Mixed Reality

- The Impact of Virtual-, Augmented- and Mixed Reality during Preoperative Informed Consent: A Systematic Review of the Literature
- Super-resolution for localizing electrode grids as small, deformable objects during epilepsy surgery using augmented reality headsets
- Augmented Reality for Identification of Temporal Bone Anatomy and Comparison to Conventional Imaging
- Mapping the use of extended reality (XR) in radiation oncology education: a scoping review protocol
- Evaluation of augmented reality guidance for glenoid pin placement in total shoulder arthroplasty
- Discrepancy between MRI and intraoperative findings in a rare intramedullary epidermoid cyst: A case report and literature review
- Patient-centered insights into virtual reality rehabilitation for stroke: a systematic review and qualitative meta-synthesis
- Minimal invasive vertical hemispherotomy in a 2.5-month-old infant with hemispheric Sturge-Weber Syndrome and recurrent status epilepticus using neuronavigation and augmented reality support

Mixed Reality (MR) technology has opened new avenues for planning, visualization, and education in surgery. Neurosurgical diseases require a very clear understanding of the relationships between pathology and critical neurovascular structures. The decline in cadaveric dissections and resource constraints has pushed educators to find newer ways of rendering the same knowledge. The aim of the study was to determine the feasibility of employing an MR device in a high-volume center for neurosurgical teaching. The study also evaluated the results of the trainee experience in using the MR platform.

3 neurosurgical consultants who are part of the teaching faculty were asked to facilitate the session. No prior training on utilizing the MR device was given to the trainees. HoloLens 2 was used as the MR device. 2 questionnaires were used to understand the experience of the trainees.

Results: 8 active neurosurgical trainees who are currently training at our institution were recruited for the purposes of this study. Despite having no prior training on an MR platform, the learning curve was short for most of the trainees. Whether MR replaces current traditional methods of teaching neuroanatomy, the response was divided among the trainees. The results of the User Experience Questionnaire (UEQ) were positive with the trainees finding the device attractive, dependable, novel, and user-friendly.

Conclusion: This study demonstrates the feasibility of using the MR platform in neurosurgery training without significant preparation requirements. This data is required to justify future investment in this technology for training institutions [1)].

In neurosurgery, it is important to inspect the spatial correspondence between the preoperative medical image (virtual space), and the intraoperative findings (real space) to improve the safety of the surgery. Navigation systems and related modalities have been reported as methods for matching this correspondence. However, because of the influence of the brain shift accompanying craniotomy, registration accuracy is reduced. In a study, to overcome these issues, Koike et al. developed a

spatially accurate registration method of medical fusion 3-dimensional computer graphics and the intraoperative brain surface photograph, and its registration accuracy was measured.

The subjects included 16 patients with glioma. Nonrigid registration using the landmarks and thin-plate spline methods was performed for the fusion 3-dimensional computer graphics and the intraoperative brain surface photograph, termed mixed-reality computer graphics. Regarding the registration accuracy measurement, the target registration error was measured by two neurosurgeons, with 10 points for each case at the midpoint of the landmarks.

The number of target registration error measurement points was 160 in the 16 cases. The target registration error was 0.72 ± 0.04 mm. Aligning the intraoperative brain surface photograph and the fusion 3-dimensional computer graphics required ~10 minutes on average. The average number of landmarks used for alignment was 24.6.

Mixed-reality computer graphics enabled highly precise spatial alignment between the real space and virtual space. Mixed-reality computer graphics have the potential to improve the safety of the surgery by allowing complementary observation of brain surface photographs and fusion 3-dimensional computer graphics [2].

1)
Jain S, Timofeev I, Kirollos RW, Helmy A. Use of Mixed Reality in Neurosurgery Training: A Single Centre Experience. World Neurosurg. 2023 May 2:S1878-8750(23)00591-0. doi: 10.1016/j.wneu.2023.04.107. Epub ahead of print. PMID: 37141939.

2)
Koike T, Kin T, Tanaka S, Takeda Y, Uchikawa H, Shiode T, Saito T, Takami H, Takayanagi S, Mukasa A, Oyama H, Saito N. Development of Innovative Neurosurgical Operation Support Method Using Mixed-Reality Computer Graphics. World Neurosurg X. 2021 Mar 13;11:100102. doi: 10.1016/j.wnsx.2021.100102. PMID: 33898969; PMCID: PMC8059082.