

Application Experience of Eyesi Operation Simulation Training System in the Teaching of Cataract Surgery for Ophthalmology Masters

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Abstract: *Objective:* To explore the application effect of the Eyesi surgical simulator in the teaching of cataract surgery for professional ophthalmology postgraduate students. *Methods:* The professional postgraduate students who were trained in the third year of ophthalmology at the First Affiliated Hospital of Xi'an Medical University were selected as the research objects. After passing the theoretical examination, they were randomly divided into the pig eyeball group, Eyesi group, and pig eye + Eyesi group, with 5 students in each group. The pig eyeball, Eyesi surgery simulator, and pig eye + Eyesi surgery simulator were used for microscopic technique operation and cataract surgery steps training, respectively. After the training, the overall training effects of the three groups of postgraduates were scored, and questionnaires were used to objectively evaluate the three training methods. *Results:* The scores of the students in the pig eye + Eyesi group were better than those in the Eyesi group, and the students in the Eyesi group were better than those in the pig eyeball group. *Conclusion:* The Eyesi surgical simulation training system can evaluate the microsurgical skills of professional masters and improve their surgical skills. This system is of great significance for the training of the cataract surgery skills of professional masters.

Keywords: Surgical simulator; Microsurgical skills; Cataract surgery; Ophthalmology postgraduate students

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1. Introduction

In the modern medical field, ophthalmic microsurgery, as a highly difficult and high-risk surgical operation, is one of the skills that professional ophthalmologists must master^[1]. With the rapid development of society and the intensification of population aging trend, the demand for treatment of ophthalmic diseases is increasing. In order to ensure patient safety and treatment effect, it is necessary to have a high-level ophthalmologist team. The goal of professional Master's courses is to enable students to systematically learn and master professional knowledge and skills, improve their overall quality, and gradually become high-end professionals^[2]. Ophthalmic microsurgery is one of the most important skills, and its uniqueness and particularity need to be established based on systematic, comprehensive, and in-depth mastery of relevant knowledge, and at the same time, it is necessary to gradually improve the skill level through repeated practice and continuous exploration^[3]. Only by fully understanding and mastering the skills of ophthalmic microsurgery and combining them with the objectives of the professional Master's course can one truly become an outstanding and professional ophthalmologist^[4].

In postgraduate teaching, due to the limitation of actual conditions, many colleges cannot provide enough opportunities for clinical practice, resulting in certain difficulties in the training of postgraduates in

ophthalmic microsurgery, especially in the training of cataract surgery techniques. In addition, there are problems in the training of graduate students in ophthalmic microsurgery due to the boundaries and insufficient coordination between disciplines^[5]. Some graduate students did not receive enough guidance and support, so they had to rely on their learning and exploration, resulting in unsatisfactory results; some graduate students only studied in the classroom, lacked practical opportunities, and could not master the skills of ophthalmic microsurgery^[1].

With the continuous development and improvement of surgical simulator technology, more and more schools and hospitals have begun to apply surgical simulators in ophthalmic microsurgery education^[6]. Eyesi surgery simulator has many advantages, such as repeated practice anytime and anywhere, improving students' skill level, reducing surgical risks, etc. At the same time, the surgical simulator can also provide instant feedback and guidance to help students correct mistakes and improve skills in the process of operation^[7]. Through the rational use of surgical simulators, students' skills and self-confidence can be improved, surgical risks can be reduced, and the development and progress of ophthalmology can be promoted. In order to better deal with the challenges and problems in surgical simulator training, it is necessary to optimize surgical simulator technology through continuous research and practice, reduce costs, improve efficiency, and allow more students to benefit from surgical simulator training.

2. Materials and methods

2.1. General information

In this study, 15 graduate students majoring in ophthalmology were selected as the research objects, and they were divided into three groups according to the random grouping method: pig eyeball group (group A), Eyesi group (group B), and pig eye + Eyesi group (group C), 5 people in each group. Among them, group A used pig eyes for practice and training in ophthalmic microsurgery; group B used the Eyesi simulator for practice and training in ophthalmic microsurgery, and receive corresponding real-time feedback and guidance; group C used both pig eye and Eyesi simulators for microsurgery operations and practice. Inclusion criteria of the study included: (1) aged between 18 and 35; (2) having professional background knowledge and basic skills in ophthalmology; (3) not having severe hand or visual dysfunction; (4) being willing to cooperate with the experimental requirements, and willing to sign the informed consent. Exclusion criteria of the study included: (1) suffering from severe heart, liver, lung, and other organ diseases; (2) suffering from mental illness or psychological disorder; (3) having received microsurgery training or related skill practice in the past 6 months; (4) have used the Eyesi simulator for the operation and practice of ophthalmic microsurgery; (5) cannot participate in the whole experiment due to other reasons. Through the establishment of the inclusion and exclusion criteria of the above participants, this study will ensure that the background knowledge and basic skills of the participants are relatively uniform, and at the same time exclude the interference factors that may affect the experimental results.

2.2. Methods

All students received corresponding training within 3 months. The training content included 4 modules practicing surgical postures, operating microscopes, mastering surgical tools, and simulating surgical operations. The teaching teacher conducted a comprehensive overall rating (global rating scale, GRS) on the simulated operation process^[8]. Meanwhile, the simulator will record the students' operation process and execution effect, and provide real-time feedback and guidance. Statistical analysis and comparison of all the data were performed to evaluate the surgical skill level and effect of students under different training methods.

2.3. Statistical methods

SPSS17.0 statistical software was used for data analysis. Normally distributed measurement data were expressed as mean \pm standard deviation (SD). Two independent sample *t*-tests and paired *t*-tests were used. All data tests were two-sided, and $P < 0.05$ was considered statistically significant.

3. Analysis of experimental results

3.1. Scores of different modules in each group

After 3 months of training and operation, the following data collected were statistically analyzed and compared (Table 1) to determine the surgical skill level and effect of students under different training methods.

Table 1. Score comparison of the three groups after differential surgical training (points)

Group	Number of people	GRS score	Posture for surgery	Microscope operation	Mastery of surgical tools	Simulated surgical operation
Group A	5	69.98	64.8 \pm 5.45	61.5 \pm 9.64	80.4 \pm 4.51	73.2 \pm 8.99
Group B	5	80.75	73.4 \pm 5.94	81.6 \pm 5.27	84.0 \pm 5.87	84.0 \pm 3.71
Group C	5	85.95	85.2 \pm 5.34	83.0 \pm 7.14	88.2 \pm 3.56	87.4 \pm 3.21

3.2. Comparison of different module scores

After simulator training, the GRS score, posture for surgery, microscope operation, mastery of surgical tools, and system scores of simulated surgical operations in group C were all higher than those in groups A and B (Table 1), and the scores of group C in the posture for surgery is higher than the comparison between A and B groups, which is statistically significant (Figure 1A). There were statistically significant differences between group C and group A in microscope operation, mastery of surgical tools, and simulated surgical operation (Figure 1B–D). Compared with group B and group C, there were statistically significant differences in surgical posture, microscope operation, and simulated surgical operation (Figure 1A, B, D).

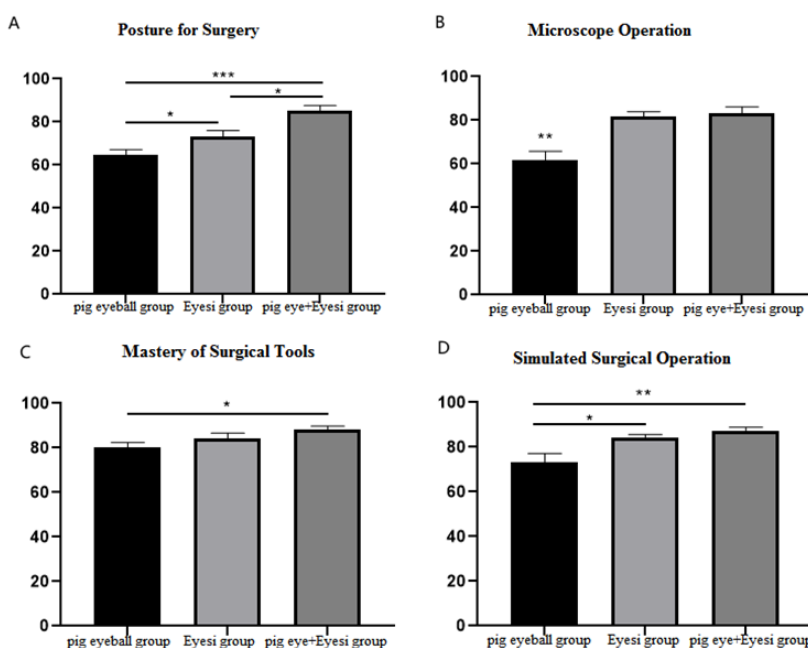


Figure 1. Comparison of performance scores of each group in different modules. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

In summary, the experimental results of this study show that the Eyesi simulator has obvious advantages in cataract surgery training. It can effectively improve students' surgical operation ability and surgical-related skills and has very important practical application value. The students in group C performed the best, suggesting that the combination of multiple practice methods can more effectively improve the students' surgical skills.

4. Discussion

Eyesi surgical simulator is a widely used intraocular microsurgery simulation training system, which aims to provide a near-real surgical experience through virtual reality technology^[9]. The surgical simulator is a very effective microsurgery practice tool. Students can perform operations and exercises of different difficulty and complexity through the simulator to improve their surgical skills. At the same time, the simulator can also provide timely feedback and guidance to help students find and correct mistakes^[10]. The use of the Eyesi simulator enables medical students to perform repeated surgical exercises without involving real cases and gain rich surgical experience^[11].

Professional master's education is a higher education course for those who have a certain professional background and want to deepen their professional skills and academic accomplishment. Professional masters put more emphasis on practicality and application, and cultivate students' innovative and practical abilities in the professional field^[12]. Combining the technical characteristics of the Eyesi simulator and the characteristics of professional master education, applying the Eyesi simulator to the teaching of professional masters will have positive effects. Firstly, it can better meet clinical needs by providing opportunities for repeated practice to strengthen students' surgical skills. Secondly, it can improve students' awareness and understanding of ophthalmic surgery and provide better support for related medical work. Finally, it can also provide valuable experience for the training of future medical talents.

Animal tissue such as a pig's eye is also a commonly used microsurgical practice tool^[13,14]. Students can further improve their surgical skills through the practice of pig eye surgery. It should be noted that relevant ethics and animal protection regulations should be followed when using animal tissues for practice^[15]. Studies have shown that the combination of multiple practice methods can improve students' surgical skills more comprehensively^[16]. Therefore, it is recommended to combine the above several practice methods to achieve a better teaching effect.

To summarize, the significance and advantages of the Eyesi surgical simulator in ophthalmic microsurgery training are obvious. In the actual teaching, the experimental results and the actual needs of the students should be combined, and various teaching resources and means should be flexibly used to comprehensively improve the students' surgical skills and overall quality.

Disclosure statement

The authors declare no conflict of interest.

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