Development of Mice Visual Pathway

Jiayi Zhang[1,#]

[1] *Institutes of Brain Sciences and State Key Laboratory of Medical Neurobiology, Fudan University, China*
[#]*jiayizhang@fudan.edu.cn*

The visual world is organized into stereotypic maps in mammalian animals. Spontaneous neural activities exist early in development and play important roles in the development of visual maps such as eye-specific segregation. Our study focuses on how the neural activities affect the anatomical and functional development of visual maps. We first developed optogenetic tools to precisely manipulate the spatiotemporal patterns of retinal and cortical activities *in vivo*. Transgenic mouse lines and viral-mediated transfection methods enabled the expression of light-gated channelrhodopsin (ChR2) in retinal ganglion cells (RGCs) and different types of inhibitory neurons. Whole mount retinal patch-clamp experiments verified the optical responses of RGCs, whereas *in vivo* multielectrode experiments demonstrated the uniform postsynaptic light responses in visual cortex (VC). In anatomical visual map studies, we focused on how the corticothalamic feedback pathways regulate the development of eye-specific segregation and retinotopy. In functional visual map studies, the entrainment and replay of rhythmic activities has reliably been observed in VC, suggesting a working memory-like behavior of VC neurons. Underlying mechanisms of such phenomenon include calcium-mediated long-term plasticity and spike-time dependent plasticity. Finally, optic neuritis were used as a disease model in visual system to monitor the degeneration process of visual pathway.