

Adaptive optics shows patient pathology

Pippa Wysong
in Fort Lauderdale

RETINAL pathology can be observed directly using adaptive optics ophthalmoscopy, reported researchers at the annual meeting of the Association for Research in Vision and Ophthalmology (ARVO).

While the device has been tested on various series of healthy eyes, a US research team has now tried the device on a patient with known pathology. Sample images of the patient's eyes were presented by Jessica Wolfing, a graduate student and PhD candidate in Optical Engineering from the University of Rochester in New York.

"What is different here is that we are applying it to a progressive retinal disease," she told *EuroTimes* in an interview.

She added that conventional clinical fundus cameras show retinal vasculature and macroscopic retinal pigment epithelium (RPE) defects. These cameras produce images at 15 times magnification. In general, adaptive optics images have 240 times magnification and can show individual cells.

The patient studied was a 26-year-old female patient who had advanced cone-rod dystrophy and underwent traditional imaging and testing modalities, including fundus photography, optical

coherence tomography (OCT), mfERG (electroretinography), fluorescein angiography, and visual field tests. Each was compared to high-resolution retinal images from an adaptive optics ophthalmoscope and an adaptive optics scanning laser ophthalmoscope.

Close-up view of retinal pathology

The patient had a decrease in her ERG, and had a 'bull's eye' lesion in the macula. OCT showed there was retinal thinning throughout. The adaptive optics images were done of multiple sites on the retina throughout the bull's eye lesion, Ms Wolfing said.

With adaptive optics and images with high resolution and high magnification (about 240 times magnification), it was possible to see the photoreceptor mosaic in the patient. Compared to what would be expected in an age-matched normal, the patient had an increase in cone diameter and a decrease in cone density.

"Adaptive optics quantitatively revealed decreased cone density and increased cone size in the macula. The technology allows for non-invasive imaging of single cells in the live retina," she said.

In fact, the detail was good enough to enable her to count the number of photoreceptors in

a given location. That is how she measured cone density in that patient.

Finding the underlying mechanisms

In previous studies using the technology on normal eyes, research focused on learning about the photoreceptor mosaic and the normal retina.

"We are now trying to move more in the direction of learning about the mechanisms behind clinical problems or retinal degeneration, and then also being able to track these diseases over time, and measure treatment efficacy," Ms Wolfing said.

With conventional imaging, individual cell counts or size measurements cannot be done. Moreover, adaptive optics allows for retinal imaging to be done over time using this same sort of detailed scale.

Within the atrophic regions of the patient's eyes, researchers were able to observe sections that had no wave-guiding cones. In contrast, images of the clinically less affected regions revealed a completely tiled cone mosaic. The cones were abnormally large, and this resulted in an 85% reduction in peak cone density, numbering 30,100 cones/mm² compared to the normal average of 199,200 cones/mm².

Findings from mfERG were consistent with this and showed that there was a 76% functional loss at the functional peak. Here, the findings were 10.8 nV/deg² compared to what an average normal peak would be: 45.3 nV/deg².

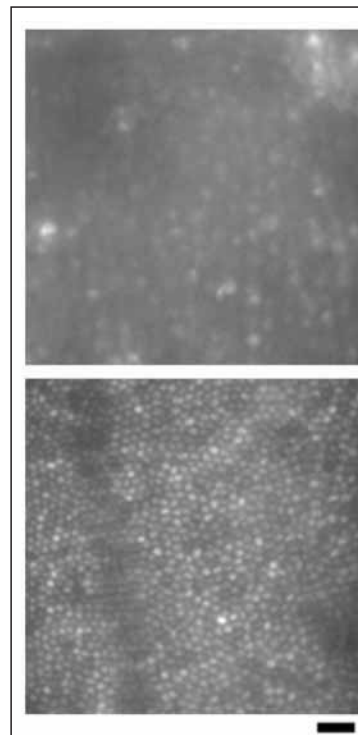
Although treatment for this particular patient—who was already undergoing treatment for advanced disease—did not change



Jessica Wolfing

because of their findings, Ms Wolfing said adaptive optics could be useful as a screening tool for the early detection of retinal disease, especially age-related macular degeneration. It could also be used to follow patients and assess how well they respond to treatments.

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Adaptive optics images showing photoreceptors of cone-rod dystrophy patient (top), and of a normal patient (bottom). Scale = 25 microns.

Courtesy of Jessica Wolfing