

Original Reports

**Recruitment of Young Medical Apprentices (RYOMA) Project: A Comprehensive Surgical Education Program at a Local Academic Institute in Japan**

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**Running title:** Surgical education RYOMA project

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**Abstract:**

*Objectives:* The number of young surgeons in Japan has significantly decreased in recent years, which may lead to future problems in the medical field. Therefore, comprehensive training programs for young surgeons are needed. *Design:* Retrospective study. *Setting:* We developed a specific education program called the “Recruitment of Young Medical Apprentices” (RYOMA) project. *Participants:* We performed this project between January 2008 and August 2013 on 4<sup>th</sup> to 6<sup>th</sup> year medical students and internship doctors. The RYOMA project included step-by-step surgical education programs on open and scopic procedures as dry, wet, and animal laboratory training. Our goal was to increase the number of young and specialist surgeons. *Results:* Based on an interview questionnaire answered by 90 medical students, most young students were interested in surgical training, and several chose to become surgeons in the future. The most positive opinions regarding the field of surgery were the impressive results achieved with surgery, while negative opinions included the difficulty of the surgical skill, physical concerns related to difficult work environments, and the severity of surgical procedures. The present program has begun to resolve negative opinions through adequate training or simulations. Of the 19 medical students and internship doctors who attended the RYOMA project in 2008, 17 trainees (90%) were satisfied with this special surgical program and 16 (88%) showed interest in becoming surgeons. The number of participants considering the field of surgery increased between 2008 and 2013. Nineteen of 23 participants (83%) had a positive opinion of the program after the training. *Conclusions:* Gaining experience in surgical training from an early stage in medical school and step-by-step authorized education by teaching staff are important for recruiting students and increasing the number of young surgeons.

**KEY WORDS:** surgical education, medical students, internship, step-by-step education, RYOMA

Surgery used to be a common specialization for medical physicians worldwide. However, the number of medical students choosing to study general surgery has declined since 2004, resulting in a significant decrease in the number of general surgeons, particularly in the younger generation in Japan.<sup>1</sup> The Japan CENS association reported a gradual decrease in the number of new surgeons per year (1667 new surgeons in 1995, 1204 surgeons in 2003, 499 surgeons in 2004, and 832 surgeons in 2008) (CENS website; [http:// www.npo-cens.org/newsletter/newsletter\\_vol05.html](http://www.npo-cens.org/newsletter/newsletter_vol05.html)). Because the number of new surgeons in Japan reached a low of 499 in 2004 (versus a peak of 1667 in 1995), a new internship system was initiated. This system allowed free selection for graduated students. An increase in rigorous work requirements has been reported in the surgical field in recent years, with the frequency of physiological or mental stress and lawsuits for bad surgical outcomes rising in Japan. These issues have likely contributed to medical students avoiding the general surgery field. The lack of young surgeons will become a problem in the future if efforts are not undertaken to reverse this issue. The recruitment of physicians from rural areas of Japan has been particularly difficult; therefore, special attractive programs were initiated in 2008.

The necessity of systematic education programs for young surgeons has been reported worldwide.<sup>2-4</sup> Education in the earlier stage of medical school has been described in several studies. Some questions that arose from these studies included how to resolve the current situation and when such programs should be started. As the immediate answer, newly educational efforts with the defined goal of conveying the significance of surgery to young students and interns should lead to an increase in the number of young and expert surgeons in the future. By considering this situation, we developed a special training program to increase the number of young surgeons called the RYOMA project, meaning *Recruitment of Young Medical Apprentices*, which includes a step-by-step systematic education program. RYOMA Sakamoto is an historical hero from the Samurai period in the 19th century who developed

innovative methods aimed at modernizing old procedures by gathering young trainees or fellows (<http://www.kochi-kia.or.jp/english/index.html>). Mature specialists appeared in business and political fields in our home city of Nagasaki through his educational methods. Therefore, we modeled our latest RYOMA project on the education philosophy of Ryoma Sakamoto. In the present study, we attempted various step-by-step surgical education programs to motivate medical students to gain surgical skills and encourage the development of more specialist surgeons. To show our pilot effort, data on the 6-year outcomes of this program were preliminary indicated.

## **METHODS**

### Trainees

Trainees participating in the RYOMA project included 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> year medical students at Nagasaki University Graduate School of Biomedical Sciences, and internship trainees studied for an additional 2 years after graduating. Teaching staff included residents, fellows, and more experienced surgeons from the thoracic, digestive, pediatric, and endocrine groups at the Department of Surgical Oncology, Nagasaki University Graduate School of Biomedical Sciences. The entire management and evaluation of this program was performed by Professor and Director T.N. and the Faculty of the Department (Professor T.S., Dr. A.N., and Dr. S.H.) Human subjects were not used in this program. Our institute did not publish any documents for permission regarding the human subject protection for this survey and, however, student and instructors' agreement has been obtained before study.

### Questionnaire to medical students

A specific questionnaire related to interests regarding surgical training or internship, surgeon images, and concerns over the career-path selection of surgeons was sent to 4<sup>th</sup> to 6<sup>th</sup> year medical students in 2008. Questionnaires were: A) interest in surgical training, B) interest in becoming a surgeon in the future, and c) images or concerns related to becoming a surgeon.

### Training steps of the RYOMA project

The first training step was basic dry-box training using a training tray for surgical knot tying (Ethicon Endo-Surgery Inc., Blue Ash, OH), endoscopic physical simulator (i-Sim<sup>TM</sup>), and a virtual system (LapVR<sup>TM</sup>) (Gadelius Medical K.K., Tokyo, Japan) (Figure 1A). The second step was wet laboratory training (Figure 1B). The third step was animal laboratory

training using a live pig under general anesthesia at a branch of the special training institute of Johnson and Johnson Inc. (New Brunswick, NJ, USA) in Japan (Figure 1C). The humanity and morals of surgeons were emphasized by the staff surgeons during these programs.

Training was started in 4<sup>th</sup> year medical students and mainly included lectures to 6<sup>th</sup> year students during the usual program in the clinical practice at Nagasaki University School of Biomedical Sciences. Several 4<sup>th</sup> year students who selected surgical programs in the medical seminar performed laparoscopic procedures for a few hours. All 5<sup>th</sup> year medical students performed surgical practices for two weeks at our department. During this period, students firstly performed basic surgical procedures such as surgical knot tying, sutures, resuscitation, palpation examinations of breast tumors, and endoscopic surgery using i-Sim<sup>TM</sup> for 90 minutes. They then performed open surgery techniques including knot tying and sutures using pig skin for 90 minutes. They also performed actual operation at wards through the feedback of the above training. Sixth year students who selected surgical programs practiced for 4 weeks and learned actual clinical practices together with the surgical staff. During this period, they attended four technical programs for 3 hours every week. This program consisted of step-by-step training as follows: 1) endoscopic procedures, 2) resuscitation, knot tying, and suture techniques using a dry box simulation, 3) open surgical techniques using thick skin and the intestines, and 4) time trials and evaluation of the procedures described in 1)-3).

We conducted special wet laboratory training called the “RYOMA” project in August and December every year. This program was mainly performed with wet laboratory training using various organs such as thick skin, the intestines, lungs with the trachea, and the liver with the gallbladder of pigs, and a virtual system (LapVR<sup>TM</sup>) for 5 hours. The surgical devices used in these operations were supplied by Covidien Group Japan without compensation (US Headquarters; Covidien CO., Mansfield, MA). Trainees included medical students at Nagasaki University, other medical university students, and internship doctors in the Kyusyu

area who were interested in surgery. This project was introduced in the Nagasaki University information pamphlet and on a website for students or physicians who wanted to obtain information on this project (<http://www.med.nagasaki-u.ac.jp/surgery1/>). The number of attending trainees who went on to become surgeons after the RYOMA project was examined.

## **RESULTS**

### Results of the questionnaire by medical students

Figure 2A shows the results of the interview questionnaire used to determine whether students were interested in surgical training in medical school. The results of this questionnaire indicated that most young students were interested in surgical training. Figure 2B shows the responses to whether the students had chosen surgical training after graduation. One third of medical students were interested in surgery. Figure 2C shows the students' images of surgeons and concerns regarding this field of medicine. Frequent answers were summarized, and the most positive opinion on the field of surgery was related to the impressive results achieved with surgery. On the other hand, negative opinions varied, and included the difficulty of the surgical skill, physical concerns related to difficult work environments, and the severity of surgical procedures. These negative mindsets may be addressed with adequate training or simulations in the early period of medical training.

### Outcomes after training

Of the 19 medical students and internship doctors who attended the RYOMA project in 2008, 17 (90%) trainees were satisfied with this special surgical program. Sixteen of 19 (88%) students had an interest in surgery after the program and 13 of 17 teaching staff (76%) thought the program would influence the future decisions of attending trainees. In the animal laboratory training portion of the program, internship doctors could perform laparoscopic distal gastrectomy and anastomosis as a chief surgeon under the instructions of teaching staff.

Figure 3 shows the number of participants in the RYOMA project who planned to become surgeons in our department although approximately 100 medical students have undergone regular bedside training per year. These numbers were slightly higher in 2010 than in 2008.

In this study, 19 of the 23 participants (83%) had a positive opinion of the program after training.

## **DISCUSSION**

Surgical education programs have been increasingly reported worldwide in recent years.<sup>2-5</sup> Adequate education may be beneficial for the field of surgery by increasing the number of young surgeons, improving surgical techniques, and encouraging instructors in future generations.<sup>6,7</sup> The importance of a systematic education system was not recognized in Japan two or three decades ago because the traditional apprentice system was used as the main method of education. Young surgeons could only develop skills by observing and imitating the operator's methods. It was not difficult to recruit young surgeons at that time because of the high number of surgical candidates at medical schools. However, the number of young surgeon candidates has gradually decreased since then and many active surgeons have taken administrative leave due to the difficult work environment and risk of lawsuits. Moreover, a significant change occurred in the recruitment system of internship doctors after medical school graduation in Japan in 2004,<sup>8</sup> and it has subsequently become difficult to secure doctors in the surgical field, especially in rural locations. This phenomenon has led to a lack of surgeons in many hospitals, including our academic hospital and some associated hospitals.

The RYOMA project is characterized by several important points: 1) surgical training at an earlier stage than in most medical programs, 2) consistent and active instruction for young candidates, 3) systematic education programs, 4) cooperation with associated hospitals with industrious instructors, 5) innovation of education programs every year, 6) feedback from the trainee's opinions and actions, and 7) advertisements using websites and related platforms. By considering these points, we have continued to develop the RYOMA project over the past 6 years. Encounters with young candidates have also led to improvements in the teaching concepts of our instructors. Therefore, most medical students developed an increased interest in the surgical field. While many students expressed concerns over the difficulty of the field,

including dexterity, physical conditions, and the lifestyle of surgeons, some of these concerns were resolved by working alongside active surgeons. Thus, we implemented this project on a large scale from 2008.

The goal of the RYOMA project is to foster the development of expert surgeons in various fields of general surgery. In Japan, many licenses of medical specialists are permitted based on skills, experience, and knowledge in each special field of surgery.<sup>9</sup> The final goal of the RYOMA project at this stage is for our students to obtain these licenses. Furthermore, we also want to increase the number of instructors and develop innovations in the surgical education system. The continuation and improvement of the RYOMA project is warranted. Differences in time schedules between the traditional education system and newly developed RYOMA project are summarized in Figure 4. The continuity of surgical education from medical students to residents is maintained in the RYOMA project, and preserving motivation for the field of surgery is a major focus.

In the next step of the RYOMA project, we plan to introduce new systems for young surgeons in order to increase the number of special licensed experts among young surgeons. One of these systems is a proposed educational system to obtain a license from the Japan Surgical Society at Nagasaki University Hospital. This program will be led by professors from three departments of surgery (mainly managed by Professor K. Eishi, T. Nagayasu, and S. Eguchi) and will be open to new surgeons and internship doctors. The program will include various special training programs and lectures on general and cardiovascular surgery. Another program will involve regular video conferences of open and endoscopic surgeries several times per year with experienced specialists and young residents or fellowship surgeons who belong to the associated hospitals of the Division of Surgical Oncology in Nagasaki University. This second program aims to develop more special licensees and improve expert techniques. Lastly, our goal is to further develop systematic programs in the

current RYOMA project and the latter two systems described above in the near future. Our concepts for future education in the program for surgical experience are training at the earlier stage of medical school and cooperation with educational experts. Changes in the educational system according to this new era involve cooperation between the university and associated academic hospitals in the local area. The scheduled surgical specialist programs may lead to the development of subspecialty expertise in each field such as thoracic, cardiac, digestive, endocrine, and pediatric surgery, We previously reported a surgical training system for hepatobiliary and pancreatic surgery.<sup>10, 11</sup> In these studies, an analysis of surgical records such as operating time, blood loss, and postoperative morbidity for any type of major hepatectomy or pancreaticoduodenectomy revealed similar results between residents, fellowship surgeons, and teaching operators under adequate management by experienced surgeons. Thus, even young trainees can safely perform complicated and advanced surgery based on our experience. If adequate surgical education can be achieved systemically from an earlier stage, our goal will be achieved in younger surgeons. When considering the basic concepts of surgical training, a balance of artistic skill, scientific knowledge, and humanity for patients is required to become an expert surgeon. Furthermore, cooperation and innovation will be important for future surgery in the era of laparoscopic surgery.

## **SUMMARY**

We reported our newly developed system of surgical education for medical students and internship doctors, the RYOMA project. Over the past decade, the number of participants has increased and new surgeons are consistently trained every year. To motivate students or internship doctors to become surgeons, adequate educational systems, including instruction in surgical techniques led by expert surgeons, are needed in order to avoid decreases in the number of medical students entering the surgical field.

## **ACKNOWLEDGEMENTS**

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## **FIGURE LEGENDS**

**FIGURE 1.** A) virtual system (LapVRTM) for dry box simulation. B) Wet laboratory training using pig organs under instruction by the surgical staff. C) Advanced animal laboratory training for internship doctors under instruction by the surgical staff.

**FIGURE 2.** Questionnaire responses by trainees.

**FIGURE 3.** Number of participants in the RYOMA project in August and December each year. The number of participants that were considering becoming surgeons and new surgeons in this program. Opinions after training in the program.

**FIGURE 4.** Differences in the time courses between the traditional and newly developed surgical training system.

Figure 1

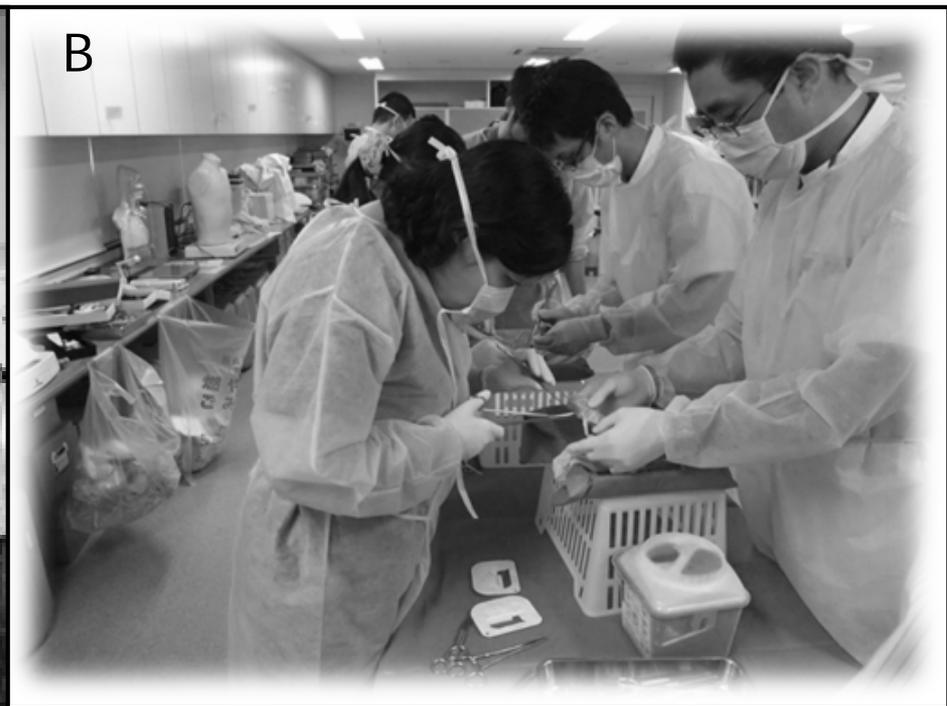


Figure 2

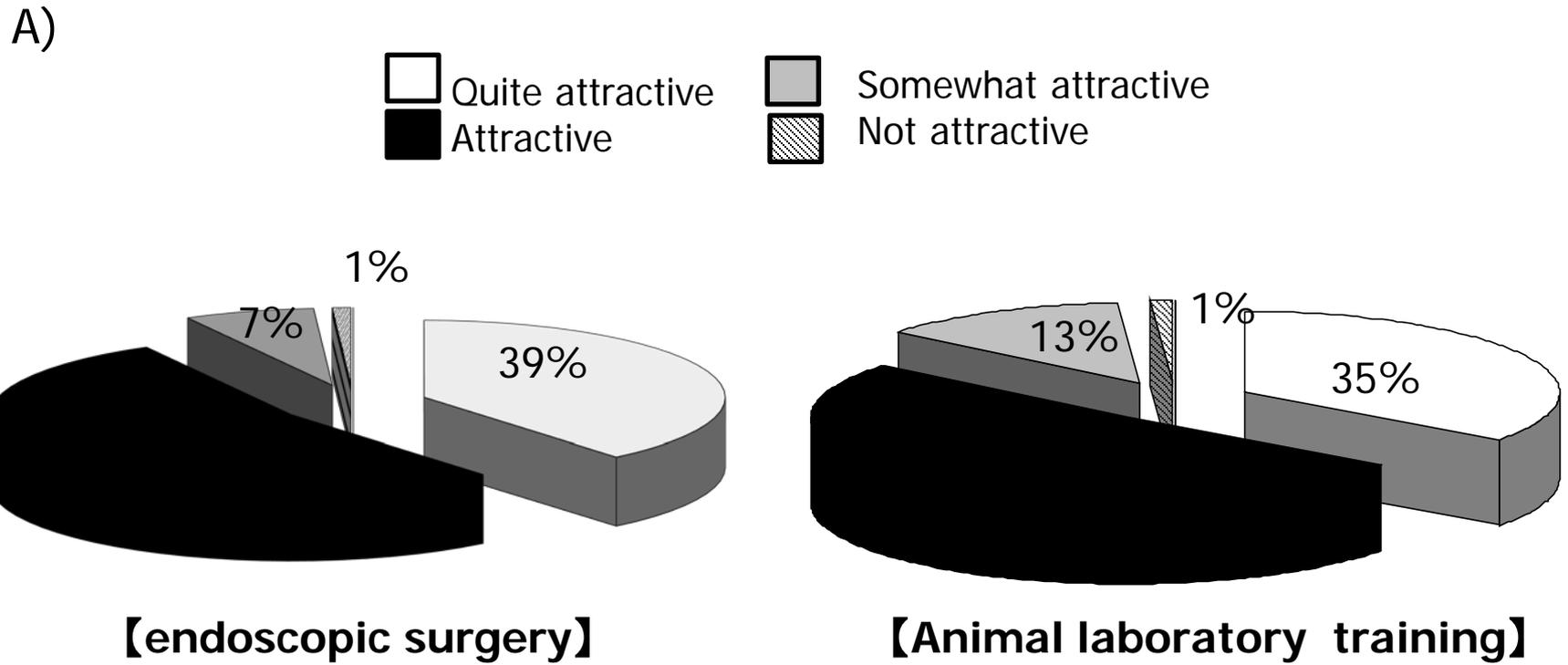
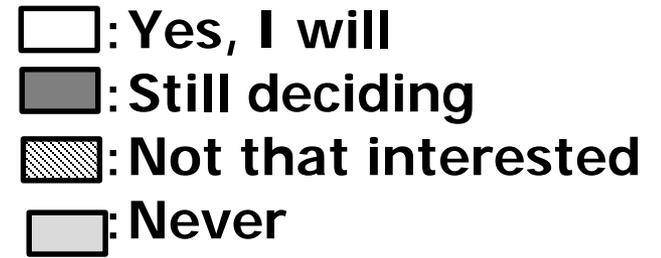
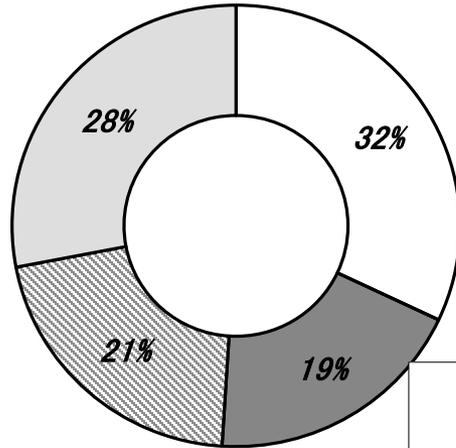


Figure 2

B)

**57 Men**



**33 Women**

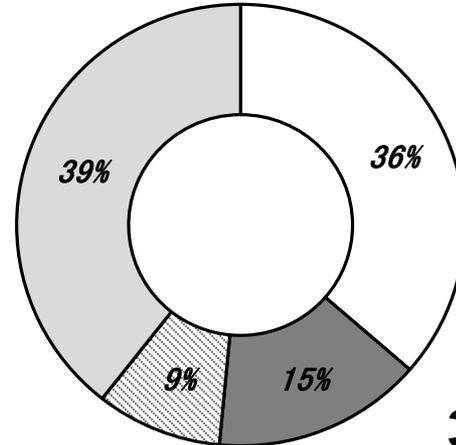
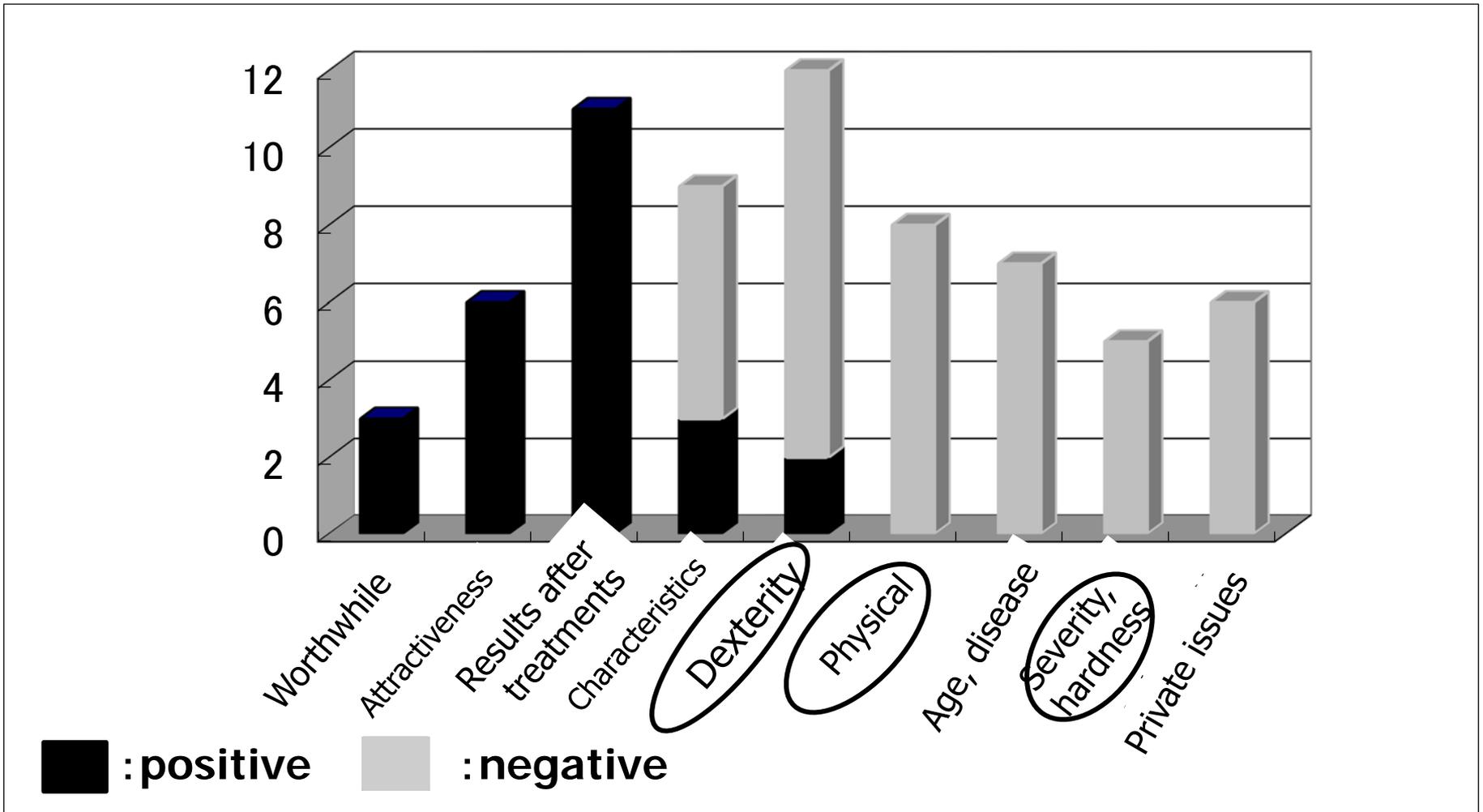


Figure 2

c)



"Negative mind set that can be changed"

Figure 3

	2008	2009	2010	2011	2012	2013
Participants of RYOMA project		7	23	22	23	20
Planning to be surgeons	2	2	5	3	6	4
Considering		1	2	7	7	16

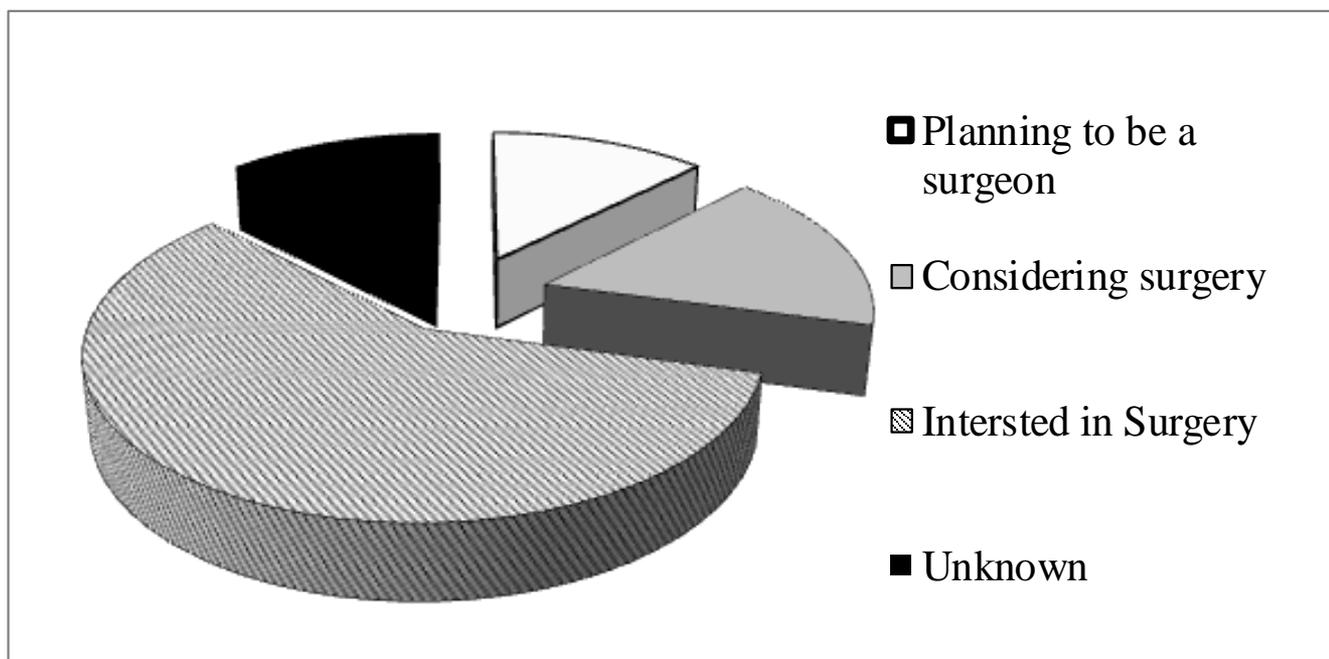


Figure 4

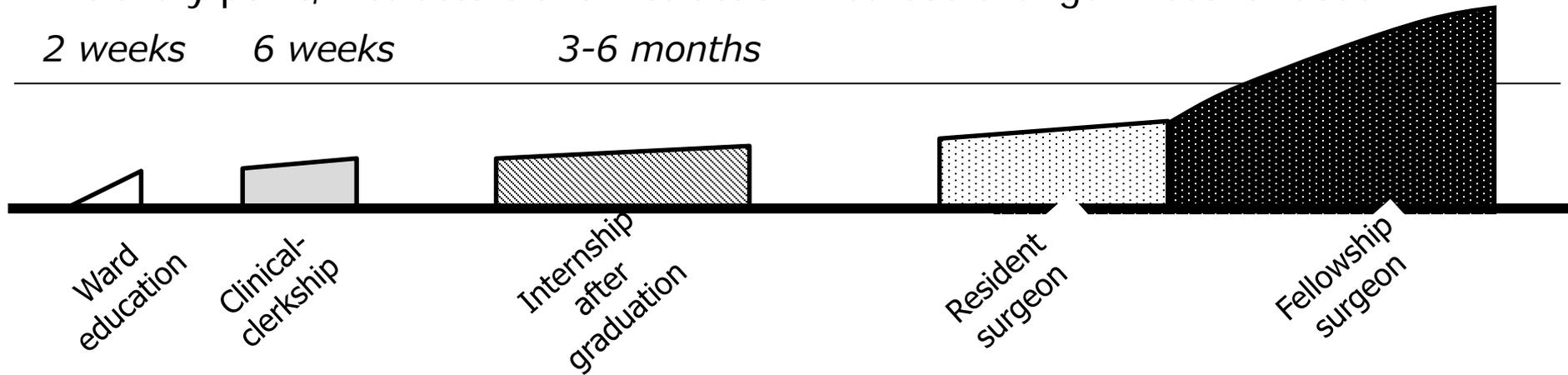
### <Traditional surgical education>

At every point, instructors and instruction methods change. Discontinuous.

2 weeks

6 weeks

3-6 months



### <Newly developed education system: RYOMA project>

Instruction using a consistent system with relationship with surgery.

Method of instruction is not changed under every instructor. Continuous.

*Establishment and evaluation of educational goal*

