DIGITIZATION IN DENTISTRY: REVOLUTIONS AT CROSS ROAD

Dr Rony T Kondody[1], Dr. Nagaraj E[2], Dr. Rashmi P Karschi[3], Dr. ManjushaNambiar'
Dr Bhavya Shetty[5*]

1. Department of Orthodontics and Dentofacial Orthopedics, Sri Rajiv Gandhi College of Dental Sciences, Bangalore. Email:ronykondody55@gmail.com **ORCID:** 0000-0002-4382-8428

2. Department of Prosthodontics. PMNM Dental College and Hospital. Bagalkot. Email id:dr_nagaraj_e@yahoo.co.in

3. Department of AI and ML. Nagarjuna college of Engineering and Technology, Bangalore. Email:rashmikarchi@gmail.com

4. Department of Periodontics. Sri Rajiv Gandhi College of dental sciences, Bangalore. Email id: drmanjushanambiar@gmail.com **ORCID ID**: 0000-0002-9791-0558

5. Department of Periodontics. Faculty of dental sciences. Ramaiah university of applied sciences. Email:bhavyashetty123@gmail.com

*Corresponding Author
Dr. Rashmi P Karschi. Department of AI and ML. Nagarjuna college of Engineering and Technology, Bangalore.
Email:rashmikarchi@gmail.com

Abstract

Over the past few decades, the field of dentistry has faced varying challenges which has paved the way for the emergence of a digital world that has revolutionized the way dentist practitioners address their practice and patient care. This has changed the focus of dentists in handling the latest technologies in diagnosis and treatment planning which encompasses a range of technologies such as CAD/CAM, 3D printing, artificial intelligence and web-based communication technologies, etc. However, with the technologies replacing human involvement, questions still arise about the potential risks associated with these applications concerning the privacy of patients' information, ethical considerations, and others. This review focussed on providing overall information regarding benefits, limitations, and recent advancements that have happened as a part of dental digitization and also its influence on dental education as well as its effects on the overall practice of dentistry

Introduction

Today's digitization is reshaping every aspect of our daily lives and is also having a wide range of effects on the fields of medicine and dentistry, from electronic data-keeping and analysis to the latest diagnostic tools, cutting-edge prevention strategies, and ground-breaking treatment options.[1] While practice management tools and web-based education programs have also recently had a favorable impact along with newer virtual reality (VR)-based dentist instruction program has also made significant progress thanks to simpler human-computer interfaces.[2]

Another significant development that has been made has to do with machine learning and artificial intelligence. Future dental applications and restorations are anticipated to be automated through the use of artificial intelligence (AI), and these technologies' image analysis capabilities are anticipated to continue to advance.[3] On the other hand, the creation of dental appliances using computer-aided design and manufacturing is becoming more and more commonplace globally.[4]

Along with this development, web-based communication technologies are becoming more and more prevalent, especially in rural as well as in underdeveloped areas where there may be a lack of dental practitioners or limited access to oral healthcare, as a result of the expanding availability of high-speed internet and mobile devices. This can lead to reduced inequities in dental treatment and an improvement in the general oral health of the population. Therefore, by enhancing treatment outcomes, cutting down on treatment time, and increasing access to care, these developments have the potential to transform dental care.[5]

Additionally, the socioeconomic impact of research in digital dentistry may be substantial, enhancing patient outcomes, lowering costs, and increasing access to care.[6] By offering more precise and tailored therapy recommendations, cutting down on treatment time, and raising patient awareness, digital technology can assist in enhancing treatment outcomes.[7]

With the advancement of technology, procedures that were once thought to be too difficult to complete are now a routine aspect of dental care. Along with more personalized and comfortable treatments, recent years have seen a considerable improvement in overall patient satisfaction. Given these advantages, previously irrational upfront investments in cutting-edge technology become a practical substitute for analog techniques or manufacturing offshore. This review's main goal was to comprehend contemporary developments in digital technology related to dental practice.

Artificial intelligence in Dentistry

Over the last few years, AI-based technologies have become a mainstay of dental practice. Recent developments in computing infrastructure, machine learning, and digitized data collecting have allowed AI applications to spread into fields previously regarded to be the domain of human knowledge. AI can significantly enhance patient care and transform the medical and dental industries. AI is also being researched in dentistry for several uses, applications include making more accurate and efficient diagnoses, decision-making, treatment planning, and prediction of treatment outcomes thus reducing workload in day-to-day practice.[8]

Nowadays, dentists depend more on digital programs to make their routine choices in their patient management.[9,10] On the other hand, dental computer programs are improving in intelligence, accuracy, and dependability. All areas of dentistry are now engaged in AI research.

Even though there are many advantages, there remain some limitations. The main issues faced by AI systems include the limitations in administration and also sharing of clinical information. The initial training of AI algorithms as well as ongoing training, validation, and enhancement require personal data from patients.

Also, the development of AI will promote data sharing across multiple institutions and, in some circumstances, across international borders. AI must be integrated into healthcare operations while modifying systems that protect patient confidentiality and privacy.[11] So, before thinking about a wider distribution, personal data must be anonymized.[12] Even if these protections are technically possible, the medical community is dubious about secure data sharing.

Web based communication/ Teledentistry

The healthcare system is evolving quickly in the age of technology and connectivity where hospitals have incorporated several communications methods which are called telemedicine".[13] As a subset of telehealth, telemedicine uses communications networks to deliver medical facilities and education, particularly to address issues like unequal access, a lack of infrastructure, and a shortage of human resources. Together with telemedicine, teledentistry is a branch of telehealth that focuses on dentistry and was created by combining interactive tools, telecommunications, and dentistry.[14]

Consultation between a dentist, specialized specialists, and a patient can happen in real-time via video calling or conferencing. For diagnosis, they can swiftly analyze clinical and general data, medical history, radiographic images, and laboratory results. Real-time visuals and improved comprehension between the patient and the doctor are made possible by this interactive method.[15,16,17]

This field recently included remote patient management. With this approach, dentists or other medical professionals can simply send patients to clinical facilities after receiving precise information about their medical conditions directly from the patients' homes. The primary benefit of this approach is that it lowers healthcare expenses.

Dental Education

Dental education and patient care have been completely transformed by digital technology, ushering in a new era of accuracy, effectiveness, and patient-centered treatment. One of the most important developments is digital radiography, which substitutes digital images for conventional X-rays to reduce radiation exposure and improve diagnostic capabilities.[18] In the case of dental education here are three key elements: simulated training courses, clinical skills training, and lectures/tutorials and problem-based learning (PBL) interactions.[19]

While one of the most significant advancements in dental education is the use of virtual and augmented reality (VR/AR) in training. These technologies provide a unique learning experience that allows students to practice dental procedures in a simulated environment without the risk of causing harm to patients.[20]

Limitations and challenges in Digital Dentistry

Cybersecurity risks and patient privacy violations could be a drawback of digital dentistry. Dental professionals must make sure that they have sufficient security measures in place to secure patient information because digital photographs and patient data are susceptible to cyberattacks.[21] Finally, due to worries about job loss and automation, some dental professionals may be reluctant to accept digital technologies. It is crucial to understand that digital dentistry does not aim to replace dental professionals, but rather to improve patient care and their capabilities.[22] But digital dentistry is a discipline that is continually changing. AR, VR, and ML will all be used in the future of digital dentistry.[23,24]

Although the use of digital technologies can increase the precision of diagnoses and treatment planning, an overreliance on these tools could result in incorrect diagnoses or subpar treatment results. To produce the greatest patient outcomes possible, dental professionals must combine the use of digital technologies with clinical judgment and knowledge.[25]

Conclusion

Dental professionals now have more precision, efficiency, and accessibility because of the advancements in digital dentistry. The dental industry has changed as a result of developments in imaging, CAD/CAM technology, 3D printing, and regenerative dentistry. Digital dentistry's capabilities could be improved in the future by technologies like teledentistry, augmented reality, and artificial intelligence. With breakthroughs and technology constantly being developed, it is true to say that the future of digital dentistry is exciting and bright. It is also critical for dental practitioners to keep up with the most recent developments and moral considerations as the use of digital technologies in dentistry expands.