Assessing the Efficacy and Quality of Electrical Retina Stimulations by Analyzing Single−Unit and Mass Activity from Cat Visual Cortex

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Introduction. It has been shown that blind patients with degenerated photoreceptors per−ceived localized phosphenes when their retinal surface was electrically stimulated. However, the development of retina−implants requires evaluation of stimulation parameters optimized for spatio−temporal resolution, power consumption and biocompatibility. Hence, extensive testing in animals is required before applications in humans are possible. **Methods.** For this we developed semi−chronical methods for epi− and intra−retinal microstimulation in anes−thetized cats in order to optimize spatio−temporal selectivity. Success, efficacy and quality of retinal stimulation was assessed here by *recording of single−unit, multiple−unit* and *slow local field potentials* (LFP, e.g. 10−140 Hz) from area 17/18 by multiple micro−electrodes. Receptive field positions of retinal and cortical sites were mapped in order to distinguish be−tween corresponding and non−corresponding retinal stimulation and cortical recording sites. In order to find appropriate electrical stimuli, we applied different stimulation sets consisting of charge balanced current impulses as basis elements. The charge balance of stimulation currents is a necessity for safety of tissue and electrodes. Spatio−temporal distributions of current impulses were varied including polarity, delay, amplitude and duration of single impulses. In addition, distance between stimulation electrodes and retinal tissue was varied. **Results.** 1.) To date cats could be used repeatedly due to our minimal invasive ocular and cortical preparation methods. 2.) Threshold of successfull retina stimulation depended strongly on electrode positioning. In cases with excellent positioning current thresholds were as low as 5 µA. However, in most cases currents for a safe suprathreshold stimulation were about 20 µA. Activation threshold of ganglion cells increased rapidly with their distance to epiretinal stimulation electrodes. 3.) Successfull stimulation of ganglion cells depended on polarity and delay of biphasic current impulses: cathodic first impulses with shortly delayed anodic impulses yielded stronger cortical responses than vice versa (Fig.). 4.) Activation threshold was lower for trains (≈ 1 kHz) of biphasic impulses than for single biphasic im−pulses. 5.) Magno− and parvocellular stimulation could be separated by analysis of the first deflections of LFP responses. **Conclusion.** Our results show how the efficacy and quality of electrical retina stimulations can be optimized with respect to cortical responses. (Supported by BMBF grants to R.E. and L.H.)