The Impact of Augmented Reality Laparoscopic Simulator in Improving Performance Metrics in General Surgical Trainees.

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Introductions

Advances in technology have led to laparoscopic surgery becoming a common part of surgical practice.

The main benefits of laparoscopic surgery include decreased length of postoperative ileus; decreased postoperative pain and narcotic use, improved cosmesis and higher patient satisfaction (1).

The main constraints of laparoscopy include loss of depth perception and haptic feedback (2); the fulcrum effect and the use of instruments with limited range of motion (3).

Adverse patient outcomes can occur if surgeons are not given adequate training and this is constrained further by the medicolegal, fiscal and time limitations of teaching operative skills in the clinic setting(4).

The covid-19 pandemic has been particularly disruptful for surgical trainees as can be demonstrated by a recent review of UK surgical trainee logbooks comparing 2019 with 2020 which showed a 50% reduction in operations with trainees as the primary operating surgeons (5)

Aim

To assess the impact of simulated laparoscopic trainers on improving surgical trainees' technical ability in completing a laparoscopic appendicectomy by measuring effect on completion time and distance travelled with standard instruments.

Method

Six CT1 (early-stage) trainees with little prior operative exposure were selected from the North-West of England Deanery to perform x10 appendicectomy simulated exercises with the Augmented Reality Laparoscopic Simulator (LapAR™), interspersed by x9 Lapass exercises.

Metrics including 'Time of completion' and 'Distance travelled' were collected by the simulators and analysed.

Results

Repeated laparoscopic appendicectomies with the LapAR™ improved performance time (Graph 1) for 100% of trainees, with an average of 53% (Regression coefficient -0.63) and improved distance travelled (Graph 2) for 75% of the trainees with an average improvement of 37% (Coefficient -1.67).

Improvement in instrument smoothness, acceleration and ambidexterity were also observed.

Conclusion

LapAR™ use has improved all performance metrics for most surgical trainees and proves to be an invaluable tool for surgical training. Benchmarking by HEE is needed in the future in addition to larger cohort studies to further validate this.



Figure 1. A Kirkpatrick Evaluation Pyramid highlighting outcome 2 satisfied through this study.

In a concurrent study, we collected surveys prior to and after: including demographics, prior experience, and self-confidence scores for key laparoscopic tasks on a 1-10 scale, as well as operative skill data using Inovus AR simulation software.

Every area of student's self-confidence improved, with a mean improvement of 3.82 (p=0.03). The more junior the student, the greater their increase in confidence (Mean Pre-FY = 5.23)."

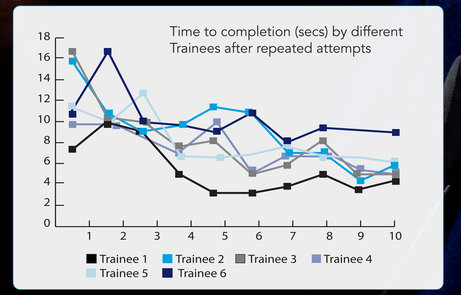
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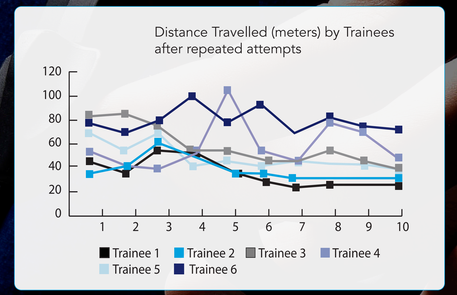


Figure 1: The Inovus LapAR

LapPass® Tasks	Objective Metrics	Subjective Metrics
Passing thread through a hoop	Time to completion	Feedback by experienced surgeons using the work-based assessment (WBA) framework
Manipulating hoops between instruments	Distance travelled by instruments	
Positioning hoops on posts	Instrument acceleration	
Cutting simulated skin within guidelines	Hand dominance	
Placing sutures	Instrument time in view	



Graph 1



Graph 2



Figure 2 Simulated mobilisation of the appendix

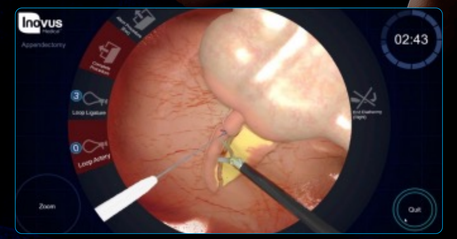


Figure 3 Simulated resection of the appendix