# Connectivity-based probabilistic parcellation of the striatum in human brain by diffusion tensor imaging

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**Introduction:** The striatum is a part of the basal ganglia, composed of the caudate and the putamen. Previous studies in non human animals have revealed that cortical areas project to the striatum with distinct patterns of anatomical connectivity, but it is difficult to prove in human brain in vivo. Diffusion tensor imaging (DTI) is a new technique that allows demonstration of fiber tracts in vivo in humans [1]. The aim of the study is to investigate the corticostriatal connections in the human brain by DTI, and to define the location of projections from the different cortex to the striatum with automated probabilistic tractography.

**MATERIALS AND METHODS**: Diffusion weighted images and T1 images were acquired in 6 healthy volunteers (3.0T Siemens sonata, 12 diffusion directions, b=1000 $smm^{-2}$, 36 slices, thickness 3mm). Image analysis used by FDT toolbox of FSL software (www.fmrib.ox.ac.uk/fsl), the different cortex and the striatum masks generated by WFU_PickAtlas toolbox in Matlab and SPM (www.fil.ion.ucl.ac.uk/spm), including the frontal, parietal, temporal, occipital, insular lobes, especially the motor cortex such as M1, supplement motor area (SMA) and premotor cortex (PMC) were selected. The T1 images were registered to the ICBM152-T1 template then the diffusion space transferred to the standard space. The striatum masks served as seeds for probabilistic tractography with each target mask, and the striatum seeds were classified according to the target mask with which they show the highest probability of connection.

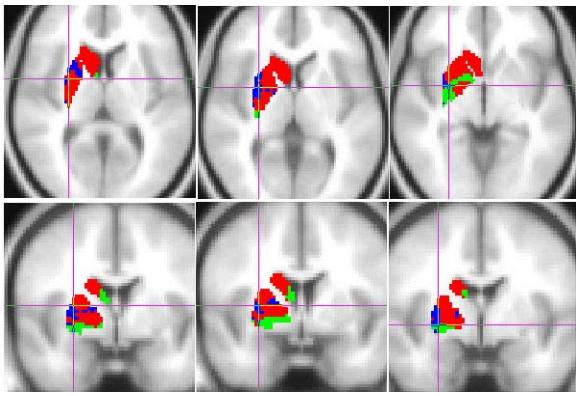

Fig.1 showed the frontal (red) and insular projections (blue), the temporal, parietal and occipital projections (green) overlapped on axial (up) and coronal (low) sections

**RESULTS:** The automated parcellation of the striatum according to their probability of connections with the different cortical target masks resulted in clearly distinct location in the striatum with specific spatial distribution. The frontal projections were located to the head of the caudate nucleus and the superior part of the putamen, the insular projections to the lateral striatum, the projections from the parietal, temporal and occipital lobes overlapped to the posterior part and the inferior part of the striatum (Fig.1). The motor connectivity to the striatum was also defined, the M1 projections were connected to the posterosuperior part of the striatum, the SMA projections were connected to the middle part of the striatum, the PMC projections were connected to the anterior and posteroinferior parts of the striatum (Fig.2a). Probabilistic tractography displayed the fibers from M1, PMC and SMA to the striatum (Fig.2b).

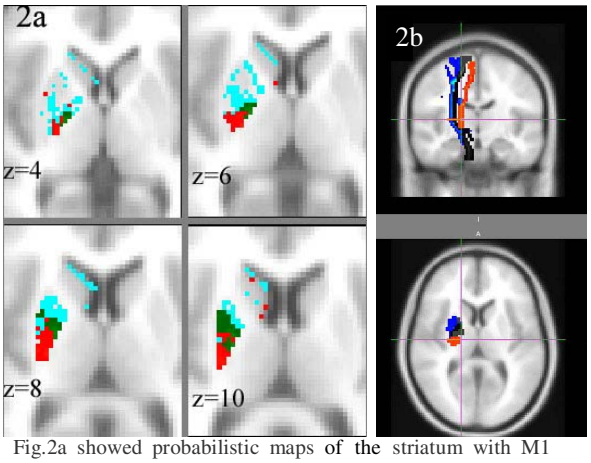


Fig.2a showed probabilistic maps of the striatum with M1 (red), PMC (green) and SMA (cyan) on axial sections.
Fig.2b Showed probabilistic tractography of the striatum with M1 (red), PMC (blue) and SMA (black).

**CONCLUSION:** These results showed that the human striatum have specific connections with the different cortex, and provided the direct demonstration of distinct corticostriatal connections in humans in vivo, which is consistent with previous report [2]. The diffusion tensor imaging is non-invasive method to human, connectivity-based probabilistic tractography by diffusion images can classify the seed voxels according to the target mask with which they show the highest probability of connection, and these differential connections usually are consistent with special function [3]. In conclusion, connectivity-based probabilistic tractography and parcellation is valuable in the functional anatomy of human brain, can identify the different sub-region of the human brain structures by virtue of their different probability of anatomical connectivity.

**References:** [1] Holmes AA, et al. Magn Reson Med, 2000; 44: 157-161. [2] Lehericy S, et al. Ann Neurol, 2004; 55:522–529 [3] Mori S, et al. Magn Reson Med, 2002; 47: 215-223.