



## Access to Oral Health through Tele Dentistry -A Review

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### Abstract

Dental professional and the patient, when situated at distant places, it is really difficult to provide dental care. Tele dentistry (TD) offers accessibility in such situations through messaging, emails with attached photographs and videos, video calls and video conferencing. Tele dentistry avoids the need for making a visit personally and can efficiently get or give an advice. Identifying serious conditions like oral cancer through tele dentistry can avoid serious repercussions in one's life. Patients can get timely advice, diagnosis and preliminary treatment without leaving their own houses. Patients living in remote areas which are underserved by professionals can get professional attention because of the implementation of TD which is a good solution for the shortage of qualified professionals. Time and money are greatly conserved through TD. This review briefly narrates the different speciality areas where TD is put into practice.

**Keywords:** Telemedicine; Teledentistry; Remote Patient; Video Conferencing; Technological Support for Tele Dentistry

### Introduction

Delivering health care and medical education to remote places necessitated the introduction of telecommunication systems and the specialty of 'telemedicine' got initiated. Tele dentistry is an important component of tele medicine or tele health. Tele dentistry projects were first launched in 1994 with the initiative of US military to serve their troops all over the world. After obtaining government approval, the Minnesota school of dentistry with its specialists, other dentists and patients situated in very remote areas established a tele dentistry network. Development of tele dentistry was slower when compared to other health care specialties. With Covid-19 pandemic, face to face communication with patients and students had to be avoided and hence advanced telecommunication technology had to be implemented. As a result, the following services were made available viz. tele-consultation, tele-diagnosis, tele-treatment, tele-monitoring, tele-education, tele-training and tele-administration. Presently all the specialities of dentistry make

use of tele-dentistry services. In the earlier days tele dentistry was synonymous with video conferencing [1,2]

In tele dentistry, patient care and education can be given in synchronous and asynchronous modes. The former mode uses a live video session between general dentist and specialist, dentist and patient or teacher and student. In the latter, recorded health information like photographs, radiographs, video, digital impressions, photomicrographs and power point presentations can be sent to a dental professional through an electronic communication system. Remote patient monitoring and mobile health services were included as two modes of tele dentistry by the American Dental Association. Online video consultations are getting more acceptable to both the health care giver and the patients. Online classes are not considered to be very effective because of the long uninteresting didactic sessions and the freedom students get to move away from the sessions without getting noticed. Tele dentistry is very useful in

monitoring patients, collecting data and transmitting them to the dentist or a specialist who are remotely situated [3-5]. (Figure 1)



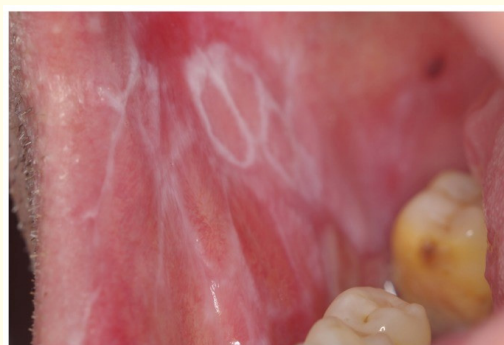
**Figure 1:** Video consultation.

### Technological support for tele dentistry

The simplest technology which was popular two decades ago was taking photographs with a reasonably good digital camera and sending them to the expert via email. Procuring a camera, learning the basics of photography, training an assistant to take photographs were factors that deterred general dentist from tele dentistry. Once the mobile phones and tablets got upgraded and the transmission was simplified with WhatsApp, dentists started seeking opinion from the specialist quite frequently. Smart phones with zoom facility and flashes can make good quality pictures which are accepted even by scientific journals. Intra oral cameras can get extreme close-up shots of single tooth surfaces but sextant, quadrant or full arch pictures are not possible with intra oral cameras. A smart camera, a set of cheek retractors and intra oral mirrors can get reasonably good quality photographs. With WhatsApp video calls video consultation is possible. Video conferencing applications can improve the quality of video images. Storage of images and videos in the cloud is a method to handle large quantity of images. Many tele dentistry apps are available with google play store and apple app store under the categories of patient education, dentist appointment, under graduate, post graduate and general dentists and for kids. Tele dentistry, smile mate, teledentix and dento control are some of the apps available in the app stores [6-9].

### Diagnostic applications

A major concern in oral health is the delayed diagnosis of oral cancer. Tele dentistry aids in the early detection of oral cancer. Patients get professional help because of enhanced accessibility through tele dentistry. Many specialists can be involved in the diagnostic process and hence the precision of remote diagnosis can be improved. Professional accessibility even though remote, improves the confidence of the patient because the anxiety is relieved greatly and unnecessary referrals are avoided (Figure 2).



**Figure 2:** White lesion on the cheek.

Tele dentistry was generally well accepted by patients with trauma, salivary gland disorders and head and neck cancers whereas the lowest acceptance was found in patients with temporomandibular joint disorder. Concerning how dentists and clinicians perceive tele dentistry, most of the dentists were happy with it. However, some of them expressed concern about its effectiveness because of the inability to perform physical examinations which can lead to an incomplete diagnosis [10].

### Application in Orthodontics

In orthodontics, because of the advanced technology and convenience tele dentistry is being adopted as a means of consulting and monitoring a patient. Tele dentistry (TD) has not completely eliminated the need for personalised clinical care. TD can be used for preliminary orthodontic consultations; reviewing; explaining, diagnosis and treatment planning; monitoring and aligning; evaluating maxillary expanders, functional appliances, clear aligners, and removable appliances; explaining and checking patient cooperation with the elastic use; and guiding parents with minor emergencies that can be handled at home. In addition, online checkups are more time-saving and economically appealing to both clinicians and patients. Currently used virtual communication technology in orthodontics include virtual consultation, orthodontic review of the patient's self-loaded dental/smile photos and artificial intelligence (AI)-assisted treatment monitoring with photos or videos taken by the patients. It would be wise on the part of the dentist to modify informed consent forms to include TD for all the patients [11,12] (Figure 3,4,4a). Practitioners do endorse TD in orthodontic practise in order to decide on referrals to a specialist.

### Application in Endodontics

Endodontic care can be extended to underprivileged patients through the use of TD. It can be used to recognize root canal orifices from a distance. Highly trained endodontists can help general dentists in the identification of root canal orifices by providing guidance and instruction over the telephone after watching videos or photographs. Tele dentistry, which utilizes the internet as a communication medium, has proven to be effective in the diagnosis



Figure 3: Monitoring system in Orthodontics.



Figure 4: Dental monitoring.



Figure 4a: Grin scope.

of periapical lesions of the anterior teeth. It has the dual benefit of lowering the costs associated with long-distance visits and increasing the accessibility of emergency assistance [13,14] (Figure 5).

**Paedodontics and tele dentistry**

Pediatric dentists can use the technological developments in tele dentistry to serve their patients and encourage better oral hy-



Figure 5: Lesions appearing in radiographs discussed.

giene habits. Preventive counselling can be given over the phone to initiate treatment regimens. Over the telephone or through email, dietary charts can be sent or provided in advance and introducing patients to online dental hygiene resources is possible. Some paediatric patients could be sent to a pedodontist for delayed tooth eruption or tooth exfoliation [15,16] (Figure 6).

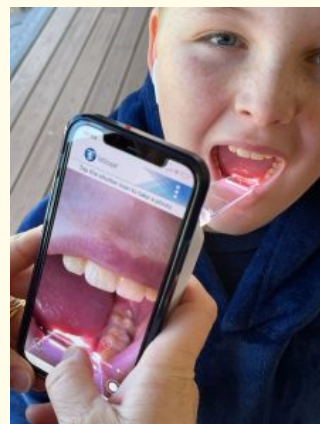


Figure 6: Paediatric consultation through tele dentistry.

**Prosthodontics and tele dentistry**

In Prosthodontics there are a wide variety of applications successfully employed through tele dentistry. Dental implant treatment planning has almost become digital with the careful integration of computerised tomography. CT is done in one clinic, evaluated by the specialist sitting remotely, surgical templates are fabricated in the lab and sent to the clinic. In fixed prosthodontics, impressions are a technique of the past and impression materials are almost disappearing from the clinics. CAD/CAM assisted fabrications are almost done through tele communication. Previously casts were the first step in the fabrication of a prosthesis, but now it has become optional and made in the post fabrication phase and that too if the dentist insists on it. Prosthodontics has really caught up with tele dentistry (Figure 7-10).

**Advantages of tele dentistry**

Tele dentistry is advantageous to the patients that in an emergency, they can contact the dentist directly from a remote location. Dentist can evaluate the problem in detail, prior to visit to a



Figure 7: 3D digital dental record.



Figure 10: Implant surgical guide.

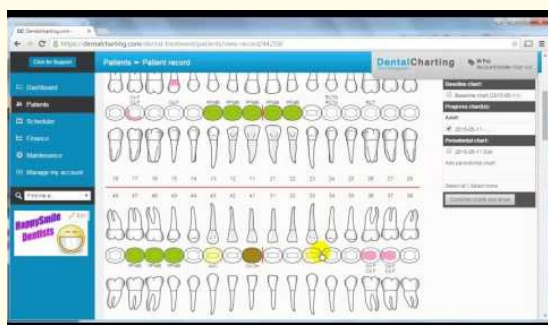


Figure 7a: Digital patient record.



Figure 8: 3D printed model.



Figure 9: 3D printed models.

hospital or clinic. Consequently, there is less need for travel and a shorter wait time in dental offices. Tele dentistry is less expensive than face-to-face dental care without compromising the quality of service. Patients get an option to select a dentist based on their requirement and choice. Without moving away from their homes, patients get an opportunity to get a second opinion from a spe-

cialist who is geographically situated in a far-off place. Dentists are also benefitted that they can attend on more patients because of the possibilities of electronic communication [17].

### Discussion

Dentist and the patient make the contact through virtual media and based on the information collected, treatment is planned or advises are given. Credentials of the dentist can be ascertained by the patient and at the same time patient should also cooperate by providing a true picture of the ailment and should give photographs, videos and radiographs if asked for. Limitations are experienced on internet accessibility, image quality, the ability to connect to the software, ability to give interactions in video consultations, proper light arrangement, manual dexterity and acquaintance with mobile/tablet devices. Both the dentist and the patient should be realistic in their expectations in assessing extraoral and intraoral swellings, grossly carious teeth, soft tissue lesions, mobile teeth, fractured prosthesis and orthodontic emergencies.

In nearly 40% of situations, intra oral and extra oral digital cameras were put into use. 5% of tele dentistry practitioners make use of mobile phones with success. Decayed and filled dental surface was detected with 94-100% accuracy. In the area of diagnosis and treatment planning the accuracy obtained was in the range of 81-88% [18,19]. The success of TD depended greatly on the image quality; the resolution of the image and the colour reproduction [20].

Tele dentistry was introduced in India during the Covid time but it has not become very popular afterwards except in a few specialties. Both the dentist and the patients did not accept it whole heartedly. Governmental systems also did not promote much because conventional facilities were available. Tele dentistry has to be promoted in areas where dentist accessibility is limited and it has to be linked with government clinics. Patients who remain inside their homes because of health reasons can now obtain dental consultations and treatments with the simple press of a phone button, thanks to the advent of tele dentistry. When natural calamities like

floods and earth quakes occur, tele dentistry will be a great boon. Challenges such as limitations in providing hands on treatment, privacy concerns and regulatory issues are some of the challenges TD has to address.

### Future

Artificial intelligence can be carefully integrated to tele dentistry to reduce human error and to improve the quality-of-care delivered at a distance. The level of digital literacy amongst the dental professionals and patients should be improved through appropriately designed training programmes. The technology of tele dentistry should be made affordable and user friendly to enhance popularity amongst the concerned professionals. In the educational field, tele dentistry has already become popular and which is going to continue. In the future, world tele dentistry has an unavoidable role.

### Conclusion

TD finds suitable and relevant applications in all specialities of dentistry. TD found applications more effectively, first in the laboratory operations followed by clinical situations. In largely populated countries, TD is a good solution for the dearth of professionals and for the people who suffer from financial restrictions.

### Author Contributions

*Conceptualization*-K. Chandrasekharan Nair, *Review of articles*-Pradeep Dathan, K.Chandrasekharan Nair; *Initial draft preparation*: Lovely Annamma, Bheemalingeswara Rao; *Review and editing*- K. Chandrasekharan Nair, Pradeep Dathan; *Supervision* – K.Chandrasekharan Nair. All authors have read and agreed to the published version of the manuscript.

### Conflict of Interest

The authors have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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### Figure credits

Fig 1. <https://www.dentalclinicdelhi.com/blog/tele-dentistry-a-game-changer-in-covid-times>

Fig 2,3. <https://www.clonmelorthodontist.ie/what-is-teledentistry/>

Fig 4. White lesion - <https://www.panafrican-med-journal.com/images-in-medicine>

Fig 4a. - <https://trueocity.com/products/grin-dental-scanner-with-complimentary-consultation->

Radiographs: <https://endopracticeus.com/endodontic-diagnoses-and-treatment-plan-formulations-performed-by-general-dentists>

Fig 5: <https://thedoctorweighsin.com/teledentistry-dental-practice/>

Fig 6: <https://www.wadingriverpediatricdentistry.com/teledentistry/>

Fig 7, 7a: <https://www.youtube.com/watch?v=aQwxx9ZzuPc>

Fig 8. <https://luxcreo.com/four-features-of-the-best-3d-printer-for-dental-models/>

Fig 9. <https://oceanbreezeprosthodontics.com/digital-dentistry-delray/digital-implant-surgical-guides/>

Fig 10. <https://www.lafonddesjardins.com/en/products/virtual-occlusion>