Do we measure gray matter activation with functional diffusion tensor imaging?

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A commentary on

Interpreting functional diffusion tensor imaging

In this comment by Autio and Roberts (2014) on our second fDTI article “Functional Diffusion Tensor Imaging at 3 Tesla” (Mandl et al., 2013) the authors suggest that BOLD signal originating from gray matter could in part explain the reported task-related FA changes in white matter. The rationale is that the relative contribution from activated gray matter to the measured signal increases in voxels containing both gray and white matter. Because the ADC value for gray matter is between the parallel and perpendicular ADC for white matter, this increased contribution effectively could lead to an increase in the measured parallel ADC and a decrease in the measured perpendicular ADC and hence an increase in FA. Indeed, contamination by signal “leaking” from gray matter into white matter has been observed in the human brain along white matter tracts (Mandl et al., 2008). This movie shows the combined fDTI and BOLD fMRI results for the tactile experiment in a single subject (subject nr 5). It can be readily seen that the hypothesized partial voluming with possible active gray matter voxels could only occur at the endpoints of the fiber bundle. Furthermore, three, in the second fDTI paper (Mandl et al., 2013) we introduce a time lag between the stimulus and the start of the acquisition of a fDTI volume to make the measurement less sensitive to relatively fast varying signal changes (e.g., BOLD related signal changes). Still, similar effects were reported for the tactile experiment.

Taken together we conclude that although the hypothesized mechanism by Autio and Roberts is intriguing and more experiments are needed to obtain better insight in the underlying mechanisms it cannot explain our measured task-related changes in FA in functional Diffusion Tensor Imaging.

REFERENCES


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