

The application of artificial intelligence in implant dentistry

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Abstract

Implant dentistry is rapidly adopting artificial intelligence (AI), revolutionizing various aspects of the field. AI facilitates efficient systematic reviews, predicts implant failure rates, and aids in detecting complications using radiographs and CT scans. Additionally, AI enhances patient education and engagement by providing personalized reports. Advancements include automated implant planning, image analysis, predictive modeling, virtual surgical simulation, and AI-assisted robotic surgery. These applications optimize treatment processes, improve accuracy, and ensure better outcomes. Continued research will further enhance AI integration in implant dentistry, benefitting both patients and clinicians.

Keywords: Artificial intelligence; Implant dentistry; CBCT; Deep learning

1. Introduction

Implant dentistry is a specialized field within dentistry that focuses on the placement and restoration of dental implants. With advancements in technology, artificial intelligence (AI) has emerged as a promising tool in various medical fields, including dentistry. This article aims to explore the application of AI in implant dentistry and its potential benefits.

Artificial Intelligence (AI) has been making waves across various sectors and the field of dental implantology is not an exception. Advances in AI have opened up new avenues in implant dentistry, transforming the way procedures are performed, outcomes are predicted, and results are evaluated (1).

As revealed in the systematic review and meta-analysis on porcelain-fused-to-metal tooth-implant-supported prostheses versus implant-supported prostheses by Fathi et al., (2) evaluating the outcomes and complications of implant procedures is a complex task. This process can be made more efficient with AI.

AI can be used to analyze large data sets, such as those collected in systematic reviews, more efficiently and accurately. AI algorithms can sift through hundreds of articles, selecting relevant ones for review, evaluating the quality of research, and extracting pertinent information. This can significantly decrease the time it takes to perform a systematic review, increase the accuracy of results, and allow clinicians to make informed decisions quickly.

Moreover, AI can potentially be used in the prediction of implant failure rates. Using AI, data from past implant procedures, clinical observations, and other patient information can be utilized to establish predictive models. These models can help to identify the risk of implant failure, or failure in other field of dentistry (3,4) thus aiding clinicians in making the most suitable treatment choice for their patients.

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AI can also be used to evaluate the success of dental procedures and identify potential complications. Utilizing images from radiographs and CT scans, AI can be taught to recognize signs of complications such as bone loss around the implant, infection, or incorrect placement of the implant.

AI can also be used to detect anatomical landmark from various radiographical images, as it shown in the Dashti, et. al. (5), deep learning algorithms have an high accuracy for detecting anatomical landmarks using lateral cephalometric images.

Not only does AI have the potential to speed up research and aid in clinical decision-making, but it can also enhance patient education and engagement. By delivering personalized, comprehensible reports of implant procedures and outcomes, AI can inform patients about their dental health and treatment options, enhancing their understanding and participation in their care.

AI can help scientists and researchers with writing of papers and scientific articles, but there is still a need for an oversight on the use of AI in that field. Dashti, et. al. (6) showed that artificial intelligence language chatbot, the ChatGPT has zero accuracy when it comes to generating citations and references, and it must be used by caution.

Overall, the application of AI in implant dentistry can streamline the research process, increase the accuracy of predictions, assist in early detection of complications, and promote patient engagement. Further research and development are needed to unlock the full potential that AI holds in transforming implant dentistry.

Some of the advancement of AI in the field of implant dentistry are as bellow:

1. **Automated Implant Planning:** AI algorithms can analyze multiple patient factors, such as bone density, anatomy, and occlusion, to generate automated implant planning. By utilizing machine learning techniques, AI can provide accurate and efficient implant placement recommendations, optimizing the treatment process.
2. **Image Analysis and Interpretation:** AI systems can analyze dental radiographs, cone-beam computed tomography (CBCT) scans, and other imaging modalities to identify relevant structures, anatomical landmarks, and potential complications. This enables efficient diagnosis, treatment planning, and evaluation of implant success rates.
3. **Predictive Modeling:** Machine learning algorithms can analyze large datasets of patient records, implant outcomes, and systemic factors to develop predictive models. These models can assist in estimating the long-term success rates of dental implants and help clinicians make informed decisions about treatment options.
4. **Virtual Surgical Simulation:** AI technology, combined with virtual reality, enables dentists to simulate implant surgery in a virtual environment. This allows for preoperative planning, practice, and visualization of complex implant procedures. Virtual surgical simulation enhances accuracy and reduces the risk of complications during the actual surgery.
5. **AI-assisted Robotic Surgery:** In recent years, robotic systems have been developed to assist dentists during implant surgery. AI algorithms enable real-time feedback, precise navigation, and automation of certain surgical tasks. This technology enhances the accuracy, safety, and efficiency of implant placement procedures.

2. Conclusion

The application of AI in implant dentistry holds great promise for improving accuracy, efficiency, and outcomes in various aspects of the treatment process. Automated implant planning, image analysis, predictive modeling, virtual surgical simulation, and AI-assisted robotic surgery are some of the key areas where AI is making a significant impact. Continued research and development in this field will further enhance the integration of AI in implant dentistry, ultimately benefitting both patients and clinicians.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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