Quantification and Volumetric Imaging of Retinal Pathologies Using High-Speed Ultrahigh Resolution OCT

High-speed UHR-OCT of the retina allows for evaluation of volumetric analysis and thickness mapping of individual retinal layers. In the future, this may provide retinal specialists with a unique diagnostic tool in the management of retinal pathologies.

BY CONNI BERGMANN KOURY, EDITOR-IN-CHIEF

The enhanced resolution, decreased motion artifact and improved retinal coverage provided by high-speed ultrahigh resolution optical coherence tomography (UHR-OCT) allows for the quantification of intraretinal layer, according to data presented at the 2006 Association for Research in Vision and Ophthalmology Annual Meeting in Fort Lauderdale, Fla.

Bryan K. Monson, from the department of ophthalmology, New England Eye Center, Boston, said that segmentation and mapping are achievable with high reproducibility and operator independence. "Volume and segmentation analysis of individual retinal layers are possible due to the dramatically improved resolution and speed of high-speed ultrahigh resolution OCT. Intraretinal layer volumes or thickness maps may prove to be unique diagnostic and management parameters for retinal pathologies," he and colleagues concluded.

With this investigation, Mr. Monson and colleagues sought to establish UHR-OCT quantitative volumetric mapping of intraretinal features in normal eyes and explore how this technique might be of value in patients with retinal disease. They presented values of intraretinal layer thickness determined from measurements in 40 normal eyes, establishing a normative database for comparison with pathologic eyes.

> The investigators used a prototype, high-speed UHR-OCT developed by a group in the Research Laboratory of Electronics at MIT.

RESEARCH PROTOTYPE

Mr. Monson and colleagues used a research prototype, high-speed UHR-OCT system developed by the research group of James Fujimoto, PhD, in the Research Laboratory of Electronics at the Massachusetts Institute of Technology and adapted for patient imaging at the New England Eye Center, Tufts-New England Medical Center. The technology uses high-performance

spectral/Fourier domain detection that has achieved an imaging speed approximately 60 times faster than commercial standard OCT systems. The technology also enables axial image resolutions of about 3 µm. According to Mr. Monson, this technology enables better visualization of intraretinal layers, including the photoreceptor inner and outer segments and improved coverage of the retina. Intraretinal layer volumetric measurements of normal and pathologic eyes can be displayed as en face false color maps precisely registered to the fundus, he said.

The intraretinal layers were visualized in cross-sectional images and detected by computer software. Intraretinal layers were segmented and mapped, enabling volume analysis.

The investigators performed high-speed UHR-OCT imaging on more than 500 patients with various retinal pathologies. Conventional UHR-OCT imaging was previously performed on 711 patients. The intraretinal layers were visualized in cross-sectional images and detected by computer software. Intraretinal layers were segmented and mapped, enabling volume analysis. Forty normal eyes were analyzed to establish a preliminary normative baseline to which pathologic conditions could be compared.

POTENTIAL FOR WIDER DIAGNOSTIC PARAMETERS

Mr. Monson and colleagues found that the quantification of intraretinal layers is possible with improved resolution, decreased motion artifact and improved retinal coverage provided by high-speed UHR-OCT. Segmentation and mapping are achievable with high reproducibility and operator independence. Volumetric measurements of individual retinal layers are potential unique diagnostic and management parameters for retinal pathologies. ■

Bryan Monson is a research associate from the department of ophthalmology, New England Eye Center, Boston. He may be reached at bryanmonson@tufts.edu.

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