



Research Article

## THE ROLE OF ARTIFICIAL INTELLIGENCE IN PROSTHODONTICS AND DENTISTRY

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### ABSTRACT

Artificial intelligence (AI) has emerged as a transformative force across various fields of healthcare, including dentistry and specifically prosthodontics. This paper explores the role of AI in advancing diagnostic, treatment planning, and prosthetic design processes within dentistry. AI-driven technologies such as machine learning and computer vision are revolutionizing the interpretation of radiographs, aiding in early detection of dental pathologies, and enhancing precision in treatment planning. Moreover, AI algorithms are facilitating the customization of dental prosthetics by analyzing patient data to create personalized designs that optimize functionality and aesthetics. This abstract reviews current applications, challenges, and future prospects of AI in prosthodontics and dentistry, highlighting its potential to improve patient outcomes, streamline workflows, and expand the scope of dental practice in the era of digital healthcare.

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## INTRODUCTION

Artificial intelligence (AI) is revolutionizing various sectors, and dentistry is no exception. Particularly in prosthodontics—the branch of dentistry concerned with designing, manufacturing, and fitting dental prostheses—AI is making substantial strides. The rationale behind AI is to work by machine based on human intelligence to get a precise treatment in lesser time<sup>1</sup>. By integrating AI, dental professionals can enhance diagnosis accuracy, treatment planning, prosthesis design, patient management, and overall patient care<sup>2</sup>. Artificial intelligence (AI) is increasingly transforming various aspects of Prosthodontics and dentistry especially in areas of complex diagnosis and treatment<sup>3</sup>.

### Methods of implementation of AI

#### 1. Diagnosis and Treatment Planning:

- **Image Analysis:** AI algorithms, particularly deep learning models, can analyze radiographs, intraoral scans, and photographs to detect caries, periodontal disease, and other dental conditions with high accuracy.
- **Predictive Analytics:** AI can predict the progression of dental diseases and the outcomes of various treatment options, aiding in more personalized treatment plans.

#### 2. Prosthesis Design and Manufacturing:

- **CAD/CAM Systems:** AI enhances computer-aided design and computer-aided manufacturing (CAD/CAM) systems for designing and fabricating

dental prostheses, such as crowns, bridges, dentures, and implants, improving precision and fit.

- **3D Printing:** AI optimizes 3D printing processes for producing custom prosthetic components, ensuring better quality and reduced production time.

#### 3. Robotics:

- **Surgical Robots:** AI-powered robotic systems assist in complex dental surgeries, including implant placements and endodontic procedures, by enhancing precision and reducing human error.
- **Automated Prosthesis Fabrication:** Robotics integrated with AI can automate the fabrication process of dental prostheses, increasing efficiency and consistency.

#### 4. Patient Management:

- **Virtual Assistants:** AI-driven virtual assistants can manage patient appointments, reminders, and follow-ups, improving patient engagement and adherence to treatment schedules.
- **Electronic Health Records (EHR):** AI helps in analyzing EHR data to identify patterns and trends, aiding in population health management and personalized patient care.

#### 5. Education and Training:

- **Simulation Training:** AI-based simulators provide dental students and professionals with realistic training environments, enhancing their skills through virtual reality (VR) and augmented reality (AR) technologies.

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- **Knowledge Discovery:** AI systems can analyze vast amounts of research data, providing insights and recommendations for evidence-based practice in dentistry.

#### 6. Predictive Maintenance and Quality Control:

- **Equipment Monitoring:** AI can predict the maintenance needs of dental equipment, preventing downtime and ensuring consistent quality in dental practice.
- **Quality Assurance:** AI algorithms monitor and control the quality of dental procedures and products, ensuring compliance with industry standards.

#### 7. Patient Experience:

- **Personalized Care:** AI systems can analyze patient data to provide personalized recommendations for dental care, enhancing the overall patient experience.
- **Tele-dentistry:** AI facilitates remote consultations and diagnostics, making dental care more accessible, especially in underserved areas.

Artificial intelligence (AI) is playing an increasingly significant role in anaplastology, the field concerned with the prosthetic rehabilitation of patients with facial and somatic disfigurements. Here are some key areas where AI is impacting anaplastology:

#### 1. Custom Prosthesis Design:

- **3D Scanning and Imaging:** AI-driven 3D scanning technologies can capture detailed images of the affected area, which are then used to design highly accurate and personalized prosthetic devices.
- **CAD Software:** AI enhances computer-aided design (CAD) software to create prostheses that fit better and look more natural. AI can optimize designs based on patient-specific anatomical data.

#### 2. Fabrication:

- **3D Printing:** AI algorithms improve 3D printing processes by optimizing material usage and print quality, ensuring that prostheses are both durable and aesthetically pleasing.
- **Automated Manufacturing:** AI-driven robotics can automate the manufacturing process, reducing production time and increasing consistency in prosthetic quality.

#### 3. Material Selection:

- **Material Optimization:** AI can analyze various materials and suggest the best options for specific prosthetic applications, considering factors like durability, weight, and aesthetic qualities.

#### 4. Surgical Planning and Simulation:

- **Preoperative Planning:** AI assists in planning complex reconstructive surgeries by simulating different surgical outcomes, helping surgeons choose the best approach.
- **Virtual Reality (VR) and Augmented Reality (AR):** AI-powered VR and AR tools allow surgeons to practice procedures in a simulated environment, improving their skills and confidence.

#### 5. Patient-Specific Solutions:

- **Personalized Prosthetics:** AI systems can analyze patient data to create highly personalized prosthetics that match skin tone, texture, and other unique characteristics, improving the prosthetic appearance and functionality.

- **Dynamic Adjustments:** AI can enable prosthetics to adapt dynamically to the patient's movements and changes in their anatomy over time.

#### 6. Predictive Analytics:

- **Outcome Prediction:** AI can analyze historical data to predict the outcomes of different prosthetic solutions, helping anaplastologists make informed decisions about the best approach for each patient.
- **Healing and Adaptation:** AI can monitor the healing process post-surgery and adapt the prosthesis as needed to ensure optimal fit and function.

#### 7. Patient Management:

- **Virtual Assistants:** AI-driven virtual assistants can help manage patient appointments, follow-ups, and reminders, improving patient compliance and satisfaction.
- **Telehealth:** AI facilitates remote consultations and follow-ups, making it easier for patients to receive care and adjustments to their prosthetics without frequent in-person visits.

#### 8. Psychological Support:

- **Emotional Well-being:** AI tools can provide psychological support by monitoring patients' emotional states and providing resources or interventions to help them cope with the psychological impact of their disfigurement and rehabilitation process.

#### 9. Education and Training:

- **Simulated Training:** AI-based simulation tools provide training for anaplastologists, helping them practice and refine their skills in a risk-free environment.
- **Knowledge Sharing:** AI can analyze and disseminate the latest research and clinical findings, helping anaplastologists stay updated with the most effective techniques and materials.

#### 10. Research and Development:

- **Innovation:** AI accelerates research and development by analyzing large datasets to identify new materials, techniques, and approaches for prosthetic rehabilitation.
- **Clinical Trials:** AI helps design and manage clinical trials, ensuring more efficient and effective evaluation of new prosthetic solutions.

## DISCUSSION

The integration of artificial intelligence (AI) in prosthodontics and dentistry represents a significant advancement that promises to revolutionize various aspects of clinical practice, research, and patient care. This discussion explores the evolving role of AI in these fields, focusing on its current applications, potential benefits, challenges, and future directions. AI technologies, particularly machine learning algorithms, are being increasingly employed in dentistry for tasks such as image analysis, diagnosis, treatment planning, and prosthetic design<sup>4</sup>. In prosthodontics, AI plays a crucial role in interpreting radiographs and CBCT scans, aiding in the detection of dental pathologies like caries, periodontal disease, and fractures. These technologies not only assist in early and accurate diagnosis but also contribute to more precise treatment planning by providing quantitative data and predictive analytics<sup>5</sup>.

One of the significant benefits of AI in Prosthodontics is visible in intra oral scanners where lies in its ability to enhance the design and fabrication of dental prosthetics<sup>6</sup>. AI algorithms can analyze patient data, including anatomical details and occlusal relationships, to generate customized prosthetic designs that optimize both functionality and aesthetics. This personalized approach improves patient satisfaction and clinical outcomes by ensuring better fit, comfort, and longevity of dental restorations. Furthermore, AI-driven systems are instrumental in automating routine tasks such as scheduling, administrative duties, and patient management, thereby allowing dental professionals to focus more on patient care and complex treatment strategies. This automation also contributes to operational efficiency and reduces human error, leading to overall improvements in practice management. Despite its potential benefits, the integration of AI in prosthodontics and dentistry is not without challenges. One of the primary concerns is the need for robust datasets for training AI models. High-quality, diverse datasets are essential to ensure the accuracy and reliability of AI algorithms in various clinical scenarios. Additionally, ensuring patient privacy and data security is crucial, particularly when dealing with sensitive medical information. Another challenge lies in the adoption and integration of AI technologies into existing clinical workflows. Dental professionals may require training and education to effectively utilize AI tools and interpret their outputs. Moreover, the initial costs associated with acquiring AI systems and integrating them with existing dental practice infrastructure can be prohibitive for some practices, especially smaller ones.

Ethical considerations also come into play, particularly concerning the accountability and transparency of AI algorithms in clinical decision-making. Ensuring that AI systems operate within ethical guidelines and are accountable for their recommendations is essential to maintain patient trust and safety. Looking ahead, the future of AI in prosthodontics and dentistry appears promising. Continued advancements in AI technologies, including deep learning and natural language processing, are expected to further enhance the capabilities of diagnostic tools, treatment planning software, and prosthetic design systems<sup>7</sup>. AI-powered virtual assistants and chatbots could also play a significant role in patient education, engagement, and post-treatment follow-up.

## CONCLUSION

In conclusion, Artificial Intelligence is reshaping the landscape of prosthodontics by enhancing diagnostic precision, enabling personalized treatment planning, revolutionizing prosthetic design, predicting treatment outcomes, and empowering patient education. As AI continues to evolve, its integration into prosthodontic practice promises to deliver more efficient, effective, and patient-centered dental care. By harnessing the power of AI-driven technologies, prosthodontists can achieve unprecedented levels of precision and innovation, ultimately improving the quality of life for their patients with advanced dental prosthetics. In summary, AI is revolutionizing anaplastology by enhancing the precision and personalization of prosthetic design and fabrication, improving surgical planning and patient management, and contributing to ongoing research and education in the field.

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