Altered white matter microstructure in Parkinson's disease

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Why the White Matter?

Imaging studies in PD:
• Functional disruption
• Wide spread metabolic changes
• Subtle Gray Matter atrophy

The findings point to the possible changes in structural connectivity
Diffusion Tensor MRI is a non-invasive imaging technique that allows in vivo quantification of water diffusion magnitude and directionality in tissue.
WM changes in Parkinson’s disease

• Global WM microstructural deterioration is evident in individuals with PDD
  (Perea et a., 2013)

• WM microstructural damage occurs with increasing PD severity
  (Agosta et al., 2013; Gattellaro et al., 2009)

• WM correlates with cognitive deficits
  (Agosta et al., 2013; Hattori et al., 2012; Deng et al., 2013; Theilmann et al., 2013)
Protocol and data analysis

• Protocol: 3T, b=1000, 1 b0, 32 directions.
• Participants: 14 PD-MCI, 13 PD-non-MCI, 18 CON
• Analysis: Tract-Based Spatial Statistics (Smith et al., 2006)
• Parameters:
  FA ("directionality")
  MD ("magnitude")
  RD ("myelination")
  AD ("axonopathy")

(http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/TBSS/)
• FA differences mostly in the right side, multiple areas
• No differences in MD, RD, and AD

FA
all PD < CON
p < 0.05, uncorr

0.2 < d < 0.5
0.5 < d < 0.8
d > 0.8
No differences comparing CON and PD-non-MCI
FA
PD-MCI < CON
p < 0.05, uncorr

MD
PD-MCI > CON
p < 0.05, uncorr

RD
PD-MCI > CON
p < 0.05, uncorr

AD
PD-MCI > CON
p < 0.05, uncorr

0.2 < d < 0.5
0.5 < d < 0.8
d > 0.8
FA
PDMCI < PD
p < 0.05, uncorr

MD
PDMCI > PD
p < 0.05, uncorr

RD
PDMCI > PD
p < 0.05, uncorr

AD
PDMCI > PD
p < 0.05, uncorr

0.2 < d < 0.5
0.5 < d < 0.8
d > 0.8
Correlation between FA in CON and all PD with:

• Digital-Span (backwards)
• Color-Word score
• Short Delay Free Recall
• Tower

Short Delay Free Recall

patients
p < 0.01, uncorr

controls
p < 0.01, uncorr

Digit-Span (backwards)

patients
p < 0.01, uncorr

controls
p < 0.01, uncorr
Discussion

• Widespread WM alterations in different brain areas
• PD-non-MCI and CON show no differences
• WM alterations are more prominent in PD-MCI

Limitations

• Unclear underlying mechanisms of the observed microstructural changes
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