Three-Dimensional Topographical Fiber Tract Anatomy of the Cerebrum

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Introduction

Subcortical white matter fiber tracts may be a more important determinant of resection limits than the cerebral cortex. Knowledge of 3D anatomical organization of fiber pathways is crucial to plan safe, accurate surgery for cerebral lesions.

Methods

25 formalin-fixed human brains and 4 whole cadaveric heads were examined by fiber dissection technique and X6-X40 magnification. Fiber tracts and central structures, including insula and subcortical grey matter of basal ganglia were examined and their relationships photographed in 3D. Depth between the surface of the cortical gyri and selected fiber tracts was measured.

Results

Topographical relationships of the important association, projection, and commissural fasciculi within the cerebrum and superficial cortical landmarks were identified. For instance, the inferior fronto-occipital fasciculus passes deep to the middle frontal gyrus (3.0±0.8cm deep from surface), insular cortex (0.6±0.2cm deep), superior and midde temporal gyri (2.4±0.8cm deep), and occipital gyri (3.3±0.42cm deep). Important landmarks with consistent relationships to the fiber tracts were the cortical gyri and sulci, limiting sulci of the insula, nuclear masses in the central core, and lateral ventricles. The fiber tracts were also organized in a consistent pattern in relation to each other. The anatomical findings are briefly compared with functional data from clinical-radiological analysis and intraoperative stimulation of the white matter.

Conclusions

An understanding of the 3D anatomical organization of the fiber tracts of the brain is essential to planning safe and accurate cerebral surgery.

Learning Objectives

To examine the topographical anatomy of white matter fiber tracts and subcortical grey matter of the human cerebrum and their relationships with consistent cortical, ventricular, and nuclear landmarks.

References

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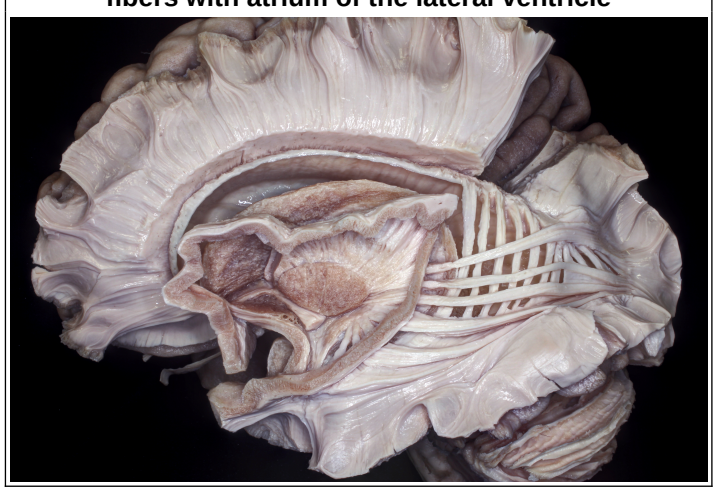
Schmahmann JD, Pandya DN. Fiber pathways of the brain. Oxford, New York: Oxford University Press; 2006;393-409, 501-530.

The relationship of the optic radiation and tapetal fibers with atrium of the lateral ventricle



Location of the fiber tracts in coronal section