

AbstractID: 1643 Title: Local Susceptibility Effects on Diffusion Tensor Mapping in Human Brain

Diffusion tensor imaging (DTI) of human brain, which reflects underlying microstructure of living tissue, can be confounded by interactions between external diffusion gradient(G_d) and internal background gradient(G_b) from local magnetic susceptibility effects in the brain, such as iron deposition. Potentially, these local gradient interactions may cause systematic errors in DTI measurements. The goals of this study, therefore, were first to derive a theoretical expression for effects of gradient interactions on DTI measurements and second to test if normal brain exhibits a systematic pattern of local gradient interactions. To determine gradient interactions, two DTI image sets with alternating polarity of the G_d were measured in 20 subjects using a 1.5T MRI system. The theoretical derivations showed that the diffusion tensor \mathbf{D} is uniformly scaled by the ratio of gradient interaction to G_d . Consequently, mean diffusivity (MD), which is the trace of \mathbf{D} , is scaled accordingly. In contrast, relative anisotropy RA, which is generally expressed as ratios of the tensor eigenvalues, is not affected. Analysis of spatially normalized DTI maps of the subjects showed regionally significant effects on MD, as expected, while no significant regional effects were observed for RA. Interestingly, the most prominent effects on MD from gradient interactions occurred in the occipital and temporal lobes of the brain but in frontal regions, suggesting a regional heterogeneity of microscopic susceptibility effects in the brain. In conclusion, effects of local brain magnetic susceptibility need to be considered when water diffusivity in the brain.

Supported by the NIH/NIA RO1 AG10897.