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Special Section: Diagnostics & Imaging

Ultrasound system

A new view on imaging the anterior segment

Having a clear picture helps improve our understanding and diagnostic capabilities

By E. Randy Craven, MD
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Ultrasound imaging is the only technology available today that provides anterior segment surgeons with a full view of the entire anterior segment—so much so that it almost is possible to underestimate its value.

Although the ophthalmic ultrasound system (Eye Cubed, Ellex) has been around for years, and it represents the gold standard in ultrasound imaging for the retina, we have recently incorporated the third version of this system, with its high-frequency B-probe, into our practice.

Previously, ultrasound primarily meant A-scan biometry for us. With the addition of the newer system, we've started to change the way we use the technology because of its unique ability to image all aspects of the anterior segment. As a key differentiator to optical coherence tomography, the ophthalmic ultrasound system enables us to see behind the iris and create dynamic movies rather than static images.

What sets this ophthalmic ultrasound system apart from the others is its ability to perform high-resolution, wide-field imaging. With ultrasound, resolution is based on the frequency of the probe. The area of view can be widened by an oscillating head. The wide-field anterior segment B-scan has a 20-MHz scanning (oscillating) system, providing exceptional resolution—0.075 mm of axial and 0.09 mm of lateral.

The system also offers a 30° image field with a depth of up to 12 mm, which means that we can see the entire lens apparatus, as well as the zonules and ciliary muscles—areas that we really haven't been able to visualize previously. According to the manufacturer, this is due to a high signal-to-noise ratio, which reduces noise to a minimum, thereby improving the quality of the resolution.

In addition, the system captures up to 10-second movies during the exam, with a sampling rate of 13 frames per second, the highest available today. That rate enables us to view movement in the anterior segment in real time, something that was not possible before.

In the time since we've added the ophthalmic ultrasound system, I've been putting the system to the test to see how we can benefit from its imaging capabilities. What I've found is that it is particularly useful in cases in which patients are experiencing issues with their IOLs, particularly premium IOLs, as well as in my patients with glaucoma.

Following are several case studies illustrating how the ophthalmic ultrasound system has helped improve our understanding and diagnostic ability.

IOL case studies

Case 1—A 57-year-old, who had undergone bilateral implantation of an apodized diffractive lens (AcrySof ReSTOR, Alcon Laboratories) just a few days earlier, arrived in our office presenting blurred vision in the right eye. Refraction showed a myopic error of –2 D in that eye.

Using the ophthalmic ultrasound system, I did a B-scan of the eye and discovered that the IOL was not properly positioned; it was not in the bag, but in the sulcus (Figure 1). This positioning certainly would explain

Take-Home Message

A new version of an ophthalmic ultrasound system (Eye Cubed, Ellex) has the unique ability to image all aspects of the anterior segment. As a key differentiator to optical coherence tomography, the ultrasound system, which has a high-frequency B-probe, enables the user to see behind the iris and create dynamic movies rather than static images.

'With the wide-field probe, we've been able to spot subtleties that we had never seen before.'

E. Randy Craven, MD

The imaging of the second eye, with the newer model [IOL] implanted, showed more of an anterior vaulting during accommodation. This result supported what the patient was experiencing: better vision with the second eye.

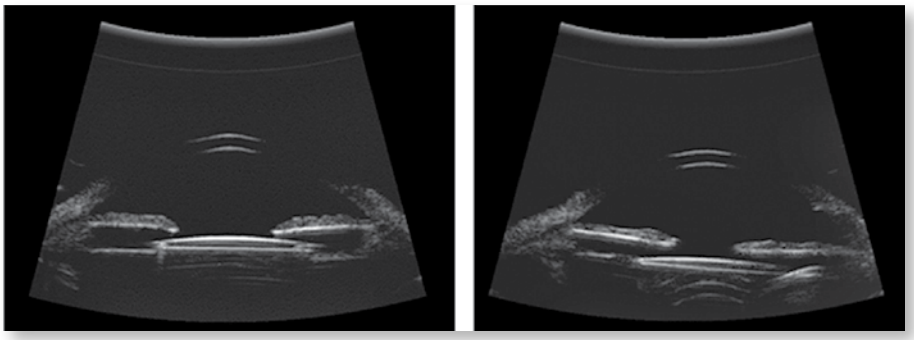


Figure 1 Ultrasound B-scan found that a jolt from a car accident had caused a newly implanted IOL to jump out of the capsular bag and become lodged in the sulcus, resulting in blurred vision in the right eye.

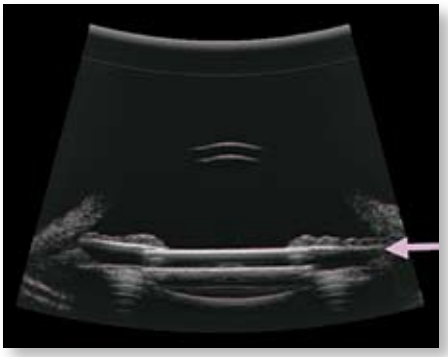


Figure 2 With the ophthalmic ultrasound system, it was possible to diagnose dysphotopsia in this patient and correct it by implanting a piggyback IOL that extended beyond the first IOL.

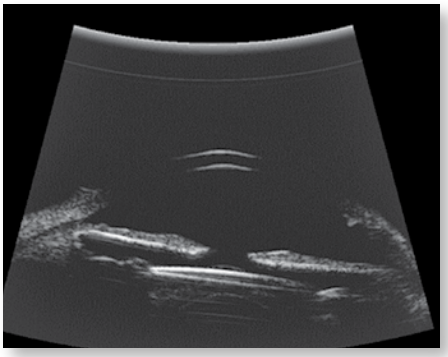
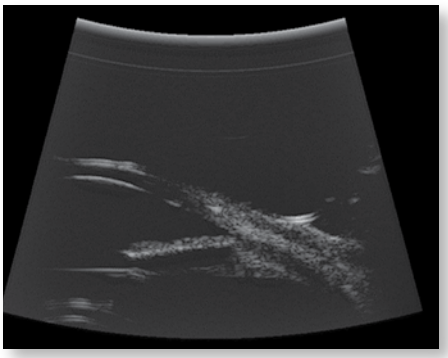


Figure 3 Using the feature that allows for the capture of short video clips, it was possible to watch how an accommodative IOL responds as the patient's eye focused.



Figures 4 and 5 The ophthalmic ultrasound system also is valuable in determining the presence of an open or narrow angle in glaucoma cases.

the myopic shift.

What went wrong? On the way home from the 1 day postoperative visit, this patient was involved in a car accident and suffered a significant jolt—one that was strong enough to vault the IOL out of the bag and into the sulcus.

Case 2—This patient came to see us complaining of dysphotopsia that she described as arcs of light. She already had been to several surgeons, asking that her IOL be removed, although refraction was 20/15. To treat the problem, we placed a plano, foldable IOL (Elastimide, STAAR Surgical) in the ciliary sulcus and in front of the IOL in the capsular bag.

Ultrasound imaging showed that this second IOL extended beyond the edge of the first IOL (Figure 2). This configuration helped to cut down on the unwanted arcs of light hitting the edge of the first lens, which were causing the dysphotopsia, and resolved the problem.

Case 3—How exactly accommodation works remains uncertain. Use of the ophthalmic ultrasound system can help us understand better what is happening during the accommodative process, both with natural lenses as well as in eyes that have phakic lenses. In the imaging work that we've done with the wide-field probe, we've been able to spot subtleties that we had never seen before.

An excellent example of this situation is a 64-year-old man who had received two accommodating IOLs (crystalens, Bausch & Lomb Surgical). He had great near vision in one eye, with a poorer result in his fellow eye. As it turned out, he had received two different models of the accommodative lens. In one eye, he had received a square-edge design IOL (AT45SE, Bausch & Lomb) in June 2006; in the second eye, he had received a new model with a different haptics design in March 2007.

When we imaged the eye with the

Focal Point

In patients with glaucoma, the wide-field B-scan imaging can be useful in determining what is happening with the angle, such as iris plateau syndrome and similar problems.

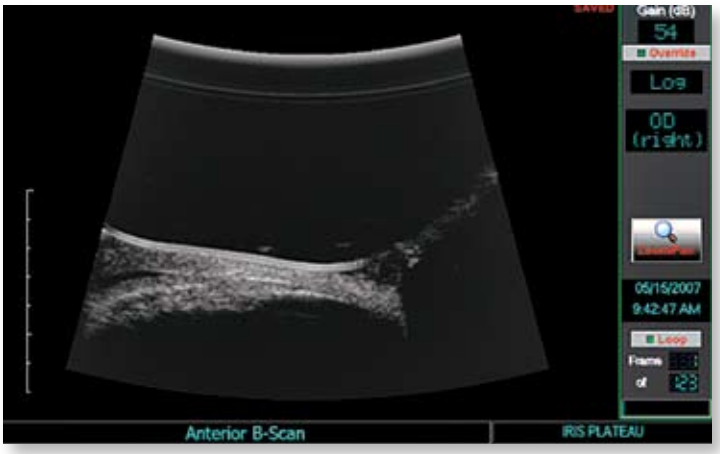


Figure 6 **Iris plateau syndrome in a patient with glaucoma with narrow angles.**

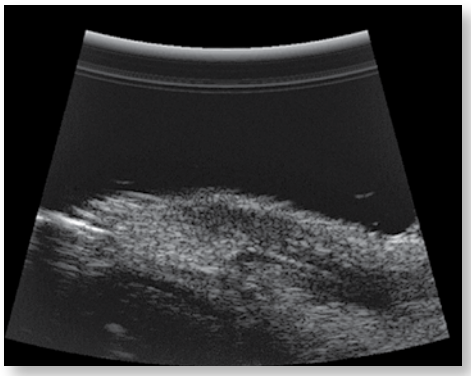


Figure 7 **Imaging helped to determine that the reason IOP did not drop in this eye was due to a non-functioning valve.**

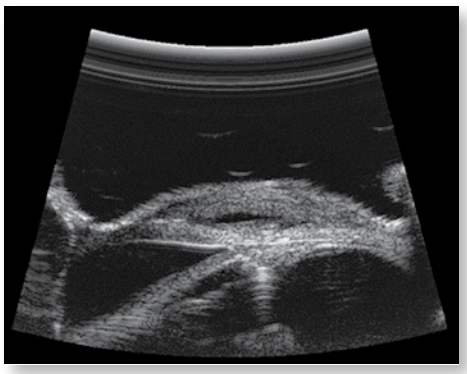


Figure 8 **The system also is useful in checking that a filtration bleb is functioning properly.** (Images courtesy of E. Randy Craven, MD)

older IOL model, it was possible to see the space between the anterior surface. The iris had shortened by about 1 to 1.5 mm during accommodation (Figure 3). A slight shift also occurred in the haptics of the IOL.

The imaging of the second eye, with the newer model implanted, showed more of an anterior vaulting during accommodation. This result supported what the patient was experiencing: better vision with the second eye. We elected to leave the IOL in the bag and live with some monovision because the IOLs seemed to be positioned correctly.

Imaging in glaucoma cases

In patients with glaucoma, the wide-field B-scan imaging really can be of use in trying to determine what is happening with the angle, such as iris plateau syndrome and similar problems.

Case 1—This is a great example of the imaging capabilities of the ophthalmic ultrasound system. In this eye, we can see the open angles and the angular anatomy showing an approximately 30° angular approach and then down toward the ciliary body (Figure 4).

Case 2—In this eye, the imaging showed a much different picture because the patient with glaucoma had narrow angles (Figure 5). With the wide-field ultrasound imaging, we were able to measure the anterior chamber depth and the papillary distance. We paused the image and used calipers to get the measurement.

Compared with the first glaucoma case, in which the angle is very open, in this eye, minimal definition of the angle exists, and the space between the iris and angle is narrow. In addition, some evidence of slight iris plateau syndrome was found because the iris is rotated slightly forward (Figure 6).

Case 3—Another area where wide-field high-resolution imaging is helpful in glaucoma is in eyes with a valve or tube implanted that is not functioning properly.

In case 3, the patient had a glaucoma implant (Baerveldt, Advanced Medical Optics) placed superiorly, with a glaucoma valve (Ahmed, New World Medical) placed inferiorly. When the IOP did not drop as we had expected after the valve was implanted, we used the ophthalmic ultrasound system to investigate.

The ultrasound showed no encapsulation and also no fluid moving around the plate (Figure 7), which indicated a tight capsule or no fluid coming through the tube due to a failure of the opening pressure to keep fluid draining. We found that the valve was not working at the time of surgery revision.

The ophthalmic ultrasound system also is useful in checking bleb function in patients with filtration. The wide-field system can help you clearly trace the path of the aqueous, as well as visualize the filter, helping to improve diagnosis if a bleb is not functioning as expected (Figure 8).

Our experience has found that the wide-field B-scan on the ophthalmic ultrasound system quickly has become one of the best diagnostic tools we have for helping to sort out anterior segment issues. The ability to have a live, dynamic image really helps to provide a clear picture of what is going on in the eye, which can help to determine better treatment options.**OT**

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