CURRENT APPLICATIONS OF VIRTUAL AND AUGMENTED REALITY IN RADIOLOGY
Virtual reality (VR) is a computer-generated simulation of a three-dimensional (3D) environment where users can interact with virtual objects via a head mount or eyewear device.

Augmented reality (AR) enhances the 3D world by fine-tuning a user’s visual, tactical, and auditory senses.

VR/AR simulations allow residents to repeatedly practice, hone, and perfects their skills by making mistakes that they can learn from without causing harm to patients.
OBJECTIVES

- Present applicability and educational value of VR/AR simulations that is widely used in various aspects of medicine and medical education to facilitate:
  - Meetings
  - Workflow
  - Surgical/procedural planning
  - Resident education
  - Radiologist workstations
METHODS

Broad literature search investigating current common uses and applications of VR/AR in the general medical community

Focused literature review specifically looking at VR/AR use in medical school and residency

Focused literature review looking at VR/AR use in all aspects of radiology
Results: Applications in Meetings

- The applicability and educational value of VR/AR simulations allows its wide use in various aspects of medicine and medical education such as:
  - Education of individual or small groups in anatomy labs$^{1-2}$
  - Surgical laparoscopic skill practice through simulation$^{3-5}$
  - Residency applicant hospital tours$^5$
Results: Applications in Workflow

- VR/AR impact in radiology workflow includes assisting in multiple levels of patient care, scheduling, and medical education.
- VR/AR technology use to improve workflow operations includes:
  - Assisting in obtaining patient consent by creating a simulation of the planned procedure for the patient to better clarify the procedure to be done\(^6\)
  - Improving the patient experience for imaging exams (for e.g. MRI), by using relaxation and “distraction therapy” through simulation\(^6-7\)
Pre-operative vascular mapping for Interventional Radiology procedures has benefited from VR/AR by creating simulations/reconstructions of a patient’s specific anatomy.

This allows the interventionalist to be better prepared to handle variant anatomy and possibly reduce fluoroscopic exposure time to the patient.
Results: Applications in Resident Education

- Regarding medical education, radiology residents have already begun experimenting with simulations that allow the use of virtual sonographic equipment\textsuperscript{10-11}

- This includes exchanging different probes and learning about various sonographic settings (for e.g. adjusting gain and brightness)
Results: Applications in Radiology Workstations

- VR/AR for reading diagnostic images is an exciting and upcoming application
- Using a headset, users are transformed from the physical reading room into a virtual reading room\(^\text{12}\)
- This allows one to decrease physical equipment requirements, including:
  - Monitors
  - Dictaphones
  - Mouse and keyboard
- The user is transported to a virtual world, immersing the user into the imaging study to be read\(^\text{12}\)
Results: Applications in Radiology Workstations (continued)

- A virtual radiology reading room not only reduces space needed and cost of equipment, but corrects and accounts for:
  - Poor lighting
  - Screen reflections
  - Ergonomics

- Reduced glare may improve users’ attention spans, likely due to minimization of distractions inherent to the physical reading room\(^\text{13}\)
CONCLUSIONS

- Contrary to William Halsted’s surgical adage of see one, do one, teach one, VR/AR simulation allow residents to practice their skills until the correct patterns become habits.
- While VR/AR technology continues to improve, the use of simulation technology can greatly benefit the radiologist, department workflow, and the patient experience.
- More studies are needed to further highlight these possible benefits, but the paradigm shift of simulation technology in radiology has arrived.


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