

Brain activity in input deprived V1 in glaucoma – (no) evidence of plasticity?

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Background:

Brain activity in input-deprived primary visual cortex (V1) of patients with visual field (VF) defects could be interpreted as bottom-up cortical plasticity. In contrast, fMRI studies in congenital macular degeneration (MD) and retinitis pigmentosa (RP) showed that these abnormal cortical signals in the lesion projected zones (LPZ) of V1 depend on the task performed. We studied the scope of such task-dependent responses in glaucoma, a prevalent eye disease and a leading cause of blindness.

Methods:

We performed 3T fMRI patients with extensive VF defects due to advanced glaucoma (n=5), RP (n=2) and healthy controls (n=4). Participants viewed contrast patterns drifting in 8 directions alternating with uniform gray (block design) and performed 3 different tasks: (1) Passive viewing (PV), (2) 1-Back task (OBT) and (3) Fixation-dot task (FDT). During PV, they passively viewed the stimulus fixating on a central dot, whereas they reported a succession of the same two motion directions for the OBT and a change in the fixation color for the FDT task.

Results:

During PV, we observed in patients and controls, positive responses in the intact V1, i.e. the normal projection zone (NPZ), but negative responses in the LPZ. Importantly, during the OBT condition, we observed in both glaucoma and RP, strong positive responses in the LPZ, which was absent in the control's simulated LPZ. Interestingly, we observed a positive shift in LPZ responses in only 2 patients when they performed the FDT.

Conclusion:

Our study showed activity in the deafferented visual cortex in glaucoma not only to be exclusively task-related as for MD and RP, but also depend on the nature of task. These findings support and extend earlier studies, indicate a lack of bottom-up plasticity, and suggest higher order plasticity in the visual system of these patients. We believe that these insights are of importance for the development of treatment and rehabilitation schemes in glaucoma.