



Review Article

COVID-ified' orthodontic practice: A review

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ABSTRACT

Corona virus disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome corona virus (SARS-CoV-2). It emerged as a global pandemic in early 2020, affecting more than 200 countries and territories. As SARS-CoV-2 has also been identified in the saliva of infected individuals, it poses a significant risk for dental professionals and their patients. This article focuses on the changes which are to stay in the wake of COVID-19 especially with respect to orthodontic practice. It is important to have a thorough knowledge about handling the procedures and emergencies in the current scenario or in the wake of an unprecedented future lockdown. Practitioners must anticipate and be prepared for the effects of unsupervised orthodontic treatment in the wake of unprecedented suspension of elective treatment due to COVID 19. This literature also focuses on publications regarding this new corona virus and supplies valuable indications to professionals concerning protective and preventive measures that can be adopted. Orthodontically relevant sources of information were searched using electronic databases including PubMed and Google Scholar, Scopus and SciELO. As keywords, the terms "Orthodontics" and "Covid-19" were used in English. Where available, peer-reviewed and more recent publications were given priority.

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1. Introduction

In October 2015, blood samples were collected from 218 villagers in Jinning, China. The villages surround caves that are known to host SARS-related coronavirus harbouring bats. The blood samples found that nearly 3% carried antibodies against SARS-like coronavirus. There was no history of contact with bats nor did they exhibit any clinical symptoms. This was the first recorded incidence of a bat-to-human transmission of the coronaviruses. This research,¹ also mentioned that these coronaviruses have a high rate of mutation and "are prone to recombination if different viruses infect the same individual."²

With its beginnings in Wuhan city, China, as a cluster of cases of pneumonia with unidentified aetiology, it was soon identified to be caused by a novel strain of coronavirus (CoV), called severe acute respiratory syndrome CoV-2

(SARS-CoV-2), which spread primarily through droplets, respiratory secretions and through direct contact. The COVID-19 pandemic is an unprecedented global crisis. By mid-September, 2020, over 22 million confirmed cases of COVID-19 had been reported worldwide, with almost 9,30,000 deaths.

SARS-CoV-2, has created a much deadlier pandemic in part because once it infects a person it can lie undetected for a long time. An individual who had the SARS coronavirus do not transmit the disease until 24 to 36 hours after displaying symptoms such as fever and dry cough; people feeling ill could be isolated before they made others sick. But individuals with COVID-19 may transmit the virus even before they show clear symptoms. Not feeling sick, infected men and women work, commute, shop, eat out and attend parties, all the while exhaling the virus particles into the airspace.

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COVID-19 came out of nowhere!! And so, dental practice owners now face a challenge they have not been prepared for. No dental practitioner could have envisioned a situation like this one, where there is a prolonged period of interruption. It is important to be informed, be prepared, be smart, be safe and be ready to fight COVID 19. The standard protective measures in daily practice are not effective to prevent the spread of COVID-19, especially when patients are in the incubation period or choose to conceal their infection.

This article is intended to throw some light on the changes which are to stay in the wake of these tough times especially with respect to orthodontic practice. Unlike other specialities, orthodontic treatment requires multiple visits rather than a single sitting treatment and so it is important to have a thorough knowledge about handling the procedures and emergencies in the current scenario or in the wake of an unprecedented future lockdown. This review also focuses on publications regarding SARS CoV-2 and supplies valuable information to professionals concerning protective and preventive measures that can be adopted.

Documentary technique based on pre-existing literature on the subject was used to carry out this review. The research included the search for articles published in the bibliographic databases PubMed, Scopus and SciELO. As keywords, the terms “Orthodontics” and “Covid-19” were used in English. As eligibility criteria, articles published up to August 2020, written in English, which had the full text available within the theme addressed, were included. Articles involving the letters to the Editor and those studies carried out on animals (in vivo) were excluded.

2. SAFER aerosol free emergent (SAFER) dentistry

Dentistry is significantly impacted by the COVID-19 pandemic as dental procedures carry a high risk of infection for providers and patients due to the spread of aerosols. Dentistry is seriously disrupted and may not be able to return to the clinical routines of a pre-COVID-19 time. At this point of the pandemic, what is needed is a concept for continued dental services that avoids procedures generating infectious aerosols while being able to address patient’s oral health needs.³

There are three main pathways for virus transmission in dental settings: (1) direct transmission through inhalation of droplets containing the virus; (2) transmission via eye, nasal, or oral mucous membranes; and (3) contact transmission through contaminated surfaces.⁴ All these transmission pathways are facilitated and possibly amplified by aerosols generated during dental procedures.^{4,5}

Therefore, interventions that avoid aerosol generation should be the interventions of choice. Such procedures may replace possibly hazardous “standard” therapies in an emergency context with airborne pathogens such as SARS-CoV-2. Safer Aerosol-Free Emergent Dentistry (SAFER

Dentistry) prioritizes the most common patient needs, and systematically selects categories of effective, evidence-based, and value-based care that do not require aerosol-generating procedures.³

Focusing on emergency and urgent dental services, SAFER Dentistry addresses common care scenarios with a set of bundled interventions. They comprise the following.

1. Tele-dentistry: when performed in person, this includes antiseptic mouth rinse and visual and/or tactile inspection without intraoral radiography for diagnosis.
2. Acute pain, swelling, or infection: depending on the diagnosis, pulp devitalization/temporary filling (pulpitis), antibiotic therapy (acute inflammation), and/or local anaesthesia and tooth extraction.
3. Pain due to caries without pulpal involvement: silver-diamine-fluoride application (SDF), glass-ionomer sealants/Atraumatic Restorative Treatment (ART), fluoride varnish/gel, and/or toothbrushing with high fluoride-containing toothpaste.
4. Acute periodontal infection: hand scaling and metronidazole/amoxicillin combination for 1 week
5. Denture repair/reline, lost crown or orthodontic bracket, or orthodontic wire: denture repair with soft re-line, crown and bracket re-cementation, and wire adjustment, repair, or removal as well as removal of stitches from previous surgery.³

2.1. General guidelines for clinical practice

Be prepared... but don't panic...

Although it remains unclear which devices are most effective for protection against SARS-CoV-2 infection, all dental patients should be considered as potentially infected.⁶ Therefore, the use of Personal Protective Equipment (PPE), such as disposable waterproof scrubs and bonnets, gloves, eyewear protection, face shields, disposable shoe-covers and masks, is highly recommended.^{7,8}

2.2. Airway protection

In dentistry, the most indicated PPE for airway protection is the Filtering Face-piece (FFP) mask, which can block virus particles. FFP masks are designed to protect the wearer and are divided into the following different categories based on their filtration efficiency towards powders $\geq 0.3 \mu\text{m}$ in diameter: FFP1 (80% minimal total filtration efficiency); FFP2 (94% minimal total filtration efficiency); and FFP3 (99% minimal total filtration efficiency). An FFP2 respirator corresponds to an N95 mask, while an FFP3 respirator corresponds to an N99 mask. Because air droplet COVID-19 particles are estimated to be 0.06–0.14 μm in diameter, the most efficient masks are presumed to be FFP2/N95, FFP3/N99 and N100. Surgical masks, however, remain valid devices for all procedures that do not create an aerosol.⁹

2.3. Eye protection

The ocular pathway is known to be one of the most frequent routes of infection with SARS-CoV-2.¹⁰ Eyewear with enveloping frames should be used, and should have wide lenses to cover the face as much as possible. Alternatively, face shields may be preferred to glasses because of their greater capacity to protect the face from aerosol droplets. These shields can be worn directly on the forehead or can be included in the surgical mask.⁹

2.4. Patient considerations

A triage area is mandatory for initial evaluation of patients, and this area should be set up in such a way that close contact between individual patients and between patients and healthcare personnel is avoided.⁶ Preliminary evaluation of patients should consist of body temperature measurement and a brief survey to investigate possible fever, respiratory issues, cough or dyspnoea in the past 14 days, as well as contact with individuals who could have been potentially infected.

All patients should be regarded as potentially infected because only symptomatic individuals exhibit fever and breathing symptoms. As a general rule, patients affected by COVID-19 with a body temperature of >37.5 °C (99.5 °F) cannot be treated in a dental clinic, and should be confined to their home or hospitalised if they exhibit severe symptoms.

2.5. Environmental considerations

Each potentially contaminated surface should be cleaned and then disinfected with hydro-alcoholic disinfectants containing an alcohol concentration of $>60\%$. Coronaviruses can persist on plastic, glass and metal surfaces and remain infective for a maximum of 9 days, with a mean infective period of 4–5 days. Coronavirus could be effectively eliminated in 1 minute when the surfaces were disinfected with 62%–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite.

SARS-CoV-2 was viable in aerosols, with a progressive reduction of its infectious titre within the first 3 hours and a median half-life of approximately 1.1 hours.¹¹ Moreover, SARS-CoV-2 appeared to be more stable on plastic and stainless steel than on cardboard or copper; the following differences were found regarding the duration before SARS-CoV-2 became inactive: 72 hours for plastic, 48 hours for stainless steel, 24 hours for cardboard and 4 hours for copper.¹¹ Thus, for environmental disinfection, it may be useful to place a dispenser containing an alcoholic hand sanitizer (with an alcohol concentration of 60%–85%) in the waiting room, for hand cleansing.

2.6. Antimicrobial agents

A valid method to reduce the microbial load in the oral cavity is rinsing before dental procedures. There remains controversy regarding the effectiveness of chlorhexidine against coronavirus.^{10,12} Because SARS-CoV-2 is sensitive to oxidation, mouth rinses containing 1% hydrogen peroxide or 0.2% povidone-iodine have been proposed.¹⁰

2.7. Hand hygiene

Hand hygiene is considered the most important preventive measure to reduce the risk of transmission of microorganisms between dentists and patients.⁶ Soap and cleansers must be rubbed extensively on both hands, until the appearance of abundant foam which dissolves the lipid sheath around the viruses, causing dispersion and decomposition of viral molecules. At concentrations greater than 60%–65%, alcohol can dissolve fatty molecules of the external lipid layer of the virus, which leads to disruption of the virus particle; therefore, friction with an alcoholic hand sanitiser is suggested after handwashing.

2.7.1. Procedural considerations

1. It is recommended to avoid dental procedures that could cause cough and regurgitation. Orthopantomography (OPG) or cone beam computed tomography (CBCT) are preferred; periapical X-rays should be avoided because they could provoke hypersalivation, coughing or vomiting.⁶
2. RUBBER DAM: When handpieces or ultrasonic devices must be used, a rubber dam significantly reduces the amount of aerosol containing saliva and/or blood, providing a 70% reduction of droplets around the surgical field.¹³ When isolation using a rubber dam is not possible, manual instrumentation is preferred over high-speed handpieces.
3. High-speed saliva ejectors: Considerable reduction of droplet spread during dental procedures can be achieved using either high-speed saliva ejectors or surgical ejectors, and the use of such devices is therefore highly recommended.¹⁴
4. Anti-retraction high-speed handpieces: anti-retraction handpieces effectively reduce the return of bacteria and viruses into the tubing system, the use of handpieces without an anti-retraction system should be avoided.
5. UV light can damage microbial DNA and RNA, thus preventing reproduction of microbes and reducing the harmful effects of infectious organisms. These UV lights can be installed with a filtration apparatus and used in water- and air circulation systems to eliminate powders, bacteria and viruses.
6. Air depuration systems have been developed to filter and recirculate the air of surgical rooms and medical and health clinics. Air is drawn through different

filters: the first stops bacteria and larger droplets; the second reduces gas components; and the third reduces the numbers of the smallest droplet particles and the smallest microorganisms. These systems can filter droplet particles smaller than 0.01–0.3 μm , with a filtration efficiency of 85%–99%.

2.8. COVID 19: Impact on orthodontic practice

With the postponement of orthodontic consultations, the concern with the prolongation of the treatment arose among patients,¹⁵ as well as anxiety about scheduling the next visit to the orthodontist,¹⁶ as social isolation became a regulation adopted by several countries.¹⁷

Without the possibility of face-to-face consultations, professionals and patients undergoing orthodontic treatment had the opportunity to use technology to offer and receive virtual assistance, using photo, video or video-call applications, thus allowing the orthodontist to evaluate the need to be seen at the office.^{18,19} These technological communication tools, aside from keeping the patient-professional relationship active, decrease anxiety, since there is no risk of contamination, contrary to what happens during face-to-face care.²⁰

However, we are bound to deal with and take care of certain emergencies which are almost unavoidable. From an orthodontic perspective, emergencies include;

1. Orthodontic appliance (it may be of removable or fixed) breakage into the gingiva or oral mucosa leading to severe pain and or infection, circumstances related to dental trauma or where a lack of management would be harmful to the patient.
2. Tooth pain –it may be after the placement of fixed appliance, advise to take an analgesic to relieve the pain
3. Bleeding gums- advised to use brush and mouthwash to keep the area clean without debris.
4. De-bonded or loose brackets- Can be secured to the tooth (if not fallen off) and the arch wire with a relief wax
5. Ulceration as result of poking of wire/ligature tie dislodgement- place a relief wax until the next appointment. Use of gel for ulcerations is advised.
6. Expansion therapy - advised to stop activation as there are chances of dislodgement of the appliance.²¹

2.9. Virtual orthodontic consultation

It is inexpensive and valuable for providing health care instructions and requires interactive applications with necessary audio-visual functions in order to have discussion related to an upcoming appointment or an emergency situation. With the use of Wats App and other available technology it is now easier to deliver instant messages through audio or video conferencing.²² The

virtual assistance is performed by using photos, videos, or video call. In particular, the business version of WhatsApp can be linked to the firm's fixed number, activating the verification on call. Large hospital setups can activate WhatsApp Web and have the QR code sent by the dental office staff on duty in order to manage problems.²³ In the case of orthodontic emergencies, orthodontists should first try to manage the emergency over the phone or remotely. A verbal or electronically signed consent should be obtained to provide advice in this manner and orthodontists should record all advice that was given in accordance with normal record keeping. If possible, orthodontists should guide patients on how to manage minor emergencies at home.

1. When telecommunication is made by the orthodontist, the patient's health history should be obtained to elicit symptoms or contact history relevant to COVID-19.
2. The patient should be advised to seek appropriate medical treatment or hospitalization based on the analysis of this history.
3. In the event that the patient has to be seen in person, the medical history will also allow the orthodontist to assess the potential transmission risks and to ensure that the clinical operatory is equipped with the proper personal protective equipment (PPE).
4. In-person orthodontic treatment should be deferred for 2 weeks if the patient has been in contact with someone who has been infected or if the patient has travelled.

2.10. Handling orthodontic treatment during COVID 19

There are some specific orthodontic procedures and appliances that may have to be modified, at least in the short term in case of an unforeseen lockdown.²⁴

2.10.1. Bonding

1. Use non-AGP options for bonding.
2. Light-cured RMGIC can be used without any prior enamel preparation such as polishing, etching, or drying which are AGP.
3. Self-etch primers can be used.
4. Use a dry cotton roll to clean the enamel surface instead of a 3-way syringe.
5. Indirect bonding may be another alternative. Flash removal for indirect bonding is an AGP and must be performed with caution.

2.10.2. Levelling and alignment

1. The arch wires can be cinched back to prevent the sharp ends from impinging on the gums. To avoid slippage, it is wise not to include the second molars during the first few visits; they can be incorporated during the stages employing flexible rectangular wires.

Orthodontic Emergency	How the patient can attempt to handle it at home
Irritation of lip and/or cheek from the brackets	<ul style="list-style-type: none"> ● Place a small piece of rolled relief wax which is harmless ● Topical anaesthetic – for mouth sores (eg, Orabase, Colgate-Palmolive, New York, New York; or Orajel, Church & Dwight, Ewing, New Jersey) directly to the ulcerated surface using a cotton swab (reapplication might be needed).
Loose Elastic ligature Loose metallic ligature impinging on mucosa	<ul style="list-style-type: none"> - It can be placed back or removed by using a sterile tweezer If the ligature is loose, it can be removed with sterile tweezer - If it is not loose but is sticking out, a cotton swab/cotton bud or a clean pencil eraser can be used to bend the ligature back down.
Broken or loose elastic chain Loose orthodontic attachment (bracket, tube, or band)	<p>The extra segment can be removed with a sterile tweezer or cut with a sterile clipper.</p> <ul style="list-style-type: none"> -If the loose bracket is flipping (rotating) around on the wire and causing discomfort, a sterile tweezer can be used to correct this problem. - If the bracket is used as an anchor for wearing elastic rubber bands, it should be stopped. - If the loose bracket is the last attachment in the arch, it can be slid off the wire -The wire with the loose bracket can be cut at the point of the last tooth that has a secure orthodontic attachment on it -The cut end of the wire with the loose bracket attachment should be carefully removed from the mouth.
Protruding wire at the end of the braces	<p>A cotton swab/cotton bud or clean pencil eraser can be used to push the wire so that it flattens against the tooth.</p> <ul style="list-style-type: none"> - arch wire slipping away can be corrected with a sterile tweezer by moving it back - If the wire cannot be moved to a comfortable position, the wire can be covered with relief wax - If the wire is extremely irritating, the patient or care provider may use a sterile nail clipper to cut the wire. -Folded tissue or gauze should be used around the area while cutting the wire to reduce the possibility of swallowing of the snapped piece of wire.
Piece of appliance or a bracket is swallowed	<ul style="list-style-type: none"> -Most small orthodontic appliances (eg, brackets) that are swallowed will pass through the digestive tract uneventfully. - If an object is swallowed, it should be confirmed that the patient did/does not have difficulty breathing or sudden coughing. In the case of sudden difficulty should go to an emergency department of a hospital.
Broken bonded retainer	<ul style="list-style-type: none"> -The patient is advised to wear their removable retainer (if provided) until their next visit - If only one or two resin pads are loose, attempt to push the loose retainer wire back towards its tooth as much as possible, or cut the exposed unbonded part of the retainer using a sterile clipper - If a small portion of the retainer is still bonded, a sterile tweezer can be used gently to pull and remove the whole retainer. If too much force is required to remove the retainer, then it should be cut with a sterile clipper.
Broken or loose fixed expander or a lingual/palatal arch	<ul style="list-style-type: none"> - If the expander/lingual/palatal arch is partially glued and still present in the mouth, it can be placed back in position, and any remaining screw activations should be stopped until the patient can be seen in-person by the orthodontist. - If the expander has fallen out completely it should be kept in a safe place until further instructions are received from the orthodontist.
Broken intermaxillary spring, eg, Class II corrector appliance	<ul style="list-style-type: none"> - If completely broken (and the spring cannot be reattached to the rod) the patient or home care provider can use a piece of dental floss to secure the loose end of the appliance to the remaining arch wire and brackets.
Part of orthodontic appliance embedded in the gingiva leading to severe pain and or infection	<ul style="list-style-type: none"> - This would represent a true emergency -a sterile clipper to cut the wire if it is attached to the broken or loose part and remove the broken part from the mouth using sterile tweezers. However, this may not be possible to do with large diameter wires.

2.10.3. Ligation

1. Passive self-ligating brackets offer advantages in delayed appointments. First few appointments for patients during the levelling and alignment phase can be scheduled about 10 weeks apart.

2.10.4. Extractions and expansion

1. Orthodontic extractions may be carried out with standard precautions, but they should be planned for a single visit to reduce patient exposure with measures to avoid anchorage loss.
2. Expansion treatment is possible with close monitoring. Once rapid palatal expansion is complete, retain the achieved results by recalling the patient as soon as possible in case of a future lockdown.
3. Slow expansion is preferable because they are more fail-safe and do not create abrupt changes over short intervals.

2.10.5. Space closure

1. Closed coil springs used to exert continuous forces during space closure, can cause overclosure or unnecessary tipping if the patient does not report for a long time. In case of an unforeseen future lockdown, it is wiser to employ power chain or elastic thread.
2. Sliding mechanics are preferable over frictionless mechanics for preadjusted edgewise appliance systems because when not monitored closely, frictionless mechanics can produce deleterious effects as excessive tipping, unwanted intrusion or extrusion, and occlusal canting.
3. Tiebacks may be a useful method.
4. The use of intermaxillary elastics for space closure might be avoided at this time, because they require continuous monitoring and can cause adverse effects such as tipping and bite deepening, leading to unexpected gummy smiles in Class II cases.

2.10.6. Mini screws

1. In the current environment, mini screws should not be placed in patients with poor oral hygiene or existing periodontal problems, since the chances of failure are higher.
2. Strict measures must be employed to keep the tissue around mini screws clean and thus reduce infection- or inflammation-related emergencies.
3. Avoid using direct cantilever mechanics from the mini screws, because they may become dislodged and cause irritation to the soft tissues.

2.10.7. Retention

1. Finishing and polishing should be performed with caution during the debonding appointment because they are AGP.

2. An Essix or another removable retainer is preferable over a bonded retainer to avoid unnecessary aerosol contamination.
3. Providing patients with additional sets of removable retainers may be a good policy in case one is lost or damaged during a potential COVID-19 resurgence.

2.10.8. Functional appliances

1. Patients using removable functional appliances can be monitored remotely through video conferencing.
2. In case of a second COVID-19 outbreak before the start of Phase II treatment, the fixed appliances can be delayed and the retentive phase extended by placing an upper anterior inclined plane to retain the corrected incisor relationship.

2.10.9. Aligners

1. Clear plastic aligners may offer some advantages in the COVID-19 era.
2. In the infrequent instance of loss or breakage of an aligner, the patient is usually advised to wear the previous aligner or, if unavailable, the next one in the series.
3. If no aligner is available, a replacement “stage retainer” might be ordered from the manufacturer without a new digital scan.
4. Fractured attachments can be replaced using one of the protocols described earlier to reduce aerosol generation during bonding.

2.10.10. Financial constraints

In these difficult times, when the whole of the world has been forced to hunker down, we are dealing with a huge economic crisis. This has affected the dental sector as well. The patient, dental staff and the dentist themselves have problems related to finance in terms of recession and are forced to restrict themselves from non-essential expenditures. Certain points are to be considered while taking steps towards making a firm decision which would jeopardize the situation further as dental health is as important as medical health.

1. Offer the patient provisions to pay in installments
2. Consider accepting payments in full after the crisis is over.
3. Temporary cessation of payments in case the treatments are delivered through a virtual approach.
4. Individuals (doctor and the patient) involved are to seek help from the state-run oral health care programs for dealing with the situations of economic concerns.

3. Conclusion

This literature review was intended to collect all relevant published data in the orthodontic field since

the identification of the new coronavirus, Sars-CoV-2. It is aimed to supply practical information to orthodontists regarding the measures that should be taken to modify the practice and procedures in the wake of this pandemic. However, there are plenty of studies and researches going on and many new strategies, products and technologies that are more effective against COVID-19 is still in the making.

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5. Conflict of Interest

The authors declare they have no conflict of interest.

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