SCIENTIFIC PAPER JSLS

Students' Interest in Surgery Affects Laparoscopic Practicing Performance

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ABSTRACT

Background and Objective: Earlier exposure to laparoscopic techniques is thought to be beneficial for medical students. Reports have demonstrated that practice improves performance in laparoscopies. In this study, we intended to evaluate whether medical students' interest in surgery is affected by the amount of practice and the performance on a laparoscopic simulator.

Methods: A laparoscopic simulation curriculum was introduced at Taipei Medical University, Wan-Fang Medical Center. Study participants included 36 sixth-year and 14 seventh-year students who were divided according to whether they had indicated an interest (group A) or not (group B) in surgery. The students had twice-a-week practice sessions for 2 weeks. They underwent baseline measurement (BM) before training and posttraining measurement (PTM). Self-guided practice on the simulator was allowed. The learning outcomes were assessed comparing the BM and PTM scores by using the interquartile range (IQR) test. We also tested the correlation between total score and number of self-guided practice sessions.

Results: All study participants showed improvement. No differences were observed between BM and PTM scores and between 6th- and 7th-year medical students. Significant differences were found in PTM scores between groups A and B ($P < .001$). Analysis of variance with a post hoc test for different groups revealed that the PTMs were significantly higher for both the 6th- and 7th-year medical students in group A than for those in group B ($P < .001$). Total performance scores were improved with a higher number of self-guided practice sessions. Linear regression analysis demonstrated a significant correlation between the number of self-guided practice sessions and total performance score ($P < .001$).

Conclusion: Those clerks and interns interested in surgery who had more sessions for self-guided practice, displayed more improvement than those not interested in surgery did. Improvement in performance correlated highly with trainees' number of self-guided practice sessions.

Key Words: Medical students, Interest in surgery, Laparoscopic simulator, Performance Score, Self-guided practice

INTRODUCTION

At all medical schools in Taiwan including Taipei Medical University (TMU), high school graduates are directly enrolled in medical classes. The medical education program requires spending 7 years in Taiwan. Medical students spend their first 2 years in premedical education and the 3rd and 4th years in studying basic medical sciences. Afterward, they enter into clerkships in their 5th and 6th years and internships in the 7th year before graduation. Some medical students take their surgical clerkships or internships at TMU-Wan-Fang Medical Center, which is 1 of 3 TMU teaching hospitals. (Starting during the 2013–2014 academic year, 7 years of medical school education in Taiwan was changed to 6 years. The main change is to shorten the 2-year premedical education into 1 year by moving more humanities and ethics classes to the last 2 years taught at the hospitals and removing internship after graduation from the medical schools).

Several recent studies have demonstrated that medical students with early exposure to learning surgical techniques show increased interest in surgical careers.[1] Early exposure to laparoscopic techniques can generate benefits during surgery rotations in medical students and may help identify their difficulties in learning laparoscopic skills.[2–4]

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Chih-Cheng Luo received Grant 103-wf-eva-17 from the Wan Fang Medical Center.

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DOI: 10.4293/JSLS.2016.00039

Currently, medical students and surgical residents receive training in basic and advanced laparoscopic techniques with box trainer drill stations or virtual-reality simulators, which have been shown to be effective.[5,6] The benefit of simulator use in improving development of basic laparoscopic skills during clerkships and internships has yet to be fully assessed. In this study, we intended to evaluate whether surgical interest may affect the practice performance in the laparoscopic simulator.

METHODS

Because our experiments did not involve human subjects, the study protocol was exempted from the review of the TMU-Joint Institutional Review Board. At TMU-Wan-Fang Medical Center, a laparoscopic simulation curriculum for clerkship was introduced in August 2013 to determine the effect of early exposure to laparoscopic techniques in a simulator. A total of 36 clerks (the 6th-year medical students) and 14 interns (the 7th-year medical students) of the TMU entrance classes of 2008 and 2007, rotated to a surgical course at TMU-Wan-Fang Medical Center for the 2013–2014 academic year. The 7th-year medical students had hands-on routine clinical duties, but the 6th-year students had no routine clinical duties during the study period. All students were asked about their surgical interest and any previous experience with laparoscopy before the training began. Surgical interest was divided into general surgery, surgical subspecialty, and nonsurgical categories. Students who were interested in general surgery or a surgical subspecialty were included in the surgical interest group (group A), and those who were not interested in surgery were included in the noninterested group (group B). None of the participants had any previous laparoscopic experience.

Study Procedures

For training in this study, all students performed 3 tasks in a simple laparoscopic trainer box (Lagis Enterprise, Taipei, Taiwan) in twice-per-week practice sessions for 2 weeks. The students' performance of 3 tasks was evaluated using baseline measurements (BMs) and posttraining measurements (PTMs).

Each student received training from 8:30 a.m. to 12:30 p.m. for 4 days. The BM was performed by having the students follow a tutor, to receive training in laparoscopic techniques, equipment handling, and correct performance of all tasks. Each student received individual coaching, feedback, and 1 of 4 tutors demonstrated how to use the simulator on the 3 remaining training days. Tutors were instructed to take turns in training students to ensure unbiased coaching. Feedback was provided when students had questions or when the tutor identified that a task was being incorrectly performed. Self-guided practice sessions were offered on all study days other than the training days. We also recorded the students' number of sessions for self-practice days. PTM of each task was performed on the last day of those practice sessions.

Content of Tasks

In this study, the 3 tasks were modified from the established tasks[7–9] and ranged from basic to more advanced laparoscopic techniques.

Task 1: Red Bean Transfer

The operator individually picked up 30 red beans within a bottle and inserted them into a gloved finger. This required the use of the dominant hand in a complementary manner. This task was to test eye–hand coordination and was scored by completion time, with a cutoff time of 240 seconds. The penalty score was determined by counting the number of beans not inserted or dropped outside the glove finger; 4 seconds were deducted for every dropped bean.

Task 2: Pattern Cutting

The operator cut a circular predrawn pattern 5 cm in diameter from a piece of suspended gauze. This task tested grasping ability by using one hand to place the material under tension and the other to manipulate the endoscopic scissors. The task was scored by completion time, with a cutoff time of 300 seconds. The penalty score was determined by calculating the percentage area of deviation from the circle; 2 seconds were deducted for every 1 percent area of deviation from a circle.

Task 3: Intracorporeal Knot-Tying

A 20-cm-long simple suture was placed through a premarked longitudinal cutting line on a rubber board. The suturing was performed with an intracorporeal knot-tying technique. This task is to learn needle transferring, suture placement, and knot-tying skills. The cutoff time was 600 seconds. The penalty score was failure of the suture to approximate the edges of the cutting line; 20 seconds were deducted for failure, and 30 seconds were deducted when the knot was loose or not secured.

Scoring of Performance

Performance of each task was graded objectively, and both speed and precision were considered.[10] For each task, the timing score was calculated using the following formula: timing score = preset cutoff time (seconds) − task completion time (seconds). If the task completion time exceeded the preset cutoff time, then a score of 0 was given, because no negative values were assigned. The precision of performance was also scored by calculating the penalty score for each task. Finally, the total score for each task was calculated using the following formula: total score = timing score − penalty score. Thus, more accurate and rapid task completion yielded a higher score.

Statistical Analyses

Analysis of variance (ANOVA) was used to determine the effects of the interest level of the 6th- and 7th-year medical students in groups A and B on performance. The interquartile range (IQR) test was used to compare the differences in scores between BMs and PTMs of the 6th- and 7th-year medical students and between groups A and B. Linear regression analysis was used to test for correlation between average posttraining total score and number of self-guided practice sessions.

All study data were computed with Statistical Package of Social Science software version 9.3 for Windows (SPSS Inc., Chicago, Illinois, USA). The differences between groups were considered significant if $P < .05$. The data are expressed as the score interquartile range (IQR).

RESULTS

All medical students demonstrated significant improvement in each task and in the total score (sum of scores of all 3 tasks; **Table 1**). The total BM and PTM scores were 199 (192) and 589 (315), respectively ($P < .001$).

Table 1.
Comparisons of BMs and PTMs for all Students

	BM	PTM
Red bean transfers	26 (32.5)	86 (59.5)***
Pattern cutting	52 (71)	143 (61.5)***
Intracorporeal knot	120 (166.5)	371.5 (205)***
Total performance	199 (192)	589 (315)***

Data are scores (SD). ***$P < .001$.

The BM and PTM scores in the 6th- and 7th-year medical students demonstrated no significant difference in each task (**Table 2**). The total BM scores in the 6th- and the 7th-year medical students were 180.5 (194.3) and 231.5 (193), respectively, which was not significantly different. The total of the PTM scores in the 6th- and the 7th-year medical students were 618 (337.5) and 533 (263.5), respectively, which was also not significantly different.

Significant differences ($P < .05$) were observed in the BMs for intracorporeal knot-tying between groups A (144.5 [150.5]) and B (99[124]) (**Table 3**). Significant differences were observed in PTMs between groups A and B ($P < .001$); the total scores of the 2 groups were 718 (122) and 373 (138.3), respectively.

ANOVA with a post hoc test revealed no differences in the BMs between the 6th- and 7th-year medical students in both groups A and B, but the total PTM scores were higher in the 6th- and the 7th-year medical students in group A than were those in group B (**Figure 1**).

We found that group A had significantly more sessions for self-guided practice than those in group B ($P < .001$); the average numbers were 4 (0) and 2 (0). The total average performance scores were improved with increased number of practice sessions (**Figure 2**). We used linear regression analysis (**Figure 3**), demonstrating that the number of practice sessions correlated significantly more with improvement of total performance scores ($P < .001$).

DISCUSSION

We found no studies evaluating whether practice on a laparoscopic simulator affects medical students' interest in surgery. Our data showed that medical students displayed significant improvement ($P < .001$), on all tasks and the total score after training (**Table 1**), and that no significant differences were observed in all tasks between 6th- and 7th-year medical students (**Table 2**). Medical students with surgical interest had more self-guided practice sessions (data not shown) and showed significantly more improvement on each task ($P < .05$ or $P < .001$).

Laparoscopic training is multifaceted, and students should be familiar with the instrumentation and develop the fundamental skills necessary to perform laparoscopy safely. One of the models used for training is the surgical simulator. Currently, the surgical simulator is mostly used to train medical students and surgical

Table 2.
Comparisons of BMs and PTMs between 6th- and 7th-year medical students

	BM		PTM	
Task	6th-year (n = 36)	7th-year (n = 14)	6th-year (n = 36)	7th-year (n = 14)
Red bean transfers	26 (31.5)	25 (38.5)	83.5 (56.5)	89 (54)
Pattern cutting	46.5 (71)	67 (55.75)	150.5 (70)	136 (53.75)
Intracorporeal knot	120 (173.75)	127 (130.25)	393 (242.75)	320 (192)
Total performance	180.5 (194.25)	231.5 (193)	618 (337.5)	533 (263.5)

Data are scores (SD). No significant difference was found the 6th- and 7th-year students in all comparison between the BM and PTM groups.

Table 3.
Comparison of BMs and PTMs between groups A and B

	BM		PTM	
Task	Group B (n = 20)	Group A (n = 30)	Group B (n = 20)	Group A (n = 30)
Red bean transfers	25 (27.25)	26 (34.75)	50.5 (32.5)	106 (40.7)***
Pattern cutting	52 (52.75)	52 (73.75)	99 (67)	172 (50.7)***
Intracorporeal knot	99 (124)	144.5 (150.5)*	200 (84.5)	439 (74.5)***
Total performance	166.5 (132.75)	256.5 (212.75)	373 (138.25)	718 (122)***

*$P < .05$; ***$P < .001$.

residents in basic and advanced laparoscopic techniques.[5,6] Several tasks have been performed in the laparoscopic simulator and range from basic to more advanced laparoscopic techniques.[11] We selected 3 tasks: red bean transfer for laparoscopic coordination skills, pattern cutting for using certain laparoscopic instruments, and intracorporeal knot-tying for learning advanced laparoscopic techniques.

Several systematic reviews and a meta-analysis revealed that simulation-based training provides better laparoscopic performance than no training.[12–14] A previous study also showed that successful integration of training into a surgical simulation curriculum depends on factors such as participants' motivation, available resources, and trainee and faculty commitment.[15] In our study, after training with a structured approach to supervised learning, all medical students in our study (**Table 1**) displayed significantly more improvement in skills for performing all tasks ($P < .001$). The total score of the PTM was significantly higher than that of the BM for all students ($P < .001$). Based on those study results, we suggest that early exposure to laparoscopic techniques and effective coaching from instructors can improve medical students' technical skills.

Previous reports demonstrated that performance on a laparoscopic simulator can progressively improve with practice.[6,16] Some authors emphasized that trainee motivation is essential for learning, because it drives participation in training sessions and ensures deliberate practice and persistent efforts to improve performance.[17,18] In our study, none of the students had any previous experience with laparoscopy, but no significant differences were observed in the BM and PTM scores between 6th- and 7th-year medical students for each task (**Table 2**). This result was independent of the fact that the 7th-year students had clinical exposure, and the 6th-year students did not during the study period. Significant differences were observed in the BMs for intracorporeal knot-tying between groups A and B ($P < .05$) (**Table 3**). A significant difference in performance of all tasks was observed in PTM scores of groups A and B ($P < .001$). ANOVA with post hoc test

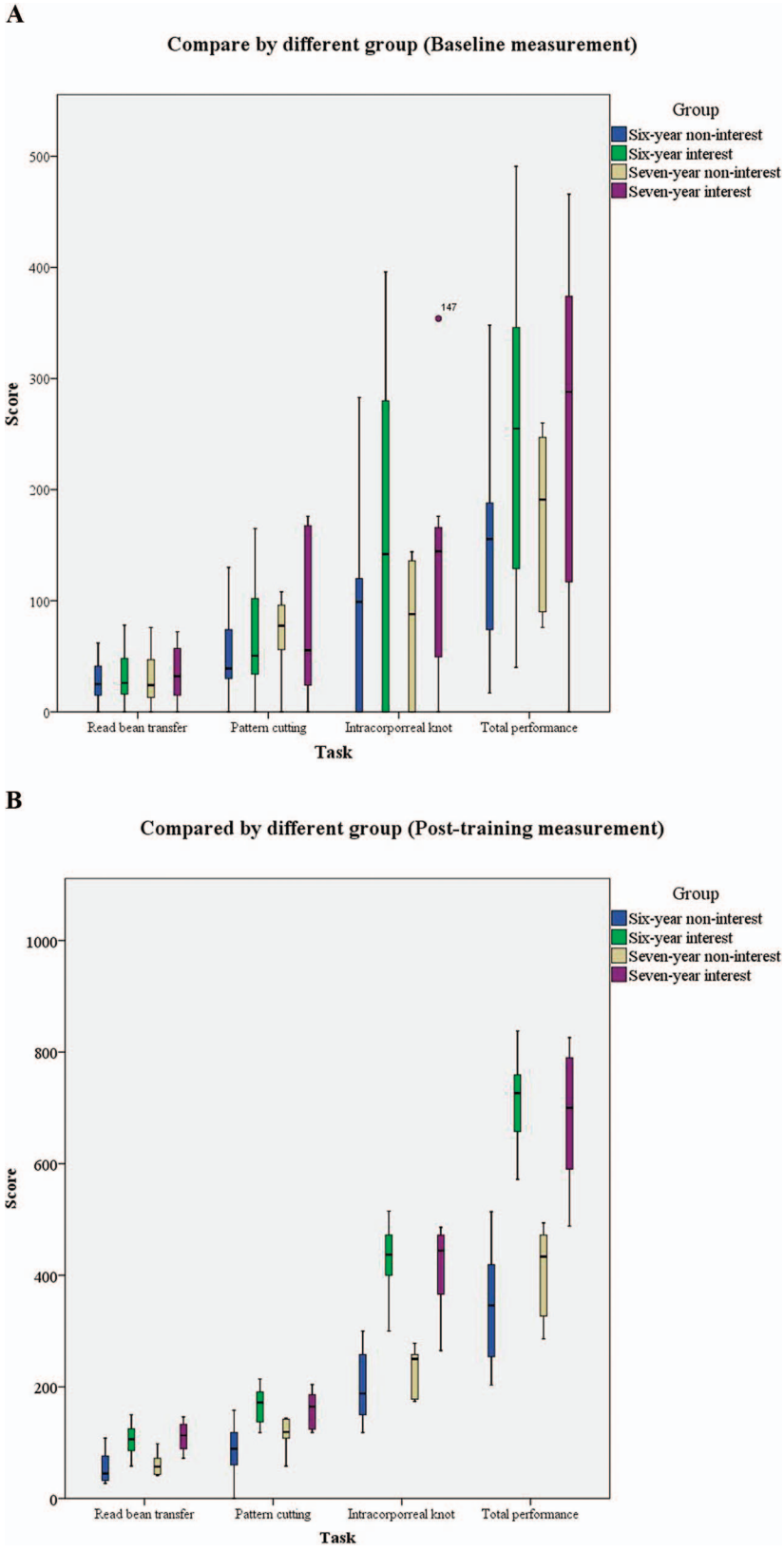

Figure 1. ANOVA with a post hoc test of BM and PTM results between the study groups. BMs were the same in 6th- and 7th-year medical students in groups A (top) and B (bottom), but PTMs were higher than in 6th- and 7th-year medical students in groups A than those in group B ($P < .05$).

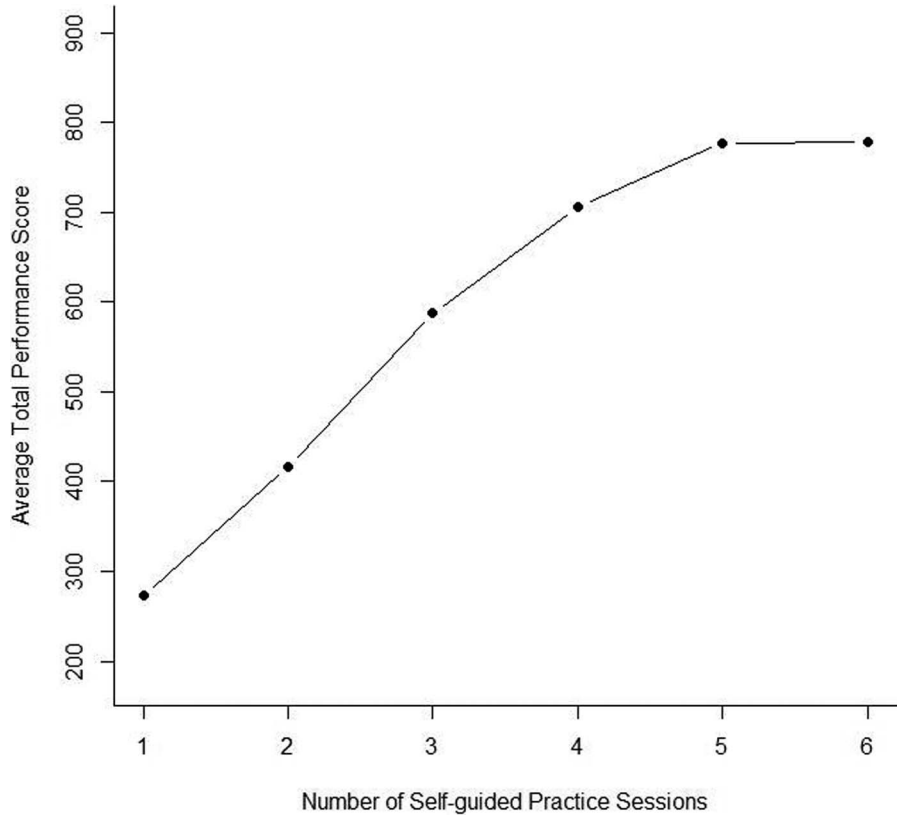

Figure 2. Total average performance score for self-guided practice sessions (1–6).

revealed that the 6th- and 7th-year students in group A had higher scores than did those in B ($P < .05$), perhaps because medical students with surgical interest engaged in more self-guided practice than the noninterested students did. The average number of sessions was 4 (0) to 2 (0) ($P < .001$) (data not shown). Total average performance scores improved with an increased number of practice sessions, according to linear regression analysis. We demonstrated that the number of practice sessions correlated significantly with improved total performance scores ($P < .001$).

Study limitations

The reader are advised against generalizing the study findings, because this study has 3 major limitations: (1) The study had only 36 study participants, only about a quarter of the total size of medical classes every year at TMU. (2) The medical students were enrolled from only 1 medical university. It is doubtful that they represent all students in all 13 medical universities in Taiwan. (3) The measurement tasks used in this study may not adequately reflect the overall capacity to measure surgical skills or to identify medical students who are interested in surgery.

SUMMARY

All medical students in this study began at the same ability level. Despite the above-listed study limitations, we found that all students demonstrated improvement during the study. Those who were interested in surgery had more self-guided practice sessions and displayed more improvement than those who were not interested in surgery. The improvement of performance correlated highly with an increased number of practice sessions.

A second study that addresses the limitations of the current one is needed to validate our findings, by recruiting the necessary sample size, enrolling students from various medical schools, and adding refined study tools. Finally, the identification of students' interest in surgery is also an important finding in this study. Therefore, further exploration of this topic may help medical students decide upon surgery as their medical career choice.

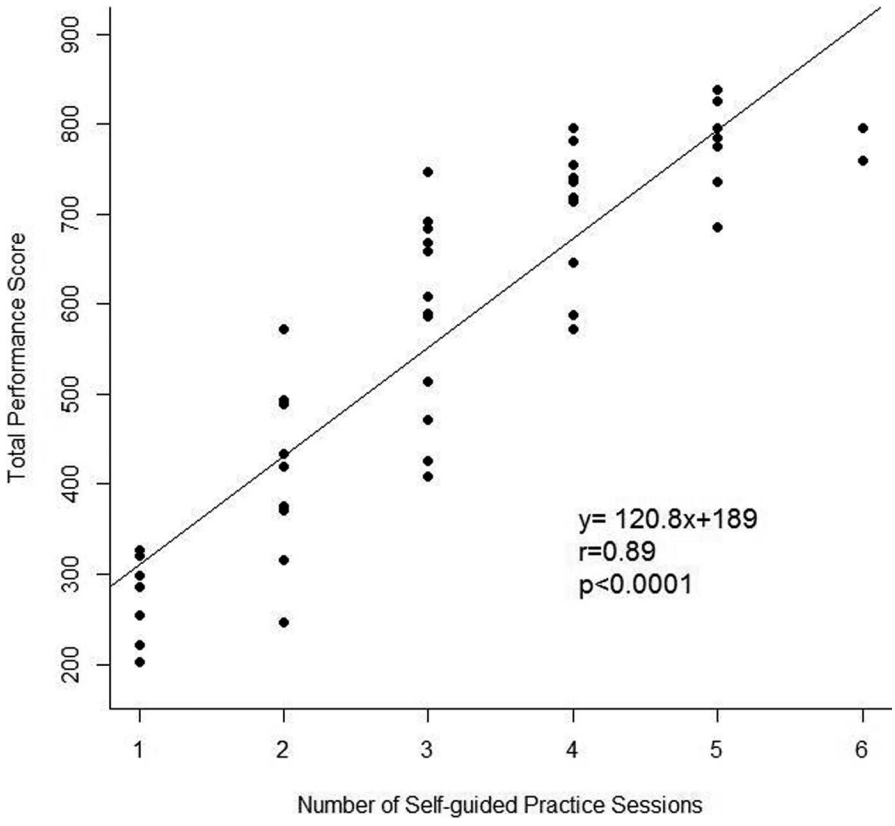

Figure 3. Correlation of self-guided practice sessions with total average performance score (correlation coefficient, $r = 0.89$; $P < .001$).

Prof. Winston W. Shen at TMU-Medical Center gave helpful editorial comments on a previous version of the manuscript.

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