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Research Article

AEROSOLS AND SPLATTER IN DENTISTRY

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A R T I C L E I N F O

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A B S T R A C T

As concern about indoor air quality increases, attention is being placed on the aerosol and splatter produced during dental procedures that involves airotor, ultrasonic scalers etc. With the advent of the droplet-spread disease (severe acute respiratory syndrome - SARS), the infection control procedures for aerosols is warranted. Aerosols quantify the contamination produced by ultrasonic scalers and airotors during scaling and cavity preparation procedures. When compared with the handheld curette used as a control, all ultrasonic scalers and airotor bur tips tested produced significant aerosol and splatter regardless of the type of scaler and speed of the aerator instrument. The recommended method for controlling contaminated aerosol and splatter is the use of a large-bore high-volume evacuator for ultrasonic scalers and controlled speed for airotor instrument.

INTRODUCTION

Dentist, dental hygienist and oral health care workers practices in a highly contaminated environment, which is the human mouth where they are exposed to variety of bacteria, viruses, fungi, and protozoan.[1] Dental unit is the main element of dental surgery equipment being a multifunctional set of tools, which enable dentist to perform basic procedures. It consists of dental chair, an operation lamp and spittoon. According to international standards, a dental unit has a minimum of 3 working handpiece for a dentist, i.e. a high-speed handpiece (turbine) a low-speed handpiece (micro engine with straight and contra-angle handpiece) and air-water syringe as well as a minimum of 3 handpiece for an assistant – two sucking handpiece (sucking device and saliva ejector) and an air-water syringe. Dentist's working handpiece are supplied with water through a system of thin plastic tubes, which constitute dental unit waterlines (DUWL).[1,2] Apart from that, every chair is equipped with an ultrasonic scaler unit to perform oral prophylaxis. All these equipments when used for various dental procedures can result in the formation of aerosol and splatter which are commonly contaminated with bacteria, virus, fungi and blood. The most intensive aerosol and splatter emission occurs during oral prophylaxis with ultrasonic scaler tips and during the use of bur with high speed handpiece. This article highlights mainly the potential risks that can be encountered with dental aerosols and also about the various methods used for controlling infections caused by dental aerosols.

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Dental Aerosol and Splatter

The term "aerosol" and "splatter" in the dental environment were used by Micik and colleagues in their pioneering work on Aerobiology. Aerosols are nothing but they are the combination of both solid and liquid particles.[3] These are particles less than 50 µm 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 smaller passages of lungs and are thought to carry the greatest potential for transmitting infections.[4,5] Splatter are known as airborne particles larger than 50 µm in diameter and are visible to the naked eye. Splatter particles moving along trajectories can come into contact with the mucosa of nostrils, open mouth, eyes and skin and it shows limited penetration into the respiratory system. They are deposited on hair, clothes and in the immediate surroundings of the splatter source.

Sources of Dental Aerosols and Splatter

Potential sources of air borne contamination during dental procedures are:

1. Dental Instrumentation
2. Patient (Saliva and respiratory source)
3. Operative site.

Dental instrumentation

Contamination from the dental instrumentation is due to dental unit water lines.

Instruments which can produce dental aerosol include:

a. Dental handpiece along with burs

b. Ultrasonic scaler tips
c. Polishing cups

The dentist's handpiece are usually supplied with water through a system of thin plastic tubing's which constitute the DUWL'S. The contamination of DUWL'S is due to narrow bore water lines, water stagnation, heating of dental chair unit, anti retraction valve failure and contamination of reservoir bottles. The bacterial biofilm, which forms on the surface of the DUWL tubings are very adherent.[5] This is due to the intermittent usage of the dental unit, improper cleaning and sterilization of the DUWL'S. Another factor which encourages the bacterial adherence to the surface of the tube is the material used to make the tube which is hydrophobic polymeric plastic tubing (eg: polyvinyl chloride and polyurethane).[5,6] This leads to the formation of biofilm which releases high number of planktonic organism within 8 hours followed by formation of community of micro colonies which is protected by extracellular amorphous matrix in 6 days. Microorganisms from the biofilm that shed during the usage of dental units through the DUWL to the oral cavity can lead to spread of infection. This can be minimized to a certain extent by the use of ADA-recommended methods to treat the DUWL. This can be minimized by routine cleaning and sterilization of all dental instruments except those being used with the current patient.

Patient

Dental aerosol can also be produced from the patients. The amount of contamination of dental aerosol depends on the quality of saliva, nasal and throat secretion, blood, dental plaque, periodontal infection, blood and presence of any dental infection.[7,8] Thus the composition of aerosols probably varies with each patient depending on the type and site of the dental procedure.

Operative site

The main source of infection is from the operative site. Most dental procedures that use mechanical instrumentation will produce airborne particles from the site where the instrument is used. All these instruments remove materials from the operative site that becomes aerosolized by the action of the rotary instrument, ultrasonic vibrations or the combined action of water sprays and compressed air.[9,10] The water spray usually is nothing but the portion of the aerosol (splatter) that is most visible to the naked eye and it is easily noticed by the patient as well as the dental personnel. Literature review have shown that when an ultrasonic scaler used without any coolant water there was large amount of aerosol and splatter formation.[11-14]

Risks To Dentist's And Patients

During dental procedures, the most common contaminated sites are:

1. Doctor's and assistant's masks.
2. Dental unit lamp.
3. Surfaces close to spittoons.
4. Mobile, instruments, material, tables etc.

Pathogenic Microorganisms

Commonly isolated microorganisms from the contaminated surfaces includes Streptococcus genus, which constitute 42% of total bacteria, Staphylococcus – 41%, and Gram negative bacteria – 17%. It also includes non-diptherial corynebacterium, Staphylococcus aurous (0.6%), Pseudomonas spp. (0.6%) and fungi (0.9%).[14] The oral environment which is always unique favours the growth of bacteria. Hence, the use of personnel protective equipments is very much needed. Nejabanesh. F *et al* in 2013 demonstrated that areas around nose and inner corner of the eyes are significantly at a higher rate of contamination.[15] The dental unit usually consists of DUWL'S which is considered to be the most favourable environment for biofilm formation. The microflora from DUWL and the patient's oral cavity in the form of aerosol mixes with the surrounding air thus leading to change in the original composition of the environment and also it acts as a source of infection for both the dentist as well as to patients. It can also contaminate the nearby instruments on the instrument trays, which can further act as a source of infection to the patient. Failure to attain the infection control can affect the dentist as well as the patient.

Microorganisms isolated from dental aerosols have been associated with many bacterial diseases such as tuberculosis, staphylococcal infection, conjunctivitis, viral infections and other skin infections.[16-18] The main source for these diseases is through inhalation and contact with blood and other body fluids. Among the risks, tuberculosis (TB) and severe acute respiratory syndrome (SARS) are said to be fatal. Mycobacterium tuberculosis (TB) is carried in droplet nuclei released by individuals with pulmonary or laryngeal tuberculosis disease by coughing, talking, sneezing, etc. Patients known to have active TB should be treated using special respiratory precautions so that the aerosols produced during treatment can be controlled. Patients with undiagnosed, active, infectious TB, however, remain a risk for the dental team and other patients. Similarly SARS is also transmitted via droplets, close contact and fomites. SARS (SCoV) – virus that causes severe acute respiratory syndrome is a virulent corona virus containing RNA.[19,20]

Methods to Reduce Airborne Contamination

1. Screening of patients is needed. A thorough case history should be taken as it helps in early diagnosis of the disease before the commencement of any dental procedure.
2. Immunization of dental personnel against Hepatitis A, Hepatitis B, Influenza, Mumps, Measles, Tetanus, Rubella, Tuberculosis, and whooping cough, Varicella, MMR, DPT, Rubella, Meningitis, Polio and Diphtheria for infection control should be done at proper periodic intervals.[21]
3. Provision of good ventilation with its diluting effect on the airborne microbial load.
4. Purification of airborne microbial pollutants (Disinfection with physical and chemical means).
5. Hand hygiene of the dental personnel should be maintained.
6. Minimizing biofilm formation in dental unit water lines - Use of sterile water or sterile saline. Drain and flush water for several minutes before beginning each day. Perform periodic chemical treatment as recommended by manufacturers.[22,23]
7. Proper protocols to be followed prior to any dental procedure:
    a. Use of pre-procedural rinses with water and 0.12 to 2% chlorhexidine gluconate or essential oil

containing mouthwashes for duration of 60 seconds can cause substantial reduction in bacterial counts. Gupta DG *et al* demonstrated the efficacy of pre-procedural rinsing in chlorhexidine reduce the aerosol contamination produced by ultrasonic scaling.

b. The water line has to be flushed at the start of each day and between patients, for 30 seconds to 1 minute to reduce microbial accumulation due to overnight waterline stagnation.
c. High vacuum suction/evacuator, which is correctly positioned near the handpiece and close to mouth can reduce 90% of aerosol production.
d. Use of rubber dam during conservative procedures.[24]
e. At the end of the day, the suction lines should be cleaned with ammonia or enzymatic detergent with water.

8. Surface contamination can be minimized by the usage of thin plastic bags, wraps or aluminium foils. These barriers can be placed on surfaces like dental unit light handles, electrical and mechanical controls, head and arm rest, dental unit controls and high and slow speed handpiece, ultrasonic scaler, air/water syringe, saliva ejector and hose
9. Personal hygiene of the dental personnel should be maintained.
10. Personal protective equipments to be used during dental treatment such as gloves, mouth mask, head cap, face shield, eye protective wear (goggles) and gowns. Masks should have at least 95% filtration efficiency for particles 3.0-5.0µm in diameter and should be changed for each patient.[25] Change of mask after 20 minutes in aerosol or 60 minutes in non aerosol environments is recommended.
11. Periodic evaluation of the dental office must be done for maintaining a healthy environment.

CONCLUSION

Aerosols and splatter produced during the dental procedures have the potential to spread infection to the dental personnel as well as the other people in the dental office. From a practical point of view, it is easy to remove as much airborne contamination as possible from the treatment site. But, it is difficult to completely eliminate the risk posed by dental aerosols but it is possible to minimize the risk with relatively simple and inexpensive precautions and following certain protocol prior, during and after the dental procedure. However, these preventive measures and precautions have to be monitored periodically to maintain a good and healthy dental environment.

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