AEROSOL: A SILENT KILLER IN DENTAL PRACTICE

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INTRODUCTION

Transmission of infection during dental treatment or surgery can occur through several routes: direct contact with blood, saliva or tissue debris; indirect contact with contaminated instruments or surfaces that have been improperly sterilized; or contact with infective agents present in either the droplets or aerosol particles from saliva and respiratory fluids. 

During dental treatments, saliva may become aerosolized and microorganisms from the oral cavity will contribute to the spread of infection. Aerosol creating instruments are known to be the main cause, and recent attempts to quantify this environmental hazard have shown the seriousness of this potential cross-contamination. The propelling force of a high-speed dental drill and the cavitation effect of an ultrasonic scaler, both being used in combination with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials. Therefore aim of this review is to highlight the potential sources of aerosols, its hazardous effects and the different ways to reduce the contamination caused as a result of its production.

ABSTRACT:

Potential transmission of disease to personnel during dental procedures has become a source of increased concern to the dental profession. During dental treatments, saliva may become aerosolized and microorganisms from the oral cavity will contribute to the spread of infection. Aerosol creating instruments are known to be the main cause, and recent attempts to quantify this environmental hazard have shown the seriousness of this potential cross-contamination. The propelling force of a high-speed dental drill and the cavitation effect of an ultrasonic scaler, both being used in combination with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials. Therefore aim of this review is to highlight the potential sources of aerosols, its hazardous effects and the different ways to reduce the contamination caused as a result of its production.

Key words: Aerosol, Transmission, Dental healthcare workers (DHCWs), Contamination.
pathogenic aerosol. The propelling force of a high-speed dental drill and the cavitation effect of an ultrasonic scaler, both being used in combination with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials. Thus, diseases like pneumonia, influenza, hepatitis, and skin and eye infections may be transmitted during dental treatment procedures from these infectious aerosols. At present, the most serious diseases threatening dentists and their staff are hepatitis B and acquired immunodeficiency syndrome (AIDS); dental personnel are at risk of contracting these diseases during dental operative procedures. 6,8,10

Most of the aerosols generated during dental treatment procedures have been found to radiate toward the patient's chest and the operator, as well the dental assistant's face. It is known that poorly maintained ventilation and air-conditioning systems can be a potential source of fungal and other microbial organisms. The air-conditioning system could therefore act as a vehicle for the transmission of bacteria and other microorganisms in the dental clinic. 11

Aerosols are important considerations in infection control as well as in occupational health. Aerosols may carry potentially hazardous microbes, viruses, fungi, allergens, and other toxic substances that may harm the dental operator, patient, and the dental assistant by causing nosocomial infections. 11

Therefore aim of this review is to highlight the potential sources of aerosols, its hazardous effects and the different ways to reduce the contamination caused as a result of its production.

Dental handpieces, triplex syringes, ultrasonic scalers and cross infection

Dental handpieces, triplex (three-way) syringes and ultrasonic scalers also require particular attention when it comes to infection control. In dentistry most drilling procedures require water for flushing and cooling. Ultrasonic and sonic scalers are referred to as power-driven scalers. High vibrational energy generated in the oscillation generator is conducted to the scaler tip, causing vibrations with frequencies in the range of 25 000–42 000 Hz. The amplitude ranges from 10 to 100 lm. Microvibration crushes and removes calculus under cooling water. The ultrasonic scalers must be used with a large amount of coolant to keep the scaler tip and handle from becoming too hot. The coolant water spraying against the tip of the scaler greatly increases the aerosol volume.12

Three-way syringes, rotating instruments and ultrasonic scalers generate very fine aerosols which the patient may inhale during treatment. The aerosol and the microorganisms this may contain can thus enter deep into the patient’s respiratory tract. These aerosols which may transmit pathogenic microorganisms could be hazardous to health because studies have shown that bacteria and blood are routinely present in aerosols produced by ultrasonic scalers and aerosols can be suspended in the air. In dental clinics where ultrasonic scalers are being used, there is an increased amount of airborne bacteria, which increases the potential for the spread of infection between patients and between patient and operator. 13

Investigations into this manner suggested that bacterial diseases such as tuberculosis, staphylococcus infections and the presence of other pathologic organisms could decrease air quality in the dental offices and could be transmitted to the operator and the patients in the clinic and the smaller particles of an aerosol have the potential to penetrate and lodge in the smaller passages of the lungs and are thought to carry the greatest potential for transmitting infections. 13

Reducing the contamination risk

Several options were considered in the control of aerosol and splatter related to powered scalers used in the dental clinics. The use of the equipment could be discouraged or banned, various insert designs might result in less aerosol production, additional barriers such as respirator masks or face shields could be required, better evacuation techniques for the coolant could be required, disinfecting the patient’s mouth prior to treatment might reduce the contamination, and using a disinfectant coolant might reduce the infectivity of the aerosols. There is surprisingly little information specific to these issues, although reviews are available.

Ban the use of powered scalers

There has never been one single reported case of disease transmission to either the clinician or to the patient related to the use of powered scaling devices. Aerosols generated by powered scalers containing both pathogenic bacteria and blood borne pathogens are a cause of concern to some clinicians but there is neither a case report nor any documented, systematic report of disease transmission, even though powered scalers have been used extensively in dental practices for many years. It is important to note that powered scalers have grown use tremendously in the last 15 years, during the time of increased awareness of disease transmission in dental settings, and again, no case has ever been reported. There is not even an anecdotal impression among clinicians about a health risk. Clearly, banning the use of these instruments is not warranted and is not realistic based on this total lack of evidence. 14

Disinfecting the patient’s mouth

Pre-procedural rinsing with antimicrobial agents has been shown to reduce the bacterial load in dental aerosols by more than 90%. One 30-second rinse with essential oil mouthrinse produced a 92% reduction in bacteria in aerosol generated by powered scaling, and a 50% reduction in the saliva for 40 minutes. Salivary reduction of
bacteria up to 97% for 60 minutes has also been shown following two 30-second rinses with 0.12% chlorhexidine. It must also be noted that the control rinses also reduced bacterial recovery by about 30%. It should be remembered, however, that powered scalers aerosolize blood as soon as the tip is applied subgingivally, and the oral fluids also contain viruses. Using a pre-procedural rinse may reduce the bacterial load, but has no demonstrated effect on blood borne pathogens, viruses, or pathogens aerosolized from the subgingival flora. The very limited scope and nature of scientific evidence demonstrating efficacy of antimicrobial pre-procedural rinses does not justify their incorporation in this policy.15,16

Use of a high volume evacuator during the scaling procedure

The studies that investigated the use of a high volume evacuator sheath with the ultrasonic scaler hand piece indicated that use of this kind of device could minimize aerosol contamination up to 93% during ultrasonic scaling. However, methods to minimize the formation of aerosols during ultrasonic scaling are limited; there are some procedures to reduce of contamination risk.16

An ultrasonic insert which has been recently introduced that focuses the spray produced may reduce aerosol contamination during ultrasonic scaling. It may be assumed that there is less aerosol produced and thus less contamination by focusing the water spray. But studies indicate that the amount of aerosol contamination produced by traditional style of ultrasonic insert and thereby the newer focused coolant water insert is similar.17

Use of a rubber dam

During many dental procedures, the use of a rubber dam will eliminate virtually all contamination arising from saliva or blood. If a rubber dam can be used, the only remaining source for airborne contamination is from the tooth that is undergoing treatment. This will be limited to airborne tooth material and any organisms contained within the tooth itself. In certain restorative procedures such as subgingival restorations and the final steps of crown preparation, it often is impossible to use a rubber dam. The use of a rubber dam also is not feasible for periodontal and hygiene procedures such as root planing, periodontal surgery and routine prophylaxis. This is of particular concern owing to the fact that periodontal procedures are always performed in the presence of blood and instrument such as the ultrasonic scaler, which have been shown to create the greatest amount of aerosol contamination are used.16

In conclusion, the findings support the use of aerosol reduction devices such as high-volume evacuator whenever an ultrasonic scaler is used to avoid pathogenic bacterial between both patients and clinicians.18

Eye Protection

Operators and close support dental nurses should protect their eyes against foreign bodies, splatter and aerosols which may arise during operative dentistry, especially during scaling (manual and ultrasonic), the use of rotary instruments, use of the air/water syringe, adjusting and cutting of orthodontic wires and the cleaning of instruments and equipment. Patient’s eyes should always be protected against possible injury. Protective glasses with top and side shields are strongly recommended and should be disinfected between patients.14

Face Masks

A well-fitting surgical facemask should be worn by HCW’s. The theatre or dome type facemask is preferable to the paper type which rapidly becomes permeable and inefficient.14

Protective Clothing

Protective clothing which covers areas likely to be contaminated should be worn. Surgery clothing should be retained for use within the surgery only.15,16

Aspiration and Ventilation

Good surgery ventilation which exhaust externally from the premises will reduce most of the risk of cross-infection and cross-contamination from aerosols. (Splatter and droplet may remain a potential source of cross contamination). Efficient high-speed aspiration is essential. Aspirators and tubing (suction hose) should be cleaned regularly in accordance with the manufacturer’s instructions and the system should be flushed through twice daily with the recommended non-foaming disinfecting agent. Aspirator tips should be discarded or sterilised, if non-disposable tips are used. Filters should be removed and disinfected at the end of each day as per the manufacturer’s instructions.19

Surface cleaning and decontamination20

The area around the dental unit becomes contaminated by direct splatter, droplet nuclei and by touching surfaces with gloved hands. Surface cleaning prevents transmission of infection by direct contact with hands and equipment. (N.B Hand hygiene also prevents transmission of surface contaminants). Dental chair, dental handpiece unit, 3 in 1 syringe handle and hoses, lights, bracket table, cabinets will all require surface cleaning and disinfection. You will need to check with the manufacturer’s instructions whether individual items of
surgery equipment can be cleaned with a deterrent and/or disinfectant. Commonly used - surgery surface disinfectants are virucidal and low residue, such as isopropyl alcohol spray or diluted hypochlorite solution (1 in 100 dilution). Alcohol wipes are preferred to spray on products because of the generation of unnecessary aerosols, which may cause sensitization of staff and patients. Avoid whenever possible using hypochlorite on metal surfaces.

Zoning

Zoning (delineating areas) simplifies and speeds up the decontamination process. The aim is to separate the areas that are likely to become contaminated by direct contact or splatter during treatment procedures ("dirty zones") from those areas unlikely to be directly contaminated ("clean zones"). Most of the splatter settles out within 1 metre radius of the patient’s mouth.

Dirty zones:

- Bracket table and handle
- Dental handpiece unit, connectors and switches
- Dental chair head rest
- Light handle and switch, chair handle controls
- Suction connectors
- Spittoon

Only the "dirty zones" or visibly soiled areas need to be cleaned and disinfected between each patient, which reduces the time required for decontamination. Dirty areas which cannot be disinfect ed easily between patients or which are not practical to disinfect between patients such light handle and switches, dental unit switches, buttons on 3 in 1, ultrasonic handle, control buttons on the dental chair can be covered with clear plastic wrap (cling film) or impervious plastic sleeves. Because such covering become contaminated by splatter and direct contact with gloved hands, the covering should be disposed of (wearing gloves) into hazardous waste bags and replaced between patients. If impermeable plastic coverings are not employed then a surface disinfectant should be used to disinfect these items and surfaces between patients.

At the end of the clinical session all work surfaces whether within the clean or dirty zones need to be thoroughly cleaned and disinfected. Wearing of heavy duty household gloves offers greater protection to the skin when using chemical disinfectants. Protective eyewear and masks should be worn during environmental cleaning to protect the staff from exposure to hazardous chemicals and infectious material.26

CONCLUSION

Dental clinics pose high cross-infection risks for patients and dental healthcare workers. The aerosols and splatter produced during dental procedures have the potential to spread infection to dental personnel and patients in the dental office. It is difficult to completely eliminate the risk posed by dental aerosols; but it is possible to minimize the risk with relatively simple and precautions. Routine use of standard barriers such as masks and gloves, the universal use of pre-procedural rinses and high-volume evacuation is recommended. And the recommended infection control protocol, for members of the dental team and patients should be adhered to.

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