Sir,

Comparison of Orbscan and Ultrasound pachymetry in the measurement of central corneal thickness

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Measurement of central corneal thickness (CCT) is of ever increasing importance to glaucoma specialists. Studies indicate that measurements of intraocular pressure (IOP), especially when taken by applanation tonometry, are influenced by corneal thickness. A recent meta-analysis showed that a 10% difference in CCT would result in an average of 3.4 ± 0.9 mmHg difference in IOP (1.1 mmHg for normal eyes, 2.5 mmHg for chronically diseased eyes, and 10.0 mmHg in eyes with acute onset active disease).[1] Moreover, the Ocular Hypertension Treatment Study (OHTS) outlined the powerful predictive value of corneal thickness measurements in determining the risk to eyes with ocular hypertension of developing primary open-angle glaucoma (POAG).[2] These important findings may influence aspects of routine glaucoma care, and it is clear that some form of CCT measurement should be included as a standard test in all patients undergoing screening for glaucoma.

Indeed, measurements of CCT by different corneal pachymetric methods have become a widely recognised clinical technique. Ultrasound (US) pachymetry has become the gold standard for making these measurements and works by averaging several rapidly repeated A-scans. However, this method is not without its drawbacks and requires direct corneal contact with the ultrasonic probe. Other studies have therefore looked at slit-scanning and optical coherence techniques and compared them with US.[3–7] In a recent study undertaken on Chinese individuals, Wong *et al*[6] suggest that the results obtained with Orbscan and US are comparable clinically. This finding is not supported by previous studies, and we therefore undertook a similar study in Europeans to see whether these results could be duplicated.

Methods and results

We examined 34 right and 32 left eyes of 35 patients who were undergoing screening for glaucoma. In total, 15 male and 20 female subjects were studied with a mean age of 62 ± 13 years. Informed consent was obtained in all cases. Noncontact CCT measurements were first taken using the Orbscan II device using an acoustic factor set to its factory default value of 0.92. This was then immediately followed by measurement of IOP using applanation tonometry and then measurement of CCT by US pachymetry using the TOMEY SP-3000 device (A-scan velocity 1640 m/s). US pachymetry was performed by the same experienced clinician in all cases, with the ultrasonic probe perpendicular to the cornea centred on the pupil. CCT was recorded as an average of five measurements from each eye to minimise measurement error. In 20 eyes of 10 patients attending this clinic, we measured CCT before and again after applanation tonometry and found no difference in CCT.

To ascertain whether the instruments were comparable clinically, and to assess efficacy of the calibration algorithm, the results were analysed using the method described by Bland and Altman.[8] The SPSS professional statistics program was used for this purpose (SPSS for Windows Version 11.0). This involves construction of plots for the differences between the results obtained from each device against their mean. Least-squares regression analysis for the differences was also performed to further assess any bias.

The mean (±SE) obtained from the Orbscan was 564.74 ± 6.43 μm for right eyes and 565 ± 6.28 μm for left eyes. For the US pachymetry, the mean (±SE) was 557.74 ± 5.94 μm for right eyes and 559.03 ± 6.13 μm for left eyes. Correlation was 0.91 ($P<0.0001$) for right eyes and 0.88 ($P<0.0001$) for left eyes. The difference between means for left and right eyes for either Orbscan or US is not significant at the 5% significance level. Plotting the results of Orbscan measurements against those from ultrasonic pachymetry shows that readings from Orbscan are mostly above the line $y=x$ (for both right and left eyes) and therefore greater than ultrasonic pachymetry (Figure 1).

Figure 2 depicts the Bland and Altman plot for the differences between instruments against their means. Included are the 95% confidence intervals for the upper and lower limits of agreement with their associated 95% confidence intervals for the accuracy of the limits. For the right eye (upper limit, lower limit ± SE of limit) these are 38.20, −24.20 ± 4.63 μm and for the left eye 42.11, −26.73 ± 5.27 μm. When the differences between instruments against their means were calculated with the least-squares regression line, the correlation was not significant (for either eye) at the 5% significance level.

Comment

Our study found that, using the factory default for the acoustic factor (0.92), the CCT as measured by Orbscan was, on average, 7.00 μm greater for right eyes and 7.69 μm for left eyes than those obtained with US pachymetry. The range for the differences between the two devices was −24.20 to 38.20 μm for right eyes and −26.73 to 42.11 μm for left eyes (95% confidence interval), suggesting that the results from the two instruments are not in agreement. In the study by Wong *et al*,[6] an average difference of 0.85 μm was found (using the same linear

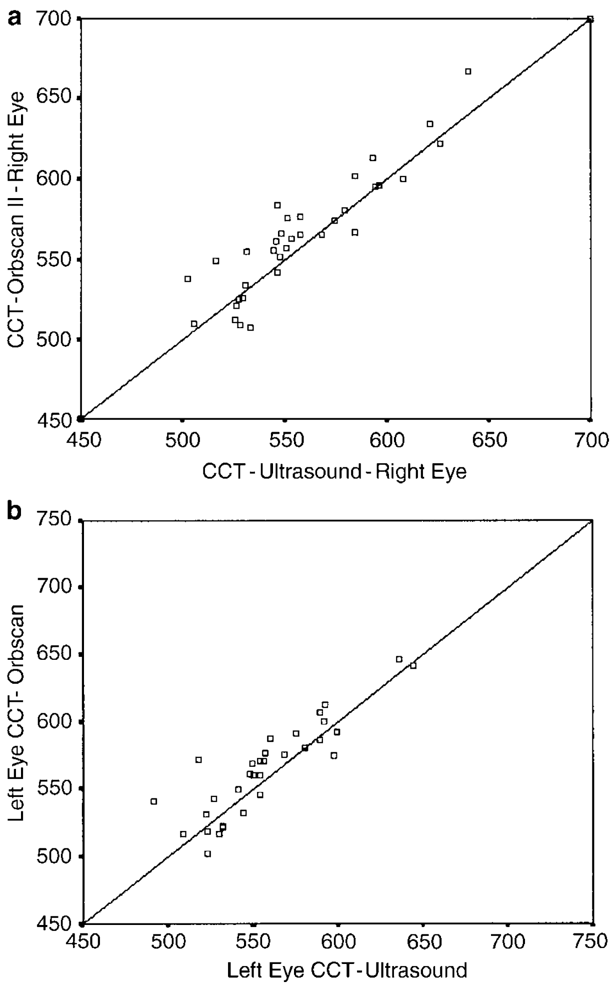

Figure 1 Plots of CCT measurements—Orbscan against US findings for the right (a) and left (b) eyes. The line represents $y=x$.

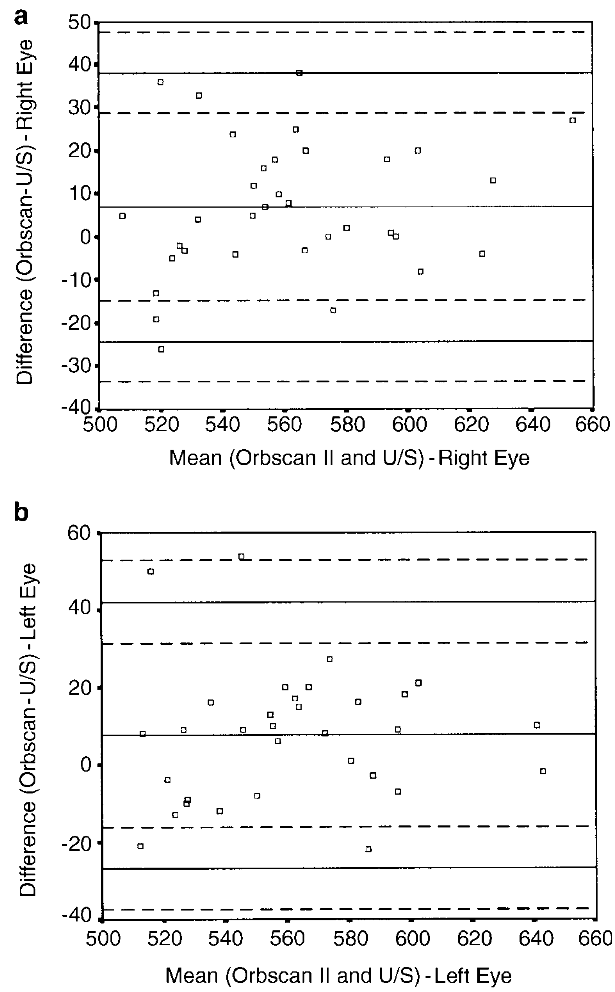

Figure 2 Bland and Altman plots for right (a) and left (b) eyes. The difference in CCT between instruments is plotted against the mean CCT of the two instruments.

correlation factor). However, other studies report greater CCT measurements with Orbscan compared with US. Yaylali *et al*[3] report values 23–28 μm higher and Chakrabarti *et al*[5] similarly report readings 28 μm higher on average, in normal eyes. Our results are similar in magnitude to those of Giraldez-Fernandez *et al*[4] (8.74 ± 1.78 μm).

It has been proposed that a linear correction factor could be applied to transform precisely the values obtained with the two devices and correct for this bias.[3,4] The proprietary software available with the Orbscan allows a different acoustic factor to be programmed into the machine. Some studies do not quote the acoustic factor value and it cannot be assumed that the Orbscan instruments used were set to the factory default of 0.92. Wong *et al*[6] realised this and suggest that their use of 0.92 for the acoustic factor may explain the good agreement between US and Orbscan.[8] However, we used 0.92 as the value for the acoustic factor in this study and did not find that the two devices were in agreement. As Chakrabarti *et al*[5] state, there is no definitive answer as to why the measurement differences between the two devices exist. Possibilities that have been suggested include effects on US by changes in corneal hydration.[10]

In conclusion, our results are consistent with the findings by other groups that Orbscan II overestimates measurements of CCT when compared with US. Our results, from Europeans being screened for glaucoma, do not support the findings by Wong *et al*,[6] in normal Chinese subjects, that an acoustic factor of 0.92 provides good agreement between the devices. The limits of agreement are such that the results obtained from the two devices are not clinically interchangeable. We should note that a small difference has been found between different US pachymeters[7] and that the OHTS used the DGH system. Although our study has a small sample size, our study suggests that the recent findings of the OHTS[2] may not be generalisable to CCT measurements taken using the Orbscan II device.

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Sir,

Retinal infarction following lipoma excision in a patient with secondary ophthalmic artery stenosis

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We present a case of ophthalmic artery stenosis manifesting after routine lipoma excision under general anaesthetic in a patient.

Case report

A 36-year-old patient presented to eye casualty with a 5-day history of acute reduction of vision in his left eye. The fall in his vision was noticed on waking up from a general anaesthetic, which was administered for excision of a large lipoma on the dorsum of the neck. There was a past history of bilateral treated retinoblastoma. It was suggested that external beam radiotherapy or possibly of plaque brachytherapy was used for treating the retinoblastoma in childhood. Unfortunately, no records of this treatment were available. Cataract extraction was subsequently performed to remove radiation-induced cataracts. Following treatment, he developed a meningioma of the right temporal lobe, which was removed surgically. He was a heavy smoker and a known case of coronary artery disease. Ocular examination revealed a visual acuity of hand movements in the right and 6/12 in the left eye. The right eye had a relative afferent pupillary defect. He was bilaterally aphakic. Fundus examination showed blurred disc margins in the left eye consistent with optic disc drusen, which were later confirmed on B scan ultrasound. Chorioretinal scarring suggestive of a regressed retinoblastoma was also visible along the superotemporal vessel. Nasal to the disc was an atrophic area with some exudates inferior to it. A refractile embolus was seen in the inferonasal artery. Fundus fluorescein angiography confirmed the optic disc drusen; the atrophic area nasal to the disc had blocked choroidal fluorescence indicating that it was the old plaque site for irradiation and an infarct inferonasal to the macula explaining the field defect. A magnetic resonance angiography showed a stenosis of the left ophthalmic artery about 2 cm from the globe (Figure 1).

A diagnosis of a retinal infarct secondary to stenosis of the ophthalmic artery was made. The infarct was probably caused by a combination of stenosis of the ophthalmic artery and a hypotensive episode during the general anaesthetic.