

AEROSOL FREE PROSTHODONTIA DURING COVID 19 REALITY- FACT- FUTURE

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ABSTRACT

A dentist's life will never be the same as what it was before COVID-19 & after COVID-19. The serious implications on cross infection ensure that the use of the indispensable air turbine drills and ultrasonic devices that induce aerosol would be restricted. A large number of operative procedures entail the use of conventional high-speed drills and now onwards we might have to be without them. And moreover we, The prosthodontist cannot imagine a work life without the air turbine hand piece.

So, The Prosthodontist can decide what we are going to think in any given situation. Our thoughts and techniques determine our prosthodontic practises and determine the results what we will get. It all starts with our thoughts & safety measurements. This article summarises the reality, facts & future of aerosol free prosthodontic protocols.

KEY WORDS

Aerosol, Aerosol transmission in dentistry, Airborne Infection, Prevention of Bioaerosol

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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 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; 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 and the dental assistant: a potent threat. 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 μ m. The smallest particle size (ranging between 0.5 μ m and 10 μ m) has the greatest potential to penetrate the respiratory passages and the lungs, possessing the ability to transmit the disease.²

Since its emergence in December 2019, corona virus disease 2019 (COVID-19) has impacted several countries and making it a global public threat. The routes of transmission are direct contact, and droplet and possible aerosol transmissions. Understanding the significance of aerosol transmission and its implications in general dentistry and in prosthodontics can facilitate the identification and correction of negligence in daily dental practice.

As stated in the 6th Edition of COVID-19 Treatment Regimen (Trial Implementation)³ published by the National Health Commission of the People's Republic of China (2020), the possible routes of Covid 19 transmission are mainly direct contact and droplet transmission & in a relatively closed environment.

Aerosol transmission and its implication in dentistry

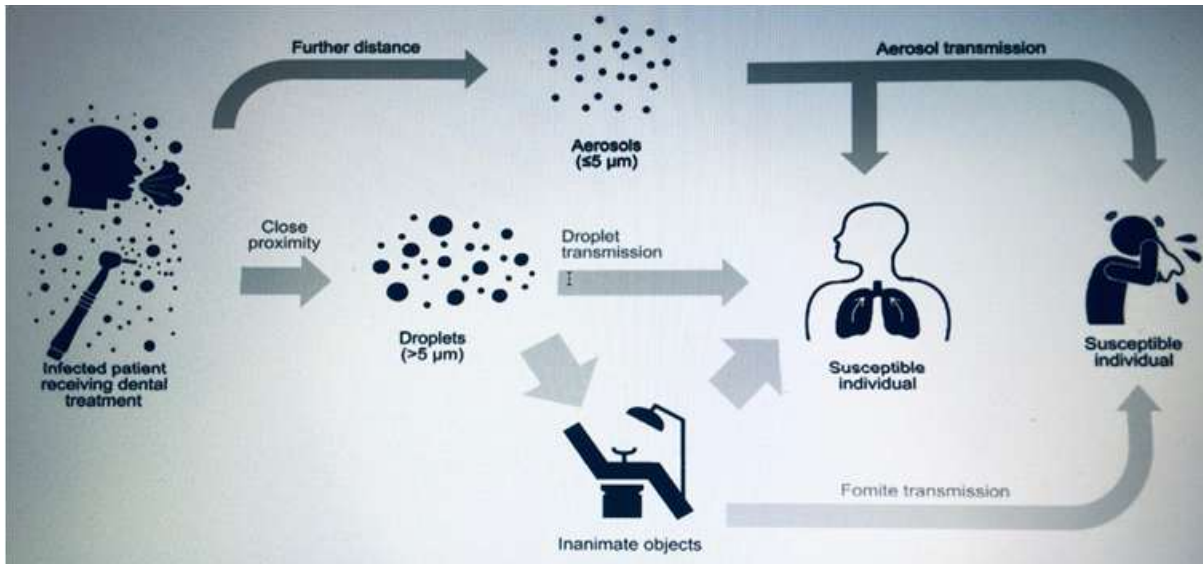


Figure 1: Different route of transmission in dental setting : aerosol, droplet and fomite

Droplets and aerosols and their significance in the transmission of diseases

When a person coughs, sneezes, laughs, or talks, large (>5 μm diameter) and small (≤5 μm diameter) droplets or aerosols are generated. Due to gravity, larger droplets fall to the ground quickly. On the other hand, small droplets or small particle residues of evaporated droplets have a low settling velocity, so they may remain in the air for a longer time and travel further before they can enter the respiratory tract or contaminate surfaces (WHO, 2014)⁴ (Fig. 1). Some studies have shown that aerosols from highly virulent pathogens like severe acute respiratory syndrome-coronavirus (SARS- CoV) can travel more than six feet (Kutter et al., 2018).⁵

Contaminated surfaces have been found to be a route of transmission of several nosocomial pathogens (Otter et al., 2013).⁶ Several studies have reported that SARS-CoV and (MERS-CoV) persist on a surface for a few days, particularly when suspended in human secretion, and undergo onward transmission (Kramer et al., 20067 ; Otter et al.,

2013).⁶ Hand contact with contaminated surfaces may lead to pathogen acquisition and transfer to the eyes, nose, or mouth, resulting in a new case of infection (Otter et al., 2013).⁶

Droplets and aerosols in dental setting

Highspeed handpiece creates excessive heat & to prevent heat gain water coolant is required during dental procedures (Farah, 2019),⁸ as shown in Fig. 2. The water coolant generates aerosols which combine with bodily fluids creating bio-aerosols.

These bioaerosols are commonly contaminated with bacteria, fungi, and viruses having potential to float in the air for a considerable amount of time and be inhaled by the dentists or other patients (Grenier, 1995; Jones and Brosseau, 2015).⁹

In terms of coronavirus, a study conducted by Wang et al. (2004) examined the oral cavity of SARS patients and found large amount of SARS-CoV RNA in their saliva (7.08×10³)to (6.38×10⁸) copies/mL,

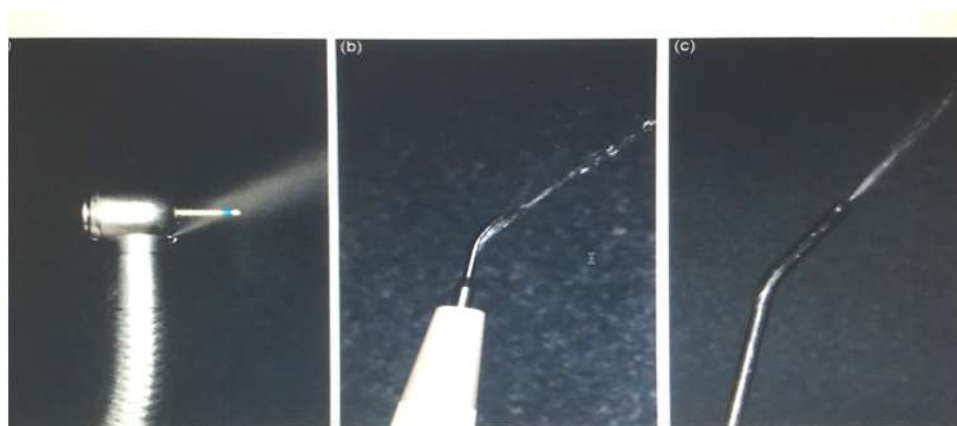


Figure 2: Aerosols generated by dental high-speed handpoece (a), ultrasonic scaler (b), and air-water syringe (c)

suggesting the possibility of coronavirus transmission through oral droplets¹⁰.

Current infection control guidelines for prevention of transmission of disease specific to Covid-19 should be followed as advised by The Indian Dental Association (www.ida.org.in)¹¹ Indian Prosthodontic Society (www.ips.online.in), American Dental Association (www.ada.org).

Susceptible Areas of Bio Contamination Aerosol

- 1) The dental clinician, 2) The assistant, 3) Patient
- 4) Dental instruments, dental hand pieces along with burs, 5) The dental clinic on the whole

Dental aerosols may stay in the dental clinic as long as 30 minutes¹²

Airborne Infection

During prosthodontic treatment like crown preparation 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 Microorganisms in excess of 5 times that of outdoor air are present in dental surgery units¹³.

1. Patient screening: As is the routine, dentists should take a thorough medical history from each patient and confirm the health status at each recall visit. Targeted screening questions for COVID-19 must be asked. Temperature and lower respiratory tract symptoms should be closely monitored. For suspected/confirmed cases of COVID-19 requiring urgent dental treatment, highest level of personal protection should be implemented. WHO (2020a)¹⁴ recommends the use of a negative pressure room with a minimum of 12 air changes per hour or at least 160 L/s per patient.

2. Waiting area

Patients should be placed in an adequately ventilated waiting area. For rooms with natural ventilation, 60 L/s per patient is considered adequate ventilation (Atkinson et al., 2009)¹⁵. Spatial separation of at least 1m should be maintained between patients. Equipment such as blood pressure cuffs and thermometers should be cleaned and disinfected with 70% ethyl alcohol after each use, as recommended by the WHO (2016)¹⁶.

3. Hand hygiene

The WHO (2020c)¹⁷ stated that hand hygiene includes either cleansing hands with 70%–90% alcohol-based hand rubs or with soap and water. As suggested by WHO (2009)¹⁸, hand hygiene should be performed before touching a patient, before any cleaning or aseptic procedure is performed, after exposure to body fluid, after touching a patient, and after touching a patient's surroundings.

4. Personal protective equipment

During dental practices, the spread of oral microorganisms mostly radiates toward the dentist's face, particularly in the inner part of the eyes and around the nose, which are important areas for infection transmission (Bentley et al., 1994; Nejatidanesh et al., 2013)¹⁹

Protective eyewear and face shields: It is clinically evident that COVID-19 may also be transmitted through contact with the mucous membranes in eyes, as infectious droplets could easily contaminate the human conjunctiva (Lu et al., 2020)²⁰. During dental procedure, protective eyewear or face shield should be worn throughout the treatment and disinfected between patients.

Face masks: surgical or procedure mask was used if working at a distance of less than 1 m from the patient. Use of particulate respirator National Institute for Occupational Safety and Health (NIOSH)-certified N95, European Standard Filtering Face Piece 2 (EU FFP2), or equivalent is must.

5. Preprocedural mouth rinse

Preprocedural mouth rinse with 0.12 to 2% chlorhexine gluconate for duration of 60 seconds is one of the most effective methods of reducing the proportion of microorganisms in oral aerosols (Samaranayake and Peiris, 2004; Feres et al., 2010)²¹. It has been proven that CHX is effective against several infectious viruses, including herpes simple virus (HSV), human immunodeficiency virus (HIV), and hepatitis B virus (HBV) (Wood and Payne, 1998)²²

6. Rubber dam isolation- If the rubber dam is placed correctly, the only source of contamination would be the tooth that is undergoing treatment (Harrel and Molinari, 2004)²³. Rubber dam is applied in all aerosol-generating procedures.

Prevention of Bioaerosol Contamination in the Clinic

Four technologies that target the decontamination of air are:

(a) Filtration or decontamination-

High-volume evacuator filter : It is a suction device that helps remove air at rate of up to 2.83 mper minute. It is the easiest way to remove dental aerosols as they are generated and could effectively reduce contamination caused by the operating site by 90% (Narayana et al., 2016)²⁴.

High-Efficiency Particulate Arrestor : It is an air filtration device that can remove 99.97% of the particles measuring 0.3 μm in diameter. One disadvantage is that the filter may become a source of microbes if the retained microorganisms proliferate and enter back into the filtered air (Chuaybamroong et al., 2010)²⁵. In addition, soiled HEPA filters are

difficult to clean and expensive to replace (Day et al., 2018)²⁶.

Adequately ventilated single rooms & negative pressure rooms with minimum of 12 air changes per hour or at least 160 litres/second/patient in facilities with natural ventilation is required. Avoid the presence of unnecessary individuals in the room²⁷.

(b) Ozonization

(c) Ionization

(d) Air sterilization - By use of ultraviolet irradiation, the DNA of all bacteria and viruses are ruptured, thus, rendering them sterile and incapable of reproduction²⁸ & fumigation with formaldehyde on regular basis.

Risk reduction for Dental unit waterlines

• Non chemical approach and Chemical approach

Improving the quality of water, using anti retraction valves and retrograde aspiration.

Physical cleaning

• Chemical approach-By using chemical disinfectants like chlorhexidine gluconate, povidine iodine, glutaraldehyde, ethanol, hypochlorite and peroxide.

• Environmental surface disinfection

Surrounding surfaces can be efficiently inactivated by surface disinfects within one minute with 62%–71% ethanol, 0.5% hydrogen peroxide, and 0.1% (1 g/L) sodium hypochlorite (Kampf et al., 2020)²⁹.

Strategies to reduce droplet generation during Prosthodontic treatment

Salivary suction & Selection and adjustment of trays to the right size for impression. During removable partial denture or complete denture try-in, avoid touching other objects in the dental office after contacting patients' saliva.

Upon removal from patient's mouth, dental prosthesis, impressions, and other prosthodontic materials should be thoroughly disinfected by a disinfectant having at least intermediate level activity

All procedures enlisted are to be performed³¹

1. Use of Clinical micro motor and a contra angled hand piece with latch type burs without water or irrigation & working position -11 o'clock or 12 o'clock position.
2. Reducing the air pressure on the three-way syringe to a minimum

Procedures to be completely avoided are

1. Full coverage crowns needing extensive reduction of teeth
2. Crown and bridge restorations

Monoblocking with composite resin³¹, Stainless steel crown Prepress indirect veneers³¹-Lab fabricated veneers with minimal thickness can be fabricated.

Direct composite restorations :

Diastema Closure & Multiple teeth build ups with composite resin

Removable denture fabrication can be done.

Fractured prosthesis can be removed using controlled force with crown remover under split dam technique³⁰.

Recementation of dislodged crowns/bridges can be done.

BONDED RESTORATIONS FOR MISSING ANTERIOR TEETH^{31,36}

1. Maryland bridge
2. Fibre reinforced bridge
3. Lithium disilicate bonded bridge

Digital impression preferred over conventional impression.

IMPLANT PLACEMENT PROTOCOLS³¹: Implant surgeries should be postponed as far as possible. CBCT data is mandatory for carrying out implant placement surgeries during this period.

DISINFECTION PROTOCOLS

American Dental Association (ADA) guidelines state that impressions should be rinsed to remove saliva, blood and debris and then disinfected before being sent to the laboratory.

Impression disinfection³²: Immersion in disinfectant is better than spraying that increases risk for assistants. Immersion is more likely to assure exposure of all surfaces of the impression to the disinfectant for the recommended time.^{33,35}

ADA-recommended disinfectants

Chlorine compounds such as sodium hypochlorite solutions (1:10 dilution), iodophors, combination synthetic phenolics such as phenyl phenol 9%, O- benzyl-p-chlorophenol 1% and aldehydes such as formaldehydes and gluteraldehydes³⁴.

CONCLUSIONS

The emergence of COVID-19 has brought new challenges and responsibilities to dental professionals as well as prosthodontist. Standard precautions, implementation of special precautions could prevent disease transmission from asymptomatic carriers. Dental fraternities and moreover prosthodontists 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 attention³⁶

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