Evaluation of the Advising Doctor for Operating of Medical Student by Laparoscopic Surgery Simulator

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Abstract. Laparoscopic surgery is less intraoperative hemorrhaging and pain than open surgery, reducing the patient's burden. However, laparoscopic surgery requires time for practicing to acquire the procedure due to restrictions such as work through instruments or limited viewing. In this study, we elucidate the relationship of evaluation of simulator and evaluation of advising doctor, and verified the possibility of constructing educational system including education as guidance. In this experiment, the subjects were surgeons with 18 years of experience of laparoscopic surgery to qualify as an instructor. The content of the experiment was the 5-grade evaluation for the work by viewing the candidate movie. The 5-grade evaluation is "A", "B", "C", "D", "E", and it is an evaluation that it is bad from "A" to "E". We compared them with the evaluation items of the simulator and focused on the items of moving distance of forceps considered to be related to the medical student's skill. It was found that the shorter the moving distance, the better the evaluation by the advising doctor depending on the moving distance of the forceps. However, in "D" as well, it was a value approximate to "B". From this, it is considered that the reason why the forceps movement distance was short in the medical students of "D" evaluation is because they forceps are not operated (not moving). Therefore, it is thought that more accurate evaluation can be made by evaluating no only the evaluation of the simulator but also the evaluation judgment of the advising doctor, that is, the operation of the forceps.

Keywords: Evaluation · Advising doctor · Laparoscopic surgery simulator

V. G. Duffy (Ed.): HCII 2019, LNCS 11581, pp. 345–354, 2019.
https://doi.org/10.1007/978-3-030-22216-1_25

1 Introduction

Japanese doctors counted statistics on the number of doctors by the Ministry of Health, Labor and Welfare [1]. According to it, the number of surgeons, especially those under 29 years old decreased from 3,383 in 1998 to 1,422 in 2016. That means that medical students and residency who wish for surgeons are getting less. As one of these causes, it will take time to acquire skills. One of the factors that raises the difficulty of acquiring skills will be surgical techniques. In addition, in recent years, surgery of another method such as laparoscopic surgery as well as open surgery will be performed, and surgical techniques for it must be acquired. Laparoscopic surgery differs from open surgery in the following points.

- Work with forceps.
- Obtain surgical field with video of endoscope camera.

For the above reasons, the field of vision is restricted and you have to get used to operating forceps. The eye-hand coordination is regarded as important, and there is a problem that it takes time to familiarize.

The aim of the research was to construct a self-learning educational support system that feedbacks the evaluation results to the learner for laparoscopic surgery. We measured the medical student's eye movement in practice and reported the results of gaze point and gaze time in last year's HCII [2]. Thereby, we clarified the medical student's eye movement and the guidance content of the advising doctors and suggested that we can see the proficiency level by gaze time and evaluation of simulation. And we compared the moving distance of forceps obtained by the simulator and the evaluation by the surgeon in the japan ergonomics society kansai branch [3]. The moving distance of forceps was shorter as a surgeon evaluated good medical student. However, medical students with low evaluations also had short the moving distance. Besides whether the medical student is good or bad, there is a possibility that the work may be complicated, and as a result, the moving distance may be shortened. We reported that we need to evaluate them differently and clarify the difference.

In this research, we clarified the relationship between the evaluation items of the simulator obtained by the previous research and the evaluation of the advising doctors and searched for a new evaluation axis.

2 Experimental Method

In this content of implementation, participants watched target videos and evaluated it. Participants were a surgeon of 18 years' experience with qualification of advising doctors. Figure 1 shows the videos watched by participants. The target videos was 37 medical students targeted in previous research. The content of the videos was a practice of laparoscopic cholecystectomy using a surgical simulator. Evaluation method was set to 5 grades of "A", "B", "C", "D" and "E". It is an evaluation that "A" is the best and it is bad with E.

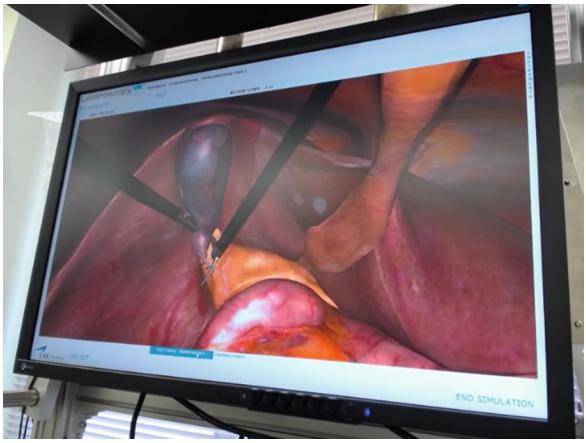

Fig. 1. Target video watched by participants

3 Result

3.1 Comparison of Evaluation of Simulator and Evaluation by Surgeon

Among the evaluation items of the simulator, comparisons were made on 9 items considered to be related to skills. Table 1 shows item names and their contents. The value of the evaluation item is evaluated by a numerical value or "01". For example, "Actual Result for time.complete.task" is expressed by working time. "Actual result for Duct.First" is expressed by "0" or "1", indicating whether or not it is done. "0" indicates that it is not for the item, and "1" indicates what it was done for the item.

Table 1. Focused evaluation item of the simulator

Evaluation item	Evaluation method
Actual result for Time.Complete.Task	Numerical value
Actual result for Time.Cautery.Used	Numerical value
Actual result for Duct.Proximal.Clipped	01 notation
Actual result for Duct.Distal.Clipped	01 notation
Actual result for Artery.Proximal.Clipped	01 notation
Actual result for Artery.Distal.Clipped	01 notation
Actual result for Duct.First	01 notation
Actual result for Blood.Loss	Numerical value
Actual result for Clips.Placed	Numerical value
Actual result for Clips.Dropped	Numerical value

3.2 Comparison Between Numeric Data and Advising Doctor's Evaluation

The average and the standard deviation (SD) were calculated with the evaluation value of the simulator of each evaluation divided by the advising doctors in order to make a comparison. Also, since there is only one medical student of "E" evaluation, average and standard deviation are not calculated. Figures 2, 3, 4, 5 and 6 show the comparison between each evaluation item and the advising doctor's evaluation.

"Actual result for Time.Complete.Task" means working time, working time was long from "A" evaluation to "C" evaluation. And "D" evaluation shortened working time. "Actual result for Time.Cautery.Used" means the operating time of acusector.

No predominant difference was seen between the evaluations. "Actual result for Blood.Loss" means the operative hemorrhage. The worse bleeding amount was increased as the advising doctor's evaluation was bad. "Actual result for Clips.Placed" means the number of clipping times. In this practice, medical students were instructed to do 6 times in total, 3 times to the cystic duct and 3 times to the cystic artery. The worse the advising doctor's evaluation, the less the number of clipping was filled. "Actual result for Clips.Dropped" means the number of clipping dropout intraoperatively.The worse the advising doctor's evaluation, the more dropped out.

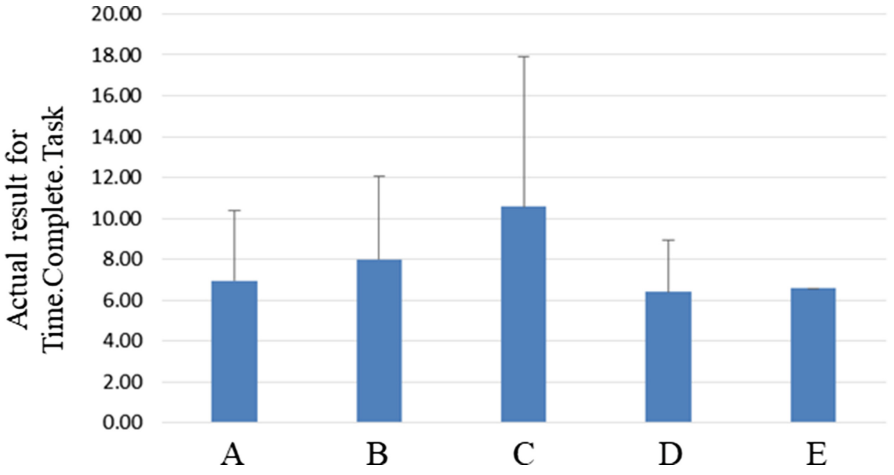

Fig. 2. Comparison of "Actual result for Time.Complete.Task" and advising doctor's evaluation

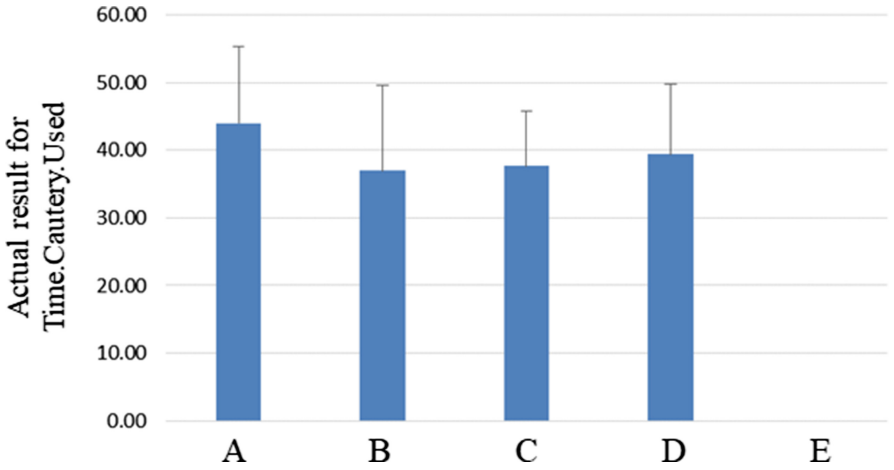

Fig. 3. Comparison of "Actual result for Time.Cautery.Used" and advising doctor's evaluation

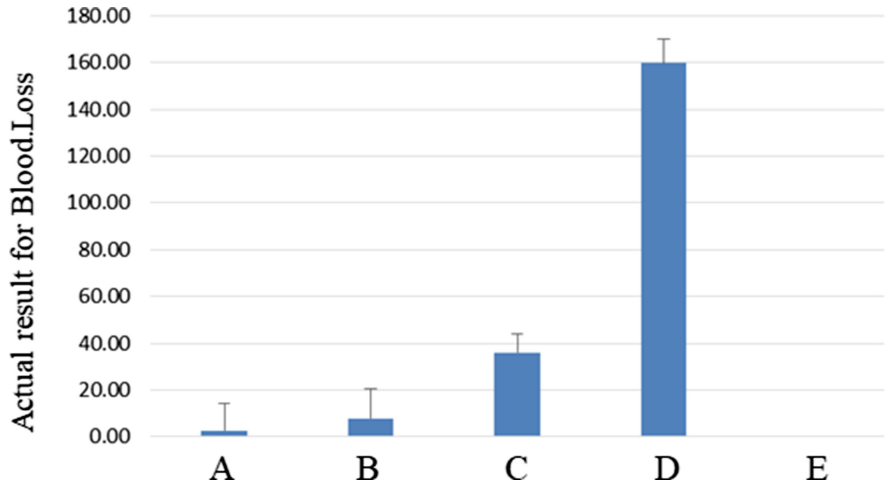

Fig. 4. Comparison of "Actual result for Blood.Loss" and advising doctor's evaluation

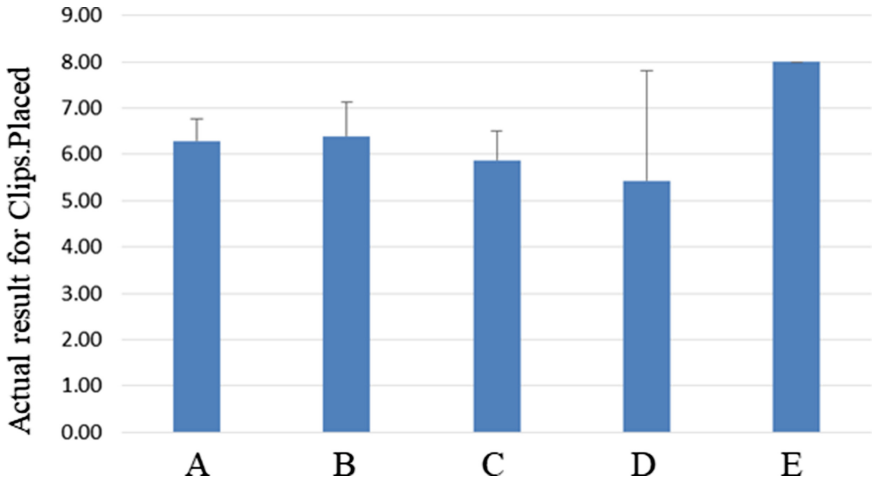

Fig. 5. Comparison of "Actual result for Clips.Placed" and advising doctor's evaluation

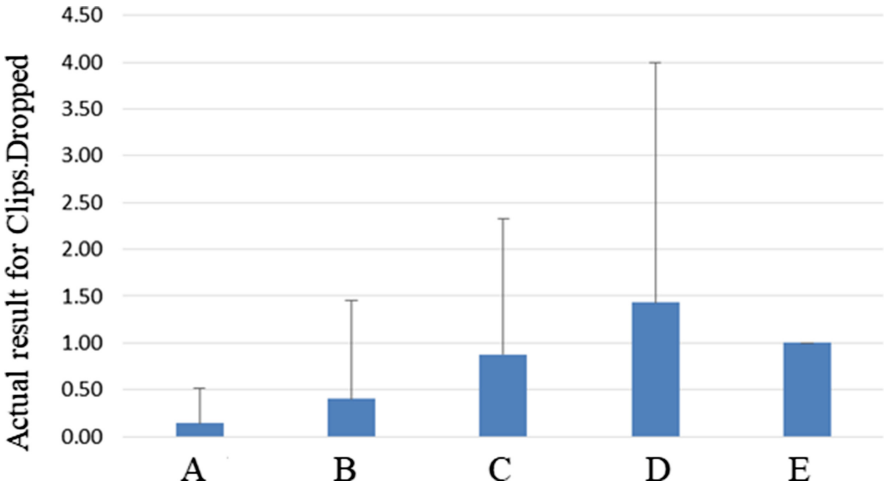

Fig. 6. Comparison of "Actual result for Clips.Dropped" and advising doctor's evaluation

3.3 Comparison with "01" Data and Advising Doctor's Evaluation

Next, we calculated the rate of the medical student who was "1" in each evaluation and the medical student who was "0". Figures 7, 8, 9, 10 and 11 show to compare the rate of the evaluation item of the simulation and the advising doctor's evaluation. "Actual result for Duct. Proximal. Clipped" and "Actual result for Duct. Distal. Clipped" means clipping at a position close to the cystic duct or clipping to a distant position. "Actual result for Artery.Proximal.Clipped" and "Actual result for Artery.Distal.Clipped" have the same meaning and do for the cystic artery. Doing these tasks makes easier to cut the

cystic duct and the cystic artery. The results show that the worse the advising doctor's evaluation, the more medical students are not doing it. Finally, "Actual result for Duct. First" means that the cystic duct was worked before the cystic artery. It is said that the cystic duct is located on the near side of the gallbladder artery and working with the gallbladder earlier is easier to work. There was a medical student who could not work the cystic duct earlier in every evaluation. Also, the worse the advising doctor's evaluation, the higher the proportion of "0" was.

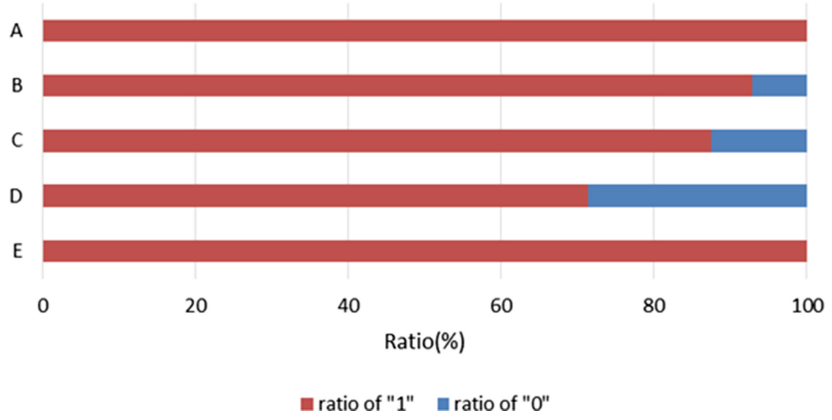

Fig. 7. Comparison of "Actual result for Duct.Proximal.Clipped" and advising doctor's evaluation

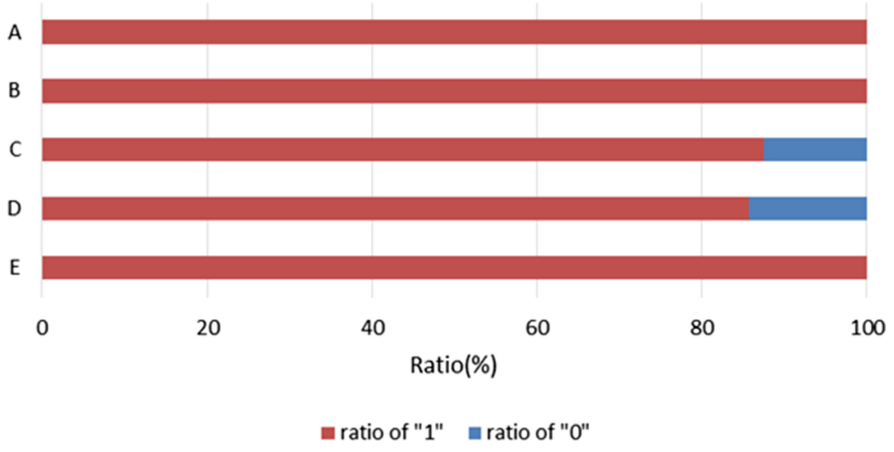

Fig. 8. Comparison of "Actual result for Duct.Distal.Clipped" and advising doctor's evaluation

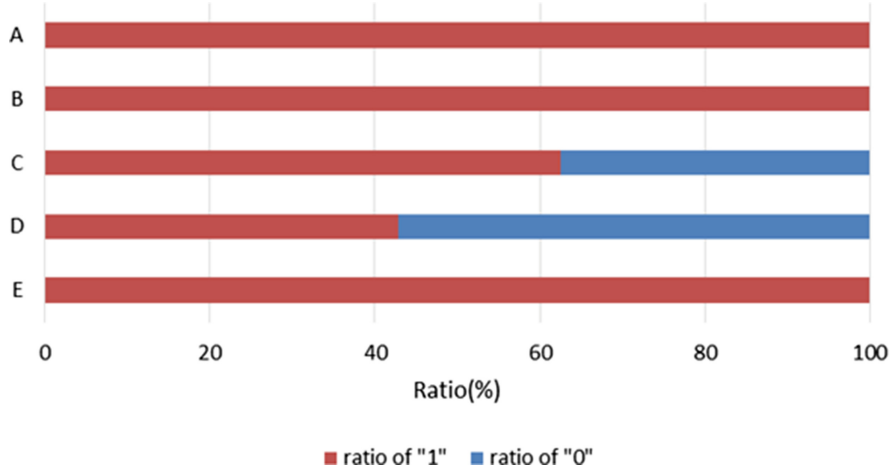

Fig. 9. Comparison of "Actual result for Artery.Proximal.Clipped" and advising doctor's evaluation

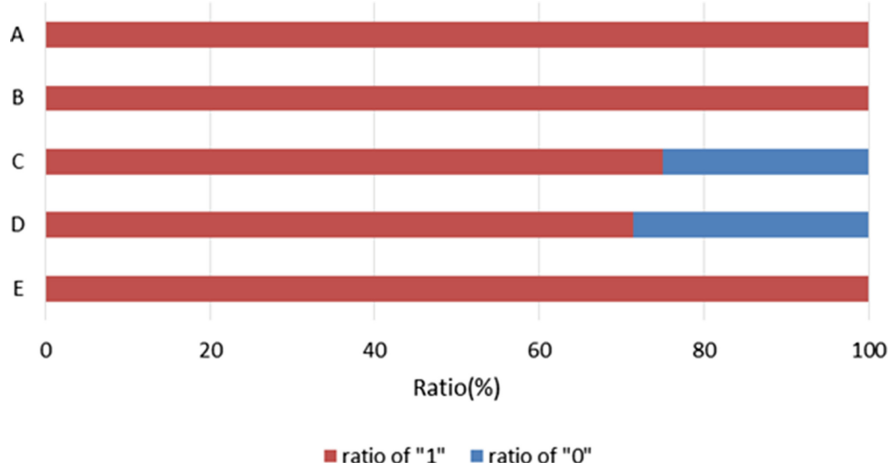

Fig. 10. Comparison of "Actual result for Artery.Distal.Clipped" and advising doctor's evaluation

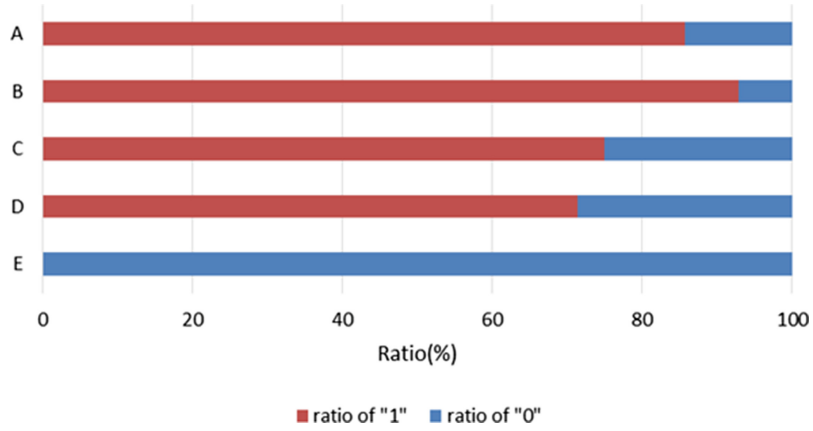

Fig. 11. Comparison of "Actual result for Duct.First" and advising doctor's evaluation

4 Discussion

There was a tendency similar to each item compared. Table 2 summarizes the evaluation for each trend. First, "1" filled the criteria. Also, they are items that the advising doctor's evaluation was bad with the increase and decrease of the numerical value. We think that it is possible to see the evaluation of the simulator and the advising doctor's evaluation as the same evaluation. "2" was that the advising doctor's evaluation grow worse according to the increase and decrease of the numerical values. However, it was an approximate value for D evaluation and B evaluation. Almost, there were no predominant differences. We think quantitative evaluation is difficult in these items. As mentioned in the previous study, medical students did complicated working, so good evaluation and bad evaluation will be approximate values, or it may be difficult to evaluate without difference. It is considered that it is also necessary to evaluate these items according to the manipulation method of the forceps (the holding time of organs, etc.).

Table 2. Evaluation items for each trend

No.	Evaluation item
1	Actual result for Duct.Proximal.Clipped
	Actual result for Duct.Distal.Clipped
	Actual result for Artery.Proximal.Clipped
	Actual result for Artery.Distal.Clipped
	Actual result for Duct.First
	Actual result for Blood.Loss
	Actual result for Clips.Placed
	Actual result for Clips.Dropped
2	Actual result for Time.Complete.Task
	Actual result for Time.Cautery.Used

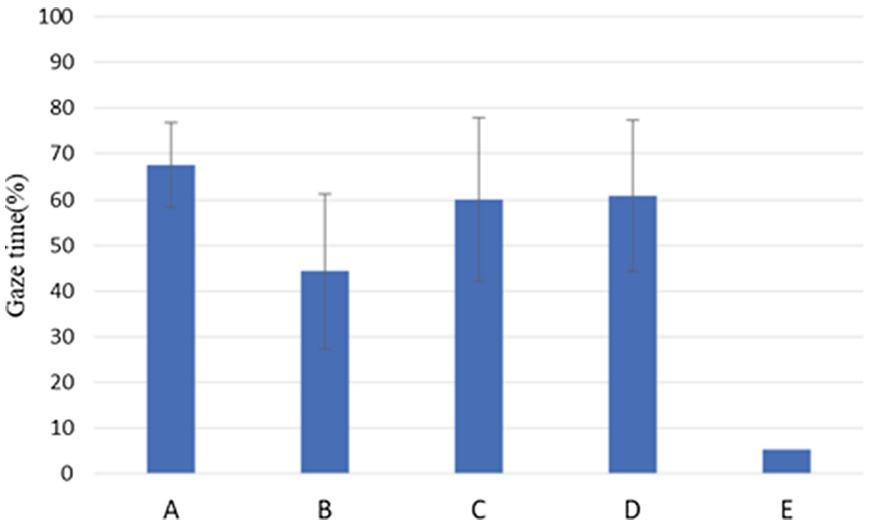

Fig. 12. Comparison of medical student's eye movement and advising doctor's evaluation

5 Conclusion

This study revealed that items evaluated by advising doctor coincide with those of simulators. On the other hand, there were items that did not fit with the evaluations of the simulator and the advising doctor. The item of operation of the forceps is easy to evaluate the skill of medical students. However, an advising doctor's evaluation is necessary to judge whether the work is good or bad. It is important to evaluate these quantitatively.

In addition, Fig. 12 shows a graph that divides the results of the eye movement of medical students obtained by previous studies for each the advising doctor's evaluation. This shows that medical students with the highest evaluation are more frequent in medical students who are closely watching organs. In the future, we will consider whether the result of eye movements can be used for evaluation.

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