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Promoting Technology and Collaboration

Novel Retrieval-Augmented Generation (RAG) Models for Hand Surgery Education in Plastic and Orthopedic Surgery

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Background: Artificial intelligence (AI), large language models (LLMs), and retrieval-augmented generation (RAG) models have made significant strides in recent years. Hand surgery represents a diverse surgical subspecialty, with cases performed by plastic, orthopedic, and general surgery residents and attendings. Exposure to certain cases within hand surgery is not equal between surgical specialties. With the advent of wide-awake local anesthesia no-tourniquet (WALANT) surgery, there is an added challenge within hand surgery teaching as residents and students may feel more restricted from asking questions when the patient is awake and listening.

Technology Overview: We developed a novel retrieval-enhanced AI large language model specifically tailored for hand surgery (HandRAG), capable of effectively utilizing peer-reviewed published hand surgery literature for clinical decision support in real-time at point of care or in case preparation. The system was evaluated using 15 standardized clinical queries assessed using automated computational metrics for correctness and semantic similarity to source documents.

Potential Application in Surgical Simulation and Education: We propose the wider distribution of HandRAG as a clinical learning tool where residents are able to ask questions and study answers in a dynamic fashion. The HandRAG AI chatbot, like well-known AI models such as ChatGPT, is able to adapt to the user's prior queries to provide a personalized learning tool. The model is fully sourced from a high-quality hand surgery literature library, making its outputs more appropriate for surgeon-to-surgeon dialogue than open-sourced AI models. All answers are able to be cited back to their founding literature.

Potential Opportunities to Collaborate: The proposed model may be adapted in the future to be fine-tuned to other surgical subspecialties using the same systems once new literature libraries are built. This RAG model is an exciting avenue for specialized surgical education tools.