AbstractID: 10881 Title: Clinical Value of Diffusion-Weighted MRI in White Matter in Vivo

The excellent soft tissue contrast of diffusion-weighted magnetic resonance imaging, DW-MRI has made it an invaluable technique especially in oncological assessment bringing hope in distinguishing between brain abscesses and necrotic and cystic neoplasms. However, a clear characterization of brain tumors and the associated pathologic structures is still a challenge. In this study, a tissue model is proposed to interpret the water diffusion behaviour in white matter based on the measured apparent diffusivities and their volume fractions.

Measurements were performed on a 1.5T clinical scanner (Siemens). The protocol included: DTI measurements (b=0 and 500s/mm^2), DW images (96 b-values ranging from 0 to 10,000s/mm^2 with diffusion gradient rotated in the x-z plane, NEX=6, TE=200ms) and 96-echoes, non-linearly sampled using T2- sequence.

All decay curves measured in the splenium agreed well with the assumed bi-exponential function: $S/S0=f_{fast}\exp(-b*ADC_{fast})+f_{slo}\exp(-b*ADC_{slow})$.

The fast water pool, ADC_{fast} had a long apparent T_2 relaxation rate while the slow water pool, ADC_{slow} had a shorter T_2 constant. The volume fraction f_{slow} correlate with the volume fraction directly estimated from the T_2 spectrum. Markedly anisotropy was observed in ADC_{fast} and f_{slow} and more subtle in $ADC_{slow.}$

Evaluation of water diffusion in normal appearing corpus callosum is clearly assisting the peculiar properties of water in biological system, invoking long-range hydration structures modulated by the concentration of lipid-protein complexes in the membranes, cellular size and tissue architecture. ADC_{slow} originate from the water in the hydration layers, as ADC_{fast} the rest of the tissue bulk water. The membrane and associated hydration layers form a barrier to water diffusion perpendicular to them since diffusion within the hydration layers is anisotropic.

This model is very sensitive to cellularity and further to a brain tumor grade; cell swelling and increased density of membranes enlarge f_{slow} resulting in a decreased ADCs linked to cell proliferation.