CONNECTIVITY OF THE HUMAN PRIMARY MOTOR CORTEX USING PROBABILISTIC DIFFUSION TRACTOGRAPHY

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INTRODUCTION

- Previous studies demonstrated connections from primary motor cortex to various cortical and subcortical areas in nonhuman primates (Ref. 1, 2).
- In humans, anatomical studies are limited and often restricted to post mortem investigations.
- Advances in Diffusion Tensor Imaging (DTI) tractography now allows tracking fibers in the human brain in vivo
- We reconstructed cortical fiber tracts from a region within the primary motor cortex (handknob area) and compared them across subjects.

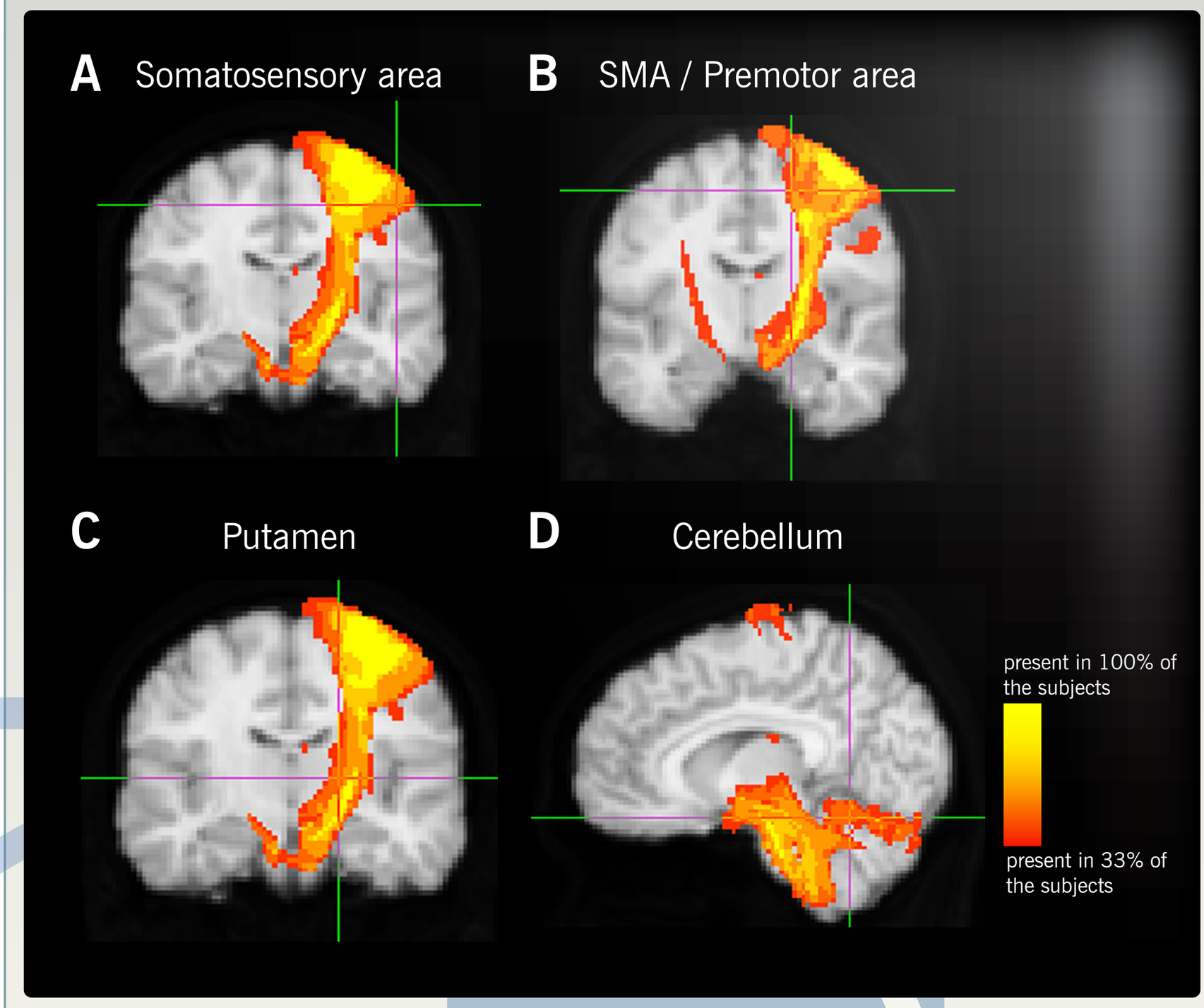
DATA ACQUISITION

- 1.5 Tesla MRI Sonata scanner (Siemens) using echo-planar imaging
- Repitition tIme: 9300ms
- Echo time: 94ms
- Flip angle: 90°
- Slice thickness = 2.2mm
- Number of Slices: 60
- In-plane resolution: 2.1875mm x 2.1875mm
- Acquisition time approximately 9:30 minutes
- Diffusion weighting along 60 independent directions
- b-value: 1000 s/mm^2
- Reference image with no diffusion weighting

IMAGE PROCESSING

- Raw DTI data corrected for motion and eddy currents
- Probability distribution function was estimated on the principial fiber direction at each voxel using Bayesian Techniques (Ref.3, 4)
- Probabilistic fiber tracking was initiated from the handknob area within the primary motor cortex
- Region of interest was identical in size across subjects and defined 3-dimensionally on the subject's T1-weighted image of the left hemisphere
- Tracts were registered to MNI standard stereotaxic space, thresholded, binarized and summed across subjects
- Results were displayed as a population map demonstrating tracts that were present in at least 33% of the subjects

RESULTS



Reconstructed fiber tracts of the handknob area project ipsilaterally to somatosensory (**A**; x=50, y=-16, z=50), to the supplementary (SMA) and premotor areas (**B**; x=16, y=-10, z=54), the putamen (**C**; x=20, y=-16, z=6) and the cerebellum (**D**; x=8, y=-56, z=-20).

CONCLUSIONS

- The handknob area of the primary motor cortex appears interconnected with several cortical and subcortical areas.
- We were able to demonstrate ipsilateral connections to the putamen, cerebellum, as well as the somatosensory, supplementary (SMA) and premotor areas.
- Obtained tracts were consistent across subjects.
- These results are in accordance with previous studies in nonhuman primates as well as in humans using repetitive magnetic stimulation (Ref. 1) and functional imaging (Ref. 2).

REFERENCES

(1) Rounis E et al. Frequency specific changes in regional cerebral blood flow and motor system connectivity following rTMS to the primary motor cortex. Neuroimage 2005; 26(1): 164-76.

(2) Zhuang J et al. Connectivity exploration with structural equation modeling: an fMRI study of bimanual motor coordination. Neuroimage 2005; 25(2): 462-70.

(3) Behrens T et al. Non-invasive mapping of connections between human thalamus and cortex using diffusion imaging. Nature Neuroscience 2003; 6(7): 750-7.

(4) Behrens T et al. Characterization and propagation of uncertainty in diffusion-weighted MR imaging. Magnetic Resonance in Medicine 2003; 50(5): 1077-88.

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