International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Dental Aerosols: A Silent Hazard in Dentistry!

Rosiline James[1], Amit Mani[2]

[1] Post Graduate Student, Rural Dental College, Pravara Institute of Medical Sciences, Loni, Ahmednagar, India

[2] Professor, Rural Dental College, Pravara Institute of Medical Sciences, Loni, Ahmednagar, India

Abstract: ***Dental aerosol as an infection vector is totally ignored. Aerosols are liquid and solid particles, 50 micron or less in diameter, suspended in air where as splatter is usually described as a mixture of air, water and/or solid substances; water droplets in splatter are from 50 micron to several millimeters in diameter and are visible to the naked eye. Both are produced with the use of dental unit hand pieces and are commonly contaminated with bacteria, viruses, fungi, often also with blood. The most intensive aerosol and splatter emission occurs during the work of an ultrasonic scaler tip and a bur on a high-speed hand piece. Air-water aerosol produced during dental treatment procedures emerges from a patient's mouth and mixes with the surrounding air, thus influencing its composition. The air contained in this space is the air breathed by both dentist and patient, its composition is extremely important as a potential threat to the dentist's health as well as to the patient and the dental assistant. In this review, the author describes about the formation of dental bio aerosols, its hazardous nature to the clinician, patient and the assistant and also the protective measure against it thereby preventing it.***

Keywords: dental aerosols, bio aerosols, splatter

1. Introduction

Bio aerosols can be defined as airborne particles of liquid or volatile compounds that contain living organisms or have been released from living organisms. Bio aerosols is a recognized consequence of certain types of dental treatment and represents a potential mechanism for the spread of infection [1].

Spread of infection through splatter and aerosol is considered a major risk factor for the dental professionals because of transmission of the infection from the patient to health care providers. Various dental equipment such as the dental hand pieces, air–water syringes, ultrasonic scalers, and air polishing units are known to produce the aerosols during the procedures, and they produce many folds increase in colony forming units (CFUs) when compared to pre- and post-operatively. Aerosols are the suspension of liquid or solid particles containing viruses and bacteria which are suspended in gas for few seconds. The size of the particle may vary from 0.001 mm to more than 100 µm. The smallest particle size (ranging between 0.5 µm and 10 µm) has the greatest potential to penetrate the respiratory passages and the lungs, possessing the ability to transmit the disease. Periodontal disease, being multi factorial in nature, the oral cavity harbors millions of bacteria and viruses from the respiratory tract, saliva, and dental plaque. These microorganisms get aerosolized when come in contact with the dental equipment. Miller in a study concluded that aerosols generated from the patients' mouth contain millions of bacteria per cubic foot of air. King et al. reported that could be recovered 6 inches from the mouth of patient and the CFUs formed were significantly reduced when aerosol reduction device was used. Aerosols may not only contain bacteria but also HIV virus and mycobacterium tuberculosis [2]. The most intensive aerosol and splatter emission occurs during the work of an ultrasonic scaler tip and of a bur on a high-speed hand piece.

During conservative treatment and professional oral hygiene procedures, the sites showing the highest microbiological contamination due to aerosol and splatter doctor's and assistant's masks, a unit lamp, surfaces close to spittoons, and mobile instrument material tables. The main contamination route involves inhalation of Infectious particles that remain suspended in air, settle on surfaces and are re aspirated [5].

2. Contents of Dental Aerosols

Aerosols may accommodate micro organisms like multi-resistant Staphylococcus aureus, influenza, legionnaire's disease, pneumonia, mumps, chicken pox, cytomegalovirus infection, hepatitis B and C virus infection, herpes simplex virus Types 1 and 2 infection, human immunodeficiency virus etc [3].They may also harbor mycotoxins, fungal cells such as molds, spores, yeasts, saliva, blood, protozoa {Acanthomoa spp, Cryptosporidium spp Microsporidium spp, Giardia spp} and dead cell debris.

3. Susceptible Areas of Bio Aerosol Contamination

1) The dental clinician
2) The assistant
3) Patient
4) Dental instruments, dental handpieces along with burs, Ultrasonic scaler tips, Polishing cups
5) The dental clinic on the whole

Dental aerosols may stay in the dental clinic as long as 30 minutes

3.1 Table

Condition	*Habitat*	*Routes of transmission*
Common cold	Upper Respiratory tract	Aerosol, contact
Sinusitis	Upper Respiratory tract	Aerosol, droplet
Pharangitis	Upper Respiratory tract	Aerosol, droplet
Pneumonia	Respiratory tract	Aerosol, droplet
Tuberculosis	Respiratory tract	Aerosol, droplet
SARS	Respiratory tract	Aerosol, droplet, Intimate contact
Avian influenza (H5N1 flu)	Respiratory tract	Aerosol, droplet, Intimate contact
Avian influenza (swine flu)	Respiratory tract	Aerosol, droplet, Intimate contact

[Raghunath *et al.; BMRJ, 14(2): 1-8, 2016; Article no.BMRJ.24101*]

4. Airborne Infection

The role of the air as a carrier of infection is seen in Tuberculosis, measles, severe acute respiratory syndrome, multi-resistant Staphylococcus aureus, influenza, legionnaires disease, pneumonia, mumps, chicken pox, cytomegalovirus infection, hepatitis B and C virus infection, herpes simplex virus Types 1 and 2 infection, human immunodeficiency virus, etc. The dispersion of bacteria and viruses (reservoir being mouth with saliva, blood, sub gingival fluids, and moisture from the nasopharynx) into the air due to coughing, sneezing, general exhalation, and exacerbated by the use of the high-speed instruments such as ultrasonic scalers and hand pieces starts the chain of air-borne infection. During dental treatment, several thousand droplets are aerosolized. The larger droplets fall quickly to the floor and onto other surfaces, the smaller droplets evaporate quickly, leaving dry microscopic droplet nuclei which remain suspended in the air for extended periods of time and require prolonged hours to settle down. The bacteria and viruses become highly mobile in the air and circulate from one room to another by convection currents. Microorganisms in excess of 5 times that of outdoor air are present in dental surgery units [3].

5. Measures to be taken by the Dentist

When the patient enters the dental clinic, every attempt should be made from the dentist's end to avoid cross contamination. A thorough case history, clinical examination and all the necessary investigations should be carried out. The dental team should be vaccinated, protective equipment which include gloves (latex gloves or vinyl gloves, general purpose utility gloves or surgeon's sterile gloves), gowns, face shields, hair protection, mouth masks (preferably with fluid shield), and goggles/eye wear are the other preventive steps to be taken.

Preprocedural rinses with water and 0.12 to 2% chlorhexine gluconate or essential oil containing mouthwashes for duration of 60 seconds can cause substantial reduction in bacterial counts.

The water line has to be flushed at the start of each clinical day and between patients, for 30 seconds to 1 minute to reduce microbial accumulation due to overnight waterline stagnation.

High vacuum suction/evacuator which is correctly positioned near the handpiece and close to the mouth can reduce 90% of aerosol production.

Use of rubber dam during conservative procedures [4].

6. Prevention of Bio aerosol Contamination in the Clinic

Four technologies that target the decontamination of air are:

a. Filtration or decontamination - Through high-efficiency particulate arrestor (HEPA) filters.

b. Ozonization — Subjection of air to high voltage charges. resulting in the separation of adjacent oxygen atoms which brings about the creation of the ozone isotope. Ozone molecules being highly reactive, when they come into contact with microorganisms they react, rendering them harmless. However, the amount of ozone required to destroy pathogens in the air would present a health risk to dental personnel and patients.

c. Ionization - It uses charged electrodes to project negative ions into the air. The microorganisms floating in the air attract these negatively charged ions and become heavier as a result and then precipitate onto surfaces. However, the microorganisms are not destroyed through this process. They remain viable and thus require further treatment through some more conventional form of disinfection.

d. Air sterilization — By use of ultraviolet irradiation, the DNA of all bacteria and viruses are ruptured, thus, rendering them sterile and incapable of reproduction [3].

The dental clinic should be fumigated with formaldehyde on regular basis.

Approaches in risk reduction for DUWL { Dental unit waterlines} can be broadly divided into:-

Non chemical approach and Chemical approach

Non chemical approaches include flushing of DUWL water, improving the quality of water, using anti retraction valves and retrograde aspiration. An autoclavable assembly of water reservoir which is made up of silicon multilumen dental unit water line tubing and fittings has been designed to be sterilized between patients which has been approved by Food and Drug administration and helps in providing secure and sterile water system. Physical cleaning can be done by using sponges or balls, making them pass through the pipeline at high pressure in order to remove the biofilm and destroy biofouling.

Chemical approach includes the use of chemical disinfectants which have broad spectrum anti-microbial activity like chlorhexidine gluconate, povidine iodine, glutaraldehyde, ethanol, hypochlorite and peroxide.

Sterilization and disinfection - external sterility of dental handpiece can be achieved with autoclaving whereas internal sterility can be achieved by chemiclave . This is because the

spores inside the high speed handpieces may survive autoclaving therefore it has to be treated internally with chemical disinfectant.

At the end of the day, the suction lines should be cleaned with ammonia or enzymatic detergent with water.

Surface contamination can be minimized by the usage of thin plastic bags, wraps or aluminium foils which 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 hand piece, ultrasonic scaler, air/water syringe, saliva ejector and HVE hose [4]

7. Conclusions

Dental fraternities are highly exposed to the hazardous effects of the aerosols and splatter produced during dental procedures. It is virtually impossible to completely eliminate the risk posed by dental aerosols, minimizing the risk by adopting protective procedures along with universal barrier techniques together with immunization protocol requires attention [5].

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