How Valuable Is Anterior Segment Imaging?

Imaging devices are useful for further screening after first-line diagnostic assessment.

BY SHAN LIN, MD

The primary value of anterior segment imaging in glaucoma care is for the detection and quantification of angle closure. Angle-closure glaucoma (ACG) is a major cause of blindness worldwide. It should be distinguished from open-angle glaucoma, because the treatment algorithms for each disease differ significantly, with potentially devastating results for patients in whom angle closure is not identified. The prevalence of ACG is especially high among Asians: in China, ACG is the leading cause of bilateral blindness. That said, although ACG and the anatomic risk factors for this disease are most often identified in Asians, the prevalence of this disease is not insignificant in whites.

Even as the role of anterior segment imaging in glaucoma care grows, many glaucoma specialists are questioning if it is imperative to have such a device in the office, especially if gonioscopy is the gold standard for assessing closed angles.

GONIOSCOPY

Gonioscopy has many advantages, including rapidity of use, low to no expense, the ability to distinguish synechial from appositional closure, a 360° view, and a direct view of the angle recess. Unfortunately, gonioscopy is also subjective and thus has a lot of variability. Moreover, the technique is uncomfortable for both the patient and the surgeon. It is generally accepted that inadvertent compression during gonioscopy with a Zeiss-style lens may lead to artifactual opening of the angle and erroneous grading by the examiner.

Perhaps the greatest limitation of gonioscopy is its lack of use. The examination is not performed in most glaucoma cases, possibly because many physicians feel that the assessment of the Van Herick grading is sufficient to determine occludability of the angle. The approach’s correlation with gonioscopy, although good,
is not perfect, however, and there is a high probability of missing clinically significant cases when only the Van Herick method is used. Also, peripheral anterior synechiae or vertical quadrants cannot be viewed with this technique.

**ULTRASOUND BIOMICROSCOPY**

Ultrasound biomicroscopy (UBM) is a relatively low-cost imaging technology that typically ranges from 25 to 75 MHz and has a resolution of about 50 µm (Figure 1). Traditional UBM involves the placement of an eyecup and a coupling solution for transmission of the echogenic signal while the patient is supine. More recent advances include containment of the coupling solution within a condom tip or plastic tip that is placed directly on the ocular surface. UBM captures cross-sectional images of the anterior segment, typically to a depth of 5 mm. Compared to optically based devices, UBM has the advantage of penetrating the iris and imaging the ciliary processes, important for distinguishing the anatomy of the plateau iris from other causes of narrow or closed angles (Figure 2).

Disadvantages of UBM include the need for a skilled technician, the potential for corneal abrasion or discomfort due to its contact nature, the possibility of ocular compression if the contact tip is used, and the difference in anatomy related to supine positioning for the eyecup approach.

**OPTICAL COHERENCE TOMOGRAPHY**

AS-OCT obtains a high-resolution cross-section of the anterior segment without touching the eye. The resolution can be up to 5 µm with Fourier-domain OCT (FD-OCT). The Visante OCT (Carl Zeiss Meditec) is a time-domain OCT device that scans the anterior segment, generating images that extend from limbus to limbus. FD-OCT units intended for posterior segment imaging are increasingly evolving to include anterior segment imaging. Compared to traditional time-domain AS-OCT devices, FD-OCT units have shorter wavelengths (typically 800-840 nm) and are less able to penetrate the angle recess. Although limbus-to-limbus scans are possible, the top of the cornea is usually removed from the image, because there is a limited depth of imaging.

A new swept source FD-OCT device (Casia SS-1000; Tomey Corporation) can rapidly obtain high-resolution scans with three-dimensional reconstruction of the anterior segment. Using a 1,310-nm light source, similar to the Visante OCT, the Casia SS-1000 can penetrate the angle recess. Approval of the device by the FDA is pending.

Downsides of OCT include a relatively high cost and an inability to image deep to uveal tissues, including the iris.

**OTHER MODALITIES**

Other modalities for imaging the anterior segment include the Scanning Peripheral Anterior Chamber Depth Analyzer (model SM-70; Takagi Seiko) and the EyeCam (Clarity Medical Systems). Although the former is a noncontact device and is relatively inexpensive, it has poor resolution and often provides poor visualization of the angle recess. The EyeCam uses the RetCam (Clarity Medical Systems) to allow gonioscopy-like imaging of the angle. It requires direct contact with the eye using a coupling agent.

**CLINICAL RECOMMENDATIONS**

In my opinion, slit-lamp examination and gonioscopy are still the first line of diagnostic assessment for angle closure. If found to have narrow or closed angles, my patients undergo AS-OCT for further screening. I also order AS-OCT imaging to determine if the angle has opened adequately after a laser peripheral iridotomy. I may request UBM when I suspect plateau iris, iris cysts, a tumor, or other secondary causes of angle closure.

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Anterior segment imaging is an important facet of glaucoma care. The various devices have their own pros and cons, and the decision to use these modalities depends on their cost, technicians’ expertise, and medical professionals’ clinical preferences.

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1. Do you currently use anterior segment imaging in your practice?
   - Yes
   - No

2. Are you considering purchasing a device to image the anterior segment?
   - Yes
   - No

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