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Revolutionizing Dental Care: The Rise and Impact of Teledentistry in Modern Dentistry

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Abstract: ***Teledentistry is an innovative new way to expand access to the dental care while streamlining the time needed from the dental professionals as well as patients. It has proven to be a boon during lockdown period for providing easy access and prompt treatment. So this article focuses on applications of teledentistry in various fields of dentistry. Moreover, it also enlists the origin, ethical and legal concerns related to teledentistry.***

Keywords: Teledentistry, Dental Care Access, Ethical Concerns, Legal Aspects, Telemedicine in Dentistry

1. Introduction

The field of dentistry has seen ample of technological innovations in recent years. Advances have been made in the use of telecommunication technology, computer, digital diagnostic imaging services, devices and softwares for pre and post analysis of dental treatments. New information and technology has not only improved management of dental patients, but also has made possible their partial or complete management at distances of thousands of kilometers away from healthcare centers [(1).] Teledentistry is a blend of telecommunication and dentistry, involving the two way exchange of clinical information and images for dental consultation and treatment planning. This technology served as a boon for the dentists to manage dental emergencies during the Covid-19 pandemic [(2).] It is an innovative technology first described in 1994, aiming to provide remote consultation and dental health care for patients. It is an alternative to traditional methods that seek to overcome the disadvantages being faced by traditional services [(3).] Teledentistry can meet the dental care needs of the people in the rural areas who do not have access to good oral health care and it plays a major role in ensuring good oral health care services of the children in schools and child care centres [(4).] Cook defined teledentistry as "the practice of using videoconferencing technologies to diagnose and provide advice about treatment over a distance [(5).] Now-a-days, Tele-dentistry services are widely used in various fields of dentistry. Teledentistry in a way can provide an effective mode of interaction between dentists and patients for different purposes of visit, consultation, triage, screening, and training. [(6)] Teleconsultation can be established in two ways, one is the synchronous (real time) and other is asynchronous (store-and-forward) assistance. The synchronous modality involves a live communication between the pateint and dentist via audiovisual technology. Asynchronous assistance consists of health information collected at onepoint of time and shared with practitioners and patients for help and knowledge. [(7)]

2. Origin

Teledentistry as a subspeciality field of telemedicine can be linked to the wide range literature published since 1994 and a military project of the United States Army. It involved doing dental consultation on people located more than 100 miles apart and aiming to improve the quality of patient care provided. Telemedicine began in 1924, with the concept of a specialist seeing his patient over the radio using a television screen. This military project demonstrated that teledentistry reduced treatment cost, extending dental care to rural areas and offering complete information required for deeper analysis and treatment planning. [(1)] The various upgraded technologies which were made available over the past few years changed the dynamics and scenario of the dental care delivery methods.

3. Applications in Dentistry

i) **Application of teledentistry in Rural areas:** Availability and delivery of oral health care services are poorly distributed in various regions of India especially in rural areas, where majority of population resides. This limited access of services is a consequence of many combined factors such as poor transportation, economic unstability and geographical remoteness. All of these can be overcome by the use of teledentistry that can increase the access to specialists even in the remote areas, also making it convenient and cost efficient [(4).]

ii) **Application of Teledentistry during Covid-19 pandemic:**

During the lamentable event of Covid-19 which originated and spread from Wuhan, China in December 2019, teledentistry empowered dental care while limiting the spread of the disease as well as protecting the practitioners from exposure of this pandemic. To prevent the infection, it was recommended to avoid visits to the hospitals, dental clinics etc. As we all know that dental clinics are a remarkable source of infection and most of the dental procedures involve the production of aerosols and spread of droplets of saliva which are contaminated by these microorganisms. Therefore dentists and dental patients are more prone to infection and spread to their families. To avoid this, 'teledentistry' a new concept has been performed to give dental care across distance. [(2)] With the use of internet, phones, laptops and audiovisual applications, online conversations allow the exchange of data in written/voice messages for diagnostic doubts as well as therapeutic suggestions [(8).] With these services a good patient satisfaction was observed during pandemic period. This application can supplement the traditional face-to-face dentistry, even without pandemic.

iii) **Application of teledentistry in dental education:**

Formal dental online education can be categorised as: Web-based self instruction and self interactive video-conferencing [9]. In web based self instruction, information has been developed and stored before hand the user can independently operate the application and examine the program. Whereas in self interactive video-conferencing, both a live interactive videoconference (video cameras at both the location) and supportive information (radiographs, patient medical history are involved). Advantage of former is that user can review the material as many times as he/she wants whereas the advantage of later is that user can receive immediate feedback from the concerned specialist [10].

Use of teledentistry in education can be broadly categorised as:

A) Application of teledentistry in school and child care centres
B) Teledentistry and it's role in dental/medical post graduate education
C) Application of teledentistry in dental/medical undergraduate education

A) Application of teledentistry in school and child care centres:

Schools and children care centres play a major role in ensuring the oral health of children. The advancements in the information and technology availability can be used by paediatric dentists to provide better oral health services and improve oral health habits of children. As we know the children of current generation are skilled in using digital technology so we can use this to create awareness towards oral health care in them. There are many mobile applications, games to create awareness among them like they provide instructions on how to perform an activity, demonstrate the behaviour and provide warning and signs to be kept in mind. Some applications might reward the users on completion of the desired behaviour [4].

B) Teledentistry and it's role in post graduate dental education:

For education of post graduate students, teledentistry plays a significant role for providing continuing updates for the practising dentists. For interaction and feedback between the educator and the students, interactive video-conferencing can be used in which patient information is evaluated first. Students can review and evaluate the patients cases at their own pace. The data is collected and transmitted without patient being present physically, and the cases can be discussed for a longer period of time. This can provide golden opportunities for dental students to learn and enhance the student zeal and their knowledge and understanding of the concepts [11].

C) Application of teledentistry in under graduate dental education:

Use of teledentistry for educating students pursuing BDS is very vast so this article will be categorising the applications according to various departments of a dental institute:

- Role in oral medicine and diagnosis-**Oral medicine** is primarily a non-surgical speciality with procedures limited to diagnostic biopsies and other minor procedures. Use of teledentistry in this field has been stated by Bradley M et al using a prototype teledentistry system [12]. Prevelance of advanced lesions is much more in rural areas as compared to urban areas however the accessibility to a oral medicine specialist is very limited in rural areas. To overcome this problem, teledentistry is a feasible solution which can increase the access and decrease the waiting period leading to fast diagnosis and better prognosis.
- Role in oral and maxillo-facial surgery: This speciality focuses on surgical treatment of **cranio maxillo-facial complex** as well as associated structures. Rollert MK et al stated that consultation via smartphone for assessing the patients of dentoalveolar surgery and nasotracheal intubation is as reliable as conventional aids. It even has a upper hand due to its cost effectiveness [13]. Teledentistry also provides oral surgeons with free mobility when he/she can consult other specialists in field via emails which ultimately raises the overall standard of dental care to a maxillofacial patient.
- Role in endodontics: **Endodontics** is a speciality of dentistry that manages the prevention, diagnosis, and treatment of dental pulp and the **periradicular** tissues that surrounds the root of the tooth. According to Zivkoic D et al, for the diagnosis of periapical lesions of the anterior teeth, teledentistry is based on Internet as a telecommunication medium can be successfully applied, and also decreasing the cost associated with distant visits and provide an immediate aid [14]. It also provide endodontic services in the impoverished communities. Teledentistry can help the endodontist to diagnose the periapical lesions and prescribe the medications through teleprescriptions which can provide immediate relief to the patient.
- Role in prosthodontics: According to **GPT-8**, it is a speciality pertaining to the diagnosis, treatment planning, rehabilitation and maintenance of the oral function, comfort, appearance and health of patients with clinical conditions associated with missing teeth using biocompatible substitutes. Teledentistry approach plays a vital role in management of prosthodontic emergencies such as fractured prosthesis can be repaired by the communication of dentists, patient and laboratory technicians with the help of digital technicians. Even if the prosthesis cannot be repaired or replaced, prosthodontist can guide the patient to remove it until face to face consultation is possible.
- Role in orthodontics: **Orthodontics** is a dental speciality focused on aligning your bite and straightening your teeth. Teledentistry can be a important tool for consulting and monitoring a patient without an in-office visit. We know that physical appointments with dentist can't be compared with online appointments but it can be a good adjunct as teledentistry can help in orthodontic consultations, reviewing case details, diagnosis, explaining treatment plans, and providing information to parents about minor paediatric emergencies that can be handled at home [15]. A teledentistry platform gives you a

virtual access to your patient for step-by-step details to obtain a traditional mold used for Invisalign® or another clear aligner treatment. Virtual visit with teledentistry can save patient's time throughout their treatment [16].

- Role in pedodontics: **Pedodontics** or **paediatric dentistry** is the branch of dentistry that deals with the oral health care of children right from birth to adolescence. Children and adolescents are core subjects for early diagnosis and prevention of oral diseases [17]. Various efforts have been done to improve overall oral health in children but infirmity still prevails due to socioeconomic and geographical limitations. So teledentistry can be used to increase the access of children to oral health care services.
- Role in periodontology: **Periodontics** is a branch of dentistry that studies supporting structures of test, as well as diseases and conditions that affect them. Periodontal disease, which is one of the most common reason for tooth loss because it is a silent disease of the underlying structures of the teeth and that's why remains a global dental problem. Quick detection and diagnosis can prolong the life of the teeth in oral cavity [18]. If a medically compromised patient were seen in dental practice, the technologies would allow for easy multidisciplinary consultation enhancing the holistic medicine.

4. Limitation of Teledentistry

As we all know teledentistry serves as a boon for dentists, but nothing can match the exactitude of the diagnosis of the patient performed clinically. In teledentistry, the various essential steps of diagnosis cannot be performed, in which palpation and percussion are the most important ones. If a patient requires treatment, he has to visit the clinic for various procedures for example restorations, endodontic treatments, and extractions as teledentistry helps only in the diagnostic and preventive procedures.2 Diagnosis is based on clinical photography that may change on face-to-face communication. The accuracy of intraoral photographs or video recordings may be different from what is present actually. Diagnostic aids such as percussion and palpation cannot be performed by using teledentistry [19]. There are various constraints like poor access to internet in rural areas, shortage of appliances, insufficient financial backing, difficulty in cooperation with remote areas, cost involved in installation are the barriers faced by dentists [20].

Ethical and Legal Issues

The world wide use of teledentistry, attainability to information has elevated a number of legal concerns. It is each practitioner's liability to understand the significance of the use of information technologies and their associated legal consequences for dental practice [21]. Thereupon practitioners immersed in teledentistry must be licensed in each state where they practice. The one who is licensed can reciprocate easily with any of the states with a good standing in one state. If there is an equipment failure or malfunction and that failure results either direct or indirect injury to the patient, the health care professional may find themselves sued for the same. Dentists immersed in teledentistry must ensure the security of their systems as well as the data they may transmit. [5] Patient should be enlightened that there may be the probability of an imprecise diagnosis, treatment or both as a result of failure in technologies. Informed consent in teledentistry should shelter everything that exists in a standard, traditional consent form [22].

5. Conclusion

Dentistry is an ever evolving branch and introduction of teledentistry has for sure widened its scope beyond its scope beyond imagination. Teledentistry has given quick and precise solution to many problems. Overall accessibility of dental care has shown an exponential growth and improved patient health. Digital dentistry is also a rising branch these days so the combination of it along with teledentistry can do wonder for patients as well as practitioners. However further investigation and wide application is required before teledentistry can rise its peak.

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