

COVID-19 in Children: Its Impact on Oral Health and Paediatric Dentistry

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ABSTRACT

SARS-CoV-2 is a novel strain of coronavirus that has not been recognized in humans earlier. The disease originated in China and has now become a pandemic affecting countries worldwide. The clinical characteristics in children seem to be milder as compared to adults, but the exact clinical features related COVID-19 is still unknown and unclear. This is the reason why a child can be considered as a "Silent carrier" for COVID-19. However, the importance of children in transmitting the virus remains undefined. During this period of pandemic, management of child's oral health presents specific difficulties related to the infectious spread of the disease. Dental clinics and Dental hospitals are considered to be hotspot for any type of cross contamination which may eventually result in transmission of disease. Hence, paediatric dentist are in a unique situation as they are approached for the assessment and management of odontogenic pain, swelling and dental alveolar trauma in these children. The purpose of this article is to review the impact of COVID-19 on paediatric dentistry and paediatric oral health.

Keywords: Coronavirus, pandemic, COVID-19, children, paediatric dentistry

INTRODUCTION

Coronaviruses (CoVs) belong to the large family of Coronaviridae. These RNA viruses range from 60-140 nanometer with spike like projections on its surface. This strain of viruses are considered to have a zoonotic nature and cause respiratory illness in humans.^[1] Severe acute respiratory

syndrome coronavirus (SARS-CoV) and the Middle East respiratory syndrome coronavirus (MERS-CoV) are some of the lethal varieties which emerged in 2002 and 2012 respectively.^[2] SARS-CoV-2 also called as 2019 novel coronavirus has recently emerged in Wuhan city of China.^[3] It belongs to the genus of beta coronavirus that originated in bats.^[4] The transmission of this virus occurs through droplets and infected fomites.^[3] Currently it is causing a severe outbreak of a disease termed as COVID-19 in India and other countries, leading to global pandemic.

Considering the extensive spread of SARS-CoV-2 and reports of its spread to health care providers, dentists are considered to be at higher risk.^[5] This high risk can be ascribed to aerosol generation, handling of sharp instruments and vicinity of the patient.^[5] In the view of current COVID-19 crises, management of oral health presents specific challenges related to infectious spread of the disease. These concerns can be managed by implementation of oral health prevention methods and specific protocols. Taking children into consideration, paediatric dentists are carrying out procedures that not only limit the spread of the contagion but at the same time maintain the integrity of the child's oral health. These procedures include Alternative Restorative Technique (ART), chemomechanical caries removal and Hall technique. On the other hand preventive strategies include use of sealants,

remineralising agents and resin infiltration technique.^[6] Moreover, home care measures taken up by parents acts as an additional advantage. Hence, this review article focuses on COVID-19 in children and its impact on paediatric oral health and paediatric dentistry.

Role of children in transmission of COVID-19:

Children are asymptomatic or show mild symptoms when affected by COVID-19 which has raised concerns for its hidden role in transmission. The role of children in spreading the disease was a major question since the early days of pandemic. The reason can be attributed to their playful and talkative nature. Children talk loudly and express themselves without restraints. Documentation suggests that talking loudly and shouting may cause the spread of the infection through droplets. Similarly, touching the face, nose and mouth is common during play among children.^[7] These age specific concerns might suggest their role in transmission. However, on the contrary there is light evidence by World Health Organisation (WHO) which suggested there is no transmission from child to adult.^[8-9]

Reasons children spared from COVID-19:

The published data regarding COVID-19 globally supports the notion that most children don't exhibit severe disease. It is unknown why the children are less severely affected. However, three theories have been proposed for the same. Firstly, it was noticed that tendency toward immune dysregulation is less in children.^[10] Secondly, markers of pro-inflammatory response like C-reactive protein is uncommon in children which is suggestive of reduce inflammatory response to infection.^[11] Lastly, reduced expression of angiotensin converting enzyme 2 (ACE-2) receptor which is necessary for binding of the virus further reduces the incidence of COVID -19 in children.^[12]

General manifestations of COVID-19 in children:

The incubation period of the disease is 7-14 days. Children suffering from this infection may be asymptomatic or have mild symptoms.^[13] These symptoms may include fever, dry cough and fatigue with a few upper respiratory symptoms like nasal congestion. It rarely progresses to lower respiratory tract infections. Moreover, obscure symptoms such as nausea, diarrhoea, hyposmia and dysguesia have also been reported.^[14] With emerging cases of COVID-19 in children a recent trend of Kawasaki like disease also called as multisystem inflammatory syndrome (MIS-C) has been noted. It usually manifests itself 3 to 4 weeks after the child recovers from SARS- CoV-2 infection and develops antibodies against the virus.^[15] Overall the prognosis of COVID-19 is good in children with a fatality rate of 0.01 %.^[16]

Oral manifestations of COVID-19 in children:

The intraoral findings in a child affected by the disease are usually non-specific which can be attributed to the mild form of COVID-19. Martin et al in 2020 presented a case series on oral manifestations as ulcers and blisters in patients affected or suspected of the disease.^[17] However, the patients were adults with underlying comorbidities. There is no literature yet available that states the intraoral findings in a COVID positive child. Paediatric dentists should be vigilant while examining COVID positive children due to the paucity in information.

Laboratory findings:

Children affected by COVID-19 show a reduced amount of white blood cell count particularly lymphocytes and neutrophils. Thrombocytopenia may occur. In patients severely affected by COVID-19 show elevated liver enzymes, as well as abnormal coagulation and elevated D-dimers.^[18]

Radiological findings: On chest radiography, children mostly show bilateral patchy airspace consolidations often at the periphery of the lungs, peribronchial thickening and ground-glass opacities.^[19]

Prevention of COVID-19 among children:

Role of the family members:

As small children may not be able to take their own responsibility, parents or guardians are expected to take the charge for the same. Centers of Disease control and Prevention (CDC) has proposed various guidelines in order to create awareness and prevention among children about COVID-19. The recommendations for its prevention among children include:^[20]

1. Monitor the activities of children at home, school and outside the home setting.^[20]
2. Restrict large group activities and keep distance during play and interaction.^[20]
3. In the home and school setting, there is a need to keep the surfaces and objects sanitized as these remain the medium of transfer of pathogens.^[20]
4. Group travel, picnics and study tours are to be discouraged.^[20]
5. Children need to be taught about hand hygiene regularly and they need to be monitored for implementation of the same.^[20]

Role of Health care professionals:

On the other hand a paediatric dentist plays a pivotal role in oral health education when children are considered and thus explaining them its importance. This is usually done by conducting dental camps and providing early identification with prompt treatment. Considering the COVID - 19 crises it becomes difficult to conduct these camps, in such situations preventive strategies play a vital part. Social and digital platforms can be used to educate the child and parent. Teledentistry is gaining attention in this pandemic as the patients cannot come up for regular check-ups.^[21]The main objective of these guidelines is to avoid any unfavourable consequences and thus maintain good oral health.

Apart from the precautions suggested, children should avoid contact with persons or other children with recent

travel history or those with respiratory infections or fever. Moreover, it is imperative to target various risk factors like immune compromised state and comorbid conditions to limit the chances of getting infected.^[22]

Management of COVID-19 in children:

Treatment of children affected by COVID-19 is mainly symptomatic.^[23] Supportive treatment including sufficient fluid, calorie intake and additional oxygen supplementation should be instituted in these children.^[24]The antiviral treatment constitutes use of lopinavir, ribavirin and chloroquine diphosphate.^[25]

Measures taken by dentist to limit the spread of contagion:

Teledentistry: It is defined as the use of telehealth systems and methodologies in dentistry.^[21] During this pandemic of COVID-19 it is gaining attention from various health care providers. Teledentistry is an effective way to triage patients with symptomatic or possible COVID-19 disease. Tele triage can be done using the COVID-19 screening questionnaire that includes:^[26]

10. Any exposure to a person with known or suspected COVID-19 infection in last 14 days?^[26]
11. Recent travel history in areas with high number of COVID-19 cases in last 14 days?^[26]
12. Presence of any symptoms of respiratory illness such as fever or cough in last 14 days?^[26]
13. Have you or any household member had history of exposure to COVID-19 biological material?^[26]

If response to any of the above question is affirmative then dental treatment is not carried out.^[27] Use of contact free forehead thermometer for every paediatric patient and accompanying person is mandatory.^[28]In situations where patients present with fever of dental origin treatment can be performed.^[27-28] (Fig. 1)

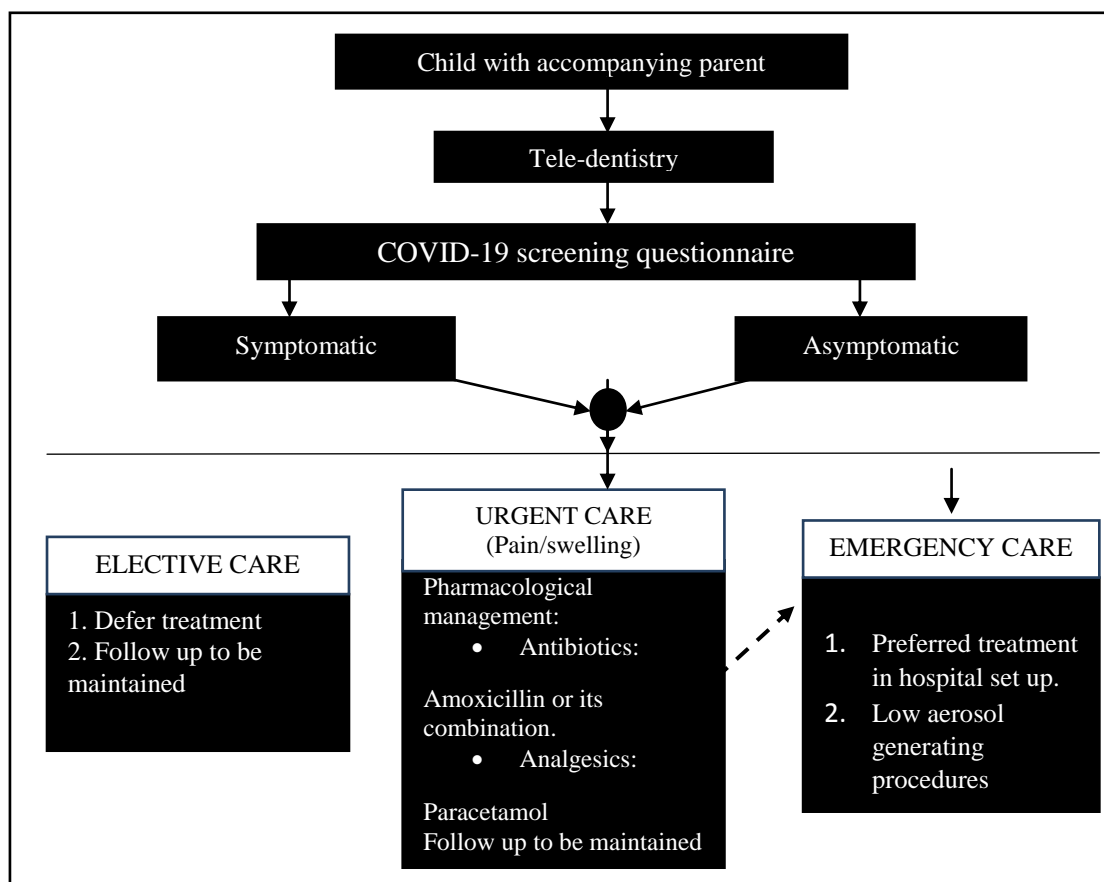


Figure 1: Algorithm for pediatric patient screening in COVID-19 (Adapted from Ather et al) [28]

In this midst of COVID-19, triage of dental treatment modalities for paediatric patients has become the need of hour. The primary dental care relies on provision of three A's that include analgesics, antimicrobials and advise. [29] Based on the

various guidelines given by American dental association (ADA) we have deduced a table for paediatric population on dental procedures. [30-31] (Table1). These procedures are divided on the basis of pain relief and type of dental procedure to be conducted.

Table 1: Treatment triage for paediatric patients (Adapted from ADA) [30-31]

EMERGENCY CARE Immediate care to be delivered	URGENT DENTAL CARE Medications are given for symptomatic relief along with dental procedure		ELECTIVE DENTAL CARE (deferred dental procedures)
	AEROSOL GENERATION	WITHOUT AEROSOL GENERATION	
Cellutis (Acute cellulitis of dental origin, Ludwig's Angina)	Irreversible pulpitis	Reversible pulpitis	Dislodged restoration with no pain
Trauma to the oral cavity	Dento alveolar abscess	Unavoidable extraction	Fracture involving enamel or dentin
Cracked tooth (if inhaled piece of tooth)	Avulsion	Luxation injuries	Adjustment of orthodontic appliances
Uncontrolled bleeding	Fracture involving enamel, dentin and pulp	Acute pericoronitis	Esthetic procedures
Avulsion		Fracture involving enamel dentin and pulp	Scaling and polishing
			Sealant and Varnish application
			Cavitation that does not cause pain and can be treated with restoration

Waiting Room:

1. Animated videos showing the technique of hand hygiene.
2. When the child washes hands music should be played for 20 seconds so that hands can be washed effectively.
3. Visual alerts at the entrance and in strategic places to provide instructions

about hand hygiene and respiratory hygiene. Instructions should include wearing a facemask for source control.^[32]

4. Provide alcohol-based hand rub with 60-95% alcohol, tissues and no-touch receptacles for disposal.^[32]
5. Place chairs in the waiting room at least six feet apart to maintain social distancing.^[32]
6. Remove toys, magazines and other frequently touched objects that cannot be regularly cleaned or disinfected from waiting areas.
7. Minimize the number of persons in the waiting room.^[32]

Hand Hygiene:

The reinforcement of good hand hygiene is essential. WHO recommends the use of the "two before and three after" technique as a regular hand hygiene procedure.^[33] The technique recommended involves washing hands

- Before touching a patient,
- Before clean/aseptic procedures,
- After body fluid exposure/risk,
- After touching a patient and
- After touching patient surroundings.

Use of Personal protective equipment (PPE):

The use of PPE along with protective eyewear, masks, gloves, caps and face shield is strongly recommended.^[34] Particulate respirators (N-95 masks authenticated by the National Institute for Occupational Safety and Health or FFP2-standard masks set by the European Union) are suggested for dental practice.^[35] A triple-layered surgical mask with a full face shield can be worn in cases where respirators are not available.^[34] The PPE suits and face shields can also be modified with various cartoon designs to modify child's behaviour.

Dental operatory:

Procedures carried out should be done with minimal or no aerosol generation. In cases where it is required the patient should be scheduled at the end of the day.^[36] Moreover, use of four handed dentistry is

strongly recommended. Taking of radiographs should be avoided as it may induce gag reflex and thus stimulate saliva secretion.^[37] However, other modalities like CBCT and OPG can be undertaken. It is recommended that position of the operator should be at 10 or 11 o'clock to avoid splatter.^[36] While the treatment is being carried out parents are advised to be in the waiting room unless the child is below 3 years of age.^[38]

Preprocedural mouth rinses (PPMR):

Preoperative mouth rinse with oxidative agents has been suggested.^[39] Chlorhexidine, one of the most commonly used mouth wash in dentistry is considered to be ineffective against novel coronavirus.^[40] Alternatively, mouth rinses containing 1% hydrogen peroxide or 0.2% povidone can be used to reduce microbial load in saliva.^[41] It also play a major role in cases when rubber dam cannot be used.

Use of rubber dam:

The use of airtight results in formation of aerosols and droplets that are usually contaminated. These aerosols and droplets signify a potential route for transmission of infectious disease such as COVID-19. The use of rubber dam results in a significant reduction in the microbial content of aerosols produced during operative procedures, thus reducing the risk of cross-infection in the dental practice.^[42]

Children with special health care needs:

Dental management always possess a challenge in these patients due to their underlying medical condition. These individual are at risk of oral diseases throughout their lifetime. When these patients suffer from pain of dental origin they succumb to self-injurious habits which further deteriorates their oral health.^[43] Since the incidence of COVID-19 is more in such patients, the treatment for these patients is usually delayed unless there is an emergency. These patients are always treated in a hospital based dental clinics to prevent cross infection. In addition, scheduling appointments for these patients also needs special attention as

recommended by (American Academy of Paediatric Dentistry) AAPD. [44]

Behaviour management:

In situations where emergency care needs to be carried out in patients that are anxious, behaviour management becomes essential. Children showing extreme negative behaviour increase the chances of aerosol spread due to their restless and crying behaviour pattern. Moreover, the attire of the dentist with PPE further frightens the child. Use of distraction techniques like wall mounted television can be used. Apart from this other techniques like tell show do and modelling can make a significant difference. However, patients that require aversive techniques of behaviour management should be deferred as suggested by AAPD. [44]

Disinfection:

Fumigation or fogging with chlorine dioxide should be done after every patient. Contaminated surfaces or those adjacent to the operating room should be disinfected with 0.1% sodium hypochlorite. Flushing of suction and disinfection of waterlines with this agent. Moreover, mopping of the floor and cleaning of dental chairs should be done several times in a day. [45]

Dental management during COVID-19:

In a dental setting SARS-CoV-2 can be transmitted mainly through aerosol generation. [46] Children can be potential carriers of this virus along the mild and asymptomatic course of the disease. Because of this, children are also called as silent carriers. [9] During this pandemic of COVID-19 managing dental pathologies in children involves a mixture of preventive and minimally invasive strategies. Due to which not every time a child can visit a paediatric dentist unless it's an emergency. In such situation measures taken by the parents at home.

Home care measures:

1. **Oral hygiene:** Children must be instructed to brush twice daily using a fluoridated toothpaste. However, in infants use of clean cloth or finger is recommended. [47-48]

2. **Teething problems:** Parents are advised to use clean swabs that help in removal of food debris between the tooth and gingiva. Gel application and chewing on hard foods can be done to reduce the painful symptoms. [49]
3. **Delay in tooth shedding:** Children are instructed to bite on foods with hard consistency like bread toast and fruits. This technique hastens the process of exfoliation by creating pressure on the alveolar bone. [50]
4. **Tooth ache:** The source of tooth ache may be dental caries, a cracked tooth or an infection. For temporary control of symptoms, antibiotic therapy with amoxicillin or its combination and pain relievers such as paracetamol are recommended by AAPD. [51] In cases with suspected or confirmed case of COVID-19, ibuprofen should be avoided due to its interference with the immune system. [52]
5. **Pericoronitis:** Parents are advised to keep the area clean. As an adjunct gargles with chlorhexidine mouthwash can also be done. [53]
6. **Dislodged restoration:** Displaced restoration from a tooth treated endodontically or vital pulp therapy causes excruciating pain. Parent are advised to keep the cavity clean to prevent food lodgement along with avoidance of food stuff with extreme temperature. [54]
7. **Patients undergoing orthodontic therapy:** Children who are on a removable appliance therapy their parents are strongly advised to follow a strict hand hygiene and sanitize the box in which the appliance is stored at night. On other hand for children on fixed appliance therapy the activation should be suspended along with avoidance of sticky foods to avoid undue consequences. [50]

Dental emergencies:

1. Trauma:

Owing to the playful nature of children, falls account for the major cause of

injuries to the young permanent teeth. Apart from these automobile accidents, children with seizure disorders also cause significant dental trauma. When the type of injury is considered it is seen that permanent teeth are more susceptible to crown fractures in contrast to crown fractures. This can be attributed to low crown root ratio and dense alveolar bone.^[55] Managing traumatic injuries at home may be difficult for the parent and child due to the anxiety created by the fall. However, in cases where only

enamel and dentin are involved application of desensitizing paste works.^[56] On other hand injuries involving pulp, luxation and avulsion injuries to the tooth require urgent dental care. In case of avulsion the parent is asked to reimplant the tooth. However, if it is not possible the tooth is kept in transport media like milk and taken to the dentist. The procedure involves replantation of the tooth followed by application of the splint for 2 weeks.^[57] (Figure2)

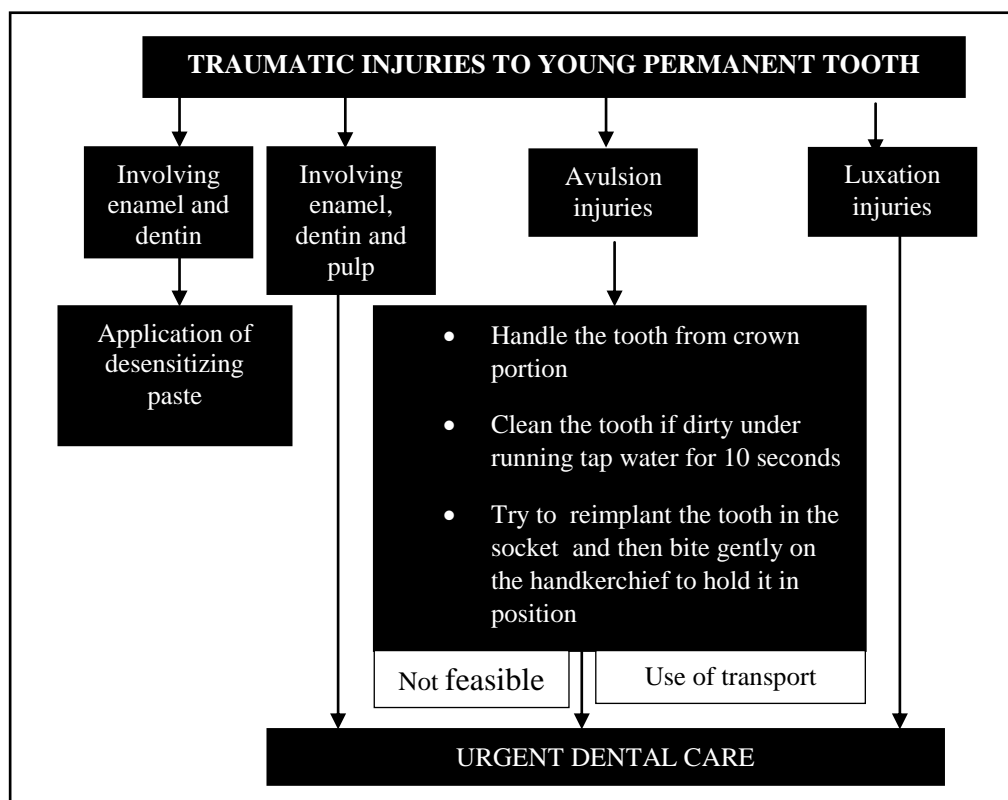


Figure 2: Treatment of traumatic injuries to young permanent teeth. (Adapted from Scottish dental effectiveness programme; 2020)^[29]

Pain and swelling due to dental caries:

Caries when involves pulp causes agonising pain in deciduous or permanent tooth. Initially pharmacological treatment is considered as the first line of treatment. In cases where there is no relief intervention along with the medications is considered. Untreated pulpal exposure are major cause of pulpitis or pulpal necrosis.^[58] In cases where only the coronal pulp is involved agents that induce reparative dentin formation can be used.^[59] On the contrary, where radicular pulp is affected a pulpectomy is indicated.^[60] Depending upon

the indication a single visit or multi visit technique is preferred.^[61] Single visit pulpectomy should be advocated as much as possible as it not only reduces the symptoms of the child but also reduces the patient exposure. However, when the tooth is non restorable or has extensive root resorption it is advisable to extract the tooth followed by a space maintainer.^[61] Considering the various guidelines suggested for emergency dental care we have deduced an algorithm for treatment of pain and swelling due to caries.^[27,60] (Figure 3)

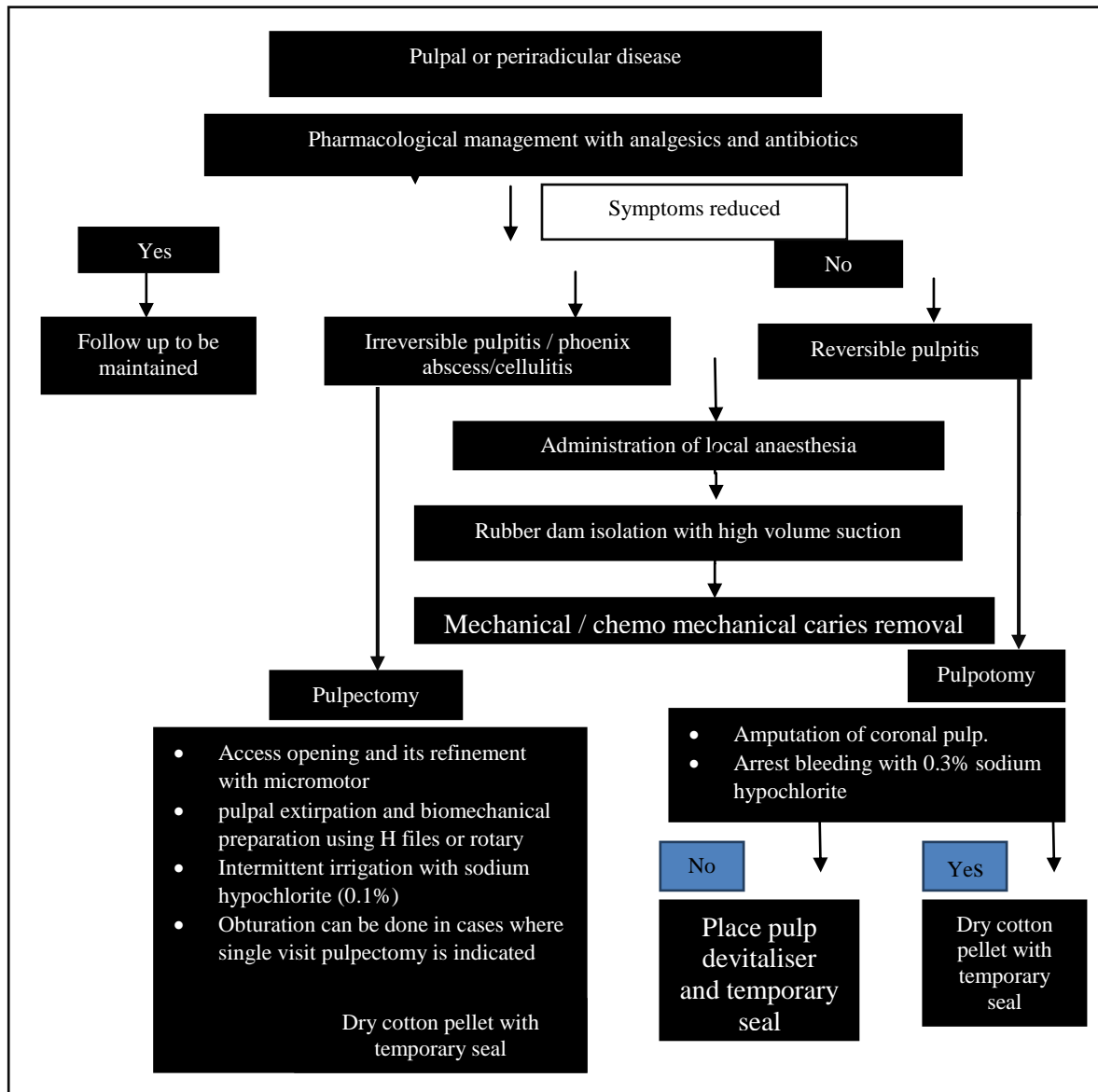


Figure 3: Algorithm for treatment of pain and swelling with carious pathology

Non-aerosol generating procedures:

1. **Alternative restorative technique (ART)**- It was first developed in Tanzania as a treatment approach for areas where resources are not available for a definitive dental treatment.^[62] This procedure is recently gaining more popularity during this COVID-19 crises owing to its minimum equipment and no aerosol production. Initially it was used only for sealing minimal caries but with its new modification also called as (Silver modified atraumatic restorative technique) SMART technique it can also be used in teeth with caries approximating the pulp.^[63] In this

modification use of silver diamine fluoride (SDF) arrest the dental caries and Glass ionomer cement (GIC) seals the cavity. Moreover, fluoride releasing property of GIC gives an additional beneficial effect.^[63]

2. **Chemo-mechanical caries removal technique**- It can be defined as a technique of eliminating infected dentine by use of chemical agent.^[64] It is not only effective in caries removal but at the same it is non-invasive. It is broadly divided into two types on basis of its major content. They can either be sodium hypochlorite based agents or enzymatic agents.^[65] Various studies

and Cochrane review have claimed its effectiveness.^[66-67] Since this procedure is considered as a biological method of treating dental caries, its use can be considered during this pandemic.

3. **Silver Diamine Fluoride (SDF):** It is a colourless odourless liquid that not only arrest caries but also prevents its progression.^[68] It was initially used as a preventive agent in Japan. Although it has several advantages of prevention and arrest of dental caries, it can also be used as a desensitizing agent.^[69] The only disadvantage associated with this liquid is discolouration of teeth overtime.^[68]
4. **Hall technique:** A non-surgical technique used to restore asymptomatic carious primary molars.^[70] It advocates the use of separators for 3-5 days followed by placement of crown.^[70] No local anaesthesia is administered nor is removal of caries attempted. On the basis of evidence available hall technique can be effective done on a child.^[71-72] The technique relies on the principle of sealing caries from the oral environment and thus stopping its progression.^[70] Apart from its use in primary molars it can also be used in children have mutilated first permanent molars due to hypo-mineralisation.^[73] However, literature supporting it is less. Since this procedure does not involve generation of aerosols it can be considered as an option during this pandemic.

Preventive strategies:

With the growing significance of preventive dentistry new innovations have been developed with the aim of early disease prevention:

1. **Fluoride varnish:** Vast literature is available that supports the effectiveness of topical fluorides on dental caries.^[74-75] Topical fluorides in the form of varnishes can also be used as cavity liners.^[76] AAPD suggests the application of varnish biannually. When the caries reduction potential is

considered its effectiveness ranges from 40-60%.^[75] It can be considered as a safe and effective way of fluoride retention on tooth structure.

2. **Pit and Fissure sealants:** High susceptibility of caries in molars and premolars can be attributed to its occlusal surface. Presence of deep fissures and grooves prevents the chemical or mechanical cleaning of these areas. Thus application of pit and fissure sealants becomes mandatory in children.^[77]
3. **Resin infiltration technique:** it was first introduced by Munoz et al (2013).^[78] The technique basically involves arresting enamel lesions and also masks the white spot areas. Its mechanism of action relies on the penetration of low viscosity resin and thus arrest the caries progression.^[78] A recent meta-analysis suggested its effectiveness in caries reduction.^[79] Apart from this various studies are available that show its effectiveness in smooth surface as well as proximal lesions.^[80]

CONCLUSION

COVID-19 seems to affect children less severely as compared to adults. However, they remain vulnerable to infection and pose a substantial transmission risk. Currently there is no active treatment and diagnosis is still a challenge. These characteristics put the dental offices at a risk of cross infection between children and dentists. Pediatric dentists during this pandemic should enact universal infection control protocols to the highest standards to limit the spread. Hence, understanding the present situation is helpful in terms of predicting future dental needs.

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