Cortical Activitiy Distributions in Cat Area 17/18 Elicited by Short Visual and Electrical Retinal Point Stimuli: Investigations for a Retina-Implant

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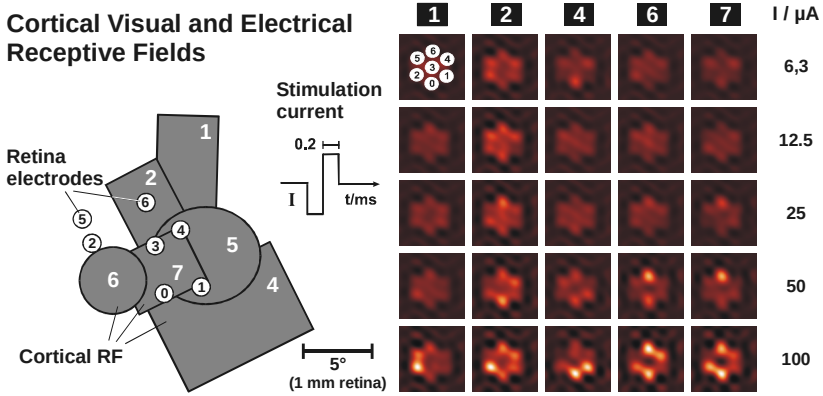
Introduction. Blind persons with photoreceptor degeneration and intact retinal ganglion cells can perceive phosphenes elicited by intraocular electrical stimulation [1]. However, the development of a retina implant for restoring simple basic vision requires an estimation of the spatio-temporal resolution feasible with electrical retina stimulation. Here we focus on the estimation of the spatial resolution with epi-retinal stimulation. **Methods.** We recorded cortical activities from anaesthetised cats with linear arrays of 7 or 16 µ-electrodes (spacing: 0.5/0.35 mm), while stimulating with trains of biphasic charge-balanced impulses (200 µs/phase) directly at the inner limiting membrane. Stimulation by the hexagonally arranged 7 retinal electrodes was at retino-topically corresponding and non-corresponding locations with respect to cortical recording sites. Additional recordings from the retinal stimulation electrodes enabeled monitoring of their tip locations at the retinal surface, and by measuring the retinal RFs, their relative positions to the cortical RFs. The distributions of cortical group activities (multiple unit: MUA; local field potentials: LFP, 1-140 Hz) were measured for dynamic multi-focal electrical and visual point stimuli. Reverse correlation revealed the visual and electrical receptive fields (vRF, eRF), respectively.



Results. The spatial cortical distributions of MUA and LFP in response to short visual and electrical point stimuli are in general similar in their size, with the electrically evoked distributions on average slightly larger than their respective visual equivalents. We obtained a similar result for eRF and vRF sizes. **Conclusions**. The cortical distributions, activated by short focal electrical stimuli in the retina, provide a coarse estimate for an upper bound of the possible perceptual resolution achievable with retina implants. More confined distributions and hence, higher resolutions, may be obtained if cortical single unit activity is used. Since the cortical activity distributions obtained for electrical point stimulation in the retina obey the retinotopic mapping to the cortex, stimulation with a retina-implant for restoring basic vision should be feasible. However, the cats used in our experiments had an intact visual system that might be considerably different to that of a blind with retinitis pigmentosa or macula degeneration.

/1/ Humayun MS, deJuan E, et al. (1999) Vis Res 15: 2569-76.
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