Review Article

Artificial Intelligence– Ray of Hope

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ABSTRACT

Artificial Intelligence (AI) technologies are having a profound impact across sectors such as healthcare, engineering, science, and smart cities. In healthcare, AI has shown great potential to enhance patient care and treatment outcomes while reducing the risk of human error.[1] Dentistry is undergoing a similar transformation, with AI being utilized for the diagnosis of dental diseases and providing treatment recommendations. Increasingly, dental professionals rely on AI for diagnosis, clinical decision-making, treatment planning, and prognosis prediction across ten dental specialties.[2] A key advantage of AI in dentistry is its ability to rapidly analyze large volumes of data with precision, providing valuable insights that support enhanced decision-making.[3] This paper aims to explore the advancements in AI algorithms frequently used in dentistry and evaluate their performance in diagnosis, clinical decision-making, treatment, and prognosis across ten dental specialties: dental public health, endodontics, oral and maxillofacial surgery, oral medicine and pathology, oral and maxillofacial radiology, orthodontics and dentofacialorthopedics, pediatric dentistry, periodontics, prosthodontics, and digital dentistry.[4]

Key-Words: Artificial Intelligence, Digital Dentistry, Dentistry, Dental Specialty

INTRODUCTION

Artificial Intelligence (AI) refers to the ability of machines to perform tasks typically requiring human intelligence. AI has been adopted in various industries, including robotics, automotive, smart cities, and financial analysis. In healthcare and dentistry, AI plays a role in medical and dental imaging diagnostics, decision support, precision medicine, drug discovery, wearable technology, and robotic assistants.[5] In dentistry, AI helps alleviate clinicians' workloads by diagnosing diseases using multi-modal data, learning from various sources beyond human capabilities.[6] For example, AI can analyze fundus photographs alongside patient data such as age, BMI, smoking habits, and blood pressure to predict conditions like heart disease, in addition to identifying eye diseases.[7] AI's success relies on advancements in computing, algorithmic research, and large data sets, demonstrating immense potential for its application in dentistry and medicine.[8]

Augmented Reality and Virtual Reality

Dentistry demands the integration of vast data and clinical skills. Augmented reality (AR) overlays computer-generated images on a user's view of the real world, enhancing prosthetic design and patient experiences.[9] AI algorithms in AR allow patients to "try on" prosthetics virtually, which can be adjusted before final production to meet precise specifications.[10] In contrast, virtual reality (VR) is a 3D computer-generated simulation that interacts with the physical world. In combination with AI, VR has been employed as a tool to alleviate patient anxiety and manage pain that may not respond to medication.[11]

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Artificial Intelligence in Dentistry

Operative Dentistry: AI has been used to detect dental caries, vertical root fractures, apical lesions, and assess pulp space volumetrically.[12] Studies show that AI is effective and cost-efficient for diagnosing proximal caries in comparison to dentists' evaluations.[8]

Periodontics: Despite treatment advances, diagnosing and predicting the prognosis of periodontally compromised teeth (PCT) remains a challenge. AI offers promising accuracy in diagnosing and forecasting the need for tooth extraction in PCT.[13]

Dental Public Health: AI can assist in diagnosing, preventing, and controlling dental diseases through research, education, and public dental care programs.[14]

Oral and Maxillofacial Radiology: AI is applied in radiology to reduce image distortion caused by radio-opaque objects, enhance radiographic images, and reduce radiation dosage while improving diagnostic accuracy.[15]

Pediatric Dentistry: AI is applied similarly in pediatric dentistry as in adults, offering preventative and therapeutic oral health diagnosis. AR is also used to educate families about disorders and treatment.[16]

Prosthodontics: AI aids in tooth shade selection, automated restoration design, and optimizing the all of

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manufacturing processes. It also assists in predicting facial changes in patients with removable prostheses and designing removable partial dentures.[17]

3D Digital Dentistry: AI and 3D imaging technologies allow dental professionals to digitize procedures, enhancing accuracy, quality, and efficiency while reducing costs and time.[18]

CONCLUSION

Despite AI's potential in dentistry, it is not yet capable of replacing human dental professionals. AI should be considered a supplementary tool that enhances dental care and decision-making. Safe and controlled integration of AI into dentistry is crucial to ensuring humans remain in control of treatment. Institutions need to prioritize education and training for effective AI implementation. Augmented reality (AR), virtual reality (VR), and mixed reality—integrating AI, VR, and AR—offer significant advantages in learning and surgical planning. While early AI applications in dentistry are promising, the technology is still evolving. AI-based tools hold great promise as valuable resources for dental professionals, particularly in improving clinical solutions and enhancing treatment accuracy, efficiency, and affordability.

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