The Impact of AI on Digital Dentistry: What It Means for Prosthodontics Today

Autor: Ali Nankali, Clinical Reader in Digital Dentistry, D. Stom, PhD, CMS, SFHEA – Prosthodontics, Queen Mary University of London

Abstract

Artificial Intelligence (AI) is becoming an increasingly influential component of digital dentistry, particularly within prosthodontic practice. While historically associated with laboratory-based CAD/CAM systems, AI now extends far beyond fabrication, supporting diagnosis, treatment planning, design optimisation, and communication. This article reflects on current applications of AI in prosthodontics, drawing from recent literature, clinical observation, and informal academic insights. Examples include radiographic interpretation, CBCT-based implant planning, margin detection, and prosthesis design—all of which demonstrate measurable gains in accuracy and efficiency. Despite these advances, adoption across the profession remains varied, influenced by practitioner familiarity, perceived reliability, and limited exposure in training. This article reinforces the understanding of AI as a supportive adjunct—not a replacement—for clinical expertise. It highlights the need for gradual, informed adoption and calls for increased digital literacy among practitioners. AI holds significant promise for enhancing prosthodontic care, provided its integration is guided by professional awareness, ethical oversight, and educational readiness.

Keywords

Artificial Intelligence, Digital Dentistry, Prosthodontics, Clinical Decision Support, Dental Technology, Implantology, Diagnostic Tools, CAD/CAM, Digital Workflow.

Introduction

Artificial Intelligence (AI) is rapidly emerging as a transformative tool across various fields of healthcare, including dentistry. Recent advancements in machine learning and data analysis have positioned AI to revolutionise how dental professionals diagnose, treat, and manage oral health (Dhingra 2023). Once limited to theoretical research and speculative fiction, AI technologies are now being integrated into daily dental workflows, enhancing clinicians' abilities to diagnose, plan, and deliver care with greater precision and efficiency (Versaci 2023).

Digital dentistry is increasingly benefiting from AI. These intelligent systems can now analyse clinical data to spot patterns, lend a hand in treatment planning, and boost the precision of design and fabrication. Prosthodontics, a specialty that has long embraced digital innovations such as CAD/CAM and intraoral scanning, stands to benefit significantly from AI integration. Unlike previous hardware-driven advancements, AI introduces an intelligent layer that supports clinical judgement, automates routine tasks, and personalises patient care in unprecedented ways (Shan 2023).

Despite the potential benefits, some clinicians remain cautious, expressing concerns about the complexity, cost, and reliability of AI systems. Nevertheless, AI is already embedded in many tools currently used in dental practice. For instance, AI-powered imaging systems can automatically detect issues such as cavities, fractures, and tumours, allowing dentists to make more precise diagnoses and intervene earlier, ultimately improving patient outcomes (Lively 2024).

Methodology

This reflective article is based on a narrative review of recent, peer-reviewed literature relating to the integration of artificial intelligence (AI) in digital dentistry, with a particular focus on prosthodontic applications. Literature was sourced through recognised academic databases including PubMed, ScienceDirect, and the British Dental Journal archives, focusing on publications from 2020 to 2024.

The article is further informed by the author’s clinical and academic experience as a prosthodontist and Clinical Reader in Digital Dentistry at Queen Mary University of London. Teaching, supervision, and engagement with postgraduate students and have

provided additional insight into the current perceptions, misconceptions, and adoption barriers surrounding AI tools in prosthodontic settings.

Informal discussions within academic settings and early-stage audit observations from internal institutional reviews have also contributed to this reflective analysis. No identifiable data or individual feedback is reported, and ethical principles regarding anonymity, consent, and institutional confidentiality have been upheld throughout.

Results / Observations

Current Applications of AI in Prosthodontics

AI technologies are increasingly being integrated into various facets of prosthodontic practice, enhancing precision and efficiency in several key areas as below. However, uptake is not yet consistent across all aspects of practice, and adoption levels vary depending on several factors—most notably, the extent to which practitioners are familiar with the science and confident in its application.

Key areas:

- **Diagnosis and Treatment Planning:** AI algorithms have been developed to assist in diagnosing dental conditions and formulating treatment plans. By analysing patient data, AI can predict the success rate of dental implant surgeries and identify the most suitable type of prosthesis for a patient, thereby improving treatment outcomes (Sikri 2023). AI-assisted diagnosis and treatment planning systems have demonstrated high levels of accuracy, with studies reporting sensitivity and specificity rates exceeding 90% in detecting common dental conditions. In implantology, AI has shown promise in analysing CBCT scans to assess anatomical structures and predict surgical outcomes, contributing to improved precision and patient care (Bayrakdar 2012).
- **Design and Fabrication of Prostheses:** In the realm of fixed prosthodontics, AI contributes to the design and fabrication of dental prostheses. AI algorithms can analyse and learn from a large database of successful crown designs, providing insights into optimal contour, extension, and marginal lines for each case. This enhances the accuracy and efficiency of tooth preparation and prosthesis design (Sikri 2023).
- **Shade Selection:** Accurate shade matching is crucial for aesthetic restorations. AI applications have been developed to aid in shade selection, ensuring that prosthetic solutions are matched to the individual needs of patients, thereby improving patient satisfaction and treatment efficacy (Heboyan 2023).

- **Margin Detection and Tooth Preparation:** AI assists in detecting tooth margins and evaluating tooth preparations, which are critical steps in prosthodontic procedures. By automating these processes, AI reduces the potential for human error and enhances the quality of the final prosthesis (Al Hendi 2024).
- **Predicting Implant Success:** AI is utilised to predict the success of dental implants by analysing various patient-specific factors. This predictive capability aids clinicians in making informed decisions about implant placement and anticipating potential complications (Al Hendi 2024).
- **Fabrication of Maxillofacial Prostheses:** AI contributes to the design and fabrication of maxillofacial prostheses, enabling the creation of customised prosthetics based on anthropological calculations and patient preferences. This personalisation enhances both the functional and aesthetic outcomes for patients requiring complex rehabilitations (Benakatti 2024).

Current Utilisation and Perceptions in Prosthodontics

Despite the advancements and potential benefits, the adoption of AI in prosthodontics remains varied:

- **Limited Adoption:** While AI has gained traction in fields like orthodontics, its adoption in prosthodontics is still limited. This may be due to the complexity of prosthodontic procedures and the need for highly individualised treatment approaches (Oral Health 2025).
- **Concerns About Reliability:** A significant number of dental practitioners' express concerns regarding the reliability and accuracy of AI systems. A recent survey indicated that 67% of dental practitioners worry about the dependability of AI technologies, highlighting a barrier to widespread adoption. (Vedeahealth 2025)
- **Patient Acceptance:** On the patient side, there is a growing openness to the use of AI in dentistry. Surveys have shown that over half of respondents are receptive to AI applications, especially if they contribute to early issue detection or reduce the need for invasive treatments (Dentistry, 2023)
- **Educational Gaps:** There is a need for enhanced education and training regarding AI applications in dentistry. Studies have revealed varying levels of knowledge and attitudes towards AI among dental students and professionals, suggesting that increased exposure and instruction could facilitate more confident adoption (Yılmaz 2024).

Conclusion

The integration of artificial intelligence into digital dentistry is no longer a distant concept—it is already influencing various aspects of prosthodontic practice. From diagnostic support and treatment planning to prosthesis design and communication tools, AI is enhancing precision, efficiency, and accessibility across the workflow.

This article has highlighted how AI is currently used in prosthodontics, where adoption varies, and where perceptions and familiarity still shape its uptake. While AI is not a replacement for clinical expertise, it serves as a valuable adjunct, supporting decision-making and streamlining routine tasks. For AI to be integrated safely and effectively into specialist dental practice, it's crucial that professionals stay informed, remain open to learning, and implement these tools step by step.

Discussion

As digital dentistry continues to evolve, artificial intelligence (AI) presents both an opportunity and a challenge to modern prosthodontic practice. The evidence reviewed in this article confirms that AI-enhanced tools are already improving diagnostic accuracy, treatment planning, and design processes, particularly in areas such as implantology and prosthetic fabrication. However, the rate and extent of adoption remain variable. While some clinicians engage actively with AI-enabled systems, others express uncertainty or concern, particularly around reliability, transparency, and the perceived threat of automation.

The reluctance among some dental professionals may stem from limited exposure to AI during training, lack of confidence in interpreting machine-assisted results, or a misconception that AI requires advanced technical knowledge. These concerns are not unfounded. Like any evolving technology, AI tools vary in quality and must be evaluated critically before integration into clinical care. The risk of overreliance or misinterpretation, particularly without clear guidance or validation, cannot be ignored.

Yet, as the examples in this article illustrate, AI is already embedded in everyday systems used by dental professionals—sometimes without them even realising it. From automated radiograph analysis to virtual design suggestions and communication tools, AI supports efficiency without displacing clinical judgment. Rather than being viewed as a replacement for professional skill, AI should be embraced as a complementary resource that enhances the practitioner’s capabilities.

Moving forward, a key priority is education. Dental curricula and continuing professional development programmes must begin to include foundational training in digital literacy and AI concepts. This does not require coding knowledge but rather critical

understanding—knowing how these tools work, what their limitations are, and when to rely on them. Building digital confidence among practitioners will be essential to ensure ethical and effective integration.

Institutionally, there is a growing need to assess readiness for AI adoption. Informal insights from academic settings suggest that while interest is high, structured pathways for engagement are limited. Auditing current usage and identifying barriers will support evidence-informed strategies to guide future implementation. Professional societies such as BSSPD have a clear role in facilitating this evolution—through discussion, education, and sharing of best practice.

As with any innovation in healthcare, AI must be introduced thoughtfully and responsibly. With proper guidance, professional curiosity, and gradual implementation, AI has the potential to elevate prosthodontic care, benefiting clinicians, laboratories, and, ultimately, the patients they serve.

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Pictures

AI-generated visualisation of a ceramic crown (Micro-prosthetics) fitted on a mandibular molar, illustrating internal and external anatomy using advanced artificial intelligence design technology in prosthetics area.

A digitally designed mandibular partial denture mid-print, showcasing AI-driven workflows in modern prosthodontics.