

Article title

Pediatric Oral Health during and after the COVID-19 Pandemic

Running title

Pediatric oral health during COVID-19 pandemic

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TITLE

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ABSTRACT

Background During the period of health emergency linked to the current COVID-19 pandemic, the paediatric dentists' management of oral health problems in children must have as primary objective the control of the spread of the disease according to specific protocols aimed at minimizing the risk of viral transmission.

Aim This paper examines the possible clinical conditions that may require intervention by the paediatric dentist, distinguishing clinical situations that fall into the category of paediatric dental emergencies from conditions of oral pathologies that normally do not represent an emergency. The definition of rigorous and highly effective infection control protocols in the dental settings must therefore be complemented by the development and strengthening of remote communication techniques with the parents, who must be adequately educated on preventive and palliative measures for the management of their children's oral health, with the aim of postponing clinical attendance to when the circumstances become favourable.

Conclusions The experience gained with these approaches and models of treatment, where remote interaction techniques play a central role, will hone the communication skills of the paediatric dentist and will retain its usefulness even at the end of the current emergency period.

KEYWORDS

COVID-19 pandemic; oral health prevention; paediatric dentistry.

MAIN TEXT

1. Introduction

Prevention of oral health in children represents the gold standard towards which health professionals specialized in paediatric dentistry should always be oriented. This is even more true in times of health emergency such as the one we are going through today in which the WHO first declared the COVID-19 epidemic a Public Health Emergency of International Concern¹ and then recognized it as a pandemic².

It is precisely during the COVID-19 epidemic period that an adequate management of the oral health of children becomes of crucial importance by implementing specific protocols relating both to the pathologies of the oral cavity that normally do not represent an emergency and to those clinical situations that fall within the category of paediatric dental emergencies.

In both conditions, the main objective is to limit the spread of the epidemic and the onset of cross-infections. Therefore, not only are rigorous and highly effective infection control protocols urgently needed in the dental environments of the regions affected by COVID-19, but it is also essential to work on remote communication and education aimed at maintaining the oral health of children.

2. COVID-19 Risk Factors Associated with Paediatric Dental Treatment

Genetic and epidemiological research reports that the COVID-19 epidemic started with a single transmission from animal to man, followed by an important human-to-human transmission³. The human-to-human transmission of COVID-19 occurs mainly through respiratory droplets in air suspension and aerosol and through direct or indirect contact⁴. Mother-infant vertical transmission has not yet been confirmed⁵. Also, preliminary epidemiological results seem to indicate that paediatric COVID-19 infection is relatively mild when compared to adults, and children are reported to have a better prognosis⁶.

In dental settings, oral fluids from the patient or contaminated dental instruments or environmental surfaces create a potential way of spreading the virus to the operators and to other patients. Standard dental procedures that include the use of rotating instruments such as the high-speed turbine handpiece and the use of scalers for oral hygiene are associated with the generation of large quantities of aerosols and droplets

from the saliva and blood of the patient. These can remain suspended in the air for long periods (hours) before settling on the environmental surfaces and on the medical instruments or before penetrating the respiratory tract through the nose and mouth. Hence, it is clear how the aerosols generated during dental treatment can expose the paediatric dentist, the assistant to the chair and other patients to risk of cross infection.

A recent article⁷ reports a review of the main risk factors for COVID-19 associated to paediatric dental treatments. A first way of contagion is represented by direct transmission through the respiratory droplets: the virus can be transmitted between the dentist, the dental assistant and the small patients through the droplets generated by coughing and sneezing or by the dental procedures themselves. An indirect transmission can occur when the droplets containing the virus settle on the surfaces of the instruments with consequent transmission when the paediatric dentist, the assistant in the chair and other patients come into contact with the contaminated surfaces. Similarly, the use of high-speed turbine, ultrasonic scaler and spray gun produce an aerosol of saliva, blood and other fluids that can remain in air suspension for long periods, with an increased risk of transmission.

While the previous transmission pathways are common to the treatment of any dental patient⁸, paediatric patients present additional risks of transmission: the use of removable orthodontic appliances or auxiliary elements in fixed orthodontic therapies, such as the use of intermaxillary elastic bands, entails risks of contamination if handling is not carried out with due precautions. Another problem is related to the difficulty for the child to use/endure personal protective equipment (PPE) during medical visits. Finally, the very presence of caregivers, with whom the paediatric dentist must unavoidably interface, will increase the risk of infection.

3. Oral Health Prevention during the COVID-19 Pandemic

3.1 General oral health prevention measures

In general, the prevention of oral health in children is based on the periodicity of the check-ups and on oral hygiene education through adequate information of the parents on orodental diseases. In the COVID-19 epidemic context, even in absence of an international consensus on the provision of dental services, many countries restricted access to, or strongly discouraged non-emergency dental services⁹, therefore the

difficulty of managing regular follow-ups of dental check-ups makes it essential to focus prevention on oral health education interventions that go through adequate remote information. For this purpose, in the recent years much attention was dedicated to the use of "social" digital platforms on which the paediatric dentist can publish and disseminate behavioural guides for the protection of the oral health of children¹⁰. These platforms must be accompanied by more direct forms of interactions between patient/parents and paediatric dentist, such as telephone consultations or, whenever possible, teledentistry¹¹. In the current emergency, the main goal of these guides would be to avoid, or at least minimize, the onset of unfavourable situations for the stomatognathic system, thus improving the oral health of the child and reducing the necessity of immediate interventions.

3.2 Prevention of carious pathology

Prevention against the carious pathology must be based on adequate and effective home oral hygiene measures, on the use of dental floss in the tooth exchange phase associated with the completion of permanent dentition, and on correct alimentary behaviours which limit the intake of fermentable carbohydrates. One of the risks of this epidemic period, in which children are forced to spend most of their time at home, is the acquisition of incorrect alimentary habits. It is important in this sense to inform parents about the carioprotective and cariogenic properties of specific foods¹². A diet rich in fruit and vegetables not only protects from the onset of caries, thanks to a mechanical protection associated with the stimulation of saliva, but also helps to protect against the onset of gum diseases. Furthermore, it is of fundamental importance to limit the consumption of soft and energy drinks since, in addition to containing high quantities of sugars, their acidic content produces dental erosion and makes the enamel tissue less resistant to the attack of cariogenic bacteria.

Also related to the effects of the COVID-19 is the increased stress level linked to home confinement and infection anxiety, with side effects on children's physical and mental health¹³. For children in the preschool age group, a stress-induced alteration of the sleep patterns may push parents to adopt erroneous expedients to encourage the sleep of the child, such as the administration of bottles filled with fermentable liquids containing carbohydrates, rather than pacifiers dipped in honey or sugar. These behaviours would increase the risk of developing Early Childhood Caries (ECC)¹⁴, which

has a rapidly worsening clinical evolution with easy onset of local abscess infectious complications associated with painful symptoms and would require an immediate dental intervention.

Finally, it should not be forgotten that preservation of the oral health of the parents also has a protective effect for the child, as the risk of bacterial mother-child transmission is high in the age group between 3 and 5 years and can easily induce severe ECC¹⁵. Therefore, during the period of confinement, strict oral health prevention measures must also be followed by the parents.

3.3 Other aspects of paediatric dental prevention

The need to spend the whole day in a home setting can stimulate more lively play modes in the children, with an increased risk of traumatic events affecting the dental elements¹⁶ and the consequent need for urgent interventions that increase the risk of contagion from COVID-19. Parents should therefore be instructed on the need for careful supervision of the child's activities, possibly suggesting the use of protective mouthguards of the type usually indicated for contact sports.

In general, correct oral health must always be combined with a healthy lifestyle, thus contributing to a good general health. Therefore, physical activity at home, sleeping for an adequate number of hours, and proper nutrition and hydration throughout the day are strongly suggested.

4. Dental Management during the COVID-19 Outbreak

4.1. Management of orodental pathologies that do not represent an emergency

In Italy, during the lockdown period associated to the COVID-19 epidemic and together with all other medical activities, routine dental work was suspended and postponed in relation to the progress of the epidemic situation, with the recommendation of limiting dental interventions to emergencies only¹⁷. Hence, the need to be able to follow the oral health status of children only through adequate remote interaction with the parents. The paediatric dentist must be able to effectively communicate with the parents both to educate them to the correct oral health prevention practice, as seen in the previous paragraph, and to recognize oral pathologies that do not require immediate intervention and that can therefore be managed with palliative measures, waiting to be treated in an outpatient setting as soon

as the circumstances become favourable. In this case the paediatric dentist must always take into account that parents lack the knowledge of basic behavioural management techniques needed to approach a paediatric patient.

In agreement with previous literature⁷, we list here several clinical situations that can cause concern for the parents but that do not require emergency treatment and can therefore be remotely managed. For each situation we included recommendations which, according to our clinical experience, could help the parents solve the problem or at least mitigate the insurgency of painful symptoms, thus delaying the need for direct professional intervention. These recommendations are also summarized in Table 1.

1. Deciduous or permanent teeth affected by previous carious lesions and treated with temporary dressing: in this case if the dressing were to decement from the prepared cavity, it is recommended to keep the cavity always free of food debris through careful removal with mechanical brushing after meals to prevent the onset of painful symptoms. It is also recommended to avoid too hot or too cold foods that could trigger the onset of painful symptoms if the original treatment involved the removal of carious dentin-enamel tissue.
2. If the dressing concerns an endodontically treated deciduous or permanent tooth and the spontaneous removal of the dressing paste occurs, home treatment may involve washing the cavity with water diluted hydrogen peroxide by means of a special syringe without a needle to remove food debris, followed by application of a cotton pellet during the child's meals. Given the irritative properties of hydrogen peroxide associated with the risk of periapical leakage, this procedure should only be applied when the closure of the root apex is complete. Also, to avoid accidental ingestion, during the application younger children should be positioned with the face facing down
3. Chronic periapical periodontitis can occur with dental pain when chewing. For temporary control of symptoms, pain relievers such as ibuprofen and antibiotic therapy with amoxicillin or cephalosporin, subject to the careful verification by the clinician of the patient's history for resistance or hypersensitivity to the antibiotic, are recommended as adjuvants to temporarily relieve symptoms and postpone dental treatment¹⁸.

4. Delays of deciduous teeth exfoliation with their persistence in the arch, in conjunction with the simultaneous eruption of the corresponding permanent tooth are quite common occurrences. In this case, parents should be advised to encourage the child to chew hard consistency foods such as raw fruit and vegetables, that can stimulate the loss of the deciduous tooth by mechanically inducing its complete removal from the alveolar support.

5. Inflammation of soft tissue associated with the eruption of permanent teeth is an additional clinical condition that can be managed during this period. It manifests itself with swelling, edema and redness of the gum in distal position to the erupting tooth and is more frequent for the permanent first molar. This condition affects school-aged children, on average between 6 and 7 years. The advice to give to the parents is to use cleaning swabs that help the removal of food debris in the gingival bag between tooth and gum. In order to reduce the inflammatory state and the painful symptoms, the clinician can also recommend the local application of Chlorhexidine antiseptic sprays or gels¹⁹.

6. Malocclusions associated with crowding of the dental elements and with overjet and overbite alterations do not represent an emergency. Parents must be instructed to postpone the correction to the end of the epidemic. In case of increased overjet, a condition most frequently associated with the risk of fractures affecting the upper incisors, it is possible to recommend the use of standard mouthguards, easily available in the pharmacy.

4.2 Management of children undergoing orthodontic treatment

If the child is using a removable orthodontic appliance, the first indication to the parents is linked to the correct hand hygiene measures before inserting the device into the oral cavity. According to recent studies²⁰, the oral cavity has in fact a high expression of the ACE2 receptor, considered the main host cell receptor for the SARS-CoV-2 virus. This fact also underlines the importance of a correct hygiene associated with the management of orthodontic devices, which must be carefully sanitized before each use and stored in the appropriate box after use.

If Schwarz removable plates are used, a broken retention hook, such as the Adams hook that normally fits on the first permanent molar, is a not unusual occurrence. In this

case, if the entire hook breaks from the resin section of the appliance, the child can continue to wear the device as long as the retention is preserved. Alternatively or in case of doubt, it is advisable to limit the use of the device during the daytime hours only, always under parental supervision, postponing the repair of the device at the end of the epidemic.

For fixed orthodontic devices cemented on the palatal arch, such as the rapid palatal expander, it is recommended to temporarily suspend the activations in order to avoid carrying out incongruous maneuvers that can facilitate the detachment of the device from the dental surfaces. Given the current epidemic, it should be forcefully reiterated to the parents that the child must avoid eating viscous foods, such as caramel or chewing gum, or hard foods that can favor the partial detachment of the device, thus triggering an emergency situation that requires an immediate intervention by the paediatric orthodontist.

In the case of fixed multi-bracket therapy, the arch may slide and move distally to the cemented tube on the molars. In this case, especially when light NiTi wires are in use, if the child reports a feeling of discomfort and puncture on the gum, it is possible to advise the parent to manually reposition the arch by sliding it towards the teeth most mesial to the molar using the fingertips of thumb and index. If a bracket decements from the dental surface and rotates by 180° with respect to the tooth while remaining tied to the arch, the parent can reposition it manually, postponing the re-cementation to the end of the epidemic.

4.3 Management of orodental pathologies that represent an emergency

Many paediatric dental emergencies require immediate treatment even during the COVID-19 outbreak. Among these, we can list, e.g., acute pulpitis, acute apical periodontitis, dental trauma and maxillofacial trauma²¹.

The management of all paediatric dental emergencies during the epidemic must take place by adopting protective measures for healthcare personnel and for the young patient in accordance with the recommendations and guidelines related to the use of effective protocols for the prevention and control of infections referred to by the scientific literature²²⁻²⁴.

4.3.1 Patient evaluation

In this preliminary triage phase it is necessary to make a recording of the temperature of both the child and their carers and to carry out an anamnestic evaluation to investigate not only trips to geographic areas affected by the epidemic of COVID-19 made in the 14 days preceding the dental visit but also if there is a history of contact with COVID-19 patients or suspected such⁴. The child should be accompanied by a minimum number of people. In addition to measuring the temperature, medical protective masks should be provided to patients and their carers.

4.3.2 Personal protective measures for the paediatric dentist

Since the main route of transmission of COVID-19 is through airborne droplets, during the epidemic period, additional protective measures with personal protective equipment (PPE) are recommended for the paediatric dentist and other healthcare professionals, in particular when performing aerosol generating procedures (AGP). PPE usually include: surgical mask, face shield, protective goggles, gloves, medical cap, and protective suits.

According to the type intervention and on the possible presence of a COVID-19 infected patient, as assessed by the preliminary triage, we can distinguish three levels of protection for the paediatric dentist²⁵:

- standard primary protection: disposable work cap, disposable surgical mask, work clothes with white coat, protective goggles or face shields, disposable latex or nitrile gloves. This is the minimal protection for all staff in a clinical context. Can be used by a paediatric dentist when performing dental activities not involving AGP (e.g. first examinations, control visits) on non-COVID-19 patients;
- secondary or advanced protection: disposable work cap, disposable surgical mask, protective goggles, face shield, white work coat with disposable or external surgical insulation clothing, disposable latex gloves. Should be used by the paediatric dentist when performing activities involving AGP (e.g. any activity requiring the use of the high-speed handpiece) on non-COVID-19 patients;
- tertiary or enhanced protection: special full-body protective clothing is required or, if none is available, a lab coat with an external disposable protective suit and, in addition, disposable work cap, disposable surgical masks, protective goggles, face shield, disposable latex gloves, waterproof shoe covers. Although any treatment on a patient with suspected or confirmed infection with COVID-19 should be

postponed, if this is not possible and the paediatric dentist cannot avoid close contact, the maximum level of protection should be worn for the whole duration of the intervention.

4.3.3 Hand hygiene

The reinforcement of good hand hygiene of the reception staff, of the patient, and of the medical staff is of fundamental importance especially in the period of transmission of the epidemic from COVID-19. Given the transmission characteristics of the SARS-CoV-2 virus, a bad compliance of hand washing in the dental practice poses a challenge to controlling infection during the epidemic period. A Chinese study²⁵ recommends the "two before and three after" technique as a standard hand hygiene procedure, emphasizing that oral professionals should wash their hands before examining the patient, before dental procedures, after direct contact with the patient, after touching the environment without previous disinfection, and after touching the patient's oral mucosa and skin or coming into contact with saliva and oral fluids.

4.3.4 Mouthwash rinses

Preliminary results²⁶ indicated that chlorhexidine, the most commonly used mouthwash in dental studies, might have reduced efficiency against the SARS-CoV-2 virus. On the other hand, the virus appears to be vulnerable to several available disinfectants²⁷. Debate on the best mouthwash to use during the COVID-19 pandemics is still ongoing, also taking into account dilutions and patient compliance²⁸. In any case, it is recommended to let the child rinse with dedicated antiseptic solutions to reduce the oral bacterial load before any treatment.

4.3.5 Management of traumatic orodental injuries

Traumatic pathology has a high prevalence in children²⁹ and can therefore present itself as an emergency to be managed during the COVID-19 epidemic. The standard therapeutic approach to dental traumas should be followed³⁰, always keeping in mind that these often require the use of the high-speed turbine and are at high risk of COVID-19 transmission. Utilization of high level PPE is therefore mandatory.

4.3.6 General recommendations for treatment

Based on previous literature^{7,22,24,25,31,32}, Table 2 summarizes a set of general recommendations to minimize the risk of cross infection during dental treatment in a paediatric dental setting.

5. Clinical implications

In the current context of epidemiological emergency linked to the COVID-19, it is necessary to re-evaluate the paediatric dentist's activities taking into account the challenges in terms of contagion containment. In this sense, the possibility of remote education of parents must be considered both as regards the general prevention measures for oral health, and as regards the home management of milder oral pathologies for which direct intervention of the specialist in paediatric dentistry is not necessary or can be postponed. On the other hand, if, in the presence of dental emergencies, immediate intervention is required, the observance of strict protection protocols of the subjects involved and environmental disinfection becomes crucial in order to minimize the risk of cross infection.

The end of the pandemic will have to mark the beginning of new methods of approach and management in paediatric dentistry. The smart technological systems, that during the pandemic period blossomed to become the most powerful remote communication tool, could be of great help as standard projection tool for educational material on oral health in children, especially in school age, who are treated in outpatient clinics, boosting and strengthening the approach in paediatric dentistry and the children's motivation for oral health. On the other hand, the specialists in paediatric dentistry will have matured and strengthened their dedication to the practice of this medical specialty in the post-pandemic period, not only by improving and modernizing the approach techniques, but also by proposing new models of treatment that may include the use of remote controls through special platforms, with practical guides dedicated to parents, in order to monitor and preserve the great heritage of general health, of which oral health is an important component.

Why this paper is important to paediatric dentists

- This article is a consultation and orientation tool on operative protocols in paediatric dentistry during and after the COVID-19 pandemics.

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TABLES

Table 1. Recommendations for non-emergency clinical situations. See text for operational details.

Clinical Situation	Recommendation
Temporary dressing decementing from a treated carious lesion.	<ul style="list-style-type: none">• Remove foot debris from cavity with brush.• Avoid hot/cold food.
Dressing decementing from endodontically treated tooth.	<ul style="list-style-type: none">• Wash cavity with water diluted hydrogen peroxide.• Apply cotton pellet during meals.
Pain at chewing from chronic periapical periodontitis.	<ul style="list-style-type: none">• Antibiotic therapy with amoxicillin or cephalosporin and pain relievers such as ibuprofen.
Delays of deciduous teeth exfoliation with persistence in arch and simultaneous eruption of corresponding permanent tooth.	<ul style="list-style-type: none">• Chew hard consistency foods to stimulate the loss of the deciduous.
Inflammation of soft tissue associated with the tooth eruption	<ul style="list-style-type: none">• Use cleaning swabs to remove food debris in the gingival bag between tooth and gum.• Locally apply Chlorhexidine antiseptic spray or gel.
Malocclusions associated with crowding of the dental elements and with overjet and overbite alterations.	<ul style="list-style-type: none">• Postpone the correction to the end of the epidemic.• Use of standard mouthguards for increased overjet.

Table 2. General recommendations for treatment in a paediatric dental setting.

1. **The environment where the dental treatments are carried out must be properly disinfected and always well ventilated.**
2. **Get parents to leave the operating room.**
3. **Always use the appropriate type of PPE.**
4. **Use four-handed dentistry techniques to optimize the intervention time.**
5. **Use a high volume aspirator to minimize droplets and aerosol during**

high-speed turbine operation.

- 6. Isolate the operating field with the rubber dam in order to minimize the production of aerosols contaminated with blood and saliva, especially during the treatment of the pulpits.**
 - 7. Use high-speed turbines with anti-retraction valve, which significantly reduces the return flow of oral bacteria.**
 - 8. After any type of treatment, it is necessary to proceed to an adequate disinfection of the environment.**
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