Corneal thickness with a puff of air

Bill Harvey takes a look at the new Canon TX-20P which measures corneal thickness as it measures intraocular pressure

The debate over the need to refer patients with intraocular pressures over 21mmHg, which has flared up since the release of the NICE guidelines a couple of years ago, emphasised the importance of corneal structure to tonometry measurements. Thicker or more rigid corneas will offer more resistance to any deforming force and this may be interpreted as higher pressure within the eye, often erroneously. As Goldmann Applanation Tonometers (GATs) are calibrated to interpret the force required to flatten a set thickness of cornea then those corneas below say 500 microns or those over 600 microns in thickness will result in respectively low or high IOP readings.

When GAT was originally devised, it was believed that significant variations in corneal thickness were uncommon and a corneal thickness of 520 microns was assumed in calibration of the applanation tonometer. As clinical measurement of corneal thickness has become widely available, studies have found a wide variation in the thickness of cornea between individuals. Distribution analysis of central corneal thickness measurements revealed that the largest cluster of African American patients had around 520 to 540 microns, whereas the largest cluster of Caucasian patients had corneal thickness of between 580 and 600 microns.

As part of a series of courses in Scotland a few years back, I and a few colleagues ran workshops during which we must have carried out GAT on well over 100 optometrists attending. Several had readings in excess of 21mmHg and therefore would be considered ocular hypertensives. A measurement of their central corneal thickness (in this case with a handheld contact pachymeter) showed that in every case the CCT was over 600 microns and the adjusted IOP was below the referral level. This is the reason why the NICE recommended ocular hypertension pathway includes pachymetry and classifies patients according to central corneal thickness.[1]

Figure 1 The Canon TX-20P non-contact tonometer was launched this summer

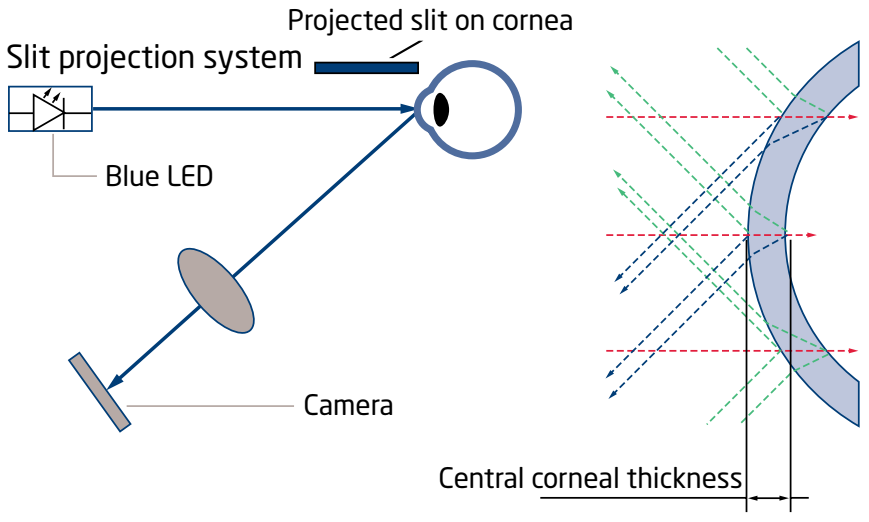

Figure 2 Light from a blue LED is reflected onto a peripherally placed camera and the reflections from the front and back of the cornea interpreted to define the thickness

Non-contact pachymetry

Measurement with a contact pachymeter after GAT is straightforward enough as the cornea is already anaesthetised. However, the majority of practices still use non-contact tonometers (NCT) and might be loath to then have to incorporate a contact technique into the IOP measurement process. I was, therefore, very interested to hear about the recent launch of the Canon TX-20P (Figure 1). Launched this summer, the instrument is an NCT which incorporates a pachymeter and then automatically adjusts the IOP reading to reflect corneal thickness. The majority of pachymeters currently in use employ an ultrasound technique relying on contact with the eye to

Figure 3 The touch screen can be tilted

provide a very accurate measurement between the echo from the front and the back of the cornea. Most modern OCT instruments include an anterior programme able to produce a cross-section of the cornea from which thickness data can be measured.

Pachymetry based on the reflection of oblique light sources is not new and 'more experienced' readers may well remember the black box Goldmann pachymeter that could be fitted to slit lamps. It was basically a prism which could split the view of a corneal section produced by a beam of light from a known angle and, when the insides of the two images were made to just touch, give a measurement of thickness. Scheimpflug imaging describes the use of a camera at an angle to a slit beam, creating an optic section of the cornea and lens. Scheimpflug measures of central corneal thickness and anterior chamber depth are accurate and have good repeatability compared with Orbscan topography, partial coherence interferometry, ultrasonography and MRI.[2,3] As shown in Figure 2, the TX-20P incorporates a similar principle. Light from a blue

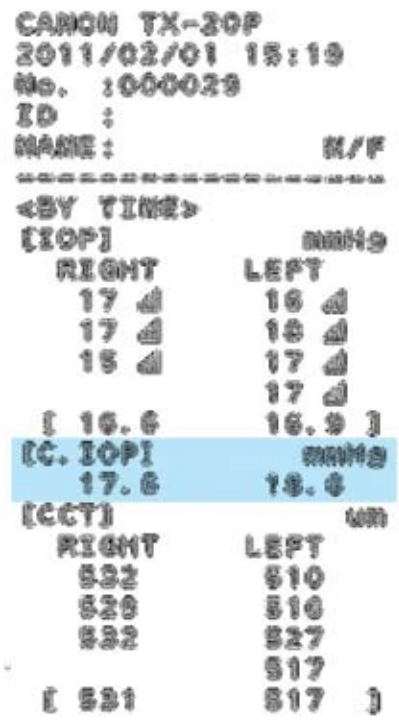

Figure 4 Printout with adjusted reading highlighted

LED is reflected onto a peripherally placed camera and the reflections from the front and back of the cornea interpreted to define the thickness. Assuming steady fixation, the repeatability is good.

Touch-screen operation

The introduction of touch screen control and auto alignment has made many modern instruments incredibly easy to use and the TX-20P is no exception. Once the patient is seated comfortably at the instrument, the measurement is activated via the 5.7 inch tiltable touch screen (Figure 3). Patient data may be recorded via the screen and then the intrument positioned in front of the patient's eye. At this point the instrument takes over, automatically aligning itself and then taking the tonometer reading and thickness reading at the same time. The default setting is for three automatic readings but this may be adjusted accordingly.

The printout (Figure 4) shows the individual IOP readings plus their average and then the c.IOP adjusted reading. This is higher than the standard value where the pachymeter function has found the corneal thickness to be lower than the standard norm. LAN and USB outputs ensure that data may be easily transferred if you are moving away from paper printouts in your practice.

I found the instrument very easy to use and the incorporation of pachymetry data useful and important when reviewing patients with those 20-23mmHg borderline readings. I think this is an important development in non-contact tonometry. A comparison between the data from an ultrasound, anterior OCT and light-based pachymeter will be published in *Optician* later in the year.

Acknowledgement
Many thanks to Carleton for loan of the instrument. Further information from 01494 775811 or www.carleton.com

References

1 Spry P, Harper R. *Essential Handbook of Glaucoma,* 2010. *Optician* Publications.
2 Koretz JF, Strenk SA, Strenk LM, Semmlow JL. Scheimpflug and high-resolution magnetic resonance imaging of the anterior segment: a comparative study. *J Opt Soc Am A Opt Image Sci Vis,* 2004; 21, 346-354.
3 Hashemi H, Yazdani K, Mehravaran S, Fotouhi A. Anterior chamber depth measurement with A-scan ultrasonography, Orbscan II, and IOLMaster. *Optom Vis Sci,* 2005; 82, 900-904.