Achieving precision with artificial intelligence - A review.

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Abstract

Purpose: The purpose of this literature review is to present a composite framework of various literatures on Artificial intelligence readily accessible in the area of dentistry.

Data sources: Searches were conducted in PubMed, Embase, Springer, Elsevier, Google scholar and the Cochrane Library for articles without regard to language or publication date. Search terms included Prosthetic dentistry, Artificial intelligence, Implantology, maxillofacial, Diagnosis and innovation. To find further studies, experts in the field of artificial intelligence were also approached.

Study selection: The authors evaluated the various studies done on artificial intelligence in dentistry. The concept and application of artificial intelligence in dentistry was also identified and selected from the previous studies. The studies not fulfilling the purpose of the study were excluded.

Data extraction: Data extraction, study selection, and citation identification were all done independently. The disagreement was settled through consensus.

Results: All studies reported pronounced data for the dental applications of artificial intelligence.

Conclusion: The present literature review summarizes that the Artificial intelligence has significantly changed both medicine and dentistry. Still more studies have to be done to get more precision in the work.

Keywords: Artificial intelligence, Diagnosis and Innovation, Implantology, Maxillofacial, Prosthetic dentistry.

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Email address: - awanigupta1996@gmail.com . **Phone no:** 8279914797. **DOI:** 10.5281/zenodo.7834141
Submitted: 28-Feb-2023 **Revised**: 7-Mar-2023 **Accepted:** 21-Mar-2023 **Published:** 16-Apr-2023
Bibliographic details: Journal of Orofacial Rehabilitation Vol. 3(1), Apr 2023, pp. 52-56.

Introduction

The field of prosthodontics, or dental prosthesis, is important to dental sciences and has a broad influence on the accomplishment and transformation of various stages of human existence. Many factors contribute to the significance of dental prosthesis fabrication. First, compromised physical, mental, and emotional well-being as a result of tooth loss.[1] Its absence causes issues with chewing (or mastication), which ultimately causes someone to avoid meals and change their eating habits. Second, lacking teeth makes people more reclusive because of a concern of being accepted by others.[2] Socializing is greatly aided by having teeth that are properly aesthetically pleasing because everyone wants their entire body to look good. Last but not least, the existence of teeth in the oral cavity aids in maintaining the correct positioning of the tongue, lips, and cheeks, giving the facial features an appropriate shape. Human intelligence and visual-tactile evaluation are the only available conventional diagnostic techniques. Throughout the past few decades, the field of artificial intelligence (AI) has experienced phenomenal progress. AI has been used for a variety of tasks, including as the detection of healthy and unhealthy structures, illness diagnosis, and the prediction of treatment outcomes. John McCarthy claimed the phrase "artificial intelligence" in 1955. [3] The Father of Artificial Intelligence is the mathematician John McCarthy. AI for short, is the ability of a machine to simulate human thought and

behavior. In 1959, the term "machine learning" was first used by Arthur Samuel to describe the mechanism that enables a computer to learn without explicit programming. [4] The goal of machine learning is not to replace oral healthcare professionals, but rather to provide a additional, well-informed view based on statistical analysis and prediction.

Through the use of sophisticated algorithms, computers may infer their own laws thanks to machine learning.[5] Electronic commerce, automobiles, internet searches, sensors, robotics, speech recognition, picture recognition, and other fields all employ machine learning. Four kinds of learning are used to categorize machine learning.

• Supervised learning: A human expert accurately labels a batch of tracing data before it is input into the computer.

• Unsupervised learning: The term "machine learning" was first used by Arthur Samuel to describe the mechanism that allows a computer to acquire without explicit programming.

• Semi-supervised learning: As it is challenging to monitor every dataset, the accuracy of machine learning can be increased by combining a large collection of unlabeled data with a small set of labelled data.

• Reinforcement learning is a method of sequential experimentation used by computers to try to accomplish a task while interacting with a dynamic external environment, according to Hal Varian.[6]

Neural network: As the name implies, it sets the algorithm using artificial neurons. It functions almost exactly like the human brain.

Deep learning: This type of machine learning analyses the input data using a network with numerous computational layers. Traditional neural networks are another name for deep learning.

AI and Healthcare: Historical overview

The development and testing of computational systems for clinical data processing and analysis, as well as the modelling of clinical reasoning in ways beyond logical, statistical, and pattern recognition are all goals of this research, which aims to study, understand, and develop computational models of the scientific information and problem-solving approach used by biomedical scientists.

By the middle of the 1970s, the earliest stage of AI in medicine research had been realized thanks to Stanford University's time-sharing facility. SUMEX-AIM[7] and a series of workshops on AI in medical field started at Rutgers University[4] enhanced on study trends in the USA that eventually touched over the following ten years to a knowledge engineering standard for creating professional and skillful systems. This resulted in the broad and global development and use of rule-based systems and heuristic problem-solving techniques for a variety of sectors outside of biomedicine, including the Japanese fifth.

Due to early widespread use of knowledge-based systems and the blatant underestimate of the expense of building, maintaining, keeping up with, and assuring dependable performance of expert knowledge-bases, a second "AI Winter" unfortunately occurred by the middle to end of the 1980s. A variety of statistical and experimental models for pattern recognition, machine learning, and discovery were examined in the 1980s as the second AI Winter drew near. Also, it placed a lot of emphasis on explanation and description models as a way to teach students about the fundamental assumptions behind the creation of knowledge- and rule-based systems.

Applications of AI:

Health care systems have a wealth of data that can be used as excellent learning inputs by decision support systems that use machine learning. Clinical decision support can increase the reliability of the diagnosis and aid healthcare professionals in deciphering the intricacies of clinical variabilities. It could be used for condition analysis and treatment planning in the fields of periodontics, oral surgery and orthodontics. It also serves to lower the number of frivolous dental insurance claims by verifying that the information that patients supply is accurate.[8] The dental assistant may eventually be replaced by an AI complete care system in dental clinics The treatment strategy will be decided upon by the patient analyst in advance of each appointment based on the patient's age, sex, health records, vital signs, present health conditions, and drug use.

AI and Compute aided Designing / Computer aided Milling (CAD/CAM)

Both the patient and the physician expect the prosthetics in the field of prosthodontics to be of the highest quality. A massive amount of equipment and manpower go into producing a flawless result; but occasionally, manpower alone may fall short of requirements. The computer features a designing and manufacturing unit that permits us to design, mill, or print according to the patient's demand in order to save time and energy. The primary advantage of AI is its capacity to evaluate and learn from the millions of dentist-approved crowns in the database, which are continuously updated to the cloud. The enormous amount of dental anatomical data that may be available is routinely used to evaluate aesthetics.

Implant Therapy and AI

The most effective dental implant treatment planning utilizes both the Cone beam computed tomography picture and intra-oral scan. The use of Artificial intelligence in implantology has ability to combine both and create the prosthetics of the future. The Alan Turing Institute, Planmeca, and University Hospital of Tampere researchers have developed a novel model to accurately and automatically pinpoint the mandibular canal for dental implant surgeries. Using panoramic radiography pictures, implant systems can be identified using deep learning-based object detection.[9]

Fixed Dental Prostheses and AI

When creating fixed dental prostheses in the past, dental experts would often use a handpiece and a variety of burs to physically prepare the tooth edges. The appropriate extension and contour of the marginal line surrounding the teeth offered a healthy environment and protection for the gums and periodontal tissues, which also helped keep the prosthesis in place. These techniques demanded additional time and highly developed technical abilities. The intention was to eliminate the tiresome manual errors. Zhang et al. used a model to study deep learning and precisely evaluate the marginal line.

Maxillofacial Prostheses and AI

Twelve individuals with vision impairments have previously tried the artificial eye, which was developed in the US. These technologies can assist patients in achieving vision without surgery with the use of artificial intelligence. In this way, a smart camera mounted on specialized glasses might read text or identify faces. The expert decodes the data the camera recorded, transforms it to audio, and then uses a small headset to transmit it to the

visually impaired patient's ears. Those with severed limbs might no longer be able to sense in those areas. Scenarios are altering as a result of the artificial skin developed by scientists at the California Institute of Technology and the Federal Polytechnic School of Zurich. The tissue can detect temperature changes in the range of 5 to 50 degrees Celsius since it is covered with a thin, transparent coating of pectin and water. By simulating the human olfactory system, which can distinguish between different smells and is used in a variety of fields, including environmental monitoring, disease diagnosis, public security issues, agricultural production, and the food industry, artificial olfaction plays a critical role in robotics. [10]

Tongue Controlled Devices

Our goal has been to create tongue-computer interfaces that are non-invasive, precise and self-contained, and that can make up for hand and arm functions, which are considered to be the most important for severely disabled people. The tongue drive system (TDS) has ability to track the movements of the tongue inside the mouth and respond to orders given in the guidelines. These instructions can then be utilized to operate a wheelchair, access a computer, or manage the surroundings around the person. [11]

Limitations and Future Scope:

Datasets had a big impact on AI. These datasets should be accurately categorized and filtered for excellent model training. The majority of the data were in paper format, and because follow-up therapy was not properly informed, data consolidation was not done properly. The medical industry had begun digitizing reports and diagnoses at the time, but there was still more work to be done before accurate data could be collected for model training. The introduction of AI held promise for the future because it would allow for a decentralization of the therapeutic process. AI improved the manner that medical practitioners delivered remote care. In the future, disease diagnosis will be more accurate because AI will be able to foresee outcomes that may be paired with manual diagnosis to boost the likelihood of accurate diagnosis.

Conclusion:

Artificial intelligence has significantly changed both medicine and dentistry. Although artificial intelligence systems are very useful in dentistry and dental education, it should be highlighted that these technology advancements are still the result of human inventions and discoveries because the human biological system is complex. Furthermore, AI cannot replace human knowledge, expertise, or treatment planning; it can only assist the physician in carrying out the responsibilities in a professional manner.

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