



# Sovereignty of AI Over Prosthodontics: An Era Where Technology Meets Perfection

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## ABSTRACT:

Artificial intelligence in the current scenario is grabbing attention all over the globe due to its high impact, precision and innovation. The technology has engraved deep impact over the last few decades. In order to pace up with the age of digitalization it's important to encounter recent trends and probabilities associated with its supremacy. The field of artificial intelligence (AI) with its broad spectrum is conquering areas that were previously thought to be reserved for human experts. When applied to medicine and dentistry, AI tends to improve patient care and revolutionize the health care field. In dentistry, AI is being investigated for a variety of purposes, specifically identification of normal and abnormal structures, diagnosis of diseases and prediction of treatment. It aids as an valuable asset in the process of patient documentation, diagnosis, treatment planning and patient management; providing dental health care professional to work smarter not harder. This review tends to visualize scope, probable outcomes, current and future applications of AI in prosthetic rehabilitation.

## Introduction

AI has created a revolutionary impact in every field of industry including healthcare. The technology with its devastating roots is quite complicated and is filled with data science and challenges. The concept of AI accounts for any technique which enables computer to mimic human behaviour.

The term was first used by John McCarthy in the year 1955.<sup>1</sup> AI can help the doctors and healthcare professionals in improving their decision making and patient care. Google has been working on various ventures using AI technology in healthcare for a long time. One such domain in this ambitious project is Med-PaLM2, introduced in Google IO in 2023. Med-PaLM2 is a powerful language model that can understand and generate natural language in context of medicine and can perform reasoning and inferences on basis of medical language. Med-PaLM2 a healthcare processed

version of PaLM2 which was build with ethical values, clarity in decision making, more language support and efficient to tackle complex medical complications which were initially a major concern for AI. Currently MAYO clinic is using this technology to help their doctors and medical staff in assessing patients. National institute of health (NIH) is also taking advantage of the concept to support their biomedical research and inventions.

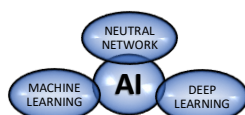
30 November 2022 was the day that changed the world's perception forever with the introduction of Chat GPT by open AI portal. It was basically a computer program that uses AI for conversation. It was for the first time when intelligence was formulated in numbers and the machine was talking to humans in their own language. This was the reason why it was adopted by millions in just 5 days. GPT stands for Generative Pre-trained Transformer, with its initial versions 1, 2 and 3



which was build for developers and version 3.5 and 4 for public domain.

### KEY ASPECTS OF AI

To understand fundamentals of AI, the basics should be acknowledged for better assessment of the technology.<sup>2</sup>



Machine learning (ML) refers to system learning which is programmed to perform services on basis of knowledge or hand-crafted rules. It was earliest documented in 1959 by Arthur Samuel.<sup>3</sup> The objective is identified from available database followed by subsequent processing. In this concept algorithm generates experience through the available data and provides subsequent adjustments by creating identification patterns. It's like when we say apple, our mind automatically generates a picture of it which has been taught to us from childhood.<sup>4</sup> Its subdivisions include-

**Supervised learning:** It comprises of tracing data set labelled by a human expert.

**Unsupervised learning:** The data is used without human guidance.

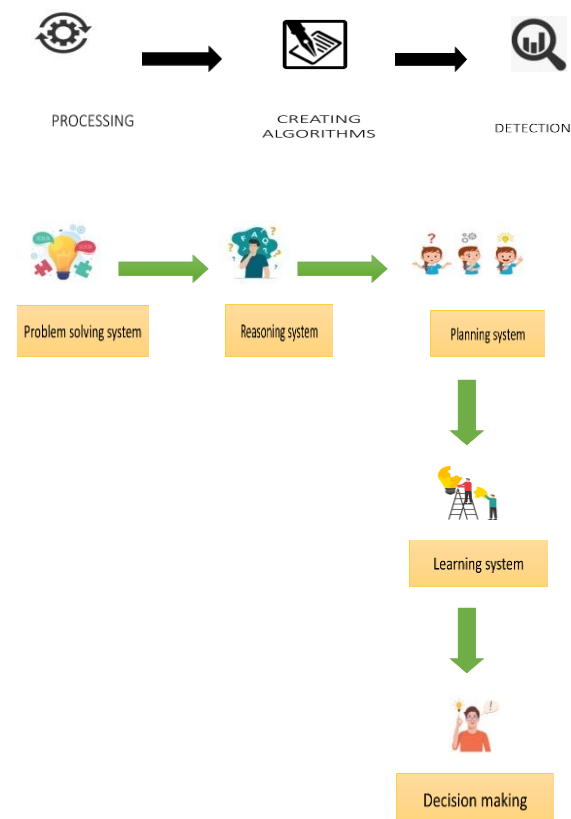
**Semi supervised learning:** At times it's not easy to supervise individual dataset, so combining large amount of unlabelled data with a small labelled data is done to enhance accuracy.

**Reinforced learning:** Sequential experimentation by system to build results from dynamic external environment.<sup>5</sup>

**Neural network:** It utilizes artificial neurons to set the algorithm and work similar to human brain.

**Deep learning (DL)** tends to create its own rules. It attempts to learn the sequential patterns and try to create a memory out of it. When we see an apple the color and shape creates a memory for it.<sup>6</sup> Deep learning is also known as conventional neural network.

### PRINCIPLE OF WORKING



### CURRENT STATUS

The technique has already influenced different medical branches and research institutes. Ample number of hospitals and institutes are taking advantage out of it. The newer versions of software that are using AI technology can predict medical events way before it is being caused on the basis of identified medical records. AI avatar for remote healthcare (Telemedicine) can help rural areas in providing emergency healthcare.

Google is also making a way to collaborate with hospitals to support generative AI in ambulatory healthcare settings. Amazon is also heading a step forward to launch new services with google and Microsoft to improve AI services in healthcare. Health Scribe Service is also a new AI powered service that automatically generates clinical documentation.

#### *Trending AI tools*

Merlin extension, Askyourpdf.com, 12 Ft.io, playground AI and gamma.ai counts for some of the popular AI tools that are being widely used in public domain that minimizes effort and save time.



## Implications of AI in prosthodontics

### *Decision making and Educational tool*

In healthcare profession machine learning enabled decision support systems are often encountered. In such cases a support in decision making may elevate diagnostic accuracy and solving complexities in clinical practice. It can help in treatment planning in specialties like Oral medicine and radiology, orthodontics, Periodontics, Prosthodontics and Oral surgery. When used as an educational tool, it guides students, graduates, and even postgraduates. It also provides the opportunity to support less-experienced undergraduate students in their professional development.

AI can help in biomedical diagnosis, therapy planning, patient recording, and management that save time and money. It can produce a forecast that could be merged with human diagnosis to improve clinical diagnosis.

Long-term goals of AI research in dentistry should include models that could detect early abnormalities that are undetectable from naked eye.

It can also be used to minimize the feudal claims in field of dental insurance; by cross checking accuracy of details provided by the patients.<sup>7</sup> The dental clinics in future may establish an AI comprehensive care system replacing the dental assistant. System with every subsequent appointment can plan treatment with reference to age, gender, vital signs, medical and dental history or any health complications.

### *Radiographic assessment with AI*

Multiple diagnosis or scans can be performed in fraction of seconds which saves time and aids value in clinical diagnosis and treatment planning. Accurate and precise radiographic diagnosis can help the clinicians to perform better with especially in cases of implant driven treatment procedures.

Periapical and panoramic radiography were used to classify implants using CNN's (convolutional neural networks) based on AI.<sup>8</sup> Studies show that AI-CNN system was virtually as efficient and effective as humans in classifying implant methods.<sup>9</sup>

A systematic study conducted by Takahashi et al.<sup>10</sup> to develop an AI model that categorizes dental arches by making use of CNN to assist in denture fabrication.

### *Applications in FPD crowns and bridges*

Recording accurate details of impression plays a very vital role during fabrication of crowns and bridges. Any potential shift in accuracy may result in improper fit and failure of prosthesis. With advancements in scanning process and assistance from AI may help in depletion of hose errors. Margin detection and precise accuracy of detail using AI assistance may help the clinicians to improve clinical cases.<sup>11</sup>

### *Optical impressions and AI*

In Prosthodontics, gold standard quality of prostheses aids a fundamental requirement for both clinician and patient. In order to achieve desired goals and perfection both manpower and machinery play a vital role and sometimes manpower alone may fail to deliver for success of prosthesis. To save the time and energy the computer has this designing and manufacturing unit that enables us to design mill or print according to the patient's desire. AI has the ability to assess and learn from the millions of clinician-approved crowns and bridges in the database which are built and updated in cloud on regular basis. Perfect esthetics and contouring can be evaluated by visualizing and detecting the anatomical information available in data base. It adds value by replacing the conventional techniques available, which consumes time and may cause error in decision making.<sup>12</sup>

### *Clinical Implantology and AI*

To achieve successful treatment planning for dental implant prosthesis CBCT image and intraoral scans play a key role. With introduction of AI in field of implantology, it will not only elevate diagnosis and treatment planning but will also improve errors in prosthesis fabrication.<sup>14,15,16</sup>

Researchers at the Finnish Center for Artificial Intelligence (FCAI), the University Hospital of Tampere, Planmeca and the Alan Turing Institute proposed a model that can accurately and automatically identify the exact position of the mandibular canal for dental implant procedures. With the help of deep learning based object detection, implant systems can be identified from panoramic radiographic images.

### *AI's Assistance in Maxillofacial prosthodontics*

AI uses CNN's that mimic human neurons. In US patients having vision impairments were tried with AI-powered which helped them to see without surgery. AI driven tools help clinicians to fabricate prosthesis for



patients, visualizing anthropological calculations, ethnicity, face dimensions, and patient preference. There are smart glasses with innovative voice-activation designed to help blind and visually impaired people.<sup>17</sup> Development of artificial skin in patients with limb amputation has changed the scenario.

Artificial olfaction mimics human olfactory structure to identify different smell sensation. Different sensors are built to identify various odors. The pattern combination of these signals help in recognizing, identifying and categorizing different sensations.<sup>18</sup>

#### *Cloud dentistry and AI*

The program is already in association with AI technique to match dental jobs, consultations in co-relation with clinics and hospitals for clinicians seeking for jobs.

#### *Rapid prototyping with AI*

In recent years rapid prototyping has revolutionized the approach towards prosthesis design and fabrication. It allows us to quickly visualize and test ideas, making development process more agile. However a careful assessment is needed so as to perform proper functioning. It is important to step back and assess whether the prototype aligns with users need and objectives. AI has made digital products faster and accessible for users, it can help the clinician to spot out those errors and rectify them for better results.

#### **Would AI replace doctors? Challenges for AI**

Every innovation deals with risk of acceptance. Change is a constant rule of nature, the merits and demerits associated with any technology have to be resolved accordingly. The scenario if AI would replace doctors is a hot topic of concern for upcoming professionals. The basic flaws that play a key role in subsiding AI supremacy is its transparency and legality issues.<sup>19</sup> Every technology has a fear of being outdated and inconsistent if not updated with time and harmful if not properly handled.

Moreover the potential of AI model to deal with rare and complicated condition is yet to be tested. At times many clinical cases demand for a quick and instinct decision which is again a dilemma for a machine based algorithm. It is important to build trust with technology. AI models are generally backed by giant profit making organizations, sharing personal data and information is of high risk as every model is designed according to

choice of developer.<sup>20</sup> It is important to ensure that they are not biased or influenced by external factors such as advertisements, sponsors and political agencies. The technology should respect individual's autonomy and dignity as human being and not to treat patient as mere objects of analysis and prediction.

Emotional link and trust are the key aspects of a strong bond and relation between doctor and patient which accounts for a set back with AI technology. Another factor that would hinder with the success of AI would be its accessibility to reach more people overcoming language, geographical barrier and offering scalable solutions. Now another point of conflict which arises is who will be held responsible if a patient faces unintentional consequences resulting due to an error or adverse event caused by the AI technology? The ability of AI depends on accuracy of algorithms and labeling of the dataset used in training. Poorly labeled data may tend to poor results.<sup>21</sup>

#### *Clinical assistance and AI*

Augmented reality can be used to improve patients comfort and reduce dental anxiety. AI can elevate the skills for scheduling the appointment timing, temperature setting for the patient, music and entertainment of their taste and even the lighting that relaxes the patient.

#### **CONCLUSION**

Today we are driven in with an incredible impact of AI in healthcare. The progressive development of AI will benefit clinicians and researchers to integrate different source of knowledge and patient care. The potential ability of AI in improving accuracy of diagnosis, predicting the treatment prognosis and enhancing clinical decision making process has made a huge impact. It is boundless and limitless no bars can back AI to indulge its supremacy in human life. It is never late to start fresh, in order to cope up with newer advancement in technology one has to be smart enough to follow and grab maximum from the trend. Whenever any industry undergoes disruption there is always redistribution of wealth. Now it depends on the fact that are we ready to enjoy our share of pie. Luck happens when preparation meets opportunity. There is a chance to change the future perception of dentistry. Either we can delay and deny the future outcomes and stick to old school process or we can be action takers in order to step up with reality and be a part of the change.



It is essential to strike a balance between technology and human perfection to generate best possible outcome. Every innovation deals with limitations and challenges. AI is not “THE VOICE OF GOD” the decision could be biased and rare conditions and complexities accounts for more precision and reference.

The dilemma for upcoming healthcare professionals is the impact of AI in their field. For this proper knowledge of AI should be provided so as to gain benefit from the technology. AI is just a human built tool not a replacement. It can enhance the diagnostic procedures, improve assistance and can guide as a helping tool for clinicians. The future of AI will depend upon how fast it will update, modify and resolve its technical flaws in order to help clinicians in more beneficial way.

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