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Defocused images affect the multi-neuronal firing patterns in the mouse retina-a multielectrode array study

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- Footnotes

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Purpose: Myopia is a substantial public health problem, affecting 33% of individuals over the age of 12 years in the United States and more than 80% people in Hong Kong. Although it is well established that defocused images alter eye growth and refraction contributing to myopia and that the retina can sense the focus of an image, defocused images's effects on retinal signaling that accounts either for emmetropization or for refractive errors has remained elusive. It is important to identify the cells and to understand the neuronal circuit that contributes to myopia to provide new insight and means for myopia prevention and modulation.

Methods: Ganglion cells of dark-adapted retina from all quadrants were recording from adult C57BL/C57BL:129 wild-type by using 256 channels Multielectrode Arrays (MEAs). For MEA recording, retina–eyecups (n=20) were isolated. Defocused images generated by white or mono green organic light-emitting display (OLEDXL, Olightek, China; 800 × 600-pixel resolution, 85 Hz refresh rate) was controlled by computer and was presented different spatial frequencies light bar generated by PsychoPy onto the photoreceptor layer. The intensity of the light bar was above 100 isomerizations (R*)/rod/s in the photopic range were applied on the surface of the retina. Data analysis was performed by using Off-line Sorter (Plexon, Dallas, TX, USA) and NeuroExplorer (Nex Technologies, Littleton, MA, USA).

Results: Dark-adapted mouse ganglion cells (GCs) were recording under different light intensity to find their thresholds and intensity-response profiles. The firing patterns of GCs varied under the different powers of defocused images. OFF delayed cell (GCs or amacrine cells (ACs) with time latency more than 2 seconds, had synchrony firing with GCs and/or ACs. The spatial synchrony firing pattern between OFF delayed cell and other GCs/ACs had significantly change after image defocused. Compared with focused image, the number of synchronized cells with OFF delayed cell decreased with increased power of defocused images.

Conclusions: Our results showed that defocused images induced multi-neuronal firing patterns changed in the mouse retina. Spatial firing patterns varied with different powers of defocused images. Synchrony firing of OFF-delayed cells possibly related to edge detection, a potential therapeutic target for myopia patients in future.