

DTI Analysis: Tumor Impact on Language Related White Matter Tracts

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Introduction

Aims:

- Characterize pathological changes localized to language related white matter tracts caused by brain neoplasms through a diffusion tensor imaging-derived tractography approach (DTI).
- Identify clinically relevant biomarkers that can ultimately aid physicians in diagnosis, management and treatment of brain neoplasms.

Hypothesis:

- We anticipate that brain neoplasms will disrupt ipsilesional language related white matter tracts with respect to the contralesional hemisphere.

Rationale:

- DTI is often used as an aid in resection of brain tumors. More research is needed to characterize the effect of brain tumors on local language related white matter tracts.

Introduction:

- Language related white matter tract bundles: arcuate fasciculus (AF), extreme capsule (EC), inferior frontooccipital fasciculus (IFOF), inferior longitudinal fasciculus (ILF), uncinate fasciculus (UF).
- Intra-axial brain tumors are often adjacent to motor and language related white matter tracts causing difficulties in tumor management and resection.
- DTI is a non-invasive method used to characterize structural and functional effects of primary and secondary brain neoplasms on surrounding tracts.
- DTI provides information on white matter tracts that is used by neurosurgeons to aid in resection while sparing function.

Methods: Tractography and Volumetric Pipeline

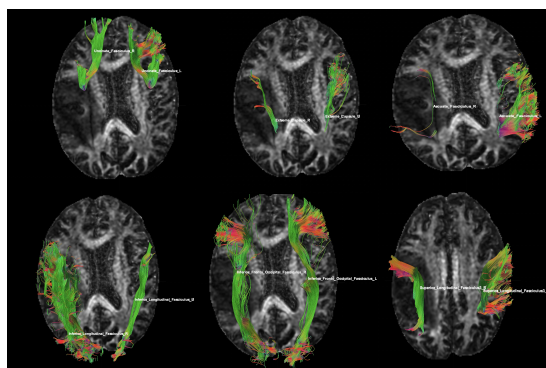


Figure 1. Extraction of language related white matter tracts. Example of the ipsilateral and contralateral language related white matter tracts from a patient with a brain neoplasm. Tracts are superimposed onto the fractional anisotropy (FA) map.

Results: Tract Count Comparison and Spearman Correlation

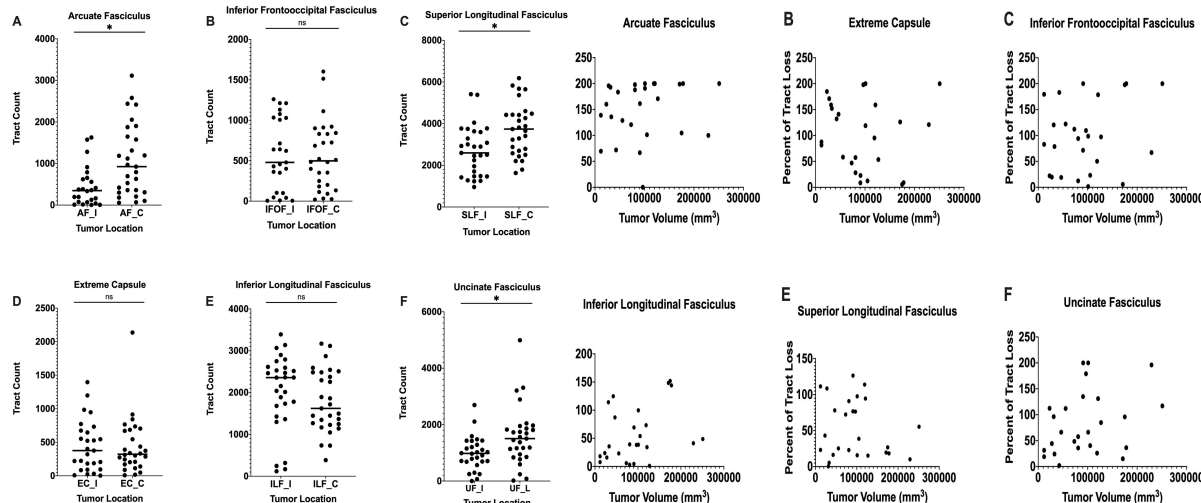


Figure 2. Paired t-test comparing ipsilesional and contralesional tract counts. A-F) Median language tract count (horizontal black line) is plotted with scatter shown as data points for each group. P-values are 0.028, 0.989, 0.013, 0.689, 0.213, and 0.019, respectively. * = significance, ns = not significant

Analysis:

Processing Pipeline:

- Tract Count analysis: n = 29; Correlation: n=26
- Step 1: Language tract extraction (DSI studio)
- Step 2: Tumor segmentation, Masks (ITK-SNAP, version 3.8)
- Step 3: Volumetric Analysis (ITK-SNAP)
- Statistical analysis: paired t-test comparing tract count in two groups, ipsilesional and contralesional. Spearman Correlation of tumor volume (mm³) versus percent of tract loss (Prism 8).

Discussion

Tract Count Differences between groups:

- Significant differences in tract count were observed for AF, SLF, and UF among both groups. No significant difference was observed for IFOF, EC, and ILF.

Percent of Tract Loss as a Function of Tumor Volume:

- No significant correlation was observed for percent of tract lost as a function of tumor volume.

Significance:

- Preferential effects for AF, SLF, and UF may indicate a spatial relationship and intrinsic behavior specific to primary or secondary brain tumors.

- Correlation data suggest that tumor volume may not contribute to degree of tract loss.

Improvements:

- Increase sample size.
- Refine segmentations of brain neoplasms.

Future Directions:

- Incorporate DTI coefficients, tract geometry, and network parameters in analysis.

References

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