

Diffusion Tensor Tractography of the Internal Capsule Differentiates Stages of Cognitive Impairment in Parkinson's Disease



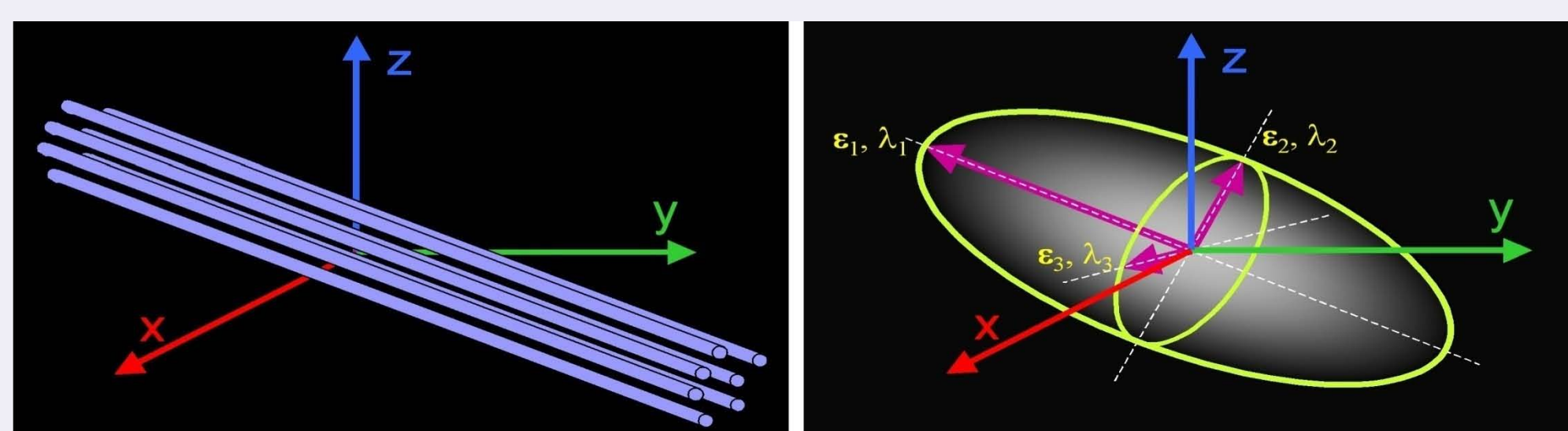
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BACKGROUND

Cognitive dysfunction, a prominent feature of Parkinson's disease (PD), is clinically heterogeneous and varies in the extent of decline across cognitive domains. Diffusion tensor imaging (DTI), which allows us to see brain white matter by measuring the shape and organization of the water molecules may be used to clarify the neural circuitry that is associated with PD-related cognitive decline. Decreased diffusivity in white matter tracks leading from the thalamus to the prefrontal and parietal cortices in PD may reflect direct damage or secondary degeneration due to disruption of white matter tracts.

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



Fractional anisotropy (FA) is determined by the thickness of the myelin sheath and of the axons. Apparent diffusion coefficient (ADC) is the average magnitude of the diffusion. Radial diffusivity (RD) is the mean of secondary and tertiary eigen values.

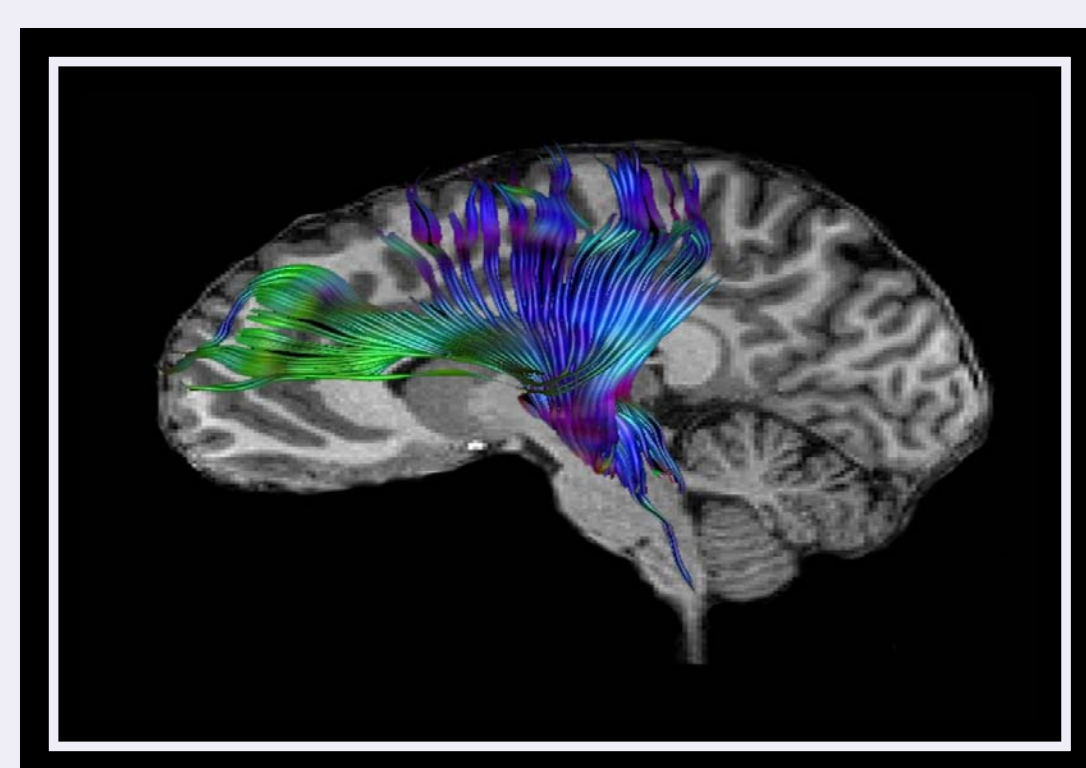
Objective: To investigate the association between DTI indices and memory and executive functioning, we used DTI tractography (DTI-t) and region of interest (ROI) analyses to dissect the clinical heterogeneity of PD-related cognitive impairment.

METHODS

Table 1: Demographics

	PD-I (n=8)	PD-MCI (n=6)	PDD (n=18)
Gender (M/F)	6/2	4/2	13/5
Age	70.1 (6.9)	62.0 (7.1)	70.5 (7.5)
Education	15.0 (1.6)	14.8 (3.2)	14.8 (2.7)
H&Y off	2.0 to 3.0	2.0 to 3.0	2.0 to 3.0

- **DTI Tractography (DTI-t):** FA, ADC, RD for right and left anterior and posterior limbs of the internal capsule.
- **DTI-Region of Interest (ROI):** Caudate and thalamus
- **Neuropsychological evaluation:** Rey Auditory Verbal Learning Test (RAVLT), Wisconsin Card Sorting Test (WCST), Stroop Color Word Test (Stroop), and Semantic Fluency

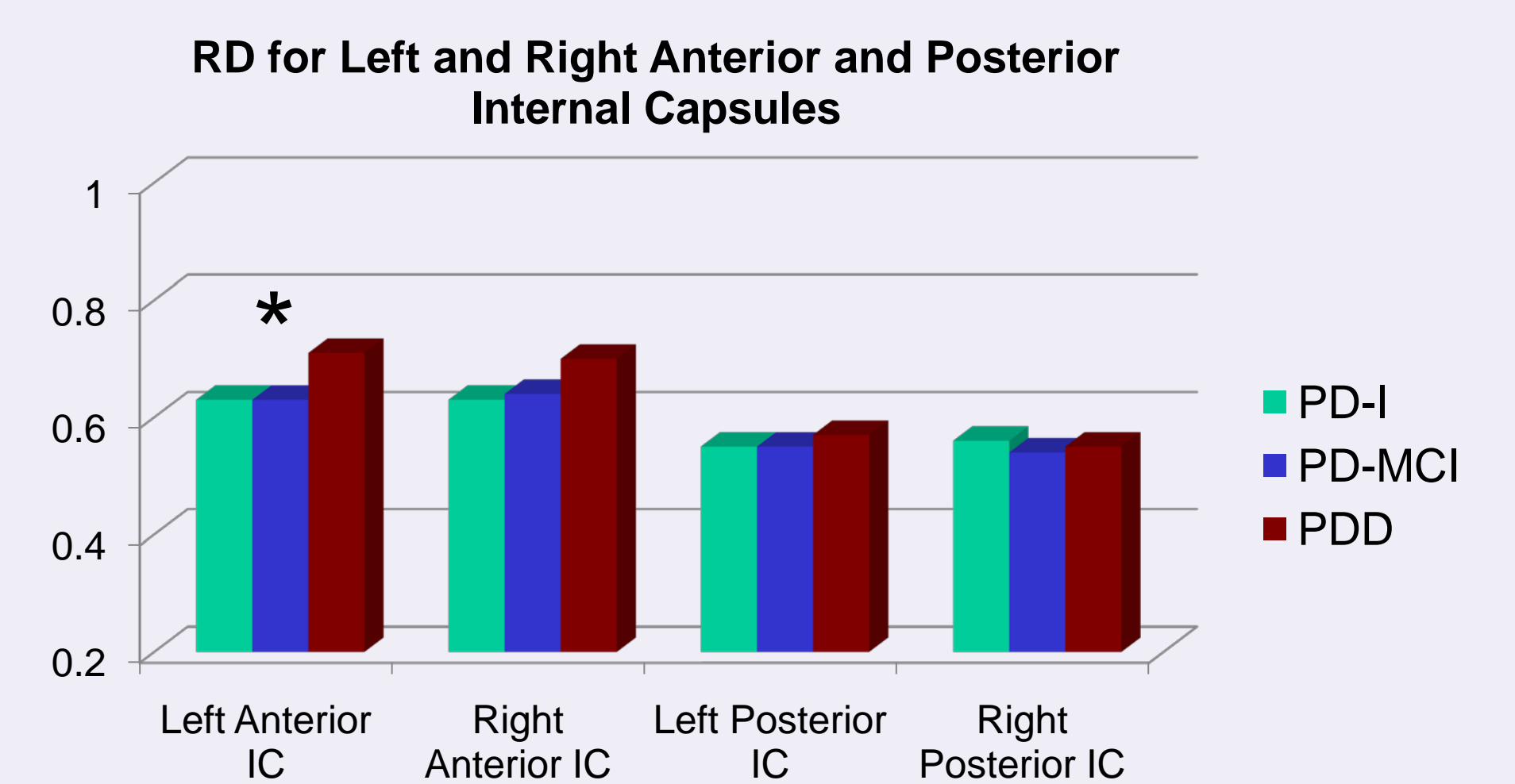
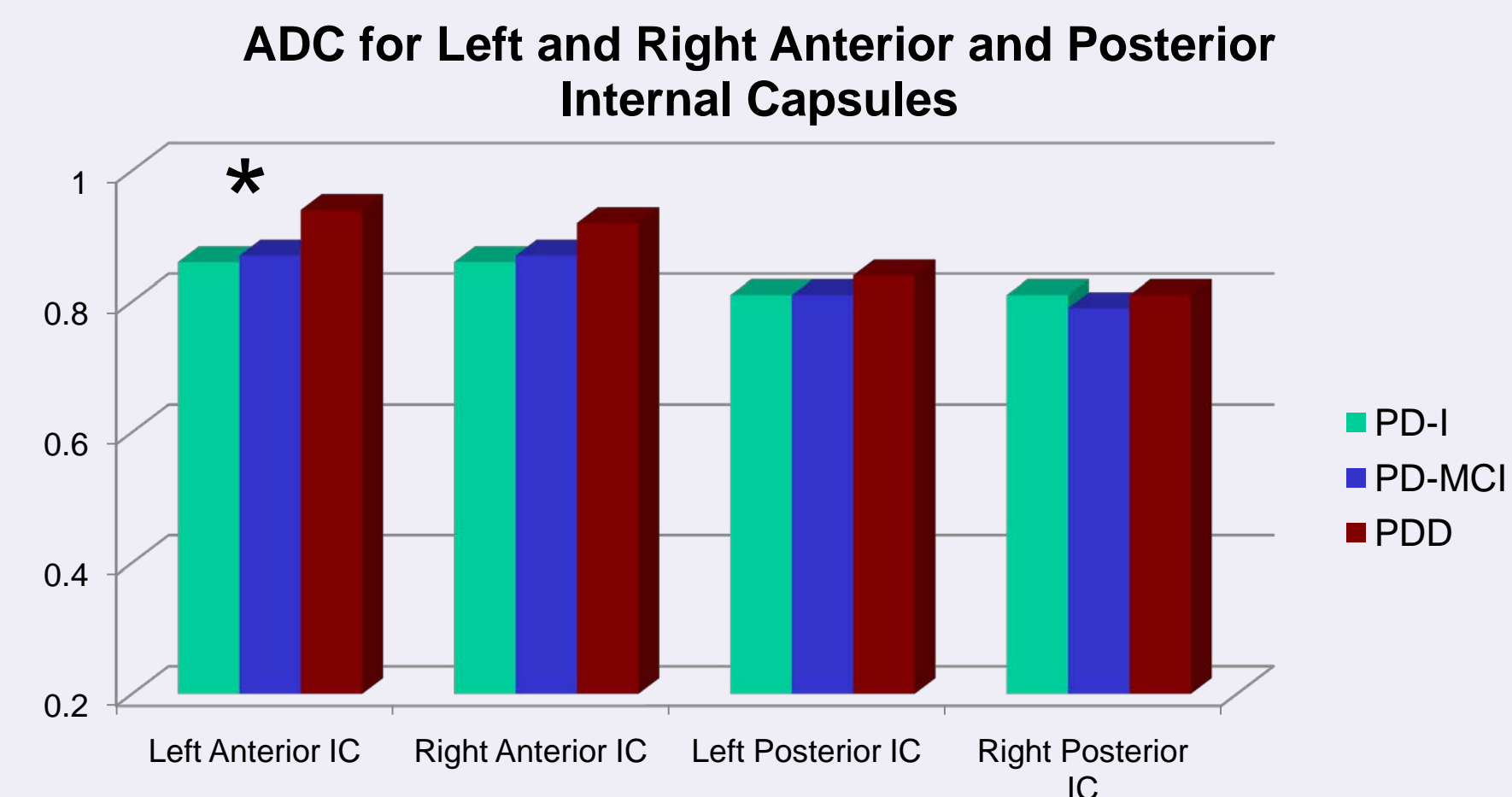
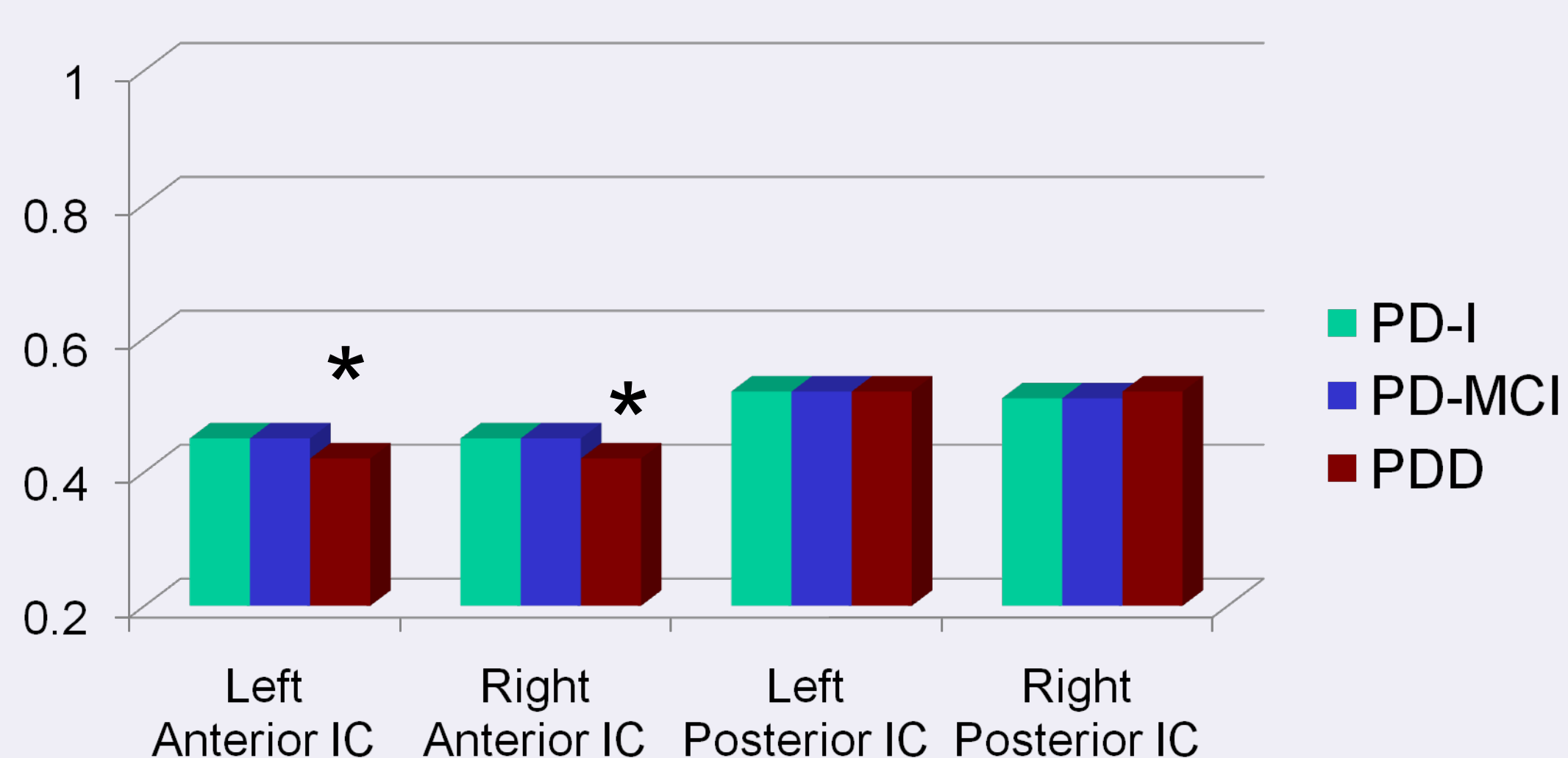


DTI Tractography of Anterior and Posterior Internal Capsules

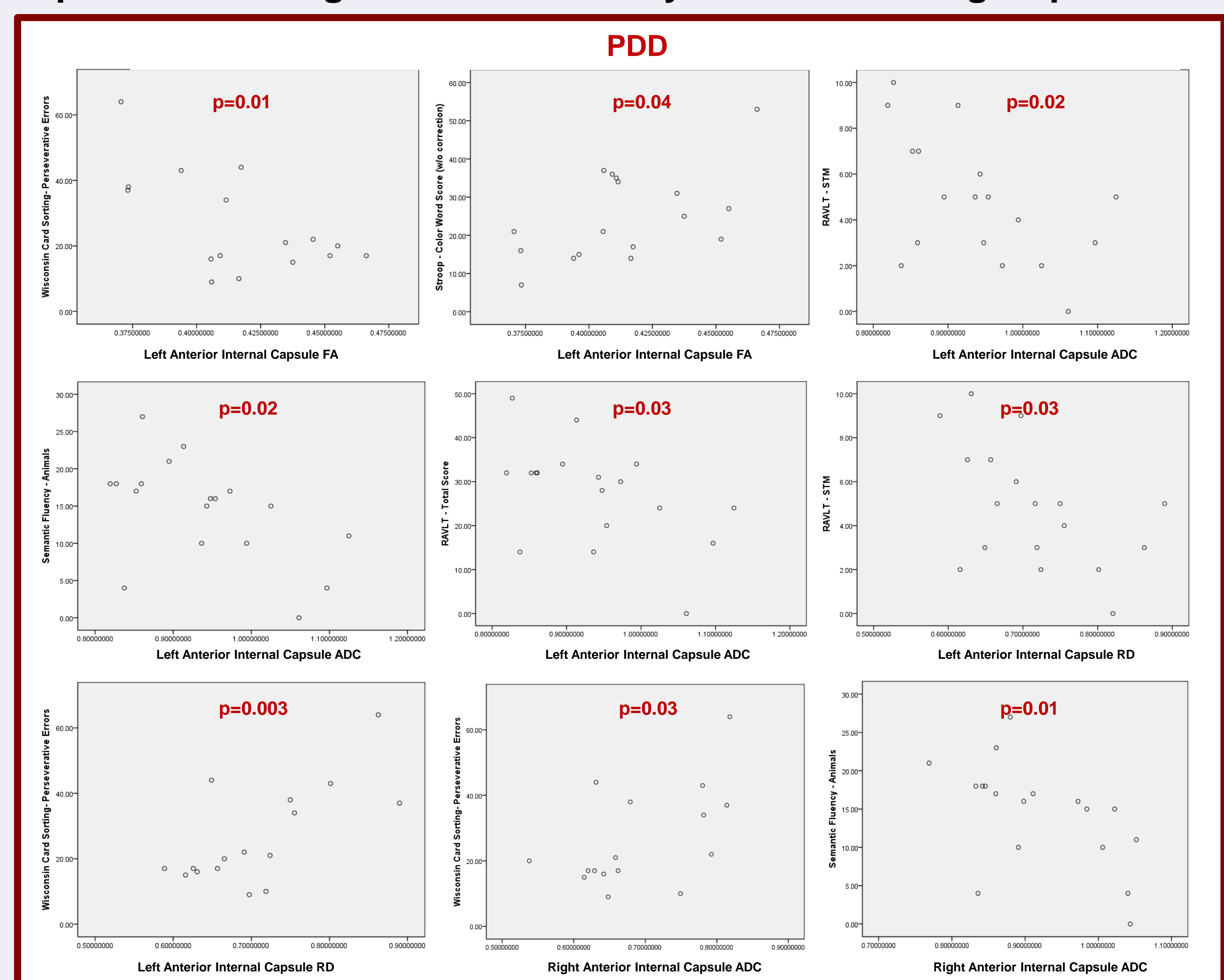
RESULTS

- PDD patients demonstrated increased diffusivity compared to the PD-MCI and PD-I patients for the left (FA, ADC, RD) and right (FA) anterior internal capsule.

FA for Left and Right Anterior and Posterior Internal Capsules



- Decreased integrity of white matter tracts was correlated with poor problem solving, inhibition, verbal short-term memory, and semantic fluency for the PDD group and with poor problem solving and verbal fluency for the PD-MCI group.



CONCLUSIONS

- The right and left anterior internal capsules, which connect the thalamus to the frontal lobes, demonstrated greater diffusion for PDD patients compared to PD-MCI and PD-I individuals.
- Decreased integrity of the white matter tracts was associated with impaired memory and executive functioning tasks.
- These findings suggest that DTI-t of the internal capsule can differentiate the stages of cognitive impairment in PD secondary to axonal loss.
- Future research will incorporate larger sample sizes, particularly for the PD-MCI group.

REFERENCES

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