Optical coherence tomography (OCT) is a high-resolution, cross-sectional imaging modality that was initially developed for visualizing the retina. When first described in 1994, anterior segment imaging with OCT utilized a 0.8-µm–wavelength light source similar to that used in retinal OCT. This wavelength, however, is suboptimal for imaging the anterior chamber angle; 0.8-µm light cannot penetrate the sclera and thus prevents the visualization of the underlying angle structures.

OCT using 1.3-µm–wavelength light is better suited for imaging the anterior chamber angle due to two significant properties. First, the amount of scattering in tissue is lower at this wavelength, a difference that increases the penetration of light through scattering ocular structures such as the sclera and the iris so that the morphology of the anterior chamber angle is visualized with more detail (Figure 1). Second, because water in the ocular media strongly absorbs 1.3-µm–wavelength light, only 10% of the light incident on the cornea reaches the retina. This improved retinal protection allows the use of higher-powered illumination, which in turn enables high-speed imaging. The advantages of high-speed imaging include an elimination of motion artifacts, decreased examination time, and an ability to image dynamic ocular events. This article explores how anterior segment OCT works and its potential applications.

Anterior segment OCT has several advantages over gonioscopy for the evaluation of the anterior chamber angle. The latter is subjective, requires a highly trained examiner, and involves ocular contact. In contrast, anterior segment OCT quantitatively measures the anterior chamber angle in a noncontact fashion, and the technology is easy to use after minimal training. Because it does not require contact with the eye, anterior segment OCT is safer and more comfortable for patients, and it avoids the mechanical distortion of the structures to be examined. A potentially significant advantage of this technology is that it may be used in complete darkness. Any changes in the angle configuration that are induced by ambient lighting are thus eliminated.

Comparing Modalities
OCT has several advantages over other cross-sectional imaging modalities such as ultrasound biomicroscopy (UBM) and Scheimpflug photography. Compared with

Figure 1. The difference in visualization with 0.8-µm- and 1.3-µm-wavelength anterior segment OCT is evident.
UBM, OCT provides a higher resolution, is completely noncontact, and is relatively easy to perform. Because Scheimpflug photography does not image the actual angle recess, it does not provide visualization of important structural detail. In contrast, OCT provides detailed direct imaging of the anterior chamber angle region.

**PROTOTYPES**
Several anterior segment OCT prototypes have been described in the literature, and an FDA-approved device (Visante; Carl Zeiss Meditec Inc., Dublin, CA) recently became commercially available. We have employed some of these prototypes in our studies. The system that we currently use was developed by Carl Zeiss Meditec Inc. It uses a 1.3-µm–wavelength light source and delivers 2,000 A-scans per second. The device acquires and displays eight image frames per second in real time, each with 500 axial scans. The geometry of the scan is telecentric with adjustable scanning widths of 1 to 16 mm and scanning depths of 1 to 8 mm. The axial resolution is 15 µm.

**QUANTITATIVELY MEASURING THE ANTERIOR CHAMBER ANGLE**
Structures in the anterior chamber angle are well delineated by 1.3-µm OCT (Figure 2). To perform quantitative measurements, the OCT image must first be processed to obtain correctly dimensioned images, with adjustments for the geometry of the scan and the refraction of the OCT beam at the eye’s anterior surface. Highly reflective and easily identifiable in OCT images, the scleral spur is the landmark used for measuring the parameters of the anterior chamber angle. The quantitative parameters that we have used in our studies include the angle-opening distance at 500 µm, the angle recess area at 500 and 750 µm, and the trabeculo-iris–space area at 500 and 750 µm (Figure 3).

**CLINICAL STUDIES**
In two recently published studies, the quantitative measurement of the anterior chamber angle with OCT correlated well with gonioscopy in terms of identifying occludable angles. In one of these studies, the investigators also acquired UBM measurements, and they found that both the OCT and UBM parameters were comparable in terms of their reproducibility and correlation with gonioscopy. The best OCT parameters were slightly superior to UBM, with 100% sensitivity and 95.7% specificity for detecting gonioscopically occludable angles.
Anterior segment OCT can quantify changes in the width of the anterior chamber angle due to various factors. A recent case report used a prototypic system to demonstrate the deepening of the anterior chamber angle after a laser peripheral iridotomy.11 Preliminary data from an ongoing study to evaluate illumination-induced changes in the anterior chamber angle with OCT indicate a significant deepening of all anterior chamber parameters under conditions of bright illumination.12

CONCLUSION

Anterior segment OCT appears to be a promising tool for evaluating the anterior chamber angle configuration, including changes induced by illumination and laser peripheral iridotomy. As a rapid, easy-to-use, and completely noncontact modality, the device may be a useful screening tool for occludable angles. Ongoing clinical studies will help to evaluate its efficacy in this regard. The use of anterior segment OCT for evaluating trabeculotomy blebs is a future area of study.

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