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The role of antimicrobial mouth rinse in dental practice and home oral hygiene

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This educational piece is intended as an educational resource for dental healthcare professionals in terms of: 1) infection risk and control within a dental practice environment; 2) the role of antimicrobial mouth rinses in infection control and patient oral hygiene; and 3) encouraging smoking cessation in patients who are smokers and facilitating access to a smoking cessation programme.

Infection Risk in the Clinic

Dental patients and dental healthcare professionals can be exposed to pathogenic micro-organisms in the dental setting, including bacteria and viruses, which can be transmitted via:

- direct contact with blood, oral fluids, or other patient materials
- indirect contact with contaminated objects or surfaces (e.g., charts, instruments, equipment)
- contact of conjunctival, nasal, or oral mucosa with droplets generated from an infected person and propelled a short distance (e.g., by coughing, sneezing, or talking)
- inhalation of airborne droplets that remain suspended in the air for long periods.[1,2]

Aerosols, sprays, and splatter generated during routine dental procedures, especially during ultrasonic and air turbine procedures, can contain blood and saliva.[1,3] The terms aerosols, sprays, and splatter are often used interchangeably to describe droplet particles; however, they differ in terms of their size. Mist-like aerosols are typically invisible and can remain airborne for long periods of time. Splatter and spray consist of larger droplet particles, which can travel further than aerosols to land on the skin and other surfaces.[1]

Dental and oral health practitioners strive to manage these generated aerosols, sprays, and splatters by using personal protective equipment, barriers, and infection control protocols. However, practitioners may not fully appreciate that the spread of potential pathogenic micro-organisms is greater than previously considered and may encompass the majority of the dental operatory area (**Figure 1**).[4]

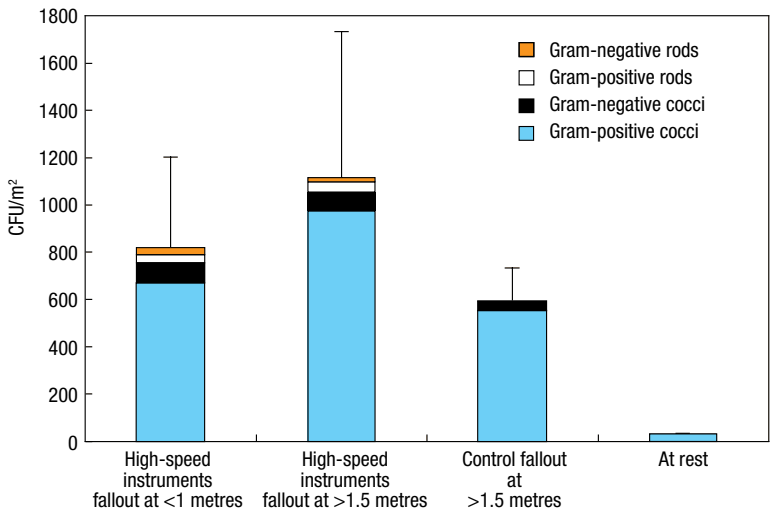

Figure 1. Mean number (with standard deviations of total counts) of colony-forming units (CFU) of different types of bacteria at various distances from treatment units after 1.5 and 3 hour collection times. Significant contamination was detected at all distances sampled when high-speed instruments were used.[4]

The behaviour of these droplet particulates and their associated health risks are complex,[3] but aerosols, sprays, and splatters contaminated with pathogenic micro-organisms represent a potential route for disease transmission.[1,5,6] Whether or not the spread of micro-organisms results in clinical infection depends in part on the virulence (infectivity) and dose (load) of a particular micro-organism and on the susceptibility of the host.[1,5]

Infection Control in the Clinic

The purpose of infection control in dental practice is to prevent the transmission of pathogenic micro-organisms between patients and between dental staff and patients.[2,5] In Australia and New Zealand, the following procedures are recommended to minimise the generation of aerosols and splatter and reduce the bacterial load, and hence the risk of disease transmission in the dental setting:

- use of personal protective equipment, including gloves, masks, and protective eyewear
- use of a high-volume extractor, which exhausts externally during aerosol-creating procedures, such as ultrasonic and air turbine procedures
- use of a rubber dam to reduce the risk of contamination by infective aerosols (use whenever possible to isolate an area of the patient's mouth during treatment)
- use of an antimicrobial mouth rinse by the patient prior to any intra-oral procedure, especially high-speed instrumentation – to reduce the number of resident and transient micro-organisms capable of transmitting disease.[5,7]

In addition to the routine use of personal protective equipment, the use of pre-procedural mouth rinses, high-volume evacuation, and rubber dam are the most effective methods of minimising the risk of exposure.[2,3,5-7]

Precautions for Infectious Patients

Given that most of the procedures used in dentistry generate aerosols, patients with active infectious diseases (e.g. influenza) who require urgent dental treatment pose a considerable infection risk to dental staff and other patients. In such cases, the specific transmission-based precautions that must be followed include: scheduling these patients at the end of the day; use of pre-procedural antimicrobial mouth rinses and rubber dam; minimizing the use of aerosol-generating techniques; and applying two cycles of cleaning for environmental surfaces.[5]

Pre-Procedural Mouth Rinsing

The use of antimicrobial mouth rinses by patients prior to a dental procedure is intended to reduce the number of micro-organisms released from a patient in the form of aerosols or splatter that might contaminate a dental surgery and its equipment surfaces. Pre-procedural rinsing may also reduce the number of micro-organisms accessing the patient's bloodstream during an invasive dental procedure.[2]

There is no conclusive published evidence that pre-procedural mouth rinsing prevents clinical infection in dental staff or patients. Nevertheless, clinical studies have demonstrated that pre-procedural rinsing with essential oils-, chlorhexidine gluconate-, or cetylpyridinium chloride-based mouth rinses, either alone or together with high-volume extraction, is effective in reducing the microbial load of the aerosols produced during ultrasonic scaling.[8-12] In one double-blind, randomised, cross-over study of patients undergoing ultrasonic scaling, pre-rinsing for 30 seconds with an essential oils-based mouth rinse resulted in a significant ($p<0.001$) reduction in the number of colony-forming units in recoverable aerosol samples (**Figure 2**).[11] Reduced bacterial load implies reduced risk of infection.

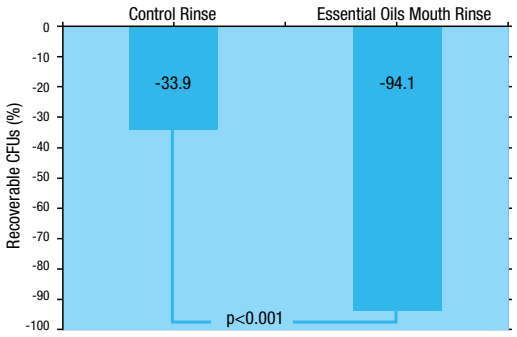

Figure 2. Reduction in colony-forming units (CFUs) contained in aerosols generated during 10 minute ultrasonic scaling performed after first rinsing with an essential oils-containing mouth rinse in a randomised, double-blind, cross-over study.[11]

Practice Tips 1 – Infection Control

1. Dental healthcare professionals should be aware of the risk of disease transmission during dental procedures, especially when treating patients with active infectious diseases.
2. Aerosols and splatter generated during high-speed dental procedures are the primary means of potential disease transmission.
3. The following techniques should be employed to minimise the risk of exposure to aerosols and splatter:
   a. use of standard personal protective equipment
   b. use of high-volume extraction
   c. use of a rubber dam
   d. use of patient pre-procedural antimicrobial mouth rinse.
4. See patients with active infectious disease at the end of the day.

Antimicrobial Mouth Rinses

The oral cavity harbours a vast variety of species of bacteria, viruses, and fungi, but it is bacteria that are the primary cause of periodontal disease. More than 300 species of bacteria associated with periodontal disease have been isolated from the oral cavity. Periodontal disease results from the establishment of dental plaque biofilm, which involves bacteria attaching to one of several oral surfaces, including the tooth and epithelium, as well as with other bacteria already attached to these surfaces.[13]

Mechanical plaque biofilm removal through tooth-brushing and flossing is the gold standard for the prevention of periodontal disease and dental caries. However, most people fall short of optimal oral hygiene.[14,15] Hence, the use of an antimicrobial mouth rinse is an important adjunct to professional care and tooth-brushing and flossing in the home. The most commonly used antimicrobial agents in clinical mouth rinses are: chlorhexidine gluconate, essential oils, and cetylpyridinium chloride.

Active Ingredients and Mechanisms of Action

To varying degrees, chlorhexidine gluconate, essential oils, and cetylpyridinium chloride all disrupt the integrity of the bacterial cell membrane, leading to lysis and death.[15] The major advantage of chlorhexidine gluconate is its ability to bind to soft and hard oral tissues, enabling it to act over a long period after use and to inhibit adsorption of bacteria onto oral surfaces.[15,16] Cetylpyridinium chloride binds to teeth and plaque to a lesser degree than chlorhexidine gluconate and is generally less efficacious than chlorhexidine gluconate. Chlorhexidine gluconate and essential oils penetrate plaque biofilm and produce changes in microbial cell surface morphology that alter co-aggregation, decolonisation, and, thus, survival.[15]

Active Ingredient	Description	Mechanism of Action
Essential oils	Fixed combination of: – Eucalyptol (0.092%) – Menthol (0.042%) – Methyl salicylate (0.060%) – Thymol (0.064%)	• Ruptures bacterial cell wall, leading to leakage of contents and cell death • Penetrates the plaque biofilm to exert anti-microbial effects
Cetylpyridinium chloride	Quaternary ammonium compound	• Ruptures bacterial cell wall, leading to leakage of contents and cell death • May disrupt bacterial metabolic pathways, inhibiting cell growth
Chlorhexidine gluconate	Cationic bis-biguanide	• Ruptures bacterial cell wall, leading to leakage of contents and cell death • Binds to salivary mucins and oral surfaces, which inhibits bacterial colonisation • Binds to bacteria, inhibiting their adsorption onto teeth surfaces • Penetrates the plaque biofilm to exert anti-microbial effects

Table 1. Descriptions and mechanisms of action of the three most-commonly used active ingredients in antimicrobial mouth rinses.[15,16]

By virtue of their various mechanisms of action, chlorhexidine gluconate, essential oils, and cetylpyridinium chloride exhibit broad spectrums of antimicrobial activity, including activity against Gram positive and Gram negative bacteria, and against a wide variety of aerobic and anaerobic bacteria.[15]

An additional benefit of an essential oils-containing mouth rinse is that it has a neutral electrical charge and therefore does not interact negatively with other charged ions found in dentifrices, such as sodium lauryl sulphate. Also, the essential oils are not inhibited by blood proteins, unlike chlorhexidine gluconate, suggesting an effective, user-friendly option in conjunction with mechanical brushing and interproximal cleaning.[15]

Clinical Efficacy

Two recent systematic reviews of published evidence support the effectiveness of antimicrobial mouth rinses in reducing plaque and gingivitis when used as an adjunct to home care.[17,18] The majority of studies have shown that daily use of mouth rinses containing chlorhexidine gluconate or essential oils provide clinically significant anti-gingivitis and anti-plaque benefits compared to inactive control mouth rinse. Mouth rinse containing cetylpyridinium chloride appeared to provide more limited clinical benefits, possibly due to fewer clinical trials evaluating the same formulations of cetylpyridinium chloride.[17,18] In addition to their anti-plaque and anti-gingivitis effects, the majority of antimicrobial mouth rinses have shown beneficial effects in reducing oral malodour in both short- and longer-term studies.[19,20]

In a meta-analysis of head-to-head studies that evaluated the effects of long-term (≥4 weeks) use of chlorhexidine gluconate- versus essential oils-based mouth rinses, chlorhexidine gluconate produced better results for anti-plaque benefits but was associated with considerably more staining and calculus. For the long-term control of gingival inflammation, both active ingredients produced similar results.[21] On the basis of these findings, the investigators concluded that an essential oils-containing mouth rinse is a reliable alternative to a chlorhexidine gluconate-containing mouth rinse where long-term anti-inflammatory oral care is deemed beneficial. For indications where plaque control is the main focus, chlorhexidine gluconate remains the active ingredient of first choice.[21]

Practice Tips 2 – Patient Oral Hygiene

1. Remind patients that mouth rinses are not a replacement for mechanical hygiene – rinses are an adjunct to professional and home mechanical hygiene.
2. Brushing and flossing are the primary means of removing plaque in the home – adjunctive use of an antimicrobial mouth rinse helps to reduce plaque build-up and gingivitis.
3. Advise patients to choose a mouth rinse with a pleasant usage experience – enjoyment using the product will increase compliance.
4. Advise patients to follow usage instructions, in particular not to dilute mouth rinses since doing so may reduce their effectiveness.
5. Advise patients not to smoke and, where possible, facilitate access to a smoking cessation programme.
6. Smoking cessation guidelines and training programmes for oral health professionals are available and should be used.

Safety and Tolerability

Studies show that daily, long-term use of chlorhexidine gluconate or essential oils mouth rinses does not adversely affect oral microbial flora, including no microbial overgrowth, opportunistic infection, or development of microbial resistance.[15] Long-term use of chlorhexidine gluconate-, essential oils-, or cetylpyridinium chloride-containing mouth rinses does not appear to contribute to the development of soft tissue lesions or mucosal aberrations.[15,18] However, taste perception alteration, increased supragingival calculus formation and brown staining of the teeth and other oral surfaces is associated with the use of mouth rinses containing chlorhexidine gluconate.[15,21] In some cases the staining is severe, requiring professional prophylaxis.[16]

Regarding concerns that use of alcohol-based mouth rinses can result in desiccation of the oral mucosa, leading to xerostoma, clinical studies have shown no significant difference in salivary flow rate with alcohol-based mouth rinse.[15,18,22] In addition, there is no evidence of a causal link between use of alcohol-based mouth rinses and the risk of oral and pharyngeal cancer.[15,23]

Smoking and Oral Health

Tobacco smoking is a major factor associated with chronic periodontal disease and contributes to higher levels of tooth and bone loss.[24-26] The mechanisms behind the destructive effects of smoking on the periodontal tissues are not fully understood but are likely to involve interference with vascular and inflammatory processes and the negative effects of nicotine and carbon monoxide in tobacco smoke on healing.[25,26] Indeed, constituents of cigarette smoke have been shown to induce chronic inflammation of mucosal surfaces, modify immune responses to introduced antigens, and stimulate production of autoantibodies, such that cigarette smoke impairs immunity levels within the oral cavity and promotes gingival and periodontal disease and oral cancer.[27]

The risk of periodontal disease is 3- to 20-fold higher in smokers than in non- or never-smokers.[25,26,28] The rate of progression of periodontal disease is increased in smokers, but reverts to that of a non-smoker following smoking cessation.[28] Indeed, there is evidence indicating that smoking cessation is an important component of periodontal treatment, and smokers should be encouraged to quit as part of their overall oral health maintenance.[29]

The incidence of oral cancer, specifically squamous cell carcinoma, is four to seven times greater in smokers compared to non-smokers,[30] and when considering the associated increased periodontal disease morbidity and poor wound healing, smoking cessation counselling and support should form an essential role of all dental practitioners.[31]

A recent Cochrane review determined that, based on available clinical trial evidence, behavioural interventions for tobacco cessation conducted by oral health professionals, incorporating an oral examination component in the dental office or community setting, may increase rates of smoking cessation.[30] UK researchers, who demonstrated that quit rates following smoking cessation advice given as part of a periodontal treatment compare favourably with national quit rates achieved in specialist smoking cessation clinics, concluded that the dental profession has a crucial role to play in smoking cessation for patients with chronic periodontitis.[32]

Smoking Cessation Guidelines and Training Programmes for Dental Professionals

Training Programmes

Cancer Council Queensland:
Smoking Cessation Brief Intervention Online Training for Dental Professionals (Registration Form)

Cancer Council Victoria:
Quit Victoria Training Package: DVD and Training Booklet for Smoking Cessation (Order Form)

New Zealand Ministry of Health:
ABC – Smoking Cessation in Practice Online Course (Login)

Guidelines

New Zealand Ministry of Health:
New Zealand Smoking Cessation Guidelines (PDF)

New South Wales Public Health Bulletin:
Models of Smoking Cessation Brief Interventions in Oral Health (PDF)

Royal Australian College of General Practitioners:
Supporting Smoking Cessation: A Guide for Health Professionals (PDF)

US National Institutes of Health:
Smoking and Tobacco Control Monograph (PDF)

Against this background, both the Australian and New Zealand Dental Associations advise that dental healthcare professionals should be encouraged to educate the public on the adverse health implications of smoking as well as how to quit, and that appropriate smoking cessation programmes should be integrated into dental practices.[24,33] Of note, brief intervention and motivational interviewing techniques are encouraged along with nicotine replacement therapy to double the chances of long-term quitting.[31,34]

Online smoking cessation guidelines and training programmes for dental professionals are available (links to a selection of these are provided in the associated box).

Expert Commentary by Jonathan Leichter

The efficacy, safety, and patient acceptance of mouth rinses has been widely documented in the literature, with regards to both their prophylactic use before dental procedures, as well as their long-term efficacy in reducing plaque and gingivitis.

Although bacteraemias can result from invasive dental procedures, a review by the American Heart Association and the British National Institute for Health and Clinical Excellence has shown that daily activities such as brushing and flossing create more exposure than a patient's 6-monthly dental visit.[1] This would no doubt be exacerbated in those patients with poor oral hygiene. Rinsing with essential oils reduces the level of bloodstream bacteria in patients with mild-to-moderate gingivitis – an easy, cost-effective, and low-risk strategy.[2] In addition to an effect on bacteria, antiviral properties of both essential oils-containing and chlorhexidine gluconate mouth rinses (at their commercial concentrations) have also been shown *in vitro*.[3]

In the dental office setting, antiseptic mouth rinses, when combined with other precautions (such as the use of dental dam, protective equipment, and high-volume evacuation), provide us with an effective strategy to minimise risk for both patient and operator. In the home setting, although not a substitution for regular and effective mechanical biofilm control, mouth rinses provide a proven adjunct with validated long-term efficacy.

Although concerns have been voiced with regards to the risk of oral cancer associated with regular use of mouthwash, a meta-analysis of 16 epidemiological studies of mouthwash and oral cancer showed no statistically significant association.[4]

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Expert Commentary by Saso Ivanovski

Recent years have seen several well publicised outbreaks of airborne diseases, especially several virulent variants of the influenza virus. The nature of dental treatment dictates that airborne micro-organisms can be introduced into the dental office environment as a result of interventions within the oral cavity that create aerosols and splatter. This raises the possibility of disease transmission of airborne diseases between patients, the operator, and auxiliary staff. The use of mouth rinses as a pre-procedural rinse has been shown to result in a significant decrease in airborne micro-organisms following dental treatment and hence can be recommended as a way to reduce the risk of airborne disease transfer in the dental operatory.

Dental plaque is the primary cause of the common periodontal diseases, gingivitis and periodontitis. Mechanical plaque control involving brushing and flossing is the most effective way to control plaque levels in the oral cavity. Chlorhexidine gluconate- and essential oils-containing antimicrobial mouth rinses have been shown to have anti-plaque and anti-gingivitis properties when used as adjuncts to brushing and flossing.

Plaque alone is not sufficient for the progression from gingivitis to the destructive form of periodontal disease, periodontitis. A susceptible patient is also required for this progression, and an important risk factor is smoking. Therefore, dental practitioners should make their patients aware of the strong association between periodontitis and smoking, and advise them to seek assistance with smoking cessation.

TAKE-HOME MESSAGES

- Aerosols and splatter are a potential source of cross-infection in the dental surgery.
- Steps should be taken to minimize the generation of aerosols and splatter, e.g. use of high-evacuation, rubber dams, and pre-procedural use of anti-microbial mouth rinse.
- As an adjunct to mechanical plaque removal, the daily use of an antimicrobial mouth rinse helps to reduce plaque formation and gingivitis.
- Smoking is a risk factor for periodontal disease and dental health practitioners should encourage smoking cessation and facilitate access to a smoking cessation programme, where available.

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