



ARTIFICIAL INTELLIGENCE IN PROSTHODONTICS- A NARRATIVE REVIEW.

Dental Science

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ABSTRACT

Prosthodontics is just one area of dentistry that has been impacted by artificial intelligence (AI). Artificial intelligence (AI) technologies, such as machine learning models and natural language processing, are used to handle and analyse massive amounts of data while minimising errors and manual input. In prosthodontics, artificial intelligence is now used in a variety of applications, including diagnosis, treatment planning, therapy, post-operative care, and patient management. This article outlines the AI platforms now in use for digital workflows in the production of removable, fixed, and implant-supported prostheses, as well as for diagnosis and dental imaging.

KEYWORDS

AI Technologies, Deep Learning, Dental Prostheses, Enhanced Patient Satisfaction

INTRODUCTION

The application of artificial intelligence (AI) has emerged as a transformative force across a variety of hospitals and medical facilities.^[1]

AI's potential has been used in dentistry to improve patient management, treatment planning, and diagnostics, completely changing the way dental care is provided. In particular, artificial intelligence (AI) technologies have been a game-changer in the prosthodontics discipline, which deals with the replacement and restoration of lost or damaged teeth. For the best functional and aesthetic results, prosthodontists depend on accuracy and precision in the design and construction of dental prostheses, such as crowns, bridges, and dentures.

Numerous technologies, including machine learning (ML), deep learning (DL), neural networks, and natural language processing (NLP), are included in artificial intelligence (AI). These technologies have the capacity to analyse vast amounts of data, identify patterns, and provide predictions.^[2]

Current Status of AI in Prosthodontics

The state of AI in prosthodontics now represents notable developments in a number of fields. Scanners with AI capabilities improve digital impression quality, enabling accurate prosthetic production. AI evaluates patient data during treatment planning to enable personalised treatments. The design and manufacturing of crowns, bridges, and dentures are streamlined by AI-powered CAD/CAM technologies. AI-powered diagnostic tools use intraoral image processing and radiography to help identify oral problems. Clinical decision-making is aided by machine learning models that forecast treatment results. Dental laboratories can increase production and decrease manual labour by implementing automated operations.

Virtual articulators mimic jaw movement to increase precision, while AI optimises prosthesis design for improved fit and function. AI also speeds up research and development by offering insights based on data. AI has the potential to significantly impact prosthodontics in the future by providing fully automated prosthetic manufacture and real-time clinical supervision. The following are the crucial elements.

A. AI in Diagnosis and Treatment Planning

Digital Imaging and Radiology: Artificial intelligence (AI) algorithms have been used into radiographic analysis to assist in the detection of dental problems such caries, periapical lesions, and bone loss. Convolutional Neural Networks (CNNs) are very good at interpreting panoramic radiographs and cone beam computed tomography (CBCT) images. Current AI systems, such as Diagnocat, provide rapid evaluation of two- or three-dimensional radiographs.^[3]

In order to create a diagnosis and a treatment plan, Videahhealth, another platform, imports and analyses radiographs and intraoral scans. To increase the influence of AI, even diagnostic devices like

CBCT machines have Safe Beam technology, which uses AI to determine the radiation dose and exposure duration needed for a given patient based on bone density and soft tissue thickness. This method has significantly decreased the patient's exposure to radiation.

Virtual Smile Design: Prosthodontists may see the results before starting treatment thanks to AI-powered software that makes virtual treatment simulations possible. This helps to improve patient satisfaction and communication. An AI-based software such as Smile Design Pro imports patient photos and assists in designing the prosthetics' shapes, colour, and form. In addition to helping the clinician, this gives the patient more control over their treatment choices.^[4]

Dental Implants: A number of AI-based technologies enable precise treatment planning for dental implants.^[5] Better diagnosis evaluation, virtual surgical planning, implant size determination, and final prosthetic design are all aided by the platforms. Current software, such as Noble Biocare's DTX Studio, lowers the likelihood of a dental implant being placed incorrectly by 50%. Radiographs, CBCT images, and intraoral scans are imported by another platform called Simplant.

AI-assisted software diagnoses, develops a treatment plan, and even predicts the treatment plan's outcome. Invivo's Anatomage software^[4] is a platform specifically designed for treatment planning while dealing with multiple implants, such as All on Four cases. In these situations, the platform helps create bespoke abutments or attachments in addition to assisting with the production of surgical guides.

B. AI in Fabrication of Prostheses

AI revolutionises prosthesis manufacture by improving accuracy, productivity, and personalisation. Artificial intelligence (AI)-driven CAD/CAM systems in prosthodontics automate the design and machining of dental prostheses, such as crowns, bridges, and dentures, guaranteeing precise fit and excellent performance. By analysing patient-specific data, machine learning algorithms allow for customised prosthetic designs that complement unique anatomical characteristics. Rapid production and prototyping are made possible by AI-driven 3D printing technology, which shortens turnaround times. AI-powered automated quality control systems identify flaws instantly, guaranteeing high production standards. By reducing human error and expediting the fabrication process, this AI integration opens the door to totally digital and patient-centered prosthetic systems.

Computer-Aided Design and Manufacturing (CAD/CAM):

3D Printing: From predicting material behaviour throughout the printing process to optimising printer settings, artificial intelligence (AI) improves the accuracy of 3D printing technologies in prosthodontics.^[6] This lessens the need for manual adjustments and produces restorations that fit better.

C. AI in Patient Management and Follow-up

By improving care coordination, monitoring, and individualised

therapy, artificial intelligence is transforming prosthodontic patient management and follow-up. By automating appointment management, intelligent scheduling solutions lessen administrative workloads and guarantee on-time visits. Chatbots driven by AI give immediate patient support by responding to questions and providing instructions for pre- and post-treatment care. By evaluating clinical data, machine learning algorithms monitor patient development, allowing for individualised follow-up plans and early problem diagnosis. When combined with wearable technology, remote monitoring tools provide ongoing evaluation of dental health, encouraging preventative care. AI aids in predicting patient needs using predictive analytics, enhancing therapy results and encouraging sustained patient involvement.

Tele-Dentistry and AI Chatbots:

Chatbots with AI capabilities are being used to follow up with patients, respond to questions, and make appointments. Better patient involvement and post-treatment care adherence are thus guaranteed.^[7]

Wearable AI Devices:

When AI is incorporated into wearable technology, it can track jaw motions, keep an eye on oral habits, and give patients receiving prosthodontic treatments—like sleep guards or TMJ appliances—real-time feedback.

D. AI Integration In Dental Lab

By increasing productivity, accuracy, and scalability, AI integration in dentistry labs has completely transformed the manufacturing of dental prostheses. The production of extremely precise crowns, bridges, and dentures is made possible by AI-powered CAD/CAM systems that automate the design and milling operations. Better fit and function are ensured by machine learning algorithms that optimise prosthetic design and material selection based on patient-specific data. Real-time product inspection via automated quality control systems lowers human error and guarantees reliable results. Same-day prosthesis fabrication is made possible by AI-driven 3D printing technology, which speeds up production. This integration turns conventional dental labs into completely digital production facilities by optimising workflows, reducing manual labour, and increasing productivity.

Advantages of AI in Prosthodontics

AI has many benefits for prosthodontics and is transforming the way doctors plan, diagnose, and treat patients. The ability of AI-powered diagnostic tools to analyse imaging data, including radiographs and 3D scans, to detect dental abnormalities more accurately than traditional approaches is one important advantage. This makes it possible to identify diseases early and schedule treatments more successfully. Artificial intelligence (AI)-powered CAD/CAM technologies guarantee extremely precise design and manufacturing of prosthetics, like as crowns, bridges, and dentures, leading to better fit and enhanced functioning. Additionally, because automated workflows increase efficiency and patient throughput by streamlining historically labour-intensive operations, these technologies drastically cut down on treatment times.^[8]

Challenges in Implementing AI in Prosthodontics

Since AI systems manage sensitive patient data, data security and privacy are important issues. Strong cybersecurity measures are necessary to guarantee adherence to healthcare data protection laws like HIPAA or GDPR.^[9] The absence of standardised procedures and regulatory frameworks tailored to AI in dentistry is another difficulty, raising questions about clinical validation and legal responsibility.^[10]

Future Prospects of AI in Prosthodontics

AI in prosthodontics has bright future possibilities; ongoing developments are anticipated to transform patient care, research, and clinical practice. AI can be very helpful in anticipating dental problems in the future, enabling preventative care.^[11] Predictive models, for example, can predict how prosthetic materials would wear, allowing for prompt replacements or modifications. Through improved imaging and data processing, AI-driven diagnostic tools will probably become more accurate and widely used, allowing for the real-time diagnosis of oral diseases. Robotics and AI integration could lead to automated implant drilling, tooth preparation, and precise prosthesis placement modifications. This could speed up surgery and increase prosthodontic procedure accuracy.^[12]

CONCLUSION

To sum up, prosthodontics has seen tremendous advancements thanks

to artificial intelligence (AI), which has transformed many facets of patient management, diagnostics, treatment planning and manufacturing. Prosthodontic care has become more accurate, efficient, and customised with the use of AI-powered tools including CAD/CAM systems, diagnostic imaging software, and predictive analytics. In addition to improving clinical results, AI's capacity to automate workflows, expedite lab procedures, and shorten treatment periods has also raised productivity in dental offices.

In the end, AI has the potential to revolutionise prosthodontics by improving clinical procedures, improving patient outcomes, and streamlining operations in dental clinics and labs.

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