# Advancing Guided Implant Surgery: A Comprehensive Literature Review on the Integration of Artificial Intelligence and Augmented Reality for Precision and Predictability

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## Introduction

The field has witnessed significant evolution since the FDA's 2017 endorsement of robotic implant dentistry. Broadly categorized, robotic-assisted surgeries fall into two types: static and dynamic, with our attention centered on the dynamic approach. With current technologies predominantly leveraging Artificial Intelligence (AI) for enhanced precision, there's emerging literature hinting at the potential of Augmented Reality (AR). This poster explores the synergistic integration of AI and AR in robotic implant dentistry, postulating a combined approach as the future of surgical excellence.

## Background

The purpose of this literature review is to investigate how AI and AR have been reshaping dental practice, with a focus on systems like Yomi (Neocis, Inc) that employ AI for precise implant dentistry. By understanding the added potential of AR's real-time visualization, we aim to identify opportunities for a synergistic approach that could optimize outcomes in robotic implant placement.

## Materials and Methods

A comprehensive literature review was undertaken using various search engines and databases, namely PubMed, Cochrane, Embase, and Google Scholar. Our search strategy hinged on keywords such as: "artificial intelligence“ AND "augmented reality“ AND "robotic implant dentistry“ OR "guided implant placement” OR “dynamic navigation”. From the plethora of articles retrieved, 11 articles were deemed most relevant to our research objectives. The literature articles include but are not limited to systematic reviews, meta-analyses, and clinical reports, including case series.

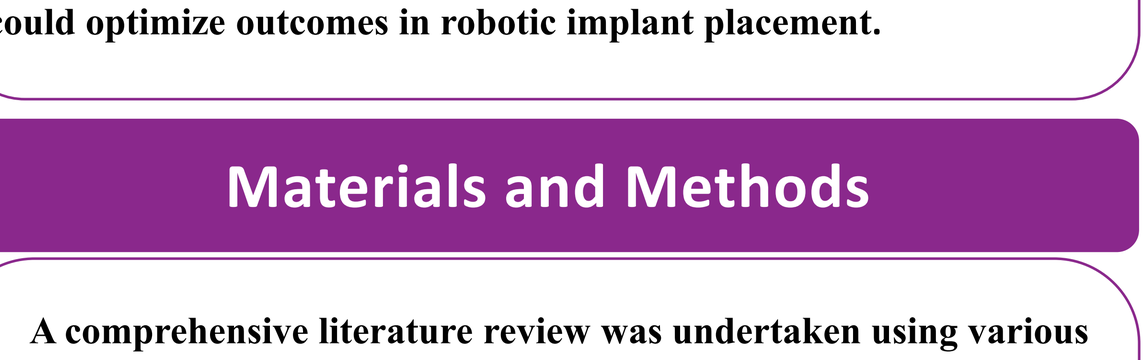



Figure 1: Augmented reality (AR) dental implant navigation system. CBCT: cone-beam computed tomography (AI); HMD: a head-mounted display device; IV: integral videography.

## Combining AI and AR in a synergistic approach for robotic implant placement offers:

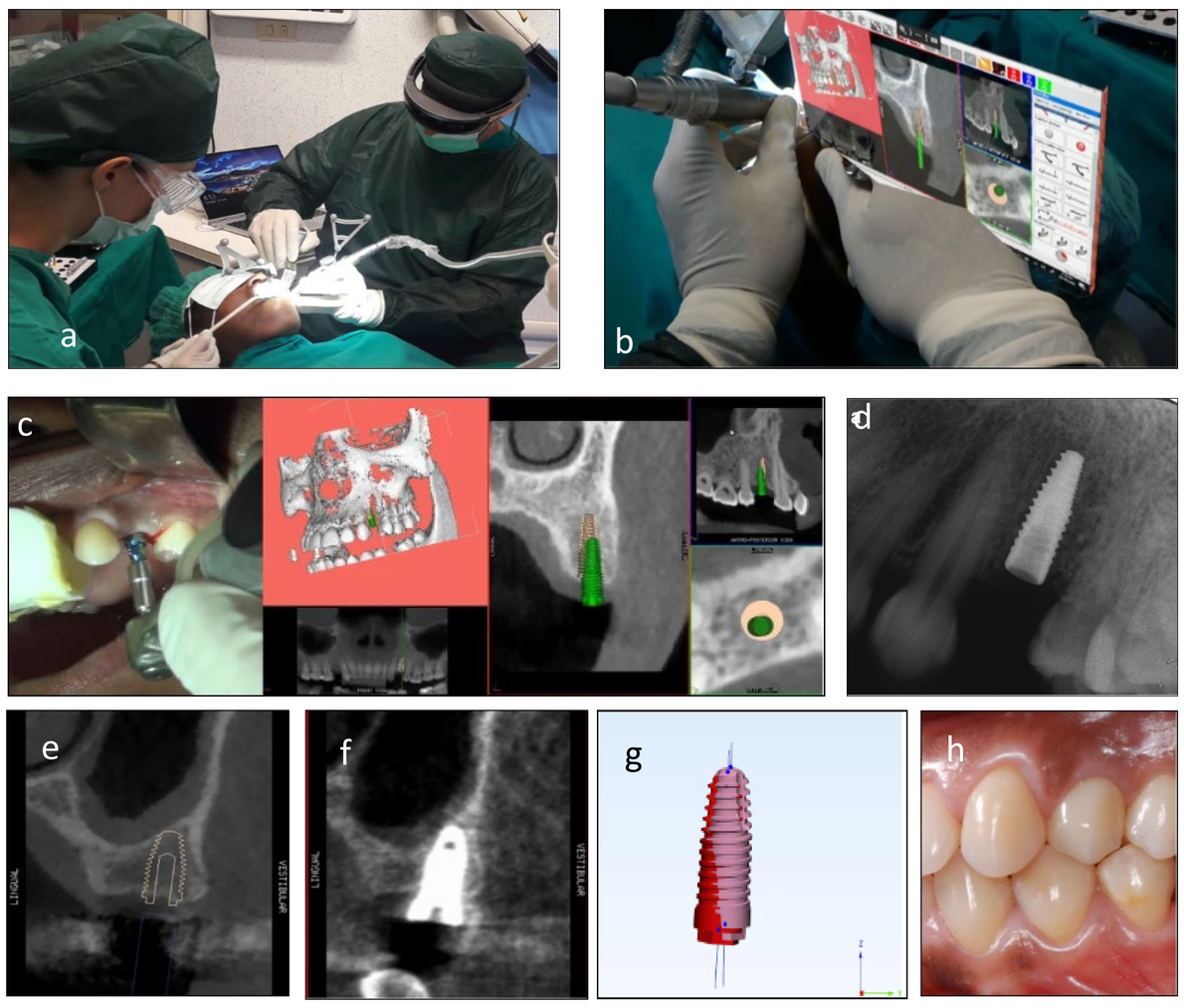
- **Tailored Visualization:** AI-driven analytics and design optimization integrated with AR's immersive visualization for superior implant selection and customization.
- **Precision Navigation:** Combining AI's predictive trajectories with AR's real-time guidance, ensuring flawless implant placements.
- **Proactive Risk Management:** AI detects potential osteointegration challenges, while AR highlights these zones visually during surgery, ensuring heightened awareness.
- **Advanced Path Planning:** Depth perception from AR complemented by AI's algorithms refines implant trajectory forecasts, making them more reliable.
- **Comprehensive Decision Support:** The synergy of AI's data analytics with AR's live visualization provides clinicians with enriched insights, promoting better surgical outcomes.

## Results

| Mean Deviation | Conventional Navigation (Robotic Implant Placement) | AR Navigation |
|---|---|---|
| Apical (mm) | 0.95 | 0.93 |
| Coronal (mm) | 1.04 | 0.86 |
| Depth (mm) | 0.42 | 0.78 |
| Angular (°) | 2.56 | 3.96 |

Figure 2: positional deviations of the implant placed with conventional navigation vs AR navigation

## Case




The case is taken from Article 1 mentioned in the references

Figure 3 a: HoloLens glasses and navigation system, b: The view of the surgeon during the surgery, c: The real and the virtual implant position, d: Postoperative radiographs, e: Implant position planned to be close to the maxillary sinus, f: Postoperative implant position on CBCT, g: Superimposed view showing the correspondence between the planned and the real implant position, h: The prosthetic rehabilitation of one implant with a screw-retained crown

## Conclusion

The synergy of AI and AR in implant surgery offers undeniable advancements in patient-centric care. By eliminating the surgical stent and providing real-time feedback, dentists no longer need to divert their gaze, potentially shortening procedure lengths and enhancing precision. However, success hinges on extensive research, more case reports, and mastering a steep learning curve. Dentists must adapt to this technological evolution, ensuring meticulous skill development to exploit AI and AR's full potential. In an ever-evolving dental landscape, embracing such innovations is not just beneficial—it's essential.

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