The Relationship between Diffusion Tensor Tractography and Cognitive Functioning in Parkinson's Disease

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Introduction

Cognitive impairment is a common non-motor manifestation of Parkinson's disease (PD). However, it is unknown whether PD-related cognitive declines are accompanied by neuroanatomic changes in white matter tracts connecting the basal ganglia to prefrontal and parietal cortices.

Diffusion Tensor Imaging (DTI) is a novel neuroimaging technique that estimates myelination *in vivo*. DTI utilizes the principle that water molecules tend to move faster along nerve fibers rather than perpendicular to them.

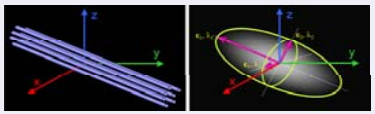


Figure 1: Schematic representation of diffusion displacement for the diffusion tensor.

Our objective was to investigate the neurobiological mechanisms of cognitive impairment in PD by evaluating the relationship between cognitive performance and quantitative DTI tractography.

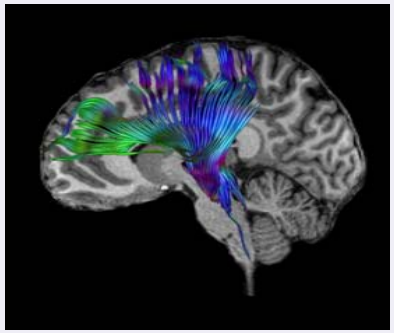
Methods

6 PD patients and 6 healthy controls (HC) were evaluated using neuropsychological evaluations and quantitative DTI tractography.

Table 1: Demographics

	PD	HC
Gender	67/33	50/50
Age	67.5 (4.3)	62.7 (7.2)
Education	12.8 (2.9)	15.7 (2.3)
H&Y off	2.0 to 3.0	NA

Fractional anisotropy (FA), apparent diffusion coefficient (ADC), axial diffusivity (AD), and radial diffusivity (RD) were analyzed for right and left anterior (RAIC, LAIC) and posterior limbs (RPIC, LPIC) of the internal capsules.

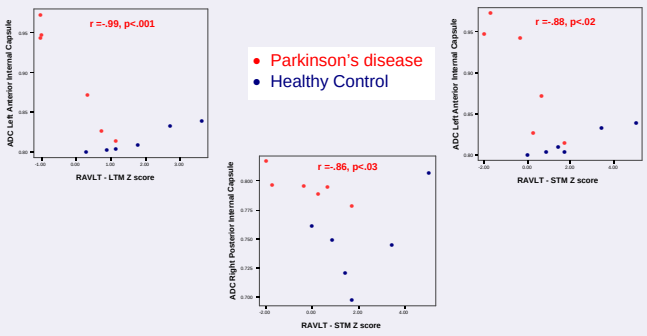


Results

A typical pattern of PD cognitive impairments was found, including deficits in mental status, verbal and nonverbal memory and executive functioning.

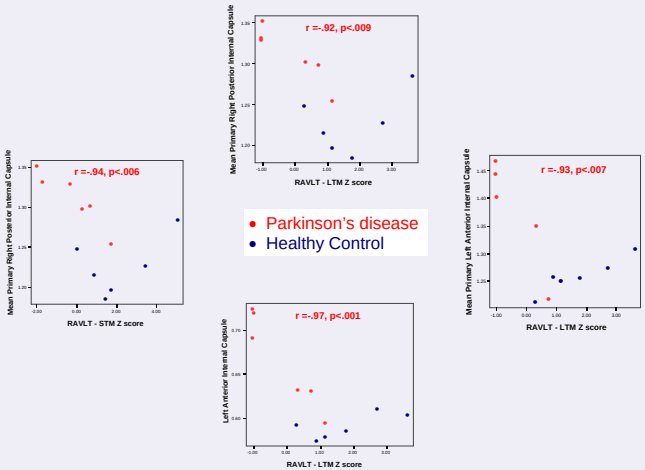
	ADC			AD			RD		
	PD	HC	p	PD	HC	p	PD	HC	p
RPIC	.80 (.01)	.07 (.03)	**.01**	1.31 (.03)	1.23 (.04)	**.002**	.54 (.01)	.51 (.04)	.10
LPIC	.81 (.04)	.77 (.03)	.07	1.34 (.05)	1.26 (.04)	**.01**	.55 (.03)	.53 (.03)	.35
RAIC	.90 (.09)	.83 (.04)	.11	1.35 (.10)	1.27 (.05)	.10	.67 (.09)	.61 (.04)	.15
LAIC	.90 (.07)	.81 (.03)	**.01**	1.35 (.10)	1.27 (.03)	**.05**	.67 (.05)	.59 (.01)	**.008**

In the RPIC and LAIC, ADC was significantly higher for the PD patients as compared to HC, and ADC was negatively correlated with verbal short-term (both) and long-term memory (LAIC) scores for the PD patients.



Results

AD was also significantly higher for PD patients versus HC, and was negatively correlated with verbal short-term (RPIC) and long-term memory (both) for the PD patients. RD was significantly higher in PD patients for the LAIC and was negatively correlated with verbal total learning, short-term and long-term memory scores for the PD patients.



Discussion

The right posterior internal capsule and the left anterior internal capsule demonstrated greater diffusion for PD patients compared to the controls.

Decreased integrity of these tracts was associated with lower scores on verbal short and long-term recall for the PD patients only.

These preliminary analyses suggest that Parkinson's disease related cognitive dysfunction may be accompanied by microstructure changes in white matter pathways connecting the affected structures.

Future research will incorporate larger sample sizes and analyses between cognitive impaired versus intact PD patients.

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