Compensation of Navigation Inaccuracies with the Aid of Microscope Integration

BRAINLAB

Bopp et al. (2022), in *Sensors*

Products
Cranial Navigation, Microscope Navigation, Elements Image Fusion, Elements Object Management, Automatic Image Registration (AIR)

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Clinical Background
Neuronavigation has become an integral part of cranial procedures. However, the potential benefits require high registration and navigation accuracy. Even if the initial registration accuracy is high, intraoperative mechanical impact as well as brainshift or simply continuous resection will lower the accuracy. Therefore, it is essential to repeatedly verify and update patient-to-image registration. For this purpose, next to intraoperative MR or ultrasound, Brainlab Microscope Navigation update is a quick and easy option to achieve this. A maximum intensity projection or pre-segmented objects and prominent structures are superimposed with augmented reality (AR) on the patient's in-situ anatomy. The accuracy is either verified or inaccuracies are corrected as needed.

Study Objective
The aim of this study was to investigate the capability of Microscope Navigation to evaluate (= verify and update) intraoperative registration and navigation accuracy using AR-overlays of anatomical landmarks and/or cortical vascular structures and/or cortex representations.

N = 293 consecutive patients, case series, single surgeon setting

Results
Accuracy verifications were performed:

1. immediately after microscope calibration before durotomy using anatomical landmarks, or
2. after durotomy using cortical vascular structures, or
3. using cortex representations (if no vascular but 3D MRI data was available)

Anatomical landmarks:
- Verification successful in all 85 cases
- Misalignment corrected in 2/2
- Ø correction (6.27 ± 7.31 mm)

Cortical vascular structures:
- Verification successful in all 242 cases
- Misalignment corrected in 43/43
- Ø correction (3.00 ± 1.93 mm, 0.38° ± 1.06°)

Cortex representations:
- Verification successful in all 40 cases
- Misalignment corrected in 2/2
- Ø correction (5.31 ± 1.57 mm, 1.75° ± 2.47°)

Summary
- **AR overlay facilitated quick and easy detection of inaccuracies**, making misalignments in prominent structures easy to detect with the eye
- **100% successful corrections of detected misalignment** with the limitation that the z-axis was not measured. If there was an inaccuracy, it was of non-negligible extent (see mean correction in Results)
- The authors conclude "**fast, valuable and straightforward tool**"
- Registration accuracy was overall good

Source: Bopp et al. (2022): DOI: 10.3390/s22249591, in *Sensors*, 22(24)