

Evaluating the Anterior Chamber Angle

A combination of techniques can yield a clear picture.

BY ROBERT M. FELDMAN, MD

Because anatomy plays a large role in chronic angle closure, evaluating the angle anatomy is a critical first step in treating this disease. Gonioscopy is the current gold standard, but imaging techniques such as ultrasound biomicroscopy (UBM), Scheimpflug photography, and anterior segment optical coherence tomography (AS-OCT) provide additional valuable information. Using a combination of these techniques to evaluate the angle will give the examiner a clear picture of the angle anatomy and help him or her to make appropriate treatment decisions.

GONIOSCOPY

Gonioscopy provides the examiner with a dynamic, broad view of the angle. The ability to analyze the angle under compression and without compression allows him or her to differentiate peripheral anterior synechiae (PAS) and appositional irido-trabecular contact. The extent of PAS may affect treatment decisions.¹

Although gonioscopy is quick, inexpensive, and valuable, it is also subjective and difficult to perform. Reproducible, quantitative information cannot be obtained. Two examiners looking at the same angle often disagree on what they see. This technique is therefore less than ideal for research and in clinical situations where repeated measurements are needed.

SCHEIMPFLUG IMAGING

This technique uses light scattering to image the anterior chamber.^{2,3} Although the resolution of the images is high (4 μ m laterally and 1 μ m axially for the Galilei Dual Scheimpflug Analyzer [Ziemer Ophthalmic Systems]), this method is of limited usefulness for evaluating the angle because of its inability to image the peripheral angle in many eyes.

ULTRASOUND BIOMICROSCOPY

Because it uses sound waves, which penetrate the iris, UBM can image the ciliary body and sulcus.⁴ The technique can be used to visualize the anterior rotation

of the ciliary body present in plateau iris syndrome. Unfortunately, the resolution with UBM is lower than that of other techniques (50 μ m laterally and 25 μ m axially²). In addition, this is a contact-dependent technique, and it requires an experienced and skilled technician to avoid distortion of the angle anatomy. Although quantitative studies have been conducted using UBM,^{5,6} other techniques provide better reproducibility and image quality.

ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY

Advantages and Developments

AS-OCT adapters are available for many retinal optical coherence tomographers (such as those made by Heidelberg Engineering, Carl Zeiss Meditec, and Optovue).

These adapters do not change the wavelength, and although they offer quality scans, they cannot image the angle recess in some eyes. Dedicated AS-OCT uses 1,310-nm light to visualize the anterior chamber. Unlike the 820-nm light used in posterior optical coherence tomography, this wavelength infiltrates farther through tissues that scatter light (sclera and limbus) and thus allows for better imaging of the cornea, iris, angle, and lens.² AS-OCT has a high resolution (10 μ m axially and 30 μ m transversally with the CASIA SS-1000 [Tomey]), and many images can be obtained in one session (30,000 A-scans/s, with horizontal and vertical plane scanning simultaneously). Additionally, with this number of images, 360° reconstruction is possible for a three-dimensional view of the angle.

AS-OCT imaging and its use for the anatomical characterization of angle closure is currently a very active area of research. The effect of treatments such as laser peripheral iridotomy and lens extraction can now be studied in a reproducible, quantitative fashion.⁷⁻¹⁰ With newer swept-source Fourier domain AS-OCT (such as is available with the CASIA SS-1000), quantitation of a greater number of angle parameters is possible.



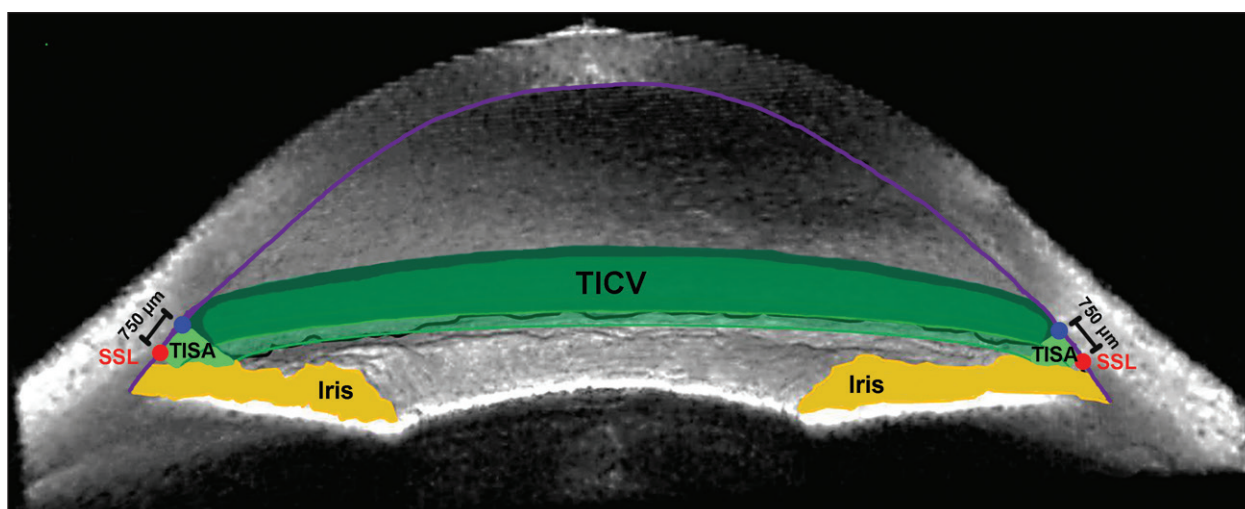


Figure. TICV. A three-dimensional AS-OCT image exhibits TISA at 750 μm (TISA750) from the scleral spur landmark (SSL; red circle) and TICV750 (darker green spaces), along with the iris (yellow) and cornea (violet line).¹²

The CASIA SS-1000 produces images of 128 meridians (256 angles or every 1.4°) in 2.4 seconds, more than previously available. This gives a much deeper view of the peripheral angle. Moreover, it allows greater quantitation of not only the angle itself but also of other factors that affect its anatomy such as the iris, which has not been as well characterized and may play a greater role in angle-closure disease than previously realized. Common angle parameters studied include angle opening distance and trabecular-iris space area (TISA).

In order to measure these angle parameters reproducibly, the scleral spur must still be manually identified and placed. Previous research by my group showed that reproducible identification of a scleral spur landmark is possible, leading to the reproducible measurement of angle opening distance and TISA.¹¹ From this, we were able to develop a new parameter, trabecular-iris circumference volume (TICV; Figure) and recently published a database of TICV values for normal eyes with open angles.¹² We now have the ability and sensitivity of measurement to evaluate the peripheral angle, which is probably more important in the puzzle of angle closure than overall anterior chamber depth. AS-OCT also allows us to measure eyes with irregular angles, such as those with irregular PAS. In addition, AS-OCT can quantify changes in the angle after treatment (such as after laser peripheral iridotomy or lens extraction), possibly promoting better and more definitive treatment decisions.

Drawbacks

Although AS-OCT offers many advantages, it also has several important disadvantages. For one, it cannot distinguish between PAS and irido-trabecular contact, which is very important in treating angle-closure disease.

Second, AS-OCT cannot confirm a diagnosis of plateau iris, because the light wavelength does not penetrate beyond the iris to visualize the ciliary body in most eyes.

CONCLUSION

Evaluating the anterior chamber angle anatomy is crucial to treatment. Many techniques are available, and when used together, they can provide a detailed description of the angle that is useful both clinically and in research. ■

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