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Review Article

AEROSOLS AND ORAL HEALTH

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ABSTRACT

The spread of infection through aerosol has long been considered. "Aerosol" and "Splatter are two different terms. Aerosols were defined as particles less than 50 micrometers in diameter. Splatter was defined as airborne particles larger than 50 µm in diameter. Aerosols containing microbes from the oral cavity of the patient are created when using modern high-speed rotating instruments in restorative dentistry. The possible sources of airborne contamination during dental treatment are dental instrumentation, saliva and respiratory sources, and the operative site. The objective of this article is to describe the effects of aerosols on oral health.

Keywords: Bacterial aerosol; Dental surgery; Hygiene; Hospital bacteria.

INTRODUCTION

The oral cavity is host to a multitude of species of aerobic and anaerobic bacteria, as well as viruses and fungi. More than 300 species of bacteria associated with periodontal disease alone have been isolated from the oral cavity, and between 30 to 100 species can be found at one periodontal site[1].

The spread of infection through aerosol has long been considered one of the main concerns in the dental community because of possible transmission of infectious agents and their potential effects on the health of patients and dental personnel. Even before the discovery of specific infectious agents such as bacteria and viruses, the potential infection by the airborne route was recognized[2].

"Aerosol" and "Splatter are two different terms. "Aerosol" and "Splatter" in the dental environment were used by Micik R E *et al* in his pioneering work on aerobiology[3].

Aerosols were defined as particles less than 50 micrometers in diameter. Particles of this size are small enough to stay airborne for an extended period before they settle on environmental surfaces or enter the respiratory tract.

The smaller particles of an aerosol (0.5 to 10 µm in diameter) 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.

Splatter was defined as airborne particles larger than 50 µm in diameter behaving in a ballistic manner, which are ejected forcibly from the operating site and are in a trajectory similar to that of a bullet until they contact a surface or fall to the floor. These particles are too large to become suspended in the air and hence airborne only briefly. The possible sources of airborne contamination during dental treatment are dental instrumentation, saliva and respiratory sources, and the operative site. The oral cavity harbors numerous bacteria and viruses from the respiratory tract, dental plaque, and oral fluids. Any dental procedure that has a potential to aerosolize saliva will cause airborne contamination with organisms from some or all of these sources[4].

Medium to spread aerosol

Micro-organisms may colonize dental equipment and water pipes, and form biofilms on the surfaces[5]. Bacteria and yeasts from the biofilms may produce aerosols in the dental surgery[6]. Bacterial species such as Pseudomonas aeruginosa, Pseudomonas cepacia, Legionella pneumophila and Mycobacterium chelonae have been identified in biofilms[7,8].

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[9,10]. Aerosols, sprays, and splatter generated during routine dental procedures, especially during ultrasonic and air turbine procedures, can contain blood and saliva[9],[11].

Dental hand pieces, ultrasonic scales, air polishing devices and air abrasion units produce airborne particles by the combined

action of water sprays, compressed air, organic particles, such as tissue and organic fluids, such as blood and saliva, tooth debris, dental plaque, calculus, and restorative materials.

This form of contamination also involves the personal protection equipments (PPE) defined by OSHA regulations 1992[12], as "specialized clothing or equipment worn by an employee for protection against infectious materials".

Mycobacterium tuberculosis, aerosol generation may prove a significant health hazard to dentists and their assistants[13].

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.[14,15] In Australia and New Zealand, the following procedures are recommended to minimize 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).

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 minimizing the risk of exposure[14-16].

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[15].

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[14].

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[17-21].

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[22].

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[23,24]. Hence, the use of an antimicrobial mouth rinse is an important adjunct to professional care and tooth-brushing and flossing in the home.

Various means have been investigated to prevent or reduce bacterial aerosols during dental treatment. These include use of a rubber dam, which has been shown to be highly significant in reducing contamination of the atmosphere, and giving the patient antiseptic mouth rinse before treatment[25,26].

However, in practice, it is impossible to totally eliminate bacterial aerosols during dental treatment. Furthermore, new monitoring techniques have revealed infectious agents such as Legionella spp. that may contaminate the atmosphere during dental treatment[27].

However, since it is virtually impossible to completely eliminate the risk posed by dental aerosols, it is possible to minimize the risk by layering of protective procedures along with universal barrier techniques.

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