

Validation of Preoperative Fibertracking after Intraoperative MRI-based Elastic Fusion



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Products

Elements Image Fusion, Elements Fibertracking, Elements Virtual iMRI

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Clinical Background

DTI-tractography (Elements Fibertracking) enables visualization of eloquent white matter pathways and plays a major role in cranial tumor resection planning to preserve motor and language function. However, inaccuracies due to brain shift may impair the ability of neurosurgeons to localize fiber tracts during surgery. Intraoperative MRI (iMRI) is considered most reliable to compensate for brain shift, entailing relevant technical limitations and high failure rate for DTI data analysis. Therefore, preoperative fibertracking (FT) can be combined with iMRI using conventional rigid fusion (RF). As RF can cause spatial inaccuracies, a novel method of elastic fusion (Elements Virtual iMRI), developed to compensate for brain shift, could be applied to facilitate more precise neuronavigation.

Study Objectives

Aim of the study was to evaluate the accuracy of preoperative FT adjusted by Elements Virtual iMRI compared to rigid fusion with gold standard intraoperative FT.

N = 17 supratentorial brain tumor patients, single center retrospective study

Results

Spatial overlap index (Dice coefficient / DICE) and average surface distance (ASD) of pre- and intraoperative FT after Elements Virtual iMRI compared to RF in the operated hemisphere:

- **Motor pathway (CST*):**
 - DICE: +0.09 max. ($p < 0.001$)
 - ASD: -0.5 mm max. ($p < 0.001$)
- **Language pathway (AF**):**
 - DICE: +0.03 max. ($p = 0.012$)
 - ASD: -1.0 mm max. ($p = 0.012$)

*CST: corticospinal tract

**AF: arcuate fascicle

Summary

- Preoperative Elements Fibertracking adjusted by Elements Virtual iMRI can be considered a **reliable alternative to intraoperative FT**
- When **compared to RF**, preoperative **Elements Fibertracking with the adjustment of Elements Virtual iMRI** shows consistent and **noticeable improvement** in localization **accuracy** in the surgical area
- Elements Virtual iMRI is a method to **adjust preoperatively visualized fiber tracts to intraoperative changes** such as brain shift and the presence of resection cavities