Seeing cells in the living eye: Pushing the limits of high-resolution retinal imaging

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Visualization of individual cells in the living retina is critical to understanding normal retinal structure and its changes with disease. Advances in adaptive optics scanning laser ophthalmoscopy have made it possible to image the living retina with better resolution than ever before, making it possible to see the smallest retinal cells including cones at the foveal center, individual rods and blood cells flowing through the smallest capillaries. Other cell layers in the retina are either transparent or opaque and are thus more difficult to visualize. However, the addition of fluorescence imaging capabilities is making it possible to successfully image a larger variety of cells. With single photon-fluorescence, the retinal pigment epithelium, a single layer of opaque cells behind the cones that provide critical support for photoreceptors, is now accessible. By using extrinsic fluorophores, the structure and function of transparent neural cells can be observed. Two-photon fluorescence imaging in the living eye provides a method to non-invasively, without the use of extrinsic fluorophores, image not only retinal structure, but also to assess retinal function.