

Guidelines to Practice Prosthodontics During Covid-19: A Narrative Review

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ABSTRACT

The WHO proclaimed COVID-19 as a pandemic due to the alarming levels of escalation and asperity. In response to the current risk, many countries have employed various containment blueprints to safeguard people from health risk and avert strain on the national health systems around world. Nonetheless, despite great endeavor, this outbreak continues to increase due to the community spread. This article presents a narrative review regarding COVID-19 and dentistry, necessary alterations in dental and laboratory settings; and recommended disinfection obligations in prevailing scenario. Special insistence has been placed to discussing guidelines for the management of different prosthodontics procedures and ramification of this pandemic on prosthodontic practice, education and research.

Keywords: COVID-19, Dentistry, Prosthodontics, Laboratory

INTRODUCTION

On January 30, 2020, the WHO announced a public health exigency of international matter due to the COVID-19 epidemic, which began in December in Wuhan, China.^{1,2} On March 11, 2020, COVID-19 was announced a pandemic, a public health calamity that is still having a contagion effect across all sectors. Due to its connotation, dental health care has faced various clinical, psychological and economic backlash, having unexpected aftereffect on dental professionals and their future careers, patients and laboratory personnel.^{3,4} Due to the ubiquitous transmission of COVID-19 and the exceptional peculiarity of the dental office, both dentist and patients are at increased peril of cross infection.^{5,6}

Coronaviruses belong to the Coronaviridae family in the order Nidovirales.⁷ They are tiny single-stranded RNAs, ranging from 65 to 125 nm in diameter and 26 to 32 kbs in length, spherical or elliptical in shape and pleomorphic in nature.^{7,8} The mode of transmission comprises person-to-person transmission and direct contact with respiratory droplets through speaking, coughing, touching virus-contaminated surfaces, and aerosols generated during clinical procedures. The clinical symptoms can vary from case to case due to the pleomorphic nature of the virus; the most common symptoms are fever, continuous dry cough, myalgia or fatigue, and dyspnea.^{9,10} Most infected people have mild to severe respiratory ailment. People with underlying systemic diseases, such as diabetes, heart disease, and respiratory disease, are at increased risk of mortality. Even there is wide variation between countries in the number of deaths and positive asymptomatic cases, and some reports indicate

that approximately 80% of infected cases are asymptomatic. In about two-thirds of cases, the infection can progress to a severe illness with respiratory failure; multi-organ damage such as shock, arrhythmias, acute myocardial damage, acute liver damage, and sepsis.^{12,13}

The propinquity to oral fluids, aerosols, and the lengthy incubation period of the virus; positions the dentist at high risk of contracting and transmitting the virus.¹⁴ Even after the patient's recovery, recusal was reported during the convalescent period. This is persuasive since some virus strains have been reported in saliva for 29 days in the literature.¹⁵ The Centers for Disease Control and Prevention (CDC) also periodically updating regarding interim infection prevention and control guidelines for dental set up during the COVID-19 pandemic. It states that "prioritize the most critical dental services and provide care in a way that minimizes harm to patients from delaying care and harm to staff due to potential exposure to COVID-19."¹⁶

Prosthetic procedures notably require to be altered because the ultimatum for the prosthodontist will be much greater due to factors such as the high concentration of copious saliva in the trays and dentures, vulnerability to blood during pre-prosthetic surgeries and implant placement, and exposure to aerosols during tooth preparation and implant placement. Also the target populace made up of the geriatric group with or without comorbidities, post-oncological immunosuppressed patients or patients with extra-oral maxillofacial defects that require prosthetic rehabilitation, makes it imperative to establish guidelines that are adaptable and compliant on the part of patients and prosthodontists alike.^{17,18} Unlike other routine dental procedures that can be completed in a single session, almost all prosthetic treatments require multiple visits by patients, presenting a challenge in assuring mutual safety at each visit. A very crucial aspect in the practice of prosthodontics is the laboratory service, in any form of prosthodontic treatment, is essential unlike other specialties of dentistry. Therefore, the imperative function that the laboratory plays in prosthetic rehabilitation cannot be sabotaged and therefore additional precaution must be taken at each control point. It is essential to consider the fact

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that laboratory work involves several people in a group, from the dentist, assistant, runner, lab supervisor, lab technician to runner, and dentist again. More individual in the group increase the likelihood of potential contamination.^{19,20}

After the lockdown, most prosthodontists began to restart their dental office rather than running out of income for expenses, repayment of various loans, and payment of salaries to the parodontal staff and to maintain the desired social status. There is also despair of a third wave and it is also arduous to measure how long this pandemic would last, it is crucial to be prepared for all situations. However, if the catastrophe continues indefinitely, prosthodontists will have to strategically reform their clinical practice to reduce expenses, and focus only on items important to endurance. Thus, following recommendations can be implemented for systematic work by prosthodontists to assure safe practice.

1. GENERAL CONSIDERATIONS

1.1. All patients must undergo an initial tele-screening to identify suspected COVID-19 carriers. Before scheduling an appointment, a detailed travel and medical history should be recorded through a tele-screening. Reschedule appointment in case of a recent trip to any foreign country. All patients should be considered as a possible asymptomatic carrier of COVID-19 and also involve recently recovered patients by considering them as possible carriers of the virus for at least 30 days after confirmation of recovery by a laboratory test. Postpone appointment if there is any suspicion while performing a tele-screening to a minimum of 2 weeks. In case of doubt, the regional health authorities should be informed immediately without delay.²¹ Patient can also self-test using the ICMR-approved COVID-19 home test using RAT kit such as CoviSelf™, PanBio COVID-19 Rapid Antigen Test Device, and CoviFind COVID-19 Rapid Ag Self-Test.²² Patients should be advised to wear a surgical mask and gloves while visiting clinics and to come alone or with a single attendant at the time of their appointment.¹⁸ It is also recommended, depending on the need of the hour, the complete clinical setup to have separate areas for donning / doffing, a separate sterilization room along with the segregation of clinic into different areas.²³

1.2. AREA 1: Reception and waiting area.

The first area that will come into contact with any patient, dedicated to obtaining basic information about the patient. The patient is asked to remove accessories such as jewelry, watches, etc. and disinfect their hands with a hand sanitizer or wash hands thoroughly as soon as they enter the clinic. They should be warned and encouraged to avoid touching their eyes, nose, and mouth at all times. Non-contact temperature logging, sensor taps, pulse oximetry and non-contact sanitizer dispensers are essential add-ons in this area.²⁴

Single attendant should only be allowed in case of emergency, major dental procedure, pediatric patients and special cases such as the geriatric and those who are medically or physically incapacitated due to the rule of maintaining

physical distancing.²⁵ The patient should be provided with a triple-layer mask, disposable shoe covers, head cap, and gloves. A glass barrier can be installed at the reception desk to prevent droplet transmission between patient and staff. An evaluation form that includes the medical history of the patient and their relatives, including recent travel history and an informed consent must be duly completed in the patient's own language. Posters can be designed and displayed to educate patients on hand hygiene, respiratory regulations, etc. Magazines, reading materials, and other items kept in waiting areas must be removed.²⁶

In India, the use of the indigenous “Aarogya setu app” facilitates COVID-19 contact tracing and self-assessment.²⁷ The “Namaste campaign” was also started to minimize the transmission of the virus.²⁸ Some essential recommendations for the patient's appointment at the clinic; requesting patients to arrive on time for their appointments, rather than too early to reduce the time spent on dental treatment, that is, appointments that do not overlap with an interval of at least 15 minutes.²⁶ Continuing physical distancing and digital payments are some other recommendations to follow. The area must be kept well ventilated at all times along with separate seats for patients. Installing improved air ventilation systems in clinics can also help ease the elimination of airborne pathogens and lessen the probability of cross infection from the clinical setting.²⁹

1.3. AREA 2: Screening area.

Screening and initial diagnosis will be accomplished in this area, using sterilized instruments. Whenever feasible, use disposable instruments to curtail the probability of cross infection. The maximum viral load is present at the commencement of the disease, primarily in the upper respiratory tract; therefore, pre-procedure mouthwash using an oral preparation of povidone iodine in a concentration as low as 0.5% for at least 15s can absolutely deactivate the virus due to its strong virucidal activity. Other mouthwashes include ethanol, 0.2% chlorhexidine, cetylperidinium chloride, and 0.5-1% hydrogen peroxide, which require further evidence-based research before a final approval can be made. Swab teeth and tissues with hydrogen peroxide (1%) or chlorhexidine 0.2% prior to the procedure, notably if a pre-procedural mouthwash has not been feasible (e.g., children).³⁰⁻³³

Extra-oral radiographs such as OPG and CBCT are suggested instead of intraoral radiographs to avert salivary contamination and curtail salivation and gag reflex. It's preferable to have in-house facility of taking digital radiographs in conjunction with double barriers than sending patients outside for this purpose to avert cross infection.^{25,34,35}

1.4. AREA 3A: Non-aerosol generating area.

Involves procedures that do not incorporate the use of air-rotor handpieces and ultrasonic scalers. Preference is given to hand instruments like spoon excavators and chemical based caries removal agents. Four-handed dentistry with involvement of digital workflow is advised. PPE is the only efficient method within the limits of administrative

environmental controls to avert cross-infection.^{36,37}

1.4. AREA 3B: Aerosol generating area.

The use of high-speed hand pieces generates aerosols with a particle size of less than 50 µm in diameter.³⁸ It has been hypothesized that aerosols tend to remain suspended for at least 30 minutes even after the finalization of the procedure and can reach up to 2 feet from the dental chair. Also clinically generated aerosols can become infected with human coronaviruses and if the virus can survive on hard surfaces and can remain viable for up to 3 days, the liability of transmission becomes very high in this area.³⁹

Only emergent and urgent aerosol generating procedures are recommended. The use rubber dam along with anti-retraction hand pieces must be aided in conjunction with the use of high volume extra-oral vacuum aspiration systems and high speed saliva ejectors to curtail the spread of aerosols. Low-speed contra-angle micromotors can also be preferred. Only crucial items must be kept open, while remaining items must be kept in closed cabinets.^{19,25}

MoHFW has proposed averting ceiling fans during such procedures; frequent maintenance of air conditioners and; blocking the return air vents in the operating room with central air conditioning. Adequate ventilation, both mechanical and natural with the help of exhaust fans, is proposed to insure dilution of the viral load and the eviction of infected air.⁴⁰ Nonetheless, in well-established clinics, finite by paucity of space and ventilation, it is recommended to filter contaminated room air using a high-volume evacuator and high-efficiency particulate arrestor (HEPA) filter or negative ion generators.^{14,41,42}

Further to the safety measures above, a pre-COVID test is advised for patients undergoing aerosol-generating procedures, based on practicability and available resources.⁴³ Primarily, it is preferred to perform such procedures during the latter part of the day or to maintain a 2-hour interval before receiving the next patient. It is advised to work from the 10 or 11 o'clock position. The eight o'clock position of the chair must be completely fended off to avoid direct contact with the splash. Four-hand dentistry with high-volume suction for aerosols must be enforced in combination with regular suction. In addition, sterilization with air purification and disinfection must be carry out before and after dental procedures.^{44,45}

1.5. Guidelines for hand hygiene and personal protective equipment (PPE)

The significance of hand hygiene for both the dentist and associated personnel is very crucial. The WHO illustrated the "5 Moments of Hand Hygiene" in dental care as:

1. Before touching a patient
2. Before clean / aseptic procedure
3. After the risk of exposure to bodily fluids
4. After touching a patient
5. After touching the patient's surroundings.

During the aerosol generation procedure, the dentist and assistant must have three layers of PPE beginning with a minimum N95 mask or higher, waterproof surgical gown

with head cap and shoe cover, goggles and face shield. The ideal code calls for donning and doffing all PPE kit after each patient. Reception staff must also be dressed with an N95 mask and head cap as basic equipment while the patient goes through the procedures.^{6,46-49}

1.6. Disinfection protocols for dental clinics and laboratories

Prevention of cross infection and disinfection of the dental clinic and laboratory are also fundamental steps in keeping a sterile environment by averting cross-infection.

In clinics:

Scheduled appointments should be set in such a manner that there is sufficient time between two patients, making sanitization of clinic and sterilization of the instruments feasible. Time overlap should be strictly averted for proper implementation of the sanitization protocol.²⁵

Chair-side assistants, support staff and laboratory technicians should be trained and recruited on rotary basis with an aim to keep minimal workforce at a specific time. Continual monitoring of staff involved in disinfection and waste disposal should be done to avert any lapses in the protocol.⁵⁰ Biomedical waste management (BMW) generated during the screening, treatment, management and immunization from COVID-19 patients and healthcare personnel working in wards should be isolated effectively and disposed accordingly e.g., covid waste disposal in double layer bags, PPE in yellow bag etc.⁵¹ 0.1-1% sodium hypochlorite solution, ethanol (70-90%) and vaporized hydrogen are commonly suggested surface disinfectants. Furthermore, the role of UV-C (wavelength = 200-280 nm) has been proposed as a method of terminal disinfection method for dental clinics and laboratories, which still lacks evidence for its specific action against corona virus. The entire unit instituting treatment must be covered with disposable sheets that can be changed after each patient.^{52,54}

In laboratory:

Laboratory technicians must also follow strict protocols while fabricating prostheses. The entry of laboratory personnel must be strictly controlled.⁵⁵ They must be allowed in the laboratory only after routine temperature checks and pulse oxymeter readings.^{56,57} Functioning of dental lab with minimal working staff is also suggested along with other de rigueur protocols such as undertaking social distancing, use of PPE kits, intermittent use of hand sanitizer, use of vinyl gloves and use of high vacuum suction during fabrication procedure of prostheses.⁵⁶

1.7. Waterlines and water quality

All dental equipment with water lines that deliver water to any device that enters the patient's mouth should be equipped with an anti-retraction valve to curtail backflow of contaminated fluids from the oral cavity. Flush air and water lines for at least two minutes at the beginning and end of each day, and for 30 seconds between patients. Clean and disinfect water lines according to manufacturer's instructions. The use of distilled water or reverse osmosis (RO) treated water, in a separate water supply system (tight bottle), is suggested for

dental units and drinking.⁴⁴

1.8. Fumigation versus fogging

Used for disinfection of clinics and dental laboratories. In fumigation, the vapors from the formaldehyde solution mixed with potassium permanganate in a fixed proportion rises that are very competent in killing bacteria, fungi and their spores, but formaldehyde is a known carcinogen, so the fumigation is now antiquated. Fogging can be done with a mixture of hydrogen peroxide and a solution of silver ions or third generation quaternary ammonium compounds (QAC). It is a fast, efficient and residue-free method, making it a preferred protocol for clinical disinfection. This method of "non-contact surface disinfection" generally takes 45 minutes followed by a contact time / dwell time of one hour.⁴⁰

2. Prosthodontic considerations during treatment in covid 19 era

The prosthodontist, dentists, and staff are at conceivably increased risk of COVID-19 infection due to their closeness to patients. Therefore, both staff and patients must carry out pertinent risk assessments. Prosthetic dental treatment procedures can be divided into four categories (Table 1). During prosthetic dental treatment, approaches to aerosol exposures, procedural risk alleviation, decontamination, and personal protective equipment should be considered.

2.1. Removable Prosthodontics

It is the branch of prosthodontics concerned with the replacement of teeth and contiguous structures for edentulous or partially edentulous patients by artificial substitutes that are readily removable from the mouth by the patient.⁵⁸

2.1.1. Chair-side protocol.

Age has been recorded as the main imperil factor for increasing the death rate from COVID-19, aggravated by the presence of comorbidities. Therefore, a complete medical history is imperative before starting any geriatric patient to weigh risk versus need for benefit. In case of geriatric patient, wearing poorly fitting RPD / CD, a home care instructions on tele-consultation can be elucidated, including regular denture disinfection [denture soaking in 3% hydrogen peroxide for 30 minutes or in 0.2% chlorhexidine gluconate for 10 minutes or in 100% vinegar (acetic acid) for 6-8 hours] at home, as well as before sending it to the clinic. Any COVID-19 infected denture wearing geriatric patient, should promptly abandon the use of dentures.¹¹

The fractured prosthesis must be repaired by first thoroughly disinfecting. Mucosal ulcerations or erosions can be managed by tele-consultation recommending some analgesic and antiseptic gels for local application and cessation of the prosthesis for the time being. Gentle smoothing of the sharp edges with sandpaper may be recommended if the patient cannot come to the clinic. Patients should be recalled in the clinic on a strict appointment schedule if additional alteration of the prosthesis is inevitable to restore function. Denture alteration should be done with a low speed micromotor, otherwise a new prosthesis must be fabricated if it is affecting the systemic health of the patient.

Emergency Treatments		Urgent Treatments Managed with Minimally Invasive Procedures and Without Aerosol Generation		Managed with Invasive and/or Aerosol-Generating Procedures		Non-routine Treatments		Routine Treatments	
Pain with diffuse infection-causing extraoral and/ or intraoral swelling that can compromise the patient's airway		<ul style="list-style-type: none"> Fractured prosthesis or soft tissue trauma from denture Cementation of crown or bridge Severe pain from tooth fracture from biting or trauma Severe pain from pulpal infection or inflammation Localized dental/ periodontal abscess 		<ul style="list-style-type: none"> Fracture of removable or fixed prosthesis causing soft tissue injury Deboned fixed prosthesis cleaning and cementation Severe pain from tooth fracture that need to be managed by generating aerosol Severe pain from pulpal inflammation that need to be managed by generating aerosol Removable dentures adjustment for radiation therapy patients 		<ul style="list-style-type: none"> Removable dentures adjustments or repairs for normal patients Asymptomatic fractured or defective restoration or prosthesis Chronic periodontal disease 		<ul style="list-style-type: none"> Examination Restorative treatment procedure Aesthetic dental procedures Dental Implant surgery 	

Primary impressions should be made on well-fitting sterile stock trays and secondary impressions should be made on custom trays that can be discarded after the master cast is obtained. One-step border molding is preferred to curtail chair time, followed by disinfection of impressions and models.⁵⁹

2.1.2. Laboratory protocol.

Record bases and wax rims should be pre-adjusted in order to avert any alterations after insertion in the mouth. Care must be taken to curtail processing errors in laboratory and dentures must be remounted to adjust occlusion. This will assure fewer follow up patient visits.

2.2. Fixed Prosthodontics

It is the branch of prosthodontics concerned with the replacement and/or restoration of teeth by artificial substitutes that cannot be removed from the mouth by the patient. These are elective and aerosol generating procedures. Therefore, strict disinfection precautions and protocols are compulsory.⁵⁸

2.2.1. Chair side protocol.

The use of rubber dam and high vacuum suction is recommended during tooth preparation.⁶⁰ This adequately removes most of the blood and saliva contaminants; also keeping the viral load to a lowest.⁶¹ Shade matching must be done using digital spectrophotometers and patient consent must be obtained. Intraoral photographs can be submitted online to the laboratory to avert any shade discrepancies. Alternatively, digital impressions using intraoral scanners can be made.⁶²

Removal of fractured and faulty prostheses using a crown remover is recommended. Dental tools like air rotor and burs must be autoclaved as per manufacturer's instructions. Further steps include dentist working position at 11–12 o'clock, reduced air pressure in 3-way syringes, full protective PPE for doctor and assistant, use of anti-retraction hand pieces and disposable burs. Intermittent rinsing and spitting must be illicited.⁵⁰

In event of dislodged prosthesis, the patient is recommended to safely store the dislodged prosthesis in a box with butadiene solution. Following tele-screening, if it is urgent and the patient is healthy, appointment is scheduled. The prosthesis is cleaned of the remaining cement; it is re-disinfected in the operatory room and tried in patients' mouth. If the fit is adequate, the prosthesis is re-cemented and appropriate instructions are instructed to the patient. In case of ill-fitting prostheses, the patient should provide a temporary prosthesis that can be fabricated alongside chair or sent to the laboratory as considered necessity.⁶³

2.2.2. Laboratory protocol.

Dental impressions, which can act as spread route for cross-infection between clinic and laboratory, must be disinfected (1% sodium hypochlorite for ten minutes) and stored in disposable bags. If it's an external laboratory, each work item should be stored separately in a sealed bag and collected by the technician. The prosthesis must be soaked in disinfectant

before it is send back to the clinic. The dentist can wash and store the prosthesis in a mouthwash before inserting it into the patient's mouth.

Laboratory personnel and technician must practice physical distancing, hand hygiene and optimal disinfection. CAD-CAM restorations should be preferred over conventional casting. Casting metal perpetually involves the generation of fumes and spatter. Furthermore, a digital workflow is recommended to curtail the salivary contact between different materials.⁶²

2.3. Implant Prosthodontics

The selection, planning, development, placement, replacement of missing teeth and/or associated structures, and maintenance of restoration(s) with dental implants.⁵⁸

2.3.1. Chair side protocol.

Implant treatment planning involves multiple dental visits which along with use of surgical aerosol generating hand pieces, requires extreme caution with regard to disinfection and infection control. Healthy patients without other comorbidities can be cared for based on CBCT and virtual planning.

Before surgery, it's recommended to obtain COVID-19 test reports. During surgery, low speed drilling with sharp drills is desirable. Periodic external irrigation should be performed in conjugation with high volume suction. The use of ultrasonic devices and piezoelectric surgery must be curtailed; while the use of osteotomes must be encouraged to minimize aerosol formation.

Immediate implants with immediate loading must be taken up where indicated as they necessitate fewer visits. It is desirable to avert complex full mouth procedures. Digital impression with scan bodies and digital radiographs along with double barriers is recommended to avoid cross-infection.

Further steps include dentist working position at 11–12 o'clock, reduced air pressure in 3-way syringes, full protection PPE for doctor and assistant.

2.3.2. Laboratory protocol.

Impressions and implant components must be disinfected/ autoclaved carefully before reuse. Careful impression making using resin jig and accurate pouring of the impressions are imperative to avoid repeating any chair-side steps.

2.4. Intraoral and extra oral maxillofacial prostheses

It is the branch of prosthodontics concerned with the restoration and/or replacement of stomatognathic and craniofacial structures with prostheses that may or may not be removed on a regular or elective basis.⁵⁸

2.4.1. Clinical protocol

Fabrication of interim and surgical obturators should be performed at this time to rehabilitate the function for patients with intraoral defects. But due to compromised immune status of post-operative carcinoma patients, they should be postponed for definitive obturator fabrication. The fabrication of extra oral prosthesis should be considered after estimating the risk benefit ratio. Furthermore, psychological counseling and encouragement for the sustenance of the

prosthesis can be done through tele-consultation.^{64,65}

Dental impressions are a high risk source of infection transmission. Autoclaved stock trays must be used and material must be loaded cautiously to avert gag reflex. Impression must be kept under running water dodging direct flow over tissue surface to avoid losing surface details. The disinfectant spray can be used for chair side disinfection and then packed in zip lock bags before sending the impressions to the laboratory for pouring. Relying on the chemical composition of impression materials used, different disinfection methods could be used to retain the dimensional stability of the impression. Work authorization forms must be sent in separate zip-lock bag.^{25,66}

3.3. Prosthodontic considerations after treatment in covid 19 era

After treatment, crucial consideration must be given to the procedures to protect the patients and staff. Hands must be washed properly and the dentist and the patient should consider using hand sanitizer.⁶⁷ After which the entire dental surgery is disinfected and the protective covers and tapes are replaced. Proper disposal of dental waste and placement of instruments in the sterilization room must be performed.⁶⁸ Adequate follow-up of patients must be carried out. It is critical that prosthodontic teams follow a rigorous and competent disinfection protocol for clinical and communal areas periodically to minimize cross infection. COVID-19 risk assessments are required for all clinic staff. All staff should be watch carefully if they feel unwell.

Definitely, a multidisciplinary clinical approach is needed, in the treatment of this condition through a clinical practice backed by scientific knowledge. Psychological intervention and mental health support are necessary to curtail anxiety and stress.^{69,70}

CONCLUSION

Dentists, dental assistants, dental staffs and patients around the world are in a state of fear and anxiety due to the impact of COVID-19 pandemic. It is of extremely significant that dental professionals are cautious from time to time and keep patients and themselves in a safe environment by updating their knowledge on COVID-19. In addition, the prosthetic treatment procedures must be performed with standards of care and infection control following high standard guidelines and recommendations for COVID-19.

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