

# A New Approach to Imaging the Angle

The RetCam makes gonioscopy fast, easy, and effective.

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**T**he phrase *a picture is worth a thousand words* certainly applies to the field of ophthalmology, where photographic documentation serves as a bridge between the past and the present.

Capturing these images, however, may not be easy, especially in the iridocorneal angle. The pairing of a mirrored gonio lens and a photographic slit lamp has been the mainstay of imaging the angle. Unfortunately, patients often blink, squeeze their eyelids together, squirm, or lean away just as the operator swings the slit beam into position to take the photograph. The success of standard gonioscopy therefore requires considerable photographic skill, effort, and expertise at the slit lamp; a full knowledge of the angle structures; and an excellent ability to manage the patient.

A new option for photography in glaucoma is the RetCam (Clarity Medical Systems, Inc., Pleasanton, CA). This wide-field, contact fundus camera has traditionally been used in the management of pediatric retinal diseases such as retinoblastoma, retinopathy of prematurity, and shaken baby syndrome.<sup>1-6</sup> Although the camera was designed to photograph the fundus, it is not limited to this purpose. A technical modification allows the camera to provide excellent photographic documentation of a variety of pathologies affecting the angle, iris, and lens.

## THE RETCAM ANGLE TECHNIQUE

The RetCam family embodies three generations of systems, with the most recent product release known as the RetCam Shuttle

(Figure 1), a portable device. All of the systems can directly image the angle, and they share hardware consisting of a handheld digital video camera connected fiberoptically to a light-emitting control unit and computer assembly. The operator controls focus, illumination, and the acquisition of images with a foot switch. Images are automatically captured to a DVD-RAM disc and/or to a computer. Alternatively, a short video stream can be captured to the RAM of the computer with still frames saved from the video at the end of the imaging session. The video mode helps to overcome

movement on the part of the patient or operator and thus allows for the acquisition of clear, well-focused frames.

For the anterior segment, the operator uses the same lens as for imaging infants; specifically, the 130° fundus lens (also known as the ROP [retinopathy of prematurity] lens) is attached to the camera. Instead of sitting at the slit lamp, subjects are in a semisupine position on a bed or reclining chair, while the operator approaches them from behind the top of their heads. To maintain a reproducible point of reference, the operator should keep the cable connecting the camera to the RetCam's mainframe in a 12:00-o'clock orientation to the patient.

Subjects will require topical anesthetic drops. The operator should place a viscous coupling gel (eg, GenTeal Gel; Novartis Pharmaceuticals, East Hanover, NJ) on the smooth concave surface of the lens' tip to provide an optical coupling bridge between the camera and the eye and permit a direct view of the angle. The process can be thought of



Figure 1. The RetCam Shuttle system.



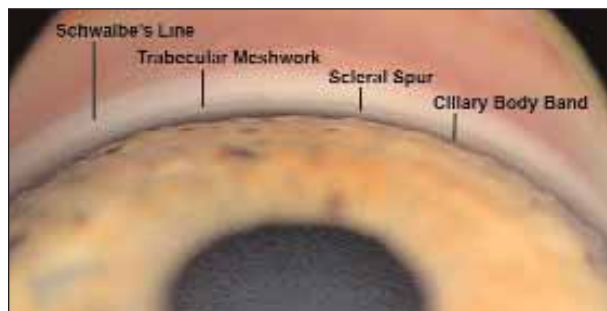
**Figure 2.** For direct imaging of the angle, the lens in coupling gel is placed at the opposite limbus (nasal) and directed toward the opposite angle (temporal).

as building a Koeppe lens at the tip of the camera. The camera need not touch the globe if a generous amount of gel is applied.

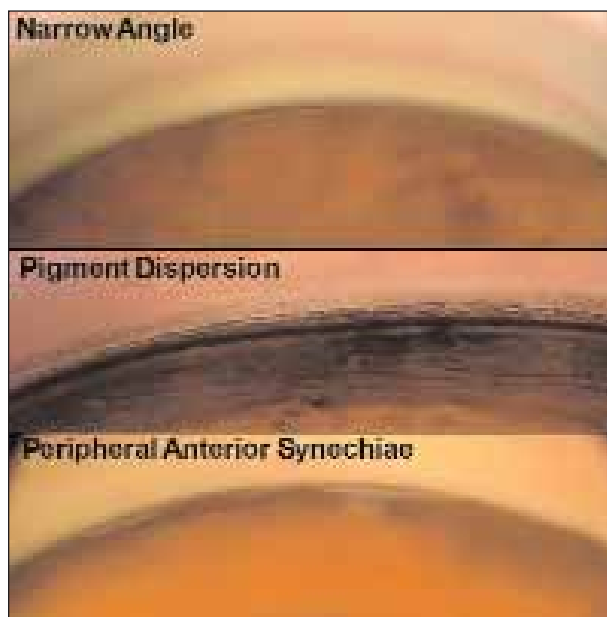
The RetCam's user gently holds the patient's eyelids open and instructs him to look in the direction of the angle being imaged (Figure 2). After placing the camera at the opposite limbus of the iridocorneal angle to be photographed, the operator instructs the patient to look away from the light. To view the inferior angle, for example, the patient should look down. The operator then lifts the patient's upper eyelid, places the camera at the superior limbus, and directs it toward the inferior angle. Illumination and focus are adjusted based on a real-time view of the image displayed on the computer's monitor.

### PATIENTS' COMFORT

Several advantages to the mechanics of the RetCam technique facilitate successful imaging of the angle. Because patients are supine, their heads are supported, and they cannot pull away from the camera lens' tip—a common problem when using gonio lenses. The tip of the RetCam's lens is also smaller than the standard gonio lens and does not sit on the patient's lower eyelid. In fact, gonioscopy is performed in a noncontact fashion, because the camera's tip is suspended within coupling gel. Patients are therefore less likely to squeeze their eyelids shut and to struggle against the stimulus of a foreign object in their eyes. Because the illumination



**Figure 3.** This angle is normal.



**Figure 4.** Glaucomatous pathology is visible, including a narrow angle, pigmentary dispersion, and peripheral anterior synechiae.

from the camera sweeps across their pupils, patients are also less likely to experience discomfort from the light's intensity, so angle-related artifact from pupillary constriction is minimal.

In our experience, patients undergoing imaging with the RetCam find the technique to be comfortable and noninvasive.

### WHAT IS ACTUALLY VISIBLE?

The anterior chamber angle is hidden from direct external observation, because oblique viewing exceeds the critical angle of the cornea. Light illuminating the angle is completely refracted back into the eye when it hits the corneal interface, thus obscuring the observer's view. To bypass this problem of optics, clinicians use a contact gonio lens to neutralize the corneal reflex and allow the light to travel beyond the corneal layers to a



Figure 5. The authors assess the pathology of an angle, which includes the ostium from filtering surgery, a tube shunt (New World Medical, Inc., Rancho Cucamonga, CA), and posttraumatic angle recession.

camera or viewer.

The RetCam 130° lens is engineered to document a posterior concave or curved surface of the fundus with great depth of field and a wide angle of view. We found that this design suited the camera to photographing the horizontal curved surface of the angle structures. When in contact with the eye through coupling gel, the concave tip of the RetCam 130° lens neutralizes the corneal reflex so that the camera becomes an all-in-one device for imaging the angle.

With the RetCam, it is easy to identify and photograph angle architecture such as the ciliary body band, trabecular meshwork, scleral spur, and Schwalbe's line (Figure 3). One can also readily assess pigment, the angle's grade, and the iris' profile in eyes with various abnormalities of the angle/iris, including angle closure, pigment dispersion, iris lesions, and peripheral anterior synechiae (Figure 4). Moreover, the RetCam readily captures detailed postoperative images of the trabeculo-Descemet's window after nonpenetrating glaucoma surgery, the internal ostium after trabeculectomy, and the tube's position after its implantation (Figure 5).

## CONCLUSION

Using the RetCam to image the angle of adults and children eliminates the need for auxiliary gonio lenses and makes gonioscopy fast and easy. Furthermore, because the technique is relatively straightforward, operators should be able to achieve excellent photographic results with minimal training. To our knowledge, this is the first reported use of the RetCam for direct imaging of the angle.

The immediacy offered by the real-time view of the camera on the computer monitor can also serve as an excellent tool for training residents, fellows, and ophthalmic personnel to identify variability in angles and localize subtle pathology. For the novice photographer or ophthalmic technician, live viewing on the monitor easily facilitates guidance by the physician. In addition, the rapid acquisition of these images has the potential to augment patients' and their caregivers' understanding of the nature of glaucoma.

We have found that adults who have undergone both standard gonioscopy and RetCam gonioscopy find the latter method to be more comfortable, because they are supine and the light from the camera is directed across the irides' aperture instead of directly into their eyes. The described technique minimizes compression and light artifact. The new application for the RetCam should significantly enhance the use of a camera as a clinical, educational, and research tool; it provides documentation of angle structures that can be otherwise difficult to achieve. □

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