

Re-establishing New Normality as We Return to Orthodontic Office

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Authors' contributions

This work was carried out in collaboration among all authors. Author AKC designed the study. Author SKD wrote the protocol and the first draft of the manuscript. Author AAB managed the analyses of the study and author DKT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Coronavirus disease 2019 (COVID-19) is a contagious disease caused by the SARS-Cov2 virus. It emerged as a global pandemic early in 2020, affecting more than 200 countries and territories. The infection is highly contagious, spreads through person-to-person contact, via aerosol and droplets. The practice of social distancing - maintaining a distance of 1 - 2 meters or 6 feet -- between people has been widely recommended to slow or halt the spread. This places dentists at high risk of acquiring and transmitting the infection. The objective of this article is to reinforce infection control and prevent cross-transmission among orthodontic clinic and precautions to be taken for the treatment of orthodontic patients in a post-lockdown era, until at-home or in-office testing, vaccines, or successful treatments for COVID-19 shall be available.

Keywords: COVID-19; disease prevention; disease management; emergency treatment.

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1. INTRODUCTION

Covid-19 is a highly infectious disease caused by the newly discovered coronavirus, SARS-CoV-2. This virus was officially regarded as the causative pathogen of COVID-19 by the Chinese Center for Disease Control and Prevention on Jan. 8 [1]. This epidemic started in the region of Wuhan, China, last December and has since become a major public-health challenge, not only for China, but for virtually all countries around the world. On Jan.30, the World Health Organization (WHO) announced that this outbreak constituted a global public health emergency and declared it a pandemic [2]. Among front liners, the dentists are more prone to this deadly virus and the orthodontists requires special precautions because of long treatment time with multiple visits of patients.

2. TRANSMISSION ROUTES

The common transmission routes of novel coronavirus include direct transmission (cough, sneeze and droplet inhalation transmission) and contact transmission (contact with oral, nasal and eye mucous membranes) (Fig. 1) [3].

2.1 Infection Controls Measures to Be Adopted

Many dental procedures produce aerosols and droplets (high speed hand pieces, triple syringes, ultrasound, etc) that may be contaminated with the virus. Therefore, droplets and aerosols are a cause for great concern in dental clinics and hospitals, because it is difficult to avoid the production of great amounts of aerosol and droplets mixed with patient saliva or even blood during the clinical practice of dentistry. Besides coughing and breathing from infected patients, dental tools such as handpieces use high-speed air to operate their turbines and operate with

water. When these devices are used in the patient's mouth, a great amount of aerosol and droplets mixed with patient saliva or blood are generated. These droplets and aerosols are small enough to remain suspended in air for a long period of time before falling into environment surfaces or entering the respiratory tract of other individuals.

Moreover, droplets and aerosols containing microorganisms from an infected person may have contact with the conjunctival, nasal or oral mucosa of dental care workers and other patients. Working at a short distance from the patient's face, as well as coughing and engaging in mask-less conversation are reasons to apply efficient strategies to control infection and prevent the dissemination of diseases such as COVID-19.

- A. Patient Evaluation
- B. Office Settings Modifications
- C. Personal protective measures
- D. Sterilization and Disinfection

A) Patient evaluation

1) Mobile Digitalization: (Box 1)

- AROGYA SETU app should be mandatory for everyone.
- Whatsapp should be used to monitor patient's oral cavity by asking him to send the latest picture of his oral cavity who are under quarantine or by somehow cannot visit during this pandemic. It also helps the orthodontist to decide the unnecessary patient contact if there is no emergency like breakage of brackets, wires etc.
- Cashless transactions by using paytm app, google pay should be promoted.

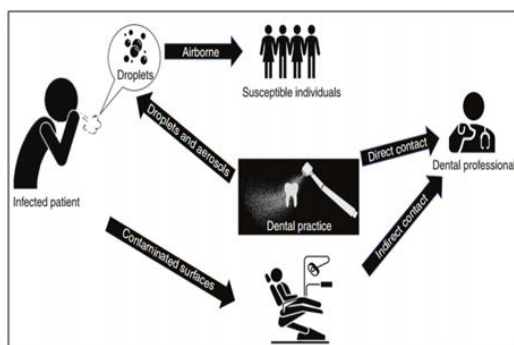
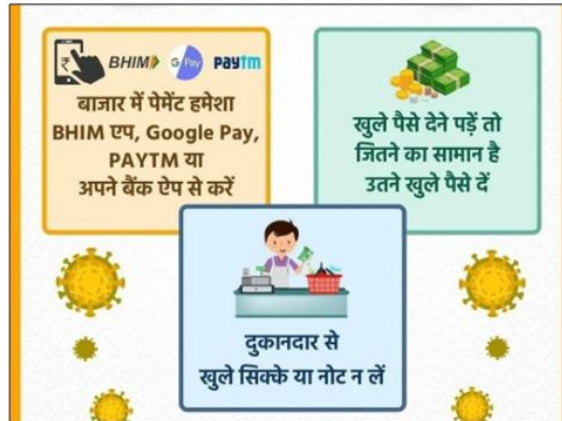


Fig 1: Illustration of transmission routes of 2019-nCoV



Box 1: Mobile Digitalization

1. Have you recently participated in large gatherings and/or gatherings of people unrelated to you?
2. Have you traveled to or reside in a country/area reporting local transmission of COVID-19?
3. Have you been within six feet of a person with a lab-confirmed case of COVID-19 for at least five minutes, or had direct contact with their mucous or saliva, in the past 14 days?
4. Have you had any of the following symptoms within the last 48 hours?
 - Fever of 100.4°F or above, or potential fever symptoms such as alternating shivering and sweating
 - Cough
 - Trouble breathing, shortness of breath, or severe wheezing
 - Chills
 - Muscle aches
 - Sore throat
 - Diarrhea
 - Loss of smell or taste or change in taste
5. Were you a patient who has recovered from COVID-19?

Box 2

2) Screening

Use of tele-consultation to assess the requirement of a patient to visit the dental clinic.

Auxillary team should inform patients on preventive measures to undertake prior to their visit. Digital record maintenance to be promoted. Screening or self-assessment tools published by CDC and the Mayo Clinic include following questions which should be asked to the patient (Box 2) [4].

- If all answers are NO: Appointment can be scheduled to manage orthodontic emergency.
- If any or all of questions 1, 2, or 3 were answered YES: Self-quarantine procedure is to be recommended.

- If any or all of questions 1, 2, 3, or 4 were answered YES: Patient will be referred to a hospital for management.
- If question 5 was answered YES: Patient should secure clearance first.

3) Precautions in the waiting room:

- Keeping an antibacterial disinfectant rug in the entrance of the waiting room.
- The waiting room for patients and visitors should have 1.2 m² per person.
- Chairs should be at a distance of 1 meter from each other.
- Dispensers to distribute alcohol based sanitizer or alcohol at 70% to encourage people in the waiting rooms to clean their hands. Informative posters should be placed for awareness and patient education (Fig. 2) [5].



Fig 2: Various awareness posters

- Presence of simple tools to allow people to wash their hands and faces: a sink with a liquid soap dispenser, paper tissue holders, and trash bins with lids that can be opened without using one's hands.
- Room environment should be well-ventilated.
- Elimination or restriction of sharing objects that patients might use, such as pens, sheets, telephones, and magazines.
- Devices like tablets that may be sanitized with alcohol must be made available in waiting rooms.
- Here the communications assistant wearing appropriate clinical PPE will take over. Their role is to welcome and dismiss patients from the clinic area without any actual treatment contact. They also note any information for the appointment, generates prescriptions, takes clinical photographs, and obtains needed supplies.
- Only the communication staff shall use the computer hence avoiding cross contamination and PPE waste. Wireless and washable keyboards and mouse are available from companies such as Seal Shield.
- Arranging orthodontic chairs in an open space creates social distancing or separating units with room dividers are also helpful. Upon completion of the appointment, the communication staff directs the patient back to the reception area. The staff then communicates with the parent by phone, text, video chat reporting the treatment progression, procedures accomplished, concerns and advices if any. If video connection software is being used, the orthodontist can also be brought in on the conversation without physically meeting the parent. This saves the doctor's time and avoids the waste of doffing and donning PPE for a trip to chat with each parent.

B) Modification of office settings [6].

1) New roles in office – Enhancing Auxiliary Support

- Once patient arrives in our office, they can intimate us of their presence by phone, text, or a video option (Zoom).
 - Auxiliary help includes recording initial body temperature (Fig. 3) [6], asking screening questions, provide details of what to expect during the appointment, and noting specific patient's concerns or questions that needs to be addressed.
 - Auxiliary staff [wearing appropriate PPE (Personal Protection Equipment)] instructs the patient to come to the practice entrance alone asking other persons accompanying the patient to remain in the waiting room or in their own vehicle.
 - After patients are directed to wash their hands or use provided hand sanitizer, they are escorted to the clinic area.
- 2) Minimizing Aerosol Generation/Increasing Aerosol Evacuation
- Aerosol production should be restricted, and if necessary, particulate respirator

- such as N95, EU FFP2 or equivalent in addition to face shield are required.
- It is important to determine where the high-volume evacuation (HVE) and low-volume evacuation (LVE) dental units exhaust all the contaminated air that they suction from patients' oral cavities. The contaminated air that are so diligently suctioned from the patient's mouth using HVE is simply being pumped right back into the environment through basement or exhaust negating any of our carefully planned filtration efforts.
 - Laser-induced graphene (LIG) water and air filters are developed which reduces contamination in the HVE system. LIG is a microporous foam that actively kills microbes and viruses using a low-level current.
 - A number of hands-free intraoral LVE attachments, including ReLeaf, Isolite, PushBackVac, Mr. Thirsty, DryShield, and NOLA, are familiar to dentists. Other intriguing options include the HVE Dental Mirror—a single instrument that incorporates suction through a modified dental mirror, which doesn't require an assistant to hold the evacuation.
 - Other products include the Purevac system of mirror tips with HVE hose adapter and the Nu-Bird Silver Raven Evacuation Mirror (Fig. 4) [6].
 - Many simple “funnels” or “dry cup” HVE attachments have been introduced for next-to-the-lips evacuation, but this kind of device must be held steady by the patient near the lower lip. Also interesting are HVE devices that are attached to standard cheek retractors, providing aerosol “scavenging” immediately adjacent to the lower lip (Fig. 5) [6].

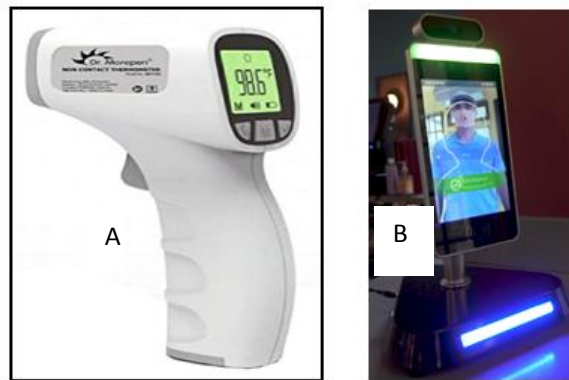


Fig 3: No contact thermometer(A), Temperature scanning kiosk by digital touch systems(B).

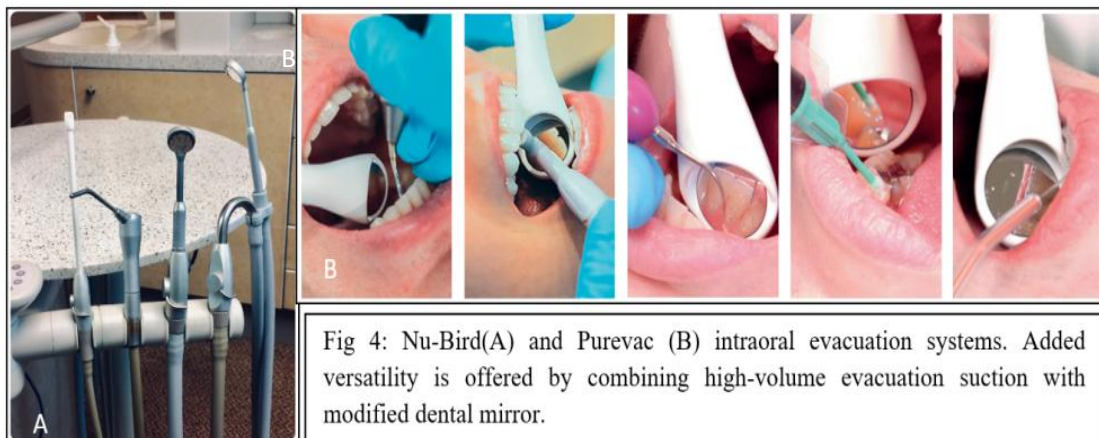


Fig 4: Nu-Bird(A) and Purevac (B) intraoral evacuation systems. Added versatility is offered by combining high-volume evacuation suction with modified dental mirror.

- A variety of external mobile aerosol suction units have entered the professional marketplace for propeos(close-to-the-mouth) evacuation. These devices may have started life in the nail salon market or as dental mercury vapor scavengers. Their adjustable suction arms can be positioned close to the mouth, and they not only serve as aerosol scavengers, but often feature self-contained high-efficiency particulate air (HEPA) or ultraviolet (UV) air-purification filters (Fig. 6) [6].

3) HVAC Office Engineering

- HEPA and UV portable air filtration units of all shapes and sizes provides excellent efficacy (Fig. 7A) [6].
- Adding HEPA filtration with ultraviolet germicidal irradiation (UVGI) light units to existing air conditioning/heating units could be considered a substantial first step toward improving overall office air quality (Fig. 7B) [6].

C) Personal Protective Measures

Impermeable lab coats and aprons, gowns, gloves, surgical masks, and surface protections: must be used during appointments and disposed

after each appointment in a disinfectant bin. Sequence of donning and doffing of PPE is extremely important (Figs. 8 and 9) [5].

Goggles and face shields - must be used during direct contact with patients. May be sanitized after each appointment and then reused.

Clothes and surgical scrubs - Adequate-sized gowns comprised of 30 grams of polypropylene, ensuring that hair and ears are completely covered. Wearing long-sleeved lab coats/aprons comprised of 30 grams of polypropylene with elastic cuffs and collar. 3/4 length, until the middle of the shin, closed behind, and with shoulder strap with shoe covers comprised of 30 grams of polypropylene.

Facial Respirators (N95): Should be worn at all times also when performing tasks that generate aerosols and may be swapped after each appointment. Masks only to be reused in exceptional circumstances (max 4-5 times). To increase the shelf life of N95masks, it can be covered with a surgical mask. Mask should be stored for 4 days in a well-ventilated location before reusing. The outer part of the mask should not be touched when reusing it. New gloves should be used to touch the side bands [7].

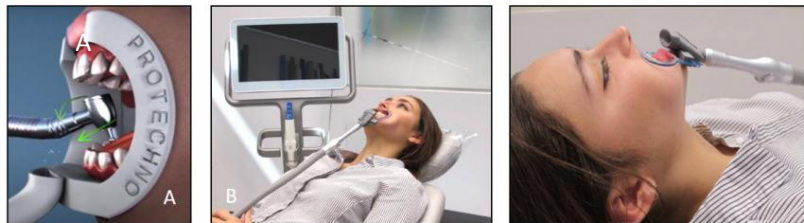


Fig 5: Astadentium Oral BioFilter (A) and Xuction Dental Aerosol Reduction Device (B) attach to cheek retractors for next-to-lips evacuation.



Fig 6: Perrona Eds 2000(A), HealthyAir Oral Aerosol Vacuum and Air Purification Filter (B) and OCTODent Aerosol Scavenging Suction Unit (C) for close-to-mouth evacuation

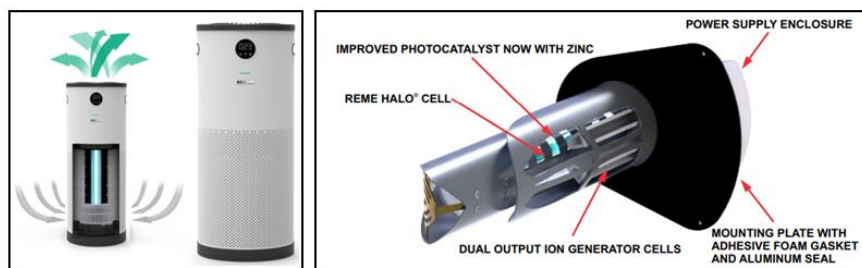


Fig 7: Jade Model SCA5000C HEPA-RX standalone filtration unit(A), In-duct REME Halo UV air-purification system can be installed into heating, ventilation, and air conditioning system(B).



Fig 8: Sequence of Donning PPE

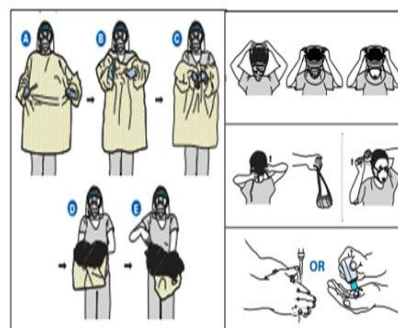


Fig 9: Sequence of Doffing PPE

D) Sterilization & Disinfection

The following are recommendations to reduce risk of cross-contamination and help protect vulnerable patients as well as the orthodontic staff:

- Orthodontic pliers can be sterilized with steam autoclave sterilization, ultrasonic bath and thermal disinfection or disinfected with chemical substances 2% glutaraldehyde [8-13].
- Orthodontic markers can be autoclaved or disinfected using glutaraldehyde solution.
- Cleaning photographic retractors with washer-disinfector was reported as the most effective method of decontamination [14].
- Disinfectants like hypochlorous acid (HOCL), H₂O₂, are to be used for disinfection of the office equipments & tools. Other options include Oxychlorine/ ammonium chloride is touted as being noncorrosive and non-irritating to the skin and is EPA-approved for one-minute SARS-CoV-2 sanitation [6].
- Environmental cleaning and disinfection procedures are to be followed consistently and correctly after each patient. We should wait for 15 minutes after completion of patient work before we begin to clean and disinfect room surfaces. This time will allow for droplets to sufficiently fall from the air after a dental procedure, and then be disinfected properly.
- Hence appointments are spaced properly. After 15 minutes the operatory is totally disinfected including the mopping of dental chair, floor and shelves with the best possible and appropriate disinfectants.
- Ultraviolet germicidal irradiation (UVGI) is done for 10 -15 minutes depending upon wattage of the light source, room size and UV light position in the room (Fig. 10) [6]. The high spectral emission lamps from these units produce photons that expose microorganisms to a short light wavelength (254 nm) that is lethal to a microorganism. Disinfectant defogging and fumigation of 30-45 min is done at the end of the day [6].
- Cleaning clinical environments with 70% alcohol, 2% Glutaraldehyde, 1% sodium Hypochlorite and 0.2% Paracetic acid.

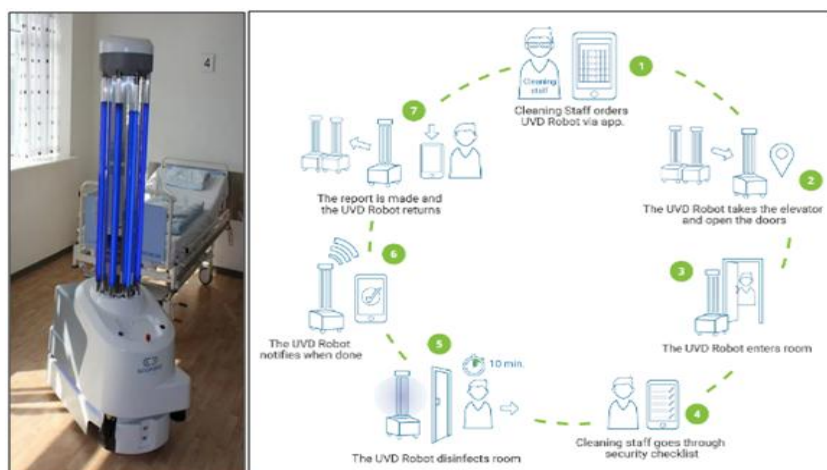


Fig 10: UVGI Robot and its procedure

3. CONCLUSION

In summary, SARS-CoV-2 is the first highly contagious pandemic infection of this millennium. While cross-contamination within any dental setting has not been reported, dentists in all disciplines, including orthodontists, need to be constantly aware of the emerging infectious threats and informed of updates in infection control guidelines. This review reinforces the work practices including hygiene, infection control, and personal protection in the post covid scenario. Given the high transmissibility of COVID-19, controlling aerosol and human-to-human contact while limiting treatment to emergency cases is advised during the outbreak. It is the responsibility of the orthodontic team to ensure safety and stop cross contamination within the clinical facility.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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