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White matter macro- and microstructure alterations in preterm born adults

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Introduction: White matter (WM) injury, both macroscopic (visible on conventional MRI) and microscopic (detectable by diffusion tensor imaging, DTI) is frequent among preterm born infants investigated in later life (Volpe 2009). Degree and localization vary, but the corticospinal tract (CST) is often affected (Eikenes 2011). The relation between the micro- and macroscopic CST alterations has only been studied to our knowledge up to adolescence (Bassi 2011, Estep 2014, Groeschel 2014) but not in adults. We aimed to assess group differences in micro- and macroscopic WM integrity of the CST between preterm and full-term born adults and to evaluate the impact of macroscopic lesions onto the DTI parameters in and along the CST.

Methods: As part of a prospective study of preterm birth (Bavarian Longitudinal Study), we investigated adults at 26 years of age by means of MRI. Artifact-free DTI data were available from 51 full-term and 55 preterm born subjects (<32 weeks gestation or birth weight < 1500g). In these subjects we probabilistically reconstructed the CST (Giorgio 2010) and extracted DTI parameters (mean, axial, radial diffusivity - MD, AD, RD, and fractional anisotropy, FA) in the CST and slice-wise along the CST. On FLAIR-MRI images we identified macroscopic WM lesions as hyperintensities, noted their relation to the CST and correlated their presence with the DTI.

Results and Discussion: WM hyperintensities, periventricular or in the corona radiata, were present in 9 of 51 (18%) full-term and 26 of 55 (47%) preterm born subjects. In 3 of 51 (6%) full-term and 17 of 55 (30%) preterm born subjects these "lesions" affected the CST. Compared to full-term individuals, the preterm born subjects had significantly higher diffusivity (MD, AD, RD) in and along the CST but no difference in FA. These changes were weaker, but nevertheless remained significant when excluding subjects with macroscopic lesions. This suggests chronic CST injury with increased tissue water content (Aung 2013) even in the absence of visible WM lesions and points towards a high susceptibility of the CST after preterm birth.

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