ARTIFICIAL INTELLIGENCE IN PROSTHODONTICS

Abstract

Artificial intelligence (AI) encompasses a broad spectrum of emerging technologies that continue to influence daily life. The evolution of AI makes the analysis of big data possible, which provides reliable information and improves the decision-making process. This chapter focuses on the specific application of AI in Prosthodontics, emphasizing its role in digital impressions, fixed prosthodontics, and implant dentistry.

Here in this chapter, capabilities of AI in accurate diagnosis, prognostic evaluations, and creative prosthetic construction are emphasised. The technology's contributions extend to implant recognition, categorization, and error reduction in dental procedures, enhancing overall treatment techniques. This chapter also includes AI's involvement in Maxillofacial Prostheses, showcasing its ability to create customized prosthetics based on anthropological calculations and patient preferences. The discussion expands to AI's impact on vision impairment, introducing smart reading glasses and bionic eyes as examples of how AI improves the lives of those with visual impairments.

The chapter is concluded by addressing the current state of AI in healthcare, acknowledging its limitations and projecting a visionary outlook for the next 5-10 years. Anticipated advancements include improved algorithms, data integration, and collaborative efforts between AI and human expertise for precision therapies.

Keywords: Artificial Intelligence, Prosthodontics, Maxillofacial Prostheses, AI in Healthcare, and Anticipated Advancements.

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In the branch of computer science known as artificial intelligence, machines can comprehend data, form opinions, and even interact with people. The strength of AI is the ability to learn and acquire skill in detecting patterns and relationships from vast datasets; for example, Using AI, whole medical history of any patient can be saved under single number. Furthermore, by learning more data AI is improving day by day.

Around the world, many healthcare systems face problem in fulfilling "the quadruple objective- improving population health, improving patient experience of care, improving clinicians experience, and lowering rising healthcare costs". Reforming healthcare delivery system is necessary by government as there is rising up in the number of chronic diseases as well as overall global health related expenditure. Recent COVID epidemic has made us aware of scarcity of healthcare workers and in providing care, as stated by the World Health Organisation(WHO).

By adding technology with AI, few "demand and supply problems" of healthcare system will get solved. As data in different modes like demographical, clinical etc. along with technology, Artificial Intelligence Augmented Healthcare System is changing traditional healthcare.

Cloud computing, in specific, is helping integration of use of AI systems into delivering health. When corelated to "on premises" healthcare institutions, for the processing of big data in increased speed and minimum cost, cloud computing is the best to use.

I. IMPLEMENTATION OF ARTIFICAL INTELLIGENCE IN PROSTHODONTICS

Machine learning models of AI based on analysis of previous data to simulate human intellect and behaviour. For more accurate results, training of AI models is necessary using already present data. The use of AI in prosthodontics resulted in major modifications in their role to digital diagnostics, predictive assessments. Prosthodontics incorporates nearly every aspect of current dental technology. There is increase in the number of replacing conventional impression making by digital impressions with an intraoral scanner. For making single crowns and short term FPD intraoral scanners are reliable. Recently this scanning technology is helping in complete denture fabrication and maxillofacial scanning.

Following an intraoral scan, AI was used to detect margins in fixed prosthodontics. Various fields of dentistry are currently using tools which are digital to help patients getting their beautiful smile which they always wish to have. 3D face tracking with low-cost virtual 3D data hybrids -fragmented cone beam computed tomography (CBCT), intraoral scans, and face scans are examples. Virtualizing their anatomy AI can provide treatment that helps to improve aesthetics of patients.

"According to a study, "AI applications in prosthetic dentistry and its integration with other branches of dentistry have resulted in a wide range of innovative opportunities, including the generation of occlusal morphology in crown contemplation of opposing teeth even in cases of

wear or fracture, programmed teeth setting for dentures, and automatic framework designs for removable dental prostheses."

II. AI IN IMPLANT PROSTHODONTICS

The most effective dental implant treatment planning utilises "CBCT image and intraoral scan". The use of Artificial Intelligence in implantology has the ability to combine both and create the prosthetics of the future.

AI based model can automatically identify the exact position of the mandibular canal for dental implant operations. Lee J et al.3 in his study conducted, panoramic and periapical radiography were implemented to segregate implants using AI- CNNs. Based on the findings of this investigation, the AI-CNN system is nearly as effective as humans in categorising implant procedure. Lerner et al. developed an AI model to reduce the risk of errors in implants such as inappropriate placement, inadequate cementation, incorrect occlusion. Takahashi et al. conducted a systematic investigation to establish an AI framework that would categorise dental arches and use CNN to aid in denture production. The training dataset was categorised using computer-based autonomous learning algorithms.

AI based deep CNN model helps in for implant type recognition using 2-dimensional radiograph and 3D CBCT images as the input data set. Clinicians attempting to restore an unidentified implant would benefit from the clinical applicability of such an AI tool. Additionally, implant dentistry specialists who lack expertise in the field can benefit from adopting software that can identify implants.

III. MAXILLOFACIAL PROSTHESES AND AI

Dental professionals can develop the most attractive prosthesis for patients with the use of AI and specific designing tools, taking into account anthropological calculations, face measurements, ethnicity, and patients demand. AI in synergy with (CNNs) mimic human neurons. Patients comprising of vision impairments used the prosthetic eye created in the United States. These AI-based gadgets assist individuals to see without surgical aid. For people who are blind or have visual impairments, there are smart reading glasses available. Being an advanced voice-activated device it can be mounted practically on any set of glasses. It is primarily intended to assist those who are blind or visually impaired. Its user can live an independent life by being able to read text from a book, smartphone screen, or any other surface quickly, recognize faces, work more efficiently.

"Bionic eye created by United States was adapted by individuals who lost their eye". The user can read text or identify faces using a smart camera on specialized eyewear. It analyses the camera data and transforms it into sound. A wireless earpiece then transmits this sound to the blind person's ears.

Artificial olfaction or Machine olfaction (automated simulation of the sense of smell) plays a crucial role in robotic technology because it closely resembles the human olfactory system, which is capable of identifying various odours in a variety of fields including disease diagnosis, environmental monitoring, concerns with public safety, the food business, and agricultural production.

People who have had limbs amputated could no longer be able to feel changes in temperature. Researchers created synthetic skin that altered this image. The tissue, which is composed of a thin, transparent layer of pectin and water, can detect temperature changes between 5 and 50 °C. It is done by capturing images using specialized thermal cameras or infrared cameras. AI algorithms extract relevant features from the thermal images. Features could include temperature gradients, temperature patterns, or specific regions of interest on the skin. Convolutional Neural Networks (CNNs) are commonly used for thermal image analysis.

In order to explore the potential of AI to augment, automate, and modify dentistry, we present a non-exhaustive set of applications for AI in healthcare for today and in next 5-10 years.

1. **AI Today:** AI systems are not yet capable of reasoning in the same way as doctors, who can rely on "common sense" or "clinical intuition and experience. AI, on the other hand, works more like a signal translator by translating patterns from datasets. Healthcare organisations are now starting to use AI technologies to automate time-consuming, repetitive procedures with huge volume. Additionally, there has been significant development in showing the application of AI in precision diagnoses such as planning radiotherapy.

2. **AI in next 5–10 Years:** In the medium term, we predict that there will be significant advancements in the creation of effective algorithms that can combine various types of structured and unstructured data, including imaging, electronic health data, multi-omic, behavioural, and pharmacological data, and are efficient (i.e., require less data to train). Additionally, medical practises and healthcare organisations will progress from using AI platforms as adopters to working with technology partners to construct cutting-edge AI systems for precision therapies.

   In the future, AI will be able to produce a forecast that can be used in conjunction with human diagnosis to raise the likelihood of suitable diagnostics and result in a greater rate of accurate diagnoses, according to the statement "AI helps doctors and patients in every profession." Everything is changing thanks to AI, from dentistry to space science. "Due to AI, the clinical and dental patient experience will improve". The system will learn preferences in order to enhance patient experience. Increased access to adequate oral health treatment will improve dental patient experiences, improving systemic health. The software will provide partial edentulism RPD designs. Dental implant therapy will be modernised by means of techniques and technology that have been tested in clinical settings. When there is only partial edentulism, the software will help with partial denture design.

In conclusion, incorporation of artificial intelligence (AI) in prosthodontics offers a revolutionary advance in the fields of dental prostheses and oral healthcare. A more accurate, effective, and patient-centred approach to healthcare is being offered by AI-powered systems that are transforming diagnosis, treatment planning, and the development of personalized prosthetic solutions. AI is enabling prosthodontists to deliver higher-quality care while improving patient comfort and satisfaction. It can analyse large datasets, optimize treatment outcomes, and expedite administrative operations. As AI develops, prosthodontic procedures have the potential to change, becoming more accessible, efficient, and customised to meet the individual needs of each patient.

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