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The Effect of Phaco-Simulators on Surgical Proficiency and Skills in Ophthalmology Surgery Education in Türkiye: Cross Sectional Study

Türkiye'de Oftalmoloji Cerrahi Eğitiminde FAKO Simülatörlerinin Cerrahi Yeterlilik ve Özgüven Üzerine Etkisi: Kesitsel Çalışma

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ABSTRACT Objective: This study aims to evaluate the impact of phacoemulsification (phaco) virtual reality simulator training on the surgical competence and skills of ophthalmology residents in Türkiye. **Material and Methods:** An online survey consisting of 21 questions was conducted among ophthalmology residents at university and training hospitals with prior experience using the EyeSI phaco-virtual reality simulator. Participants were classified into 2 groups based on their ophthalmology experience: Group 1 (≤2 years) and Group 2 (>2 years). The survey assessed surgical experience, technical adequacy of the simulator, its contribution to training, and its impact on surgical confidence. A total of 34 valid responses were analyzed. **Results:** Nineteen participants (55.9%) were in Group 1, while 15 (44.1%) were in Group 2. Before training, 50% of Group 1 participants reported low surgical self-confidence, which improved to 73.5% at a moderate level post-training. No significant difference was observed between groups regarding self-confidence gain (p=0.255, p=0.637). The simulator improved hand-eye coordination (76.5%) and phaco technique proficiency (73.5%) but was less effective in complication management (20.6%). The simulation's similarity to real surgery was rated as low by 35.3% and very high by 5.9%. Limited access, financial constraints, and technical issues were the main barriers to widespread use. **Conclusion:** Virtual reality simulators play a valuable role in ophthalmic surgical training by improving skills and self-confidence. Integrating simulator training into ophthalmology curricula may enhance training efficiency and reduce complications.

Keywords: Cataract; surgery; phacoemulsification; education; simulator

ÖZET Amaç: Bu çalışma, sanal gerçeklik tabanlı fakoemülsifikasyon (FAKO) simülatör eğitiminin Türkiye'deki göz hastalıkları asistanlarının cerrahi yeterlilik ve becerilerine olan etkisini değerlendirmeyi amaçlamaktadır. **Gereç ve Yöntemler:** EyeSI fako-sanal gerçeklik simülatörünü daha önce kullanmış olan üniversite ve eğitim araştırma hastanelerinde görev yapan göz hastalıkları asistanlarına 21 sorudan oluşan çevrim içi bir anket uygulanmıştır. Katılımcılar oftalmoloji deneyim sürelerine göre 2 gruba ayrılmıştır: Grup 1 (≤2 yıl), Grup 2 (>2 yıl). Ankette cerrahi deneyim, simülatörün teknik yeterliliği, eğitime katkısı ve cerrahi özgüvene etkisi değerlendirilmiştir. Toplam 34 geçerli yanıt analiz edilmiştir. **Bulgular:** Katılımcıların 19'u (%55,9) Grup 1'de, 15'i (%44,1) Grup 2'de yer almıştır. Eğitim öncesinde Grup 1 katılımcılarının %50'si düşük cerrahi özgüven bildirmiş, bu oran eğitim sonrası %73,5 ile orta düzeye yükselmiştir. Gruplar arasında özgüven artışı açısından anlamlı fark gözlenmemiştir (p=0,255, p=0,637). Simülatör, el-göz koordinasyonu (%76,5) ve FAKO tekniği yeterliliği (%73,5) üzerinde olumlu etkili olmuş; ancak komplikasyon yönetiminde daha az etkili bulunmuştur (%20,6). Simülasyonun gerçek cerrahiye benzerliği %35,3 oranında düşük, %5,9 oranında ise çok yüksek olarak değerlendirilmiştir. Yaygın kullanımın önündeki başlıca engeller sınırlı erişim, finansal kısıtlamalar ve teknik sorunlardır. **Sonuç:** Sanal gerçeklik simülatörleri, cerrahi beceri ve özgüven gelişimini destekleyerek göz hastalıkları asistan eğitiminde değerli bir rol oynamaktadır. Simülatör eğitiminin oftalmoloji eğitim programlarına entegrasyonu, eğitim etkinliğini artırabilir ve komplikasyon oranlarını azaltabilir.

Anahtar Kelimeler: Katarakt; cerrahi; fakoemulsifikasyon; eğitim; simülatör

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Cataracts are the leading cause of reversible blindness, affecting 94 million people worldwide.[1] Phacoemulsification (Phaco) is the most commonly used surgical procedure in cataract treatment, and 20 million surgeries are performed worldwide each year.[2] Phaco surgery, which accounts for 80-85% of all ophthalmological surgeries, is one of the important elements of surgical training in ophthalmology.[3]

Phaco surgery requires a high level of manual dexterity and experience to avoid intraoperative and postoperative complications. Surgical training has traditionally been conducted under the master-apprentice model, with residents graduating with the "see, do, teach" model.[4] However, this method has several disadvantages, including its reliance on patient cooperation, the risk of irreversible vision loss due to complications arising from surgeries performed as training cases for the assistants, and the high cost of treating these complications.[5,6]

Today, with the increasing patient population, the need to shorten the learning curve of research assistants and enhance their surgical competence is gradually growing. Therefore, the development and use of simulator models in ophthalmology as safe and effective tools for surgical training and evaluation of physicians is increasing.[7] Simulations can objectively assess skills and knowledge before starting interventional procedures in medical education, paving the way for rapid and effective learning without compromising patient safety.[8,9]

This study evaluated the effect of simulation training on surgical competence and self-confidence and its contribution to the training process in ophthalmology residents who experienced the phaco simulation device in Türkiye. It is among the first to evaluate simulator-based training outcomes in Turkish ophthalmology residency programs, providing valuable insights into local educational practices and needs.

MATERIAL AND METHODS

This study was conducted among ophthalmology research assistants at universities and training and research hospitals who had experienced the Phaco simulation device. It was conducted by the ethical principles of the Declaration of Helsinki and was approved by the Fırat University Clinical Research Ethics Committee (date: January 30, 2025, no: 2025/02-48).

Within the scope of the study, a survey consisting of 21 questions was prepared to evaluate the opinions of ophthalmology researchers using the phaco-virtual reality simulator (Table 1). By allowing one-time access to the survey, duplicate entries were prevented. Participation in the study was voluntary, and informed consent was obtained from participants regarding the anonymous use of survey data for scientific and publication purposes. Participants in the study were divided into 2 groups: Group 1, those with 2 years or less experience as research assistants in the field of ophthalmology, and Group 2, those with more than 2 years of experience.

The EyeSI Surgical Simulator (VRmagic, Mannheim, Germany) is a virtual reality-based ophthalmic training device consisting of a mannequin head with mechanical eyes, a virtual operating microscope, and instrument handles that simulate intraocular surgical tools. The simulator includes anterior segment modules such as anti-tremor exercises, forceps manipulation, capsulorhexis, and phacoemulsification. It quantitatively assesses surgical performance by recording parameters including instrument and microscope handling, tissue interaction, and overall surgical efficiency, thereby enabling objective evaluation of trainee progress. The procedural stages of surgical training performed with the EyeSI Surgical Simulator are illustrated in Figure 1.

The survey evaluated various factors related to the participating research assistants, including their demographic characteristics, duration of experience in ophthalmology, simulator training duration, pre-training knowledge and confidence levels, technical adequacy, ergonomics, and ease of use of the simulator, the effectiveness of feedback mechanisms, the extent to which the simulator could replicate actual cataract surgery and its complications, the impact of the simulator training process on skill development, the content of the training, the competence of instructors in providing guidance, and the contribution of the training to surgical performance and confidence.

TABLE 1: Evaluation of the 21-question survey sent to participants				
What is your profession/position in the healthcare field?	Research assistant (n=30) Specialist doctor (n=4)	**Group 1 (n=19)**	**Group 2 (n=15)**	**p value**
How many years of ophthalmology experience do you have?	0-2 years	**19**	**-**	**-**
	3-5 years	**-**	**11**	
	6 years and above	**-**	**4**	
Have you used a similar simulation device before?	Yes	**3**	**8**	**0,020**
	No	**16**	**7**	
How many total hours of training have you received in phacoemulsification simulation training?	1-3 hours	**19**	**11**	**0,057**
	4-6 hours	**-**	**3**	
	More than 6 hours	**-**	**1**	
How would you rate your knowledge level about phacoemulsification surgery?	No knowledge	**-**	**-**	**0,008**
	Limited knowledge	**9**	**6**	
	Moderate knowledge	**10**	**6**	
	Advanced knowledge	**-**	**3**	
What was your confidence level in phaco surgery before training?	No confidence	**3**	**1**	**0,255**
	Low	**11**	**6**	
	Moderate	**5**	**8**	
	High	**-**	**-**	
How do you evaluate the general technical features of the simulation device?	Very inadequate	**-**	**-**	**0,258**
	Inadequate	**3**	**-**	
	Moderately adequate	**12**	**12**	
	Very adequate	**4**	**3**	
How was the ergonomics (ease of use) of the device?	Not comfortable at all	**-**	**-**	**0,593**
	Slightly comfortable	**3**	**1**	
	Moderately comfortable	**11**	**11**	
	Highly comfortable	**5**	**3**	
Were the visual and auditory feedbacks of the device sufficient?	Not sufficient at all	**1**	**-**	**0,782**
	Slightly sufficient	**2**	**1**	
	Moderately sufficient	**11**	**9**	
	Very sufficient	**5**	**5**	
How well did the simulation environment simulate a real surgery?	Not similar at all	**0**		**0,969**
	Slightly similar	**7**	**5**	
	Moderately similar	**11**	**9**	
	Very similar	**1**	**1**	

TABLE 1: Evaluation of the 21-question survey sent to participants *(contunied)*

How effective was the device in improving your surgical skills?	Not effective at all	**1**	**-**	**0,671**
	Slightly effective	**5**	**5**	
	Moderately effective	**7**	**7**	
	Very effective	**6**	**3**	
How realistically did the device simulate complications that may occur during phaco surgery?	Not realistic at all	**0**	**1**	**0,671**
	Slightly realistic	**8**	**7**	
	Moderately realistic	**9**	**6**	
	Very Realistic	**2**	**1**	
Did the training content meet your needs?	Did not meet at all	**0**	**1**	**0,791**
	Partially met	**8**	**8**	
	Met	**9**	**6**	
	Exceeded expectations	**2**	**1**	
Were the knowledge and guidance of the instructors sufficient?	Insufficient	**-**	**-**	**0,218**
	Moderately sufficient	**5**	**7**	
	Very sufficient	**14**	**8**	
Was the software and control mechanisms of the simulation device easy to use?	Not easy at all	**-**	**-**	**0,692**
	Slightly easy	**1**	**1**	
	Moderately easy	**14**	**9**	
	Very easy	**4**	**5**	
How often did you experience technical problems while using the device?	Frequent problems	**-**	**-**	**0,3**
	Occasionally encountered problems	**11**	**6**	
	No problems	**8**	**9**	
What was your confidence level in phaco surgery after training?	No confidence	**-**	**-**	**0,637**
	Low	**4**	**2**	
	Moderate	**14**	**11**	
	High	**1**	**2**	
Do you think simulation training will contribute to your real surgical performance?	Not at all	**1**	**-**	**0,660**
	Slightly think	**10**	**8**	
	Think	**8**	**7**	
Would you recommend using this device in other training programs?	Yes	**18**	**13**	**0,410**
	No	**1**	**2**	

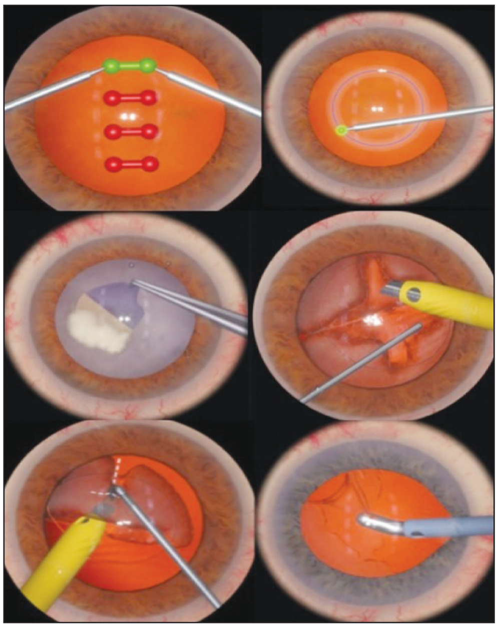

FIGURE 1: Illustration of the educational stages of the EyeSI Surgical Simulator used in ophthalmic surgical training

The inclusion criteria allowed research assistants who received phacoemulsification virtual reality simulator training to participate in the survey, regardless of the duration of their simulator training or whether they had received training on actual patients. Exclusion criteria included surgeons who had stopped practising and participants who did not consent or withdrew their consent. A total of 34 valid responding research fellows were included in the study.

STATISTICAL METHODS

In addition to descriptive methods, the Pearson chi-square test was used in the study to analyze the participants' responses. SPSS version 25.0 for Macbook (IBM Corp., Armonk, NY, USA) was used for statistical analysis. The statistical significance level was accepted as $p<0.05$.

RESULTS

Nineteen participants (55.9%) had 2 years or less of ophthalmology experience (Group 1), while 15 participants (44.1%) had more than 2 years of experience (Group 2). Among the participants in the 2nd group, there were 4 specialist ophthalmologists (11.4%). When evaluating participants' knowledge levels regarding phacoemulsification surgery, 47.3% of those in Group 1 described their knowledge as "low", while 52.3% considered it "moderate". In contrast, in Group 2, 20% reported having "low" knowledge, 40% "moderate" and 40% "advanced" knowledge (p=0.008).

Simulator experience was reported by 15.8% of Group 1 and 53.3% of Group 2 participants. In terms of the training time they received on the device, all participants in Group 1 reported receiving 1-3 hours of training, while 73.3% of participants in Group 2 reported receiving 1-3 hours, 20% 4-6 hours, and 6.7% more than 6 hours of training. This distribution may be due to the presence of more experienced residents in Group 2, who had increased exposure or access to simulation resources, or engaged in extended sessions for advanced skill refinement.

Prior to training, most participants in Group 1 reported low self-confidence, whereas Group 2 showed higher rates of moderate confidence. There was no statistically significant difference between Group 1 and Group 2 regarding pre-training surgical confidence levels (p=0.255).

Post-training, moderate self-confidence predominated in both groups; high confidence was more frequent in Group 2 (13.3% vs. 5.2%). No significant difference was found between the 2 groups regarding surgical self-confidence levels after training (p=0.637).

In the participants' evaluations regarding the level to which the Phaco virtual reality simulator training content met their surgical needs, 42.1% of the participants in Group 1 stated that the training partially met their expectations, 47.3% ultimately met their expectations, and 10.6% stated that it far exceeded their expectations. Group 2 determined these rates as 53.3%, 40%, and 6.7%, respectively (p=0.791).

In terms of the simulation environment's similarity to an actual cataract surgery, 36.8% of the participants in Group 1 stated that it had a low level of similarity, 57.8% stated that it had a moderate level of similarity, and 5.4% stated that it had a high level of similarity. Group 2 recorded these rates as 33.3%, 60%, and 6.7%, respectively (p=0.969).

Realism of complication simulation was rated as realistic or very realistic by 57.9% of Group 1 and

46.8% of Group 2, while lower realism ratings were more frequent in Group 2. (p=0.671).

The simulator was perceived as most effective for improving hand–eye coordination (76.5%) and phaco technique application (73.5%), while its perceived contribution to complication management was lowest (20.6%) (Figure 2).

Regarding the device's effect on improving surgical skills,moderate to high effectiveness was reported by 68.5% of Group 1 and 66.7% of Group 2, with slightly more Group 1 participants rating it as very effective. (p=0,671).

Most participants in both groups found the simulator beneficial for surgical performance, with 42.2% in Group 1 and 46.7% in Group 2 reporting significant contribution. No statistically significant difference was found between the 2 groups regarding the development of actual surgical skills and contribution to surgical performance (p=0,660).

During the evaluation of the instructors' knowledge and guidance in the training, 26.3% of participants in Group 1 rated them as moderately sufficient, while 73.7% considered them highly sufficient. In Group 2, these rates were recorded as 46.6% and 53.4%, respectively. The 2 groups had no significant difference regarding the instructors' knowledge and guidance (p=0,218).

TECHNICAL EVALUATION AND USAGE OF THE DEVICE

The technical features of the simulator were generally rated as moderately or highly sufficient in both groups, with no major differences observed. (p=0,258).

Considering the visual and auditory feedback, 5.2% of participants in Group 1 rated the device as insufficient, 10.5% as slightly sufficient, 57.8% as moderately sufficient, and 26.5% as highly sufficient. In Group 2, these rates were 6.6%, 60%, and 33.4%, respectively (p=0,782).

Regarding the software and control mechanisms' ease of use, 5.2% of the participants in Group 1 rated the device as slightly easy, 73.6% as moderately easy, and 21.2% as very easy. In Group 2, these rates were 6.6%, 60%, and 33.4%, respectively (p=0.692).

Device-related issues were occasionally reported by 57.8% of Group 1 and 40% of Group 2, while the remainder in each group reported no problems. (p=0.300).

In assessing the device's ease of use, 15.7% of participants in Group 1 found it slightly comfortable, 57.8% rated it as moderately comfortable, and 26.5% considered it highly comfortable. In Group 2, these rates were 6.6%, 73.3%, and 20.1%, respectively (p=0.593).

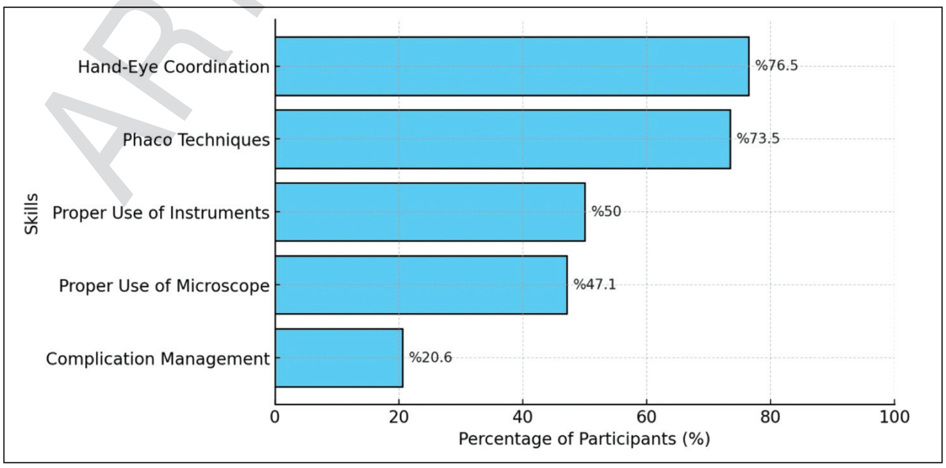

FIGURE 2: The impact of the phaco virtual reality simulator on surgical skills

DISCUSSION

This study evaluates the effects of phaco-simulation training on surgical skill development and self-confidence among ophthalmology residents in Türkiye. Our findings indicate that simulator training provides significant benefits, particularly for assistants in their first 2 years of surgical practice. Simulator training increased hand-eye coordination, microsurgical techniques, and surgical confidence in early-stage residents. Although training is also beneficial for research assistants with 2 years or more experience, it has been observed that the gains are more concentrated in specific technical skills and complication management areas. Data obtained show that integrating phaco-simulators into surgical education is a critical educational tool, especially for residents new to surgical practice, and can provide additional contributions at specific points for experienced surgeons.

In many surgical medical disciplines, virtual reality simulation training has been recognized as an important tool for enhancing skills and competence in various performance-related professions.[11,12] Cataract surgery is a technically challenging procedure that requires practising surgical techniques throughout several years of ophthalmology training to achieve proficiency and master the necessary skills. The quality of surgical training is directly linked to patient safety and the effective management of both the surgical and post-surgical processes, making proper training and assessment during the learning phase crucial for enhancing safety in the operating room. Ophthalmology training programs have traditionally relied on didactic lectures, wet labs, and live intraoperative training to help develop these necessary skills.[13]

Virtual reality surgical simulators are increasingly used by training programs to reduce the time required for surgery.[14] More importantly, simulators for microsurgery training can provide 3 dimensional vision and depth perception through the microscope, thus contributing to a more authentic reflection of real-life surgery for residents. To address this need, several cataract simulators are available on the market, such as EyeSI (VRMagic, Mannheim, Germany), Facovision (Melerit Medical), and MicroVisTouch (ImmersiveTouch).[15] The EyeSI Surgical Simulator is the most widely used ophthalmic virtual reality technical skills simulator commercially today.[16] Compared to other ophthalmic simulators such as HelpMeSee or MicroVisTouch, the EyeSI provides more advanced haptic feedback, realistic binocular microscope simulation, and a broader range of validated performance metrics. These features make it particularly suitable for structured residency training programs that aim to enhance both technical and cognitive skills in cataract surgery.

EyeSI simulation training has effectively contributed to transferring surgical skills to the operating room. Belyea et al. reported significantly reduced phacoemulsification time and phaco power usage after training on the EyeSI surgical simulator.[17] Another study found that complication rates of cataract surgeries performed by residents who received phaco training with the EyeSI Surgical Simulator were lower than reported rates in the literature.[18] McCannel et al. noticed a significant decrease in the number of complicated capsulorhexis during cataract surgery after intensive training on capsulorhexis in the EyeSI simulator 15.7% vs 5.0% in the post-intervention cohort; $p<0.0001$).[19]

Despite evidence supporting the positive outcomes of surgical training based on virtual reality simulators, a significant barrier to the widespread adoption of virtual reality simulation training, particularly in low- and middle-income countries, is the high cost of acquiring a simulator and the ongoing maintenance expenses.[20,21] Not all organizations' corporate goals and strategic planning may be compatible with adopting this technology. Even for those with access to a surgical simulator, the absence of a standardized protocol for its use before working on actual patients, limited time allocated for simulation training, lack of instructors, and minimal financial support appear significant challenges.[22-24] Therefore, some research assistants may have to participate in traditional supervised surgical training on actual patients to acquire surgical skills. Patient safety is low in surgeries performed as training cases for residents, and surgical complications and treatment costs are high. However, supervised cataract surgery training is carried out on actual patients in countries with a high demand for cataract surgery, a limited number of eye surgeons, and insufficient financial resources. Even considering all these factors, simulator laboratories have been suggested to be more cost-effective when compared to the expenses associated with surgical complications.[25]

Considering the previously mentioned factors, when participants were asked about the impact of simulation training on surgical skills, 76.5% reported that it was most effective in enhancing hand-eye coordination. In comparison, 20.6% said it was least effective in complication management. Additionally, 50% of participants described their surgical confidence levels as low before phacoemulsification simulator training, whereas after training, this rate increased to 73.5% at a moderate level. Virtual reality simulator training has been shown to help improve surgical confidence. These rates align with published studies, indicating that training with a virtual reality simulator enhances user confidence, reduces stress levels, and improves several aspects of surgical training, reducing complications and overall operative time.[26] Similarly, 26.5% of the participants in our study stated that simulation training was very effective in improving surgical skills, while 52.9% stated that it would contribute to surgical performance.

Although there was no statistically significant difference in device use between the participant groups (p=0.057), it was stated that the simulator device was sufficient in terms of its general technical features and ease of use and that it realistically reflected the complications that may occur during surgery. Most participants (64.7%) found the device moderately comfortable, while only 23.5% rated it as very comfortable, suggesting a need for ergonomic improvements. Additionally, 50% experienced occasional technical issues, highlighting the necessity for enhanced software stability, regular maintenance, and improved technical support.

Integrating AI-driven performance analysis and expanding interactive virtual reality-based training could further enhance the effectiveness of surgical education in ophthalmology. With the widespread adoption of simulation training, the process of acquiring surgical skills could accelerate, while surgical safety may also improve. The fact that participants recommended using simulators in surgical areas other than phacoemulsification (90.9%) reveals the need for residents to benefit from simulator-supported training on a broader scale. Expanding simulation training in highly technically demanding fields such as retina, glaucoma, and cornea surgeries could provide a significant opportunity to enhance surgical proficiency.

Our study found no statistically significant difference between Group 1 and Group 2 regarding surgical confidence levels before and after phaco simulator training (p=0.255, p=0.637). This situation may be attributed to several potential factors. First, participants in Group 2, who had more surgical experience, may have benefited relatively less from the training because they were more familiar with actual clinical practice. In addition, as surgical experience increases, the frequency of encountering complications increases, which may lead to a more cautious attitude towards surgical self-confidence. It should also be noted that some participants completed the questionnaire immediately after simulator training, while others responded after a certain period, potentially following real-life surgical procedures. Therefore, the observed changes in surgical confidence may reflect not only the impact of simulator-based learning but also the influence of subsequent clinical exposure. Previous studies have also shown that as surgeons gain experience, they encounter more complex cases and can better assess the possibility of making mistakes, so they can take a more controlled approach rather than experiencing a significant increase in their self-confidence.[27]

Our findings indicate that virtual reality-based simulator training provides more significant benefits, particularly for early-stage research assistants. Participants in Group 1 may have gained more from improving their technical skills and hand-eye coordination through simulator training, as they were new to surgical practice. In contrast, since surgical confidence and skills had already reached a certain level for the participants in Group 2, additional gains after simulator training may have been more limited. Previous literature reviews also indicate that surgical simulators are critical for beginning residents, particularly in acquiring manual skills and learning basic surgical techniques.[28]

Another reason for the lower impact of simulator training on Group 2 may be the differences in their surgical training background. However, the short duration of simulator training may also be why no difference was observed between the groups. In our study, most participants received 1-3 hours of simulator training (all of Group 1 and 73.3% of Group 2). Especially for experienced surgeons, implementing simulator training that lasts longer and includes more complex scenarios may make the effects on skill development and self-confidence more evident. Previous studies suggest repeated training sessions are critical to developing surgical skills.[29]

In the evaluations regarding the training process, the knowledge and guidance of phaco simulator instructors were found to be sufficient (64.7%), revealing that the instructor factor plays a critical role in simulation training. In addition to the technical advantages of simulators, it is known that appropriate instructor guidance and feedback mechanisms increase training efficiency. Considering that the training content did not fully meet expectations (44.1%) and only 8.8% found the content very sufficient, simulator training programs need to be developed and diversified in terms of content. In particular, adding different surgical scenarios, developing complication management modules, and increasing interactive evaluation tools can further increase the effectiveness of simulators in education.

In their answers to open-ended questions, participants stated that easy access to the device and adequate financial support should be provided, simulator training hours should be increased, and instructor support should be provided for vitreoretinal surgery training. They also stated that the application of viscoelastic material via a foot pedal is incompatible with real life and that the device needs to be developed.

Finally, although virtual reality-based simulators are an effective tool for improving surgical skills, they cannot fully reflect the psychological pressure and intraoperative stress factors encountered in the surgical environment. In a real surgical case, patient safety, complication management, and time pressure directly affect the surgeon's decision-making process. Since simulators cannot fully simulate such factors, their contribution to increasing absolute surgical confidence, especially for experienced surgeons, may be limited.

There are some limitations to our study. Whether the participants received training before using the phaco-virtual reality simulator is unknown. Furthermore, it was impossible to assess whether they had any experience with cataract surgery on actual patients before the simulator training. In addition, the small number of participants in our study and the inclusion of 4 ophthalmologists in Group 2 are potential limitations that may affect the general validity of the results.

Virtual reality simulators enable many training options by allowing repeated training in one or more surgery steps without requiring equipment or consumables or risking patient injury. Simulated training has been shown to reduce the length of stay in the hospital for patients undergoing phaco surgery, shorten the hospitalization period and speed up the discharge process while also reducing the use of surgical materials and the duration of surgery, helping senior physicians who provide training during surgery use their time efficiently and manage stress. Increasing the number of simulation devices in our country can benefit students and instructors in addition to the abovementioned benefits.

CONCLUSION

In conclusion, these devices improve various aspects of surgical training, especially for ophthalmology residents new to the operating room and ophthalmologists with little surgical experience. Thus, they reduce complications and total operative time while increasing user confidence and reducing stress levels. Our study highlights the need for further studies evaluating the effects of personalizing simulator training duration and content on surgical skill acquisition.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that pro

vides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

***Idea/Concept:** Murat Erdağ; **Design:** Murat Erdağ, Selma Aslan Mehmetalioğulları; **Control/Supervision:** Ali Dal, Mehmet Canleblebici; **Data Collection and/or Processing:** Selma Aslan Mehmetalioğulları, Mehmet Canleblebici; **Analysis and/or Interpretation:** Murat Erdağ; **Literature Review:** Selma Aslan Mehmetalioğulları; **Writing the Article:** Murat Erdağ, Selma Aslan Mehmetalioğulları; **Critical Review:** Hakan Yıldırım, Mehmet Balbaba.*

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