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Step-by-step training in basic laparoscopic skills using two-way web conferencing software for remote coaching: A multicenter randomized controlled study

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ABSTRACT

Background: Despite its advantages, few trainees outside of North America have access to simulation training. We hypothesized that a stepwise training method using tele-mentoring system would be an efficient technique for training in basic laparoscopic skills.

Methods: Residents were randomized into two groups and trained to proficiency in intracorporeal suturing. The stepwise group (SG) practiced the task step-by-step, while the other group practiced comprehensively (CG). Each participant received weekly coaching via two-way web conferencing software. The duration of the coaching sessions and self-practice time were compared between the two groups.

Results: Twenty residents from 15 institutions participated, and all achieved proficiency. Coaching sessions using tele-mentoring system were completed without difficulties. The SG required significantly shorter coaching time per session than the CG ($p = .002$). There was no significant difference in self-practice time.

Conclusions: The stepwise training method with the tele-mentoring system appears to make efficient use of surgical trainees' and trainers' time.

1. Introduction

While simulation training has become an integral part of surgical residency in North America,[1] it is yet to be widely adopted in surgical training in most other countries. A recent survey conducted in Japan showed that only around half of the residency programs were equipped with simulation training facilities, which was a box trainer in most programs.[2] One of the main reasons for this is the smaller scale surgical residency programs in Japan compared to those in North America. Additionally, residents are widely distributed among several community hospitals. It is common to see only one or two surgical residents training in a hospital. This makes it impractical to invest in simulation training facilities for each hospital. Attending surgeons in these hospitals also lack the time for teaching the residents outside of the operating room.[2]

The recent rapid advances in Internet communication have made real-time tele-learning feasible and economical.[3] A previous study demonstrated real-time tele-learning in laparoscopic skills between Botswana residents and a Canadian instructor.[4] While it was a single-institution trial, we introduced this concept of remote education to train residents who are distributed over a wide variety of hospitals.

In addition, due to the limited time for interaction between trainees and trainers, an efficient method needs to be developed to utilize the remote setting for surgical skills acquisition. Recent studies demonstrated techniques, which broke down challenging procedures into several simple steps.[5–7] They aimed to standardize their techniques for effective teaching and learning. We, therefore, hypothesized that a step-by-step training method was more efficient than a traditional comprehensive training method.

The first aim of this study was to assess the feasibility of the remote coaching system for basic laparoscopic skills at multiple institutions through the Internet. Second, we assessed the effectiveness of the stepwise training method in the remote setting through a randomized controlled trial.

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2. Materials and methods

2.1. Ethical issues

This study is a randomized, controlled trial which was approved by the Institutional Review Board (IRB) at Hokkaido University School of Medicine. All participants were given detailed explanations about the study, and a written informed consent was obtained from each participant.

2.2. Materials/set up

A laparoscopic training box (Tr-box, Chuo Name Plate©, Sapporo, Japan) was used for this study (Fig. 1). It is foldable into US letter size (8.5 × 11 inches) and is made of acrylic boards with port sites for laparoscopic instruments. Although the intervals of these ports are also adjustable for training in single-incision laparoscopic surgery, they were fixed at the same position during this study to make the training environment identical for all participants. A wearable camera (Go Pro HERO3+ Silver Edition, Go Pro, Inc., San Mateo, CA) was used to transmit the image of the box to a 21.5-inch monitor (ViewSonic, Inc., Brea, CA) for participants to practice laparoscopic tasks. A web camera (iBaffalo, Baffalo, Inc., Nagoya, Japan) was used to relay the image of the box to an instructor via free two-way web conferencing software (Google hangouts™, Alphabet, Inc., Mountain View, CA) during the remote training and test sessions (Fig. 2). Each participant was provided with these instruments and was taught how to set up the system wherever he/she can connect to the Internet. The Internet environment of each participant was dependent on the available facilities at their respective institutes. All participants were coached by a senior surgical resident. The instructor had the same training setup system to coach the participants.

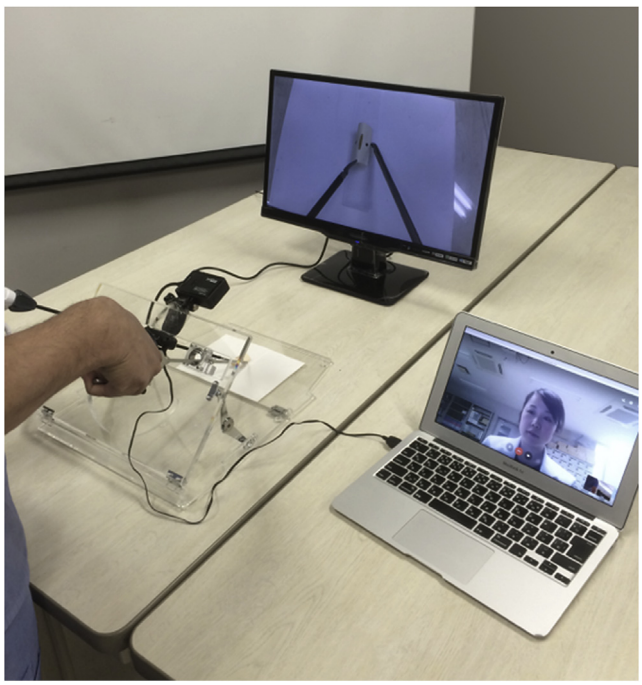

Fig. 1. Laparoscopic training box. A laparoscopic training box is made of acrylic boards and is foldable into US letter size (8.5 × 11 inches). The image of the box is transmitted to a monitor via a wearable camera attached to the box. A web camera on a box is connected to a laptop to relay the image to an instructor during remote training.

2.3. Participants

Postgraduate year (PGY) 1–5 interns and residents in several institutions in Japan enrolled voluntarily in this study. The training task was intracorporeal suturing based on the Fundamentals of Laparoscopic Surgery (FLS).[8] Each participant underwent the training until completion of the whole task within 112 s, basing on the previous study.[9] Participants were randomly assigned to either the stepwise training group (SG) or the comprehensive training group (CG) using a single-blinded block randomization plan generated by a web-based randomization service.[10] The SG trained in the task to proficiency following the stepwise method. The CG trained in the same task comprehensively. Each coaching session was scheduled based on participant availability. Participants who did not have an Internet connection or who had achieved proficiency before training were excluded from this study.

2.4. Training program details

Participants had several coaching sessions with an instructor once a week until they reached the proficiency level set by a previously published study.[9] Each session began with a test to see the proficiency of the participant in performing intracorporeal suturing. This was followed by a coaching session with the instructor about the task per the training plan. Each session included demonstration by the participant on how he/she did the task, and demonstration by the instructor to the participant. Each session ended when the participant satisfactorily understood the guidance given by the instructor. It was not necessary for the participant to return-demonstrate what he/she was taught during the session. Between each session, the participants self-practiced what they learned.

2.4.1. Stepwise training group

In the stepwise training method, the intracorporeal suturing task was divided into three simple steps described below. The proficiency goal for each step was set based on the performance of six expert laparoscopic surgeons in order to accomplish the whole task in 112 s.

Step 1. Needle-holding

This step consists of the phase from inserting the instruments into the training box until holding a needle to the needle holder in a 90-degree angle. This step was to be completed in 10 s.

Step 2. Needle-driving

This step includes driving a needle through the two marks on a Penrose drain. A participant was required to complete this step within 20 s.

Step 3. Knot-tying

This step includes tying intracorporeal knots using a surgeon's knot followed by two single throws, and cutting the sutures with scissors. The goal was to complete this step in 82 s.

This group was required to complete each step before moving to the next step. The coaching sessions focused only on the participant's current step. A participant can move to the next step only after he/she achieved the proficiency of the current step. If a participant achieved the goal in the first attempt, the participant was exempted from repeating the current step.

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