Navigating the Future of Surgical Training: Augmented Reality's Transformative Effect on Surgical Skill Development and Acquisition

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Introduction:

The delivery of post-graduate education, particularly in surgical skills training, has evolved significantly in the past few years. Factors such as the COVID-19 pandemic, which limited training opportunities, and the increasing emphasis on patient safety have led to a shift toward greater use of simulated technology for skill practice and assessment. The (LapAR™) is an innovative Augmented Reality-based surgical screen-based simulator and training suite. It utilizes soft tissue phantoms that replicate the physical and mechanical properties of the organ operated on, providing realistic haptic feedback on a platform which captures video and objective performance data.

(LapAR™) is a Novel Augmented Reality-based surgical simulator/training suite producing natural haptics from soft tissue models in combination with integrated screen-based digital overlays for immersion & objective performance capture. The take home version of the (LapAR™), the technology utilized in this study, allows for distant learning, where trainees can perform basic skill tasks, as well as full surgical procedures by connecting the simulator to their PC.

The primary objective of this study was to evaluate the impact of the (AR) simulation on the acquisition and improvement of objective surgical skills among junior surgical trainees. Additionally, the study aimed to qualitatively assess the trainees' experiences with this technology at their homes.

Methodology:

This study involved 15 junior surgical trainees benchmarked against two consultants across three training sites. The participants performed ten laparoscopic appendectomies interspersed with "LapPass" tasks, comprising camera holding and technical skill tasks. Objective metrics, including completion time and distance travelled, were collected, followed by interviews.

Results:

The study revealed significant improvements in completion time and distance travelled during repeated laparoscopic appendectomies and related LapPass tasks. It also showed enhancements in smoothness, acceleration, and ambidexterity, although these were not the primary focus of the study. It is of interest that consultant benchmarking saw improvements largely in distance travelled, and somewhat in acceleration. Qualitative analysis indicated that AR-based training is particularly beneficial at the early stages of surgical training and should be considered for mandatory integration into surgical training. Participants expressed a desire for extended access to the technology, recognizing its utility for preparing operation lists, skill acquisition, and knowledge enhancement. Home-based training provided flexibility and convenience, complementing the high-pressure theatre environment. Although there were occasional technical challenges related to setup and reliability, the AR solution was praised for its high realism and tangible educational benefits.



Figure 1: the completion time of all participants as an average. A linear regression analysis was conducted on all 15 trainees in all attempts made. A statistical significance is noted.

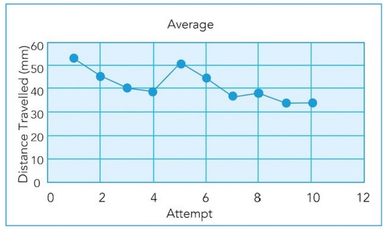


Figure 2: the distance travelled by all participants as an average. A linear regression analysis was conducted on all 15 trainees in all attempts made. A statistical significance is noted (P<0.05).

Conclusion:

Inovus Medical's AR solution offers a scalable platform to enhance surgical skills training, addressing common barriers faced by surgical trainees. The study provides evidence of construct validity through improvements in objective skill scores. Content validity is supported by positive feedback on the educational content from qualitative interviews. Face validity is partially supported by agreement on the realism of the appendix model, closely resembling real-life scenarios.



Figure 1. A Kirkpatrick Evaluation Pyramid highlighting outcomes 1 and 2 satisfied throughout the study.

Acknowledgements:

We are interns/executives within Inovus Medical, which has provided support but not funding for this study. We have sought to avoid over-mentioning products or pushing sales. Our intention is to increase awarenesss of alternative augmented reality training options to drive surgical training away from the patient's bedside.
We extend gratitude and thanks to SAGES for allowing us to present our findings.
Inovus Medical is an eligible company and is an accredited provider for CPD/CME points for surgical training.