

Tele-dentistry in COVID-19 era: A conduit for dental care in uncertain times

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Abstract

Tele-dentistry encompasses all sorts of digital technologies that involve the exchange of patient's clinical data from a distant site for the provision of dental health care. Tele-dentistry has emerged from the concept of telemedicine, which has been in practice since the 19th century. In recent times, an upsurge in the digital technologies was noted, which has made the possibility of remote access to dental care. The outbreak of COVID-19 pandemic has restricted the normal routine ways of clinical practice. In these challenging times, tele-dentistry serves as effective platform for providing dental health care. Tele-dentistry has vast applications across various disciplines of dentistry, including preventive dentistry, paediatric dentistry, oral medicine, and oral pathology etc. In these pandemic times, tele-dentistry can be efficiently used for identification of dental emergencies, allowing effective triage and subsequent management. There are different communication platforms available for tele-dentistry. The most common technologies used are web-based video conferencing and smart phone-based applications. As the clinicians are not aware of these digital technologies utilised in tele-dentistry, there are certain challenges associated with its use. In conclusion, tele-dentistry serves as an effective tool in providing health care in challenging times, but it has been under-utilised by the dental fraternity. The legislative authorities should establish proper standard protocols to ensure the safety and confidentiality of patient information while using these digital platforms.

Keywords: Pandemics, Digital Technology, Emergencies, Pathology, Paediatric Dentistry, Preventive Dentistry, Smartphone, Triage, COVID-19, Telemedicine, Dental Care.

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Introduction

The word "Tele-dentistry" constitutes all sorts of digital

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technologies that involve the exchange of patient's clinical data from a distant site for the provision of dental health care. It involves consultation, diagnosis, and screening for oral diseases without physical communication with the patient.¹ Tele-dentistry has evolved from the concept of "Telemedicine", which has been in practice since 1960s.² Historically, the concept of telemedicine was first adopted and developed by the National Aeronautics and Space Administration (NASA) and recently by United States Armed Forces (USAF), that enabled them to get specialist opinions regarding their team members from remote areas.³ Similarly, the first documented tele-dentistry programme "Total Dental Access" was introduced in 1994 as part of military programme in the United States. The aim of this project was to provide better access to dental care through an cost-effective tele-dentistry programme.⁴ In the last decade, the scientific community has witnessed exponential progress in the domains of information technology, electronic health records, digital photography, and wireless communication.⁵ This digital revolution has made the accessibility of health care at distant sites without any physical communication possible.⁵ Recently in 2019, a resurgence of interest in tele-dentistry was noted among the dental fraternity, due to the outbreak of novel coronavirus (SARS-CoV-2), which altered the ways of routine clinical practice.⁶ In such times of uncertainty, tele-dentistry has the potential to be an effective way of providing dental health care, but unfortunately a slow adoption was noticed among the dental fraternity.⁷ Tele-consultations are well accepted by both patients and clinicians as the presence of clinician on video-consultations has showed high level of satisfaction among patients than telephone calls.⁸ Hence, the objective of this review article is to familiarise the dental community with the basic framework of tele-dentistry, its applications during the pandemic era, the benefits for the provision of dental health care, and associated challenges.

Materials and Methods

Search Strategy

A comprehensive literature search was done across major health sciences databases including PubMed (NLM),

Dentistry and Oral Science, CINAHL Plus (EBSCO) and Cochrane Library by the two authors (MDHK & SQHB). Furthermore, a manual search was also performed in Google Scholar database to identify any literature relevant to our review. The following search terms were used to identify relevant literature: "tele-dentistry", "tele-health", "COVID-19", "Tele-screening", "Tele-triage", "Remote-health", "E-health", and "Electronic-health".

Inclusion Criteria: The studies having the following characteristics were included:

1. Studies that were published in English language
2. Studies that focused on the effectiveness of tele-dentistry in tele screening or tele triage in dental specialities (orthodontics, prosthodontics, restorative dentistry, endodontics, and paediatric dentistry)

Exclusion Criteria: The studies having the following characteristics were excluded:

1. Studies only available as abstracts
2. Conference proceedings, letter to editors
3. Studies registered as protocols

Results

Article citations were imported to endnote referencing manager (Clarivate analytics) where duplicate references were removed. The authors of this review screened the studies according to the preset inclusion/exclusion criteria. Lack of consensus among the authors were resolved through discussion to the point of agreement. The extracted data from the studies is presented as below:

Models of Tele-dentistry

Depending on the type of communication, there are currently two basic models practiced in tele-dentistry for providing dental health care i.e. synchronous and asynchronous tele-dentistry as shown in Figure 1.⁹

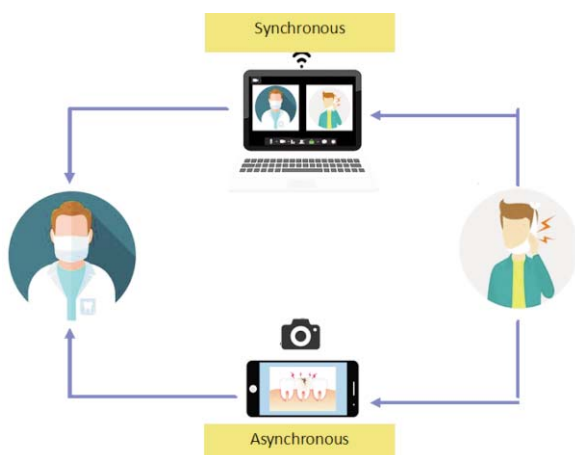


Figure-1: Synchronous and Asynchronous models of tele-dentistry.

Synchronous form involves a two-way real time communication through video conferencing, as an alternative to physical consultation. While an asynchronous model works on the principle of "store and forward".¹⁰

Synchronous model of tele-dentistry allows a comprehensive interview with the patient, allowing the dentist to better understand the signs and symptoms of disease and to discuss with the patient about treatment plan in real-time.¹¹ Although such form of communication requires a scheduled time for both patient and clinician, the result of this one-to-one communication is fruitful in terms of patient satisfaction.¹² Furthermore, such form of communication requires the necessary equipment for video conferencing and a high-speed internet connection for smooth workflow.¹¹ Conversely, asynchronous tele-dentistry does not involve presence of the patient and dentist at the same time on a digital communication platform.¹¹ The dentist reviews stored data of the patient through electronic health records or an alternate storage source, seeks a specialist opinion if required, and then decides an appropriate treatment plan.¹¹ Asynchronous model is mostly utilized for monitoring the follow-ups of a patient after a dental procedure or a disease.¹⁰

Workflow of Tele-dentistry

For an effective communication between the patient and dentist, the tele-dentistry requires the following fundamental equipment:¹³

1. Desktop computer/laptop with a microphone or mobile phone
2. Digital photography using digital cameras or smartphones
3. High-speed internet connection

The dentist after establishing a connection with the patient through video conferencing starts a thorough discussion with patient inquiring about his or her medical and dental history followed by a clinical examination.¹⁴ For examination of the oral cavity, the patient is advised to take images of the oral hard and soft tissues at different views so that the dentist can visualise any dental pathology. Additionally, if any radiological data is available, it is shared with the dentist through electronic health records.¹⁴

Effective communication plays a key role in the work dynamics of tele-dentistry.¹⁴ To achieve this aim, there are various technologies available for communication purposes. The most common technologies used are web-based videoconferencing applications and smartphone-based applications.¹ Smartphone technology has

improved significantly in recent times, due to their portability and ease of access.¹⁵ Furthermore, these user-friendly smartphones have in-built options of taking images with adequate background light and image storage options.¹ Also, patients showed high level co-operation for intra-oral image acquisition via smartphones.¹⁶ Recent studies have demonstrated that children are much more co-operative while acquiring an image using a smartphone-based tele-health application as compared to physical oral examination.¹⁶ Various smartphone-based applications have been introduced (Mouth Watch, Dentulu, Teledent etc.) which have made the delivery of tele-dentistry easy and efficient.¹⁵

In this digital era, modern medicine is witnessing a revolution as it explores the concept of Artificial Intelligence (AI) for clinical decision making processes.¹⁷ Recently, a combination of AI knowledge-based algorithms and tele-dentistry was introduced which allowed safe dental tele-consultations for patients during the COVID-19 pandemic.¹⁸ One such innovative tool, Dental Monitoring (Dental Mind, Paris, France), is exclusively designed for patients undergoing orthodontic treatment.¹⁸ This AI based tool enables the clinician to monitor the patient progress through intra-oral pictures taken by a "ScanBox" attached to a smartphone device.¹⁸

Utilizing Tele-dentistry in COVID-19

The recent outbreak of novel coronavirus (SARS-CoV-2) has emphasized the practitioners to ensure the

maintenance of Standard Operating Procedures (SOPs) by ensuring social distancing, Personal Protective Equipment (PPE), disinfection protocols and negative pressure in dental operatories before resuming regular practice.¹⁹ In order to reduce the risk of virus transmission, the routine dental care shifted towards handling emergency appointments only.²⁰ In a study by Parker and Chia¹², they introduced the use of video-consultations for orthodontic care of patients during the COVID-19 pandemic and reported high levels of patient satisfaction.¹² These challenging circumstances further reinforced the importance of remotely monitoring patients for dental emergencies and routine dental care.¹² Thus, the use of tele-dentistry should be encouraged keeping in view the current crisis faced by clinicians.¹² Hence, the following section explores the role of tele-dentistry in the COVID-19 pandemic era.

Tele-Triage

In March 2020, American Dental Association (ADA) issued a consensus statement which guides practitioners in the identification of dental emergencies, allowing effective triage and subsequent management as summarized in Figure 2. Tele-triage demonstrated to be an effective tool while handling dental emergencies in the pandemic era.²⁰ The most common emergency presentation usually faced by clinicians is swelling and pain, which can be effectively managed by prescribing antibiotics and analgesics or proper referral to hospital in case of life-threatening

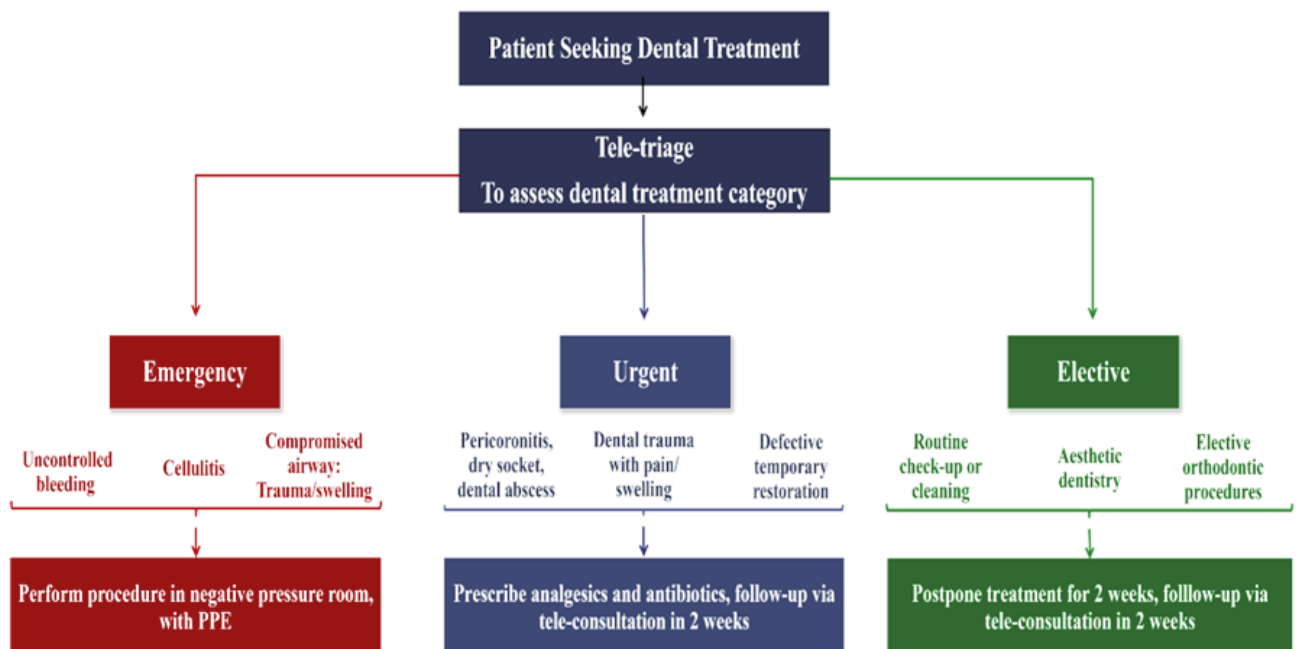


Figure-2: Algorithm for tele-triage.

infections.¹³ In a study by Ball et al, in which they evaluated the performance of a tele-consultation dental service at a secondary hospital during the COVID-19 pandemic lockdown period. They reported that most of the dental emergencies were effectively managed by providing symptomatic relief through tele-consultations, eliminating the need of physical dental visit.²⁰ The authors recognized the need for more urgent dental care services during the lockdown periods.²⁰ Several studies highlighted the effectiveness of triage through teleconsultation in minimizing unnecessary hospital encounters and thereby reducing virus exposure for both patients and practitioners.²¹⁻²³ In a study by Perelmen et al., they incorporated the American Dental Association (ADA) and Centre for Disease Control (CDC) guidelines into an algorithm for the tele-triage via teleconsultations.²²⁻²⁴ The algorithm was integrated into Electronic Health Record (EHR), allowing appropriate identification of dental emergencies and cases that require referral.²⁴ A similar result was also noted by Giudice et al. by employing photographic teleconsultations, however the guidelines followed by the authors were not reported.²⁵ It is noteworthy that pain and swelling are subjective measures for most patients and standardisation through photographs and history taking through dental professionals can add to the efficiency of triage through teleconsultations.^{24,25}

Tele-consultations

Tele-dentistry has vast applications across various disciplines of dentistry i.e. orthodontics, paediatric dentistry, preventive dentistry, oral medicine and oral pathology, periodontics and dental public health.¹

Regarding paediatric and preventive dentistry, evidence indicates that children are at higher risk of caries, dental trauma and acquiring acute oral infections.¹³ Considering the post-COVID rise in caries incidence, virtual consults can be used to explain diet modification and fluoride use, which are critical steps in reducing caries risk.²⁶ It is well established that children are more accustomed to smartphones and shows less resistance to get evaluated by intra-oral photography as opposed to a physical examination.¹⁶ Intra-oral photography has been implemented as a tool for detecting caries in recent times.²⁷ However, due to a lack of standardisation in the colour of the images, pre-cavitated lesions presenting as a grey shadow may be undetected, along with the 'white spot' lesions.²⁸ The inconsistent colour may be attributed to differences in light sources, camera resolutions, different devices and inter-operator variations.²⁹ However, owing to advancements in software and AI based algorithms, a trend towards improved caries

detection was observed in literature.²⁷ In situations of dental trauma, tele-consultations can provide adequate guidance to parents regarding replantation or storage of avulsed tooth in a proper biologic medium.¹³ Furthermore, a challenge mostly faced by clinicians during physical interaction with children in pandemic era is to gain the trust and co-operation of children, who tends to be even more frightened at the sight of PPE.³⁰ Interestingly, a virtual behavioural therapy alternative to cognitive therapy has shown to be effective as highlighted by Shahnawaz et al.³¹ Moreover, the use of interactive virtual 'waiting rooms' prior to a dental consult have been suggested, using music and animations to reinforce oral hygiene in a child-friendly manner.²⁶

The evolution of tele-consultation questions the efficiency of current referral systems in oral medicine, as highlighted by Brickley et al.³² Studies by Fonesca et al. and Wood et al. indicate that pre-surgical assessment through teleconsultations can be as effective as real time consultations.^{33,34} In their study, Carrard et al developed a tele-consultation software EstomatoNet, for the tele-diagnosis of oral lesions. They concluded that specialist's referral for oral lesions were reduced from 96% to 35%.³⁵ Moreover, in a study by Lyu et al. suggested the use of a smartphone application (WeChat) as an effective alternative for follow-up visits in patients with head and neck tumours, who are advised to limit hospital encounters during the pandemic.³⁶ Hence tele-consultation for oral lesions proved to be a reasonable alternative to physical appointments in these uncertain times.

Regular monitoring and follow-ups of patients can be effectively managed by tele-consultation during the pandemic. In a pilot study by Giudice et al. concluded that tele-consultations can be utilized for distant monitoring and check-ups of patient leading to low financial burden and less waiting times for the patients.²⁵

Challenges to Tele-dentistry

Although tele-dentistry has proved to be an efficient tool for the clinicians to provide dental care to the patients remotely, there are certain challenges faced by both the clinician and patients. As the clinician depends on digital images to assess the patient, there is always a risk of misinterpretation that may steer the clinician towards an inaccurate diagnosis.³⁷ Quality of the digital data shared during tele-consultation is dependent on the quality of equipment possessed by both the clinician and patient.³⁸ For these reasons, informed consent should be taken prior to the start of tele-consultation. Additionally, there are medico-legal concerns associated with tele-dentistry such as sharing of digital data, credentialing, state

licensure, confidentiality, and malpractice.¹³ These medico-legal concerns arise, due to lack of properly defined standard protocols for data sharing.¹³ As tele-dentistry is based on internet based communication, distant tele-consultation can be possibly done without any geographical limitation. This poses a legal concern in those regions where the dentist is not authorized to practice.³⁹ Tele-consultation is a time-consuming process as the clinicians have limited training and exposure to these digital technologies. This increases time taken as compared to a physical dental visit.¹⁴ Despite numerous benefits, clinicians are hesitant to incorporate tele-dentistry in routine practice. This under utilization can be attributed to the fact that the clinicians are not well-trained and having limited telehealth experience.⁴⁰

Conclusion

Tele-dentistry is an innovative tool that is under-utilised by the dental community. The emergence of COVID-19 presented a unique set of challenges to dentists for providing routine dental care to patients. However, these challenges can be effectively tackled by incorporating novel technological advancements such as providing tele-consultations using a digital platform or using artificial intelligence-based applications to detect oral diseases. Furthermore, it is imperative to familiarise the dentists with these novel technologies, so that tools can be explored in terms of providing better care to the patient in times of health-crisis. Also, the legislative authorities should take necessary steps to make standardisation in order to ensure the safety and confidentiality of patients' information while using these digital platforms.

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