Light-Dependent Structural Changes in Photoreceptor Neurons Imaged by OCT

Brandon Block[1], Shimpei Takita[2], and Yoshikazu Imanishi[3]

[1] MD Candidate at Indiana University School of Medicine
[2] Postdoctoral Fellow in Ophthalmology at Indiana University School of Medicine
[3] Associate Professor of Ophthalmology at Indiana University School of Medicine

Background: Optical coherence tomography (OCT) is an imaging technique with high spatiotemporal resolution used to monitor the retina, photoreceptor degeneration, and potentially the visual cycle. In this study, we aim to examine how various light conditions impact the photoreceptor structures using OCT.

Methods: C57BL/6 wild-type mice raised under a normal 12-hour light/dark cycle (200 lux) were exposed to three different light conditions from postnatal day 21 (P21) to P35: a 12-hour light/dark cycle (200 lux; normal), 12-hour light/dark cycle (2500 lux; bright), or constant darkness. Mice were imaged with OCT at P35 (n = 4 for each group).

Results: For the nasal region, the length of the outer segment (OS) to the retinal pigmented epithelium (RPE) were 20.892 ± 2.343 μm and 15.980 ± 2.284 μm for the normal and bright light conditions, respectively (mean ± SD, $p = 0.0240$). For the temporal region, the lengths were 22.185 ± 2.678 μm and 16.294 ± 2.204 μm for the normal and bright light conditions, respectively (mean ± SD, $p = 0.015$). For the ventral region, the lengths were 19.210 ± 3.027 μm and 14.875 ± 1.268 μm for the normal and bright light conditions, respectively (mean ± SD, $p = 0.038$). For the dorsal region, the lengths were 20.556 ± 2.441 μm and 19.247 ± 3.403 μm for the normal and bright light conditions, respectively (mean ± SD, $p = 0.555$).

Conclusions: We observed significant light-dependent changes in photoreceptor and RPE layers for most regions—showing that transitioning from the normal to the bright light cycle impacts the length of the OS to the RPE and that OCT can be applied for monitoring the process of light adaptation in photoreceptor cells. The results of this study will help by improving the diagnosis of vision disorders associated with photoreceptor and RPE dysfunctions.