



Relevance of Teledentistry: Brief Report and Future Perspectives

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Article Info

Article type:
Review Article

Article History:

Received: 22 Jan 2022
Accepted: 15 Jul 2022
Published: 5 Aug 2022

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ABSTRACT

Teledentistry is a type of telemedicine and telehealth that aims to make all major specialties of the discipline easier through a remote approach to prevention and treatment of oral and dental issues. This new method enables distant access to individuals instead of direct, face-to-face, doctor-patient contact and has been made possible thanks to developments in information technology. Teledentistry was described in 1997 as "... the practice of using video-conferencing technologies to diagnose and provide advice about treatment over a distance", and today it represents a modern way to practice dentistry by integrating digital imaging, electronics, health records, and telecommunications technology via an internet connection. This approach facilitates patients' access to care in remote settings and also enables specialists at distant locations to arrive at a correct diagnosis as well as to propose proper therapy or refer patients, where warranted. The current brief report aims to describe the present and future of this modern approach in dentistry and its advantages in patient management from prevention to diagnosis to treatment.

Keywords: Telemedicine; Telecommunications; Digital Technology; Dentistry

- **Cite this article as:** Fornaini C, Rocca JP. Relevance of Teledentistry: Brief Report and Future Perspectives. *Front Dent.* 2022;19:25.

INTRODUCTION

Teledentistry (TD) is a telemedicine and telehealth subunit that aims to make easier, through a remote approach, both prevention and treatment in the main dental specialties.

This new way to manage dentistry is now possible thanks to the utilization of computer science instead of direct, face-to-face doctor-patient interaction [1].

The first project of TD, conducted in 1994 in Georgia by the US Army, consisted in the management of an intra-oral camera connected to a modem, able to transmit color images of a patient's mouth to a distance of 120 miles [2]. Cook in 1997 described TD as "... the practice of using video-conferencing technologies to diagnose and provide advice about treatment over a distance" [3].

TD today represents a modern way to manage

dentistry by integrating digital imaging, electronics, health records, and telecommunications technology via an Internet connection, allowing patients access to care in remote settings and also enabling the distant specialist to establish a correct diagnosis as well as to propose the proper therapy, and where warranted to refer patients difficult to see [4].

The COVID 19 pandemic has dramatically and radically changed every medical clinical practice, due to the need to limit, or where possible to eliminate, physician-patient contact and also to reduce hospitalization. This has pushed all researchers to discover novel modalities to manage medical care [5]. Moreover, there are several situations beyond the pandemic, where it is similarly convenient to manage a distance

consultation. Oncologic, geriatric, and special needs patients who sometimes face difficulties in coming to clinics may represent examples of these situations [6-8]. TD may also be considered a great opportunity for people living in rural areas, or for those facing difficulties in reaching a dental specialist because of the distance between their homes and the clinics [9,10].

While it is possible today to “remotely” address many types of dental clinical cases, for other different treatments also it is possible to hypothesize in the future the opportunity for total at-distance management.

TD may be performed in three different ways [11]:

- 1) Synchronous, when the interaction happens in real time,
- 2) Asynchronous, when the approach is “store and forward”, and
- 3) Mobile health care services, when mobile technology is employed.

Teleconsultation, the most common form of TD, may be achieved via applications for instant messaging by the use of apps such as Telegram, WhatsApp, SMS, Instagram, and Messenger, or by video calling apps such as Skype, Google Meet, WeChat, and Facetime.

Its advantages consist of reducing non-urgent patient referrals, [12] as well as mitigating the burden on busy health care facilities [13]. One of the first indications for TD is in the field of Oral Medicine, where it is possible, with the use of very cheap smartphones or intraoral cameras today, to send images to the specialist, enabling them to make a tentative diagnosis and decide about the need for a biopsy. As demonstrated by several works, potentially malignant oral disorders' screening performed by photo-phone-messaging may be considered an efficient way and a low-cost approach in economically disadvantaged environments. [14].

CURRENT DATA ON TELEDENTISTRY

Several studies have described patients' positive virtual consultation experiences during COVID-19. Unfortunately, today we are still missing patient experiences based on universally accepted surveys, regarding virtual consultations in dentistry, particularly

in oral medicine [15,16].

Vinayagamorthy and co-authors, in a study on 131 individuals with potentially malignant oral disorders, showed a significant concert between the diagnosis by clinical examination and that by smartphone image [17].

Sunny and colleagues examined efficacy and utility, from the clinic point of view, of a tele-cytology system combined with an artificial model in the early diagnosis of potentially malignant and malignant oral lesions. The tele-cytology platform (CellScope) showed an accuracy of 85% which compares favorably with that of conventional cytology, thus confirming its reliability for the remote screening of potentially malignant and malignant lesions [18].

It will be also possible to do research on particular salivary biomarkers, using smartphone-based mobile digital PCR devices which easily permit to transform tablets and smartphones into a chemical laboratory [19].

TD may have significant accuracy for the early screening of caries in children, as described by the study of AlShaya and colleagues who studied mobile TD diagnosis without using radiographs in children with dental decay; the results showed a greater sensitivity of the TD approach in dental caries diagnosis [20].

The University of Rochester's Eastman Institute for Oral Health (EIOH) carried out a large number of projects exploring the reliability of synchronous and asynchronous TD in oral disease screening and diagnosis. The first pilot project was performed in 2004, to estimate the suitability of asynchronous TD in preschool children's dental caries screening. All the subjects first underwent a face-to-face check and then a TD imaging evaluation by an assistant. Two weeks after, the images collected through TD examination were examined by the first operator for determining the presence of decay. The quality of the TD diagnosis was established by comparing the face-to face examination results to the images obtained by the camera, and 100% sensitivity and 81% specificity were reported, without any difference between asynchronous TD observation and the face-to face evaluation performed by the

dentist. This study represented the clinical demonstration of the possibility of TD being a substitute for the in-person visual/tactile check by a dentist or dental hygienist [21]. A recent research at Newcastle Dental Hospital's Paediatric Dentistry New Patient Service has shown that TD may be employed in many steps of pediatric dentistry, including initial triage, remote assessment, reinforcement of prevention, implementing initial management, and building rapport, with maximum safety and minimal inconvenience for both child and parents [22]. Several other works show that TD consultation inserted into the standard day hospital protocol provided to patients with eating disorders is convenient, more so for particular pathologies' screening and for dental erosion prevention [23].

DISCUSSION

In conservative dentistry, remineralization treatment today gets the opportunity to be non-invasive, and it is being used more and more as a "minimal intervention treatment" for the management of early enamel decay: a solution of 38% Silver Diamine Fluoride (SDF) seems to offer an incisive treatment for decay arrest. [24]. Thus, it is possible to hypothesize that the treatment of small carious lesions may be performed "at-home" by SDF application supervised by a remote follow-up.

The term "teleorthodontics", coined by Squires, indicates a low-cost way to manage orthodontic treatment; it may help to reduce expenses, such as transferring for direct consultation with the specialist, and it also represents a great help for general dentists in screening and appropriately referring potential candidates for future orthodontic treatment [25]. Teleorthodontics makes possible the "at home" monitoring of teeth movement and treatment sequence by imaging technology performed with a smartphone device. Particularly in case of aligner treatment, it enables the patient to autonomously progress through aligner trays; this may reduce the number of "in office" visits and so help orthodontists to supervise treatment with patients even at home [26].

Salazar-Fernandez and colleagues performed

a non-randomized multicenter work to study the clinical efficacy of a "store-and-forward TD system" (SFTMS) in the treatment of patients with temporomandibular joint disorders (TMJD). The authors analyzed the behavior of SFTMS comparing it to traditional examination in patients with TMJD: they found similar reliability for both consultation systems, while achieving a significant reduction of waiting-times through SFTMS. Their conclusion underlined the most relevant advantages of the SFTMS, consisting in the reduction of lost working time for patients as well as the low cost, which is particularly interesting for patients living far from the care center [27]. The TMJD remote diagnosis may have more interesting results when coupled with the "at home photobiomodulation" which allows patients to carry out treatment by themselves through the use of the smart laser devices which have appeared recently in the market [28].

The main limitations which make it difficult to popularize TD in routine dental practice are the same as described for Telemedicine; these include a lack of consumer awareness, often associated with patient education level and age, efficiency and cost of the required equipment, lack of clarity regarding reimbursement, and confidentiality and security of the data [29].

Moreover, physicians have described some constraints regarding infrastructure, such as poor access to the Internet, hardware shortage, and TD's organizational incompatibility with healthcare systems, insufficient financial support, difficulties in securing cooperation from remote centers, inadequate guidelines, and the costs involved in the installation [30]. Resistance to new technologies, poor information literacy, and insufficient training among operators are further barriers encountered by the dentists [31].

The main barriers to change within a healthcare setting include increased workload, inadequate staff commitment and their attitude towards the intervention, and lack of support and training [32].

A great help to overcoming these barriers may consist in a user friendly, time-efficient, and

uncomplicated clinical mailbox: the use of email templates containing the hyperlinks to each digital information leaflet allows clinicians to “personalize” each patient’s email in an efficient manner by deleting the not-pertinent information [33]. Many software applications have been suggested, some of them requiring the use of complex devices for communication and others requiring the use of only a smartphone, and yet others combining a smartphone plus a tool able to correctly capture the images sent to the clinician. Very interesting among these is DentalMonitoring®, a scan box employed in a considerable number of private clinics, which makes possible remote patient control by the utilization of a smartphone and a device for correctly uploading the pictures; moreover, this software can send to the clinician useful information about the case [11].

FUTURE PERSPECTIVES AND CONCLUSIONS

A work published in 2020 described the first intervention remotely performed in Italy using a robot connected to a 5G network [34]: it consisted of a transoral laser microsurgery procedure on a cadaver. The corpse was located 15 km away from the anatomy laboratory, where the surgeon removed a polyp artificially grafted onto the body’s vocal cords, and two-way data transmission linking both ends of the system (the robot surgeon and the human surgeon) was provided by an experimental 5G network [35].

A recent paper reported the results of 12 spinal telesurgeries performed in China via a 5G network: by 12 different operations, the surgeons implanted 62 pedicle screws, without any intraoperative complications. This further proves the promising nature of applying 5G technology to telesurgery [36]. Thus, it is reasonable to think that TD has to date, expressed only a small part of its true potential, and that in the near future most of the dental treatments will be able to be performed remotely. Unfortunately, while a great number of works has established the effectiveness of TD regarding oral malignancies [37], orofacial pain [38] and MRONJ diagnosis [39], management of patients with temporo-

mandibular disorders [40] and oral surgery follow-up [41,42], there is a full lack of reports describing dental interventions performed remotely. Contrary to general surgery, no devices for this kind of practice have been developed and a great effort will be necessary for realizing technologic instruments as well as to create a new mindset among the practitioners. The next generation of dentists will in fact have new tools in the form of information networks and simulations that allow remote transference of skills. An ability to think through and work with these technologies at all education levels will determine the continued growth and direction of digital healthcare [43].

Patient acceptance of TD is one very important factor which may influence its success; in fact, lack of face-to-face communication may increase patients’ apprehension about proper and adequate communication of their problems to the dentist. Even if these challenges will take time to overcome, acceptability by patients of telemedicine in general, and TD in particular, is likely to increase day-by-day; in fact, a great number of surveys show that TD is gradually gaining acceptance among patients as well as healthcare providers [44,45]. As such, TD may be considered the future of oral health and great open-mindedness will be required in doctors, patients, and dental companies to catch this important opportunity to be able to fully change the way oral treatments are performed.

CONFLICT OF INTEREST STATEMENT

Authors declare they have no conflicts of interest.

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