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THE PLACE OF SIMULATION-BASED LEARNING IN SURGICAL TEACHING

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Purpose. Our aim was to evaluate the role of simulation training in teaching and understanding topographic anatomy and operative surgery.

Material and methods. An assessment of practical skills on the topics "Sutures in surgery" and "Laparoscopy" was carried out among 3rd and 4th year students studying General Medicine, Far Eastern Federal University, Vladivostok. Six groups of students participated in the study.

Results. Students who have already gained knowledge in the course of general surgery, but do not have practical skills, come to the topographic anatomy course. The stitches were trained on silicone artificial material. We teach how to apply and remove interrupted, continuous and intradermal sutures. After 2 hours of training, only the procedural time improved by 50%, other indicators improved by no more than 30%. In the fourth year, we learn to work on a laparoscopic simulator. Laparoscopic simulation training has effectively improved the understanding of laparoscopy, but many students, especially female students, have problems in terms of physical endurance, many students have problems of 3D perception that could not be improved by 2 hours of classes. The overall level of satisfaction of our students was very high.

Conclusion. The two-hour classes provide an opportunity to try some surgical procedures, which increases students' satisfaction with the training, but this is not enough time to develop stable surgical skills.

Keywords: *surgery, simulation training, students.*

Introduction. Practical skills are a daily routine for every physician. However, medical school graduates' performance in these basic skills often falls below expectations [1]. Training in basic skills requires balancing the student's learning needs with patient safety. Many students complain about the infrequency of skill practice during training and the lack of qualified instructors to supervise procedures.

Assessment in medicine is often subjective. Historically, our profession has relied on a combination of trainers' subjective opinions to determine the competency of individual surgeons. However, years of practice and experience, while important, are not objective indicators of skill proficiency. In recent years, access to clinical training has been declining and is expected to continue to decline. Furthermore, each student has a different sensitivity to motor learning, and many simply do not have the time to master a skill immediately at the bedside.

Providing students with feedback on their own performance allows them to strive for expert standards, moving on to the next stage of learning only after they achieve mastery. This skill-based learning improves the effectiveness and quality of learning by tailoring the program to individual needs.

The effectiveness of the assessment also depends on the availability of suitable simulation models. Many options are available, each with its own advantages and limitations. High-quality procedural models are available. They are relatively inexpensive and avoid the ethical issues associated with living or cadaveric tissue models. However, the dissection planes typically appear unrealistic, and the tissues do not bleed when cut [2].

According to educational theory, developing competence requires consistent, purposeful practice. However, clinical safety regulations have placed significant limits on practicing on real patients. Recent technological advances have revolutionized surgery. The introduction of minimally invasive surgery, computer-assisted procedures, and image-guided procedures requires trainees to become familiar with the technologies and develop new skills. The pressure on healthcare education caused by these circumstances has led to the introduction of simulation for training novices. Simulation provides the opportunity for repeated practice in a safe and controlled environment. By focusing on trainees and adapting to their needs, trainees have the opportunity to make mistakes and learn from them. Numerous simulators are already available that allow trainees to practice a wide range of skills. Many authors emphasize simulators as a useful tool for practicing procedural skills, while others argue that simulation should recreate clinical circumstances and environments, not focusing solely on the acquisition of technical skills [3].

Aim. Our aim was to evaluate the role of simulation-based learning in the teaching and understanding of the subject of topographic anatomy and operative surgery.

Material and methods. The course "Topographic Anatomy and Operative Surgery" is designed for students enrolled in the 31.05.01 "General Medicine" program. This course is offered in the third and fourth years of study, requiring 216 hours and 6 credits. The course aims to develop students' knowledge of topographic anatomy and operative surgery, and includes practical skills training on models. The School of Medicine and Life Sciences at Far Eastern Federal University (FEFU) includes a simulation center equipped with models for practicing practical skills in many disciplines, including surgery. Practical skills assessments were conducted on the topics "Sutures in Surgery" and "Laparoscopy" for third- and fourth-year students.

Results. Among the topics covered by students beginning their third-year course in operative surgery and topographic anatomy are "Typical operating room equipment. Surgical instrumentation. Modern surgical instrumentation. Suture material. Types of surgical approaches. Methods of joining and separating tissues. Types of sutures and suture removal techniques." Students who enroll in the topographic anatomy course have already completed general surgery but lack practical skills. To reinforce this knowledge, we offer a course on "Suture Material and Knots in Surgery" on the Stepik platform, developed by FEFU faculty. Suture practice is performed on models. We use standard surgical instruments and artificial skin. Students learn to apply and remove interrupted, continuous, and intradermal sutures. Skills assessment was conducted in two groups of international students and one Russian-speaking group. Suture effectiveness was assessed based on procedure time, stitch length, interstitch spacing, and asymmetry and symmetry of interstitch angles. After two hours of training, only procedure time improved by 50%, while other parameters improved by no more than 30%. Among the topics covered by students beginning their third-year course in operative surgery and topographic anatomy are "Typical operating room equipment. Surgical instrumentation. Modern surgical instrumentation. Suture material. Types of surgical approaches. Methods of joining and separating tissues. Types of sutures and suture removal techniques." Students who enroll in the topographic anatomy course have already completed general surgery but lack practical skills. To reinforce this knowledge, we offer a course on "Suture Material and Knots in Surgery" on the Stepik platform, developed by FEFU faculty. Suture practice is performed on models. We use standard surgical instruments and artificial skin. Students learn to apply and remove interrupted, continuous, and intradermal sutures. Skills assessment was conducted in two groups of international students and one Russian-speaking group. Suture effectiveness was assessed based on procedure time, stitch length, interstitch spacing, and asymmetry and symmetry of interstitch angles. After two hours of training, only procedure time improved by 50%, while other parameters improved by no more than 30%.

In the fourth year, approximately a quarter of the classes are devoted to abdominal anatomy and abdominal surgeries. We consider it appropriate to dedicate one class to intestinal anastomoses, using the same instruments and a simulated intestine. This class also introduces minimally invasive techniques, examines laparoscopy instrumentation, and teaches how to operate a laparoscopic simulator. Skills assessment was conducted in one group of international students and two Russian-speaking students. Laparoscopic simulation training effectively improved understanding of laparoscopy, but many students, especially female students, experienced challenges with physical endurance, and many have spatial perception issues that were not addressed during the two-hour class.

After each simulation session, students participate in debriefing sessions, receive feedback on their performance, reflect on their actions, and discuss ways to improve. Research has shown that debriefing significantly improves learning outcomes and clinical performance. Overall student satisfaction was very high (Very satisfied: 81%, Quite satisfied: 19%).

Discussion. The challenge is how to use simulation to achieve the best results. Feedback, repetitive practice, integration with the curriculum, varying levels of difficulty, multiple teaching strategies, the ability to capture clinical variations, providing a controlled environment, individualized learning, defined outcomes, and simulator validity must be considered [3].

Virtual simulators allow the user to pre-determine the complexity of the assessment exercise, allowing a single simulator to perform several different assessment roles. Furthermore, although simulators are expensive to acquire, their maintenance costs are significantly lower than those of comparable forms of physical simulation. Simulation laboratories using live or cadaveric animal models must be staffed by qualified instructors and must be constantly replenished with specimens. Virtual reality models, on the other hand, can be used repeatedly without any additional maintenance costs and provide immediate objective feedback to the candidate, reducing the need for personnel during the assessment. The most important advantage of virtual simulation over other, less expensive models is the ability to provide immediate, detailed feedback to the candidate [2]. We agree with the authors, but virtual simulators are still more important for residents and specialists who already have basic skills. For third- and fourth-year students, mechanical work on simple simulators such as artificial skin allows for achieving sufficient results, but in this case, there is no feedback from the simulator to the student, and the teacher's assessment is more subjective.

Basic tasks such as stacking blocks and passing a needle through a ring in a laparoscopic box trainer allow novices to become accustomed to the fulcrum effect and acquire a degree of laparoscopic dexterity, and we agree with most authors that such basic skills provide a good introduction and reinforce muscle memory, although due to individual variability between learners it is difficult to quantify the amount of simulator practice required to develop a particular skill [2-4].

Many authors emphasize the need to summarize after each lesson, with which we completely agree [5–6].

Some countries are developing entire programs for teaching surgical skills. For example, the one-day Surgical Skill Weekend training program includes practical training in surgical suturing techniques and advanced surgical procedures, hybrid simulation sessions, and an operating room session combining all of the above. By the end of the program, improved surgical suturing skills were noted in all students [7]. Some authors note the need for a course of at least 10 hours to achieve sustainable results [6]; unfortunately, the short course did not provide us with this opportunity.

Some authors find significant gender differences between students when practicing laparoscopic skills, emphasizing that this relates not only to physical endurance but also to spatial thinking [8, 9]. We also note greater fatigue in physically weak male and female students, but all students experience difficulties with spatial thinking during their first attempt at practicing practical skills.

It has been noted that an intensive and comprehensive surgical skills training program for medical students can not only improve surgical suturing skills but also increase interest in surgery as a career [7]. In our group, on the contrary, many students noted that performing minimally invasive surgeries appeared easier than they actually were. Nearly 90% of students reported significant physical fatigue after the session.

Regarding the choice of synthetic materials, randomized controlled trials have not found convincing evidence of the impact of the type of skin suture simulator on the quality of acquired motor skills. However, the effectiveness, availability, and cost-effectiveness of synthetic models are supported by numerous studies, making their use the most justified [10, 11].

Conclusion. Continuous research and technological advances offer a wide variety of simulators and modeling types available today. Each simulation type must be properly tested before use for training purposes, and the appropriate type must be selected based on the educational goals and the background knowledge and competence level of the trainees.

Technical skills are very important in clinical practice, especially in a field such as surgery, and experience requires constant, targeted practice. Two-hour classes only provide an opportunity to try out some surgical manipulations, but, unfortunately, this time is not enough to develop sustainable surgical skills.

Moreover, a high level of student satisfaction was noted even after such short-term training sessions and a sufficient understanding of the physical complexity of the work of surgeons.

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