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Activity Report

Experience using immersive virtual reality simulation during an AO trauma regional course in Latin America

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ABSTRACT

Virtual reality has been used in orthopedics for several years now, both as a training and assessment tool. The use of extended reality technologies in surgical training and simulation is the most developed and validated of all the current applications. However, formal and massive implementation in continuous orthopedic education has yet to happen. This report aimed to present our experience during the first AO trauma regional courses in Latin America that incorporated the use of immersive virtual reality (IVR) simulation as a hands-on activity as part of the program. IVR was used for the first time as part of a course activity during the advanced principles of fracture treatment course as part of the AO regional courses in Rio de Janeiro, Brazil, in 2022. The activity was implemented for 120 participants in a back-to-back fashion. Each participant used the IVR simulation for the trochanteric nail application and did a traditional hands-on exercise with a synthetic bone model. An appreciation survey was answered by participants. Seventy-four persons answered the survey. About 62% considered that the IVR simulation was like reality, and 76.38% thought that IVR was helpful in the learning process. The majority (91.6%) would like to use IVR for training, and 93% would be willing to use IVR again. This was the first time, IVR simulation was implemented as a massive and structured educational activity during the principles of fracture treatment course. Participant feedback was positive, and most people would use IVIR again. A systematic way of implementing IVR simulation sessions with educational goals needs to be developed for these activities.

Keywords: Immersive virtual reality, Simulation, Orthopedics, Education, Fracture treatment course

INTRODUCTION

Virtual reality is defined as "the use of computer modeling and simulation to enable a person to interact with an artificial three-dimensional visual or other sensory environment through devices such as goggles, headsets, gloves, or body suits."[1] Virtual reality has been used in orthopedics for several years now, both as a training and assessment tool.[2,3]

In recent years, immersive virtual reality (IVR) simulators using commercially available devices have emerged due to the creation of two startups led by orthopedic surgeons. Using headsets, the virtual reality simulation takes up all the users' field of vision as they become completely immersed in the virtual experience. The users interact with the environment using handheld controllers. This new form of simulation allowed virtual reality to become more portable and accessible.[4]

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The use of extended reality technologies in surgical training and simulation is the most developed and validated of all the current applications today.[5-7] Despite this, IVR has not been formally included in orthopedic continuous surgical training, and skill transferability that impacts patient outcomes has yet to be proved.[8,9]

This report aimed to present our experience during the first AO trauma regional courses in Latin America that incorporated the use of IVR simulation as a hands-on activity as part of the program.

MATERIALS AND METHODS

The advanced principles of fracture treatment regional courses in Rio de Janeiro, Brazil, consisted of three courses with 40 participants each with a total of 120 participants and 52 faculties. Twelve faculties were assigned to the IVR activity, with 20 participants each time.

All the course activities were performed 3 times to accommodate all participants. The trochanteric femoral fracture osteosynthesis with a trochanteric femoral nail practical exercise took place on the 2nd day and was set up for 1 h. In the first half an hour of the activity, 20 participants used the IVR simulation for the trochanteric femoral nail, while the other 20 did the traditional hands-on exercise. After 30 min, both groups switched places. This rotation was repeated 6 times.

Hardware and software

The virtual reality module used in this course was the TFN-ADVANCED™ Proximal Femoral Nailing System (TFNA) module, developed by Osso VR for Johnson and Johnson. It used in Latin America as part of the partnership between AO and Johnson and Johnson. The module development was finished in July 2022 and launched worldwide in August 2022. This was the first time; it was used in Latin America. The hardware used was the Meta Quest 2 by Meta Platforms Inc., Fresno, California.

The trochanteric femoral fracture fixation with a nail was done both with the IVR and hands-on workshop because it is the only practical exercise in the advanced principles of fracture management course that has a virtual reality simulation module.

Room and headset setup

Twenty squares measuring two-by-two meters were marked with tape on the floor. These were then used to set up the virtual boundaries for the headset. All headsets were set up so that they would launch directly to the trochanteric femoral nail module [Figure 1].

Activity execution

The activity was designed like any hands-on educational activity during AO courses. Objectives were established at the beginning and a brief tutorial on how to use the headset, controllers, and software was shown to the participants by the practical director. This lasted <5 min. After the introduction and tutorial, each participant had the opportunity to start the module and do it at their own pace. Assistance from faculties and staff was available. Five minutes before the practical ended, take-home messages were delivered, and participants were asked to answer a survey about the perceived usefulness of IVR. Each participant had a personal face covering. After each group used the headsets, the silicon covers and the controls were cleaned [Figure 2].

RESULTS

There were 120 participants in the three courses. Eighty-four participants were from Brazil, 20 were from Colombia, three were from Peru, two were from Argentina, two were from Ecuador, and one was from each of the following countries: Chile, Panama, Paraguay, and Mexico. One hundred and three participants were males and 12 were females. The median age for participants was 33.86 years of age, ranging from 27 to 64 years of age. Twelve faculty members were assigned to the IVR activity.

Seventy-four persons answered the survey. Forty-six participants (62%) considered that the IVR simulation was like reality. Fifty-five (76.38%) thought that IVR was helpful in the learning process. Sixty-six people (91.6%) referred they would like to use IVR for training and 67 (93%) would be willing to use IVR again.

Although we did not specifically measure this, we did notice that most participants only needed help in the first 5–6 min

Figure 1: Meta Quest 2 headset and controllers.

Figure 2: Room setup and participants using individual headsets for the practical exercise.

of hands-on use of the IVR. After this time, almost all of them were able to follow the in-simulation instructions. In addition, several participants completed the whole procedure, including augmentation – even though it was not part of the program. Some even did the trochanteric femoral nail module twice. Faculty members subjectively perceived that participants who did the IVR practice first referred that they found it easier to perform the hands-on activity. Some participants also mentioned that they felt that they knew the steps better after using IVR simulation.

DISCUSSION

To the best of our knowledge, this is the first time a massive and structured educational activity involving the use of IVR took part during a fractures management course. It was also the first time, TFN-ADVANCED™ Proximal Femoral Nailing System (TFNA) module was used in Latin America.

With the appearance of the Meta Quest 2 by Meta Platforms Inc, IVR has become much more portable than the previous version available in Latin America. Today, only the headset and controllers are needed, and the new software has been developed by Osso VR (San Francisco, California) in partnership with the Johnson and Johnson Institute for ©DePuy Synthes (Johnson and Johnson) implants. This technology has just been introduced in Latin America in 2022.

Several randomized trials have shown that IVR can improve translational technical and nontechnical skills acquisition over traditional learning both in students and senior-level orthopedic residents.[10-13]

So far, it has been demonstrated that simulation, and simulation with IVR can improve surgical skill acquisition, with trainees showing improvement in time to complete a procedure, procedural checklist scores, and implant placement accuracy.[8,12-14] It can also help trainees be more confident with their skills.[8]

Despite these results, formal introduction to residency and training programs has been slow, even with arthroscopic simulators.[9] Some of the main difficulties for formal training program implementation with VR are that there is no consensus on establishing training sessions or measuring outcomes. There are also few instructors or faculty prepared to work with IVR simulation. Hence, IVR utilization is usually unsupervised and the students are frequently left to learn alone.[9,15] This has been especially true during medical device companies' activities with IVR.

A seven-item task list for educators using VR simulation was proposed by Camp for the continuous educational use of VR simulators. Defining the primary goals for the educational activity is the first one.[9] For our training session, the main objective was that participants became familiar with the new technology. We consider that going forward, establishing educational goals when using IVR simulation is paramount for the success of educational activities. Otherwise, the activity becomes an entertainment session with novel technology. This opens the possibility for detractors to call IVR simulation a "realistic videogame" but not an educational tool.

Other barriers that have been identified up until now for the integration of simulation-based training into surgical education are a lack of methods for the evaluation of surgical skills in the operating room, lack of consensus for proficiency-based progression, limitations for training in problem-solving and surgical adversity, and lack of consensus for the remediation of poor performance.[16]

Limitations

The main limitations we encountered were hesitancy to use the technology, resistance from some faculty members and participants, and little familiarity of the staff and faculty members with both the hardware and software, so all the setup, support, and troubleshooting during the exercise relied on a few persons.

The Meta Quest 2's portability is also a big limitation for educational purposes while being aided by a faculty member. Since there is no laptop or external screen, the faculty member cannot see what the user sees. It is possible to cast the image to a computer or cellphone, but that would require a one-on-one ratio for faculties, casting devices, and participants. This makes it challenging to guide the participant and understand where they are struggling, especially if the faculty member or person assisting is not familiar with the simulation.

The battery life of the headsets was also a limitation, we had not considered. Battery life is established for 2–3 h in continuous use mode. Since we turned them on a couple of hours before the actual practice began to set up all the headsets with boundaries, internet access, and passwords, battery life was being consumed, even while in sleep mode. By the fifth repetition, they were running low on battery, and we had to charge them quickly. As there were no breaks between groups, this turned out to be a challenge by the final session. There were also no charging points near the assigned station for each headset and the short charging cable did not allow the headset to be charged while being used.

Next steps

Figuring out which skills can be developed with IVR, how can the use of IVR be maximized to help lower educational activity costs to make them more affordable and developing and validating curricula that involve the use of IVR are the next steps for massive IVR implementation in continuous surgical educational activities. In addition, establishing ways to evaluate surgical skill transference from simulation to the operating room are also one of the main goals of any kind of simulation.

CONCLUSION

This was the first time, IVR simulation was implemented as a massive and structured educational activity during the principles of fracture treatment course. A systematic way of implementing IVR simulation sessions with educational goals needs to be developed for these activities. Faculties and support personnel need to be prepared to assist in these activities.

Recommendations

To improve faculty members' familiarity with technology, we propose training before activities involving IVR. This way, faculty members can better aid participants both with the technological and training aspects, especially if there are no casting screens. Knowing how the simulation runs makes it easier for the faculty member to understand when the participant is struggling. If there are a small number of participants, casting what the participant is seeing to another screen can help the faculty to follow the simulation process. We also propose that, when planning activities longer than 90 min, 15–30-min breaks are taken so that the headsets can be recharged.

As we become more familiar with the technology and more headsets are available, the multiplayer option can be used for faculty members to be present in the same simulation as the participants – not only while in the same physical space but from remote locations. This way, participants can receive real-time feedback and coaching.

Finally, it is possible to gather user data after each module execution. This can help us understand how participants improve. Although this would onlye be useful after a series of repetitions, making it difficult to measure improvement during a course where participants use the IVR simulation only once.

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AUTHORS' CONTRIBUTIONS

PLB, RPH, and CAB: Designed the activity and supervised planning and execution. PLB: Gathered data from the surveys. CAB: Wrote the initial and final draft of the article. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

This case report was approved by the AO trauma Latin America Board. August 18th, 2022.

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This report is supported by the AO Trauma Latin America. AO Foundation is an independent, medically guided not-for-profit organization. Headsets were provided for the course by the Johnson and Johnson Institute as part of the commercial agreement between the AO Foundation and Johnson and Johnson.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate participants consent forms. In the form, the participants have given their consent for their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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CONFLICTS OF INTEREST

CAB, RPH, and PLB are all AO trauma faculty members and paid consultants for Johnson & Johnson medical. They did not receive any funding or payment for this case report.

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