



## Teledentistry: A Review on its Present Status and Future Perspectives

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### Abstract

Teledentistry is use of tele-communications and information technology for consultation, dental care, education and public awareness. It provides cheaper, easier and less intimidating way to associate with dentistry. Teledentistry also be useful in providing general dentists with speciality work and it improves the services to underprivileged populations i.e. rural or less developed areas. In the 1990's, videoconferencing, fax, emails and telephonic calls were used but now these days, video conferencing and high-quality image transfer now become easily accessible. Therefore, this improvement in digital camera technology provides new opportunities to the people.

**Keywords:** Teledentistry; History; Public Health; Feedback

### Introduction

Technologic innovations in the field of dentistry have been extensive in recent years [1,2]. Just as communication technology and uses of electronic information has developed over the years, terms to describe health care services at a distance, such as telehealth and telemedicine, have also evolved. Teledentistry is a combination of telecommunications and dentistry [2]. "Tele" is a Greek word meaning "distance" and "mederi" is a Latin word meaning "to heal." Teledentistry provides new opportunities for education and delivery of care that offer much potential and challenges [3,4].

### Definition

Teledentistry's roots lie in telemedicine. "Telemedicine is defined as the use of telecommunications technology to send data, graphics, audio, and video images between participants who are physically separated (i.e., at a distance from one another) for the purpose of clinical care" [2]. – by AAMC (Association of America Medical Colleges).

The term "teledentistry" was used as the practice of using video-conferencing technologies to diagnose and provide advice about treatment over a distance." - Crook 1997

### History of teledentistry

#### The Internet and broadband high-speed connections

Teledentistry is defined as only the videoconference mode of dental care. It also includes data exchange through telephone lines and fax machines, as well as exchange of computer-based documents. The corner-stones of modern teledentistry are the formation of the Internet and broadband high-speed connections, which have helped teledentistry enter a new era [4-6].

### U.S. Army project

The U.S. Army's Total Dental Access Project seen as being at the frontier of teledentistry. Teledentistry started in 1994 and this project initially used a customary plain old telephone system (POTS), with 2 different communication methods: real-time and store-and-forward. It works through telephone company with ir-

regular connections and low-speed. Higher volumes of phone use worsen this situation. As a result, video and audio signals can be severely delayed and quality sometimes is sacrificed to increase the speed.

Rocca and colleagues, 1995 conducted pilot study in Haiti to connect general dentist to dental specialist in Washington, D.C., via a low-bit-rate satellite system. The results concluded that the video quality of the tele-consultation (consisting of intraoral photographs and dental radiographs) was insufficient for accurately diagnosing most of pathological conditions.

### Integrated services digital network

Two years later, Integrated Services Digital Network (ISDN-based teledentistry) was tested in Belgium, Germany and Italy. It provides high speed and information travels in both directions, which also increases accessibility and reliability in teledentistry. Because setting up an ISDN network is very expensive (a major determinant of cost is distance in feet), it is not the ideal infrastructure for the U.S. Army's dental practice. Army dental practice must be positioned worldwide, and in the event of an emergency, the support of specialists may be needed. Establishing an international ISDN network is very impractical and expensive.

### Forms of teledentistry

- Two-way interactive or real time consultation
- Store and forward teledentistry [5].

### Two-way interactive technology or real time consultation

With the use of video-conferencing dentists and their patients can consult at different locations with advanced tele-communication technologies and ultra-high-bandwidth network connections. Eg. Dentists can consult with other dentist of particular specialization and then plan the treatment protocol accordingly. This technology allows a person at distant site to see or hear in real time images or sound occurring at an originating site [6-8].

### Store and forward Method

In store and forward, the dental practitioner collects and stores all the required clinical information, digital intraoral, extra oral images and radiographs, then forwards them for consultation via established networks [6-8].

### Teledentistry in dental education

#### Web-based self-instruction

Formal online education can be divided into two main categories: Web-based self-instruction and interactive video-conferencing.

Web-based self-instruction educational system contains information that was stored before the user accesses the program. Advantage- the user can control the pace of learning and review the material as many times as he or she wishes.<sup>6</sup> Disadvantages seen in areas of satisfaction and accuracy.

Interactive videoconferencing: (conducted via POTS, satellite, ISDN, Internet or Intranet) includes both a live interactive video-conference (with at least one camera set up where the patient's information is transmitted; however, cameras at both locations are ideal) and supportive information (such as patient's medical history, radiographs) that can be sent before or at the same time (for example, via fax) as the videoconference (with or without the patient present).<sup>8</sup> The advantage of this educational style is that the user can receive immediate feedback.

### Positive feedback

According to U.S. Army study 1990, teledentistry is a good tool for teaching postgraduate students and providing recent advancement education for dentists. In interactive video-conferencing, patient information is evaluated first, which allows for interaction and feedback between the educator and students. They received positive feedback from the participating general dentists, patients and patients' parents [8,9].

### Dental chat rooms

In addition, dental chat rooms are available through numerous dental organizations and study clubs, as well as through individual practitioners who exchange information on a variety of topics.

### Applications of teledentistry

#### Oral Medicine

Bradley M., *et al.* Proved the use of teledentistry in oral medicine in a community dental service in Belfast, N. Ireland, also working on a prototype teledentistry system. This study demonstrates that using teledentistry in the management of patients with oral mucosal disease can work successfully. It is especially suitable for management of referrals of older dependant adults who have oral mucosal disease [7].

#### Endodontics

Pulp and periapical disorders are common in day to day practice. Treatment of these disorders is not only performed by endodontist but also the general dentist. So this teledentistry provided a path to get the expert opinion for managing these disorders through a net based diagnosis, treatment plan and even the procedures [7,8].

### Orthodontics

Clinically, the use of computerized technology and presence of distant assistance in everyday work cannot be compared to any other area of dentistry. It was seen that the study casts present orthodontics makes the use of digital 2D and 3D models and all specialist analysis, measurements, and assessment of relationships are done using software to process the images.

### Oral and maxillofacial surgery

In dental surgery, it provides better diagnosis and planning of appropriate treatment solutions. Technologic development in computerized support in dental implants placement, it is possible to observe the patient in one part of the world, and in the other part make a digital project of complete implant and prosthetic construction and then route the direction for navigational technique of dental implantation [8,9].

### Dental prosthetics

CAD/CAM (computer-aided design and computer-aided manufacturing) systems are gaining priority in the manufacturing of dental crowns, dental inlays and onlays, over hand modelling and casting of prosthetic reconstructions. Computerized systems are capable of manufacturing bridges of up to three units, with satisfactory medical characteristics [9]. Teledentistry is often used in the practice of dental prosthetics in the examination of patients in order to obtain general information about the choice of prosthetic solution and gross costs of the job.

### Periodontics

Web-based tele-dentistry consultation system showed that referrals to oral surgery, prosthodontics and periodontics had the highest number of consults. 15 patients underwent periodontal surgery at Fort Gordon, Georgia, and a week later, their sutures were removed at a location 150 miles away under the tele-supervision of the Periodontist. Only 1 patient made the return-trip for a follow-up procedure.

### Pediatric and preventive dentistry

Kopycka-Kedzierawski, *et al.* in Rochester, New York have successfully performed the study of prevalence of dental caries in children using the telemedicine method and dental photographs taken with intraoral cameras and web-based storage of images [10]. These authors evaluated the net based systematic dental check-up in children, using again the transmission of digital images, have been able to get a complete insight into the status of teeth of these children, with special emphasis on early childhood caries.

### Public health dentistry

Teledentistry is a unique way to deliver long-distance clinical training and continuing education and hands-on training to the dentist/dental hygienist at remote clinics. It even facilitates patient education about self-care. It saves the time and money spent on extra appointments by the patient as the preventive and diagnostic care. It requires low technical equipments so that users at both the ends can communicate face to face. In an effort to raise the dental hygiene student's awareness concerning the public health and community health issues.

In India, Primary health centre and community health centre can be modified using equipped with teledentistry to facilitate the education and better services in the society. General dental surgeon and dental hygienists can be appointed at the sub-centres, who can provide cost-effective dental care when supported through teledentistry by specialists [12].

### Scope of Teledentistry in India

India has opened up to telemedicine to address various issues which are being faced by the healthcare delivery system, like inadequate health infrastructure and clinical services, paucity of qualified doctors, delay in the delivery of the treatment due to the greater time which is required for the transport of the patients to urban healthcare facilities [11].

To implement telemedicine technology, three premier hospitals in the northern parts of India, i.e., All India Institute of Medical Sciences (AIIMS), New Delhi, the Post Graduate Institute of Medical Education and Research (PGIMER) at Chandigarh and the Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) at Lucknow (Uttar Pradesh).

### Future prospects

- The advances in telecommunication have permitted the dental care to promise many changes during the next few years.
- There are various issues which require resolution for the success of teledentistry.
- These issues include jurisdiction, inter-state licensure and malpractice, as well as technological, security and other ethical aspects.
- The implementations of teledentistry are: The instructors of the teledentistry education courses need to be well versed with computer knowledge and they should have adequate teaching Experience.

- The practitioners who were engaged in teledentistry must have a license in each state in which they practice.
- Dentist must make effort to protect the security of their systems, as well as of any data that they may transmit.

### Benefits of Teledentistry

- Reduced cost of service and improved quality of care.
- Reduction in peer isolation and increased specialist support as well as education.
- General dentists will send multimedia patient records to dental specialists, often enabling the specialist to make a diagnosis and develop a treatment plan without having to see the patient in person.
- Improvement in diagnostic services
- Improved integration of Dentistry into the larger health care delivery system.
- Improvement in communication with the Insurance industry with respect to requirements.
- Improvement in communication with dental laboratories.

### Limitations of Teledentistry

Many constraints are also there for example, technical, legal, educational and insurance etc.

- Proper internet connections are required for teleconferencing. A backup communication system and technical support group is required.
- Experience of the peer dentist and his knowledge is also varied. Discussion of problems on social networking sites is also risky as we don't know whose opinion is the best and we have to rely on judgment of other practitioner's examination.
- The ability of providers to bill and collect fees for dental-care services provided through teledentistry is a large issue for sustaining a teledentistry program. Reimbursement for these services is limited
- Largely still untested in law, and with significant variation among countries, issues such as accountability, licensure, jurisdiction, liability, privacy, consents, and, of course, malpractice is crucial to consider when attempting establishing sound foundations for Telehealth practice. Licensure of teledentistry practice largely depends upon the country's definition of teledentistry.
- Productivity can be another issue as new practitioners become accustomed to the technology.

### Conclusion

#### Dentistry not only going digital but also advance

Currently, teledentistry has not yet become a fundamental part for oral health care. But in future, it will be just another way to access an oral health care, especially encouraging for isolated populations who may have difficulty in accessing the oral health care system due to distance, inability to travel, or lack of oral health care providers in their area. Future advances will enable teledentistry to be used in many more ways like clinical decision support, quality and safety assessment, consumer home use, medication e-prescribing, and simulation training. Teledentistry provides new opportunities for dental education by providing the primary care professionals with an easy access to efficient consultation and by helping in conducting postgraduate education and continuing dental education programmes.

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