Cortical connections of the basal-ganglia: A Probabilistic Diffusion Tractography study

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Abstract

Previous anatomical studies differentiated multiple striatal circuits in animals and suggested that anatomical sub-components of the striatum, although functionally related, project to distinct cortical areas. To investigate striatal pathways also in humans, we applied Diffusion Tensor Imaging (DTI) tractography, an innovative imaging approach which allows fiber tracking in white matter and studying brain tissue structure in vivo. Understanding the segregation of has important functional implications for models of basal ganglia function.

Experiment

We acquired DTI data on 6 healthy subjects. In the first part of this study, probabilistic fiber tracking was initiated from the putamen and caudate defined three-dimensionally on the subject's T1-weighted image using atlas warping techniques, and displayed in a population map in MNI standard stereotaxic space. In the second part of the study, we performed a connectivity based seed classification analysis on the putamen and caudate.

Results

Study 1: Tractography

Putamen: Reconstructed fiber tracts projected ipsilaterally to the prefrontal cortex, primary motor area, primary somato-sensory area, SMA and premotor area. **Caudate**:

Reconstructed fiber tracts projected ipsilaterally to the prefrontal cortex, superior temporal gyrus, FEF and thalamus.

Study 2: Connectivity based seed qualification

Putamen: A connectivty based seed qualification showed connections from the SMA to dorsal-posterior putamen, from premotor areas to medial putamen, and from the primary motor areas to the lateral putamen.

Caudate: A connectivity based seed qualification showed connections from the DLPFC to dorsal-posterior caudate and from the VLPFC to the ventral anterior caudate.

Conclusions: Reconstructed fiber tracts of the caudate and putamen projected to distinct cortical areas. Dorsal-posterior parts of the caudate were predominantly connected with the DLPFC and ventral anterior were interconnected with the VLPFC. Dorsal-posterior parts of the putamen were predominantly interconnected with the SMA, medial parts of the putamen with premotor areas, and the lateral putamen with primary motor areas. These results are in accordance with previous studies in nonhuman primates.