Title: Reconstruction of the superior longitudinal fasciculus in a cohort of older healthy adults and those with mild cognitive impairment using CSD-based tractography

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Target audience: Basic and clinical researchers interested in white matter changes in ageing and dementia; those interested in different tractography methods.

PURPOSE: The superior longitudinal fasciculus (SLF) is a large white matter tract connecting the parietal and frontal lobes, and is comprised of three branches. It is thought to play a crucial role in visuospatial attention and working memory. The recent development of spherical deconvolution-based tractography methods has enabled the complete reconstruction of the three branches of the SLF using diffusion imaging [1], however to date there have been no such studies in older adults or mild cognitive impairment (MCI). In the current study we sought to perform tractography of the SLF I, II and III in a cohort of older healthy adults and older adults with MCI using constrained spherical deconvolution (CSD)-based tractography, and to relate tract metrics to performance on neurocognitive tests.

METHODS: Sixteen older healthy adults and 9 older adults with amnestic MCI (aMCI) underwent magnetic resonance imaging. Diffusion-weighted images were acquired with 61 diffusion directions, 4 non-diffusion images, a b-value of 3000s/m^2 and a voxel size of 2x2x2 mm. The data were analysed using Explore DTI [2]. Pre-processing included head motion and eddy current correction, and correction for EPI-induced geometrical distortions [3]. Tractography based on the CSD method was conducted [4]. The regions of interest (ROIs) for the reconstruction of the SLF were defined according to previously published methods [1]. Descriptive statistics were extracted from the tracts and analysed using SPSS.

RESULTS: The three branches of the SLF were successfully reconstructed for all participants (see Fig 1 for an example). A repeated measures ANCOVA (controlling for age) revealed no difference in either FA or MD in any of the branches between the HCs and MCI. Within group there was also no main effect of branch or hemisphere. The HCs additionally completed a neurocognitive battery, and a correlational analysis showed there to be a positive relationship between FA in the right SLF II and the Trails Making Test Part B (TMT B; see Fig 2).

DISCUSSION: The CSD-based tractography method proved extremely successful for reconstruction of the three branches of the SLF. The lack of difference in FA and MD between the HCs and MCIs may be due to relative sparing of the SLF in aMCI; or may be due to atrophy in tracts which cross the SLF in the MCIs, leading to an artifactual preservation of FA in the SLF in this cohort. The results from the correlational analysis indicate that variability in right SLF II may contribute to older adults' performance on the TMT B, which is a neuropsychological task of visual attention and executive function.

CONCLUSION: Future studies should focus on repeating the tractography with a larger sample and could examine whether there are SLF differences in amnestic and non-amnestic MCI subtypes.

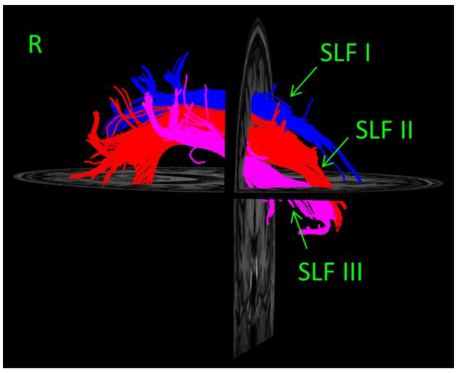

Fig 1: SLF I, II and III in an older HC

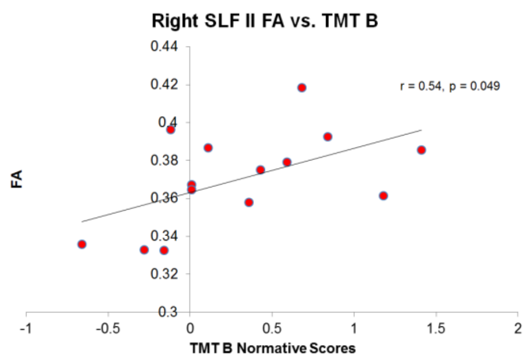

Fig 2: FA in the Right SLF II correlated with TMT B

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