Stereotactic Accuracy of a Compact, Mobile Intraoperative MRI

Michael Schulder MD; Sussan J Salas MD; Daniel J Markowitz BA; Dishen Lin BS; Nina Kohn MA
Department of Neurosurgery, Northwell Health, Manhasset, NY, USA
Hofstra Northwell School of Medicine, Hempstead, NY, USA
Feinstein Institute for Medical Research, Manhasset, NY, USA

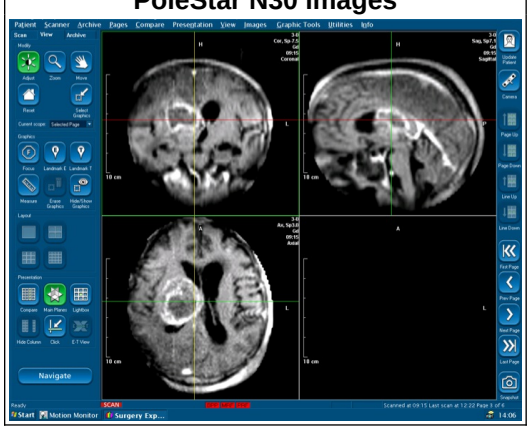
CNS 2016 ANNUAL MEETING
San Diego CALIFORNIA
SEPTEMBER 24-28, 2016

Introduction

Intraoperative imagers provide neurosurgeons with real-time information required to maintain precise navigation during surgery. In this study, we assessed the stereotactic accuracy of a compact, 0.15 Tesla (T) intraoperative magnetic resonance imager (iMRI).

PoleStar N30 iMRI

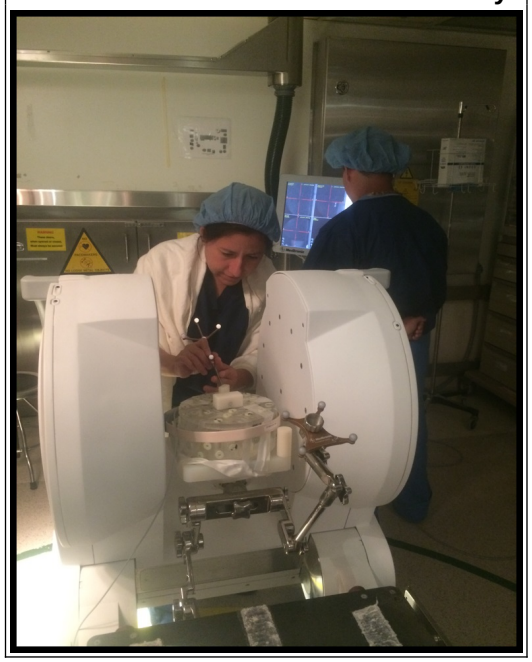
PoleStar N30 images



Methods

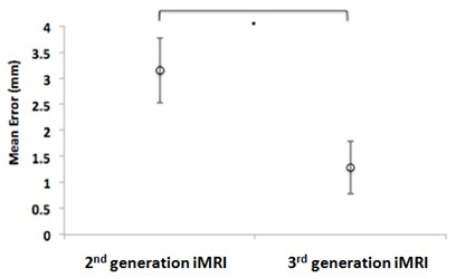
Images were acquired using a water-filled phantom model of the brain. The phantom was scanned using T1-weighted, T2-weighted, PSIF, and FLAIR sequences. Data collected with the new, 3rd generation iMRI were compared with those obtained in a previous study assessing the the 2nd generation model of this iMRI system. Additionally, the stereotactic accuracy of the new system was measured against that of standard surgical navigation on a 1.5T diagnostic scan MRI using T1 weighted images (with the same water phantom).

Measurement of stereotactic accuracy



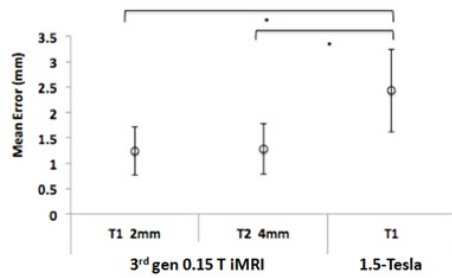
Results

Stereotactic accuracy of the PoleStar integrated surgical navigation tool on T2-weighted images



T2-weighted images acquired with the 3rd generation iMRI yielded a lower navigation error than those obtained with the 2nd generation iMRI (1.28 +/- 0.49 mm vs. 3.15 +/- 0.63 mm at the 95% CI, $p < 0.0001$).

Stereotactic accuracy of the PoleStar N30 integrated navigation tool vs. "standard" surgical navigation



Navigation with the 3rd generation iMRI was more accurate than that using diagnostic MRI. Mean error with the the 3rd generation device using T1W images was 1.24 +/- 0.47 mm and 1.28 +/- 0.49 mm with T2W images, vs 2.43 +/- 0.81 mm for navigation based on T1W images from the 1.5 T scan (95% CI, $p = 0.016$ and 0.001, respectively). This higher degree of accuracy with iMRI-based navigation may reflect the ability to bypass the registration that is needed when employing a scan acquired before surgery, a step that introduces another source of error into the process.

Conclusions

A high degree of stereotactic accuracy can be achieved with a compact, low field iMRI. Improvements in magnet design can yield progressive increases in accuracy, validating the concept of these devices designed for use during intracranial surgery. Avoiding the need for registration between image and surgical space also can increase navigation accuracy.

References

Schulder M, Liang D, Carmel PW: Cranial surgery navigation aided by a compact intraoperative magnetic resonance imager. J Neurosurg 2001;94:936-945.

Schulder M, Sernas TJ, Carmel PW: Cranial surgery and navigation with a compact intraoperative MRI system. Acta Neurochir Suppl 2003; 85:79-86.

Senft C, Franz A, Vatter H, Gasser T, Seifert V: Intraoperative MRI guidance and extent of resection in glioma surgery: a randomised, controlled trial. Lancet Oncol 2011;12:997-1003.