Neurite orientation dispersion

Neurite orientation dispersion and density imaging (NODDI) provides a simplified yet sophisticated model of diffusion MRI, which separates the signal arising from three different tissue compartments: intraneurite water, extraneurite water and cerebrospinal fluid (CSF) [1) 2)].

Twenty-four patients with high-grade glioma (HGG) in or adjacent to the corticospinal tract (CST) pathway and 12 matched healthy subjects underwent structural and diffusion MRI. The CSTs were reconstructed on both sides. The CST features including morphological features (track number, average track length, and track volume) and the diffusion parameter values including fractional anisotropy (FA), mean diffusivity (MD), intracellular volume fraction (ICVF), isotropic or free water volume fraction (ISOVF) and orientation dispersion index (ODI) along the CST were calculated. The CST features were compared between the affected and healthy side for HGG patients and between the left and right side for healthy subjects. The relative CST features were compared across the healthy subjects, patients with motor weakness and patients with normal muscle strength. A receiver operating characteristic (ROC) curve was applied to evaluate the performance of each relative CST characteristic for HGG-induced CST changes.

Results: Compared with the CST features on the healthy side, the tracking number, track volume, and FA along the CST changed significantly on the affected side for HGG patients ($p < 0.05$ for all), whereas MD and ICVF changed significantly on the affected side only for HGG patients with motor weakness ($p = 0.012$ for both). In patients with motor weakness, the relative MD was significantly higher ($p < 0.001$), whereas the relative FA and ICVF were significantly lower ($p = 0.002$ and <0.001) than those in patients with normal muscle strength. The relative ICVF had a similar area under the curve (AUC) to that of MD (AUC=0.953 and 0.969). Compared with the relative CST features in the healthy subjects, only the relative ICVF was significantly lower in HGG patients with normal muscle strength ($p = 0.012$).

Neurite orientation dispersion (NODDI) seems to be useful in reflecting the high-grade glioma infiltration to corticospinal tract (CST), and can evaluate the CST destruction with a performance similar to DTI by providing additional information about neurite density for HGG-induced CST injury [3)].

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The NODDI can effectively evaluate the condition of neurites in the CST of iNPH patients, and the ODI could be clinically useful in the diagnosis of iNPH [4].

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