

Evaluation of Somatotopic Organization of Corticospinal Tracts in the Cerebral Peduncle: Results of Diffusion-Tensor MR

Tractography

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Purpose

Diffusion tensor MR imaging can depict white matter tract in the human brain. A recent study demonstrated the somatotopic organization of the corticospinal tract (CST) in the posterior limb of internal capsule (PLIC) using DTI, in which the hand fibers oriented anterolaterally to the foot fibers. The goal of our study is to depict the location and somatotopic organization of the CST in the cerebral peduncle (CP) using DTI.

Methods

We imaged the brains of 9 healthy right-handed subjects (4 males and 5 females: mean age 32 ± 7.4) with DTI at 1.5T MRI machine (Sonata, Siemens). DTI was achieved using a single shot echo planar sequence with 12 diffusion sensitized direction (TR/TE = 5300/100, NEX=3, b-value = 0, 1000s/mm², Fov=24cm, 128x128 matrix, 3mm thickness with no gap, covering from pons to high convexity). We also obtained anatomical T1, T2-weighted images and MPRAGE images, which were correlated with DTI images. DTI map and tractography were calculated using DTI task card version 1.7 (Magnetic Resonance Center, Massachusetts General Hospital, Boston, MA) on a Siemens scanner using MRI software Mrease. An angular threshold of 35 degrees and FA threshold of 0.3 were used. We used a two ROI approach: the first four ROIs from medial (preCG1) to lateral direction (preCG4) were placed on the left side precentral gyrus (identified by using known anatomic landmarks) (fig 1); the second ROI was in the area of left side PLIC (fig2). The tractography results were assigned color by use of the different color for the each tract. The location and somatotopical organization of CSTs at the level of CP were evaluated by using multiple projection views.

Results

All of the CSTs traversed the posterior third quarter of the PLIC, and the lateral aspect of cerebral peduncle. In the lateral aspect of CP, the fiber of CST distributed anterior to posterior direction. In all patients, the fibers of the CST were organized somatotopically with the hand fibers (preCG4-red color, preCG3-blue color) medial and slightly anterior to the foot fibers (preCG1, pink color, preCG2-yellow color) at the level of CP (figure3).

Discussion

The fibers of the CST traversed lateral aspect of CP with anterior-posterior direction. Unlike the PLIC, the hand fibers oriented medially and anteriorly, the foot fibers oriented laterally and slightly posteriorly, and surrounded the hand fiber.

Reference

Holodny, AI, 2005, Radiology, 234:649-653.

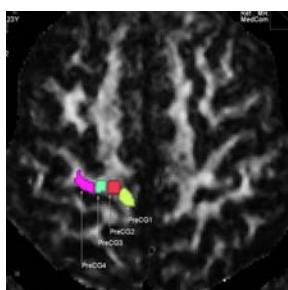


Fig 1, 4 ROIs at the precentral gyrus

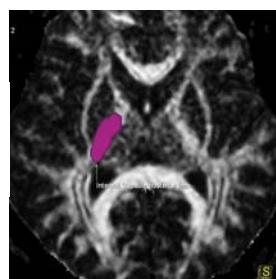


Fig 2. ROI at the PLIC

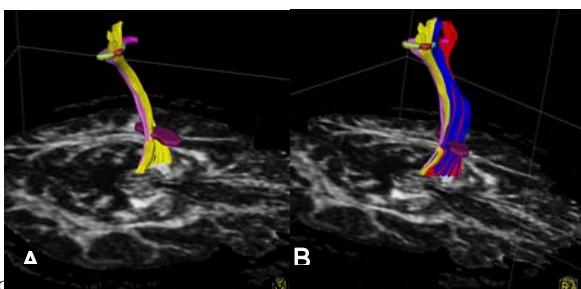


Fig 3 A, PreCG1 (pink), PreCG2 (yellow) Fiber at the CP

Fig3 B, PreCG1,2,3 (blue) and 4 (red) at the CP