Bill Harvey takes a look at a new slit-lamp apparatus offering excellent anterior images and measurement capability

The advent of digital gonioscopy

ASSESSMENT of the anterior chamber is an important part of the eye examination but does present the optometrist with some problems. The curvature of the cornea means that light from the filtration angle itself hits the cornea at greater than the critical angle, meaning that it is not visible through direct viewing conditions without the use of a contact viewing lens. This technique is gonioscopy.

I bought my gonioscopy lens in the mid-1990s just prior to the vCJD scare, after which the technique was taken off the clinical skills syllabus at our university departments. Although increasingly being encouraged again, particularly where ophthalmologists are looking to involve optometrists in glaucoma monitoring, the technique is still not widespread in general practice.

So, in general, the commonest technique for anterior chamber assessment, particularly in predicting angle shut-down risk prior to dilation or in noting unexplainable asymmetry, is van Herick (VH) which should be familiar to most readers. There are problems with this, however, not least of all the difficulty in assessing the corneal section to cornea/iris gap ratio at the very edge of the cornea in older patients who have significantly reduced peripheral corneal transparency. These are the very patients where a good anterior chamber assessment is often essential. What often happens is the slit is moved further onto the cornea for clarity, so giving an artificially high grading. It is also important to remember that the ratio is assessed quite some way from the actual angle so it is not unreasonable to assume that the actual architecture of the angle may not always reflect the VH gap. I would argue that VH, if done accurately under identical conditions, is perhaps most valuable in detecting inter-eye asymmetry or in revealing changes in anatomy over a period of time.

Figure 1. The OCT unit is a small black box

Other techniques are useful. Depth assessment may be done by Smith's method on the slit lamp, pachymetry, ultrasound or Scheimpflug imaging. Angle detail and appearance can be assessed by ultrasound (particularly higher frequency) and gonioscopy. Obviously this is important as, irrespective of the potential for angle shut-down, much can be revealed from viewing of the angle, such as the potential for secondary open-angle blockage, anomalies of apposite iris, and so on.

Now there is a newer technique to add to the armoury which, in terms of its ease of use and accuracy of data analysis, is likely to become a standard technique in years to come.

SLIT-LAMP OCT

As far back as 1878, Albert Michelson hypothesised that, if it were possible to split a beam of light into two parts and then transmit them along perpendicular paths, it might be possible upon receiving the returning beams to detect any differences in phase between them. This difference or interference would give valuable data about the surfaces from which the light has been reflected.

In optical coherence tomography (OCT), a light beam is sent simultaneously to the eye and a reference mirror. The light penetrates retinal tissues and is reflected back. The returning light is compared to the reference and this allows software to reconstruct a representation of the underlying tissues. This ability to, in effect, show a cross-section through tissues makes the technique invaluable. OCT has been used for some time in retinal screening and analysis, as has been reported upon many times in *Optician*, but there are now anterior OCT instruments appearing on the market.

I was able to use the Heidelberg Slit Lamp-OCT (supplied by Haag Streit UK) recently. The instrument is an adapted slit lamp rather than a stand-alone dedicated unit which, I feel, offers some advantages for use to anyone familiar with a slit lamp, such as control over the positioning of the unit at different points on the patient eye.

The actual OCT instrument is a small black box not dissimilar to the old optical slit-lamp pachymeters from the 1960s and 70s (Figure 1). No set up is required. The slit lamp itself comes with an attached computer within the table so only the screen is next to the instrument (Figure 2). This makes the whole unit quite compact and easy to fit into a standard clinic environment.

USING THE INSTRUMENT

Using the instrument could not be simpler. Patient data is entered into the software as with any patient database. Once this is done the instrument is ready to use. The patient is positioned at the slit lamp as normal (Figure 3) and then the lamp is

Figure 2. The slit lamp comes with a computer

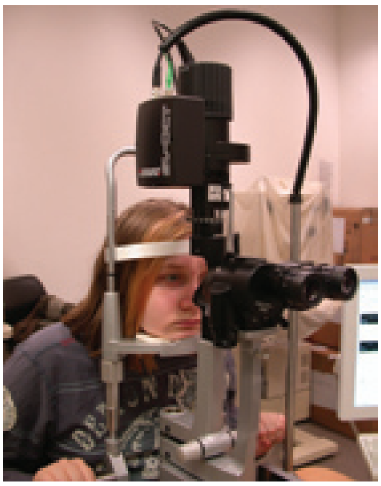

Figure 3. The patient is set up as normal

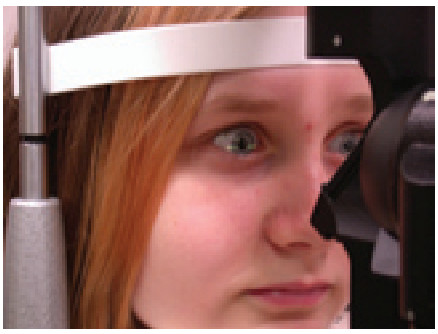

Figure 4. A horizontal beam is shone onto the patient's cornea

set so that a horizontal beam is shone onto the patient's cornea (Figure 4). At this stage the 1310nm infra-red light source scans horizontally across the patient's open eye. It is perhaps helpful to think about the process as similar to ultrasound but with an infra-red beam. In addition to the light beam directed onto the eye, a second parallel beam that covers the same distance is superimposed with the light reflected from the object. After the beams are detected, boosted and filtered by the photo diode, the signal is displayed as an A-scan (and a B-scan display combines 200 of these parallel A-scans).

As each scan, which takes just a couple of seconds, completes, the image gained appears on screen and a series builds up until the process is stopped by pressing a button on screen (Figure 5). From this sequence, the best images for examination may then be selected and ordered on the screen (Figure 6). Selection from this 'contact sheet' display allows single images to be selected and then analysed. Figure 7 shows an optimal image. It can be seen that there is a bright streak through the anterior pole of the cornea.

This is easiest to achieve by first encouraging the patient to blink minimally and maintain a steady gaze. I found the best method to ensure constancy of image was to, under highest magnification (16 times on this instrument), focus on the tear film such that dust in the tears was clearly visible. Centring the instrument can then be done visually and then refined by looking at the quality of image on the screen.

ANATOMICAL ANALYSIS

The instrument I used was still under beta-testing so some of the statistical

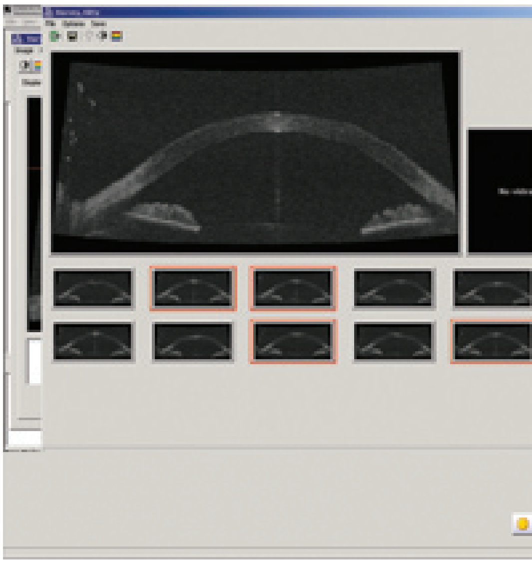

FIGURE 5

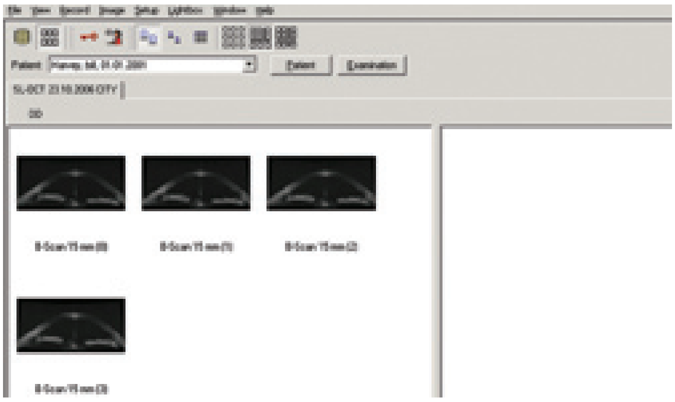

FIGURE 6

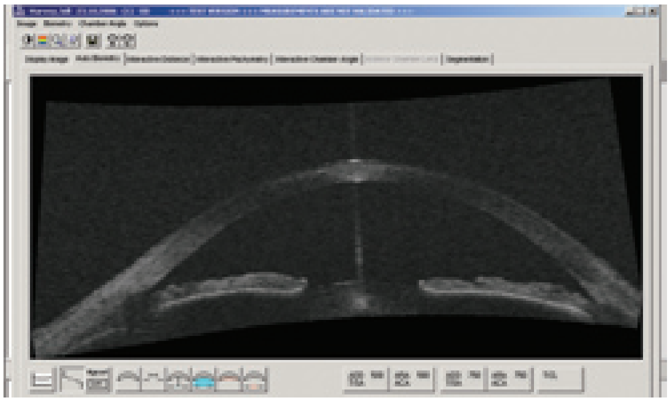

FIGURE 7

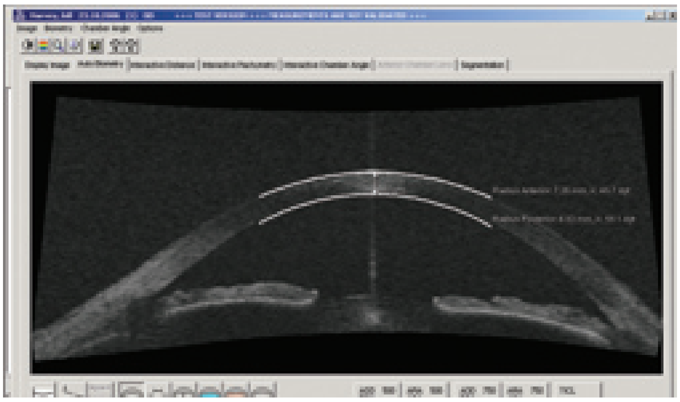

FIGURE 8

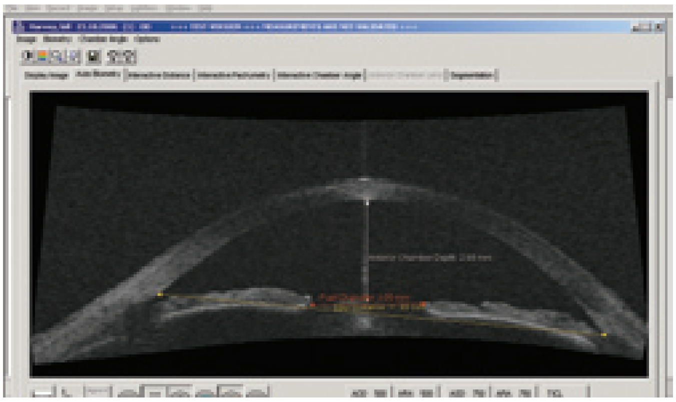

FIGURE 9

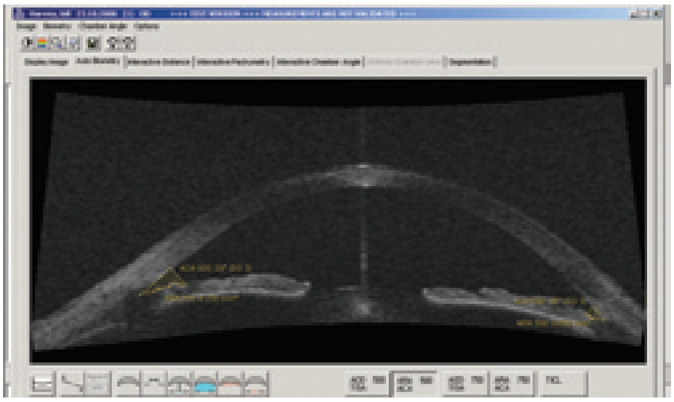

FIGURE 10

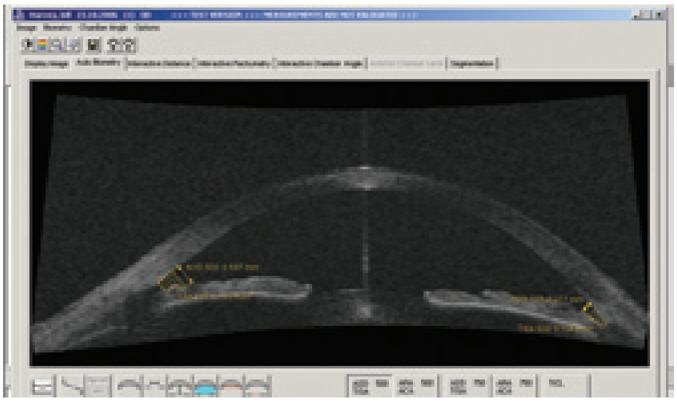

FIGURE 11

measurements cannot yet be validated. This is obviously not the case for the instruments about to be made available on the market.

After selecting the image for analysis, a number of interactive menus allow assessment of the anterior chamber. Selecting the autobiometry button gives a corneal thickness reading along with 'k's (Figure 8). Other buttons allow for anterior chamber depth, pupil size and the distance between the scleral spurs (Figure 9).

A feature I found particularly impressive was the ability to analyse the filtration angle structure, both in terms of the angle at 500 or 750 microns from the angle (Figure 10) and the size of the separation at these distances (Figure 11).

I was interested to compare these values with VH methods and sure enough the results were interesting. As the software was yet to be validated, these cannot be published as significant but a repeat trial would be a useful experiment. My own VH grade is 0.2 (grade 1 in the old parlance) and yet the openings and angles beyond what is normally visualised revealed an open and patent angle. I suspect this instrument, were it to be a realistic acquisition for optometrists, would sound the death knell for van Herick.

Other analyses include anterior chamber volume (Figure 12) and interactive pachymetry, a useful display allowing you to take pachymetry readings at specific points on the cornea, something useful for monitoring corneal ectasia conditions. This also allows the A-scan to be displayed alongside (Figure 13). An interactive distance display allows the A-scan along both meridians to be seen for selected points across the image (Figure 14). A colour display is also available (Figure 15) as well as the facility to zoom in on specific structures.

OPTOMETRY OF THE FUTURE

This was the easiest of instruments to use, the results were excellent and clinically useful, and I can see many applications for this. Digital gonioscopy, angle patency prediction, pachymetry, analysis of anterior chamber lesions, viewing structures through opacities and bleeds, to name but a few. The downside is that the set up, comprising instrument, slit lamp and computer, comes to £28,000. I can only hope that the market opens up among specialists first so that the demand leads to a price fall. I could certainly use one of these in practice.

◆ Further details are available from Haag Streit on 01279 414969.

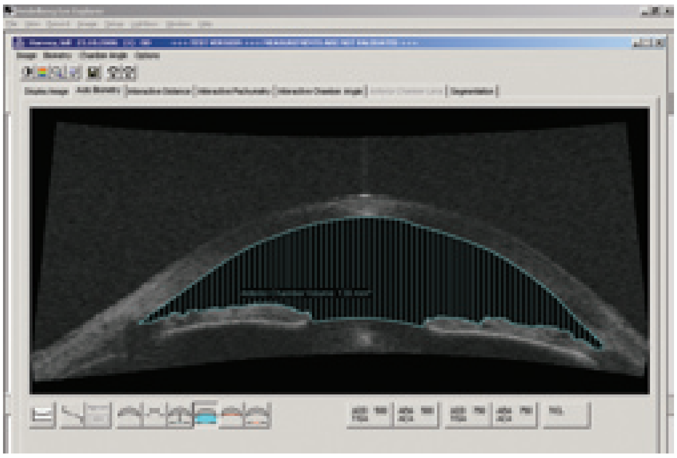

FIGURE 12

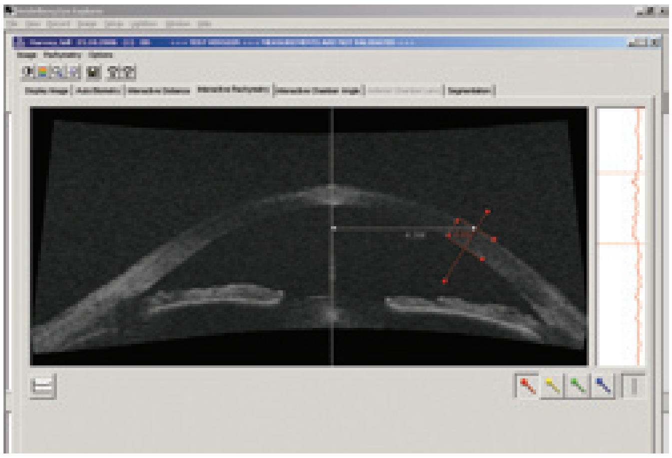

FIGURE 13

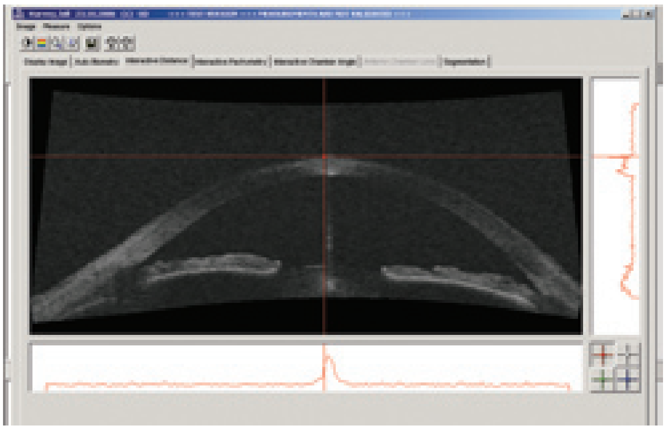

FIGURE 14

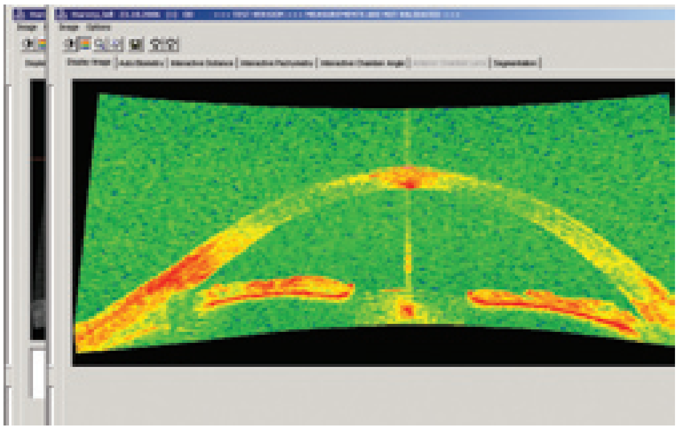

FIGURE 15