

Review Article

Artificial Intelligence in Prosthodontics and Dental Implants: Current Status and Futuristic Overview

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Abstract: With the recent advancement in the field of artificial intelligence [AI] many path breaking innovations have come up in various specialties of medical sciences. There are numerous possibilities and usages of AI in the field of dentistry. AI is being already used in field of prosthodontics and dental implantology. The future of AI in prosthodontics and dental implants is ever developing. AI-powered tools have the potential to revolutionize the way these procedures are performed, and to improve the quality of care that dentists can provide to their patients. Some of the potential benefits of AI in prosthodontics and dental implants include improved accuracy and efficiency of diagnosis and treatment planning.

Keywords: Artificial intelligence, AI, prosthodontics, dental implants.

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INTRODUCTION

Professor John McCarthy in 1956 at the Dartmouth Conference was the first person to introduce the term artificial intelligence [AI] (Lifschitz V, 2011). Artificial Intelligence [AI] is rapidly transforming the field of dentistry, with significant potential in prosthodontics and dental implants. AI-powered tools can help dentists to make more accurate diagnoses, plan treatment more effectively, and deliver better patient care. AI is reshaping clinical practice in dentistry (Xie Bo *et al.*, 2023). AI is the ability of machines to perform tasks that normally require human intelligence. AI has become more popular and a practical tool until two decades ago (Ding *et al.*, 2023).

AI in Prosthodontics:

In the field of Prosthodontics, AI can be used to:

- **Screen for oral diseases and conditions:** AI can be used to identify early signs of oral diseases and conditions, such as caries, periodontal disease, and oral cancer. This can help dentists to identify and treat these conditions early, when they are easier to manage (Chou YL *et al.*, 2021; Chau RCW *et al.*, 2023; Kühnisch J *et al.*, 2021; Warin K *et al.*, 2022; James BL *et al.*, 2021).
- **Plan treatment:** AI can be used to create 3D models of the patient's mouth, which can then be used to plan treatment. This can help dentists to visualize the

best way to restore the patient's teeth and bite, and to ensure that the treatment is precisely executed (Chen YW *et al.*, 2020).

- **Analyse impressions:** This can be used to identify areas of the impression that are not accurate, and to make adjustments to the impression as needed. This can help to ensure that the final prosthesis is a perfect fit (Morita K *et al.*, 2022; Ding H *et al.*, 2023; Wei J *et al.*, 2018).
- **Design prostheses:** This can be done by using the digital model of the teeth and gums to create a 3D model of the prosthesis. This can help to ensure that the prosthesis is designed to fit the patient's mouth perfectly and to function as effectively as possible (Morita K *et al.*, 2022; Ding H *et al.*, 2023; Wei J *et al.*, 2018).
- **Customize prostheses:** AI can be used to customize prostheses to the individual patient's needs. This can help to improve the fit, comfort, and appearance of the prostheses, and to ensure that they function as effectively as possible (Morita K *et al.*, 2022; Ding H *et al.*, 2023; Wei J *et al.*, 2018).
- **Automate tasks:** AI can be used to automate tasks in the prosthodontic workflow, such as image analysis, data entry, and treatment planning. This can free up dentists' time so that they can focus on providing more personalized care to their patients (Rodrigues JA *et al.*, 2021).

- *Create virtual impressions:* This is done by scanning the patient's mouth with a three-dimensional [3D] scanner, and then using AI to create a digital model of the teeth and gums. This can be a more accurate and efficient way to create impressions than traditional methods, such as using impression materials.
- *Minimise occlusal interferences:* With T-Scan and other occlusal analysing devices the occlusal interferences can be minimised, thus reducing the dentists' chair-side time for occlusal adjustments.

AI in Dental Implants:

In the field of oral implantology, AI can be used to:

- *Identify the best implant placement sites:* AI can be used to analyse 3D images of the patient's jawbone to identify the best sites for implant placement. This can help to ensure that the implants are placed in the correct location and orientation, which is essential for long-term success (Mangano FG *et al.*, 2023).
- *Predict implant success:* AI can be used to predict the likelihood of implant success based on a variety of factors, such as the patient's medical history, the quality of the jawbone, and the type of implant used. This information can help dentists to make informed decisions about whether or not to proceed with implant treatment (Revilla-León M *et al.*, 2023).
- *Optimize implant design:* AI can be used to optimize the design of dental implants to improve their strength, durability, and osseointegration. This can help to improve the long-term success of implant treatment (Choudhury S *et al.*, 2022).
- *Optimize occlusal scheme designing:* Even for implant supported prostheses occlusal analysing devices and AI can be used to design an occlusion which has least unwanted interferences, thus leading to better and long term stable prostheses.
- *Automate tasks:* AI can be used to automate tasks in the implant workflow, such as image analysis, data entry, and treatment planning. This can free up dentists' time so that they can focus on providing more personalized care to their patients (Rodrigues JA *et al.*, 2021).

Here are some of the challenges that need to be addressed before AI can be fully implemented in prosthodontics and dental implants:

- *Data collection and labelling:* The development of AI-powered tools requires large amounts of data, which must be carefully labelled to train the algorithms. This can be a time-consuming and expensive process (Kühnisch J *et al.*, 2021).
- *Computer power:* AI algorithms can be computationally demanding, which requires powerful computers. This can limit the accessibility of AI-powered tools to some practitioners (Chou YL *et al.*, 2021).
- *Ethical considerations:* The use of AI in healthcare raises a number of ethical considerations, such as

patient privacy and the potential for bias in the algorithms. These issues require careful considerations, before AI can be incorporated in the field of prosthodontics and dental implants (Morita K *et al.*, 2022; Morch CM *et al.*, 2021)

Despite these challenges, the future of AI in prosthodontics and dental implants is bright. As AI technology continues to develop, it is likely that AI will play an increasingly important role in these fields, improving the quality of care that dentists can provide to their patients (Chou YL *et al.*, 2021).

DISCUSSION

AI-powered tools can help dentists to identify oral diseases and conditions earlier, and to plan treatment more effectively. This can lead to better patient outcomes and reduced costs. AI-powered tools can be used to personalize the treatment plan for individual patients by customizing the prostheses and implants to the individual patient's needs. This can improve the fit, comfort, and appearance of the prostheses, and can also help to improve patient satisfaction. AI-powered tools can also be extremely useful in automatizing tasks in the prosthodontic and dental implant workflow, such as image analysis and data entry. This can free up dentists' time so that they can focus on providing more personalized care to their patients. However, there are also a number of challenges that need to be addressed before AI can be fully implemented in prosthodontics and dental implants.

In the future, AI is likely to be used in a variety of ways to improve the diagnosis, treatment, and management of oral diseases and conditions. For example, AI-powered tools could be used to identify oral cancer at an earlier stage; predict the likelihood of success for dental implants etc (Chen YW *et al.*, 2020). The use of digital designing and manufacturing has become more popular in the last two decades (Tamrakar AK *et al.*, 2014). As the field of dentistry continues to evolve and embrace technology, the use of AI is becoming an increasingly important tool for improving patient outcomes and enhancing the delivery of dental care (Bianchi J, 2023).

It is anticipated that AI will bring similar efficiencies to dentistry as those seen in other healthcare areas. AI is expected to increase the consistency in dental diagnoses and treatment (Stanley K, 2023). AI in dentistry is building upon various digital tools the dental profession has already adopted. AI will support and improve patients' oral health (Balaban C *et al.*, 2021). AI and deep learning techniques can also be used in evaluation of dental panoramic radiographs and analyses of other dental radiographic images (Singh NK *et al.*, 2022; Singh NK *et al.*, 2023).

CONCLUSION

Overall, the future of AI in prosthodontics and dental implants is bright. AI-powered tools have the potential to revolutionize the way these procedures are performed, and to improve the quality of care that dentists can provide to their patients. As AI technology continues to develop, we can expect to see even more innovative and beneficial applications of AI in this field.

Conflict of Interest: None

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