Practical Applicability of Teledentistry in Pediatric Patients Amidst Pandemic : A Narrative Review

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The coronavirus disease-2019 (COVID-19) pandemic has imposed a situation where all healthcare facilities except emergency services remain suspended. These times generated the necessity for the implementation of a healthcare delivery system that can be accessed digitally and, thus, benefit the majority of children as well as healthcare professionals. This review aims to propose a sound model of less technique sensitive, safe and handy strategies for dental traumatic injuries, endodontic and restorative concerns, and orthodontic urgencies until complete clinical help can be sought. Five hundred thirty articles were obtained from the PubMed, Google Scholar, Embase, Lilacs, and Cochrane databases published from 2011 to 2021. Nineteen articles that described teledentistry in the COVID-19 era were included. Teledentistry can serve as a vital patient management strategy that can aid in triaging urgent and elective patient treatment needs, ultimately easing the burden of clinics and at the same time providing a safer means of consultation.

Keywords: teledentistry, telehealth, teleconsultation, pediatric dentistry, COVID-19

INTRODUCTION

Dentistry has been considered as the most susceptible profession to get affected by the COVID-19 pandemic, as it involves close inspection, examination, diagnosis, and therapeutic interventions around the naso-oropharyngeal region (1). This enormously aggressive novel coronavirus SARS CoV-2, whose epicenter was Hubei province in China, was declared as a health emergency of global concern by the World Health Organization (WHO) on January 30, 2020 (2). Around the world, even after 1 year, people are still experiencing suspension of ongoing dental practices except for addressing emergent needs (3–5). A rising number of pediatric cases of COVID-19 infection with greater severity and higher risk of transmission have been seen in the second wave of the pandemic (6, 7). This has made it imperative for pediatric dentists to be vigilant in triaging, assessing, and managing patients.

During these difficult times, adapting a telehealth model has been the most sound approach practiced by all nations to manage patients presenting with health problems during lockdown and otherwise. Advisories also focus on managing the majority of patients affected by COVID-19 within the home under the supervision of a treating doctor via telehealth (8). In dentistry, this approach has been proven to be successful, as it satisfies social distancing norms and allows halting the transmission of the virus to contain its spread.
Teledentistry has been defined by Cook in 1997 as “the practice of using video-conferencing technologies to diagnose and advice about treatment over a distance” (9, 10). Teledentistry, a form of telehealth comprising of a synergism between telecommunications and dentistry that involves the exchange of clinical derived information and relevant images for consultation and treatment planning.

The concept has proven to be a boon for the continuous delivery of necessary healthcare services during difficult situations of the pandemic (11). Innovations in the form of mobile applications and other technical developments have eased the learning and referral protocol necessary to minimize direct contact between patients and doctors.

**METHODOLOGY**

An electronic search from databases of PubMed, Google Scholar, Embase, Lilacs, and Cochrane was conducted for articles published from 2011 to June 2021. The use of MeSH terms “teledentistry”, “teledentistry” AND “COVID-19” yielded a total of 530 articles (Pubmed: 256, Google scholar: 270, and Embase via Cochrane: 2) out of which 211 duplicates and 5 non-English publications were removed. Screening of the remaining 314 articles was performed based on title and abstract, and the articles were sought for retrieval. Full texts of only 147 articles were retrieved and screened for further eligibility. Articles published as systematic reviews, meta-analysis, observational studies, and randomized clinical trials were included while those published as case reports, books or documents, and conference proceedings were excluded. The exclusion was also made after screening based on relevance to dentistry, pediatric or general dentistry, triaging of patients, guidelines, protocol, and reviews from clinical experience. Out of the 147 articles, 19 that described a practical implementation of teledentistry service in the COVID-19 era were selected for the review (3–5, 8, 11–25). Refer to the flowchart in Supplementary Figure 1.

**Types of Teledentistry**

1. **Two-Way Interactive or Real-Time Consultation/ Synchronous**
   
   Real-time consultation caters to video conferencing between a dentist and a patient with simultaneous exchange of information, medical history, and reports in order to reach a diagnosis within the same appointment. It also aids in the prompt exchange of information and reporting with a peer dentist or specialist. Two-way interactive technology allows procuring live images or sound occurring in an originating site to a person in a remote or distant site (26–31).

2. **Store and Forward Teledentistry/Asynchronous**
   
   Information is gathered from one location, stored, and transferred to the treating consultant in a different location. Relevant data in the form of x-rays, photographs, and scanned images are uploaded and forwarded to the consultant after screening or storing it in the system. This system is beneficial for consulting a specialist/team from a different place/city/country before referring or managing the patient. The data can be used to educate colleagues after obtaining a prior consent. A pattern of asynchronous consultation is also available on many webpages for fetching a potential diagnosis by entering serology or pathology reports (30, 31).

3. **Remote Monitoring of Patient**
   
   Information on health and other medical data are transmitted from one location to another via electronic media for healthcare and supportive management.

4. **Mobile Health (mHealth)**
   
   The use of mobile communication devices to support public health practice and education by using devices such as cell phones, tablets, computers, and personal digital assistants (PDAs).

**Telehealthcare Model**

**Teletriaging**

Categorizing patients based on the urgency of treatment can be managed by teletriage. The dental team or front office can characterize if the case of a patient is elective or emergent. Emergent cases can be prioritized, and elective cases can be scheduled at a convenient time for teleconsultation, and appointments can be postponed to a more appropriate time (12). “Forward triage” helps to reduce the workload of a caregiver by managing non-emergent patients before they visit a hospital (32, 33). It foresees any crisis that can occur and prevents unnecessary movements in times of pandemic.

**Teleconsultation**

Interactive consultation with a clinician by telephonic or video conferencing is the prime component of the telehealth model. Consultation with a specialist can also be included if the software allows multiple participants at a time. Exchange of chief complaint, medical history, recent and previous laboratory reports, extraoral photographs, intraoral photographs, dental cast photographs, and radiographs, and examination by virtual appointments comprises a teleconsultation.

**Telediagnosis**

Analysis of collected information in teleconsultation leads to formulation of a diagnosis. The appropriate diagnosis and devised treatment plan are projected to the patient. Efforts were made in the past by Haron et al. to develop “Mobile Mouth Screening Anywhere (MeMoSA®)” for detection of oral cancer (34). Limited access to specialist has also lead to the development of tablet based mobile microscope (Cellscope Device) as an adjust to oral cancer screening (35).

**Telemonitoring**

Follow-ups and routine checkups in dentistry have always been of less priority among patients. Monitoring of postoperative cases with the help of telecommunication can be effectively carried out. Taking the help from scheduled telephonic calls, video conferencing, or merely by filling e-forms about resolution of symptoms can pave the way for sound dental health and can anticipate any treatment failure to occur (36).
Applicability in Pediatric Dentistry

The American Academy of Pediatric Dentistry (AAPD) recognizes COVID-19 as an ongoing community and global problem with ever increasing number of cases among children and have, thereby, added a COVID-19 resource page in the recent reference manual, AAPD 2020–2021 namely “Re-emergence A Report on Pediatric Dental Practice Re-entry into Practice During the COVID-19 Pandemic” (13), also holds the statement for parent-FAQ (37). It also highlights the implementation of public health initiatives and the impact on oral healthcare delivery during the suspension of dental practice.

Adoption of teledentistry in daily practice:

1. Conduction of regular virtual continuous dental education programs and webinars for dentists to appraise various recent software and technological platforms as a medium for practicing teledentistry.

2. Dissemination of approaches for adequate management by dentists can be delivered by hospital-based software with stepwise triaging of patients. The hospital-based software can also be converted into a self-help application with which patients can direct themselves according to their chief complaint and acquire help from a specialist by scheduling a call or initiating a conversation. Another approach of providing management options can be applicable in private dental practices where patients can talk to their treating doctors directly for help.

Pediatric patients may have a variety of treatment needs that requires definitive operative, endodontic, orthodontic, or surgical intervention in a dental clinic/hospital. We propose a model of teledentistry-assisted management of pediatric dental problems during the COVID-19 pandemic that can be augmented with teleconsultation demonstrations in order to minimize the need for dental clinic visits. It includes at-home recommendations for non-emergency concerns that can be disseminated via teleconsultation mode for parents and caregivers.

The main aim of this approach is to provide help during the pandemic when patients are unable to seek definitive treatment at the professional level because of the risk of infection, overburdened hospitals, and unavailability of functioning dental offices during lockdowns. The proposed specific problem-oriented management model is described in Tables 1, 2. These tables describe proposed advice and possible modified management based on established guidelines. It must not replace the definitive treatment required for a patient in a dental clinic that involves thorough clinical examination and adjunctive tests for accurate diagnosis and treatment plan (14, 38–47).

Recent Evidence of Teledentistry

As the dynamics of the pandemic are changing with time, the acquisition of updated knowledge of the usage and practical applications as well as challenges of teledentistry is important before designing any robust model of action. According to a survey by Dusseja et al. almost 70.7% of respondents were unwilling to visit dental clinics during the COVID-19 pandemic, and 80.5% of the participants were in favor of teledentistry to resolve their dental problems. Out of them, 58% of the responders received prescriptions via WhatsApp, 35% through telephone, 5% through video call, and 2% via e-mail and other means (17). Similarly, in a study by Davies et al. findings show that over 50% of photographic referrals resulted in either advice or antibiotics being prescribed, without the need for face-to-face contact. Over 70% of the images received during the study period were related to children aged 10 and under, and the majority related to swelling, pain, and dental trauma (18). Furthermore, a survey by Statista reports that 97% of those between the ages of 16 and 54 yr now own a smartphone with the capability to take photographs and send email (48).

In a survey by Rahman et al., patient satisfaction was evaluated along with ease of use, effectiveness in accessing clinical services, and reliability of the teledentistry system; 94% of the respondents were satisfied with telephonic consultation and willing to utilize it in the future. Majority of the respondents were able to express themselves satisfactorily and clearly (19). A recent study from Google interest trends on self-medication during the COVID-19 pandemic depicted an increase in the number of searches regarding self-medication, which indicates the need to reach out to the population in different ways, one of which can be through teledentistry, as reported by Sen Tunc et al. (20).

A few more acceptance-oriented studies have achieved good responses with teledentistry consultation for pain as well as for monitoring and follow-ups. Teledentistry has been beneficial in various fields, such as orthodontics, maxillofacial surgery, and pediatric dentistry (21–23).

Barriers in the Use of Teledentistry

1. Technology: The complexity of technology might make it difficult for clinicians to accept teledentistry, as they may be hesitant to learn and adopt a new skill.

2. Practical implications: Inability to perform a tactile examination of lesion/oral cavity and two-dimensional pictures, and improper evaluation of interproximal contact and posterior-most teeth might offer a limitation in accurate diagnosis (24). Clinicians might get afraid of making a wrong diagnosis and inappropriate treatment plan.

3. Communication: Patient acceptance due to lack of in-person communication may hamper in adopting a devised treatment plan, although many surveys being conducted support the gaining popularity of teledentistry (17–20, 48).

4. Rural setting: Lack of infrastructure such as internet connectivity, computer or smartphone, x-ray machine and other advance armamentarium to help in diagnosing the tooth/lesion, providing it to the patient or transferring to a specialist at different location (25).

5. Privacy: The lack of privacy of transferred information may be a roadblock in gaining the confidence of patients, although the law for breach in privacy of a patient without his/her consent is strict. It is advised to all healthcare workers and portals working for telehealth to obey the Health Insurance Portability and Accountability Act (HIPAA)1.

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1Available online at: https://www.cdc.gov/phlp/publications/topic/hipaa.html. (accessed July 06, 2021).
TABLE 1 | Management of common pediatric dental problems.

COMMON PEDIATRIC DENTAL CONCERNS 26,27,28,29

Teething problems
- Maintain oral hygiene.
- Clean gums regularly after each meal using clean moistened cotton gauze/cloth.
- Advise using cold -non-irritating teething rings/ pacifiers to relieve discomfort.

Exfoliating/ Mobile tooth
- Assist in at home extraction/ removal of tooth.
- Apply topical anesthetic gel (available online).
- Hold the tooth with clean gauze piece/sterile cotton, twist and pull out.
- Anesthetize by pressure gauze.
- Advise post extraction instructions: Bring down on a chair for at least 30-40 min, avoid hard or hot foods and avoid spitting for 24 hours.
- Prescribe analgesics (available online).
- Use of orthodontic elastics/elastics module (available online) around the tooth *may be considered to stimulate exfoliation in early retained teeth.

Oral ulcers
- Identify the cause of ulcer. Virtual diagnosis by the dentist.
- Avoid spicy and hot foods.
- Application of lignocaine based topical anesthetic gel or gelspray over the ulcer.
- Maintain oral hygiene by brushing twice daily and maintaining after each meal.

Decementation/ Accidental swallowing of crown/restoration
- Do not attempt to fix the dislodged crown.
- If swallowed, usually crowns go into the gastrointestinal tract and pass out eventually.
- In case of choking: Induce coughing or attempt Heimlich Maneuver.*
- Visit Emergency service if choking persists.

*Video based consultation and assistance can be more effective.

CARIOUS LESION & LESION INVOLVING PULP 30,31,32,33,34

Initial cavity/ Blackspot/ Discoloration
- Non-cavitary cavity control (NRCC) which involves:
  - Proper brushing twice daily with fluoride toothpaste.
  - Dietary modification.
  - Fluoride mouth rinse/ Self applied topical fluoride gels (available online).

Considerably deep cavitated lesion
- Asymptomatic:
  - Maintain oral hygiene with effective cleaning of cavitated tooth using inter-proximal brushes such as regular flossing and interdental brushes to avoid food lodgement.
  - Follow NRCC protocol of topical fluoride use at home.
  - Dietary modification

Symptomatic cavities (Pain/sensitivity):
- Dietary modifications and maintenance of oral hygiene.
  - Mild/moderate and intensive:
    - Small cotton pellet soaked in clove oil may give temporary pain relief in cavities.
    - Antiseptic mouthwash as and when required till dental visit is feasible.
  - Severe and continuous:
    - Antigenics for immediate relief but schedule dental visit as soon as possible.

Dissolved restoration:
- Maintain oral hygiene.
- Pack teflon tape into the cavity or a clean cotton pellet soaked in clove oil (in case of pain or sensitivity) using a clean toothpick/ toothbrush and change daily till dental visit is feasible.

Dental abscess:
- Teleconsultation for appropriate antimicrobial and analgesic coverage.
- Advise warm saline rinses for swollen gum and soft tissue.
- Abstain from any external hot/cold stimulation.
- Maintain stringent oral hygiene.
- Follow up on teleconsultation and accordingly decide if emergency visit needs to be scheduled.
- Cellulitis/Facial swelling/ difficulty in swallowing.

Ongoing endodontic treatment
- If intermediate restorative material is dissolved and root canals are exposed:
  - Irrigate with chlorhexidine mouthwash/ clean water using a springer/ water flosser.
  - Pack teflon tape or clean cotton pellet into the cavity and change daily till dental visit is feasible.

*Video based consultation, assistance and live demonstration for age appropriate tooth brushing can be more effective.
### TABLE 2 | Management of common pediatric dental problems.

#### DENTAL TRAUMA

**Minor Soft Tissue Injury**
- Control Bleeding:
  - Apply pressure with clean cotton/gauze piece.
  - If bleeding persists: Use moist tea bag to apply pressure.
  - Analgesic for pain relief (Over the counter /Available online)

**Tooth Fracture**
- Very small fractured segment: Non-painful:
  - No emergency treatment required.
- Considerable fracture of tooth crown:
  - Use desensitizing paste.
  - In case of sharp tooth edges:
    - Cover tooth with paraffin wax/orthodontic wax (available online) OR
    - Wrap tooth and cover edges with Teflon tape (PITE)
    - Change it regularly till the time dental visit is possible.

**Excessively Mobile Tooth Fragment**
- Apply topical anaesthetic gel (Available online)
- If possible; remove the mobile fragment with a clean gauze/cloth.

**Displaced tooth/Luxation Injury**
- Displacement without mobility:
  - Teleconsultation and regular follow-up required. Consider analgesics in case of pain and visit dental clinic when possible for a definitive treatment.
- Displacement with mobility:
  - Repositioning of permanent tooth can be attempted using finger pressure.
  - Consider soft diet and analgesics till dental clinic visit is feasible (as soon as possible).

**Knocked out tooth/Avaliation**
- Assess whether tooth is milk tooth or permanent tooth via Teleconsultation.
- Attempt to reimplant permanent tooth only.
- Wash tooth under clean running water.
- Try to put the tooth back in socket.*
- Ask the child to bite down on the clean cloth.
- Seek simultaneous Tele-help from dentist.
- Store in cold milk/coconut water if unable to replant tooth. Do not let it dry!
- Visit dentist immediately.

*Video based consultation, assistance and live demonstration for tooth repositioning and reimplantation can be provided. Advise maintenance of strict oral hygiene.

#### PEDIATRIC ORTHODONTICS

**Broken space maintainers / appliances**
- Attempt seating the orthodontic bands of appliances back on to the tooth with finger pressure if the appliance has de-cemented.
- Remove loose and completely broken appliances with sharp wire ends in order to avoid injury.
- In case of inability to remove damaged fixed appliance; cover sharp areas with orthodontic wax till help can be sought at dental clinic.
- Remove broken or debonded brackets.
- Stop usage of broken removable appliances.
- Elastic modules (available online) can be changed at home with the help of tweezer using video demonstrations during teleconsultation.

**Impinging wires and brackets**
- Cover impinging bracket areas with orthodontic wax.
- Loose or debonded brackets to be removed.
- Attempt can be made at carefully clipping impinging wire ends using a nail clipper (cleaned and sterilized at home).*

**Accidental swallowing**
- Swallowing of small component that does not cause choking/breathing problem or irritation does not require any intervention as it will eventually pass out via digestive tract.
- In case of choking:
  - Induce coughing or attempt Hemiitch Maneuver. *
  - If it doesn’t help: It is an EMERGENCY SITUATION. Visit a doctor.

*Video based consultation, assistance and live demonstration for removal or adjusting appliance can be done.
SUMMARY

Teledentistry has been widely used in the COVID-19 pandemic. Dentistry in the newer times does not only rely on technological advancements in terms of armamentarium and instruments but also ways to reach out to patients using convenient and advanced modes of communication media that include teleconsultation support anytime and anywhere as well as internet-based social media platforms for creating health awareness and disseminating valuable information to patients during times of crisis. Teledentistry can, therefore, serve as a vital patient management strategy that aids in triaging urgent and elective patient treatment needs, ultimately easing the burden of clinics and at the same time providing a safer means of consultation.

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AUTHOR CONTRIBUTIONS

MG, TN, AS, SC, AM, SS, and PJ organized database, wrote first draft, sections of the manuscript, conception, and design of the study. All authors contributed to the manuscript revision, read, and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fdmed.2021.748089/full#supplementary-material
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