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RESEARCH ARTICLE

Retina Fácil: Mobile Application as a Learning Facilitator and Fundoscopy Capture during Practical Ophthalmology Training

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Abstract: The present study addresses the use of portable devices coupled to smartphones in the practice of funduscopy, highlighting the importance of this examination in the diagnosis of eye diseases, such as diabetic retinopathy and glaucoma. The use of such devices, especially in the context of telemedicine, has become relevant during the COVID-19 pandemic, allowing virtual exams and facilitating teaching in undergraduate medical courses. A survey was carried out with 94 medical students from Centro Universitário Christus, in Fortaleza-CE, who tested the device during practical classes. The methodology included the application of questionnaires to evaluate the limitation and effectiveness of the device in learning. The results indicated high accessibility on the part of students, with 84% stating that they would like to use the device frequently. Furthermore, 91% considered that the device significantly contributed to learning fundoscopy. However, some students reported difficulties and discomfort with the smartphone flash during the exam, especially in patients with light sensitivity. The study's conclusions point to the potential of these devices to modernize ophthalmology teaching and improve medical care, especially in contexts such as the SUS. However, improvements are possible, especially regarding user adaptation and the impact of the emitted flash. The portable device has shown promise, both in educational and clinical practice, being a viable alternative to the traditional ophthalmoscope.

Keywords:Ophthalmology, health education, Fundus oculi and Digital Technology.

INTRODUCTION

Fundoscopy, also known as direct ophthalmoscopy, is a fundamental examination for assessing the fundus of the eye. This procedure is vital for identifying various conditions that may compromise vision, such as diabetic retinopathy, glaucoma, and malignant hypertension, as well as other diseases that can threaten the patient's life. Given the importance of this examination, it is essential that all physicians be proficient in its execution. Competence in fundoscopy can prevent severe consequences, such as vision loss and other ocular complications, ensuring a better quality of life for patients (2).

However, physicians still report some limitations in performing this examination due to difficulties in handling the ophthalmoscope, limited knowledge of ocular anatomy, and a sense of insecurity in conducting and interpreting findings, leading to the perception that the exam would be better performed by an ophthalmologist (7). Consequently, this technique acts as a barrier to the implementation of fundoscopy in the context of primary healthcare (11).

Regarding innovations in the modern world, in recent years, there has been significant advancement in mobile technologies and smartphones, which offer important features such as portability and personalization. These technologies provide medical students with easy and immediate access to information anytime and anywhere, acting as a "pocket computer" with which they are already familiar (13, 18, 20).

There are an increasing number of devices that assist in fundoscopy practice and, consequently, in the diagnosis of prevalent diseases today. The primary one is portable fundoscopy devices, which have demonstrated multiple benefits, improving accuracy rates and boosting the confidence of medical students compared to conventional methods (1, 9). Additionally, these mobile devices have served as an inspiring element in student-teacher interactions, thus facilitating the teaching-learning process of fundus examination in medical education (15, 16, 18).

Specialized mobile devices enable the evaluation of patients in critical situations, showing superior effectiveness compared to other conventional techniques by identifying ocular problems in emergency settings. The widespread presence of smartphones in daily life allows integration with adapters for ophthalmic lenses, combining practicality, mobility, cost-effectiveness, and data storage capabilities (5, 6, 19). In combination with telemedicine, they enable the virtual diagnosis of various ocular diseases, facilitating specialist access as a second opinion strategy, supporting primary care physicians in decision-making, and reducing long waiting lines for ophthalmologists (14).

In this context, we recognize the importance of introducing an easy-to-use and low-cost device in ophthalmology education during medical school, particularly in practical eye examination classes. The aim is to prepare students for the use of new technologies in primary care, especially in virtual consultations, highlighting the need for further research to optimize its use and enhance its effectiveness.

METODOLOGY

The study was conducted at Centro Universitário Christus (Unichristus), Fortaleza - CE - Brazil, from January to August 2024. It involved fifth-semester medical students at Unichristus who were attending practical ophthalmology classes. These students were approached during lessons featuring real-case simulations in the Communication, Skills, and Activities Laboratory and were invited to test the Retina Fácil portable device.

At first, the researchers explained the purpose of the study, demonstrated how to use the device, and provided details about its functionality to the students. Subsequently, volunteers were recruited to serve as patients for the fundoscopy examination—these were the students themselves, ideally two per group. After pharmacological mydriasis of both eyes of the volunteers, the other students performed direct ophthalmoscopy using the Welch Allyn ophthalmoscope. Then, they used the Retina Fácil device, which was attached to the researcher's smartphone, observed the images recorded by the phone's camera during the practice session, and were later invited to individually complete a questionnaire assessing the impact of the portable fundoscopy device on medical education in the ophthalmology module.

The questionnaire was created using Google Forms and contained 21 questions, divided into two sections:

- The first section contained 14 questions, answered by all students who tested the device.
- The second section contained 7 questions, answered only by students who volunteered to be examined as patients.

Responses were multiple-choice, with five possible answer options:

1. Stronglyagree
2. Agree
3. Neutral
4. Disagree
5. Stronglydisagree

The collected data were analyzed using descriptive statistical methods, including frequency, mean, mode, median, and standard error, with Microsoft Excel® 2010 software.

RESULTADOS

A total of 94 students participated in the study. Table 1 presents the questions administered to the users of the fundoscopy application, along with the corresponding percentages of their responses.

Table 1. Responses of students who performed a fundus examination using Retina Fácil. N=94. A=strongly agree; B=agree; C=neutral; D=disagree; E=strongly disagree. N (%).

Question (statement)	A	B	C	D	E
I think I would like to use this portable device frequently.	79 (84%)	15 (16%)	0	0	0
I think the portable device is complex.	3 (3,1%)	1 (1,06%)	3 (3,1%)	29 (30%)	58 (61%)
I find the device easy to use.	60 (63%)	29 (30%)	4 (4,2%)	1 (1%)	0
I find the device difficult to handle.	13 (13,8%)	6 (6,3%)	15 (16%)	22 (23%)	38 (40%)
I imagine that most people can learn to use this device very quickly.	69 (73%)	24 (25%)	1 (1,06%)	0	0
I felt very confident using this device.	57 (61%)	25 (26%)	12 (13%)	0	0
I found that the device significantly contributes to learning fundus examination.	86 (91,4%)	7 (7,4%)	1 (1%)	0	0
I found the portable device easier to use than the ophthalmoscope for performing the fundus examination.	76 (81%)	11 (12%)	5 (5%)	2 (2%)	0
I found the portable device better than the ophthalmoscope for learning fundoscopy in medical school.	75 (80%)	13 (14%)	6 (6%)	0	0

The study also addressed questions related to the complexity and ease of use of the device. These questions are essential for assessing whether the device's design is intuitive and accessible factors that directly impact user satisfaction and experience. The majority of students confirmed the simplicity of the device's use (93%) and its low complexity (91%) in their responses. However, contradictorily, only 63% did not find the device difficult to handle, demonstrating that adaptation to these devices still presents challenges.

Additionally, the questionnaire included key questions to evaluate the effectiveness and practicality of the portable device compared to the traditional ophthalmoscope. Among these, particular emphasis was placed on aspects such as ease of use, utility in learning fundoscopy, speed in visualizing fundus structures, and advantages in ophthalmology education. Notably, the question "I found the portable device better than the ophthalmoscope for learning fundoscopy in medical school" received a high positivity rate (94%), underscoring the importance of tools that not only simplify the learning process but also provide a more engaging and effective teaching experience for students.

A total of 22 students underwent a fundoscopy examination after pharmacological mydriasis in both eyes. They

completed a questionnaire regarding their experience with the device in the ophthalmology module. All students showed a certain degree of interest in being examined using the portable device. They were particularly surprised by its design, including the size of the lens that reflected the image and the fact that it was attached to a smartphone (Table 2).

Table 2. Opinions of students who underwent the examination as patients. N=22. A=strongly agree; B=agree; C=neutral; D=disagree; E=strongly disagree. N (%).

Question (statement)	A	B	C	D	E
Eu gostaria de ser examinado por meio desse dispositivo portátil de fundoscopia.	16(73%)	6(27%)	0	0	0
Eu me senti confortável sendo examinado por esse dispositivo portátil.	10(46%)	8(36%)	2(9%)	2(9%)	0
Eu me senti incomodado com o flash do celular durante o exame.	4(18%)	8(36%)	4(18%)	2(9%)	4(18%)
Eu acredito que pacientes com miopia e astigmatismo sentiram mais dificuldades em realizar o exame por conta da hipersensibilidade à luz.	6(27%)	6(27%)	5(23%)	2(9%)	3(14%)
Eu prefiro ser examinado pelo dispositivo portátil em detrimento do oftalmoscópio tradicional.	13(59%)	4(18%)	5(23%)	0	0
Eu achei o exame com dispositivo portátil bem mais rápido do que com o oftalmoscópio tradicional	13(59%)	7(32%)	1(4,5%)	0	1(4,5%)
Os pacientes, durante o exame, estariam bem mais confortáveis avaliados pelo dispositivo portátil do que pelo oftalmoscópio.	13(59%)	6(27%)	3(14%)	0	0

However, the questions regarding discomfort during the examination yielded surprising results that may not align with the initial enthusiasm when students first saw the device. The smartphone attached to the device emits a flash, which is an artificial light that, although not harmful to vision when used for a short period, can cause ocular symptoms such as asthenopia (eye strain) and dry eye syndrome, especially in individuals with heightened ocular sensitivity. It is believed that patients with certain optical conditions, such as astigmatism, may experience increased light sensitivity (54%).

During data collection, when comparing the portable device to the traditional ophthalmoscope, this technological innovation demonstrated greater approval among students, particularly in the context of clinical practice and medical education. The device was favored primarily for its ease of use and practicality, making it a valuable tool for learning ophthalmology and potentially serving as an educational resource.

DISCUSSION

Currently, in the pursuit of improving clinical techniques through technological innovations, various studies have been published highlighting the real utility of portable devices as an aid in fundoscopy (9, 10, 13). The Retina Fácil application was developed as a tool to support learning and primary healthcare. It provides clear visualization of the optic disc, retina, and its vessels, in addition to a database of fundus images, including brief descriptions of their characteristics and guidance on clinical management (3).

The findings regarding the statement "I think I would like to use this portable device frequently" highlight strong student acceptance of this new, more interactive learning method. Students also expressed interest in using the device continuously, which is directly linked to user acceptance and engagement, fundamental pillars for the development of any medical technology innovation (13).

The majority of students confirmed the device's ease of use (93%) and its low complexity (91%) in their responses. However, only 63% did not find the device difficult to handle, highlighting the ongoing adaptation challenges for such devices. It is essential to consider that students only tested the device during a single class in the semester, meaning they did not have enough time to become fully accustomed to the technology. This observation aligns with the findings of Gilmour-White et al., who reported that, despite granting students free access to a portable ophthalmoscope, students performed an average of only six examinations with the device over 18 weeks of clinical training. As a result, no significant improvement was observed in their ability to perform direct fundoscopy (4). This reinforces the idea that device proficiency and adaptation can only be achieved through regular practice.

The statement "I imagine that most people can learn to use this device" assessed participants' perceptions of the learning curve associated with the device. Most students agreed that it was easy to learn to use, as highlighted by Dunn et al., who suggested that the device could be adopted by a broad range of users, regardless of their technical skills. In this study, students found the portable device easier to use than the traditional direct ophthalmoscope ($P < 0.001$), which contributed to greater initial acceptance of this method (2).

Questions were also posed to understand whether students were interested in continuing to use the portable device throughout their medical education and clinical practice, particularly in Unified Health System (SUS). The statements "I would like to use this device later during medical school" and "I would use this device when attending to patients in SUS" received a high percentage of positive responses, underscoring the importance of this tool in medical education and practice. These results also indicate the need

for potential government investment in such devices to enhance virtual healthcare services, including remote physical examinations, by developing telemedicine programs with ophthalmology specialists, a field with limited accessibility in SUS (17).

The combination of the widespread availability of smartphones with ophthalmic lens adapters has provided a practical, mobile, and cost-effective solution, facilitating data storage and analysis. These aspects are crucial both for patient care and for medical students' training in ophthalmology (8, 12). Given these considerations, this study demonstrated the positive impact of specialized mobile devices in fundoscopy practice, highlighting their superiority in critical and emergency settings, where they proved to be more effective than conventional techniques.

However, the study also revealed areas for improvement, particularly regarding the impact of the smartphone flash, which may cause ocular discomfort in individuals with heightened sensitivity. Additionally, a lack of practice in handling the device among students could limit its full potential in education. Despite these challenges, the portable device stands out as a promising innovation, with the potential to modernize ophthalmology education and enhance the quality of healthcare services.
Finally, the comparison with the traditional ophthalmoscope reinforced students' preference for the portable device, mainly due to its practicality and usability. This finding suggests that the device could be widely adopted in educational and clinical environments, contributing to better-trained healthcare professionals and more efficient, accessible healthcare services.

CONCLUSÃO

Regarding the question of students' acceptance and enthusiasm for incorporating this technology into their learning process, the responses suggest that the device not only met their immediate educational needs but was also seen as a valuable tool for the continuous development of their clinical skills throughout medical school.

The question about future physicians' confidence in applying this technology in real-world healthcare settings demonstrated a strong willingness to use the device in public healthcare. This indicates that the device is perceived as an efficient and beneficial tool, capable of improving the quality of patient care.

These positive responses suggest that the portable device has great potential for integration into both medical education and clinical practice, contributing to the modernization and improvement of healthcare services, especially in the SUS. The adoption of technologies that facilitate learning and improve patient care is essential for training more competent healthcare professionals and delivering more efficient and accessible healthcare services.

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