ACS 2023 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Evaluation of Mixed Reality (MR) Technologies for Remote Education and Training on Transrectal Ultrasound Biopsy (TRUS-Bx) Simulation: A Prospective, Randomized, Crossover Study

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Introduction: Mixed reality (MR) superimposes two simultaneous video feeds enabling remote instruction directly onto a trainee's view. Prior comparative studies have demonstrated the potential for MR in surgical training. Using a validated transrectal ultrasound biopsy (TRUS-Bx) hydrogel model, we sought to evaluate the efficacy of MR-based remote instruction relative to that of in-person (IP) instruction.

Methods: 19 pre-clinical medical students were recruited to complete a TRUS simulation crossover study where guidance was randomized into either MR-first or IP-first groups. The students reviewed pre-learning material prior to TRUS-Bx. Each student completed a pre-test, two training sessions utilizing one modality, mid-test, two training sessions of the opposite modality, and post-test. During test sessions, participants independently measured the prostate and obtained 14 biopsies on a hydrogel model with individually-colored biopsy regions. Accuracy was defined as the percentage of core with the corresponding color for the given biopsy region. During training sessions participants were guided through a TRUS-Bx on single-colored models. MR sessions utilized Zoom to transmit the ultrasound view to the instructor and Vuzix smart glasses to display the superimposed view of the surgical field with the remote instructor's guidance to the participant [Figure 1A-B]. This allowed the instructor to directly annotate on the ultrasound view while guiding trainees with the merged surgical view. Post-training surveys assessed trainee perceptions of the session.

Preliminary Results: Pre-test core percentages were similar between groups (MR-first: 23.6%, IP-first: 29.0%). Performance on the mid-test following the first two training sessions showed significant improvement (MR-first: 64.8%, IP-first: 58.2%). Post-test core percentages also showed significant improvement in performance from both pre-test and mid-test (MR-first: 79.9%, IP-first: 75.9%) with similar net improvement in core percentages between groups (MR-first: 56.3%, IP-first: 46.9%) [Figure 1C]. Participants found remote training with MR not to interfere with learning.

Next Steps: Remote instruction using MR technology provided equivalent learning to in-person simulation instruction. This technology has the potential for cross-institutional training.