Advanced diffusion modeling characterizes FLAIR white matter hyperintensity types in an aging cohort

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Poster

Background

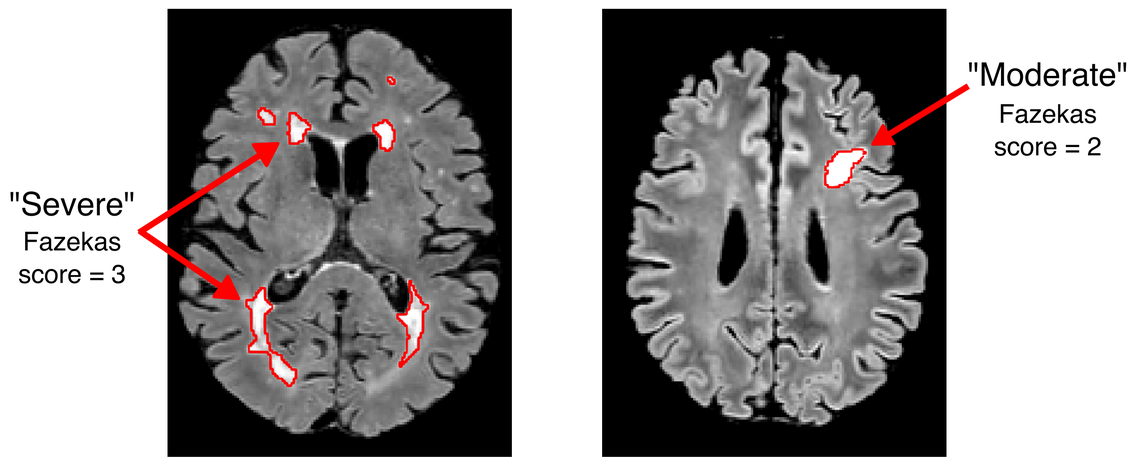
- White matter hyperintensities (WMH) in fluid-attenuated inversion recovery (FLAIR) MRI images are used as an indicator of clinical conditions ranging from multiple sclerosis to cerebrovascular disease[1,2].
- Diffusion MRI (dMRI) and diffusion modeling provides biophysically interpretable tissue properties.

Goal: Use diffusion modeling to characterize the underlying biophysical properties of FLAIR WMH.

Methods

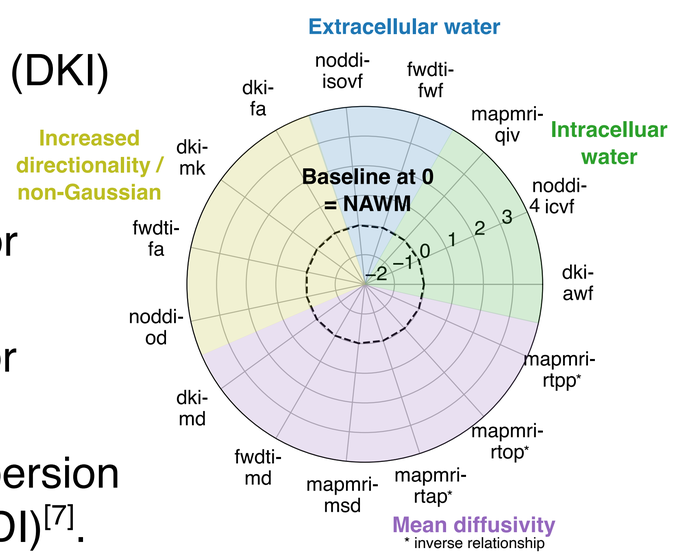
FLAIR processing:

- FLAIR WMH were segmented with a convolutional neural network, HyperMapp3r[3].
- WMH regions of interest were categorized as either periventricular (left) or deep (right) WMH.



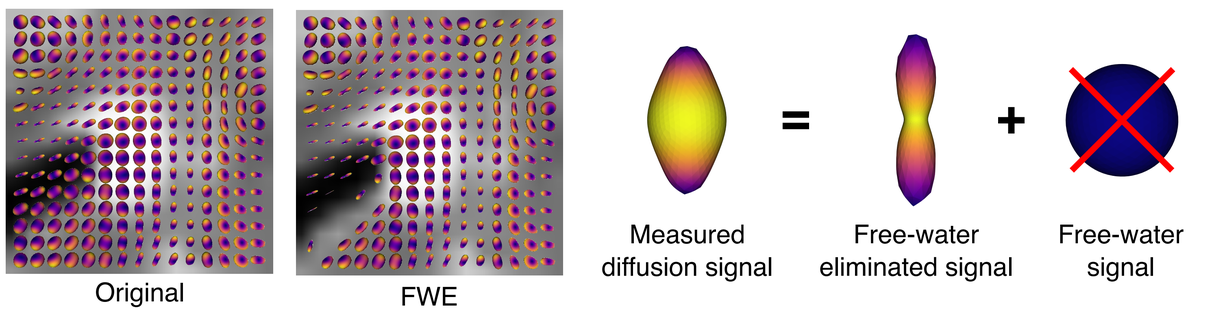
Diffusion models:

- Diffusion kurtosis imaging (DKI) and its White Matter Tract Integrity extension[4].
- Free-water diffusion tensor imaging (FWDTI)[5].
- Mean apparent propagator MRI (MAPMRI)[6].
- Neurite orientation dispersion and density imaging (NODDI)[7].



Tractography methods:

- Tractography was performed with pyAFQ[8] on the original diffusion data and after free-water elimination (FWE)[9].



Acknowledgements

Acknowledgements.
Funding sources.

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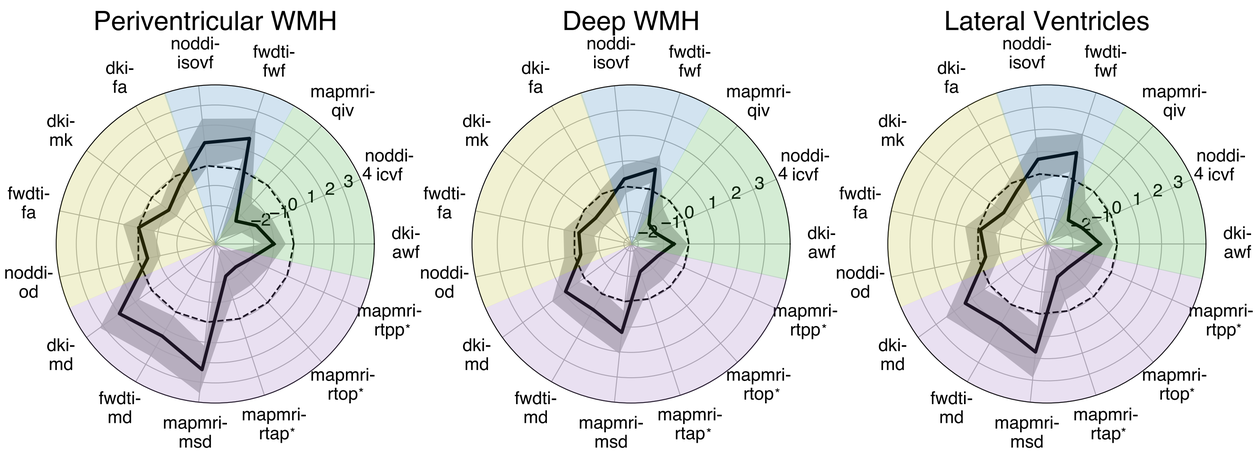
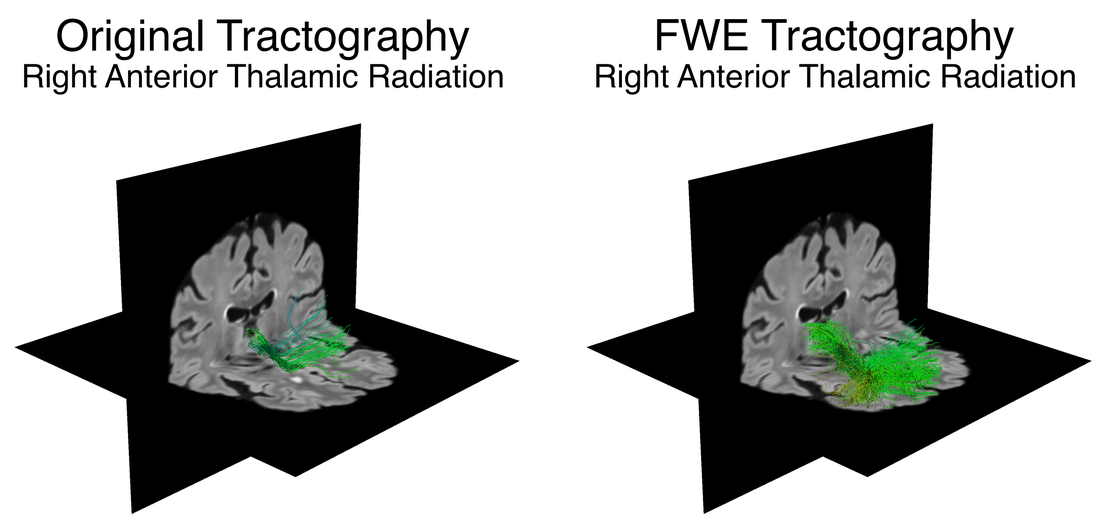
[9] Henriques et al. (2017). *bioRxiv.*

DIPY pyAFQ FWE

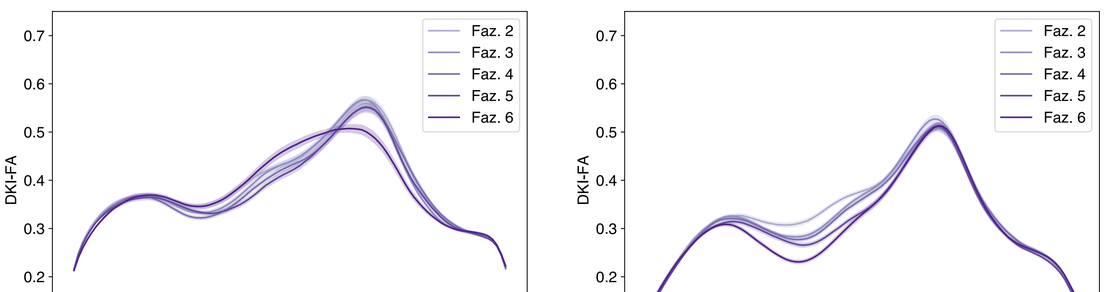
Results



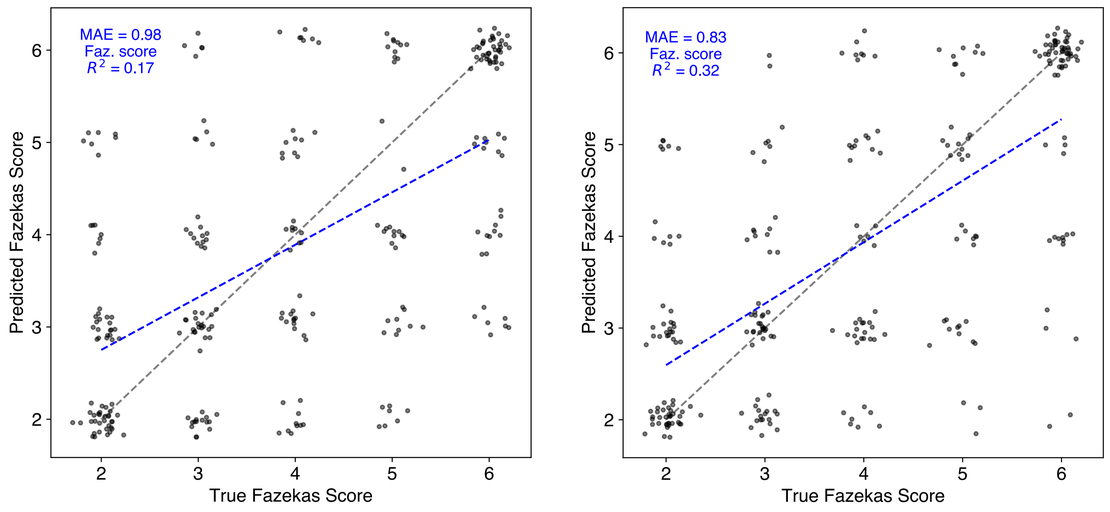
- **FLAIR WMH are characterized by increased mean diffusivity and extracellular water, especially in periventricular WMH.**
- Periventricular WMH's dMRI metric pattern resembles those of the lateral ventricles



- **FWE tractometry produced fuller tractography results.**



- **FWE tractometry produced tract profiles that better represent Fazekas scores.**



- **FWE tract profiles predict Fazekas scores more accurately than original tract profiles.**

Conclusions

- The patterns observed indicate that periventricular and deep WMH tissue begins to resemble ventricles more than NAWM, particularly in the case of periventricular WMH.
- Free-water elimination in aging brains increases the reliability in all steps of tractometry and improve the accuracy in classification of clinical phenotypes, especially in the presence of WMH.