High-Speed Optical Coherence Tomography of Laser Iridotomy

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PURPOSE: To describe high-speed (4000 axial scans/s) optical coherence tomography (OCT) findings in a patient with narrow angles.

DESIGN: Interventional case report.

METHODS: A 56-year-old woman was found to have occludable narrow angles on OCT screening. This was confirmed by gonioscopy. Bilateral iridotomy was performed. Imaging of the angles was performed with a high-speed OCT prototype before and after iridotomy.

RESULTS: OCT showed narrow angle bilaterally. Cornea, sclera, scleral spur, trabecula, iris, and iris recess were visualized. After iridotomy, the OCT showed reduction of iris concavity and patent iridotomies. Quantitative measurements of trabecula-iris space area on the OCT images showed widening of the angles to nonoccludable values.

CONCLUSIONS: A 1.3-μm wavelength OCT allows noncontact quantitative assessment of the angle and may be useful in the management of narrow-angle glaucoma. (Am J Ophthalmol 2005;xx:xxx. © 2005 by Elsevier Inc. All rights reserved.)

ACUTE ANGLE-CLOSURE GLAUCOMA IS A CONDITION that may lead to blindness. Patients with occludable narrow angles should have prophylactic laser iridotomy to avoid acute angle-closure crisis.[1] Angle anatomy should be carefully evaluated to help diagnosing this anatomical variation. Most of the examinations to evaluate angle anatomy are direct-contact examinations (gonioscopy, ultrasound biomicroscopy).[2] The 1.3-μm wavelength optical coherence tomography (OCT), a high-speed (4000a-scan/s) wide-field (15 mm) OCT system, allows noncontact visualization of anterior segment and angle anatomy. The longer wavelength allows greater penetration through highly scattering tissue such as limbus and sclera. This study was approved by the Cleveland Clinic institutional review board and is HIPAA compliant.

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PATIENT AND METHODS

A 56-YEAR-OLD WOMAN WAS FOUND TO HAVE NARROW angles during an anterior segment OCT examination at our institution. She was referred to the glaucoma specialist, and a complete ophthalmologic evaluation was performed. Bilateral Nd:YAG laser iridotomy was proposed.

Anterior segment OCT measurements were performed as followed: a 17-mm linear scanning laser beam oriented at 180 degrees was positioned at the center of the pupil to acquire the image. The trabecula-iris space area (TISA) parameter was measured. TISA is an area bordered anteriorly by the corneal endothelium (extending from the scleral spur to a point 750 μm anterior to the scleral spur), a line drawn perpendicular to the corneal endothelium at a point 750 μm anterior to the scleral spur and extending to the anterior iris surface, a line drawn perpendicular to the corneal endothelium at the scleral spur and extending to the anterior iris surface, and a line along the anterior iris surface that encloses this roughly trapezoidal area. This parameter classifies individuals with narrow angles, and the cutoff value is 0.12 mm^2 (sensitivity 100%, specificity 95.7%). The angle anatomy analysis revealed bilateral narrow angles (TISA = 0.054 mm^2 nasal and 0.099 temporal right eye [OD]; and 0.064 mm^2 nasal and 0.089 temporal left eye [OS]). Furthermore, other intraocular structures such as cornea, iris, and anterior surface of the lens were also clearly appreciated (Figure 1). F1

Five days later, the patient underwent an uneventful Nd:YAG iridotomy at 10 o'clock on the right eye and at 1 o'clock on the left eye.

One week after iridotomy, another anterior segment OCT was performed. Once again, the image was obtained with a 17-mm linear scanning laser beam oriented at 180 degrees, which was positioned at the center of the pupil (Figure 2). Additional 17- and 7-mm linear scanning images F2 were taken at the iridotomy site (Figure 3). An increase in the F3 anterior chamber angle was found in all images obtained after iridotomy (TISA = 0.268 mm^2 nasal and 0.291 temporal OD; and 0.342 mm^2 nasal and 0.354 temporal OS).

RESULTS

IN EYES WITH OCCLUDABLE NARROW ANGLE WITH RELATIVE pupillary block, the iris assumes a convex configuration. According to Tiedeman,[3] before iridotomy, the dilator and sphincter muscles and the iris root create the forces that act within the iris, which stabilizes the iris at the root and pupillary border. In case of a relative pupillary

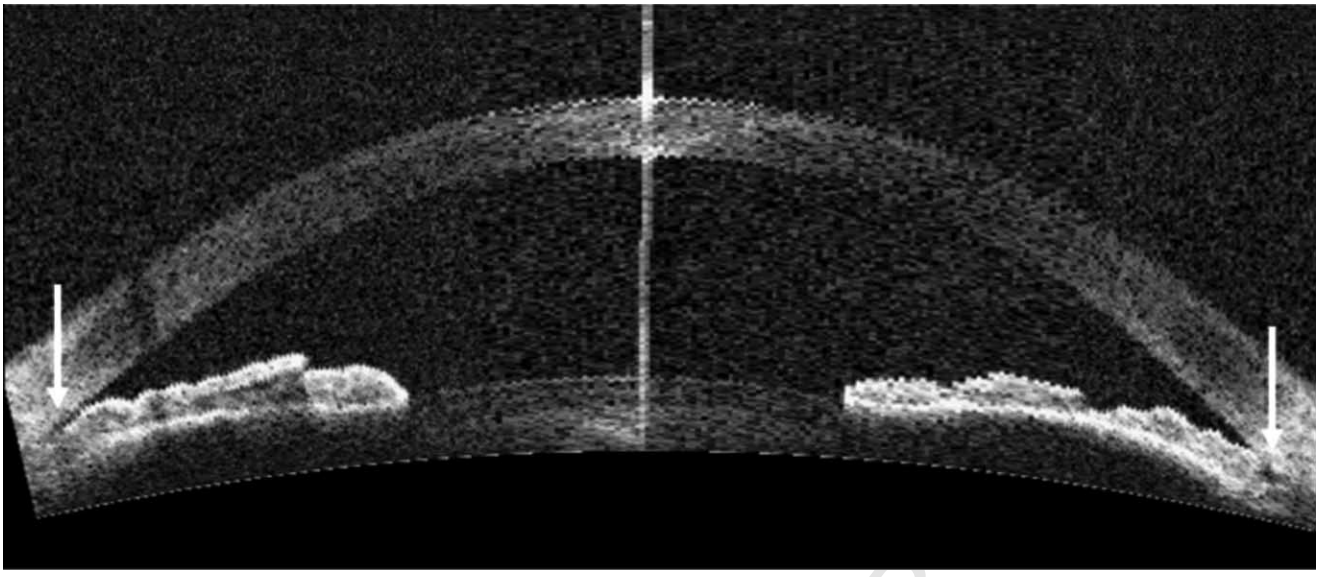

FIGURE 1. Horizontal optical coherence tomography (OCT) (15.5 × 6.0 mm) in the right eye (OD) before iridotomy in a patient with occludable narrow angles (arrows). The temporal angle (left) is open by a slit (trabecula-iris space area [TISA] = 0.099 mm^2) and the nasal angle appears closed (TISA = 0.054 mm^2), with iris contact above the scleral spur.

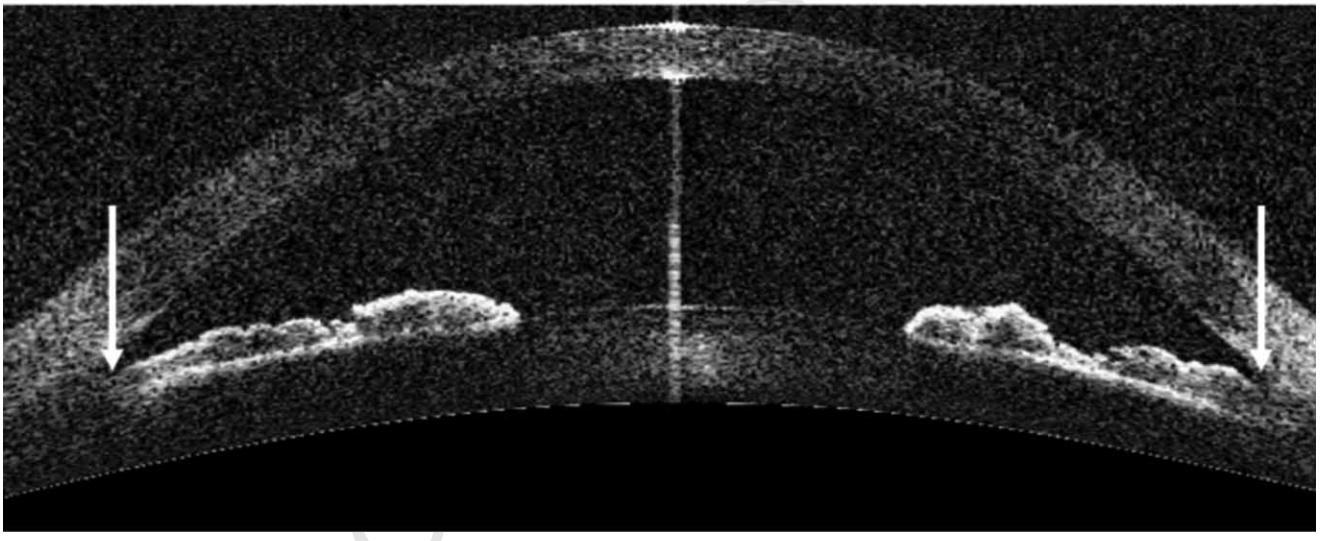

FIGURE 2. Horizontal OCT OD after iridotomy. The angle is open both temporally and nasally (TISA = 0.29 & 0.27 mm^2) as judged by the space between the iris and the trabecula, which is just anterior to the scleral spur (arrows).

block, an anterior displacement of the iris is created by the greater hydrostatic pressure in the posterior chamber, and the iris assumes a convex shape. Laser iridotomy releases pupillary block by allowing aqueous to pass from the anterior chamber flattening the convex iris and increasing the anterior chamber angle. This was already demonstrated by UBM.[4,5]

AQ: 2

DISCUSSION

SOME OF THE ADVANTAGES OF THE ANTERIOR SEGMENT OCT examination are that it shows the same structures appreciated with the UBM in a noncontact and nonpainful manner. Moreover, this novel technology allows us to achieve a scanning size as large as 17 mm, accomplishing the capacity to fit the whole cross section of the anterior chamber in a single scanning shot. Conversely, the UBM requires a composition of the segment images to achieve the same picture, which ultimately does not represent a real cross-sectional image.

In conclusion, the improvement in penetration and speed of 1.3-μm wavelength OCT allows noncontact detailed visualization of the anterior segment and angle anatomy. These advantages mean that this technique will

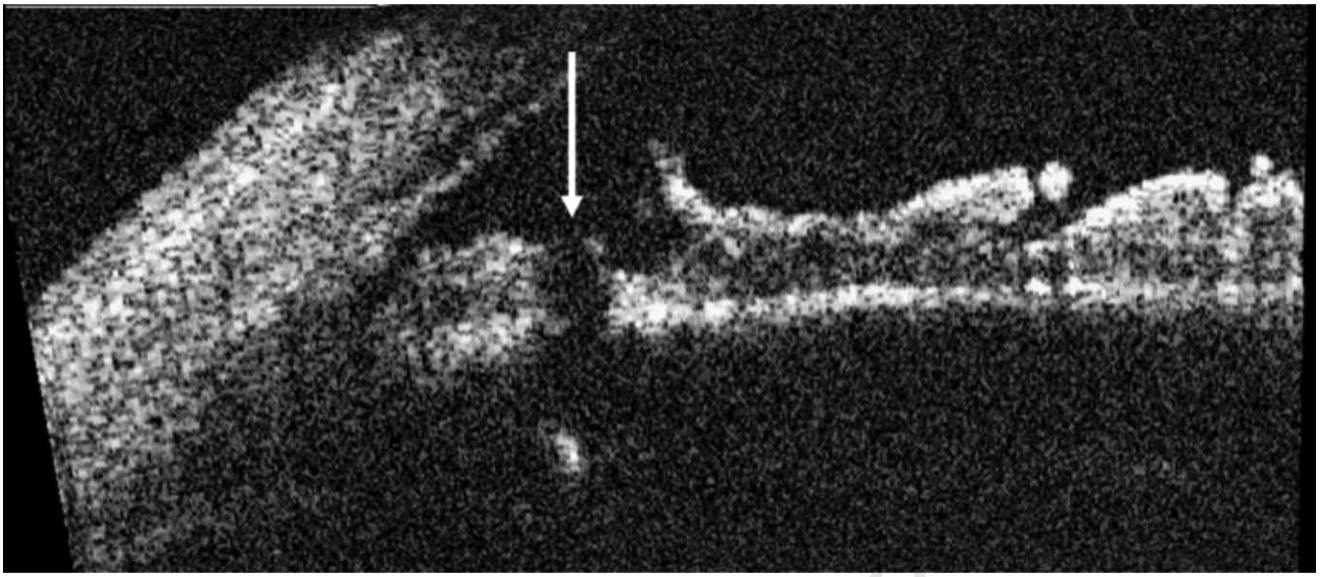

FIGURE 3. OCT scan (7.0 × 4.0 mm) across the iridotomy OD show the channel through the whole thickness of the iris (arrow).

likely play a role in the diagnosis of anterior segment pathologies.

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