OCT Angiography: The Next Era of OCT Technology Emerges

Optical coherence tomography was first described in November 1991. The two decades of optical coherence tomography can be divided into four eras. In the first era, lasting from 1992 to 1995, investigators at the New England Eye Center of Tufts University School of Medicine demonstrated the power of OCT as a macular diagnostic tool, using a system that their research team had built. In the second era, lasting from 1995 to 2000, early-stage commercial instruments were made available.

The image quality and resolution of these systems were in fact inferior to the “home-built” MIT-Tufts OCT system, so clinical adoption was low. In the third era (2000 to 2005), OCT became a widely used macular diagnostic tool with the development of the Stratus OCT by Carl Zeiss Meditec (Jena, Germany). The third era coincided with the introduction of retinal pharmacotherapy for macular degeneration and diabetic retinopathy. The explosive growth of OCT was worldwide. In the fourth era (2005 to the present), the introduction of spectral-domain (SD) OCT systems provided important new capabilities. Higher scanning speeds coupled with eye tracking provided the means for producing much higher-resolution cross-sectional images. More intensive scanning patterns produced data sets that could be analyzed to produce quantitative analysis of retinal morphology, such as measuring geographic atrophy, the volume of retinal pigment epithelium detachments, or drusen. Somewhat surprisingly, advanced retinal analysis has not been used extensively in everyday practice. Most clinicians make their decisions after reviewing the retinal topographic map and several retinal cross-sections of interest. SD-OCT has improved the quality of clinical decision making, but in reality it simply represents a refinement of the Stratus OCT approach.

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OCT angiography represents the fifth era of OCT development and a true extension of capabilities from SD-OCT. OCT angiography has been made possible by the development of even faster scanning and sampling techniques. As described in the two path-breaking articles published in this issue, OCT angiography is a dynamic strategy capable of providing a three-dimensional reconstruction of the perfused microvasculature within the retina and choroid. OCT angiography acquires images by detecting motion of scattering particles such as erythrocytes within sequential OCT cross-sectional scans performed repeatedly at the same location of the retina.

This technology is still in its earliest stages of clinical evaluation, but the initial published results are impressive and are likely to improve with improved OCT technology and enhanced analysis algorithms. Head-to-head comparison with conventional fluorescein angiography (FA) is under way. There is no doubt that OCT angiography can detect capillary nonperfusion as well as or better than FA. Although OCT angiography cannot detect the same type of leakage seen with FA, it is possible to identify microvascular abnormalities associated with leakage. Studies using OCT angiography to image choroidal and retinal neovascularization are under way.

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