

# A Randomized Controlled Trial Comparing Trainee-Directed Virtual Reality Simulation Training and Box Trainer on the Acquisition of Laparoscopic Suturing Skills

Jennifer K.Y. Ko, MBBS,<sup>1</sup> Vincent Y.T. Cheung, MBBS,<sup>1,2</sup> Ting Chung Pun, MBBS,<sup>1</sup> Wai Kit Tung, MBBS<sup>2</sup>

<sup>1</sup>Department of Obstetrics & Gynecology, The University of Hong Kong, Queen Mary Hospital, Hong Kong, China

<sup>2</sup>Hong Kong Jockey Club Innovative Learning Centre for Medicine, Hong Kong Academy of Medicine, Hong Kong, China

## Abstract

**Objective:** To compare the proficiency of novices in acquiring laparoscopic suturing skills following training in a virtual reality simulator or box trainer compared to no training.

**Methods:** This was a RCT in a university-affiliated teaching hospital recruiting participants who had no laparoscopic suturing experience to have suturing skill training in the virtual reality simulator, box trainer, or no training as control. Trainees were allowed to terminate training when they perceived competence in the procedure. Suturing skills were tested in the box trainer and scored using a modified Global Operative Assessment of Laparoscopic Skills questionnaire by their own self-evaluation and two experienced gynaecological laparoscopists.

**Results:** Of the 36 participants recruited, 27 (75%) had no laparoscopic experience. Participants with no laparoscopic experience took longer to complete training than those with experience (median 90 minutes [interquartile range (IQR) 80–115] vs. 55 min [IQR 40–65], respectively;  $P = 0.044$ ). There were no differences in successful completion of the task (7/12 [58.3%], 10/12 [83.3%], 7/12 [58.3%];  $P = 0.325$ ), median suturing time in seconds (628 [IQR 460–835], 611 [IQR 434–691], 609 [IQR 540–837];  $P = 0.702$ ), mean subjective (mean  $\pm$  SD  $9.8 \pm 1.8$ ,  $10.4 \pm 2.8$ ,  $9.3 \pm 2.4$ ;  $P = 0.710$ ), and objective ( $7.2 \pm 1.8$ ,  $8.2 \pm 2.1$ ,  $7.6 \pm 1.7$ ;  $P = 0.426$ ) modified Global Operative Assessment of Laparoscopic Skills score in the simulator, pelvic trainer, and control groups, respectively. The intraclass correlation coefficient of the two reviewers was 0.422 (95% CI 0.159–0.717).

**Conclusion:** Trainees were unable to accurately assess themselves as to skill level in laparoscopic suturing. A longer training time is

required for novices to master laparoscopic suturing using a simulator or box trainer.

## Résumé

**Objectif :** Comparer la maîtrise des techniques de suture par laparoscopie chez des apprentis formés à l'aide d'un simulateur de réalité virtuelle, formés à l'aide d'un simulateur pelvien ou n'ayant reçu aucune formation.

**Méthodologie :** Cet ECR a été mené dans un hôpital universitaire. Des participants n'ayant jamais réalisé de suture par laparoscopie ont été séparés en trois groupes : le premier a reçu une formation sur un simulateur de réalité virtuelle, le deuxième a reçu une formation sur un simulateur pelvien, et le troisième n'a reçu aucune formation (groupe témoin). Les participants pouvaient mettre fin à leur formation lorsqu'ils sentaient qu'ils maîtrisaient l'intervention. L'habileté des apprentis a été évaluée sur un simulateur pelvien et notée, par eux-mêmes et par deux laparoscopistes en gynécologie chevronnés, au moyen d'une version modifiée du questionnaire Global Operative Assessment of Laparoscopic Skills.

**Résultats :** Parmi les 36 participants recrutés, 27 (75 %) n'avaient jamais réalisé une laparoscopie. Chez ces participants sans expérience, la formation a été plus longue que chez les participants avec expérience (médiane : 90 min [écart interquartile : 80–115] contre 55 min [écart interquartile : 40–65], respectivement;  $P = 0,044$ ). Il n'y avait pas de différence dans le taux de réussite de l'intervention (7/12 [58,3 %], 10/12 [83,3 %], 7/12 [58,3 %];  $P = 0,325$ ), ni dans la durée médiane de l'intervention en secondes (628 [écart interquartile : 460–835], 611 [écart interquartile : 434–691], 609 [écart interquartile : 540–837];  $P = 0,702$ ), ni dans les scores subjectif (Moyenne  $\pm$  écart-type :  $9,8 \pm 1,8$ ;  $10,4 \pm 2,8$ ;  $9,3 \pm 2,4$ );  $P = 0,710$ ) et objectif ([ $7,2 \pm 1,8$ ;  $8,2 \pm 2,1$ ;  $7,6 \pm 1,7$ ];  $P = 0,426$ ) obtenus avec la version modifiée du questionnaire Global Operative Assessment of Laparoscopic Skills entre le groupe formé à l'aide d'un simulateur de réalité virtuelle, le groupe formé sur un simulateur pelvien et le groupe témoin, respectivement. Le coefficient de corrélation entre les scores des deux examinateurs était de 0,422 (IC à 95 % : 0,159–0,717).

**Conclusion :** Les apprentis étaient incapables d'évaluer avec exactitude leur niveau d'habileté à réaliser une suture par laparoscopie. Pour maîtriser cette technique, les apprentis ont

**Key Words:** Education, laparoscopy, simulator training, suturing, box trainer

Corresponding Author: Dr. Jennifer K.Y. Ko, Department of Obstetrics & Gynecology, The University of Hong Kong, Queen Mary Hospital, Hong Kong, China. [jenko@hku.hk](mailto:jenko@hku.hk)

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besoin d'une formation plus longue sur un simulateur de réalité virtuelle ou un simulateur pelvien.

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## INTRODUCTION

The advancement of minimally invasive surgery has enabled increasingly complex gynaecological procedures to be done via laparoscopic approach. Learner surgeons have difficulty gaining laparoscopic skills owing to the lack of depth perception, fulcrum effect, loss of tactile feedback, and limited range of movements in laparoscopic surgery.<sup>1</sup> In the current medical environment where patient safety and quality care are paramount, together with the implementation of work-hour limits that have reduced trainees' exposure to hands-on procedures, the traditional approach of surgical training where the trainee "learns" operative skills in the operating theatre is no longer acceptable. Studies have shown that trainees who have no or limited laparoscopic experience but who have undergone simulator training have improved technical skills compared with those without training, resulting in a significantly shorter time to task completion, fewer errors, and better performance scores.<sup>2-4</sup> Among the range of simulators used, box trainers are readily available, are cheap, and have preserved tactile feedback as trainees can learn tasks using various synthetic material, animal parts, and real laparoscopic instruments.<sup>5,6</sup> Virtual reality simulators, especially the more advanced high fidelity models, can offer structured learning of laparoscopic skills via pre-set programs and haptic feedback despite a higher initial set-up and maintenance cost.<sup>7</sup>

The objective of this study was to compare the proficiency of novices in acquiring laparoscopic suturing skills following either training in a virtual reality simulator or box trainer with no training. This skill is part of the Fundamentals of Laparoscopic Surgery technical skills curriculum requiring complex technical ability including skills in depth perception, eye-hand coordination, ambidexterity, and transferring skills.<sup>1</sup> Although this is an advanced surgical technique

which most trainees should be able to master during their career, they have limited chances to learn and practice on real patients.

## MATERIALS AND METHODS

The study was a prospective, randomized trial conducted from February 2015 to August 2015 at the Department of Obstetrics and Gynecology at Queen Mary Hospital, a university-affiliated teaching hospital. All junior residents, interns, and elective students who had no laparoscopic experience or early experience with no laparoscopic suturing skills were invited to participate in the study. Ethics approval was obtained from the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. Informed consent was obtained, and anonymity of participants was preserved.

Participants were randomized into three groups—the virtual reality simulator, box trainer, and control groups—by a computer-generated sequence generated by the research nurse in blocks of six. They were shown a video demonstration and taught laparoscopic suturing at the beginning of the training by the instructor. The trainees were then left alone for self-practice after they did not have any further questions. Both the virtual reality simulator and box trainer groups were allowed a maximum of 4 hours of training (2 sessions of 2 hours each). The participants could terminate training at any time point during the 4 hours if they perceived that they were competent to perform the task. The virtual reality simulator used was the Symbionix LAP Mentor (Symbionix USA, Cleveland, OH) (Figure 1A), and training took place at the Hong Kong Jockey Club Innovative Learning Centre for Medicine. Training by the box trainer (Figure 1B), and the final test took place at Queen Mary Hospital.

Within 10 days of completion of training, participants were tested on their laparoscopic suturing skills as follows: positioning a needle in the needle holder, running the needle across two pre-marked circles on a surgical glove, a double throw knot, and then two single throw knots. The knots had to be squared and the needle had to be transferred from one hand to the other between each throw. The threads had to be cut at the end to complete the task. The maximum time limit for laparoscopic suture with intracorporeal knot was 10 minutes in the original Fundamentals of Laparoscopic Surgery curriculum,<sup>8</sup> but this was extended to 15 minutes, taking into account most of our participants had no previous laparoscopic experience. The task was considered failed if it was not completed within the time

## ABBREVIATIONS

GOALS	Global Operative Assessment of Laparoscopic Skills
IQR	interquartile range
SD	standard deviation

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