



## Short communication

## Tele dentistry - A modern day boon to dental practice

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## ABSTRACT

Telemedicine is the use of electronic information to communicate technologies to provide and support healthcare when distance separates the participants. Brown N. A brief history of telemedicine. *Telemedicine Information Exchange*.

Teledentistry is a field that combines telecommunications and dentistry to provide newer opportunities of dental education and delivery of oral care. It involves delivering data in the form of clinical information and images from one point (spoke point) to another point (hub site) for dental treatment using telecommunications technology. It can potentially improve the accessibility and delivery of oral healthcare, extending to underserved patient populations, such as those in rural areas, at a reasonable cost. Teledentistry can thus eliminate the disparities in oral health care between urban and rural communities. This article reviews the role of teledentistry in different fields of dentistry.

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## 1. Introduction

Telehealth, telemedicine, and related terms, as defined by the Association of American Medical Colleges, generally refer to the exchange of medical information from one site to another through electronic communication. The Centers for Medicare and Medicaid Services (CMS) defines telehealth as a two-way, real time interactive communication between a patient and a physician or practitioner at a distant site through telecommunications equipment that includes, at a minimum, audio and visual equipment.<sup>1</sup> Being practiced as early as the late 1950s, it finds its application in the field of academic medical centers, managed care companies, rural hospitals and also used internationally to link providers in developing countries to hospitals in developed countries. Telemedicine is a term that covers the use of technology to deliver clinical care at a distance. It ensures that a person receives healthcare when needed, especially for those with

limited access to care. These advances have turned out to be an unprecedented opportunity to remote access to medical care.<sup>2</sup>

Extensive advancements in the form of telecommunications, diagnostic imaging, and software for analysis have come up in the field of dentistry.<sup>3</sup> In addition to improving the quality of treatment to patients, these technologies have helped manage far-off places from the health care centers. The entire process of networking, sharing digital information, distant consultations, workup, and analysis are dealt with by a segment of the science of telemedicine concerned with dentistry known as “Teledentistry”<sup>4</sup>

Cook in 1997, defined teledentistry as “the practice of using video conferencing technologies to diagnose and provide advice about treatment over a distance.”<sup>5</sup> Through computer technology and telecommunications, interactive access can be provided, enabling the transfer of data, graphics, and images between the physically distanced participants for clinical care.<sup>6</sup> This modern

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telecommunications also come up with the potential of offsite dentists to help their fellow dentists provide care without the limitation of time or space.<sup>7</sup>

## 2. History of Teledentistry

The beginning of teledentistry as a part of telemedicine can be related to as early as 1994, and a military project of the United States Army (U.S. Army's Total Dental Access Project) proposed to upgrade patient care, dental education, and communication between dentists and dental laboratories. This project validated that teledentistry could effectively provide care to all sectors of communities at a reduced cost of patient care.<sup>8</sup>

The concept was drafted at a conference in 1989, funded by the Westinghouse Electronics Systems Group in Baltimore was put forward as a part of the blueprint for dental informatics. It was put into practice in US army in 1994 by doing dental consultations on persons located more than 100 miles apart.<sup>9</sup>

### 2.1. Forms of teledentistry

Teledentistry can take two forms:

1. *Two-way interactive technology or realtime consultation:* The dentist and patients at various locales can communicate through videoconferencing using advanced telecommunication technologies and ultra-high-bandwidth network connections. Thus, it allows a person at a remote or distant site to see or hear images or sounds occurring at an originating site in real time.<sup>10</sup>
2. *Store and forward type:* Clinical data in case history, photographs, and radiographs collected and stored can be forwarded for examination and treatment plan through established network. Thus, the treatment can be given in timely and in a cost-effective way.<sup>11</sup>

### 2.2. Applications of teledentistry

#### 2.2.1. Role in oral medicine and radiology

Tele dentistry-assisted hygiene model put forward by the Northern Arizona University Dental Hygiene Department was found to help oral care to the underserved populations through digital linking to a distant dental team.<sup>12</sup>

An evaluation of acceptance of teledentistry by users was carried out by Estai et al. in 2017. The capability of smartphone cameras for screening dental caries was assessed, and it was found that users were convinced with the proposed model.<sup>13</sup>

Another study by Torres Pereira et al. assessed the role of telediagnosis in oral medicine. The clinical data of 60 patients in the form of images were transferred through e-mail. The use of information technology can increase the accuracy of consultations in oral medicine. As expected, the

participation of two remote experts increased the possibility of correct diagnosis.<sup>14</sup>

Oral CDx is a method that combines a painless and brush biopsy with advanced computer analysis of the slide for screening patients with premalignant or malignant lesions. This makes it easy to consult a specialist through telecommunications facilities.<sup>15</sup>

Teleradiology is another advancement by which radiographic images can be transferred through the internet to a specialist for consultation. This can save time and effectively allows peer consultations and second opinions.<sup>4</sup>

### 2.3. Role in oral and maxillofacial surgery

Diagnostic assessment of clinical diagnosis of impacted or semi-impacted third molars through teledentistry was equal to that in real time.<sup>8</sup>

Rollert MK et al. showed that in assessing patients for alveolar dental surgery under general anesthesia and nasotracheal intubation, telemedicine has been shown to be as reliable as the traditional methods, with the advantage of being cost-effective for preoperative interpretation in case of difficulty with patient transportation.<sup>16</sup>

Telecommunication advancement has been at its best level with computerized radiographic support in dental implants placement by which it is capable of monitoring a patient in one place and generate digital data of the complete implant and prosthetic construction elsewhere.<sup>4</sup>

### 2.4. Role in endodontics

Brullmann D et al. showed that remote dentists could identify root canal orifices of endodontically accessed teeth from images taken with an intraoral camera.<sup>17</sup>

Teledentistry has been shown to be successful in diagnosing periapical lesions of anterior teeth and providing emergency care which can reduce the costs with distant visits.<sup>18</sup>

On evaluating the ability to diagnose peri apical lesions, no statistical difference was seen between images transferred through video teleconferencing and conventional radiographs.<sup>19</sup>

### 2.5. Role in orthodontics

Berndt F et al. suggested teledentistry can be a helpful method to supervise interceptive orthodontic treatment by general dentists. This has been shown to reduce the severity of malocclusions in impaired children whose referral to an orthodontist is not feasible.<sup>20</sup>

Stephens CD et al. showed that the use of "TeleDent SW" proved to be an effective method to provide patients with better treatment quality and the use of appropriate services.<sup>21</sup>

Studies have shown that teledentistry helped to decrease the number of inappropriate referrals to an orthodontic

specialist. Dental practitioners could have quick access to a specialist and have their opinions regarding managing cases.<sup>22</sup> This telecommunication facility can be beneficial in orthodontics for minor emergencies like rubber ligature displacement and discomfort due to the appliance. These can be easily solved at home, reassuring parents and patients even without visiting dental clinics.<sup>23</sup>

### 2.6. Role in prosthodontics

Ignatius E et al. reviewed the role of videoconferencing for treatment planning in patients who require prosthetic rehabilitation and concluded that video-consultation could potentially increase the range of specialist services in sparsely populated areas.<sup>24</sup>

In some cases, colored images of some patients are to be sent to the laboratory for the correct selection of shade, size, and contours of the prosthesis to be fabricated.<sup>6</sup>

Computer-aided design (CAD) and computer-aided manufacturing (CAM) systems are gaining precedence in manufacturing dental crowns, dental inlays, and onlays over traditional methods. As this process requires skills, dentists and dental technicians approach the computerized dentistry specialists using teledentistry. Digital impressions are gaining popularity over traditional impression techniques, and in this, the scanned image of the jaws is sent to the dental laboratory for prosthesis fabrication.<sup>25</sup>

### 2.7. Role in pediatric and preventive dentistry

Kopycka Kedzierawski DT et al. suggested that teledentistry offers a potentially practical approach of screening high-risk preschool children for signs of early childhood caries and demonstrated that the intraoral camera is a feasible and cost-effective alternative to a visual oral examination for caries screening, especially early childhood caries.<sup>26,27</sup>

In schools, teledentistry can also be used as an effective tool to help handle traumatic injuries to dental structures better where the teacher/ physical education trainers can send intra oral photographs of an injured site in the shortest time, directly to a pediatric dentist to get guidance on assessing the injury and giving the best possible first aid advice, followed by treatment suggestions.

## 3. Advantages of Teledentistry

### 3.1. Access to care

Telecommunication facility is beneficial to elderly patients, and disabled patients, patients from rural areas or geographically remote area, as there is no need to visit the clinics for dental care.<sup>28</sup>

### 3.2. Cost effective

The initial setup cost of teledentistry equipment is high, but this is a one-time investment. As the need for transport

is avoided, the most significant cost saving is seen in the remote areas. Smartphones with network connections and newly developed mobile applications have turned out to be the simplest way of transferring data for teleconsultation with no extra expense.<sup>28</sup>

### 3.3. Early diagnosis

Teledentistry may help in early diagnosis and preventive treatment. In precancerous lesions, early diagnosis can restrict these lesions from developing into malignancy. Detection of a carious lesion at its early stage can lead to a proper treatment plan and a better prognosis.<sup>28</sup>

### 3.4. Short time

Through teledentistry, accessibility to the specialist is easy and can be within a few minutes. Insurance requirements and the exchange of images for consultation can be done instantaneously. The clinical data can be reviewed, and patients can be contacted within 2 to 3 hours, substantially reducing time.<sup>28</sup>

### 3.5. Enhanced communication

Clinical images can be shared with a fellow specialist for further opinion and peer consultation, leading to a better understanding and diagnosis of the case. It can ease the problem of a shortage of specialized dental consultants and professional isolation in rural areas. It can also improve dentist-laboratory technician communication. These enhanced communications lead to better prognosis and quality of care.<sup>29</sup>

### 3.6. Storage of data

The patient details can be stored on computers or mobile phones for record and reference purposes, making it easier than using files and records with patient records. These can be sent to a specialist at any time and can help clarify criminal cases through forensic dentistry. The stored information can further be used in surveys, retrospective and cohort studies.<sup>30</sup>

## 4. Limitations of Teledentistry

### 4.1. Accuracy of diagnosis

The step-wise procedure of examination cannot be carried in teledentistry. Palpation and percussion, being the most critical steps in diagnosis, is skipped, reducing the diagnosis accuracy.<sup>30</sup>

### 4.2. Treatment requires a visit to the clinic

Teledentistry may be effective only in diagnostic and preventive procedures. The patient will have to visit the dental clinic for restorative and surgical approaches.<sup>30</sup>

#### 4.3. Technique sensitive

Transferring the captured photographs of the lesion and further forwarding them to the specialist for opinions are technique-sensitive procedures. Any technical lag and poor connections can cause a delay in telecommunications.<sup>30</sup>

#### 4.4. Initial investment

The initial setup of an intraoral camera, mobile, or computer with a high-speed network is expensive.<sup>30</sup>

#### 4.5. Virtual examination

Intraoral photographs may display differently than the lesion than in the actual examination.<sup>30</sup>

#### 4.6. Decreased accuracy

In teledentistry, the specialists have to depend on the data provided by the dentist as they cannot perform the hands-on examination. Thus the accuracy of the diagnosis depends on the examination done by the dentist and the relationship between them.<sup>30</sup>

#### 4.7. Training

Educational courses should be guided by instructors who are experienced in leading online communication, able to promote discussion, and familiar with computer technology.<sup>6</sup>

#### 4.8. Legal issues

The patient should be aware of the whole process of tele dentistry that the data is transmitted electronically, and the risk of the information being intercepted, despite the maximum efforts to maintain security. It should be clear that improper diagnosis can occur due to technical difficulties during data transmission. Another concern is about the confidentiality of patient records. Informed consent should be obtained from the patient before the start of the procedure.<sup>31</sup>

### 5. Conclusion

“Tele” or virtual mode is the new normal in all our lives ever since the covid pandemic affected our lives. Thus it is inherent that dentistry also includes the tele or distant consultation option in regular day to day practice. Tele dentistry can thus not only eliminate the disparities in oral health care between urban and rural communities but also has the potential to improve the accessibility and delivery of oral healthcare, extending to underserved patient populations living in remote and rural areas cost-effectively.

### 6. Source of Funding

None.

### 7. Conflict of Interest


None.


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