STRUCTURAL CONNECTIVITY ANALYSIS OF THE PEDUNCULOPONTINE NUCLEUS REGION IN PARKINSONIAN SYNDROMS

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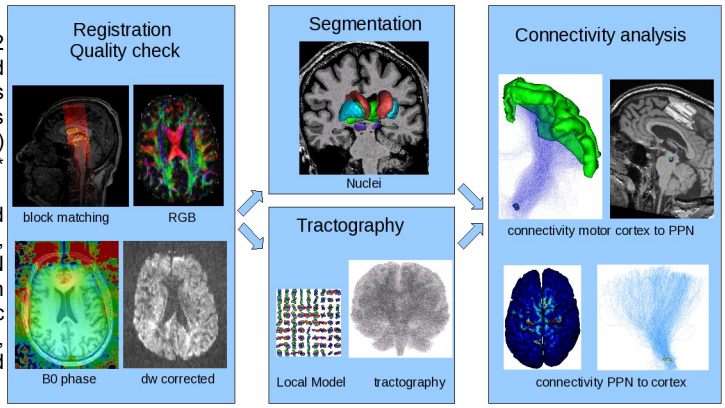
Introduction

Parkinsonian syndromes such as Parkinson's disease (PD) and Progressive supranuclear palsy (PSP) are neurodegenerative movement disorders. PD is the most common, being present in about 1% of the population above the age of 60 years[1]. PSP is rarer, and is characterized by gait and postural disturbance, gaze palsy, apathy, and dysexecutive symptoms[2]. Deep brain stimulation (DBS) of the pedunculopontine nucleus (PPN) has shown to be an effective therapy for gait palsy[3]. It has been shown that the PPN region plays an important role in locomotion in rodents, primates and cats[4,5]. Only few studies have investigated this issue in humans. These studies suggest that the PPN region would be an important relay in the circuitry that controls locomotor function[6]. Diffusion weighted imaging is a noninvasive method of brain imaging that would allow the characterization in vivo of the role of the PPN in locomotion in humans[7]. In the present study, we have combined structural and diffusion magnetic resonance imaging to investigate the connectivity of the PPN region in the Parkinsonian syndromes (PD and PSP).

Method and Data Analysis

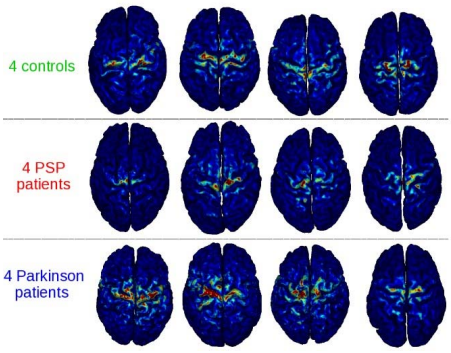
A total of 87 participants were recruited, including 45 patients PD, 12 patients PSP and 30 age-matched controls. The severity of gait and postural disturbance was assessed using clinical motor scales. Images were acquired using a 3T system (Trio Siemens) of the whole brain (images T1 1x1x1mm^3, T2 1x1x1mm^3, diffusion 60 directions b-value 1500s/mm²) and a high resolution 7T (Trio Siemens) of the brainstem (images T2* 0.6x0.6x0.6mm^3).

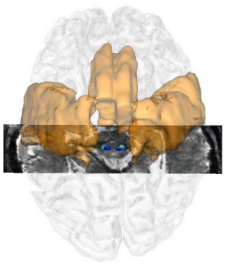
Data analysis was performed using BrainVISA/Connectomist-2.0 and FreeSurfer tools. Structural and diffusion-weighted data were coregistered, and corrected for susceptibility artifacts. The segmentation of the PPN region was done automatically[8] and validated by two independent experts in neuroanatomy. Whole brain tractography was obtained from a probabilistic streamline method based on an analytical Q-ball model. Finally, connectivity analysis between the cortex and the PPN region was carried out.



Preliminary Results

The figure below depicts the connectivity analysis results for the 3 groups of subjects, between the cortex and the PPN. The most connected regions are presented in red. These results corroborate the hypothesis that the PPN would be involved in the circuitry that controls locomotor function. Furthermore, we explored the possible topographical representation of the connectivity between the motor cortex and the PPN, which can help improving target localization in further DBS, for example.





axial view - topographical representation of connectivity between motor cortex (orange) and PPN left and right

Conclusion and future work

Preliminary results suggest that the method used in the present study can effectively show the topographical representation of the connections between PPN and the motor cortex. Currently, the same methods are applied to investigate the connectivity between the PPN and the cerebellum, thalamus and globus pallidus. Subsequently, correlation analyses will be carried out between the clinical data and the connectivity measures.

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