

Teledentistry: Past, Present, Future

Mini Review Article

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Abstract

Teleodontology or Teledentistry is the use of telecommunication and information technology to provide both care and education in the dental field at a distance. It involves the use of remote monitoring, video conferencing and other digital communication tools to enable dentists and other health professionals to consult and treat patients who are not physically present in the clinic. The aim of this mini review is to establish the most frequent indications for the use of Teleodontology, as well its accuracy and perception from both health professionals and patients' point of view. We analyzed articles related to Teledentistry, its applications and exponential rise during and after Covid-19 pandemic.

In recent years, Teledentistry has grown in popularity, especially in places with limited access to dental care. It has shown to be a successful strategy for increasing access to dental care for underserved populations, enhancing patient outcomes, and lowering the price of conventional dental care. However, nowadays, Teledentistry is not unanimously accepted, especially by some patients who question the confidentiality of their personal information and who also do not feel comfortable or overwhelmed by the new technologies. Nevertheless, technologies and their security systems are also evolving rapidly and are becoming more and more efficient, with the primary aim of patient comfort and confidence. It is therefore recommended in some cases to combine the Teledentistry with a more conventional consultation.

Keywords: Dentistry; Teledentistry; Teleodontology; Information Technology

Mini Review

Teleodontology, also called Teledentistry, is an exchange of clinical information and images. It combines telecommunication and dentistry for dental consultations and treatment planning over vast distances. In 1989, it's the first time this concept appears during the conference in Baltimore, for dental informatics and their efficacy in the delivery of oral health care in dental practice. In 1994, Teledentistry was utilized for a military project which led to advancements in patient healthcare, dental education, and improved communication between dentists and dental laboratories. The U.S. army, tried to manage a dental image system by using an intraoral camera in a way to obtain color images of

the patient's mouth and transmit them to a dental clinic situated over a distance of 120 miles. In 1997, Cook defined Teledentistry as "the practice of using video-conferencing technologies to diagnose and to provide advice about the treatment over a distance". For many authors, this new way of telecommunication will fundamentally change the future of oral health and dental practices [1-3].

Nowadays, according to WHO, the World Health Organization, Teledentistry can be defined as "The delivery of health-care services, where distance is a critical factor, by all health-care professionals using information and communications technologies for the exchange of valid information for treatment and prevention of disease and injur-



ies, research and evaluation, and the continuing education of health-care workers, with the aim of advancing the health of individuals and communities” [4].

How does Teledentistry work?

Teledentistry works by using various communication technologies to connect dentists and patients remotely. Here's how it typically works:

- a. Initial consultation: The patient contacts a dental provider to request a teledentistry appointment. The provider may ask the patient to fill out a questionnaire or provide some basic information about their oral health and medical history [5].
- b. Video conferencing: The healthcare provider arranges a virtual video conference with the patient via a secure platform that meets the HIPAA regulations. Compliance with HIPAA regulations means following the deadlines set forth in the Health Insurance Portability and Accountability Act (HIPAA) of 1996, which establish national standards for safeguarding individuals' medical information, also referred to as protected health information (PHI) [6]. During the conference, the dentist may ask the patient to show them their mouth or teeth using a handheld camera or a special dental camera [5,7].
- c. Diagnosis and treatment planning: Based on the information gathered during the video conference, the dentist can diagnose the patient's condition and recommend an appropriate treatment plan. The dentist may also prescribe medication or refer the patient to a specialist if needed [5,7].
- d. Follow-up and monitoring: The dentist might arrange subsequent visits to keep track of the patient's development and modify the treatment strategy if needed. The patient can also use teledentistry to ask questions, receive education on oral health, or get advice on maintaining good oral hygiene [5,7].

Indeed, teledentistry provides a convenient and effective way for patients to receive dental care from the comfort of their homes, especially in areas where dental services may be limited or inaccessible. It also allows dentists to reach a wider patient population and provide care more efficiently [1,5].

Teledentistry can be categorized in two approaches: Real-time consultation and Store-and-Forward method. Real-time consultation refers to a live, interactive video conference between the dental provider and the patient. This method enables the dental provider to inquire about the patient's condition, examine their teeth and mouth, and provide instant feedback and guidance. Real-time consultation is beneficial for addressing urgent dental problems and conducting routine check-ups and consultations [1,8].

Store-and-forward method: Store-and-forward method involves capturing and transmitting digital images or other data to the dental provider for later review and diagnosis. This approach is sometimes referred to as “asynchronous” telemedicine because the dental provider and patient do not interact in real-time. Instead, the patient takes pictures or videos of their teeth or mouth and submits them electronically to the dental provider, who reviews them at a later time. The dental provider may then provide a diagnosis and treatment plan remotely [1,8].

In fact, the key difference between real-time consultation and store-and-forward methods is the timing of the interaction between the dental provider and the patient. Real-time consultation provides immediate feedback and allows for a more interactive and personalized experience, while the store-and-forward method is more flexible and allows for greater convenience and access to care. Both real-time consultation and store-and-forward methods have their advantages and disadvantages, and the choice of which approach to use will depend on the specific needs of the patient and the dental provider [1,8].

Teledentistry relies on various technologies to enable remote communication and collaboration between dentists and patients [9].

Some of the information and communication technologies (ICT) used in teledentistry, include:

Video conferencing: This technology allows dentists and patients to communicate in real-time using video and audio, much like an in-person consultation. Video conferencing platforms like Zoom, Skype, and WebEx are commonly used for teledentistry appointments [1]. Mouth watch is one of them and a special teledentistry platform that offers a range of tools for dental providers, including intraoral cameras, digital imaging software, and teleconsultation capabilities. Mouth watch is HIPAA-compliant and can be integrated with a variety of dental practice management software programs [7,10].

Digital imaging: Specialized cameras and scanners can capture high-quality images of a patient's teeth and mouth, which can then be shared electronically with dentists and other dental professionals for diagnosis and treatment planning. There are different types of cameras that are used in teledentistry to capture images of a patient's teeth and mouth. Some of the most used cameras are the following:

- a. Intraoral cameras: These are small cameras that can be inserted into a patient's mouth to capture high-quality images of their teeth and gums. Intraoral cameras are designed to be lightweight and easy to maneuver, allowing dentists to capture detailed images of a patient's oral cavity from multiple angles [1,8,11].
- b. Digital cameras: Digital cameras are also used in teledentistry to capture images of a patient's teeth and mouth. These cameras can be either handheld or attached to a tripod, and they can capture high-resolution images that can be shared electronically with dental providers [7,11,12].
- c. Panoramic X-ray machines: Panoramic X-ray machines are specialized cameras that capture a panoramic view of a patient's teeth and jaw. These machines are commonly used to diagnose complex oral health issues and plan dental treatments [12].
- d. CBCT scanners: Cone beam computed tomography (CBCT) scanners employ a cone-shaped X-Ray beam to acquire three-dimensional images of a patient's teeth, jaw, and adjacent structures, making them highly sophisticated imaging equipment. CBCT scanners are commonly used in implant dentistry and other complex dental procedures [12].

The type of camera used in teledentistry will depend on the specific needs of the patient and the dental provider. Intraoral cameras and digital cameras are often used for routine check-ups and consultations, while panoramic X-ray machines and CBCT scanners are typically used for more complex diagnostic procedures [1, 7, 8, 11, 12].

- i. Electronic health records: Electronic health records (EHRs) allow dentists to access a patient's medical history, treatment records, and other important information remotely. This enables them to make informed decisions about patient care even when they are not physically present in the same location as the patient [5].

- ii. Remote monitoring: Teledentistry can also involve remote monitoring of a patient's oral health using sensors and other monitoring devices. For example, a patient might wear a smart device that tracks their brushing habits and sends that data to their dentist for analysis [5,7].

- iii. Mobile apps: There are a variety of mobile apps available that can help patients manage their oral health remotely. Some apps provide educational resources on oral hygiene, while others allow patients to track their symptoms or connect with a dental provider for a virtual consultation [5].

In 2019, Teledentistry is experiencing a major boom with the arrival of a global pandemic. Covid-19 has radically changed the daily lives of people and the medical world, especially dentists and oral specialists. Effectively, because of its high power of contagiousness and morbidity, this virus became the greatest concern during December 2019. This



virus can be lethal when it evolves in interstitial pneumonia, thus procedures involving droplets like any restorative procedures or a simple dental prophylaxis put the dental and team workers at a high risk of infection and contamination. Thereby new personal protective equipment (PPE) made their apparition in order to decrease the risk of contamination and propagation of the virus. Dental treatments become a risk for the dental practitioners and assistants but also for the patient. Despite an adaptation of sanitary and hygienic methods such as social distancing, quarantine, only urgent treatment and producing systemic symptoms are treated as a priority. Any other treatment is delayed and suspended until the global health situation has evolved and stabilized. Thereby Teleodontology is growing rapidly, allowing for long-distance dental care and advice, this helps to mitigate the risk of COVID-19 transmission [13].

After the pandemic, even if the risk of the Mondial contamination has considerably decreased, the preventive and protective measures are kept in place for the sanitary protection of both the patient and the dentist. Improving patients' access to professional advice and minimizing healthcare disparities are ones of the most important considerations of Teledentistry. It allows patients to have an easier access to diagnosis and management of their oral health concerns. The treatment duration is shortened without affecting the quality of it and thereby the waiting times are also reduced. Effectively, a reduction of dental cost was observed, and more complete information were offered for deeper dental analysis, even in distant rural areas [1-3].

Teledentistry can be applied in many specialties in dentistry such as in Oral and Maxillofacial Surgery in which oral surgeons can make a faster and easier diagnosis during orofacial emergencies such as Ludwig's angina, necrotizing fasciitis or pathologies related to impacted third molars. It's also facilitating the revision of the surgery and answer to any concerns that could have the patient related to his treatment. Oral malignant lesions for example can also be detected and diagnosed earlier, allowing a faster access to the treatment, increasing its safety and effectiveness [8].

In Endodontics, it can be used to help dental colleagues who live and work in rural areas, to recognize root canal orifices or periapical lesions without the need of travelling or send the patient far from where they live. Many doubts about pulp or periapical pathologies are resolved immediately and thus the patient could be treated in a shorter period of time [8]. Children also seem comfortable with this kind of new technology. It's a really an advantage for them and their parents. Through telecommunication, an easier access and a better control of oral hygiene have been observed in children. The virtual consultation doesn't force the parents to leave their job earlier and prevent children to miss class. In fact, children with high risk of caries can be advised online, with the presence of their parents, and thus allow dental professionals to improve their oral hygiene and their brushing techniques before another evaluation the following months. Thereby the oral health of pediatric patients can be controlled and monitored regularly and enable professionals to distinguish between emergency and urgency patient [2,8,14,15].

Teledentistry has been also really useful for patients following an orthodontic treatment. It is not a treatment that could be solved in only one appointment, it's a process in which we need time for the teeth to move correctly and regular checkups. By doing the orthodontic appointment online, it allows many professionals and patients, to gain time and money. During the virtual consultation, the patient should take pictures of his mouth and of his appliances to control if the teeth are displacing correctly. Teledentistry is a great tool especially when there is rubber ligature displacement, discomfort and irritations or to solve minor orthodontic emergencies [8,15].

Not only Teledentistry is really effective in the prevention and treatments for our young generation, but also with the geriatric patients. Indeed, becoming older is often accompanied by losing teeth and bone structure, and a relaxation of the muscles. Teledentistry has showed

an important impact on the older generation for who, traveling far distances is not as easy as before. Geriatric patient who opted and adapted to new technologies, have seen in most of the cases, their oral health controlled and enhanced thanks to these virtual consultations, especially in patients wearing fixed or removable prosthesis. Indeed, in prosthodontics, Teledentistry has also its effectiveness for the evaluation of supporting tissues structures, edentulous ridges, advices for the preparation of abutment teeth by the use of pictures, radiographs and diagnostic casts or answer to any concerns related to retainers' fracture. Patient with periodontal problems also found Teledentistry useful, especially after a periodontal surgery. They have appreciated the fact to be well followed up and to have the possibility to ask for any advice at any times [3,4,8].

Finally, Oral and Maxillofacial surgery, Restorative and Endodontic treatments Orthodontics, Pediatrics and Geriatrics patients are domains in which Teledentistry can be an effective and accurate tool for diagnosis or treatment planning. It also plays a key role in Dental Education, enabling students to learn and see many cases. Classified in two categories: self-instruction and interactive videoconferencing which allow health teachers to supplement their traditional teaching methods [8].

However, Teledentistry can have some limitations, some pathologies will still need a dental act and the respect of confidentiality is still discussed from an ethical point of view [16].

In a future, Teledentistry may play an important gap in oral health care system. Despite the previous applications, the innovation of technologies will allow us a better communication inter specialist, an overall reduction of the cost and finally an easiest access to dental consultations, decreasing the inequity between urban and rural zone [16,17].

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