Anterior Segment Imaging in Angle Closure

This technology has become a valuable tool for diagnosing, treating, and conducting research on angle closure.

BY ROBERT M. FELDMAN, MD

In experienced hands, gonioscopy is an effective technique for assessing the anterior chamber angle. There are limitations, however, to its use for the diagnosis of and research on angle closure. First, gonioscopy requires technical skill and an excellent knowledge of the anatomy of the angle. Second, the technique is not quantitative. Third, it does not allow for the assessment of structural volume.

Robert Feldman, MD, is involved in research on the usefulness of anterior segment imaging as a diagnostic and research tool for assessing the angle. He summarizes the current state of this research in this month’s edition of the “Peer Review” column.

—Barbara Smit, MD, PhD, section editor

Angle-closure glaucoma (ACG) affects an estimated 16 million people worldwide, with 4 million bilaterally blind from the disease. The global presence of ACG is approximately one-third that of open-angle glaucoma (OAG), yet the number of people blind due to ACG (3.9 million) is nearly equal to that blinded by OAG (4.5 million). Those figures are projected to be equal by 2020.

Unlike with OAG, the angle’s anatomy plays a major role in the etiology and progression of ACG. This spectrum disease is defined by the extent of angle closure and vision loss. Gonioscopy is the gold standard for evaluating angle anatomy, but the test is often difficult to perform and cannot provide reliable quantitative measurements. Although gonioscopy is unlikely ever to be replaced in clinical evaluation, imaging is becoming ever more important to the diagnosis and treatment of angle closure. Several techniques now available offer excellent reproducibility and quality in their detection of angle anatomy, and in some cases, they provide quantitative measurements of the angle, thereby furthering research into the relationship between angle anatomy and angle-closure disease.

ULTRASOUND BIOMICROSCOPY

UBM uses sound waves to image the anterior chamber. The advantage of UBM is its ability to image behind the iris to the ciliary body and sulcus (Figure 1). UBM is especially useful for diagnosing plateau iris, because it can visualize the anterior rotation of the ciliary body that causes anterior displacement of the iris in this mechanism of angle closure.

One disadvantage of UBM is its limited resolution, 50 µm laterally and 25 µm axially, which is lower than that of anterior segment optical coherence tomography (AS-OCT). Additionally, UBM is a contact-dependent technique that must be performed by a skilled and
experienced technician. The ocular structures may be distorted depending on the angle of the probe and the amount of pressure applied to the eye. Although quantitative studies have been performed using UBM, other techniques provide better, more reproducible measurements for clinical use.

SCHEIMPFLUG IMAGING

Scheimpflug imaging uses light scattering to measure the anterior chamber. Despite its high resolution (4 µm laterally and 1 µm axially for the Galilei Dual Scheimpflug Analyzer [Ziemer Ophthalmic Systems AG]), the technology’s usefulness for angle closure is limited by its inability to adequately image the angle recess.

ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY

AS-OCT recently emerged as the go-to method for obtaining high-resolution, quantitative images of the angle, including the angle recess. Not only is the technology advantageous for the diagnosis of angle closure, but it is another tool with which to research the disease.

Dedicated AS-OCT differs from posterior retinal OCT in that the former uses 1,310-nm light instead of 820-nm light to visualize the anterior chamber. The former wavelength allows for better visualization of the angle, cornea, iris, and lens, because the light infiltrates farther through tissues that scatter light such as the sclera and limbus. AS-OCT has a high resolution (10 µm axially and 30 µm transversally for the CASIA SS-1000 [Tomey Corporation]). Unlike UBM, AS-OCT is noncontact and does not require a highly skilled technician. The acquisition of images is rapid (30,000 A-scans/sec, with horizontal and vertical planes scanned simultaneously in 0.2 seconds for the CASIA SS-1000). As a result, many images can be obtained in one session. Three-dimensional reconstruction of the angle for 360° is also possible.

AS-OCT permits the quantitative, reproducible measurement of angle parameters. Common parameters in the literature are TISA, AOD, and angle recess area, usually 500 to 750 µm away from the scleral spur (Figure 2). The measurement of these distances requires the identification of the scleral spur, which may not always be visible, and, at this point, must always be performed manually. Recent research by my group has shown that the reproducible identification of a specified landmark using predetermined criteria (scleral spur landmark) is possible and results in the reproducible measurement of TISA750 and AOD750 (Figure 2).

Additional parameters being investigated include iris volume and thickness, the trabecular meshwork, and trabecular iris circumference volume. Imaging artifacts such as shadows are also being investigated to determine if there is any clinical correlation with the artifacts seen, as evident with macular thickness and pathology on retinal OCT.

In addition to imaging angle parameters, AS-OCT has been able to quantify opening of the angle after laser peripheral iridotomy and after cataract extraction. AS-OCT cannot visualize the ciliary body, however, and therefore cannot delineate plateau iris.

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Do you regularly use anterior segment imaging when evaluating a patient for angle closure?

☐ Yes
☐ No

Figure 2. AS-OCT depicts the angle opening distance (AOD) and trabecular iris surface area (TISA). SSL, scleral spur landmark.
CONCLUSION

Although investigators and clinicians are just beginning to understand the capabilities of anterior segment imaging, this tool is already becoming valuable for diagnosing, treating, and conducting research on angle closure. Future studies will provide more insight into this disease and how best to treat it.

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Robert M. Feldman, MD, is the Richard S. Ruiz, MD distinguished university chair, professor, and chairman of the Ruiz Department of Ophthalmology and Visual Science, The University of Texas Medical School at Houston and Robert Cizik Eye Clinic, Houston. He has been loaned a CASIA SS-1000 by Tomey Corporation.

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