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Review Article

Coronavirus Disease 19 (COVID-19) and Prosthodontic Consideration- A Review

Khushboo Mishra[1], Divya Hegde[2], Sajan Shetty[3], Sanjana Shah[4], Akansha Priya[5], Sree Lakshmi Reddy[6]

[1,4,5,6]PG Student, [2]Professor and Head of the Department, [3]Senior Lecturer, Department of Prosthodontics, Bangalore Institute of Dental Sciences and Hospital, Bengaluru, Karnataka, India

ABSTRACT:

The recent outbreak of SARS-CoV-2 and its associated coronavirus disease has gripped the entire international community and caused widespread public health concerns. Despite global efforts to contain the disease spread, the outbreak is still on a rise because of the community spread pattern of this infection. Dental professionals, including prosthodontists, may encounter patients with suspected or confirmed SARS-CoV-2 infection and will have to act diligently not only to provide care but at the same time prevent nosocomial spread of infection. The aim of this article is to provide a brief overview of the symptoms, specific recommendations for dental practice are suggested for patient screening, infection control strategies, and patient management protocol. One aspect is, however, getting absolutely clear; practising Dentistry in future (Post-COVID-19 era) is never going to be the same as the Pre-COVID-19 era.

Key words: corona, covid-19, dentistry, precaution, prosthodontic consideration

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Corresponding author: Dr. Khushboo Mishra Post Graduate Student, Department of Prosthodontics, Bangalore Institute of Dental Sciences, Bangalore, Karnataka, India

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INTRODUCTION:

The flaring up of coronavirus disease 2019 (COVID-19) in the area of Wuhan, China, has evolved rapidly into a public health crisis and has spread exponentially to other parts of the world and now is considered as pandemic by WHO.[1] Severe acute respiratory syndrome coronavirus 2(SARS-CoV-2)[2,3] also known as the coronavirus and previously it was known provisionally as 2019 novel coronavirus (2019-nCoV).[4-6] The novel coronavirus belongs to a family of single-stranded RNA viruses known as Coronaviridae.[7] These include severe acute respiratory syndrome coronavirus (SARS-CoV), first identified in 2002, and the Middle East respiratory syndrome coronavirus (MERS-CoV), first identified in 2012.[8] Given the widespread transmission of SARS-CoV-2 and reports of its spread to health care providers , dental professionals are at high risk for nosocomial infection and can become potential carriers of the disease. These risks can be attributed to the unique nature of dental interventions, which include aerosol generation and it can be handling of sharps. In addition, if adequate precautions are not taken, the dental office can potentially expose patients to cross contamination. Both SARS-CoV and 2019-nCoV belong to the β-genus. An envelope-anchored spike protein mediates coronavirus entry into host cells by first binding to a host receptor and then fusing viral and host membranes.[9]

VIRUS AT GLANCE :

Coronaviruses belong to the family *Coronaviridae* in the order *Nidovirales*.[10] Coronaviruses are minute in size (65–125 nm in diameter) and contain a single-stranded RNA as a nucleic material, size ranging from 26 to 32 kbs in length. The subgroups of coronaviruses family are alpha (α), beta (β), gamma (γ) and delta (δ) coronavirus. They can be classified into four genera: *Alphacoronavirus*, *Betacoronavirus*, *Gammacoronavirus*, and *Deltacoro-navirus.* WHO announced "COVID-19" as the name of this new disease on 11 February 2020, following guidelines previously developed with the World Organisation for Animal Health (OIE) and the Food and Agriculture

Organization of the United Nations (FAO). The coronaviral genome encodes four major structural proteins: the spike (S) protein, nucleocapsid (N) protein, membrane (M) protein, and the envelope (E) protein, all of which are required to produce a structurally complete viral particle.[11,12] The E protein is the smallest of the major structural proteins, but also the most enigmatic. During the replication cycle, E is abundantly expressed inside the infected cell, but only a small portion is incorporated into the virion envelope.[13] The membrane protein (M) and the envelope protein (E) are involved in virus assembly, whereas the spike protein (S) mediates virus entry into host cells. Some coronaviruses also encode an envelope-associated hemagglutinin-esterase protein. Among these structural proteins, the spike forms large protrusions from the virus surface, giving coronaviruses the appearance of having crowns (hence their name; *corona* in Latin means crown)
More recently, however, it has become clear that some CoVs do not require the full ensemble of structural proteins to form a complete, infectious virion, suggesting that some structural proteins might be dispensable or that these CoVs might encode additional proteins with overlapping compensatory functions.[12,14,15]

SYMPTOMS:
As mentioned by government Ministry of Health & Family Welfare Directorate General of Health Services **WHEN TO SUSPECT** the case under Guidelines on Clinical Management of COVID – 19 are under given :

1. All symptomatic individuals who have undertaken international travel in the last 14 days or
2. All symptomatic contacts of laboratory confirmed cases or
3. All symptomatic healthcare personnel (HCP) or
4. All hospitalized patients with severe acute respiratory illness (SARI) (fever AND cough and/or shortness of breath) or
5. Asymptomatic direct and high risk contacts of a confirmed case (should be tested once between day 5 and day 14 after contact
6. Symptomatic refers to fever/cough/shortness of breath. Direct and high-risk contacts include those who live in the same household with a confirmed case and HCP who examined a confirmed case.

Patients with COVID-19 usually present with clinical symptoms of fever, dry cough, and myalgia. In addition, less obvious symptoms such as nausea, diarrhea, reduced sense of smell (hyposmia), and abnormal taste sensation (dysguesia) have also been reported.[16] Notably, about 80% of these patients have only mild symptoms that resemble flulike symptoms and seasonal allergies, which might lead to an increased number of undiagnosed cases.[17] Severe forms of this disease have a predilection for men with a mean age of 56 years with preexisting chronic illnesses such as cardiovascular disease or immunosuppression. The higher-risk patient population manifests symptoms typical of pneumonia or acute respiratory distress syndrome.[18]

Symptomatic transmission: Symptomatic transmission refers to transmission from a person while they are experiencing symptoms. Data from published epidemiology and virologic studies provide evidence that COVID -19 is primarily transmitted from symptomatic people to others who are in close contact through respiratory droplets, by direct contact with infected persons, or by contact with contaminated objects and surfaces.[19]

Pre-symptomatic transmission: The incubation period for COVID-19, which is the time between exposure to the virus (becoming infected) and symptom onset, is on average 5-6 days, however can be up to 14 days. During this period, also known as the "pre- symptomatic" period, some infected persons can be contagious. Therefore, transmission from a pre -symptomatic case can occur before symptom onset.

Asymptomatic transmission : An asymptomatic laboratory-confirmed case is a person infected with COVID-19 who does not develop symptoms. Asymptomatic transmission refers to transmission of the virus from a person, who does not develop symptoms.

COVID-19 TESTING
WHO has published guidance on 24 April 2020 adjusting public health and social measures for the next phase of the COVID-19 response. Some governments have suggested that the detection of antibodies to the SARS-CoV-2, the virus that causes COVID-19, could serve as the basis for an "immunity passport" or "risk-free certificate" that would enable individuals to travel or to return to work assuming that they are protected against re-infection. There is currently no evidence that people who have recovered from COVID-19 and have antibodies are protected from a second infection.

The measurement of antibodies specific to COVID-19
The development of immunity to a pathogen through natural infection is a multi-step process that typically takes place over 1-2 weeks. The body responds to a viral infection immediately with a non-specific innate response in which macrophages, neutrophils, and dendritic cells slow the progress of virus and may even prevent it from causing symptoms. This non-specific response is followed by an adaptive response where the body makes antibodies that specifically bind to the virus. These antibodies are proteins called

immunoglobulins. The body also makes T-cells that recognize and eliminate other cells infected with the virus. This is called cellular immunity. This combined adaptive response may clear the virus from the body, and if the response is strong enough, may prevent progression to severe illness or re-infection by the same virus. This process is often measured by the presence of antibodies in blood.

WHO continues to review the evidence on antibody responses to SARS-CoV-2 infection.[19-25] Most of these studies show that people who have recovered from infection have antibodies to the virus. However, some of these people have very low levels of neutralizing antibodies in their blood,[23] suggesting that cellular immunity may also be critical for recovery. As of 24 April 2020, no study has evaluated whether the presence of antibodies to SARS-CoV-2 confers immunity to subsequent infection by this virus in humans.

Laboratory tests that detect antibodies to SARS-CoV-2 in people, including rapid immunodiagnostic tests, need further validation to determine their accuracy and reliability. Inaccurate immunodiagnostic tests may falsely categorize people in two ways. The first is that they may falsely label people who have been infected as negative, and the second is that people who have not been infected are falsely labelled as positive. Both errors have serious consequences and will affect control efforts. These tests also need to accurately distinguish between past infections from SARS-CoV-2 and those caused by the known set of six human coronaviruses. Four of these viruses cause the common cold and circulate widely. The remaining two are the viruses that cause Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome. People infected by any one of these viruses may produce antibodies that cross-react with antibodies produced in response to infection with SARS-CoV-2. The Johns Hopkins Center for Health Security maintains and regularly updates a Web site that lists key characteristics of many of the serological tests for SARS-CoV-2, the virus that causes COVID-19, on the market and in development.

SAFETY AND PRECAUTIONS:

It is important that each practice has in place a protocol and training for their team on how to screen for patients at risk of COVID-19. These are few approved protocoals by New Zealand Dental Association.

Clinical procedures

If a patient does need immediate treatment, the ADA recommends taking the following steps:

- Ask patients to arrive on time for their appointments, rather than too early, since that will minimize the amount of time they spend in your waiting room or reception area.
- Remove magazines, reading materials, and other objects that may be touched by others and which are not easily disinfected.
- Schedule appointments to minimize possible contact with other patients in the waiting room.
- Include temperature readings as part of your routine assessment of the patient prior to performing dental procedures.
- Use a rubber dam whenever possible to decrease possible exposure to infectious agents.
- Use high speed evacuation for all dental procedures producing an aerosol.
- Autoclave your hand pieces after each patient. Make patient to rinse with 1% hydrogen peroxide before each appointment. Coronavirus is vulnerable to oxidation; this will reduce the salivary load of oral microbes.

Aerosol generating procedures

Extensive environmental contamination can occur following an aerosol generating procedure. Given that clinically generated aerosols may be infected with the human coronaviruses and that the virus can survive on hard surfaces and can remain viable for up to 3 days, aerosol generating procedures should be limited to those procedures associated with delivery of essential dental care only.

-Aerosol generating procedures include; triplex syringe (3:1 syringe), high speed handpieces, mechanical / ultrasonic scalers, air abrasion (includes Air-flow, Rondo flex, Prophy flex, Prophy mate) intra-oral sandblasters.

-Where possible any treatment that may generate an aerosol should be delayed. If delay is not possible:

o Pre-procedural mouthwashes for 30 seconds supervised with either: Hydrogen peroxide 1% (dilute 3% to 1%), Chlorhexidine 0.2%, Povidine iodine mouthrinse (0.2%).

o Consider use of hand instrumentation (+/- temporary restorations)

o Use of slow speed handpiece without water spray.

• If an aerosol generating procedure is necessary, close attention must be paid to managing this aerosol:

-- Use appropriate PPE

-- Use a single patient treatment room (where possible) with the door closed

--Work with an assistant and use four handed dentistry

--Use rubber dam (or Isolite if available)

--Swab teeth and tissues with hydrogen peroxide (1%) or chlorhexidine 0.2% before the procedure especially if a pre-procedural mouth rinse has not been possible (e.g. children)

--Use high volume evacuation with correct tip placement at the source of the aerosol

--Patient and team positioning to optimise visibility of the operative field and access to the mouth.

Transmission Based Precautions

Transmission based precautions (TBP) are applied when standard IPC measures are insufficient to prevent the potential transmission of an infectious

agent. TBP are additional IPC precautions required for a patient with a known or suspected infectious agent. They include contact, droplet and airborne precautions.

- All staff must be aware of situations where TBP are required.
- TBP encompass administrative processes, environmental controls and personal protective equipment.
- Patients must be scheduled in a manner that facilitates the highest standard of IPC and care.
- Accompanying persons should not remain in the treatment area during care delivery if possible.

Treatment rooms

- Treatment should be completed in a single patient treatment room with the door closed. All staff should be advised that TBP apply to that room. This should be indicated by sign on door of room.
- Remove all unnecessary equipment, instruments, materials and objects from the treatment room and ensure remaining surfaces in the room are clear from clutter.
- Prepare all equipment required for the planned care.
- PPE must be worn when the treatment room is in service.
- Only essential staff should enter the room and non-essential movements in and out of the room minimised.
- Keep a record of people entering the room.
- Have a 'spare assistant' outside the room who can be called on for assistance as needed.
- Consider turning air conditioning off to reduce aerosol distribution to other rooms if on a shared system.
- Where possible, open windows after the procedure to assist with aerosol dispersion.

Personal protective equipment

Personal protective equipment (PPE) is a collective term for the clothing and equipment worn by health practitioners which acts as a barrier to protect their own tissues from exposure to potentially infectious material. PPE includes: gloves; masks; protective eyewear; outer protective clothing; and enclosed footwear.

The use of dental handpieces, sonic and ultrasonic instruments and air/water syringes produces large quantities of aerosols, with an associated risk of airborne transmission of infectious micro-organisms.

Use of PPE

➢ Wear appropriate PPE for any procedure or activity associated with a risk of contamination. Gloves

➢ Wear properly fitting disposable gloves for all patients.

➢ Use a new pair of gloves for each patient.

➢ Replace gloves as soon as possible if they become soiled or damaged, do not wash gloves as this may damage glove integrity.

Masks

➢ Wear a fluid-resistant mask

➢ Fit and wear your mask in accordance with the manufacturer's instructions, ensuring an adequate seal around both the nose and mouth. Avoid touching the front of the mask during patient treatment.

➢ Change your mask between patients and when damp or visibly contaminated during treatment. Remove by touching the strings and loops only, and discard immediately after use.

➢ Remove gloves, masks and protective eyewear before moving from a contaminated zone to a clean zone in your practice setting (refer to Environmental controls introductory comments to determine the contaminated and clean zones within your practice).

➢ When donning and removing personal protective equipment use sequencing that minimises the spread of contamination.

Protective Eyewear

➢ Wear protective eyewear that is fit for purpose, and is optically clear and distortion free.

➢ A face shield may be used as an alternative to protective eyewear. Wear a mask with the face shield to provide protection against inhalation of micro-organisms.

➢ Supply your patient with protective eyewear before commencing treatment, and ask them to wear it during treatment.

➢ Clean protective eyewear following patient treatment.

Outer protective clothing

➢ Wear outer protective clothing (for example, gowns, tunics) over your street clothing or uniform. Outer protective clothing is to be made from material that does not permit blood or other potentially infectious materials to reach clothes or skin underneath.

➢ Change outer protective clothing: as soon as possible when visibly soiled or wet, when exposed to contaminated aerosols for prolonged periods of time, and at least daily.

➢ Change long sleeved outer protective clothing at least between patients.

➢ Remove outer protective clothing before leaving the treatment area for: a break involving eating and/or drinking, a toilet break, and before leaving the practice premises.

➢ Launder reusable outer protective clothing in a commercial laundry that provides services for healthcare settings, or domestically as a separate load (not overloaded) at the hottest temperature the fabric can tolerate.

➢ Place disposable outer protective clothing in the controlled waste after use, unless it is contaminated

with blood to the extent that it qualifies as hazardous waste (refer to Safe disposal of waste).

Footwear

➢ Wear enclosed footwear that will protect your feet against injury from sharp objects

Dental Protective Face Shield

Face shields are safety devices designed to protect the face from debris or other hazards. Face guards and face shields must provide protection from hazards but also ensure that an operator's visibility and mobility are not hindered.

Specifications

Face shields typically cover the entire face and are secured over or around the head with an adjustable band. A face shield is frequently used in medical applications to protect the face and eyes from the splattering or splashing of biohazardous fluids. A full face guard covers the entire face while a mid-face guard covers only the eyes and nose. Both provide peripheral protection by wrapping around the sides of the face. Face shields may be tinted or metal coated for heat protection. A face guard should be used as additional protection; safety glasses or goggles should always be worn in conjunction. The majority of eye and face protection currently used in the U.S. is designed, tested, and manufactured in accordance with the American National Standards Institute (ANSI)/International Safety Equipment Association (ISEA) Z.87.1–2010 standard.[27]

The major structural components of a face shield include the following:

a) **Visor** b) **Frame** c) **Suspension Systems**.

Face shields provide a barrier to acutely-expelled aerosols of body fluids and are commonly used as an alternative to goggles as they confer protection to a larger area of the face.[28]

Lindsley et al.[29] reported 96% and 92% reductions in the risk of inhalational exposure immediately after a cough for a face shield at distances of 18 in (46 cm) and 72 in (183 cm), respectively. Decreasing the aerosol size to 3.4 μm resulted in the face shield blocking 68% of the inhalational exposure at 18 in (46 cm) immediately after the cough and 23% over 1–30 min post-cough (during which time the larger aerosol particles had settled out and droplet nuclei had formed and remained airborne so that flow occurred more easily around the edges of the face shield. Shoham et al.[30] sprayed a fluorescent dye (particle diameter ~5μm) at a distance of 20 in (50 cm) away from a mannequin head outfitted with various types of PPE.

Hand hygiene

Hand hygiene is aimed at reducing the number of micro-organisms on hands and is the single most important measure for preventing the transmission of micro-organisms. The term hand hygiene includes both hand washing with liquid soap and the use of an alcohol based hand rub (ABHR).

The use of an ABHR is the preferred method of hand hygiene in health care settings when hands are visibly and clinically clean (no visible bioburden). Hand washing is the advised method when hands are visibly dirty or contaminated with proteinaceous material, blood or other body fluids.

The World Health Organization describes the '5 moments of hand hygiene' in dental care as:

1. Before touching a patient
2. Before clean/aseptic procedure
3. After body fluid exposure risk
4. After touching a patient
5. After touching patient surroundings.

Hand washing:

➢Wash your hands with a liquid soap, appropriate for use in a healthcare setting, at the following times:

- When your hands are visibly dirty or contaminated with proteinaceous material, blood or other body fluids.
- At the beginning and end of each clinical session.
- After a toilet break.

➢When washing your hands, use sinks dedicated for hand washing purposes that are fitted with non-touch tapware, or employ a non-touch technique. After hand washing, dry your hands using single-use linen or disposable paper towels (not using an air-dryer).

Alcohol based hand rub

➢When your hands are visibly and clinically clean use an ABHR, specified for use in health care settings, at the following times:

- Before and after every patient contact.
- Before gloves are put on and after they are taken off.
- On entering and leaving the instrument reprocessing areas.
- After hands inadvertently touch contaminated environmental surfaces, instruments or other equipment.

➢Apply the volume of ABHR specified by the manufacturer to dry hands, and leave your hands to dry naturally; do not dry them with linen or paper towels.

Waterlines and water quality

➢ All dental equipment with waterlines that deliver water to any devices that enter the patient's mouth (such as handpieces, scalers and air/water syringes) are to be fitted with an anti-retraction valve to minimise backflow of contaminated fluids from the oral cavity.

➢Flush air and waterlines for at least two minutes at the start and end of each day, and for 30 seconds between patients.

➢Clean and disinfect waterlines according to the manufacturer's directions.

➢Assure yourself that the water within your oral health practice environment is safe to drink; information on the quality of water may be obtained from the local water authority. The use of distilled water or water treated by reverse osmosis (RO), in an independent water supply (fitted bottle) system, is recommended for dental units.

NIOSH-Approved N95 Filtering Facepiece Respirator:-

Even though you see N95 on the package, it still may not be the right kind of respirator, or one that meets NIOSH approval requirements.

You may have heard that a NIOSH-approved N95 respirator is recommended for your respiratory protection needs. This is one of the most commonly used respirators. Again, even though you see N95 on the package, it still may not be the right kind of respirator, or one that meets NIOSH approval requirements.

Filtering Facepiece respirators are divided into various classes based on their filtration capabilities. "N95 respirator" is a term used to describe the class of respirators which use N95 filters to remove particles from the air that is breathed through them. The NIOSH respirator approval regulation defines the term N95 to refer to a filter class that removes at least 95% of airborne particles during "worst case" testing using a "most-penetrating" sized particle during NIOSH testing. Filters meeting the criteria are given a 95 rating. Many filtering facepiece respirators have an N95 class filter and those meeting this filtration performance are often referred to simply as N95 respirators.

PROSTHODONTICS CONSIDERATIONS:

Following the protocols as mentioned by IDA and CDC:

1. Post a sign at the entrance to the dental practice which instructs patients having symptoms of a respiratory infection (e.g., cough, sore throat, fever, sneezing, or shortness of breath) to please reschedule their dental appointment and call their physician. The same thing applies if they have had any of these symptoms in the last 48 hours.
2. Take a detailed travel and health history when confirming and scheduling patients. Do not provide non-emergent or cosmetic treatment to the above patients and report them to the health department immediately. Screen patients for travel and signs and symptoms of infection when they update their medical history
3. Take temperature readings as part of the routine assessment of patients before performing dental procedures.
4. Take the contact details and address of all patients treated and detailed case history.
5. Install physical barriers (e.g., glass or plastic windows) near the working area.
6. Make sure the personal protective equipment being used is appropriate for the procedures being performed and follow the guidelines mentioned above.
7. Use high-speed evacuation for dental procedures producing an aerosol. Autoclave hand-pieces after each patient. Have patients rinse with a 1% hydrogen peroxide solution before each appointment. Clean and disinfect public areas frequently, including door handles, chairs and bathrooms
8. Make the impression and disinfect it with benzalkonium chloride based disinfectant.

Since conventional sterilization methods, such as dry heat sterilization, cannot be used for eliminating potential pathogen microorganisms that are present on the dental impression surface, liquid chemical immersion disinfection is currently the most widely accepted method. Current commercially available immersion disinfection solutions contain sodium hypochlorite (0.525%), quaternary ammonium compounds, glutaraldehyde, phenols and iodophors in various concentrations and immersion times. Apart from immersion disinfection, alternative methods have been suggested, such as spray disinfection, steam autoclave, ozone, microwave , ultraviolet light, etc.

The 10 minute disinfection time for the 0.525% sodium hypo-chlorite immersion disinfection was selected according to ADA specifications.[31] The 2 minute disinfection time for the 0.3% benzalkonium chloride immersion disinfection was selected according to the recommendations by the manufacturer. The 30 minute disinfection time for both immersion disinfectants was selected for the case of extended immersion time due to factors such as impressions being forgotten immersed, which happens in daily practice. The 5 minute ozone disinfection time was selected based on previous work[32] which showed efficient disinfection results. The 15 minute ozone disinfection time was incorporated in case further microbiology experiments (regarding different bacteria or viruses) show that more time is needed for disinfection.

9. In one article stated by Dr. Rajeev Chitguppi that we cannot prevent aerosol generation in dental clinics, but can we minimise the viral load in the aerosols?" We should consider using Povidone-Iodine as an irrigant in high-speed handpieces too, as it has already been a recommended irrigant in the ultrasonic scaler. The recommendation is to use 10% povidone-iodine diluted 1:9 with water. So if you have a half litre bottle attached to your chair: Put 50 ml of 10 % Povidone Iodine solution in the bottle and then add water to fill the bottle. So this dilution will be 50: 450 = 1:9

10. All the above said precautions should be taken when making impression, jaw relation, insertion and even doing cementation.

STERILIZATION :

For sterilization protocol read the CDC guidelines: https://www.cdc.gov/mmwr/PDF/rr/rr5217.pdf.

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