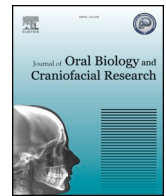




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## Review Article

## Appropriate orthodontic appliances during the COVID-19 pandemic: A scoping review

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## ARTICLE INFO

## Keywords:

COVID-19 pandemic  
SARS-CoV-2 infection  
Orthodontic appliances  
Dental bonding  
Dental aesthetics

## ABSTRACT

**Introduction:** The esoteric Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) infection or COVID-19 has been an unusual plummet in dental/orthodontic practice. Based on current recommendations for various amendments in an orthodontic practice, this scoping review aims to identify orthodontic appliances that are most appropriate to us during this on-going pandemic.

**Methods:** Electronic databases (PubMed, Scopus, Web of Science, Science Direct, and Google Scholar) were searched up until August 11, 2020. Full-text articles in English with keywords “COVID-19 and Orthodontics” and related search terms were included.

**Results:** Out of 17 retracted articles, only 4 articles were found to be brief the choice for orthodontic appliances in pandemic times speculating clear aligner therapy (CAT) to be a pragmatic solution. The remaining articles were also thoroughly studied and the new norms set by the pandemic were determined. Criteria for orthodontic appliance selection included careful patient screening and collection of records, minimal physical visits, efficient use of technology, virtual consultations but the use of PPE for physical appointments; and lesser AGPs with a lesser risk of airborne transmission.

**Conclusions:** Subject to regional demands, CAT can be considered as the relatively safer modality-predictable and effective apposite to fixed orthodontic appliances in these unprecedented times.

## 1. Introduction

The World Health Organization (WHO) officially named Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2 or 2019-nCoV) disease as ‘COVID-19’ on February 11, 2020, and declared this outbreak, a pandemic on March 11, 2020.<sup>1</sup> With the reporting cases more than over 40 million cases and 1.1 million deaths till now (as last accessed on October 21, 2020), the mortality rate is lower (3.4%) when compared to previous SARS-CoV (10%) and MERS-CoV (3.4%) outbreaks in 2009–2012 respectively.<sup>2</sup> However, its uncertain mode of transmission through droplets, fomites, and probably air-borne as well make it a highly infectious contagion. With 44 candidate vaccines in evaluation, out of which 11 have reached Phase III clinical-stage trials (as last on accessed October 21, 2020),<sup>3</sup> it can be predicted that the contagion or its effects may exist in the community for months from now until mass commercial production and community vaccination.

Dental professionals and associated health care providers are exposed to the risk of contracting and transmitting SARS-CoV-2 infection through either direct transmission (inhalation of droplets/aerosols or exposure to saliva and mucous membranes) or indirect transmission (via contaminated surfaces). While the risk of transmission through aerosol-generating procedures cannot be excluded, even more worrisome is that asymptomatic patients or patients in their incubation period are also carriers of SARS-CoV-2 and can be potentially infectious.<sup>4</sup> Strict infection control measures for the highly transmissible SARS-CoV-2 is a major area of concern. There are many published guidelines and new protocols being followed by individual nations to restore dental services across the globe.<sup>4–7</sup> For orthodontics as well, restarting the suspended services demands not just reinforcing the already existing protocols with new guidelines, but also manipulation and utilization of newer technologies with an updated digital workflow that reduces the manual task and hence the chair-side time.<sup>8–11</sup> Although an avalanche information for orthodontic appliances is available, there is still a

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<https://doi.org/10.1016/j.jobcr.2020.10.014>

Received 27 August 2020; Accepted 19 October 2020

Available online 21 October 2020

2212-4268/ © 2020 Published by Elsevier B.V. on behalf of Craniofacial Research Foundation.

**Table 1**  
PICOS- population, intervention, comparison, outcome, study design.

PARAMETER	INCLUSION CRITERIA	EXCLUSION CRITERIA
Population	Describing for Orthodontist/Orthodontic Residents/Orthodontic Patients	Describing for dentists, dental education, oral hygiene and other branches of dentistry (not orthodontics)
Intervention	Application of standard protocols for Orthodontics clinical settings prevention of COVID-19 transmission	
Comparison	Not Applicable	Not Applicable
Outcome	Considerations for Orthodontic appliance selection	
Study Design	Without Restrictions	Articles not in English Studies related dentistry except orthodontics Studies related outside the field of dentistry/orthodontics

dearth of data on the suitable appliances that could be more beneficial to the clinicians and the patients in the current pandemic.

To this unfold enigma, a thorough strategic analysis of literature was planned to map the evidence for recommendations for orthodontic appliance selections during this pandemic. The aim of this scoping review was to check for the various amendments required in orthodontic practice and their effect on the preference for orthodontic appliances in the new norms set by the pandemic. The speculation was to contemplate whether clear aligner therapy (CAT), in these unprecedented times, prove beneficial for orthodontists as well as patients when compared to any other apposite.

**2. Materials and methodology**

Considering a continuously updating COVID-19 data on a day to day

basis, this review included publications that accorded the search terms as searched uptill August 11, 2020. The PRISMA search strategy was planned using the MESH terms and Boolean terminology: (Orthodontic\*) AND (COVID-19\*) AND (SARS-CoV-2\*)/“Orthodontic\*” AND “COVID-19\*” OR “SARS-CoV-2\*”AND “Dental Bonding” AND “Dental Aesthetics”/“Orthodontic Appliance” AND “COVID-19” AND “Dental Bonding”. This search strategy was applied to the key databases PUBMED, SCOPUS, WEB OF SCIENCE, and Google Scholar. Due to the lack of clinical studies and trials with the interruptions caused by the pandemic, surveys/reviews/letters to editors/commentary/preprints/guidelines were also included to gather knowledge of the clinical requirements that mandate the restart of clinical practice (Table 1).

Screening of titles and abstracts of all the search results was performed and the full texts of included articles available in English were

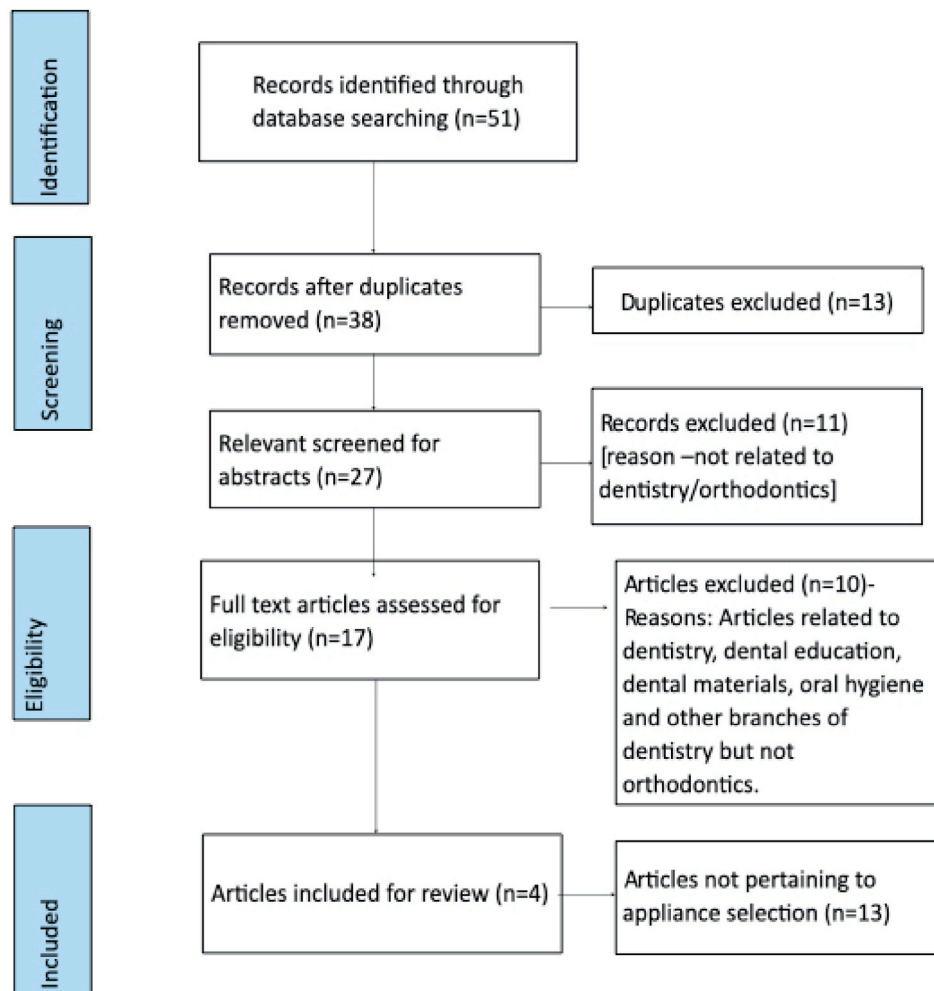


Fig. 1. The search Algorithm followed according to PRISMA statement.

**Table 2**  
Sources of literature included in this review, with levels of evidence\* gist.

Ref No.	Author	Objectives	Study design	Level of evidence*
1.	Suri et al., <sup>8</sup> 2020	To provide a comprehensive summary of the implications of SARS-CoV-2 infection and COVID-19 on orthodontic treatment, contingency management, and provision of emergency orthodontic treatment.	Review of reported data	5
2	Park et al., <sup>9</sup> 2020	Post-COVID-19 clinical and management guidelines for orthodontic practices	Narrative review, Mechanism-based Reasoning	5
3	M. Sritrengalakshmi et al., <sup>10</sup> 2020	To provide background on the current coronavirus pandemic and suggestions for implementing new office environmental and infection controls.	Mechanism-based Reasoning	5
4	M. Sritrengalakshmi et al., <sup>11</sup> 2020	Orthodontic treatment Considerations in Covid-19 Era	Mechanism-based Reasoning	5
5	Maryia A., <sup>12</sup> 2020	Utilizing aligners to solve the COVID-19-affected orthodontic practice conundrum.	Letter to editor, Mechanism-based Reasoning	5
6	Perillo et al., <sup>13</sup> 2020	To address the concerns of the orthodontic profession amid the COVID-19 crisis, and suggest recommendations for orthodontic care settings, infection prevention measures, and delivery of clinical procedures.	Narrative review,	5
7	Istekwe IG et al., <sup>14</sup> 2020	To assess the impacts of the pandemic on orthodontists and orthodontic residents, economic, psychosocial, and social well-being, in Nigeria.	Cross-sectional study	2
8	Cotrin et al., <sup>15</sup> 2020	To evaluate the impact of the coronavirus pandemic and the quarantine in orthodontic appointments, and patients' anxiety and concerns about their ongoing orthodontic treatment.	Local sample survey	3
9	Eliades et al., <sup>16</sup> 2020	To list the sources of aerosol production during an orthodontic standard procedure, analyze the constituent components of aerosol and their dependency on modes of grinding, the presence of water and type of bur, and suggest a method to minimize the quantity and detrimental characteristics of the particles comprising the solid matter of aerosol. Minimization	Review of reported data	5
10	Guo et al., <sup>17</sup> 2020	To update the preventive strategies for control of SARS-CoV-2 transmission to protect both staff and patients during the orthodontic practice.	Narrative review	5
11	Turkistani K., <sup>18</sup> AJODO, 2020	To report to orthodontists on the emergence, epidemiology, risks, and precautions during the disease crisis.	Narrative review	5
12	Xiong Xi et al., <sup>19</sup> 2020	To evaluate the mental distress of orthodontic patients and to investigate the level of their anxiety on treatment duration and outcome during the early stage of the pandemic.	Random sample survey	1
13	Turkistani K., <sup>20</sup> 2020	Impact of Delayed Orthodontic Care During COVID-19 Pandemic: Emergency, Disability, and Pain Khadijah	Local, non-random sample cross-sectional study	3
14	Shenoi et al., <sup>21</sup> 2020	To assess the impact of the COVID-19-related lockdown on the treatment and psychology of patients undergoing orthodontic treatment.	Random sample survey	1
15	Garcia-Camba et al., <sup>22</sup> 2020	To discuss essential adaptations that concern four areas of the orthodontist: practice: microbiological control, social distancing, new ergonomics, and bioethical considerations	Mechanism-based Reasoning	5
16	Martina et al., <sup>23</sup> 2020	To investigate if dentists are anxious about returning to their daily activities, and what the perception of the risk is for dentists and orthodontists regarding orthodontic procedures.	Random sample survey	1
17	Bennardo et al., <sup>24</sup> 2020	To describe COVID-19 as a new challenge for dental education using the recent literature and experience gained in the Italian University of Catanzaro.	Commentary	5

\* Level of evidence rating scheme based on Oxford Centre for Evidence-based Medicine (OCEBM) Levels of Evidence Working Group. "The Oxford Levels of Evidence 2." Oxford Centre for Evidence-Based Medicine. Available at: <https://www.cebm.net/index.aspx?o%45653>. Accessed on August 15, 2020.

**Table 3**  
Characteristics of included articles.

Full-text articles included for the review		
Studies on the psychological impact of the pandemic on orthodontic practice.	Studies providing guidelines and recommendations for orthodontic set-up and practice	Studies mentioning appropriate appliance selection for an orthodontic practice.
Isiekwe IG et al., <sup>14</sup> 2020 Cotrin et al., <sup>15</sup> 2020 Xiong Xi et al., <sup>19</sup> 2020 Shenoi et al., <sup>21</sup> 2020 Martina et al., <sup>23</sup> 2020	Suri et al., <sup>8</sup> 2020 Park et al., <sup>9</sup> 2020 M. Srirengalakshmi et al., <sup>10</sup> 2020 M. Srirengalakshmi et al., <sup>11</sup> 2020 Perillo et al., <sup>13</sup> 2020 Eliades et al., <sup>16</sup> 2020 Guo et al., <sup>17</sup> 2020 Turkistani K., <sup>18</sup> AJODO, 2020 Turkistani K., <sup>20</sup> 2020 Garcia-Camba et al., <sup>22</sup> 2020 Bennardo et al., <sup>24</sup> 2020	M. Srirengalakshmi et al., <sup>11</sup> 2020 Marya A., <sup>12</sup> 2020 Perillo et al., <sup>13</sup> 2020 Eliades et al., <sup>16</sup> 2020

**Table 4**  
Synopsis of the recommendations for Orthodontic practice, derived from the reviewed articles.<sup>8–23</sup>

Clinical Setting	Synopsis of safety measures for COVID-19 as gathered from reviewed articles
New office environment	<ul style="list-style-type: none"> <li>● Installation of physical barriers at reception and waiting area</li> <li>● Patient screening via telecommunication for obtaining a patient's health history or contact history related to COVID19.</li> <li>● An electronic screening questionnaire to be filled and temperature should be checked on the arrival of a patient at the office.</li> <li>● Utilization of proper ventilation with negative suction in operator rooms and air purifiers</li> <li>● Tele dentistry for non-emergency appointments</li> </ul>
Infection Control	<ul style="list-style-type: none"> <li>● Proper use of PPE is critical, including fit-tested N95 masks, double gloving, over the gown, and face/eye protection in case of any emergency treatment to be done.</li> <li>● Hand hygiene should be maintained by all present in the office either by washing hands by soap for 20 s or by using alcohol-based hand rubs.</li> <li>● The patient may be advised to do preoperational mouth rinse containing 1% hydrogen peroxide or 0.2% povidone-iodine for 15 s</li> <li>● Thorough disinfection and waste disposal should be followed after the dental procedure is done.</li> <li>● Rigorous sterilization should be done along with appropriate autoclaving of materials used.</li> </ul>
Patient Scheduling	<ul style="list-style-type: none"> <li>● Tele-dentistry/Virtual consultations for initial screening</li> <li>● Categorize and schedule based on urgency and procedure required.</li> <li>● Pre-examination and triage</li> <li>● Emphasize basic COVID-safety protocols (Facemasks, hand sanitization, social distancing)</li> <li>● Patient/accompanying persons to wait in the car until instructed</li> </ul>
Orthodontic emergencies	<ul style="list-style-type: none"> <li>● Some can be managed by the patient at home like soft tissue irritation by bracket/wire, broken/loose elastic chains/ligatures/elastic ties, broken bracket, part of appliance or retainer, etc.</li> <li>● Emergencies to be managed at the clinic- active and functional appliances, part of any appliance embedded in gingiva leading to pain and discomfort, etc.</li> </ul>
Orthodontic Records	<ul style="list-style-type: none"> <li>● Extraoral radiography is preferred over intraoral radiography</li> <li>● Photographs should be taken in separate rooms and for one patient single-use retractors or reflectors should be used.</li> <li>● Intra-oral digital scanners or CBCT generated STL files may be used for 3D software models instead of alginate or silicone impressions</li> </ul>
Bonding and other AGPs	<ul style="list-style-type: none"> <li>● High-volume suction is critical for AGPs</li> <li>● For bonding self-etch primers or liquid gel and/or low viscosity etchants with minimal or no rinsing; use of GIC or BPA free adhesives</li> <li>● Indirect bonding techniques or minimal bonding techniques like CAT can be preferred</li> <li>● Use of rubber dam/peri-oral dam is also recommended for all AGPs.</li> <li>● Inter-proximal reduction can be coupled in same appointment as bonding. Alternatively, use of abrasive strips preferred over burs for inter-proximal reduction.</li> </ul>
Extractions	<ul style="list-style-type: none"> <li>● Can be avoided until any signs of abscess or cyst may be seen</li> <li>● Over-spitting of saliva avoided and high-volume suction may be used</li> <li>● Prefer local anesthetics gels over sprays</li> </ul>
Wire change	<ul style="list-style-type: none"> <li>● Use of individualized packed archwires</li> <li>● Disinfect archwire with 75% alcohol when removed from the mouth</li> <li>● Use a double layer of gloves in the potential risk of laceration from the archwire</li> </ul>
De-bonding	<ul style="list-style-type: none"> <li>● Use of anti-retraction handpieces and high-volume suction</li> <li>● Most bonding material remnants be removed via hand instruments</li> <li>● For removing large composite attachment, use carbide of tungsten burs under water cooling conditions and powerful suction system or hand instruments whenever possible to reduce aerosol.</li> </ul>
Retention	<ul style="list-style-type: none"> <li>● Thermoplastic retainers may be preferred as can be fabricated through 3D software models of the patients</li> <li>● Postpone fixed retention</li> </ul>

retrieved and scrutinized by 2 reviewers (H.K and H.G) followed by a cross-check by the third reviewer (A.S.K). Disagreements were resolved by discussion among all the authors. The included articles were screened thoroughly for and the level of evidence was also determined as per based on Oxford Centre for Evidence-based Medicine (OCEBM). References of included articles also were screened using the snowballing technique (Fig. 1).

### 3. Results

A total of 17 articles were retrieved for full text and thoroughly studied (Tables 2 and 3). Amongst these, 5 studies were focusing on the psychological impact of the pandemic on Orthodontic patients, dental students, and orthodontists themselves. 11 were review articles providing guidelines and recommendations about the risk of SARS-CoV2 transmission within orthodontic clinics, the preventive measures to be followed, and the strategies of sterilization and infection control.

Apart from following the standard operative protocols, appropriate appliance selection is also a mandate. There were only 4 articles that were found to be recommending approaches for orthodontic appliances to be used during this pandemic, acclaiming aligners could be beneficial over multi-bracket appliances. (Table 4)

### 4. Discussion

SARS-CoV-2 or COVID-19 pandemic has affected the economic, psychosocial, and social lives of orthodontists as well as orthodontic patients, with increased levels of anxiety and distress. For a patient who seeks treatment and is additionally concerned regarding these risks of COVID-19 infection, what could be the most comfortable and safest appliance to place? From the present evidence of COVID-Era, the potential demands for appliance selection include careful patient screening and collection of records; minimal physical visits; utilizing technology at its best; virtual consultations but the use of PPE for physical appointments; and lesser AGPs with a lesser risk of air-borne transmission (Table 4).

Removable appliances such as aligners alone create the least risk for the transmission of SARS-CoV-2 when compared to fixed labial/lingual appliances, but cannot be used in most cases. When compared with fixed appliances, CAT does offers clear advantage of shorter chair-time, minimal bonding requirements, lesser recall visits to the office, remote monitoring through virtual means, higher accuracy of treatment planning with digital scans, better plaque control, and fewer iatrogenic effects such as white spot lesions and root resorption.<sup>11–13,25–29</sup> However, not just that CAT may have limitations here handling complex mal-occlusion, finishing with CAT alone can be challenging sometimes.<sup>30</sup> In such cases, CAT may be coupled to multi-bracket appliances or auxiliaries such as attachments, inter-arch elastics, mini-screw implants etc. may be used, where the bonding of braces/ attachments can be delayed until the pandemic subsides.

Over all, the treatment modality offered by a clinician to the patient is hinged upon the clinician's proficiency and the measures for time efficiency. Thus, to reach substantiated conclusions, further clinical investigational studies and surveys are required to know the potential choice of appliances being used in clinical practice with the unfastening of dental practices amidst the on-going pandemic.

### 5. Conclusions

The prerequisite criteria for the selection of orthodontic appliances for a clinician in the current pandemic situation is to consider all the preventive measures safeguarding patients, staff, and colleagues. Comparing CAT with other treatment options, it can be very well instituted that CAT together with digital scanners can be considered as the relatively safer modality to weather the storm. However, given the regional demands set by the pandemic and to meet the requirements of

both the patients and the clinicians, a customized approach should be undertaken.

### Declaration of competing interest

The authors declare that they have no conflict of interests.

### Acknowledgments

None.

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