Neuro-Imaging of Cortical Degeneration in Retinal Visual Field Defects.

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A large number of ophthalmologic problems result in visual field defects leading to blind areas (scotoma). The aim of this study is to determine the extent to which retinal visual field defects lead to changes in the structure of visual cortical brain areas. We investigate two visual field disorders: macular degeneration and glaucoma. Even though both retinal diseases result in scotoma, they differ in their causes: In the case of macular degeneration, a breakdown of the retinal pigment epithelium interferes with the metabolism of the retina leading to its atrophy. Whereas, the problem in glaucoma lies at the ganglion cells level leading to optic nerve damage.

The primary visual cortex is retinotopically organised: a specific stimulated area in the retina is directly linked to a corresponding active cortical area. Visual field defects disable retinal activity and most likely prevent stimulation of the corresponding part of the primary visual cortex. There is evidence from animal studies that during growth, but also at later stages, the non-use of nervous tissue can lead to degeneration.

In this study, anatomical brain structures of patients with visual field defects (glaucoma and macular degeneration; optimal n=20+20) and subjects with normal vision (optimal n=20) are compared. Degeneration of cortical tissue is evaluated using Voxel-Based Morphometry (VBM), a technique that enables us to statistically assess local changes in grey matter density using anatomical scans made with Magnetic Resonance Imaging (MRI).

Preliminary VBM analyses show interesting results. We find less grey matter in the area of the primary visual cortex in the glaucoma group in comparison to the control group. Yet no difference is found between the macular degeneration and control groups. This was expected since in the glaucoma group, the information between retina and brain is for sure interrupted by nerve damage, whereas in macular degeneration, nervous cells are believed to stay intact making signal propagation still possible.