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Learning from the surgeon's real perspective – First-person view versus laparoscopic view in e-learning for training of surgical skills? Study protocol for a randomized controlled trial

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ABSTRACT

Background: Surgical proficiency is highly dependent on continuous and efficient training. However, efficacy of training hinges on questions such as accessibility and how intuitively the training can be translated into reality. Minimally invasive surgery (MIS) in particular relies on adequate training modalities in order to compensate for its additional psychomotor and visuospatial challenges. The increasing demand for MIS procedures longs for further enhancement of training and steep learning curves. We are investigating a nouveau training concept that continuously utilizes the first person view as addendum to laparoscopic view. We hypothesize this approach to be more intuitive thus faster and more naturally to apprehend than a laparoscopic view only and aim to establish a new standard to implement into training curricula.

Methods and analysis: The present study is conducted as a monocentric, two-arm randomized trial. Participants undergo a training curriculum in laparoscopic suturing and knot tying, using e-learning video material with either the first-person perspective of the surgeon or the laparoscopic view only. Primary endpoint is the total training time needed to reach a predefined proficiency level. Participants are evaluated by blinded raters using validated checklists. Number of attempts, procedure and knot quality subscore difference as well as metric parameter analysis from the first and last knots analyzed as secondary endpoints. Furthermore, trainees are assessed with regard to surgical background, basic skills level and spatial awareness. A total sample size of 80 participants for the analysis of the primary endpoint was determined, which will be performed as a two-sided *t*-test.

Ethics and dissemination: Ethical approval was obtained from the Ethics Committee of the Medical Faculty at Heidelberg University (Code S-334/2011). This trial was registered with the German Clinical Trials Register (DRKS) in Freiburg, Germany, on May 6th (DRKS00009997). The results will be published and presented at appropriate conferences.

1. Background

With increasing demand for minimally invasive surgery (MIS) and related approaches replacing numerous yet openly performed procedures, training capacities are needed to ensure each surgeon's skills are adequate prior to patient contact. This training needs to be more efficient and apprehensible as well, since MIS comes with natural obstacles and psychomotor demands additional to those one faces when performing open surgery. Consequently, many centers and universities worldwide provide specific laparoscopic training courses and research is conducted to optimize training [1–4].

E-learning has been shown to be a valuable asset to laparoscopic training; our group continuously conducts research for further evaluation [5–7]. Since computer games are believed to be a commonplace to today's students and their experience potentially

Abbreviations: MIS, minimally invasive surgery; VR, virtual reality; MRT, Mental Rotation Test; PSVT:R, Revised Purdue Spatial Visualization Test.

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enables them to profit from different approaches, the concept of 'Serious Gaming' is subject to training research [8]. Serious games have been evaluated in various situations within the framework of surgery and combining serious gaming with competition in laparoscopy training has recently been shown to improve dexterity [9–11]. Available literature suggests that a certain number of practical repetitions as part of the learning process is required for proficiency in laparoscopic surgery thus restricting usage of e-learning platforms with regards to time efficiency [12–14]. Accordingly, further research seems to be indicated in order to maximize utility during e-learning modules and to safeguard that learning content is properly translated into reality, especially since translation of simulator training to the operating room has been proven to take place. Its described resistance to decay is favorable, but comes with risks, if apprehension during training was flawed [15,16].

Perception and imitation of movement hinges on visual perspective. The human mirror system is an important subject to neuro and cognitive sciences and presumably similarly essential to social interactions and psychomotor cognition [17,18]. We believe that approaches discussed in current research render taking advantage of the mirror system and its fluidity possible in order to enhance psychomotor training. Coherent findings of various investigations indicate the first-person view to be determinative to full-body ownership [19,20]. One might easily surmise that movements already perceived as one's own can be reproduced and implemented more intuitively. We consequently aim to evaluate this conclusion within the framework of a training concept consistently using first-person view as a reference.

2. Methods and analysis

Primary objective of this study is to evaluate whether training outcome of a structured laparoscopy training curriculum is influenced by the visual perspective chosen in e-learning video material. We are comparing the visual perspectives of first-person view showing the surgeon's hands in addition to the laparoscopic view versus laparoscopic view only (Fig. 1).

2.1. Registration

This trial was registered with the German Clinical Trials Register (DRKS) in Freiburg, Germany, a primary registry in the WHO Registry Network, on May 6th, 2016 with the trial registration number DRKS00009997 (https://drks-neu.uniklinik-freiburg.de/drks_web/navigate.do?navigationId=trial.HTML&TRIAL_ID=DRKS00009997).

2.2. Study design

This is a registered prospective, single-center, rater-blinded, two-arm, parallel-group randomized trial. A scheme of the study is shown in Fig. 2.

2.3. Setting and participants

This study is carried out in the MIS training center of the Department of General, Visceral, and Transplantation Surgery at Heidelberg University Hospital. This study is conducted in the context of a voluntary laparoscopy training course for medical students during their clinical years at Heidelberg University. Around 2800 medical students study medicine at Heidelberg University, with around 320 new students each year. In their clinical years (3–5) all students (around 1400) are obliged to participate in at least one elective module, such as the course in laparoscopic surgery, which is offered in the training center of the Department of Surgery at Heidelberg University. Every year around 100 medical students participate in this specific elective module, where this study was set.

2.4. Sample size determination

We plan to exceed this group sizes by 10% to account for possible drop outs. Sample size calculations were done according to results of a previously evaluated study [21] with identical primary endpoint and conducted in a similar context. Mean difference between group 1 and group 2 was 785.7 s, standard deviation in group 1 was 1388.0 s, whereas it was 1046.8 s in group 2. This difference can be detected with a two-sided significance level $\alpha = 0.05$ and a power of $1\text{-}\beta = 0.8$, with a group size of at least 40 participants randomized to each group.

2.5. Inclusion and exclusion criteria

The inclusion criterion mandates that participants are medical students in their clinical years (3rd–6th year) at Heidelberg University. Exclusion criteria include students who have already participated in basic laparoscopy training courses for more than 2 h, who have experience in laparoscopic suturing and knot tying, or who have experience assisting in laparoscopic surgeries for more than 2 h, respectively.

2.6. Randomization, allocation and blinding

Blocked randomization stratified by gender is used to randomly assign participants to each group (1:1 ratio) resulting in two intervention groups. Randomization is performed by an independent employee of the statistics department not involved in recruitment, allocation, training, rating, data collection and outcome assessment regarding the present study, by using Research Randomizer [22]. Block size is not revealed until the end of the study. The numbers indicating group assignment are kept in sealed, opaque and sequentially numbered envelopes. Students are allocated by the main coordinator according to their time of application to the elective module, after written informed consent is obtained. Due to the nature of the intervention, participants and main coordinator of the study, granting the participants access to the video interven-

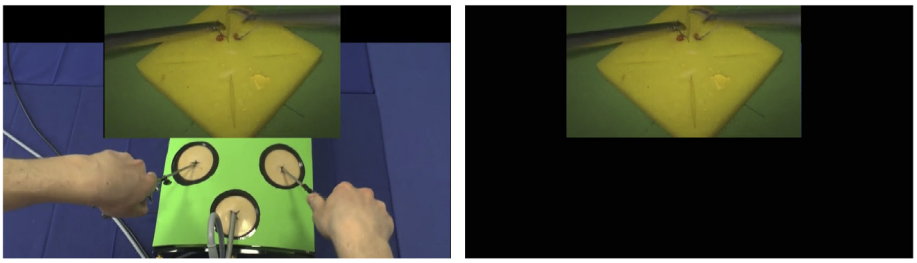

Fig. 1. Screenshot of e-learning material in combined first-person and laparoscopic view (left) vs. laparoscopic-view-only (right).