ORIGINAL RESEARCH

Tele Dentistry: An Advancement Tool in Dentistry

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Abstract

Background: The study documented below was conducted to highlight the accuracy of diagnosing caries in human teeth by examination of the intraoral photographs taken through the smartphone vs standard clinical examination through the dental operating light.

Materials and methodology: Study enrolled 100 subjects who belonged to the age-group of 30–50 years for clinical examination of missing teeth, decayed teeth, sound teeth and filled teeth. All of the teeth were examined. In the concerned procedure; Dual 12MP Wide and Ultra-Wide cameras with ƒ/1.8 aperture were used for examination. Also, cameras with ƒ/2.4 aperture, and 120° field of view, and 2× optical zoom out with digital zoom up to 5× were used. The tele screening group was made on WhatsApp (a social media application) in which 6 members were added and images were sent to that group.

Results: The kappa score in six subjects was 0.899, 0.916, 0.910, 0.925, 0.925, and 0.901.

Conclusion: Digital images from smartphone camera offers a reliable method of screening dental caries. Hence, the smartphone can be used as an adjunctive tool for tele dentistry.

Keywords: Accuracy, Communication, Dental caries, Tele dentistry.

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Introduction

Technologies based on information as well as the communication systems; refers to the telemedicine; that can be used to provide healthcare across worldwide.[1] It is a source of sharing an electronic information; in order to communicate with the technological system so that we can provide health care facilities to the patients who are at longer distances.[2] Therefore, it can be said, that telemedicine forms a part of a wider process and chain of dental care among different individuals.[3] Hence, this system can be used to improve this chain, and which in turn will enhance the efficiency and quality of health care. Telemedicine as an adjunct application is being used as a wider way today, in community hospitals, medical care centers and the rural hospitals as well. Also being used as an international link for providers and the hospitals in developing countries. Advances in digital communication, telecommunication, and the internet give, people the upper-handed opportunity to access medical care in remote areas.

Many extensive technological advancements have been seen in recent years. Such as in the use of computers, laptops, telecommunication system technology, digital diagnostic images and devices, software for analysis of the processed data and many more.[4] Using advancement in information technology, the scientific research in dentistry has crossed much longer distances, which were unexpected. New information technology has made a definite possibility in not only the partial, as well as the complete management of the dental patient residing at the longer distances by the dental care practitioners which has further led to improvement in the quality of dental treatment of patients. Hence, this entire process of tele dentistry which includes networking, sharing of digital information among medical practitioners on the basis of distant consultations among the patients, workup, and analysis can be dealt with by a segment of the scientific technology named telemedicine which when concerned with dentistry can be termed as "Teledentistry".[5]

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In the era of COVID-19 pandemic, the major concern in COVID-19 transmission risks were associated with dental operators that was further attributed to aerosol-generation procedures in the medical treatment (AGMP); this came to be a major concern in dental operatory settings.[6,7] Some of the Other major concerns were; limited availability of personal protective equipment (PPE). This was the period, i.e., the early stages of COVID-19 pandemic for which prevention of infection and control of aerosol production had to be most necessarily implemented in dental clinics.[8]

Dental technology is one of the most ambiguous fields and has undergone a significant number of advancements in technological advancements. Synonyms for healthcare services in remote areas, such as telemedicine and telehealth; have been replaced with terms like distant communication technology systems and electronic information applications. The introduction of tools of providing information technology as well as advancements in it have brought to light many new features and applications that are economical, and useful, convenient for both patients and dentists,

Figs 1A and B: (A) Dental operating light; (B) Digital smart phone

Fig. 2: Images captured through digital smart phone

therefore; it can be said that; tele dentistry is an innovation in the dentistry constituting a great promise to the world in the future of clinical care and providing the health services to each and every individual.[9,10]

In year 1997, which the term tele dentistry was coined by Cook as "the utilization of video conferencing technologies for remote diagnosis and treatment guidance." This mainly encompasses domains of dentistry that are specific to communication systems, the sharing of digital information, comprehensive networking and consultations in remote areas to further the process of evaluation and analysis of information.[11] Since, the time this innovative approach was introduced, the possibility of providing dental care services across geographical distances, along with enhancements in accessibility and communication in the fields of oral health, has come into existence.[12]

The agenda of the study being performed was to assess the accuracy of diagnosing dental caries by the examination of intraoral photographs taken by the digital smartphone system vs standard clinical examination. This study was particularly done under the maintenance of privacy, obtaining informed consent from the patients, and meeting regulatory requirements for recordkeeping.

Materials and Methodology

This study enrolled 100 subjects who belonged to the age-group of 30–50 years. These patients reported to the Department of Conservative and Endodontic for clinical examination. On examination, missing teeth, decayed teeth, sound teeth and filled teeth were examined. Standard clinical examination was done under dental operating light (Fig. 1A). Dual 12MP wide and ultrawide cameras installed in smartphone (Fig. 1B); with ƒ/1.8 aperture were used for examination. Also, cameras with ƒ/2.4 aperture and 120° field of view and 2× optical zoom out with digital zoom up to 5× were used (Fig. 2). Therefore, now the telescreening group was made on WhatsApp (a social media application) in which 6 members were added and images were sent in the that group.

Inclusion Criteria

- The subjects who belonged to the age-group of 30–50 years.
- Subjects who were prepared to undergo clinical examination.

Exclusion Criteria

- The subjects who were under the age-group of 30–50 years.
- Physically and mentally disabled individuals.

Table 1: Kappa score – representing the score of agreement between the six different dentists

Parameters	*1*	*2*	*3*	*4*	*5*	*6*
Sensitivity	93.6%	94.7%	91.8%	94.5%	92.4%	90.9%
Specificity	99.7%	97.9%	96.5%	99.6%	97.4%	96.3%
Positive predictive value	98.6%	92.9%	92.7%	93.2%	92.1%	91.5%
Negative predictive value	94.3%	98.5%	98.6%	98.7%	98.7%	98.4%
Balanced accuracy	95.1%	95.1%	95.7%	96.1%	95.8%	98.4%
Kappa score	0.899	0.916	0.910	0.925	0.925	0.901

The kappa score in six subjects was 0.899, 0.916, 0.910, 0.925, 0.925, and 0.901. Significance: Very slight differences in the kappa score represent almost satisfactory agreement in results among the 6 dentists

- Patients who didn't provide consent to participate in the study.
- Patients having eye problems.

Results

Results are depicted in Table 1, representing the kappa score by six different dentists.

Discussion

Digital images from a smartphone camera (Fig. 1B) offers a reliable method of screening dental caries. In the era of advancements in diagnosis of dental healthcare facilities, technological and the telecommunication systems have played major roles as adjuncts to routine dental examination procedures. Several telecommunications systems that have been implemented for medical and dental hospitals for diagnosing and correcting patient's health issues can be termed as telemedicine.[13] Telemedicine is basically referred as "branch of telehealth, employs sources that help in establishing, communication networks from one region to another in order to deliver healthcare facilities and medical education to patients, and resolve issues such as inadequate access to the areas that cannot be reached easily as well as the preferred practitioner of choice by the patient".[14]

Tele dentistry is considered a subfield of telehealth, along with telemedicine. Its main purpose is to give a focus on dentistry which can be made possible by the interactive tools, such as digital smartphones.[14] A digital smartphone with greater field of view and high camera clarity can be used a telecommunication tool in dentistry for sharing photographs of the dental caries (Fig. 2), which further can be assessed and hence treatment plan can be formulated accordingly. It is basically a remote dental care; rather than a face-to-face communication with a patient.[15] The US Army in 1994, conducted the 1st study on tele dentistry in name of US Army's Total Dental Access Project.[16] This particular study, illustrated a successful transition of colored images of a patient's mouth up to a distance of 120 miles.[17]

Rather than making a vague diagnosis by just using written communication systems, tele dentistry has made possible the sharing of photographs among the different dental practitioners which can not only analyze but also, can discuss the most favorable possible treatment plan beneficial to the patient. Various angulations can be adjusted on the smartphone in order to enhance the diagnostic image quality.[18,19]

Pandemic era, which is the COVID-19 has led to a dramatic change in dental and medical clinical practice, necessarily as a prerequisite for elimination of physical contact between physician and the patient and also to reduce hospital visits. There is a definitive need to push all researchers in order to discover and implement novel modalities for management in dental and medical care systems.[20]

With the ongoing advancements, patients opting for special care, such as cancer patients, and geriatric patients, handicapped patients who face difficulties in the same by multiple visits, represent the examples of such necessary situations.[21–23] Therefore, it can be said that tele dentistry represents one of the major adjuncts in the field of dentistry, which can be opted for as a treatment medium for the patients in unapproachable areas through their preferred clinicians.[24,25]

Conclusion

Tele dentistry using digital smartphone as a communication tool that can be opted as a reliable source of long-distance communication between a doctor and patient therefore, it can be said that, Digital images from a smartphone camera, a tele dentistry tool, offers a reliable method of screening dental caries.

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