

ARTIFICIAL INTELLIGENCE: A NEW FRONTIER OF POSSIBILITIES IN PROSTHODONTICS

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Abstract- Artificial intelligence has remarkably increased its presence and significance in medicine and dentistry in numerous ways and the branch of Prosthodontics is no exception to this. In Prosthodontics, artificial intelligence holds lot of importance in patient diagnosis, storage of data, medical history, radiographs and clinical examination findings, reducing manpower and providing treatment recommendations or predicting treatment outcomes. With the availability of various software and algorithms it has become a breakthrough in the field of Prosthodontics as it helps in the designing of prostheses and in the making of maxillofacial appliances.

Keywords: Artificial intelligence, prosthodontics, implants, diagnosis and treatment planning.

INTRODUCTION:

Artificial Intelligence (AI) is a rapidly evolving field that aims to develop intelligent machines capable of performing tasks that typically require human intelligence. The term artificial intelligence was first coined by John McCarthy in 1956 when he held the first academic conference on the subject^{1,2}.

AI has made significant advancements in recent years, driven by breakthroughs in machine learning, deep learning and robotics. The power of AI lies in its ability to process and analyze massive amounts of data, extract meaningful insights, and make predictions or decisions based on patterns and algorithms. Machine learning techniques enable AI systems to learn from data and improve their performance over time, making them more accurate and efficient in their tasks.

Artificial Intelligence (AI) is making significant strides in various fields of healthcare including dentistry. Prosthodontics is the branch of dental speciality that focuses on the restoration and replacement of missing teeth and associated oral structures. With advancements in AI, prosthodontics is experiencing a transformation, offering improved treatment planning, customization, and patient outcomes.

This paper aims to provide insight into the current concepts and the likely future prospects of artificial intelligence in prosthodontics.

MACHINE LEARNING³

Artificial Intelligence applications are made possible by machine learning (ML). It enables computers to learn from data. The various machine learning methods include-

1. Supervised learning- A training data set is used, which is correctly labelled by a human expert, which helps to find patterns and make predictions.
2. Unsupervised learning- In this, unlabelled data are provided to the learning algorithm and the computer then describes the hidden structure of the data without human guidance, separating the data into clusters or groups.
3. Semi-supervised learning- Large amounts of unlabelled data are combined with a small amount of labelled data, the accuracy of Machine learning classification is improved.
4. Reinforcement learning- The computer generates its own training data through experimentation and optimization of the outputs.
5. Neural networks- an artificial neural network is a computer program that "learns" by mathematically adjusting the probability weights between nodes in a number of successive layers so that the difference between the input and output layers narrows until the actual output of the network matches the desired output.
6. Deep learning- It is a subset of neural networks that use multiple processing layers of interconnected neurons between input and output layers to recognize a pattern.

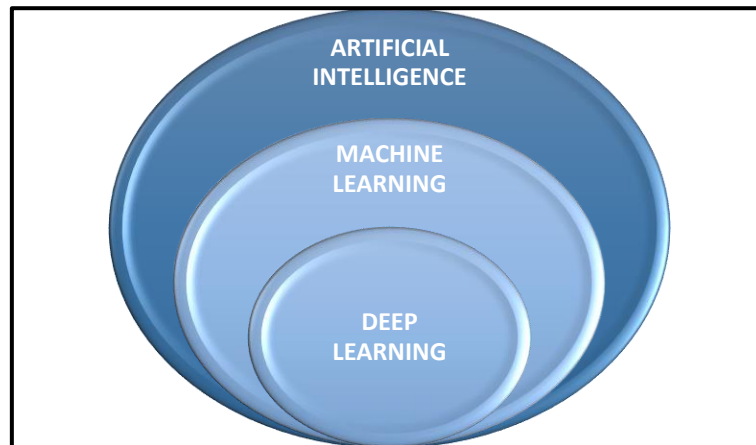


Fig 1 – Key Aspects In ARTIFICIAL INTELLIGENCE

APPLICATIONS OF ARTIFICIAL INTELLIGENCE-

1) DIAGNOSIS AND TREATMENT PLANNING-

Applications of artificial intelligence in dentistry include diagnosis, decision-making, treatment planning, and result prediction. One of the most common ones is diagnosis. The workload of dentists can be reduced by using artificial intelligence to make diagnoses that are more precise and effective.

On one side, dentists are utilizing computers to make choices more frequently. On the other side, dental computer programmes are improving in intelligence, accuracy, and dependability. When attempting to treat even one patient, prosthodontists today are confronted with a deluge of information due to the development of data processing, cloud computing, and the massive amount of data generated.

By assisting in the extraction of clinically pertinent insights from the plethora of information accessible, AI has the potential to give these experts the power to accelerate and enhance their rehabilitative capacities.^{4,5}

2) RADIOLOGY

In oral radiology, a drastic revolution is expected with respect to quality, and value of radiology's contribution to patient care with the implementation of artificial intelligence. Artificial intelligence platform detects and outlines decay and quantifies bone loss on radiographs in real-time guiding you to arrive at precise and accurate diagnostic decisions. AI is also used for the interpretation of radiographic lesions and automated interpretation of dental radiographs, vertical root fractures, and bone density evaluation to predict osteoporosis using OPGs and Forensic dental imaging⁶.

3) CAD-CAM

The computer-aided design/computer-aided manufacturing is used in the creation of both permanent and removable dental prostheses. An ideal crown design for a variety of circumstances may be provided by this technique using data from many actual crowns. Desktop design and CAD/CAM fabrication has become standard in healthcare and labs. Artificial intelligence is now being included in CAD-CAM technology as well due to emerging dental digitization advances.

Artificial intelligence application CAD-CAM technology includes machine learning which enables realigning the teeth to restore the inter-maxillary connections. Artificial intelligence (AI) might help with precise color matching in difficult aesthetic circumstances involving a single central incisor or several front teeth. In implant prosthodontics, implant locations may be identified with the use of intraoral detectors, and this information can then be inputted into the CAD program in real time⁴.

4) INTRAORAL SCANNERS

Artificial Intelligence has rightly added a lot of convenience to the digital scanning process. This is because the scanners that come with AI features help labs automate the process of designing the crowns in a negligible amount of time. Further, these scanners can easily trace the surface caries without the help of any other scanning devices. Also, you can easily plan the starting point of your treatment as you can easily move the soft tissues such as the tongue, lip, and cheeks⁷.

5) IMPLANTOLOGY

The introduction of Artificial intelligence in the field of implantology has the potential to merge together both CBCT images and intraoral scans of dental implants and design future prostheses.

The advent of robotic system in implantology includes YOMI by NEOCOIS⁸, which is the 1st and only FDA-cleared robotic system for dental surgery. Characteristics of YOMI includes Real-time patient tracking, minimally invasive treatment, accessible surgical site, accurate and precise implant placement, intraoperative flexibility and multisensory feedback.

It uses haptics to physically guide the clinician, so they can perform surgery exactly as planned. YOMI is a clinician friendly device which does not require Computed tomography based imaging.

6) SMILE DESIGNING

Prosthodontists now have access to AI-based smile design software that allows them to create highly personalized and esthetically pleasing smile designs. By leveraging advanced algorithms, the software can analyze the patient's facial features, including lip line, facial symmetry, and tooth shape and size, using a series of photos, intraoral and CBCT scans uploaded into the program to create

a virtual patient. With the ability to simulate, customize, and test proposed changes to the patient's dentition, the dentist and patient can clearly understand the final result before moving forward⁹.

7) MAXILLOFACIAL PROSTHESIS

AI employs convolutional neural networks (CNNs) that mimic human neurons. These AI-powered gadgets can help individuals see without surgery. AI and certain designing tools help dentists build the most beautiful prosthesis for patients, considering anthropological calculations, face dimensions, ethnicity, and patient preference. There are smart reading glasses available for the blind and visually challenged. It is an innovative voice-activated gadget that can be attached to almost any pair of glasses. It is designed primarily to help blind and visually challenged people. It can quickly read text from a book, smartphone screen, or any other surface, identify faces, work more effectively, and help its user lead an independent life.

The BIONIC eye was made in the United States, and a dozen people who had lost their sight tried it. AI is used in these technologies, which can help people see without having to have surgery. With this method, a smart camera on special glasses lets the user read text or recognize faces. An expert observes the data from the camera and turns it into sound. This sound is then sent to the blind person's ears through a wireless earpiece^{10,11}.

LIMITATIONS OF ARTIFICIAL INTELLIGENCE-

The impact of artificial intelligence on society is already significant and is expected to grow as technology improves. There is always a chance that a badly spelled symbol in the algorithm may cause a major error in the operation, or that overloaded mechanisms will simply cause the system to crash. Additionally, as prosthodontics is entrusting artificial intelligence technologies with more and more crucial tasks, the results of such failures may have unanticipated and highly unfavourable effects.

Today, artificial intelligence technologies are still not fully understood due to the complexity of their systems, and their ability to learn by themselves and change their behaviour. The information provided to the AI algorithms is the only way they can learn. However, if the software is given faulty or untrustworthy data, the findings may be biased. As a result, the intelligence or effectiveness of AI is only as good as the data provided.

Despite its speed and accuracy, the AI system cannot explain how it reached its conclusions, and there may be substantial initial investment as well as regular maintenance and repair costs associated with this new technology. Keeping up with the ever-changing demands of prosthodontics requires that AI software receives regular updates^{12,13}.

FUTURE SCOPE OF ARTIFICIAL INTELLIGENCE

From dentistry to space exploration, AI is transforming every industry. There are various advantages to biomedical diagnosis, therapy planning, patient documentation, and management. In the future, AI will create a forecast that may be combined with a human diagnosis to boost the likelihood of suitable diagnostics, leading to a higher rate of accurate diagnoses. AI now helps doctors and patients in every profession.

Despite the promising results, it is still crucial to confirm the generalizability and dependability of the offered AI models utilizing sufficient external data collected from recently recruited patients or gathered from other dental facilities. Improving AI models to the point where they can spot early problems that are invisible to the unaided eye is one of the long-term objectives of research into AI in dentistry.

There will be a significant need for AI-enabled algorithms as CAD/CAM technology advances and prosthodontic implant procedures require more accuracy.

At the level of the dentist and particularly prosthodontist, applications of AI are concerned with prosthesis fabrication, which will only be tested and determined when it is placed in the oral cavity. As a result, the final effect will be insignificant if the explainability of AI is not known to us as a prosthodontist^{14,15}.

CONCLUSION-

The integration of AI in prosthodontics presents exciting possibilities for improved treatment planning, precision, and patient outcomes. With ongoing advancements in AI technologies and their incorporation into prosthodontic practice, the future of this field holds great promise for transforming the way dental prostheses are designed, fabricated, and delivered to patients.

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