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# Simulation Training for Laparoscopic Surgery Can Improve Minimally Invasive Surgical Techniques for Interns and Probationers

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## Abstract

Objective: The clinical clerkship and practice stage plays a pivotal role in the transition of medical students from theoretical knowledge to practical application, bridging the gap between classroom learning and real-life clinical experience. In order to improve the teaching quality of interns and probationers, we try to let them practice the skills of laparoscopic surgery in the early stage, and summed up a set of evaluation methods that can be widely used in medical education. Methods: From September 2019 to December 2019, a total of 54 interns and 72 trainees were selected as research objects. They were assigned to training sessions and their proficiency was assessed before and after the training. The change in proficiency is compared to determine whether the training course is valuable. Results: Before the operation training, the interns' scores were BP 17.3 ± 3.1, CC 17.9 ± 3.4, KT 16.4 ± 3.4, LS 16.7 ± 3.3. The results of probationers were BP 16.9 ± 2.7, CC 16.8 ± 2.8, KT 15.2 ± 1.6, and LS 14.8 ± 2.2. After completing the operations training, the results of interns were BP 21.1 ± 1.9, CC 20.6 ± 2.7, KT 19.6 ± 3.0, and LS 20.9 ± 1.4. The probationers' scores were BP 19.3 ± 3.2, CC 19.6 ± 3.5, KT 19.6 ± 2.6, and LS 20.0 ± 2.4. After the operation training, the performance of the intern group was better than that before the training ($P < 0.05$). The same is true of the probationer group. The time-consuming intern examinations were BP 147.9 ± 38.5 s, CC 123.2 ± 28.7 s, KT 82.6 ± 24.1 s and LS 162.5 ± 31.1 s. The examination time of probationers were BP 179.9 ± 46.4 s, CC 132.1 ± 24.3 s, KT 109.3 ± 27.5 s and LS 210.0 ± 58.8 s. Conclusion: Simulation training for laparoscopic surgery can improve minimally invasive surgical techniques for interns and probationers.

*Co-first authors.

**Keywords**

Simulation Training, Interns and Probationers, Medical Education

## 1. Introduction

At present, laparoscopic surgery has been widely carried out in various medical centers. In order to promote the concept of "minimally invasive medical", laparoscopic surgery is one of the main development directions of surgery [1]. The learning content of medical students during the clinical probation and practice stage primarily encompasses comprehension and treatment of clinical diseases, with a significant emphasis on surgical interventions [2]. Consequently, the acquisition of knowledge pertaining to hepatobiliary surgery diseases and related technological advancements constitutes an intriguing focal point for medical students. However, student education cannot fully meet the development of modern medicine, and the training mode of medical undergraduates needs to be changed [3]. The key to change is to increase systematic training in laparoscopic knowledge and related skills [4]. Therefore, we have conducted training on simulated laparoscopic surgery among medical interns and probationers, in an attempt to give them a preliminary understanding of laparoscopic surgery, in the hope of improving their minimally invasive concept and laparoscopic operation technology, so as to achieve the purpose of improving the quality of teaching.

## 2. Methods

### 2.1. Participants

A total of 54 interns and 72 probationers were selected as the research subjects. They all pursued their studies in the fields of gastrointestinal surgery, hepatobiliary surgery, and vascular surgery at Chongqing Medical University from September to December 2019 and willingly volunteered to participate in this study. Four deputy chief physicians or chief physicians served as teachers. The operating procedures of two of them are regarded as the gold standard, and the other two teachers as the raters.

### 2.2. Training Course

The content of laparoscopic simulation training is divided into three parts, including theoretical teaching, adaptive training and operation training. The theoretical teaching includes the history of laparoscopy, current situation of laparoscopy, future and challenges of laparoscopy, technical essentials of laparoscopy, etc. Adaptive training refers to the adaptive training for each trainee on the special simulator for laparoscope in the spatial position of laparoscopic operation. Including the up and down orientation, the depth of position, the angle of mirror transportation, etc. So that students can initially adapt to the spatial location relationship under the laparoscopic system.

Then conduct pre-training assessment according to the operation training items. Operation training includes bean picking (BP), circle cutting (CC), knot tying (KT) and laparoscopic suture (LS) on the laparoscopic simulator. Finally, post-training evaluation can be conducted after the training.

### 2.3. Formulation of Assessment Standards

The Likert scale was applied by two teachers to assess the degree of simulation of the laparoscopic simulator and the difficulty of assessment items (1-"nothing like the clinical practice", 3-"close approximation of the clinical practice", 5-"exactly like the clinical practice"). According to the operating procedures of the teacher, a performance standard is established to record the time required for sewing, knotting, circle cutting and bean picking.

### 2.4. Trainee Test

The assessment contents included picking up 15 beans, cutting circular pieces of paper, tying 2 knots and sewing with 1 needle. The invigilator will conduct one-on-one invigilation for the assessment, record the students' assessment video, and send the assessment video to two scoring teachers. The objective structured assessment of technical skills (OSATS) scoring was conducted according to the student's performance. The scoring criteria included five items of process familiarity, stability, time consumption, operating force and instrument proficiency. Compared with the standard, each item was scored according to the Likert scale, with a minimum of 1 point and a maximum of 5 points. Each project is worth 25 points, and there are a total of 4 projects for a total of 100 points.

### 2.5. Statistical Analysis

Statistical analyses were performed using SPSS (25.0) software. Data summarized using means and standard deviations (SD) otherwise, data summarized using medians and interquartile ranges. The measurement data were subjected to two-sample t-test and rank-sum test, and the enumeration data were subjected to $\chi^2$ test. $P < 0.05$ indicated that the difference had statistical significance.

## 3. Results

### 3.1. Teachers' Performance and Evaluation

Two teachers performed a BP, CC, KT and LS and then evaluated the degree of simulation and difficulty of each project. The simulation scores of the four items by the two teachers were BP (3, 3), CC (4, 4), KT (4, 3) and LS (2, 2) (**Figure 1**). And the scores of difficulty were BP (2, 2), CC (3, 4), KT (3, 3) and LS (4, 3) (**Figure 2**). All scoring criteria were according to the Likert scale. The operating times of two teachers were BP 91/79 s, CC 56/45 s, KT 37/32 s and LS 116/103 s (**Figure 3**).

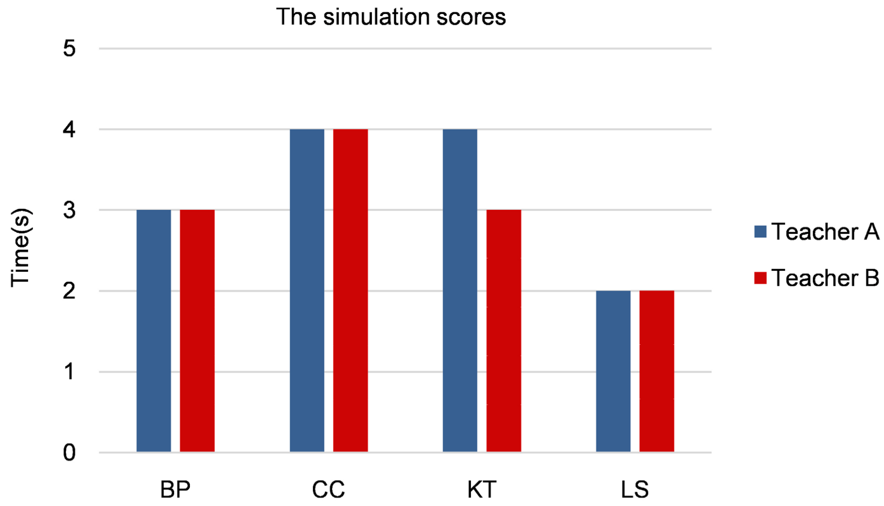


**Figure 1.** The simulation scores of the four items by the two teachers.

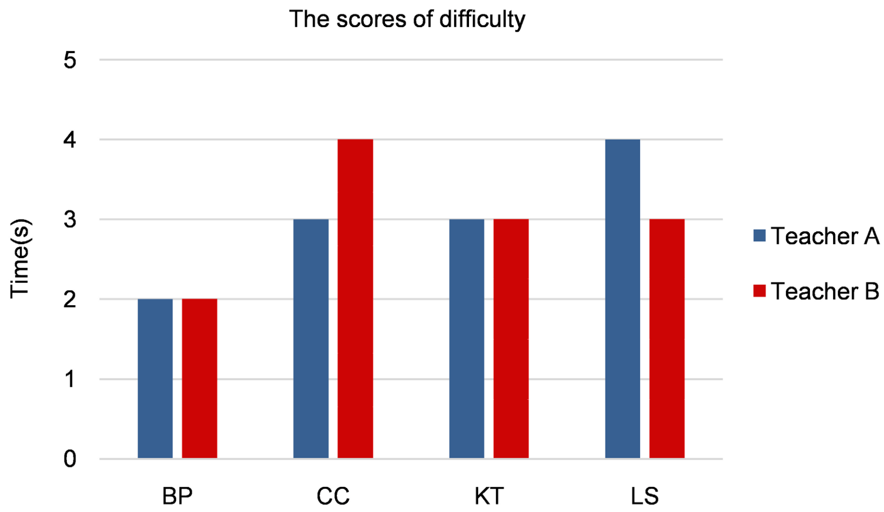


**Figure 2.** The scores of difficulty of the four items by the two teachers.

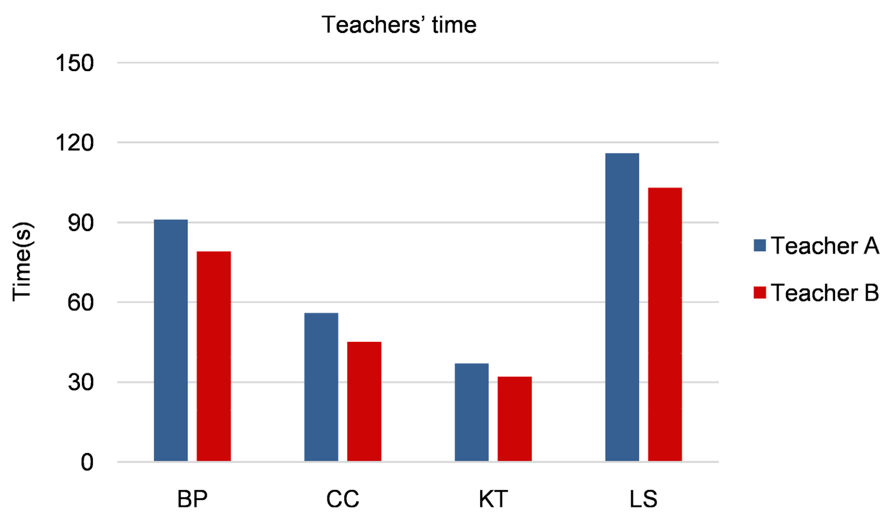


**Figure 3.** The operating time of two teachers.

### 3.2. Training Results of Interns and Probationers

After completing the second part of the training course (adaptive training), we conducted an assessment of the interns. The content included picking up 15 beans, cutting a circle, tying 2 knots and sewing with 1 needle. Then two scoring teachers gave OSATS scores according to the trainees' performance. Before the operation training, the interns' scores were BP 17.3 ± 3.1, CC 17.9 ± 3.4, KT 16.4 ± 3.4, LS 16.7 ± 3.3 (Table 1). And the results of probationers were BP 16.9 ± 2.7, CC 16.8 ± 2.8, KT 15.2 ± 1.6, LS 14.8 ± 2.2 (Table 1). After completing the operations training, the results of interns were BP 21.1 ± 2.0, CC 20.6 ± 2.7, KT 19.6 ± 3.1, LS 20.9 ± 1.4. And the probationers' scores were BP 19.3 ± 3.2, CC 19.6 ± 3.5, KT 19.6 ± 2.7, LS 20.0 ± 2.4 (Table 1). After the operation training, the performance of the intern group was better than that before the training ($P < 0.05$). The same is true of the probationer group. The time-consuming of inern examination were BP 147.9 ± 38.5 s, CC 123.2 ± 28.7 s, KT 82.6 ± 24.1 s and LS 162.5 ± 31.1 s. And the examination time of probationers were BP 179.9 ± 46.4 s, CC 132.1 ± 24.3 s, KT 109.3 ± 27.5 s and LS 210.0 ± 58.8 s (Figure 4). The operation time of the intern and probationer group was longer than that of the teachers. In BP and LS, the intern group took less time than the probationer group ($P < 0.05$).

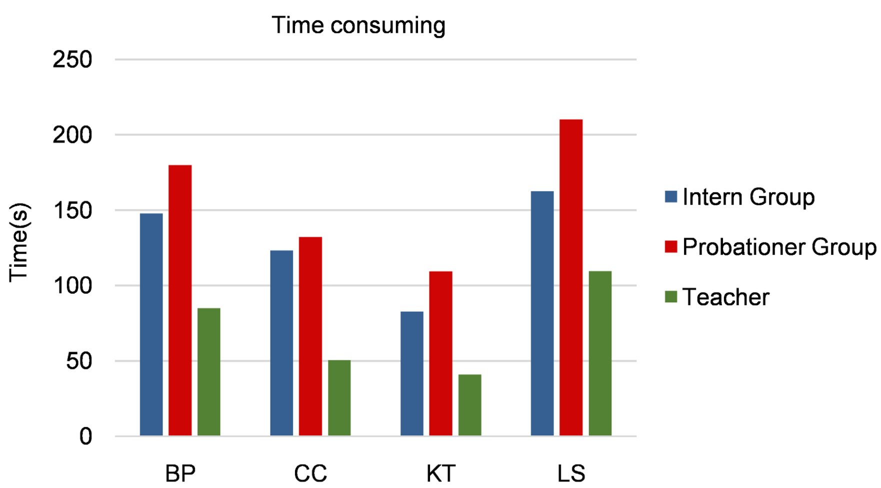


**Figure 4.** The examination time of interns and probationers.

**Table 1.** Comparison of results between the intern group and probationer group before and after training.

| Project | Intern Group (n = 54) | | | | Probationer Group (n = 72) | | | |
|---|---|---|---|---|---|---|---|---|
| | Before | After | *t* | *P* | Before | After | *t* | *P* |
| **BP** | 17.3 ± 3.1 | 21.1 ± 2.0 | −7.71 | 0.00 | 16.9 ± 2.7 | 19.3 ± 3.2 | −5.40 | 0.00 |
| **CC** | 17.9 ± 3.4 | 20.6 ± 2.7 | −4.29 | 0.00 | 16.8 ± 2.8 | 19.6 ± 3.5 | −5.57 | 0.00 |
| **KT** | 16.4 ± 3.4 | 19.6 ± 3.1 | −5.00 | 0.00 | 15.2 ± 1.6 | 19.6 ± 2.7 | −13.03 | 0.00 |
| **LS** | 16.7 ± 3.3 | 20.9 ± 1.4 | −8.39 | 0.00 | 14.8 ± 2.2 | 20.0 ± 2.4 | −13.16 | 0.00 |

## 4. Disscusion

At present, laparoscopic surgery is widely implemented. Endoscopic surgery techniques have appeared in general surgery, cardiothoracic surgery, urology, gynecology, otorhinolaryngology and other surgery [5]. In the undergraduate clinical teaching, the teaching of laparoscopy is only in the theoretical stage. Although lectures and textbooks can provide knowledge, surgical techniques are still communicated through the master-apprentice model. And only a few medical centers are trying to carry out the laparoscopic operation course [6]. Therefore, in order to enable interns and probationer to have a more intuitive understanding of laparoscopic surgery, we conducted this training course.

The traditional teaching is based on the teacher's operation demonstration. Students can see the operation content of the laparoscope from the display screen, but they cannot see the teacher's hands manipulation. They also don't have an intuitive understanding of the key to the operation under the laparoscope. Therefore, for beginners, laparoscopic operation is difficult. This is the reason for the shortage of a large number of minimally invasive doctors at present. Simulation offers the opportunity to practice in a safe, controlled, and standardized environment. Laparoscopic surgical simulation, in particular, is very attractive because it avoids learning and practicing surgical skills in the operating room [7]. After the training, the operating performance of the intern group and probationer group were significantly increased. The results of this training course also confirmed that after the standardized laparoscopic simulation training, it can lay a good foundation for beginners to learn laparoscopic in a short period of time with high efficiency.

In addition, we also recognized that interns and probationers have certain differences in clinical ability. It could be seen that there is no statistical difference between KT/LS scores before training and BP/LS scores after training between the two groups. After training, trainees' performance could be significantly improved, and there was no significant difference between the two groups in KT after training, which indicated that the basic operation ability of laparoscopy can be effectively improved in a short time after systematic training.

Similar simulation training courses have been conducted in several medical centres [8]. Bresler L *et al.* introduced the residency training of robotic surgery, and hoped that after these courses, they could acquire the skills foundation and be allowed to transition to safe clinical activities [9]. Childs BS et al. have constructed a simulation platform for the practice and training of robots, endoscopes and laparoscopes for the education of urology students. In addition, various educational and evaluation tools were adopted to effectively evaluate the results of the trainees while training [10]. Senapattis *et al.* designed a gynecological laparoscopic simulation model of the posterior vault, and the resident's performance significantly increased after training [11]. The effects of the simulation training are obvious, but equally important is the evaluation during and after the training [12]. Some studies used questionnaire evaluation, some used examination evaluation, and some used scoring evaluation. In order to describe the training effect of the trainees more accurately, we arranged different teachers to grade the students' performance with OSATS and recorded the time consumption of different projects [13].

However, there are still some shortcomings in this study, such as the trainees' training cycle is insufficient, the training content is inconsistent with clinical practice, and the cost of the course needs to be reduced.

## 5. Conclusion

Simulation training for laparoscopic surgery can improve minimally invasive surgical techniques for interns and probationers. However, large-scale promotion requires more refined economic control and more simulated operation.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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