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Research Article

Virtual Reality Glasses: A Complementary Method to the Traditional Model in Gastrointestinal Endoscopy Training

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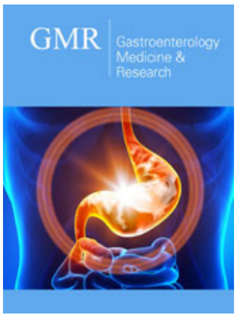
ISSN: 2637-7632



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Submission: July 15, 2024
Published: July 26, 2024

Volume 8 - Issue 1

How to cite this article: Emanuel Nascimento Nunes, Lucas Caetano da Silva, Rérycka Beatriz Lins de Andrade, Fauze Maluf-Filho and Mônica Souza de Miranda Henriques*. Virtual Reality Glasses: A Complementary Method to the Traditional Model in Gastrointestinal Endoscopy Training. Gastro Med Res. 8(1). GMR. 000676. 2024.
DOI: 10.31031/GMR.2024.08.000676

Abstract

Introduction: Endoscopy training is a long process that requires time and dedication. To improve the quality of endoscopy procedures, several medical societies over the last decade have developed training programs and quality recommendations, as well as goals and performance indicators. Simulation-based training offers a solution to this challenge, specifically Virtual Reality (VR), which can provide immersive and individualized practice without risk of harm to patients and minimal risk of contamination to users. The use of simulators in endoscopy can be useful in acquiring basic technical skills such as handling the device and recognizing lesions.

Objectives: Develop and evaluate a simulator-based training tool, VR glasses, containing theoretical and practical elements designed to optimize and accelerate learning in gastrointestinal endoscopy. Test whether the acquisition of skills and knowledge in digestive endoscopy can be improved with the use of virtual reality glasses.

Methodology: Prospective and comparative study, carried out with a virtual reality simulator Oculus Rift 2 (manufacturer Facebook) to evaluate performance and the learning curve by comparing the grades obtained in the tests. The sample was applied to experimental clinical studies with 100 trainees divided equally and randomly between two groups: conventional method (1) and virtual reality glasses (2).

Results: There was a significant difference in the Mann-Whitney test for non-parametric measurements ($U = 708$, $p = 0.001$), which showed a positive effect in the training group with VR glasses. Improvement in the posttest of 48% in the glasses group compared to 16% in the conventional group.

Conclusion: The use of VR as an active methodology is capable of improving learning skills in endoscopy and can be used as a complementary method to the traditional training model.

Keywords: Virtual reality; Learning curve; Simulation training; Endoscopy

Introduction

Education and training are fundamental to quality and patient safety, so high-standard training has become an indispensable prerequisite for quality endoscopy [1]. Problems regarding the quality of gastrointestinal endoscopy have been demonstrated in several studies, mainly related to diagnostic errors, adverse events, and negative experiences on the part of patients [2,3]. To improve the quality of endoscopy procedures, several medical societies, over the last decade, have developed training programs and quality recommendations, as well as goals and performance indicators [4]. Formal courses and training for junior doctors have a positive impact on the quality of endoscopic procedures, so well-structured and supervised training programs are vital to achieving the necessary competencies [5]. For most doctors, endoscopy training begins with gastroscopy. This training process requires time, effort, and dedication [6,7]. Simulators can help beginners gain experience by initially acquiring basic scientific knowledge and then dexterity and manual skills, which will reduce risks to patients [8,9]. The COVID-19 pandemic has imposed additional restrictions on the healthcare system, including the need to systematize and rationalize the use of Personal Protective Equipment (PPE) and retain healthcare personnel to treat critically ill patients [3]. Many doctors have been displaced from their units and allocated to units dedicated to the treatment of these patients [10]. In this sense, innovative solutions were designed and developed to mitigate the impact on education. New strategies sought to resume endoscopic practice within new configurations and with innovative technological strategies, thus providing paths for the development of skills and competencies in endoscopic procedures, guaranteeing the quality of exams, and overcoming obstacles arising from the pandemic [11,12].

Virtual Reality Simulators (SRV) can provide immersive and individualized training, without risk of harm to patients and minimal risk of contamination to users [13-15]. Virtual reality creates, using computer graphics, an artificial and immersive world, which is important for the training of unusual situations, such as rare injuries and in scenarios that require greater aptitude on the part of the endoscopist, preparing for real scenarios, improving the learning curve and performance of new techniques. Likewise, making possible tangible "feedback", which allows not only the training of basic skills but also more complex endoscopic procedures [16-18]. Virtual reality has been widely used in training surgical techniques, promoting greater learning and better performance, and reducing risks and adverse events for patients [17]. No technique can give way to procedures performed on human beings, however, some endoscopy scenarios are difficult to reproduce on traditional simulators and manikins, such as situations of gastrointestinal bleeding, procedures performed in the third space, in enteroscopy deep tissue, and interventional ultrasound [19,20].

Although the pandemic has caused inestimable losses to the healthcare system and endoscopy training, it has presented a need to rebuild the existing training approach. It is proposed here to modify the model based on only passive learning and associate new forms of active and innovative technologies – such as simulators based on the use of virtual reality glasses adapted to endoscopic training.

Objectives

1. Develop a simulator-based training program, consisting of virtual reality glasses, containing a sequence of theoretical and practical elements designed to optimize and add to conventional learning in endoscopy.
2. Evaluate whether this type of tool can contribute to the acquisition of knowledge in beginning students.

Methodology

This research was approved by the ethics committee board number 5.279.885. The first part of this project was the development of the software (Company MEDXVR- Endoscopy) using Virtual Reality (VR) technology with the use of Oculus Rift 2, manufacturer Facebook. Virtual reality was used to build an endoscopy teaching Simulator (Figure 1), that incorporates a platform that generates task-specific and self-assessment metrics (Unity 3D System). The didactic programs are based on theoretical content (classes and cards) and audiovisual content (videos photos and images), as well as the basic recognition of the main injuries. This first module developed contains the main esophageal pathologies (reflux disease and its complications, infectious and caustic esophagitis, advanced and early neoplasms, and esophageal varices). The program allows the simulation of the endoscopic examination room. And, with the use of handles (used by the operator), it is possible to simulate the introduction of the endoscopic device into the virtual patient under direct vision. After the program was developed, and the first module was completed, in a second moment, a prospective study was carried out, for validation and initial practical observation, through the evaluation of scores, using questionnaires applied before and after the use of the simulating glasses in endoscopy (pre- and post-test). Participants were randomly selected and divided into 2 groups of students: one to carry out the pre-test after class, according to the traditional method (1); another group (2), after the pre-test, used the VR simulator. Both had access to the same didactic content, a class on Gastroesophageal Reflux Disease and, after the intervention object, answered similar post-tests.

Figure 1: Endoscopy teaching Simulator - Oculus Rift 2 (Facebook).

Type of Study: Longitudinal, interventional with random sampling. The intervention object was (group 1) a conventional class with pre-and post-tests and another (group 2) was composed of a virtual reality class, using the simulator.

Study variable: 1) Grades obtained in pre- and post-test tests. Therefore, it is a quantitative variable; 2) Opinion questionnaire at the end of the experience with the glasses group, as a qualitative variable.

Statistical Analysis

Sample: The sample calculation was applied to experimental clinical queries for the pilot study with 100 students, with the aim of comparing test scores in the method conventional (group 1) and test scores using the virtual reality glasses method (group 2).

Statistical Method

The calculations performed to compare means and between groups were non-parametric tests, as they are used on variables with nominal or ordinal measurement. The Mann- Whitney test was performed for the independent variables in comparison between the two groups analyzed and the Wilcoxon test was performed between the pre- and post- test variables as they were variables linked to the same group analyzed. A $p < 0.05$ value was adopted to consider statistical significance.

Results

Positive comparative results were obtained with better performance in the VR glasses training group. Furthermore, when comparing the results of the pre-test between the two groups, it was seen that group 1 (conventional) showed a comparative difference only in the pre-test, with $p = 0.04$ and Wilcoxon Test $W = 2239.5$ (close to the threshold of the absence of statistical significance, if $p > 0.05$). To compare performance in the post-tests, there was a significant difference in the final result between the groups, with group 2 (VR glasses) having a superior result ($p = 0.001$ and Wilcoxon Test $W = 2061.5$), corroborating the hypothesis improvement in the performance curve associated with the use of VR glasses. The main finding is related to the final performance when comparing the post-tests of groups 1 and 2, with Mann-Whitney Test $U = 708$, $p = 0.000$, highlighting, once again, the difference in training with VR glasses. This aspect reinforces that, regardless of the participants' initial performance, it was possible to notice a greater improvement in the performance of group 2 with training with VR glasses. With the results of the student evaluation questionnaires, it was found that those in group 2 reported having enjoyed the learning experience with the VR glasses. The students reported that it took a considerable amount of time for them to acquire the skills to handle the VR simulator equipment, as it was a new device. Virtual reality glasses were well accepted by students and evaluated as an innovative tool, which can be used as an active teaching methodology to be aid in educational practices as a complement (Table 1) (Figure 2).

Table 1: Mean values obtained in the two groups (n=100)

	Pretest	Post test	Performance
Group 1	56,2	41,2	39,6
Group 1	44,7	59,7	61,3

Subtitle: Average accuracy values for groups 1 and 2 in the pre- and post-tests.

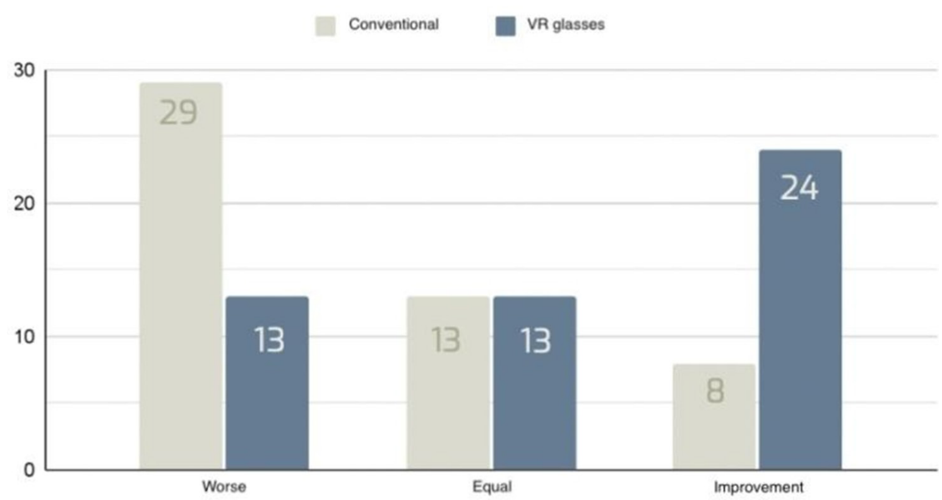

Figure 2: Comparison of correct answers obtained between groups 1 and 2.
Subtitle: Comparison between groups post-tests and performance curve. Results obtained from participants in group 1 (conventional) and from participants in group 2 (virtual reality glasses). Calculation of the Mann-Whitney Test $U = 708$, $p = 0.000$.

Discussion

The use of innovative technologies to aid student learning is already widely used in several areas. Medical schools currently use several tools to assist in this academic journey in search of improvements in the learning curve. Numerous procedures require hours of training to acquire the skills required of students and newly graduated doctors, thus seeking qualified training in the activities they will perform. Virtual reality has the potential to be useful in both medical teaching and practice. It can be applied in the surgical environment [21], for pain treatment [22], treatment of psychiatric illnesses [23], neuromotor rehabilitation [24], and reduction of pre-operative anxiety [25]. This can be seen in the case of Case Western Reserve University and Cleveland Clinic, which adopted this tool for anatomy classes, enabling the improvement of medical skills, through the creation of simulation rooms, using VR glasses, allowing the student to view 3D holograms of the entire body, including the different systems and organs [26]. Another area that has benefited from the use of VR is neurology. In a systematic review with meta-analysis carried out in 2018 with 14 randomized clinical trials, we sought to analyze the use of VR with patients undergoing motor rehabilitation after a stroke. Favorable results were observed in terms of gait and balance with the use of the VR tool, thus noting the wide application of this technology in different health fields [27]. Several articles presented positive results in favor of the use of VR simulators, with similar or even better significant results being found in the learning curve in endoscopy when compared with other learning tools, such as clinical training and other simulators without the use of VR [28,29].

Virtual reality simulator glasses are still considered high cost not widely available in many educational centers and are still not very widespread. Still, they are more viable from an investment point of view compared to other types of virtual simulators and training mannequins [28,30]. In a systematic review carried out with 18 studies that compared virtual reality simulation training for healthcare professionals undergoing endoscopy training, it was observed that, although it was not possible to group the study data, it was seen that reality-based training virtual appears to offer advantages over untrained peers and can be used to effectively complement training in conventional endoscopy [31]. Prospective studies, which used a similar methodology as presented in this research, using pre-and post-tests, also demonstrated a significant improvement in the performance of the endoscopic technique, in the reduction of exam time, in greater efficiency in the recognition and evaluation of lesions and, finally, in accelerating the learning curve [31-33].

Even with the various advantages already demonstrated, the use of this innovative technology is limited to the high cost and availability of equipment and trained professionals. However, we demonstrated in this research that it is possible to develop an accessible and cheaper endoscopy learning program from a national company with experience in software development.

Conclusion

According to the results presented here, regardless of the participants' initial performance, it was possible to notice a greater improvement in the performance of the group exposed to VR glasses. The validation of this tool, considered an active methodology, can be applied to the most diverse áreas of study in medicine as well as, as already mentioned, improving the skills of the beginner endoscopist. It was demonstrated that virtual reality technology is consolidated as an innovative tool, being well accepted by students, and can be used in educational practices, as an active teaching methodology and such as support in health procedures and technical training for professionals, minimizing possible risks to patients and bringing safer and cheaper practices.

Conflict of Interest

There are no competing interests to declare. The authors confirm that there are no relevant financial to report.

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