Anatomy and White Matter Connections of the Orbitofrontal Gyrus

Joshua Dee Burks; Phillip A Bonney MD; Andrew K.P. Conner MD; Chad A Glenn MD; Robert G Briggs BS; Lillian B Boettcher BA; Daniel L O'Donoghue; Dee H Wu; Michael Edward Sughrue MD

Department of Neurosurgery, University of Oklahoma Health Sciences Center, Oklahoma City, OK

Learning Objectives

By the conclusion of this session, participants should be able to 1.) Describe important functional/cognitive considerations of operating in the orbitofrontal cortex. 2.) Describe the key connections of the orbitofrontal cortex to other regions of the cerebrum. 3.) Describe the fiber bundles responsible for these connections, and their spatial relationship to other well known cerebral structures

Methods

Diffusion imaging from the Human Connectome Project for 10 healthy adult controls was used for tractography analysis. We evaluated the orbitofrontal cortex as a whole based on connectivity with other regions. All orbitofrontal cortex tracts were mapped in both hemispheres, and lateralization index was calculated with resultant tract volumes. Ten postmortem dissections were then performed using a modified Klingler technique to demonstrate the location of major tracts.

Introduction

The orbitofrontal cortex is understood to have a role in outcome evaluation and risk assessment, and is commonly involved by infiltrative tumors. A detailed understanding of the exact location and nature of associated white-tracts could go far to prevent post-operative morbidity related to declining capacity. Through DTI-based fiber tracking validated by gross anatomical dissection as ground truth, we have characterized these connections based on relationships to other well-known structures.

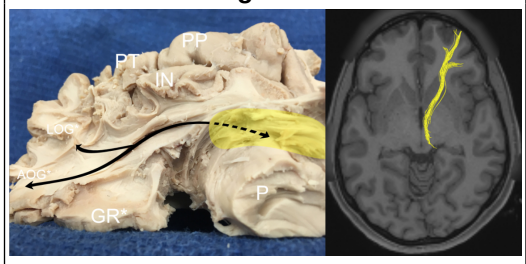
Results

We identified three major connections of the orbitofrontal cortex: a bundle to the thalamus and anterior cingulate gyrus passing inferior to the caudate and medial to the vertical fibers of the thalamic projections; a bundle to the brainstem traveling lateral to the caudate and medial to the internal capsule; and radiations to the parietal and occipital lobes traveling with the inferior fronto-occipital fasciculus. There was no significant lateralization for any of the tracts described.

Conclusions

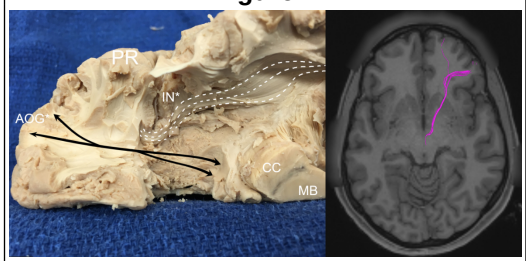
The orbitofrontal cortex is an important center for processing visual, spatial, and emotional information. Subtle differences in executive functioning following surgery for frontal lobe tumors may be better understood in the context of the fiber-bundle anatomy highlighted by this study.

Figure 1



Tractography and fiber-tract dissection showing connections between the orbitofrontal gyri and the mediodorsal nucleus

Figure 2



Tractography and fiber-tract dissection showing connections between the orbitofrontal gyri and the brainstem