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Statistical Analysis of the White Matter Connectivity of the Congenital Blind Using Diffusion Tensor Imaging

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The basic function of the occipital lobe of the blind has been replaced by the higher order cognitive functions such as Braille reading or working memory. We hypothesized that the anatomical connectivity of the occipital lobe might be reorganized according to the functional connectivity. Since diffusion tensor imaging has been widely used for quantification of white matter structures and provides information on the anatomical connectivity, we applied voxel by voxel analysis of diffusion tensor images to explore the white matter connectivity especially at the occipital lobe of the congenital blind. DTI data were acquired from thirteen congenital blind and 18 healthy young sighted. After reconstruction of the diffusion tensor, fractional anisotropy (FA) and apparent diffusion coefficient were derived. T2-weighted images that were acquired as a baseline image for diffusion tensor imaging were used to generate a T2W template of the group. All FA images were spatially normalized by applying nonlinear deformation functions that were derived during registration of corresponding T2W images to the T2W template. After spatial smoothing of FWHM 8x8x8 mm, statistical parametric mapping of the normalized FA images of sighted and the blind subjects was conducted using SPM2. Statistical significance was determined with $p < 0.001$ with cluster size 50. The results showed significant reduction of the FA at the optic radiation, occipito-temporal junction, inferior temporal lobe, optic nerves at the orbitofrontal lobe of the congenital blind. No significant increase of FA in the blind compared with healthy sighted subjects was found. Though the anatomical atrophy was not significantly found at the congenital blind, the reduction of the fractional anisotropy of the blind suggests malformation or reorganization of the blind during the development. Further research using fiber tractography could provide more information of cortical reorganization of the congenital blind.

Keywords : DTI, Blind, Fractional Anisotropy