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REVIEW ARTICLE

Decreasing Aerosol Contamination and Prevention of Cross Infection due to Ultrasonic Scaling

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Abstract

The oral cavity provides a unique ecosystem for the growth of bacteria. About 150 billion microorganisms are found in 1g of material of the gingival crevice of a patient with poor oral hygiene and over 6 billion present in 1ml of saliva. These microorganisms are dispersed into the surrounding environment through aerosol and splatter that is produce during ultrasonic scaling. Dental health care workers and patients come in contact with these microorganisms every day and are susceptible to infections by pathogenic bacteria, viruses and fungi. Aerosol and splatter are an occupational hazard that lacks awareness. Therefore it is important to know and practice the methods of decreasing aerosol contamination and prevention of infection spread. Using pre-procedural antiseptic mouthwash, high volume evacuation, personal protective equipment, adequate immunization of health care workers, as well as proper ventilation and airflow of a dental operatory are the universal precautions that need to be followed for infection control and prevention of disease transmission between patients and dental health care workers.

Introduction

Ultrasonic scaling has become part of the daily task in a dentists' job for oral prophylaxis. Ultrasonic scaling has its advantage over the conventional mechanical hand scaling as it reduces the chair time for each patient, increases the efficacy of the dentist or dental hygienist and also reduces fatigue for both dentist and dental hygienist. Unfortunately, it also brings about the disadvantage of high aerosol and splatter production which is commonly overlooked by most health care professionals in this field of expertise. Ultrasonic scalers are combined with water spray which generates a substantial mass of droplets, also known as aerosol and splatter, containing body fluids such as blood and saliva including microbes. Aerosol and splatter are commonly contaminated with minute particles that are not visible to the naked eye, such as bacteria, viruses, fungi, and often laced with blood.

Aerosols are defined as liquid or solid particles, which are 50µm or less in diameter, suspended in air. Aerosols remain in the atmosphere for a long time and are able to move with air flow over a long distance. It is also capable of penetrating deep into the respiratory system, reaching as far as the pulmonary alveoli.[1,2] This increases the risk of transmission of airborne infections to dental health care workers as well as patients.

Splatter is described as a mixture of air, water and/or solid substances, such as dental calculus, dental fillings, carious tissue, sandblasting powder, etc. Water droplets that form splatter are between 50µm to several millimetres in diameter and are visible to the naked eye. Splatter moves along trajectories and comes to rest in contact with the surrounding area. It may be mucosa of the mouth, eyes, nostrils and skin, or clothes and also surrounding objects. The range of splatter is from 15cm to 120cm of the patient's oral cavity. It has limited penetration into the respiratory system.[2,3]

Ultrasonic scaler generates aerosol with bacteria peaking over 300 CFU/cubic feet of a dental clinic.[4] Face shields worn in periodontal surgeries where ultrasonic scaling was done received an average of 3 splatters/mm^2.[5] A study

showed that ultrasonic scalers spread splatters of fluorescein dye up to 25 inches away from a dental model.[6] It was demonstrated that aerosols remained detectable in the air for at least 10 minutes following the completion of a procedure and were detected at 2 feet or more from the dental chair.[7] There is also an increase by 230% of aerosol droplets after an ultrasonic scaling procedure. In addition to that, bacterial count in air increased by 30 fold during ultrasonic scaling.[8]Such data indicates that it is important to control the production of aerosol and splatter during ultrasonic scaling to prevent cross contamination in the dental office.

DECREASING AEROSOL CONTAMINATION

The first step of aerosol control is to reduce the emission of contaminated particle to the surrounding atmosphere. However, methods to minimize the formation of aerosols during ultrasonic scaling are limited. High volume evacuator used together with an ultrasonic scaler can minimize aerosol contamination up to 93% during ultrasonic scaling.[6]A combination of pre-procedural mouthrinsing and high volume evacuator attachment is more effective in reducing the number of viable aerosol produced during ultrasonic scaling.[9] Ultrasonic scaler inserts have been designed to have the cooling water exit through the tip of the scaler. This reduces aerosol contamination as it focuses the spray produced.[10]

REDUCING NUMBER OF VIABLE BACTERIA IN AEROSOL

Pre-procedural antiseptic mouth rinses aid the control of infection in aerosols and is able to decrease the colony forming units up to 94% compared to a non-rinsed control. A study showed that mouth rinsing 40 minutes prior to ultrasonic scaling significantly reduced the bacteria in aerosol formed during the procedure.[11] Chlorhexidine gluconate was found to be more effective than other solutions.[12]

"Do not disinfect when sterilization is possible." This is an important principal to follow for every dental equipment used in a dental practice, including ultrasonic scaler tips.[13] Sterilization prevents patient to patient cross infections.[14]

Water is used as a coolant for ultrasonic scaling to prevent damage to the patient's teeth and control the rise in temperature of the scaler tip and handle in an ultrasonic unit. Bacterial growth can be seen the water lines that are channelling the water. Quality of water flowing to these ultrasonic scalers should meet the requirements of potable water. Hence, measures to ensure this water quality should be taken into consideration by various water decontamination methods.[15,16,17]

Dental units should be rinsed at the beginning of the day to eliminate microflora whose presence is due to night stagnation. It should also be rinsed for 20-30 seconds between patients to reduce the risk of retraction of oral fluids as well as reduce the risk of potential cross infection.[13]

Closed water systems are recommended for dental unit water lines. To ensure the safety of patients that are exposed to this water, the water reservoir should be cleaned regularly, disinfected (broad spectrum antimicrobial such as chlorhexidine gluconate, povidone iodine, glutaryldehyde, ethanol, hypochlorite and peroxide[18]) and possibly sterilized. Filling it with distilled water has its advantages. Application of chemicals to monitor the microbiological quality of water assures effective microbiological control of the water.[19]

Dental units that have a system to heat water to temperature of the human body should not be used as it facilitates the growth of microorganisms especially human pathogens.[20]

ELIMINATING CONTAMINATED PARTICLES FROM THE AIR

Contaminated particles should be eliminated from the air before it leaves the spaces directly surrounding the area of treatment. Ventilation systems are effective in controlling the transmission of airborne diseases in an indoor environment. Airflow pattern is important in controlling and preventing the spread of these diseases.[21] Downward ventilation systems are used in airborne infection isolation rooms and have been recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 2003) and the Center for Disease Control and Prevention 2003.[22]

Proper air conditioning system is ideal to control atmosphere contamination. Central air conditioning systems are not encouraged as mixing of air may result in cross infection between occupants in different rooms.[22] Appropriate air filters should be fitted in air conditioning devices and cleaned or replaced regularly. These steps help reduce contamination and prevent circulation of microbiologically contaminated air.[13]

Air cleaners can be used to control aerosol dispersion. Position of air cleaners is important for it to be effective. It is found that the placement of an air cleaner near the source of aerosol formation and the suitable relative position of the air cleaner, source and dental health care worker is effective in reducing the emission of aerosol to the surrounding atmosphere.[22]

Irradiation with light emitting ultra-violet radiation can be used for air disinfection. Wavelength range of 250nm to 265nm is used, it more commonly known as UV-C. Light of wavelength 254nm demonstrates high fungicidal, viricidal and bactericidal action through the destruction of DNA chain and protein denaturation. Sanitary and epidemiological regulations states that UV lamps are an obligatory dental surgery equipment.[13]

PROTECTIVE MEASURES FOR DENTAL HEALTH CARE WORKERS

Dental health care workers should be immunized against biological hazards of the workplace through specific or non-specific immunizations. Specific immunizations are vaccines such as for hepatitis A, hepatitis B, influenza, mumps, measles, tetanus, rubella, tuberculosis, whooping cough, varicella, DPT, meningitis, polio and diphtheria. It should be done by professionals at the proper recommended intervals.[23]Non-specific immunization is with gamma-globulins.

General hand washing with plain soap and water is to be done by every dental health care worker religiously before and after treating a patient, including before and after wearing gloves. Antimicrobial surgical hand scrub should be used if bare hands have come in contact with blood, saliva and/or respiratory secretions.[24]

Dental health care workers should routinely use personal protective equipment during dental treatment such as gloves, mouth mask, head cap, face shield, protective eye wear and gowns. These should be basic prevention methods done on a daily basis and has been proven to decrease the penetration of and reduce contact with bacterial aerosols and splatter.[25] For patients who are in active stages of infectious diseases, postponement of treatment is ideal if possible.[26]

PROTECTIVE MEASURES FOR PATIENTS

A complete and detailed medical and dental history of a patient prior to treatment should be recorded. Extra precautions to be taken for patients who have a greater risk of infectivity e.g. patient with present lung abscess or enterovirus infection will have more infectious respiratory secretions. Immunocompromised patients e.g. patient that have had a recent organ transplant or has developed acute immune deficiency syndrome (AIDS) should be treated with extra care as to prevent cross infection.

Vaccination status of the patient should be enquired to identify the immune status of patient. Patient who has a current infection that is able to spread through respiratory secretions should be given a regimen of antibiotics to reduce infectivity as well as decrease viable bacteria present in secretions before proceeding with treatment plan.

Patient position during dental treatment is important. Patient should be treated in a supine position so that the doctor can avoid work in the breath way of a patient.[13] Patient drape and protective eye wear should be worn by patient during treatment to prevent aerosols and splatter from coming into contact with skin and clothes as well as penetrating the eyes.

Conclusion

Awareness about the dangers of aerosol and its hazards should be spread, not only to dental health care workers but also to patients and dental students. Specific measures should be taken to control and decrease aerosol production. Also, adequate steps should be taken to prevent cross infection between dental health care workers and patients in the dental environment.

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