

## Diffusion MRI detects structural abnormalities in optic chiasm

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### Objective:

The human optic chiasm comprises partially crossing optic nerves. Here we used diffusion MRI (dMRI) for the in-vivo identification of optic chiasm abnormalities in albinism, i.e. enhanced optic nerves crossing (Hoffmann and Dumoulin 2015; Ather et al. 2019).

Methods: In 9 individuals with albinism and 8 controls high-resolution 3T dMRI data were acquired and analysed with a set of methods for signal modelling [Diffusion Tensor (DT) and Constrained Spherical Deconvolution (CSD)], tractography, and streamlines filtering (LiFE, COMMIT, and SIFT). The number of crossing and non-crossing streamlines entered ROC-analyses to compare the discriminative power of the methods based on the area-under-curve (AUC). The dMRI results were cross-validated with fMRI estimates of misrouting in a subset of 6 albinotic individuals.

### Results:

We detected significant group differences in chiasmal crossing for both DT ( $p=0.018$ ) and CSD ( $p=0.0003$ ), confirming findings reported by Ather et al. (2019). ROC analyses indicated good performance of dMRI-based discrimination (AUC for DT and CSD: 0.81 and 0.96, respectively). Estimates of crossing strength obtained with dMRI and fMRI were strongly correlated ( $R^2=0.65$  and 0.83, respectively).

Conclusions: Especially CSD-based dMRI tractography provides an efficient approach to detect structural abnormalities in the optic chiasm.

Significance: Our findings demonstrate a novel anatomical approach for the individualized diagnostics of optic chiasm abnormalities.

### References:

Ather, Sarim, Frank Anthony Proudlock, Thomas Welton, Paul S. Morgan, Viral Sheth, Irene Gottlob, and Rob A. Dineen. 2019. "Aberrant Visual Pathway Development in Albinism: From Retina to Cortex." *Human Brain Mapping* 40 (3): 777–88.

Hoffmann, Michael B., and Serge O. Dumoulin. 2015. "Congenital Visual Pathway Abnormalities: A Window onto Cortical Stability and Plasticity." *Trends in Neurosciences* 38 (1): 55–65.