



Infection Control in Endodontics During COVID Era: A Review

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The outbreak of the SARS-CoV-2 pandemic has continued to affect people's lives on a global scale. When the number of infected cases decreased, several countries across the world lifted their lock-down controls and started to open. But the latest re-emergence of COVID-19 cases across Europe once again prompted nations to step back to contain the virus spread. The most prevalent route of transmission is through aerosols and droplet inhalation, which is crucial for dental health workers as most dental procedures generate significant amounts of droplets and aerosols. Thus, it is imperative to follow infection control strategies and patient management protocols to ensure optimum dental care and at the same time prevent nosocomial infection in dental settings. This review provides an insight into the steps taken for infection control and prevention from COVID-19 transmission in endodontic practices.

KEYWORDS: COVID-19, Personal Protective Equipment (PPE), Aerosol, Infection Control

INTRODUCTION

A new coronavirus of unknown origin was discovered in Wuhan, China, in December 2019.¹ On 11th March 2020, the World Health Organization (WHO) declared the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as pandemic due to the public health threat.² Coronaviruses belong to the family of Coronaviridae, of the order Nidovirales, comprising enveloped, non-segmented, positive-sense RNA as their genome. They are subcategorized into four genera, namely Alphacoronavirus (α -CoV), Betacoronavirus (β -CoV), Gammacoronavirus (γ -CoV) and Deltacoronavirus δ -CoV. The α -CoV and β -CoV are known to infect the humans and mammals, while γ -CoV and δ -CoV cause infections among birds.³ Coronaviruses is characterized by the club-shaped spike projections emanating from the surface of the virion giving an appearance of solar corona, suggesting the name, coronaviruses.⁴ SARS-CoV, and MERS-CoV have caused pandemics in humans 2002-2003 and 2012 respectively. The outbreak of Severe Acute Respiratory Syndrome (SARS) was first reported in China and Middle East Respiratory Syndrome (MERS) first emerged in Saudi Arabia and subsequently spread to other countries.⁵

TRANSMISSION

Human-to - human SARS-CoV transmissions have been reported to occur through the coupling between the receptor-binding domain of virus spikes and the cellular receptor known as the angiotensin-converting

enzyme 2 receptor.⁶ Notably, the pattern of COVID-19 spikes in the receptor-binding domain is similar to that of SARS-CoV and pair-wise protein sequence analysis found that it belonged to the SARS-related coronavirus. Entry into the host cell is through the same receptor, ACE2 in both COVID- 19 and SARS-CoV.⁷

POSSIBLE ROUTES OF TRANSMISSION

Human-to-human transmission: Current evidence shows that there is a human to human transmission of COVID-19⁸, implying that it is the main mode of transmission of the disease. Patients with signs of COVID-19 will usually spread the disease to those in near contact.^{9,10} However, several patients with COVID-19 are asymptomatic and can act as carriers and unknowingly transmit the virus.

Direct contact transmission: Respiratory secretions or droplets released by infected individuals may contaminate surfaces and objects creating fomites. Depending on the atmospheric conditions like humidity, temperature, type of surface, the possibility to find large concentrations of viable SARS -CoV-2 virus, is high in health care centres where coronavirus infected patients are being treated. Transmission can often occur indirectly by interaction with materials in the immediate surroundings or virus-contaminated items from the infected person accompanied by contact with the mouth, nose, or eyes.¹¹



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Aerosol transmission: The aerosols generated from coughs and sneezes that infect the immediate surrounding are among media for virus spread.¹² Aerosol transmission from both symptomatic and asymptomatic COVID-19 positive patients can be source of infection.¹³

Droplet Transmission Respiratory droplets are greater than 5-10 µm in diameter while those less than 5 µm are classified as aerosols or droplet nuclei. Transmission through these droplets occurs when a person comes in close contact with an infected subject with respiratory symptoms. Respiratory droplets containing virus can reach the mucous membrane of oral cavity, nose or eyes of a susceptible person and can lead to infection.¹¹

TRANSMISSION ROUTE AMONG DENTISTS

Airborne spread: In a dental setting, the various procedures involving the use of high-speed handpiece or ultrasonic instruments may cause patient secretions, saliva, or blood to aerosolize the virus into the surroundings. Thus, droplet and aerosol transmission from the COVID-19 patients are the most important concerns in dental clinics and hospitals.¹²

Contact spread: A dental professional's direct or indirect contact with human fluids, patient products, and infected dental instruments or environmental surfaces can contribute to the spread of viruses.¹⁴

Contaminated surfaces spread: Coronaviruses can survive for up to 9 days on inanimate surfaces like plastic, metals, glass and fibres. It stands contagious for around three hours in air and up to 4 hours, 24 hours, 48 hours and 72 hours on copper, cardboard, steel and plastic respectively. Therefore, contaminated surfaces that are frequently contacted in healthcare settings act as a potential source of infection.¹⁵

Usually, root canal treatment requires a number of endodontic instruments and equipment, thereby reducing unnecessary hand contact with surfaces and equipment in the dental clinic can reduce the risk of fomite transmission.¹⁶

INFECTION CONTROL IN DENTAL SETTING

Infection control measures should address modes of transmission and persistence of the virus in the air and on the surface. Being compliant with the standard

precautions is the prime rule, assuming each and every subject visiting the setting as a potential source of infection.

Telephonic triage: Telephonic triage should be made to all the patients in need of dental care based on their signs and symptoms. Effective pharmaceuticals and comprehensive home care guidance should be provided via teledentistry when dental treatment can be postponed.¹⁷ Indian dental association (IDA) recommends teleconsulting, which is a wide range of technologies and tactics designed to deliver virtual medical, health and education services. Telehealth is not a particular program, but a set of means to strengthen the delivery of treatment and education. Teledentistry refers to the use of telehealth services and dentistry methodologies. During this pandemic, our goal as dental providers is to use telecommunications technologies to triage patients and perform problem-oriented assessments in order to restrict office visits to urgent or emergency treatment. This will promote the provision of advice and the success of triage.¹⁸

Waiting area: Social distancing, the new normal should be included in the dental practice. A poster or standee describing cough etiquette instruction should be placed at the entrance of the waiting area. The detailed instructions should include the correct use of tissue napkins to cover nose and mouth while coughing or sneezing and proper disposal of these napkins and other contaminated articles in the waste receptacles. Also, instructions should be provided to ensure adequate hand hygiene.¹⁶ Ideally, patients can wear their own fabric facemask covering upon arrival at the hospital and during their stay. If they do not have a facemask covering, as resources allow, a facemask or fabric face covering can be provided to them. In the patient care area, patients can remove their cloth facemask cover, but they should put it back on when leaving at the end of the dental procedure.¹⁷

Hand hygiene: Proper hand hygiene is a prerequisite in destroying SARS-CoV-2, as soap and detergent break the outer fatty layer of the virus. Rubbing hands for at least 20 seconds will essentially dissolve the fat layer while the remaining protein molecule will dissolve on its own. Hand hygiene should be done before and after contacting the patient, before performing any aseptic procedure and after exposure to any body fluid.¹⁹

PPE: Personal Protective Equipment known as the PPE kit is a fundamental element that forms an effective barrier against the aerosols generated from the operative site and limits their transmission. Gowns/coverall shield the torso of healthcare providers. Coverall provides 360-degree protection as they cover the entire body while the isolation gown does not provide continuous full-body protection. The protection of mucous membranes in the eyes/nose/mouth by the use of face shields/goggles is an integral part of the standard precautions. The goggle frame protects the eyes and surrounding areas. It also acts as a barrier to droplets and splashes impacting the conjunctivae of the wearer.²⁰

Surgical mask and respirators: Surgical masks are generally intended to protect healthcare workers from patients and vice versa. They act by minimizing the exposure to saliva and respiratory secretions. They are used to block large particles like droplets, splashes, sprays, or splatter containing microbes from reaching the nose and mouth. The most widely used filtering face piece respirators (FFRs) are the N95 respirators, which are disposable filtering face piece respirators that form tight seal against the face skin and have a particle filtering efficiency of around 95% or above for a median particle size. The United States National Institute for Occupational Safety and Health (NIOSH) classifies particulate filtering face piece respirators into following categories namely N95, N99, N100, P95, P99, P100, R95, R99, and R100. N means oil non-resistant, R means some resistance to oil and P depicts oil proof and the suffix 95, 99, and 100 describe the filter's minimum filtration efficiency with 95%, 99%, and 99.97%, respectively.²¹

FFRs are divided into three class in the European Standard (EN 149): FFP1, FFP2, and FFP3 where FFP stands for filtering face piece with filtering efficiency of 80%, 94%, and 99% respectively. They are categorized by inward leakage in laboratory experiments and simulated real-life applications which may result either from penetration through the face piece material matrix or through any space or gap between the face and face piece.²² FFP1-Protect against coarse solid particles with no particular toxicity 2-P2 / FFP2-Protect against solid and/or liquid aerosols defined as dangerous or irritating 3-P3 / FFP3-Protect against harmful solid and/or liquid aerosols.²³

Respirators mentioned below under 3M™ are comparable to N95 (US NIOSH-42CFR84) and are

considered as feasible alternatives to N95.²⁴

- FFP2 (Europe EN 149-2001)
- KN95 (China GB2626-2006)
- P2 Particulate respirator (1716:2012; 3M™ Australia/New Zealand)
- Korea 1st class (Korea KMOEL-2017-64)
- DS (Japan JMHLW-Notification 214, 2018)

Pre-operative considerations: Povidone-iodine or chlorhexidine may be used to scrub the patient's lips and surrounding area to maintain an aseptic technique as done in other dental procedures which require aseptic technique.²⁵

Pre-procedural use of 1.0% hydrogen peroxide or 0.2% povidone-iodine viricidal mouth rinse can be effective in eliminating oral and respiratory pathogens.²⁶ In a recent in vitro investigation, Bidra et al. concluded that the lowest PVP-I concentration of 0.5 percent with a contact time of 15 seconds successfully eliminated SARS-CoV-2.²⁷

Intra-operative considerations: Dental healthcare workers can try to avoid any procedures that generate aerosols. They may also lay stress on the use of hand tools like spoon excavators and other caries removal agents based on chemo-mechanical mechanism. If such aerosol-generating procedures cannot be avoided due to any reason, the same should be performed at the end of the day.¹²

It is advised to work from 10 or 11 o'clock position ideally. The 8 o'clock position should be avoided, to keep away from splatter.²⁸

To reduce the sterilization and disinfection protocol, it is always better to carry out single use instrumentation wherever possible.²⁵

Limit the use of intraoral radiography wherever possible. Although in endodontics, this is unlikely to be feasible, because an accurate preoperative radiograph is required.²⁵

The use of a rubber dam will significantly mitigate the contamination of saliva and blood, as it will provide a barrier to the primary source of infection.²⁵ During cavity preparation, the use of rubber dams has shown a substantial reduction in microorganisms spread by 90%.²⁹ So, it should be mandatory for all operative and endodontic procedures.

A dental handpiece with high speed and without anti-retraction valves can aspirate and remove debris and fluids during dental procedures. To be more precise, the microbes can further contaminate the water and air tubing within the dental unit possibly resulting in cross-infection. The use of anti-retraction dental handpiece, as an additional prevention measure for cross-infection is highly recommended.³⁰

To decrease surface contact of aerosol, ensure that high-volume suction is used as close to the tooth and the handpiece head as possible while drilling. It has been shown that the use of high-volume suction decreases aerosol surface pollution by 90-93%.³¹

Refrain as far as possible from the use of the 3-in-1 syringe. Using high-volume suction, debris accumulated inside the pulp system may be eliminated.²⁵

Limit the use of ultrasonic scalers, which have high aerosol production.³²

Post-operative considerations: With the paradigm shift in dental health practices, teledentistry has a significant role in the wake of the current COVID-19 pandemic. This makes it possible for the dentist to assess and record the dental status postoperatively without any conflict with the subjects. Bacteria particles and viruses can be detected in the air of dental operatory within 30 minutes of aerosol production.³² Thus, waiting for half an hour in between two patients is recommended to prevent the microbial transmission both among dentists and to the next patient.³³

Surfaces in close proximity of the dental operatory has to be disinfected after each patient visit. Surface disinfectant containing 62-71% ethanol, 0.5% hydrogen peroxide and 0.1% (1 g/L) sodium hypochlorite can efficiently inactivate infective pathogens.³⁴

Adequate room ventilation critical in maintaining the optimum indoor air quality. The air purifiers with the filtration efficiency of 99.995% or more, for particles $\geq 0.01 \mu\text{m}$, which at a virus size of $0.12 \mu\text{m}$ (120 nm) are highly effective. The air purifiers with high efficiency particulate air-14 (HEPA-14) filters or higher is recommended.³⁵

Working under negative air pressure would be preferable for procedures in which aerosol production is anticipated.³⁶

CONCLUSION

COVID-19 has given dental practitioners new challenges and obligations. Transmission of COVID-19 in dental setting occurs primarily through aerosol; droplets, fomites and contact spread. Nosocomial infection through aerosol is a matter of concern for endodontists. In addition to the usual precautions, additional precautions should be taken to diminish the infection transmission by asymptomatic carriers. It is the responsibility of dentists to follow proper infection control protocols and measures for their patients, staff and themselves in order to curb the spread of infection in dental practise.

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