Introduction: Cognitive dysfunction, a prominent feature of Parkinson’s disease (PD), is clinically heterogeneous and varies in the extent of decline across cognitive domains.

Aims: Diffusion tensor imaging tractography (DTI-t) and region of interest (ROI) analysis were used to dissect the clinical heterogeneity of PD-related cognitive impairment and to investigate the association between DTI indices and memory and executive functioning.

Methods: Eighteen PD dementia (PDD), 4 PD mild cognitive impairment (PD-MCI) and 8 PD cognitively intact (PDi) patients were evaluated with DTI and neuropsychological testing. Group differences were analyzed bilaterally for the anterior and posterior limbs of the internal capsule (IC) and centrum semiovale using DTI-t and caudate and thalamus using ROI. Correlations were examined to determine the relationship between DTI indices and memory and executive functioning.

Results: The PDD patients demonstrated increased diffusivity compared to the PD-MCI and PDi patients for the left (FA, ADC, RD) and right (ADC) anterior IC. Decreased integrity of the white matter tracts was correlated with problem solving, inhibition, verbal short-term memory, and semantic fluency for the PDD group and with problem solving and verbal fluency for the PD-MCI group.

Conclusions: The right and left anterior IC, which connect the thalamus to the frontal lobes, demonstrated greater diffusion for PDD patients compared to PD-MCI and PDi individuals. Decreased integrity of these white matter tracts was associated with impaired scores on memory and executive functioning tasks, suggesting that DTI-t of the internal capsule can differentiate the stages of cognitive impairment in PD secondary to axonal loss.