

Artificial Intelligence-Ray of Hope

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ABSTRACT

Artificial Intelligence (AI) technologies play a significant role and significantly impact various sectors, including healthcare, engineering, sciences, and smart cities. AI has the potential to improve the quality of patient care and treatment outcomes while minimizing the risk of human error.

Artificial Intelligence (AI) is transforming the dental industry, just as it is revolutionizing other sectors. It is used in dentistry to diagnose dental diseases and provide treatment recommendations. Dental professionals are increasingly relying on AI technology to assist in diagnosis, clinical decision-making, treatment planning, and prognosis prediction across ten dental specialties.

One of the most significant advantages of AI in dentistry is its ability to analyze vast amounts of data quickly and accurately, providing dental professionals with valuable insights to enhance their decision-making processes.

The purpose of this paper is to identify the advancement of artificial intelligence algorithms that have been frequently used in dentistry and assess how well they perform in terms of diagnosis, clinical decision-making, treatment, and prognosis prediction in ten dental specialties; dental public health, endodontics, oral and maxillofacial surgery, oral medicine and pathology, oral & maxillofacial radiology, orthodontics and dentofacial orthopedics, pediatric dentistry, periodontics, prosthodontics, and digital dentistry in general.

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Introduction

Artificial Intelligence (AI) is the ability of machines to perform tasks that normally require human intelligence. AI has been adopted in many fields of industry, such as robots, automobiles, smart city, and financial analysis, etc. It has also been used in medicine and dentistry, for example, medical and dental imaging diagnostics, decision support, precision and digital medicine, drug discovery, wearable technology, hospital monitoring, robotic and virtual assistants [1-5]. In many cases, AI can be regarded as a valuable tool to help dentists and clinicians reduce their workload. Besides diagnosing diseases using a single information source directed at a specified disease, AI can learn from multiple information sources (multi-modal data) to diagnose beyond human capabilities [6]. For example, fundus photographs with other medical data such as age, gender, BMI, smoking habits, blood pressure, and the likelihood of diabetes has been used to predict heart disease. Thus, the AI can discover not only eye diseases such as diabetic retinopathy from fundus photography, but also heart disease. It looks like image-based analysis using AI is sound and successful [7]. All these rely on the rapid development (as an output) of computing capacity (hardware), algorithmic research (software), and large database (input data). Given these, there is great potential for the use of AI in the dental and medical field [8].

Augmented Reality and Virtual Reality

Dental care is a one-of-a-kind career in the medical field, and it is incredibly required as it is a necessity hence the incorporation of a vast quantity of data and the development of clinical skills. A technology that superimposes a computer-generated picture over a user's perspective of the actual world, producing a composite vision, according to the definition of augmented reality [9]. The development of augmented reality has generated appealing prosthetics resulting in better and improved overall patient experiences. The patient can try on the augmented reality that can be altered until they are satisfied using AI algorithms and augmented reality. The final prosthesis is produced precisely to these specifications [10].

Irrespective of augmented reality, virtual reality is a simulation based on a 3D picture generated by the computer, which can interact with the real and physical world and electrical and electronic equipment. In combination with virtual reality, AI systems have been utilized to alleviate dental concerns and as a strong tool for treating a patient with pain that cannot be cured by medicine [11].

Artificial Intelligence in Dentistry Operative Dentistry

In operative dentistry, there has been research on the detection of dental caries, vertical root fractures, apical lesions, pulp space volumetric assessment, and evaluation of tooth wear [12]. Artificial

Intelligence help to detect dental caries on periapical radiographs, detect caries on intraoral images and the cost-effectiveness of AI for proximal caries detection with dentists' diagnosis; the results showed that AI was more effective and less costly.

Periodontics

Despite advancements in treatment methods, there has been no major improvement in diagnosing and forecasting the prognosis of periodontally compromised teeth (PCT). Clinical diagnosis and prognosis are highly reliant on empirical data. Artificial Intelligence have shown a high potential for usefulness and accuracy in diagnosing and predicting the need for extraction of PCT [13].

Dental Public Health

Artificial intelligence (AI) can be used in Dental Public Health, which involves diagnosing, preventing, and controlling dental diseases through research, education, and group dental care programs [14].

Oral and Maxillofacial Radiology

Application of the AI in dental radiology is the use of artefact reduction algorithms that help the enhancement of the radiographic images and eliminate the distortion effect radio-opaque objects on the fine details of the acquired image, while reducing the need for high radiation dose and large voxel size [15]. Early detection and diagnosis of various mucosal lesions are essential to classify them as benign or malignant. Surgery resection is required for malignant lesions.

Pediatric Dentistry

AI in Pediatric Dentistry can be used in the same way it is used in adults by providing primary and complete preventative and therapeutic oral health diagnosis, care, and consultation knowledge for infants and kids through adulthood.

AI has the potential to solve discrepancies that may arise throughout the analysis of growth data, and AR augmented reality methodologies have been developed to educate patients and families about growth disorders and their treatments [16].

Prosthodontics

AI models serve as a dependable diagnostic tool for tooth shade selection, automated restoration design, mapping the preparation finishing line, optimizing manufacturing casting, predicting facial changes in patients with removable prostheses, and designing removable partial dentures, which summarizes a set of applications for dental activities that integrates AI technology [17].

3D Digital Dentistry

The advances in Artificial Intelligence (AI) and 3D imaging systems make dentists rely more and more on digital technologies for detection and treatment. Adopting AI-based digital technology for clinical solutions and dental laboratories allows the dentist to digitally repeat the whole procedure and treatments. Furthermore, assure sharing of information across the entire process of the digital dental system. Using a digitalized dental system brings real advantages in accuracy and quality, is time-consuming, and decreases costs [18].

Conclusion

Despite numerous studies showing potential applications of AI in dentistry, these systems are far from being able to completely replace dental professionals. AI should be viewed as an additional

benefit for dentists and other professionals. To ensure that humans can continue to oversee the care and make informed judgments in dentistry, AI must be implemented in a safe and controlled manner. Most institutions are currently unprepared for the duty of providing dental and continuing education training, which is necessary for effective AI integration in dentistry. Additionally, augmented reality (AR) and virtual reality (VR) both benefit from AI. Mixed reality is a novel concept that incorporates parts of generative AI, VR, and AR into computer-superimposed information overlays to improve learning and surgical planning. As many AI systems for various dentistry disciplines are being researched and have yielded promising early results, a future for AI in the healthcare system cannot be ruled out. AI systems offer significant promise as a valuable tool for oral health practitioners.

AI-based technologies for clinical solutions and dental laboratories enables dentists to digitally repeat procedures and treatments and ensure data sharing throughout the entire digital dental system process. Furthermore, it provides significant benefits in accuracy and quality, as well as saving time and money.

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