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Abnormal white matter structures in a case of recovery from cerebral achromotopsia and prosopagnosia

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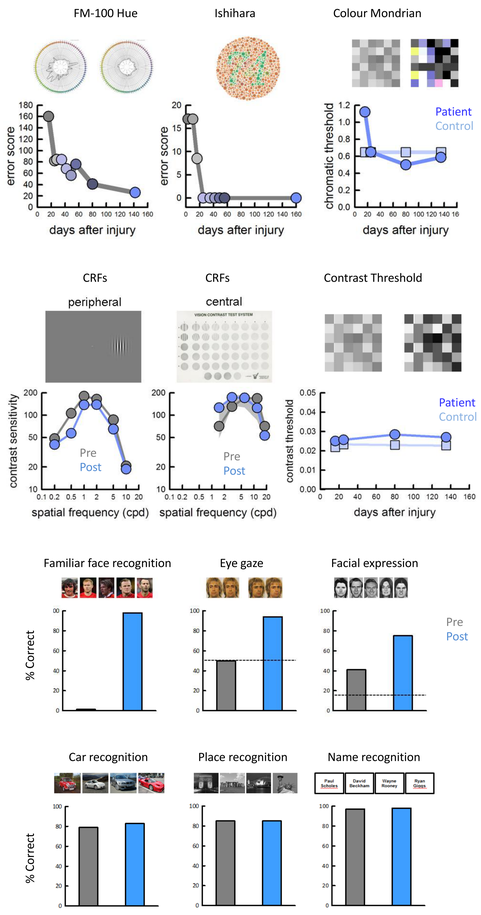
Introduction:

We tracked the recovery of a 17 year old male who presented with an acute loss of vision following a loss of consciousness. Visual acuity and fields recovered quickly, but the patient had longstanding achromotopsia and prosopagnosia, which ultimately resolved ~6 months later. While behavioural measurements confirmed the longstanding perceptual deficits, a battery of functional MRI and standard anatomical MRI measurements provided only subtle or no evidence of abnormalities within visual cortex, respectively.

Behavioural measures:

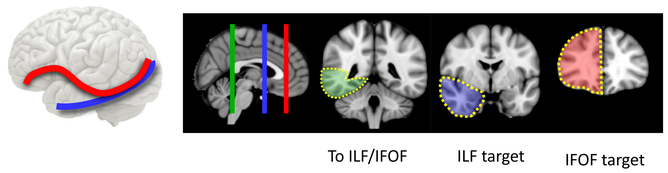


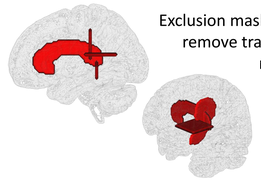
Diffusion imaging and Methods:

Diffusion-weighted data: 2 averages of whole head, 2.5mm^3 EPI data with 25 diffusion directions (B0 = 1000) and 4 non-diffusion volumes on GE 3T Signa Excite with an 8 channel whole head coil.

Subjects: 17 year old patient and 25 age- and gender-matched controls (18.9±0.3 yrs)

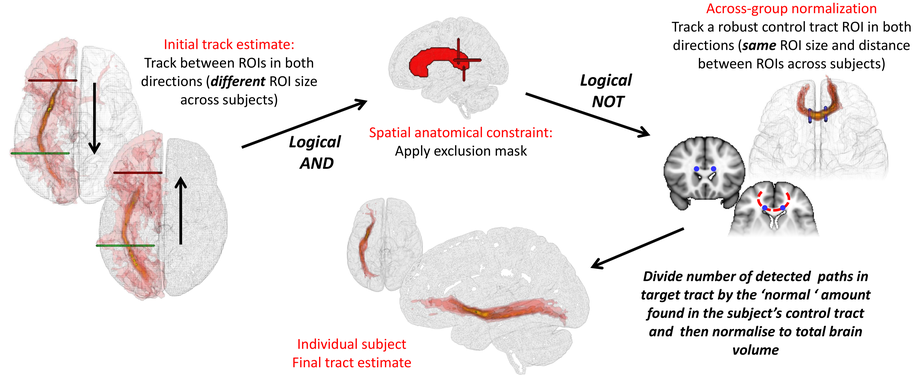
Regions of interest: Tracts for the Inferior Longitudinal Fasciculus (**ILF**) and Inferior-Fronto-Occipital Fasciculus (**IFOF**) were tracked via probabilistic[1] or deterministic[2] algorithms from the following regions of interest and restricted with the mask.



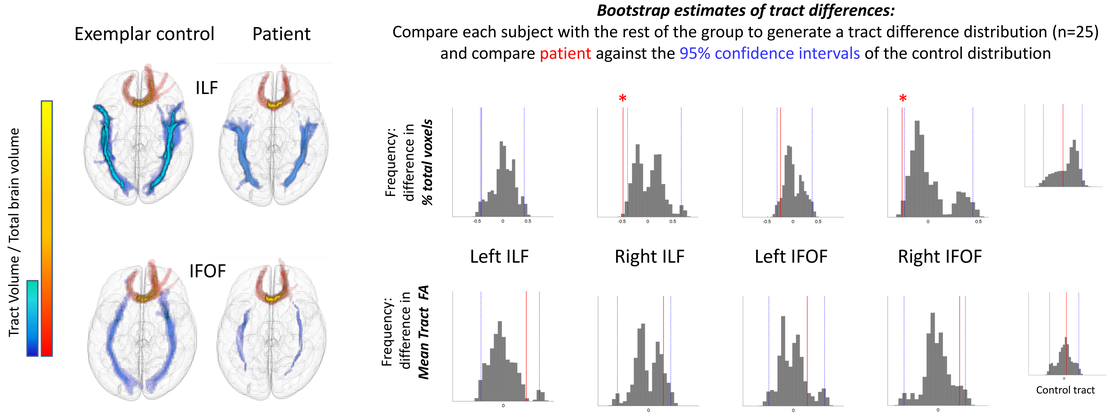


Exclusion masks were designed to remove tracts that crossed the midline, moved into the SLF, parahippo-campal formation or cingulum

Probabilistic tractography: FSL BedpostX & ProbtrackX[1]



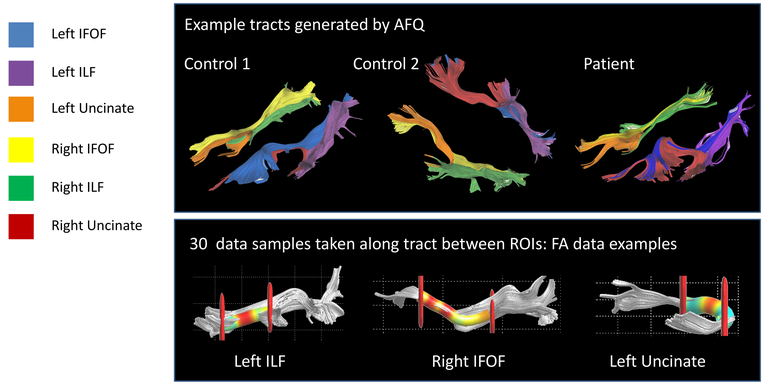
Results:

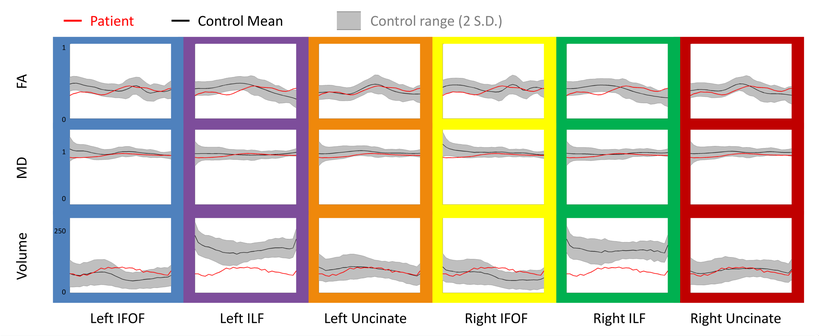


Deterministic tractography: mrVista, Quench & AFQ [2]

Regions of interest: Same ROIs as those used for the probabilistic tractography but they are auto-generated by AFQ (automatic fiber quantification)

Tracts: Seeded tracts for Left and Right ILF and IFOF but also for Left and Right Uncinate (high curvature tract supposedly difficult to track in poor data)





Conclusions

Despite the methodological differences of the complimentary analyses used, we find that the patient's Left and Right ILF white matter volume lies outside the range of the age- and gender-matched population. In addition, the probabilistic techniques suggest that, across the entire tract length, the volume of Left and Right IFOF lie towards the bottom end of the normal population distribution. We also show that we are able to reliably track other challenging tracts in the patient and control group brains, so are confident that these findings do not reflect a data quality issue.

The reduced volume in the ILF and IFOF of the patient is consistent with previously reported reductions in tract volume of the same tracts in congenital prosopagnosia[3]. This reduced volume likely plays a role in this patient's vulnerability to profound, relatively long-standing, but recoverable deficits in face and color perception, possibly caused by migraine.

References

[1] Behrens et al. *NeuroImage 34 (2007) 144 – 155.*
[2] Yeatman, Dougherty et al. *PLoS ONE (2012) 7(11):49790.*
[3] Thomas et al, *Nat Neurosci. 2009 Jan;12(1):29-31.*