

# General Considerations for the Practice of Pediatric Dentistry in the Period of COVID-19 Pandemic: A Review

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## Abstract

**Context:** Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) has been identified in December 2019. Since then, it has been spreading around the world and has caused a pandemic. Strict safety protocols should be followed to resume dental treatments. **Evidence Acquisition:** A comprehensive search was conducted on PubMed, Scopus, Medline and google scholar databases using the MeSH words of COVID-19, SARS-COV-2, Dentistry, and Child from December 2019 until July 2020. **Results:** Among COVID-19 patients, asymptomatic patients still are considered to be serious carriers of the COVID-19 which can play a key role in transmission of the virus. Children are reported to be less than 2 percent of the infected population and are considered as serious potential carriers. Telemedicine can take a key part in educating parents regarding this matter. Chronic and rare diseases such as Kawasaki Disease (KD) might show acute and more frequent symptoms amongst COVID-19 patients. Salivary testing can be a convenient chairside way for COVID-19 and it has been shown to be effective in identifying critically ill patients. Dry mouth and amblygeusia have been reported to be the oral symptoms of the COVID-19. **Conclusions:** Dentists must make tough decisions in prioritizing patient's needs in the period of pandemic. They should frequently get updated as the situation is fluid and the protocols might change.

## Keywords

COVID-19, Child Dentistry, Dentistry, SARS-COV-2, Novel Coronavirus, Coronavirus

## 1. Introduction

Severe Acute Respiratory Syndrome-Coronavirus-2 was named after the novel corona virus by the international committee on taxonomy commonly known as SARS-COV-2 which can cause the Corona Virus Disease (COVID-19) named by the World Health Organization (WHO) on 11<sup>th</sup> February 2020 [1] [2] [3]. SARS-COV-2 was named after SARS-COV due to high resemblance (79%) of genetical sequences [4] [5]. COVID-19 has been spreading around the world since December 2019 when it was outbreaked in Wuhan, China [6]. The WHO declared a public health emergency of international concern on 30<sup>th</sup> January 2020. In 2021, till July 16<sup>th</sup>, 216 countries were affected with 188,655,968 confirmed cases and 4,067,517 deaths reported in the world [7]. In Iran, as it is facing the second wave of COVID-19 by lifting the restrictions, till July 16<sup>th</sup> 3,440,400 confirmed cases with 86,391 death have been reported [8].

SARS-COV-2 belongs to the family of *Coronaviridae* and is a single stranded RNA virus. Coronaviruses are named corona due to their crown spike like projections [9]. Coronaviruses are divided into 4 groups of alpha, beta, gamma and delta. Alpha and Beta are known to infect mammals including humans, while gamma and delta are to infect birds. Six major corona family viruses that infect humans till today belong to the Beta family. Four of them can cause a mild common cold. The other two are known as Severe Acute Respiratory Syndrome (SARS-COV) and Middle East Respiratory Syndrome (MERS-COV) that caused an epidemic in 2002 and 2012 respectively which never led into a pandemic [10] [11]. Unlike SARS and MERS, COVID-19 is much more contagious and has caused a world pandemic. This may be due to its high replication number, long incubation period and possible transmission from asymptomatic patients [12] [13]. SARS-COV-2 can infect 2 - 3 people when compared with the common cold that can only infect 1 - 2 people [7]. Its mortality rate is available in **Table 1**. Till today, review articles have been published regarding dental fields providing critical safety information but have mostly focused on an adult population. Given that children make up a significant portion of the world's population and that their health is related to the health of other members of society and the next generation, it is important to study in this area.

There is low evidence available regarding COVID-19 symptoms and complications amongst children and young adults' population. Due to the importance

**Table 1.** Coronaviruses mortality rate.

Coronavirus	Mortality Rate
SARS-COV-1	10%
MERS-COV	34%
SARS-COV-2 (Iran)	5%
SARS-COV-2 (Italy)	12.63%
SARS-COV-2 (China)	4.03%
SARS-COV-2 (Worldwide)	3.4%

of infectious diseases in children, this review aims to gather current limited available and updated scientific information and safety regulations regarding COVID-19.

## 2. Evidence Acquisition

A comprehensive search was conducted on PubMed, Scopus, Medline and google scholar databases using the MeSH words of COVID-19, SARS-COV-2, Dentistry, and Child. Articles were reviewed from December 2019 until July 2020. The main focus of inclusion criteria was on pediatric dentistry, COVID-19 complications and current available guidelines from WHO, CDC and The American Academy of Pediatric Dentistry (AAPD).

## 3. Results

### 3.1. Dental Transmission Routes

SARS-COV-2 can transmit through direct droplets, fecal-oral, airborne aerosols generated in the dental office and contact transmission through infected surfaces [14] [15]. Droplets are one of the major transmission routes due to presence of SARS-COV-2 in saliva as even with a simple breathing within proximity of less than 1 meter, it can pass on [16]. Evidence has shown that SARS-COV-2 is present in feces, therefore, fecal-oral path can be one of the possible transmission routes [17]. SARS-COV-2 has been reported to survive on surfaces from 2 hours for up to 9 days [18], however, it gets heavily reduced in number after 24 hours on paper/copper, 48 hours on steel and 72 hours on plastic [19]. Thus, contact transmission can play an important role in infecting dental staff and patients. Transmission from the mother to baby before birth or immediately after the birth commonly known as vertical transmission has been reported in United Kingdom and Iran, however, still not approved [20]. Airborne aerosol transmission has only been reported in health fields such as dentistry and by use of high-speed instruments like handpieces and rotary systems [18]. SARS-COV-2 can survive in aerosols for up to 3 hours. Thus, the use of such devices must be prohibited unless necessary [19].

### 3.2. Clinical Modifications

As CDC recommended in its latest guideline issued on May 19<sup>th</sup>, non-emergency patient dental care shall be resumed, however, on a priority basis and with strict following of the safety guidelines [21]. AAPD has referred to the guidelines of CDC in resuming the dental care for children [22]. Due to the possible long way remaining until a vaccine or treatment becomes available, it is up to the judgment of the dentist/pediatrician to decide whether a patient/child should go under treatment or not and whether it is emergent. For patients that are already infected with COVID-19, CDC and ADA currently have advised a 3 day period after symptoms removal—fever and improvement in respiratory symptoms—without using any medications or 7 - 10 days from the day that symptoms de-

veloped, to be safe for recovered patients to attend a dental visit [23].

In order to avoid cross infection, it is recommended to avoid the use of hand-pieces, scalers and other aerosol generating devices during the pandemic. Other traditional methods such as use of excavators for decay removal may be used during this period. In case there is no other option but to use these devices, rubber dam isolation and high-volume saliva ejectors should be used to reduce aerosol production. Use of 4-handed technique is advised in the recent guideline issued by CDC [21]. The 4-handed technique is simply reducing the time of a procedure or dental examination by the use of the dentist's two hands and the assistant's two hands. Rubber dam has been reported to reduce aerosols up to 70 percent within the 3 foot diameter [24].

Pharmaceutical treatment becomes more popular during the pandemic to avoid unnecessary visits to dental offices. Use of NSAIDs and specifically Ibuprofen during the pandemic should be avoided [25] [26]. Use of 1% hydrogen peroxide 0.2% povidone iodine mouthwash for 1 minute is recommended prior to any dental practice for reduction of viral load and then with Chlorhexidine 2% to reduce the bacterial load [16] as chlorhexidine has been shown to be ineffective for SARS-COV-2 [27]. One application of Povidone-iodine has been beneficial to reduce viral load for up to 3 hours [16]. Handwashing is recommended to be performed frequently and for at least 20 seconds each time. Extraoral X-rays are preferred rather than intraoral radiography to avoid saliva contamination. Use of resorbable sutures are recommended to avoid repeated dental visits [16].

In case of pediatric patient, only one parent must accompany. All toys and playgrounds for children should be removed from the office to avoid surface contamination [7]. Disinfection with proper materials should be performed frequently by dental staff. Ethanol 70% for small surfaces and 0.21% sodium hypochlorite can be used for disinfection of other surfaces as use of ethanol can be dangerous for large surfaces due to its inflammability [16]. Cleansing of high-touch surfaces should be performed frequently. Research has shown that virus has more activity in 50 percent humidity when compared to 30 percent, thus, it is recommended to keep the dental clinic dry [28].

### **3.3. COVID-19 Oral Symptoms**

Based on current available information, elders (over 65 years of age), patients who have a systemic background condition such as diabetics, patients with an immunodeficiency disease, and who are pregnant are at higher risk to acquire COVID-19 [16] [29]. Oral symptoms of COVID-19 have not clearly been assessed yet, however, a study has reported dry mouth and amblygeusia in 46.3% and 47.2% of patients with confirmed COVID-19 respectively [30]. Guo *et al.* have mentioned the possibility of reoccurrence of acute and some chronic oral mucosa diseases during the pandemic due to disorders of the immune system functioning such as allergic diseases, erosive oral lichen planus (EOLP), aphth-

ous ulcers, pemphigus, etc. [31].

### 3.4. Resuming Dental Care with Tough Ethical Choices in Children

During this pandemic, dentists are challenged in defining dental emergencies and are to make tough ethical choices. Casamassimo *et al.* mentioned the importance of this challenge in dental emergencies for children. General dentists are not well prepared to make decisions to preserve the tooth or put the life of the patient/child at danger and more policies and guidelines are needed to educate future dentists for situation like this [32]. As CDC and AAPD have advised, dental care for non-emergent patients shall resume but with consideration of the harm that may affect the patient by delaying the treatment further and the harm that it might bring to the dental staff. Patients should be prioritized based on their emergent needs for dental care and based on the available PPEs in the office [21]. During this pandemic, perhaps performing an extraction may be more beneficial compared to other restorations and conventional treatments to reduce the contact of the dental staff and the patient [33]. Recommendations are available; however, it is the dentist who has to make the final decision by prioritizing patient's needs and cost benefiting the situation on a case by case basis. **Table 2** presents the recommended dental emergencies for children and pediatric dentistry to help in prioritizing pediatric patient's needs.

### 3.5. Pediatrics Clinical Complications

With a stay at home order, risk of violence against children has increased. As AAPD mentioned, it is one of the major side effects of COVID-19 during this pandemic. Caretakers are suffering from high levels of stress, financial problems and loss of jobs. As a result, children will get affected and they are at risk of both physical and mental abuse [34]. This can further affect the cooperation of children in the dental clinic. Control management of children might be more intense for pediatricians and they should be prepared for this challenge. Perhaps to better manage this condition and for better psychological health of pediatrics patients, telemedicine can be used. With this method, parental stress and further violence against children shall get reduced. It can be used for preliminary diagnosis and to avoid unnecessary visits to the dental office. Parents can get educated regarding their children's oral health habits and behaviors to take better care of their children. On May 22<sup>nd</sup>, WHO issued a warning for around 80 million children being at risk due to disruptions caused in their vaccination's programs. In light of the pandemic, children are being deprived from their routine vaccinations and thus being put in danger for other diseases. Extra care should be taken in medical centers to resume vaccination programs [35]. This can bring a surge in other diseases in the upcoming months. Acute dental emergencies should be managed early to reduce the burden of consequences on patients [36]. Chronic diseases can have acute symptoms during this period and might present more frequently. An example of this condition is Kawasaki Disease (KD). KD is

**Table 2.** Dental emergencies in children and pediatric dentistry.

Dental treatment	Symptoms	Emergency	Non-emergency
Pulpotomy (symptomatic)	Pain and food impaction	✓	
Pulpotomy (asymptomatic)	Caries extension		✓
Pulpectomy	Peri-apical infection present	✓	
Abscess (Local-Non acute)	Chronic without pain or with pain	✓ (with pain)	✓ (without pain)
Abscess (Local-Acute)	Swelling	✓	
Abscess (Cellulitis)	Swelling	✓ (needs drug therapy first)	
Trauma (deciduous or permanent teeth)	Can be with pain, concussion, intrusion, extrusion, etc.	✓ (depends on the condition)	✓ (depends on the condition)
Extractions (orthodontic)	N/A		✓
Extractions (abscess)	N/A	✓	
SS Crowns, restorations, PRRs and fissure sealants	N/A		✓
Space maintainers			✓
Apexogenesis and Apexification	With or without pain	✓	
General Anesthesia (Based on number of the teeth, age of the child and location of infected teeth)	Can be with pain, abscess or asymptomatic	✓ (symptomatic with high number of infected teeth and posterior infection)	✓ (asymptomatic with low number of teeth and anterior infection)

a rare condition with unknown underlying etiology that causes pediatric vasculitis and coronary artery aneurysm. It mostly has been targeting children younger than 5 years old. There have been reports of coinfection between COVID-19 and KD during this pandemic. Verdoni *et al.* reported 10 cases of KD amongst children with COVID-19 infection. They reported a 30-fold increased incidence of Kawasaki-like disease in their population of study [37]. In the same line, Toubiana *et al.* also reported an increase of KD in patients with COVID-19 in Paris, France. They have suggested the role of a possible post viral severe inflammatory reaction in children [38]. However, Jones *et al.* reported only one case with coinfection of KD and COVID-19 in their study [39]. In general, most of the studies have mentioned an increase of KD in their population of pediatrics COVID-19 patients. SARS-COV-2 may be acting as a trigger to begin the inflammatory response in initiating the KD condition in children. Further studies are needed to assess the function between SARS-COV-2 and immune system which may lead

to better understanding the etiology of KD.

### 3.6. Children with No Symptoms

Since COVID-19 is highly contagious and infectious diseases, it can tremendously harm children. It may be better to avoid the contact of children with possible epicenters of COVID-19. COVID-19 patients have been reported to be less than 2%, 2.2%, 1.2% and 0.8% in the United States, China, Italy and Spain respectively [40] but in general, children have been reported to be less than 2% of the recorded cases of COVID-19 [41]. Children make up a small percentage of COVID-19 cases, but their role in transmission has been unclear, but it is highly likely that children can transmit the SARS-COV-2 virus, which causes COVID-19, and even asymptomatic children can have viral loads [42].

The mortality rate for children under 10 has been reported to be almost zero so far [20]. 90 percent of infected children had no symptom or mild symptom reported in an epidemiological study of COVID-19 Children in China [43]. Several reasons have been mentioned for this. Lee et al mentioned multiple factors: children's active innate immune response, healthier respiratory tracts and fewer underlying disorders. In addition, children take less part in outdoor activities and take less international travel.

These conditions might change however, as with new data the number of infected children can increase [44]. Since high percentage of cases can be missing, these numbers are currently unreliable and most of the children might not undergo the testing procedure and get identified [40]. As reported in cases from China, most of the children have been infected with contact of a household member and got infected mostly in a family cluster pattern. Moreover, children are at more danger when compared to the adults due to their natural behavior of touching their face for several times [20]. Kwok *et al.* reported that on average people touch their faces 23 times per day [45]. Sun *et al.* reported the number of infected children to be 12% after reanalyzing the data of infected children in the epicenter of China [46].

DeBiasi *et al.* emphasized on the importance of focusing on the severity of the disease in children rather than their susceptibility. They analyzed the data for children and young adults that visited the children's hospital in Washington. 25 percent of children and young adults that visited the hospital required hospitalization while 20 percent of hospitalized patients were critically ill. The number of children aged <1 and young adults >15 were significantly higher among hospitalized patients [47]. Zhou *et al.* reported in their review that children's symptoms can start with a diarrhea and vomiting while rapidly transferring to acute respiratory distress syndrome. They emphasized that although the majority of children have mild symptoms but they can suffer from serious conditions [48]. Considering the current available data, children are less susceptible to COVID-19 but can act as serious carriers of SARS-COV-2 and thus extra care must be taken in this matter. Home isolation is recommended for children with a positive



COVID-19 test regardless of being symptomatic or not. Hospitals and medical centers should be prepared for taking care of children as they can present severe symptoms. More comprehensive studies are needed to further confirm the above results.

### **3.7. Role of ACE2 in COVID-19 and Children Immunity**

The receptor binding domains of both SARS-COV and SARS-COV-2 appears to be Angiotensin-converting enzyme 2 (ACE2) receptors. It has been reported to act as the main receptor for host cells of SARS-COV-2 [4]. All cells presenting ACE2 are susceptible to SARS-COV-2. Different organs in human body present ACE2 on their cell surfaces such as lung, heart, kidney, intestine, endothelium, oral epithelium and salivary glands [23]. The oral epithelium cells, specifically the epithelium cells of tongue have the majority of ACE2 receptors [49]. The highest viral load exists in oropharynx and nasopharynx mucosa [26] but the first point of contact for SARS-COV-2 appears to be the nasal epithelium. Bunyavanich *et al.* reported in a retrospective study that ACE2 presentation in the nasal epithelium of younger children was significantly lower and that might explain the lower population of children amongst COVID-19 patients. However, they also mentioned that the oral and lung epithelium have different environments and that further studies are needed to investigate these receptors in lung [50]. On the other hand, Chen et al showed a negative correlation between ACE2 expression and COVID-19 fatality. They showed that Asian females have more expression in ACE2 receptors and that the expression of ACE2 is low in males. They suggested the protective role of ACE2 in COVID-19 patients [51]. This is while most studies have shown that older males are to be more susceptible to acquire the virus and have taken ACE2 to be the culprit for COVID-19 [14]. More studies are needed to confirm the relation between ACE2 expression and COVID-19.

### **3.8. Saliva Testing (ACE2)**

SARS-COV-2 has been reported to be present in sputum, feces, and urine [30]. The possibility of its presence in saliva has been suggested by studies due to presence of ACE2 in epithelial cells of oral mucosa. To et al has reported saliva to be one of the major sources of SARS-COV-2 and acts as a reservoir [52]. Previously it has been reported that SARS-COV and MERS-COV can be detected in saliva [53] [54]. 3 routes have been suggested for presence of SARS-COV-2 in saliva: Lower and upper respiratory tract sputum, Blood (through crevicular and other arterial transmission), and salivary glands infection (both major and minor). Only 28% of COVID-19 patients had the sputum of lower respiratory tract in their saliva thus sputum of lower respiratory tract is not sufficient for detection of the virus in saliva [55]. Minor salivary glands have been reported to have more ACE2 receptors present when compared to cells in the lung [56]. Since the nature of saliva sampling is convenient specially in children due to their uncoo-



perative nature and the safer specimen collection without virus transmission, it can play a key role in testing and specifically in the rapid testing when it becomes available. Sabino-Silva *et al.* have specified the possibility of SARS-COV-2 detection in saliva. They mentioned the presence of SARS-CoV specific secretory immunoglobulin A (sIgA) in saliva of animal models and since SARS-COV and SARS-COV-2 have high genetical resemblance, it can be assumed that saliva testing can be used for detection of SARS-COV-2 [55]. On the other hand, study results of Chen *et al.* have showed that saliva testing alone can be effective in detecting the critically ill patients only (75%). They have cleaned the mouth with normal saline prior to sampling from the entrance of canal secretion to only collect saliva from the ducts without any contaminations by other sputum or fluids of the oral cavity. They attributed this to high viral shedding in critically ill patients and the fact that mainly glandular cells present ACE2. Therefore saliva testing was ineffective in patients without critical symptoms [30]. Further studies are needed to confirm the efficacy of saliva testing for COVID-19 as saliva testing can be performed in a convenient chairside way specifically in children.

#### 4. Conclusions

As CDC advised on its May 19<sup>th</sup> guideline, the non-emergent dental care shall resume on a priority basis. AAPD has referred to CDC guidelines in terms of resuming dental care for pediatric patients. Dentists should weigh the harm that will be caused on patients by further delaying the treatments. PPEs shortage is a serious matter during the pandemic and patients should be accepted based on their availability. Safety guidelines should be strictly followed to reduce the spreading of SARS-COV-2. Children can be serious asymptomatic carriers of COVID-19 as they have been reported to be mostly asymptomatic or with mild symptoms. Extra care should be taken however, since children can rapidly express severe conditions. Children currently form a small portion of COVID-19 infected population which may be due to low testing that is performed on them. The majority of confirmed children with COVID-19 have been infected in a family cluster pattern. In order to protect children from physical and mental abuse, telemedicine is recommended to be used during the pandemic to educate parents regarding children's health, nutrition and drug therapy to avoid unnecessary visits to dental clinics. Dentists are recommended to be better prepared for control management as children may be more uncooperative due to psychological disorders. We recommend emphasizing more on conscious sedation rather than general anesthesia in the period of pandemic, specifically if the child has low number of infected teeth with a tend to anterior area to avoid COVID-19 cross contamination. Use of Hydroxychloroquine and azithromycin and NSAIDs should be avoided in children. Chronic and rare diseases can be presented with more frequently and with more acute symptoms during this pandemic. As an example, Kawasaki diseases have been reported to be on a surge amongst identified children with COVID-19.

The role of ACE2 as the main receptor for SARS-COV-2 has been assessed in studies and has shown both positive and negative correlations and further studies are needed to confirm its role. Saliva testing for COVID-19 has been suggested based on the presence of ACE2 receptors in the oral mucosa and salivary glands and it has been shown to be effective in identifying critically ill patients. Dentists should be prepared to make tough decisions during the pandemic and modify their clinical treatments and perhaps to perform more aggressive treatments, but the situation is fluid and they should frequently update themselves with the current available guidelines.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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