion, as current guidelines extend to usage after brushing. Given current interest, all dental practitioners need to keep updated on current evidence, consider the specific oral disease to be managed and understand the active ingredients of the mouthwash in order to provide appropriate advice to patients.

Aim

To update dental clinicians on the techniques for use and effectiveness of antimicrobial mouthwashes for oral disease, in the context

of benefits and risk. Current guidelines and the highest-level available evidence for each topic underpin the opinions put forward.

Caries: the guidelines

The differential mechanisms of action of different mouthwashes on microorganisms are reviewed elsewhere,¹ which in turn relates to their differential indications for different oral diseases.¹ Clinically, systematic reviews demonstrate that fluoride toothpastes prevent the formation of plaque and reduce dental caries in children.^{6,7} The *Delivering better oral health* (DBOH) NHS (National Health Service) United Kingdom (UK) guidelines suggest that fluoride mouthwashes can be considered in addition to twice-daily brushing with 1350 ppm fluoride toothpaste in children of eight years and above,⁸ as this regimen is effective at reducing dental caries in children.² Exact fluoride concentrations in mouthwashes differ between different products, and between guidelines from different countries, so are difficult to give exact values for. However,

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as a guide, the concentrations of fluoride indicated in UK guidelines approximate to 225–230 ppm (0.05%) for daily use (superior), and 900 ppm (0.2%) for weekly use, but fluoride concentrations may further vary among OTC products, with, for example 450–500 ppm (0.1%) being found in many common mouthwash brands worldwide. Nevertheless, despite clear indications for using fluoride mouthwash to aid caries prevention, there is limited evidence to its effectiveness on plaque and gingivitis, and a lack of studies in adults other than for root caries.^{9,10} Thus, agents other than fluoride are often included in mouthwashes to help manage oral disease.

Periodontal diseases: the guidelines

A Cochrane review concluded that CHX is effective at reducing gingivitis,³ and National Institute for Health and Care Excellence guidelines with the British National Formulary suggest either CHX and/or hydrogen peroxide use for managing gingivitis.¹¹ Chlorhexidine ‘alone’, however, is relatively ineffective against more advanced periodontal diseases,³ suggesting that: i) mouthwash use should focus on prevention at the earlier stages of periodontal disease, i.e., gingivitis; and ii) mouthwashes for any stage should always be used adjunctively, i.e., alongside toothbrushing and interdental cleaning. In this context, systematic reviews have provided high-level evidence that mouthwashes containing adjunctive EOs and/or CPC can also significantly reduce plaque and bleeding scores and clinical signs of gingivitis.^{5,12} Consequently, these agents are mentioned in the European Federation of Periodontology (EFP) S3-level clinical practice guidelines for control of gingival inflammation as part of a personalised preventive approach in the earlier stages of periodontitis.¹³

When periodontitis is more advanced (e.g., up to Stage III periodontal disease), current British Society of Periodontology (BSP)¹⁴ and EFP S3-level guidance¹⁵ suggest consideration of adjunctive CHX mouthwash use for a limited period of time (usually 2–4 weeks to prevent extrinsic staining), alongside oral hygiene and professional mechanical plaque removal (PMPR).¹⁶ Of note, in the UK and Europe, OTC 0.2% CHX is advised, but in the United States, 0.12% is used, which is only available on prescription. BSP and EFP recommendations are based on a study finding that mouthwashes, such as 0.2% CHX, can confer a small clinical benefit

for reducing pocket depths when used alongside PMPR.¹⁴ In addition, the EFP S3-level guidance also mentions adjunctive use of EOs and CPC for use in periodontitis as part of supportive care (recommendation 4.13), based on the outcomes of the meta-analysis by Figueroa *et al.*⁵ However, there are often cases of the most severe periodontal disease (Stage IV), where tooth prognosis is hopeless; no amount of mouthwash will reach the depths of the periodontal pocket, or restore the bone the patient has lost. Patients are not always aware of this and it may be up to the dental practitioner to explain why mouthwashes cannot be effective in such cases.

Updated advice to practitioners

We have previously made recommendations applicable to clinicians internationally regarding the appropriate use of mouthwashes.¹⁷ These advocated fluoride mouthwashes for caries prevention, and selective short-term adjunctive use of antimicrobial mouthwashes during gingivitis and periodontal disease. However, they did not explore the best available evidence for mouthwash techniques. Therefore, using current guidelines and the best available evidence, what do dentists, dental therapists, dental hygienists and oral health educators currently tell their patients about mouthwashes techniques and routines? Until recently, it would have perhaps been to ‘use mouthwashes at some other time than brushing’, especially in people with impaired manual dexterity or challenges complying with effective oral hygiene regimens. This would involve the use of a fluoride mouthwash if at high-caries risk and sometimes the use of an antimicrobial mouthwash adjunctively for periodontal disease (but not as a substitute for mechanical cleaning). For the most part, one can stand by these, but if the profession is to focus more towards prevention of disease going forward, where mouthwashes may be of most benefit, there are additional requirements to consider.

Mouthwash: the technique

Perhaps the most surprising technique that has gained more attention recently challenges the ‘spit don’t rinse’ messaging. The most recent DBOH updated toolkit (2021) and BSP S3-level guidelines now say ‘spit don’t rinse with water’, which means dental healthcare providers can advise patients to use mouthwash after brushing (but not water).^{8,13} This replaces the 2017 toolkit, which advised ‘spit out after brushing and do not

rinse to maintain fluoride concentration levels’. Initially, single studies proposed that rinsing with a non-fluoride mouthwash after brushing reduced the anti-caries effect of toothpaste compared to using toothpaste alone.¹⁸ Later studies proposed that 500 ppm and 225–230 ppm fluoride mouthwashes after brushing produced greater amounts of fluoride in saliva compared to ‘spit don’t rinse’ after brushing with 1450 ppm toothpaste.^{19,20} This concept is detailed nicely in a previous *British Dental Journal* article.²¹ Using a mouthwash fluoride concentration less than toothpaste seems counter-intuitive, but the fluoride concentration in spit/slurry after tooth brushing without rinsing is not 1450 ppm; it is less than the concentrations of fluoride found in spit/slurry after rinsing with either 500 ppm or 225 ppm mouthwash.¹⁹ This is not true, however, if the mouthwash lacks fluoride. Despite such changes to guidelines, there is still a need for further primary research and high-level review in this field to further explore the best techniques on how and when to use fluoride mouthwashes.

OTC antimicrobial mouthwashes nowadays also tend to have a mixture of active ingredients (not just fluoride), which further hinders understanding when attempting to match specific mouthwashes to manage specific diseases or avoiding side effects. This may be because of synergistic benefits of certain chemical combinations (EOs could be an example of this).²² Natural antimicrobial mouthwashes, including propolis, also vary in their effectiveness with different extracts and formulations.^{23,24} Much research is also needed on the effectiveness of these mouthwash formulations for both natural and chemical combinations.

The bystander damage (oral microbiome)

Antimicrobial mouthwashes are effective because they are either bactericidal or bacteriostatic, i.e., they kill or reduce the bacterial load in the mouth, including the pathogenic species that are traditionally associated with oral disease, such as *Streptococcus mutans* in dental caries and *Porphyromonas gingivalis* in periodontal disease.²⁵ However, this is oversimplified and our recent understanding of the oral microbiome shifts us away from ‘killing pathogenic bacteria’ as the absolute for managing oral disease. A healthy mouth is associated with microbial diversity and the presence of commensal species, including *Streptococcus*.²⁶ In fact, mouthwashes that destroy healthy species may lead to overgrowth of those bacteria, causing dysbiosis, with worsened

oral or systemic health.^{27,28} Certain 'healthy' oral bacteria are able to reduce nitrate in food to nitrite, which, when swallowed, releases nitric oxide and reduces blood pressure.^{29,30} Therefore, ideally, mouthwash constituents should treat oral disease, without causing oral microbiome dysbiosis or reducing the abundance of 'healthy' bacteria, such that the benefits of mouthwashes on oral health outweigh any potential risks, including antimicrobial resistance – much like antibiotics.^{17,31}

It is unlikely, therefore, that one mouthwash fits all, and more research is still needed on which mouthwash is most effective for either prevention or management of specific oral diseases, at the same time as maintaining a healthy oral microbiome.²² Although there is emerging evidence that some mouthwashes, such as CHX, may cause oral microbiome dysbiosis,²² the jury is out, balancing the clinical benefits versus the oral and systemic risks, and clinicians can continue to follow guidelines using CHX mouthwashes where appropriate at the current time.^{14,27} We firmly do not know which mouthwash should be advised based on the oral microbiome outcomes. This is because insufficient research has been done on many of the chemical constituents found in mouthwashes, specifically relating clinical outcomes to the oral microbiome status. The composition and definition of a healthy oral microbiome may also differ between individuals. Thus, we should view with caution any practices in dental healthcare that jump on the oral microbiome bandwagon to offer clinical advice on oral hygiene and mouthwash regimens. Interestingly, in terms of bystander damage, the literature is also sparse regarding the effects of fluoride on the oral microbiome³² and some people still advocate its detrimental effects on human health, despite no conclusive evidence to support this with drinking water or dental products.³³ Dental professionals, therefore, continue to advise fluoride use for prevention of caries because the beneficial effects on caries prevention currently outweigh the unsubstantiated risks or fluorosis due to overdose.³³

Putting the mouth back in the body

As a profession, dentistry is arguably underfunded and undervalued because 'teeth don't kill you'. However, dental caries is caused by bacteria, and should they get into the bloodstream from an infected tooth, without extraction, pulp extirpation, or antibiotics used at the right time, more people could acutely

die from sepsis caused by toothache than they currently do.³⁴ There is also a resurgence of information on the links between oral and systemic health, with systematic reviews supporting the association between periodontal disease and diabetes,³⁵ as well as blood sugar control,³⁶ periodontal disease and hypertension/
cardiovascular disease.³⁷ Rheumatoid arthritis,³⁸ Alzheimer's disease³⁹ and various cancers⁴⁰ have also been linked to poor oral health through systematic reviews of several studies. It is perhaps in these patients, with greater risks of systemic disease, that the effective use of mouthwash adjunctively could positively outweigh the risk of any possible bystander damage and perhaps even improve systemic health. This perspective is an angle that, to date, has not really been considered.

It's all about prevention

Most people will have heard of the well-known adage 'prevention is better than cure', yet dentistry has still not 'cracked it' in terms of oral hygiene, which is our cornerstone of prevention. With good oral hygiene and no cariogenic or acidogenic foods, in theory, dental decay and periodontitis could be prevented, but in reality, there is always going to be a proportion of people who struggle with good oral hygiene, for example, due to challenges with dexterity or mental health. In terms of periodontal health, gingivitis is the prevention tipping point, before periodontitis has progressed into irreversible bone loss and a sometimes unmanageable form. Perhaps an adjunct mouthwash could slow down that progression or 'switch'? In terms of teeth, what if a diet with cariogenic or high-sugar-content foods was keeping that patient alive? Again, perhaps these sorts of cases are where the benefits outweigh the risks and for whom mouthwashes would suit best.

The scare stories

The links between alcohol in mouthwashes and oral cancer has been a recurring headline for many decades. This is despite several systematic reviews and meta-analyses failing to demonstrate a consistent link between alcohol-containing mouthwash and oral cancer.^{41,42} Nevertheless, the debate rages on because the byproduct of alcohol (acetaldehyde) is a carcinogen, and smokers are at increased risk of oral cancer when they consume alcohol. In addition, alcohol is cytotoxic to cells when used in the laboratory.⁴² A recent *ex vitro* study investigating EO mouthwashes containing

alcohol on the oesophageal microbiome re-fuelled this debate, linking mouthwashes to colon cancer, despite the fact that cancer was not studied directly.⁴³ Regardless of what the truth about alcohol mouthwash turns out to be, a single study making a huge leap of faith refuelled the debate, rather than there being consideration of a systematic review of several papers. At the moment, therefore, based on high-level evidence, there is still no definitive proof that alcohol-containing mouthwashes cause oral cancer, and more research may be needed. Nevertheless, the advice a clinician can give if a patient is worried about this fact, or if the patient wants to avoid alcohol for cultural reasons, is that there are many alcohol-free mouthwashes available OTC, containing a variety of chemical alternatives, so patients can opt for one of these if they want to avoid alcohol.

Other headlines that have concerned clinicians and patients in recent times have been the reports of anaphylactic reactions to CHX mouthwash,⁴⁴ which, while very rare, can still happen and may seem scary to some. The use of a mouthwash, therefore, has to be based on a risk-versus-benefit decision taken by the patient, which may or may not involve a recommendation from a dental professional. Some patients may read the manufacturer's instructions to make their decision based on benefits and risks; others may seek advice from, for example, the internet or social media. Clinicians have a duty to ask about oral home-care regimens during dental examinations and be prepared to sensitively correct misinformed routines where appropriate; good evidence can help having the confidence to do so. Other healthcare professionals, such as pharmacists, may also advise on mouthwash use, so there is also a need to make sure correct and appropriate use is cascaded beyond the dental profession alone.

Conclusion

In conclusion, based on the current best available evidence, the adjunctive use of mouthwashes alongside mechanical cleaning has a place in preventing dental caries and periodontal diseases, as this approach reduces plaque biofilms and inflammation. It is more important than ever to use this original literature for decision-making in a setting of ever-growing uncertainties to the accuracy of information displayed from internet search engines, social media and predatory journals with less robust review processes. Furthermore, when used adjunctively, fluoride mouthwash is currently

advised for prevention of caries, especially where oral hygiene is difficult to achieve. Adjunctive use of CHX, EOs and/or CPC can be used adjunctively at the earlier stages of periodontal diseases for prevention before tooth prognosis becomes hopeless. With regards to updates on techniques, dental practitioners need to be aware of newer guidelines on mouthwash best practice (e.g., ‘spit don’t rinse with water’) and should refer to higher levels of collective evidence when making recommendations. Some risks to mouthwash use may exist, such as oral microbiome dysbiosis, tooth staining and allergic reactions. Oral microbiome analysis, however, although it may be part of personalised dentistry in the future, currently needs more research before it can be used as a technique to guide clinical care. However, practitioners should consider which chemical constituents are most appropriate for the oral disease they are attempting to treat, bearing in mind that many mouthwashes now contain combinations of active ingredients. Further, clinicians should always weigh up whether certain benefits on oral and systemic health outweigh uncertain risks, and vice versa, as no treatment, however good, is without side effects.

Ethics declaration

The authors declare no conflicts of interest.

Author contributions

ZB: conception, design, interpretation, drafting, revising. RB: conception, interpretation, drafting. RW: interpretation, drafting. MCB: conception, interpretation. SW: interpretation, drafting. EM: conception, design, interpretation, drafting.

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