International Journal of Oral Health Dentistry 2021;7(4):257–264

Content available at: https://www.ipinnovative.com/open-access-journals

International Journal of Oral Health Dentistry

Journal homepage: www.ijohd.org

Narrative Review

Orthodontics - during and after COVID-19 pandemic

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ARTICLE INFO

Article history:
Received 29-06-2021
Accepted 07-09-2021
Available online 28-12-2021

ABSTRACT

The rapid outbreak of coronavirus syndrome 2 (SARS-CoV-2) has engulfed the entire international community and triggered serious public health issues. Orthodontists may encounter patients with suspected or confirmed SARS-CoV-2 infection and may need to work vigilantly to avoid the spread of infection, consecutively provide care and emergency treatment. The objective of this review is to provide a brief overview of the effects of SARS-CoV-2 and COVID-19 on orthodontic treatment, and to address risk management and the facilitation of orthodontic emergency care and post-pandemic orthodontic practice, using data and literature currently available.

1. Introduction

The end of 2019, marked the outbreak of a respiratory disease known as COVID-19, found to be a contagious disease.[1] Since then the virus has spread rapidly from Wuhan to other neighboring provinces in China and later on all across the globe, imposing a greater challenge on the healthcare facilities.[2,3]

The objective of this review is to provide a brief overview of the effects of SARS-CoV-2 and COVID-19 on orthodontic treatment, and to address risk management and the facilitation of orthodontic emergency care and post-pandemic orthodontic practice, using data and literature currently available.

2. What is COVID-19?

SARS-CoV-2 is a beta coronavirus, sharing close resemblance with the genetic sequence and viral structure of both severe acute respiratory syndrome coronavirus (SARS-CoV; 70% similarity), and Middle East respiratory syndrome coronavirus (MERS-CoV; 40% similarity).[4]

SARS-CoV-2's R0 (basic reproduction number) has been estimated to be within the range 2.2 and 3.28, which implies that on an average, each infected person causes 2-3 new infections.[5,6]

3. Pharmacological Management

Even though many drugs are being used as off-label drugs, none of them have been licensed or shown to be safe and effective for the treatment of COVID-19, except for Remdesivir, which has now been given authorization for emergency use in the United States.[7,8] In a recent study, the authors recommended HCQ as a better therapeutic agent than CQ for treating SARS-CoV-2 infection.[9,10] In a few review articles, convalescent plasma therapy[11] and also tocilizumab have been found to have curative effect and reduced mortality rate in severe COVID-19 patients requiring ICU care, however, the clinical evidence

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https://doi.org/10.18231/j.ijohd.2021.051

pertaining to the efficacy and safety of these therapies needs to be further investigated.[12,13]

These drugs are being used on a compassionate basis or as part of randomized controlled trials. Currently, the treatment involves repurposed therapeutic drugs and symptomatic relief which often includes the use of antibiotics, antiviral therapy, systemic corticosteroids, and anti-inflammatory drugs (including anti-arthritis drugs) for ARDS and secondary infections.[14]

4. Clinical Management and after the Pandemic

4.1. Before dental procedure

1. Office Staff → Communicate and educate them regarding the latest protocols of sterilization and protection to be followed.
2. Patients → Set-up "Virtual Appointments" to track patient progress and discuss their concerns, also share information on the required safety protocols, the orthodontic office's infection control protocol and practice status.

4.2. Virtual consultations

1. To conduct virtual consultations, a standard protocol should be adopted which will ensure a hassle-free management of patients and aid in documentation of virtual records of patient's data.
2. Prior to the virtual appointment, patients should be asked for written consent, five standard intraoral photographs (frontal, right and left buccal, upper and lower occlusal) as well as extraoral photographs (frontal smiling and relaxed and lateral). A tablespoon for retraction and ring flash for adequate lighting can be used. Patients should be asked to take help from a family member or a friend for taking photographs.
3. A Health Insurance Portability and Accountability Act (HIPPA) compliant application (zoom, GoToMeeting) should be preferred for virtual consultations. The HIPAA regulations are created to secure the privacy of patient data.

4.3. Clinical Set-Up

1. Declutter the office by removing unwanted things that are difficult to disinfect, like newspapers, magazines, etc. so that easy sterilization and disinfection can be carried out.
2. Sufficient stock of PPE and other essential hygiene care materials should be maintained.
3. Signages depicting standard hygiene practices and social distancing should be displayed in the office. Glass barrier should be present between the front desk staff and patients.
4. Schedule the appointments only after mandatory tele-screening / patient evaluation and receiving online registration and consent forms from the patients. At least 15 mins of the interval should be maintained between two consecutive appointments for carrying out proper cleaning and sterilization of the operatory area and also avoid crowding of the patient in the waiting area.
5. Patients should be advised to come alone or only one person can accompany the patient during their visit to the dental office.
6. Patients should send online registration and consent forms to the dental staff prior to the scheduled appointment.

4.4. Patient arrival

1. On arrival→ patients should be asked to notify staff; and wait until their turn, following strict protocols of social distancing.
2. Before entering the clinic → There should be thermal testing, pulse oximetry and hand sanitization. Patients should be given a mask, disposable shoe coverings, tissues and disposable non-contact receptacles.

Fig. 2: Steps to be followed on patient arrival

4.5. During the dental procedure

1. All staff members should be trained in hand hygiene. Hand rubbing should be carried out for approximately 20 seconds using mild liquid soaps, and effectively

Fig. 1: Significance of virtual consultations

dried using disposable paper towels as insufficiently dried hands are prone to skin damage and also transfer more microorganisms.

2. Practice hand hygiene before and after each therapy sessions; donning and doffing of PPE; washing instruments (use mechanical or ultrasonic washer/disinfection is necessary); before contacting steam-sterilized instruments (even if wrapped or not); after cleaning or maintaining decontamination devices used on dental instruments; and after decontamination work.

4.6. The patient treatment area

Even if the area appears uncontaminated, it should be cleaned following each session using a disposable cloth or clean microfiber materials.

1. Between each patient → Local work surfaces; dental chairs; curing lamps; inspection lights and handles; hand controls including cover replacement; trolleys/delivery units; spittoons; aspirators; x-ray units should be cleansed using 1 percent sodium hypochlorite or 70 percent alcohol between each patient.
2. After each session→ taps; drainage points; splash backs and sinks should be cleaned. Wet mopping with a disinfectant (approved by the Environmental Protection Agency, Disinfectant List Coronavirus Disease 2019 – 03/13/2020 are recommended for surface disinfection procedures) should be carried out for other areas like cupboard doors, light fittings, floors, and surfaces distant from the dental chair. According to manufacturer's instructions, spittoons and aspirating units should be washed thoroughly.
3. At weekly intervals → Window blinds; accessible surfaces such ventilation fittings, radiators, and cupboard shelves should be cleaned.
4. Single-use disposable covers → can be used on surfaces and devices such as headrests, light handles, curing light tips, etc. and also keyboard, screens, etc. should be covered for infection control.
5. Reusable devices → decontaminated based on manufacturer's instructions to prevent cross-infection.
6. Freshly or weekly prepared Hypochlorite at 1000 ppm available chlorine should be used to clean blood spillages, with a higher contact time of at least 5 minutes. Due to the corrosive nature of this solution, it should be used precautiously, and not used over the metal fittings.
7. HEPA filters should be used and air conditions should have vents facing upwards
8. At least 6 feet distance should be maintained between two dental chairs and if not, then simultaneously working over two patients is not recommended.

4.7. How to use/Remove Personal Protective Equipment (Ppe)

What to wear and when to wear ?

1. It is highly advised to use the personal protective equipment, including N-95/ standard FFP2/FFP3 masks (authenticated by the European Union's National Institute for Occupational Safety and Health), gowns, gloves, and goggles or face shields for the protection of skin and mucosa against (potentially) contaminated blood or secretions.
2. The staff should be trained in donning and doffing of PPE in designated separate areas consisting of a sink with long handle water outlet and non-contact bins for disposal of PPE and with charts and guidelines (by CDC or WHO) displayed in these areas.

4.8. Patient precautions before starting dental treatment on the chair

1. The patient should be asked to rinse the mouth using 1.5% hydrogen peroxide or 0.2% povidine iodine mouthwash for 1 minute.
2. Make use of a rubber dam, for all aerosol generating procedures, along with high vacuum suction and high volume evacuators with 4 handed dentistry.
3. Cold sterilization should be carried out with 2% glutaraldehyde and hot sterilization with B class autoclave respectively. Anti-retraction handpieces should be used and autoclaved after each patient (4-5 spare handpieces).
4. The integration of pulsed xenon-based ultraviolet light no-touch disinfection systems PX-UVC treatment into regular procedures for cleaning and disinfection has shown impressive outcomes in both reducing hygiene failures and controlling environmental contamination by highly concerned microorganisms.[15]

5. After Dental Care

1. **In Between Each Patient →**
   (a) Cleaning and sanitization in between patients the patients.
   (b) Change the PPE.
2. **At the End of The Day →** Before leaving the office, change the scrubs to personal clothing, and after going home immediately take shower and wash clothes separately.
3. **Dental Water Line Disinfection →** Regularly follow 3 steps to keep the dental waterline clean- Testing, Shocking and Maintaining.[16] Biofilm levels can be minimized through water treatments using ozonation or electrochemical activation, chemical dosing of water (e.g. with hydrogen peroxide,[17] per oxygen compounds, silver ions, or nanoparticle silver), flushing lines (e.g. handpieces and triple syringe) after every patient use, and flushing them at the start of the day to reduce overnight or weekend biofilm accumulation.[18]

6. Methods to Reduce Contamination from Aerosols

No single strategy or device can completely mitigate the risk of infection for dental personnel and other patients. Hence, the dentist shouldn't rely on a single approach for precautions. The reduction of contamination through aerosols can be brought about using a collective approach consisting of -

1. Personal protection barriers such as masks, gloves, safety glasses/shields.[19]
2. Preprocedural antiseptic rinse with a mouthwash such as chlorhexidine.[20,21]
3. Use of an HVE[22–26]
4. The use of a device, such as a HEPA filter, to minimize the aerosol contamination that escapes the operating area.

7. Managing the Orthodontic Practice

Orthodontists must be prepared to manage their patients, their staff and the office during this pandemic. The following recommendations can be implemented to reduce the risk of infection and to help protect patients as well as the orthodontic staff:

8. Orthodontic Emergencies

An orthodontic emergency can be described as a problem arising from an orthodontic appliance, which may or may not require an unscheduled appointment to the orthodontist.[27] Most of these emergencies can be managed through virtual assistance or by providing the patients with links to orthodontic websites with step by step instructions to the same.

9. Poking Wire

1. **Poking distal arch wire/ ligature wire →** A cotton bud, clean tweezers or an eraser at the back of a pencil can be used to bend the protruding distal arch wire or a metal ligature wire against the tooth.
2. **Flexible Ni-Ti arch wire → bending the wire may be difficult,** excess wire can be cut off using sterile nail clippers.
3. **Thick arch wire →** attempt to cut with a sterile hardware cutter.[27]
4. Afolded gauze piece should be used while cutting to prevent swallowing of the snipped piece of wire.
5. **Slipped arch wire from molar tube →** repositioned by gripping the wire using sterile tweezers and sliding it carefully till the wire is equal on both sides.[27,28]
6. **Difficulty in bending /cutting the arch wire** the ends can be covered with relief wax until the patient is able to visit his/her orthodontist.

9.1. Loose orthodontic attachements/appliances

1. **Loose Bracket →** loose but remains flush with the tooth→ it can be left as it is until the next visit.
2. **Bracket has Flipped around on the Wire →** Slide and reposition the bracket at the center of the tooth, using sterile tweezers and then rotate it back to its previous position (brackets on the adjacent teeth can be used as reference).If elastic bands were being engaged on that bracket, its use should be stopped.[28]
3. **Loose Band →** causing discomfort, remove it to prevent the possibility of swallowing it and may also require arch wire cutting.
4. **Loose Molar Tube** slide the tube off the wire and cut the wire at the point of the last tooth with a secure band or bracket.
5. **Loose Elastic Ligature →** can be placed back around the bracket using sterile tweezers or a toothpick.
6. **Loose Metallic Ligature →** it can be removed using sterile tweezers.
7. **Secure but Sticking Out and causing Discomfort →** a cotton bud or an eraser at the back of a pencil can be used to bend the wire towards the tooth.
8. **Ill-fitting Headgear →** if it shows tendency to come out of the headgear tubes, the headgear wear should be immediately stopped. Recall the patient as soon as possible. If an eye injury is suspected, then it is recommended that the patient be promptly referred to the nearest hospital's - accident and emergency clinic for an ophthalmic opinion. Any excessive delay could jeopardize the prospect of a successful vision restoration.[29]

9.2. Appliance rubbing against the lips and cheeks

1. The area of concern should be dried and a small piece of relief wax should be rolled and placed.
2. Broken/Ill-Fitting Appliance
3. Broken/ill-fitting appliance → the patient should send photographs to the orthodontist and stop its use.
4. Broken/ ill-fitting aligner→ the patient should go back to the one that was fitting well till a new set is received from the orthodontist.

9.3. Inhalation or Ingestion of an Orthodontic Component

1. For majority of the cases → it passes through the digestive tract uneventfully.
2. The British Orthodontic Society has set up detailed recommendations for the treatment of inhaled or ingested foreign bodies.
3. Ask the patient if he/she has any difficulty in breathing or experienced sudden coughing after the attachment was swallowed.
4. If yes → perform Heimlich manoeuvre, if condition deteriorates, refer the patient to the emergency department of a local hospital for an appropriate radiographic examination, and further management of the same. [29]

10. Orthodontic Treatment Considerations

10.1. Managing existing orthodontic cases

Removable appliances (functional appliances, aligners, etc)

1. Treatment progress → remotely monitored through virtual appointments using HIPAA compliant applications.
2. Functional appliances → once the objectives of the appliance are achieved, the patient should be called for an in-office visit as soon as possible.
3. Immediate fixed appliance treatment is not possible → an upper anterior inclined plane should be given to retain the corrected incisor relationship. [30,31]
4. Clear aligners→ at least 10-12 weeks of trays should be given in advance to minimize in-office visits.
5. Ill-fitting tray→ advised to go back to the one that was fitting well.
6. Loose tray→ advised to move on to the next tray. [32]
7. If on the last set of trays, and unable to visit the orthodontist's office → advised to reduce the wear-time to 10-22 hours a day (or at night-time only), hence the aligners last longer.
8. For existing COVID-19 aligner patients → current aligners should be stopped to prevent the potential risk of reinfection. These patients should call the orthodontist's office and get a new set made and delivered to them. [33]
9. All patients should be instructed to always wash their hands before and after wearing their appliances or elastics, and to keep the appliances clean using a soft bristle brush and toothpaste twice a day and to soak the appliance in a chemical cleanser once a week.

11. Expansion Devices

1. Ongoing expansion treatment → closely monitored through virtual appointments/photographs to evaluate treatment progress.
2. Patients should be provided with instructions regarding activation of the appliance (number of turns to be given, when to stop giving turns, key should be cleaned with alcohol after each use and stored in a clean case).
3. Recall the patient as soon as possible once the desired expansion is achieved → to avoid overactivation of the appliance, resulting in undesired buccal tipping of the posterior teeth
4. Maxillary and mandibular rigid stainless steel arch wires, with coordinated arch forms should be placed to prevent any unwanted crossbite.

12. Rebonding Debonded Attachments

1. Rebonding necessitates the removal of residual composite, which in turn generates aerosols. To avoid this, Paul Gange Jr. of Reliance Orthodontic Products has recommended the following protocol for rebonding.
2. If no residual adhesive present on the tooth→ light-cured resin-modified glass ionomer cement can be used, eliminating the need for any prior enamel polishing or etching. [34]
3. It should be noted that the above mentioned non-aerosol bonding alternatives may result in compromised bond strengths.

12.1. Space Closure

1. In contrast to the evidence of a more consistent and rapid space closure with coil springs than elastomeric modules, spaces when closed too rapidly can result in incisor torque loss, making elastomeric modules or power chains a more favourable option in the current situation. Space closure can continue for several months in patients who fail to present for normal adjustments due to the 'trampoline effect'. [35]
2. Power chains can be provided in small autoclaved pouches along with the guidelines for their usage.
3. Patients using intermaxillary elastics for space closure → remotely monitored as it can cause deleterious effects like tipping of teeth and deepening of the bite. [31]

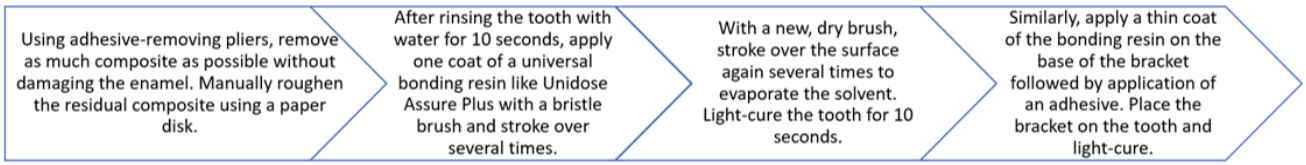

Fig. 3: Steps involved in rebonding debonded attachments without generating aerosols

12.2. Miniscrews

1. 0.12% Chlorhexidine mouthwash should be recommended twice a day, 30 minutes after brushing with a fluoridated dentifrice, to achieve good oral hygiene thus preventing complications like screw loosening, soft tissue inflammation or infection.
2. Soft tissue overgrowth/ any mucosal irritation→ prevented by pressing down the soft tissue surrounding the miniscrew/ lift the miniscrew attachments away from the tissue periodically plastic toothpick.[36]
3. Self-drilling miniscrews should be preferred over self-tapping miniscrews to avoid the generation of aerosolized tissue debris.[37]

13. Beginning New Orthodontic Cases

13.1. Aligners

Aligners may be preferred over fixed orthodontic treatment, especially in mild malocclusion cases as it requires fewer in-office visits. Aligner attachments can be placed without generating aerosols using the bonding techniques mentioned below.

1. Care should be taken to blot dry instead of scrubbing the tooth. Repeat steps 2 to 4 of rebonding mentioned previously.
2. This procedure can also be performed for rebonding when no residual composite is present on the tooth surface.
3. Alternatively, light-cured resin-modified glass ionomer cement can be used for initial bonding without any prior enamel preparation.

13.2. Banding

Selecting a band of a suitable size can require many attempts, these tried-in bands should be discarded after one use, hence preventing cross-contamination if not sterilized properly. However, if it is to be reused, it can be sterilised as follows :-[38,39]

13.3. Wire Placement and Ligation

1. Reuse of arch wires between patients should be avoided to prevent cross-contamination. Arch wires should be sterilised before placing it in the patient's mouth.
2. Individually sealed autoclavable arch wire packages should be preferred over unsealed ones for patient safety.[38]
3. Arch wires should be ligated with stainless steel ligatures instead of elastomeric rings as the latter causes comparatively more plaque retention and gingival bleeding.[40]

13.4. Extractions

1. Orthodontic extractions can be carried out using standard precautions. To avoid multiple in-office visits, all extractions should be scheduled for the same day.

13.5. Debonding

1. It is advisable to temporarily delay debonding as removal of the residual composite causes aerosol generation. However, in patients with poor oral hygiene, delaying debonding would result in deleterious effects, in such cases debonding can be carried out as follows:-

In case of aligner patients, removal of composite attachments can be done using the same technique mentioned above.

13.6. Retention

Removable retainers should be preferred to avoid aerosol contamination that would occur during bonding a fixed retainer. If giving a fixed retainer is unavoidable, especially in low compliance patients, the steps for bonding mentioned previously can be followed.

13.7. Moving forward

The field of clinical orthodontics has experienced significant changes over the last few months in terms of patient and practice management as well as treatment mechanics and will continue to evolve to meet the new standards of patient safety. The key to moving forward during these unprecedented times is to adapt to these changes and to be prepared to deal with this crisis to ensure maximum efficiency in their practices. Comprehensive guidelines need to be followed while practicing remote monitoring. The

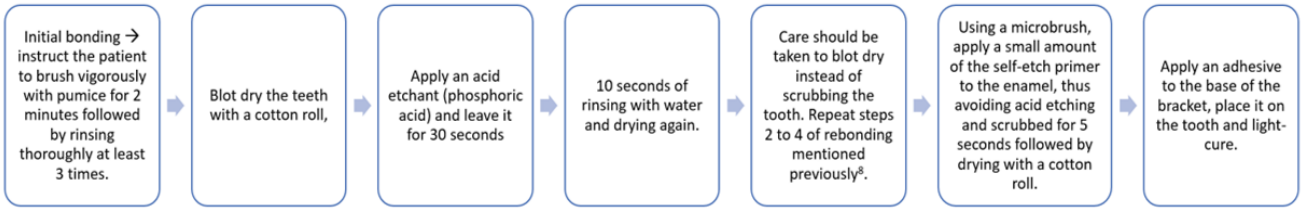

Fig. 4: Steps involved in bonding

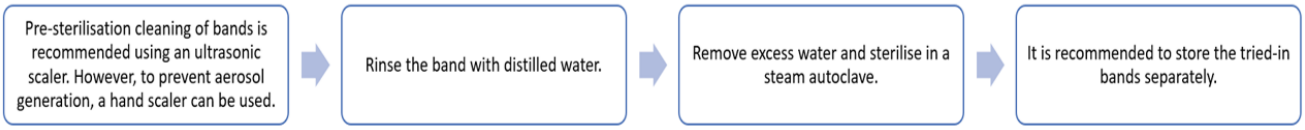

Fig. 5: Steps involved in banding by preventing aerosol generation

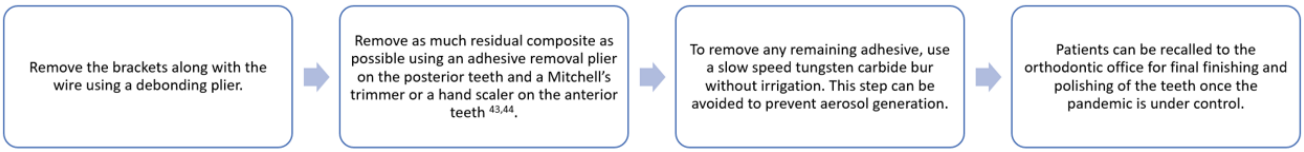

Fig. 6: Steps involved in Debonding without aerosol generation

infection control protocol practiced in the office should be re-evaluated and revised to meet the latest guidelines.

An effort has been made by the authors to recommend a few changes and alternatives that can be incorporated in the practice to limit the risk of infection with COVID-19. However, there is a need for a more comprehensive evidence-based protocol that can be followed world-wide.

14. Source of Funding

None.

15. Conflict of Interest

The authors declare no conflict of interest

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Cite this article: Kalia AJ, Kale KR, Kashmiri HMH, Nene S, Hegde A, Mirdehghan N. Orthodontics - during and after COVID-19 pandemic. *Int J Oral Health Dent* 2021;7(4):257-264.