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A Randomized Controlled Trial of Skills Transfer: From Touch Surgery to Laparoscopic Cholecystectomy

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ABSTRACT

Background: Surgical training has traditionally involved teaching trainees in the operating room. However, intraoperative training is time-intensive and exposes patients to greater risks. Touch Surgery (TS) is an application that uses animation to provide simulation training via cognitive task analysis as an adjunct to intraoperative training.

Methods: Forty students were recruited and randomly allocated to either a control or intervention group. Each group received the same preparation before intervention, including a 10-min introduction to laparoscopic equipment and a 15-min educational tutorial on laparoscopic cholecystectomies. The participants then received training via either TS (intervention) or written information (control). Their performance was compared using a validated scoring tool on a porcine laparoscopic cholecystectomy model. Significance was defined as $P < 0.050$.

Results: In total, $n = 22$ and $n = 18$ participants were randomly assigned to intervention and control groups, respectively. There was no significant difference between age ($P = 0.320$), year of medical school ($P = 0.322$), handedness ($P = 1.000$), or gender ($P = 0.360$) of the groups. The overall mean performance score was higher for intervention (mean ± SD = 41.9 ± 22.5) than control (mean ± SD = 24.7 ± 19.6; $P = 0.016$). There was no significant difference between scores for each intraoperative segment between the intervention and control group ($P > 0.050$).

Conclusions: This study demonstrates that TS is effective for providing cognitive training in laparoscopic cholecystectomies to medical students. It is likely that this effect will be seen across modules and other platforms that use cognitive task analysis alongside high-fidelity animation. Further work is necessary to extend this to other surgical procedures for evaluating its longitudinal effectiveness.

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Introduction

Surgical training is aimed at equipping surgeons with both the technical and nontechnical skills required to perform an operation.[1] Spurred by an increasing patient load and longer operating times, traditional methods of training in the operating room have become unstructured and costly.[2] They also expose patients to potential errors as trainees progress along the learning curve.[3] Furthermore, disruptive technology demands surgeons acquire novel skills rapidly to keep abreast with advances in surgical techniques and procedures.[4] Hence, it is necessary to explore other viable options such as simulation training platforms for surgeons to learn and hone their skills. Such simulation platforms need to be evaluated before their introduction and use in surgical practice.

Cognitive task analysis (CTA) is the process of creating a comprehensive breakdown of a procedure and is a technique shown to improve trainees' procedural knowledge and technical skills uptake for central venous catheterization,[5] percutaneous tracheostomy placement,[6] and knee arthroscopy.[7] Cognitive training before virtual reality (VR) endoscopic training has also demonstrated improved operative ability.[8] Recent studies have shown simulation training to transfer to improved performance during real cases, with significant reductions in the time taken, fewer errors, and decreased patient discomfort.[3,9-11]

Touch Surgery (TS) is an interactive mobile CTA-based simulation and rehearsal tool with a touch screen interface for the self-teaching and assessing of various operative procedures based on expert-derived cognitive task analyses. Through the touch screen interface and multiple-choice questions, trainees are encouraged to learn and test their cognitive knowledge of procedural steps and surgical decisions. Trainees can track their achievements, and learners are encouraged to improve their procedural knowledge and achieve higher scores with fewer errors. The TS application is available for free on the Apple App Store (Apple Inc, California) and the Google Play store for Android (Google, California).

The aim of this study was to assess the transferability of knowledge of cognitive task simulation and rehearsal app, TS, on the learner's ability to perform laparoscopic cholecystectomy, and hence evaluate the usefulness of the application for incorporation into surgical training.

Methods

TS mobile platform

The TS platform (Kinosis Limited, London, UK) is an interactive application available on smartphones and tablets. It uses CTA framework alongside immersive multimedia animations to teach operative steps across a broad range of procedures and specialties. The primary target audience is surgical trainees with modules for different procedures authored by experienced clinicians, but is accessible for clinicians at all stages of training.

Study design

A randomized controlled trial was conducted in accordance with CONSORT guidelines.[12] The TS mobile platform was compared against a control educational intervention for teaching the procedural steps of a laparoscopic cholecystectomy.

The study was performed under the approval of a local medical education ethics panel.

Setting, participants, and allocation

The trial was conducted under controlled conditions in a "dry" laboratory equipped with laparoscopic simulators. Participants were medical students currently studying medicine at Imperial College London. Each participant was provided with a certificate for his or her participation. To motivate performance, they were informed that the participant who performed the highest would be provided with an additional certificate detailing their performance.

The inclusion criteria were assessed via declarations made within a consent form and were as follows:

1. Participants had completed a faculty-taught course on gastrointestinal anatomy.
2. Participants had no prior experience with TS.
3. The participants had no prior personal experience with laparoscopic surgery or simulation.

Each group received the same preparation before intervention. First, each group was provided with a 10-minute introduction to laparoscopic equipment. This included teaching on how to handle instruments and the function of fundamental laparoscopic equipment including trocars, grasping forceps, Marylands, scissors, clip applicators, and diathermy. This was followed by psychomotor training according to tasks from the Fundamentals of Laparoscopic Surgery (FLS).[13] The participants were required to complete the peg transfer and precision cutting tasks in accordance with FLS performance guidelines before instigating the educational intervention. This allowed participants in each group to achieve the same baseline proficiency in basic skills to enable them to complete the assessment. In addition, each subject was given a 15-min educational tutorial on laparoscopic cholecystectomies to place the simulation and previous anatomy knowledge in clinical context using a combination of text, images, and video. This included, for example, making all participants aware of the borders of Calot's triangle and what the critical view of safety is.[14]

The participants who met the inclusion criteria were randomly assigned to group 1 (TS) or group 2 (control), using an online random number generator (Google, California). Allocation concealment was maintained by randomizing participants to each intervention after the study preparation. Concealment was broken at time of intervention. Setup of the assessment phase of the study was carried out before