How Does AI Support Surgical Skills Assessment?

Rasit Dinc

Rasit Dinc Digital Health & AI Research

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Abstract

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Author: Rasit Dinc

Introduction

The landscape of surgical training is undergoing a significant transformation, driven by the integration of artificial intelligence (AI). Traditionally, the assessment of surgical skills has been a subjective process, relying heavily on the observations and feedback of senior surgeons. While invaluable, this method can be prone to variability and may not always provide the consistent, objective feedback necessary for optimal skill development. AI is emerging as a powerful tool to augment and enhance this process, offering data-driven insights and personalized feedback to surgical trainees. This article explores the various ways in which AI is supporting surgical skills assessment, drawing on recent academic research to provide a comprehensive overview for health professionals.

The Role of AI in Objective Assessment

One of the most significant contributions of AI to surgical skills assessment is its ability to provide objective, standardized evaluations. AI-powered systems can analyze vast amounts of data from surgical procedures, including video recordings and instrument motion, to identify patterns and metrics that correlate with surgical proficiency. For instance, a study by Igaki et al. (2023) developed a deep learning model that can recognize standardized surgical fields in laparoscopic sigmoid colon resection. This model, which calculates an "AI confidence score" (AICS), demonstrated a strong correlation with the Endoscopic Surgical Skill Quality Scale (ESSQS) scores provided by human experts [1]. This indicates that AI can be a reliable tool for automatically assessing the quality of surgical fields, a crucial aspect of surgical skill.

Enhancing Minimally Invasive Surgery (MIS) Training

Minimally invasive surgery (MIS) presents a steep learning curve for trainees.

AI is playing a pivotal role in overcoming this challenge by providing detailed and granular feedback. A narrative review by Kankanamge et al. (2025) examined the use of AI in assessing MIS skills, highlighting the use of standardized objective metrics (SOMs) such as the Objective Structured Assessment of Technical Skills (OSATS) and the Global Evaluative Assessment of Robotic Skills (GEARS) [2]. The review found that AI systems could predict overall SOM scores with an accuracy ranging from 63% to 100%. This demonstrates the potential of AI to provide reliable and accurate assessments of MIS skills, which can help trainees identify areas for improvement and track their progress over time.

A New Era of Surgical Education

The integration of AI into surgical training is not limited to assessment; it is also transforming the educational process itself. A scoping review by Escobar-Castillejos et al. (2025) explored the use of AI techniques for training, assessment, and evaluation in surgery. The review found that AI-enhanced training environments, including simulation platforms and robotic systems, can provide automated skill assessment, personalized feedback, and adaptive learning trajectories [3]. These systems can analyze a trainee's performance in real-time and provide immediate feedback, allowing for a more efficient and effective learning process. The use of various AI techniques, such as machine learning, deep learning, and convolutional neural networks, allows for a multifaceted analysis of surgical performance, taking into account not just the outcome but also the process.

Challenges and Future Directions

Despite the promising advancements, the integration of AI into surgical skills assessment is not without its challenges. The heterogeneity in study designs and outcome measures makes it difficult to compare the effectiveness of different AI systems. Furthermore, the lack of transparency in some AI algorithms, often referred to as the "black box" problem, can be a barrier to their widespread adoption. Future research should focus on developing standardized evaluation metrics, improving the transparency and interpretability of AI models, and conducting large-scale, multi-institutional studies to validate the effectiveness of AI-based assessment tools.

Conclusion

Artificial intelligence is poised to revolutionize surgical skills assessment by providing objective, data-driven, and personalized feedback to trainees. From analyzing surgical videos to providing real-time feedback in simulation environments, AI is offering a new paradigm for surgical education. While challenges remain, the continued development and refinement of AI technologies hold the promise of a future where surgical training is more efficient, effective, and ultimately, leads to better patient outcomes. As health professionals, it is crucial to stay informed about these advancements and to embrace the potential of AI to enhance the next generation of surgeons.

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