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## Ultrasonic measurement of the optic cup shows promise

B-scan correlates well with more expensive measures.

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A diagnosis of glaucoma is made in the presence of characteristic field loss and pathologic optic disc cupping, with some regard to intraocular pressure measurements. The optic disc is typically assessed with a 90 D or 78 D lens at the slit-lamp. However, media opacities and optic disc anomalies may make it impossible to evaluate the extent of cupping, thus making a diagnosis impossible to reach. Furthermore, there is considerable inter-individual variability in cup/disc ratio estimates.

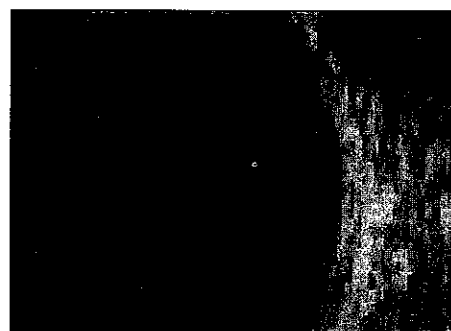
Several methods have, therefore, been developed to evaluate optic disc morphology objectively, and these include Heidelberg Retinal Tomography (HRT), optical coherence tomography and planimetry. These techniques all require expensive specialist equipment, and optimum image quality depends on clear media. To date, the role of ultrasound in the morphometric analysis of the optic nerve head has been limited because of the poor resolving power traditionally

associated with echography of the posterior pole. We measured two-dimensional optic cup parameters using a new-generation, high-resolution, eye-dedicated B-scan probe and compared the results with those of HRT.

### Instrumentation

HRT images the retina in three dimensions, thus providing topographic measurements. The maximum cup depth is automatically computed by the instrument with each acquisition of a satisfactory image, and the maximum vertical and horizontal cup diameters can be measured using the Y and X profile systems, respectively.

The new-generation B-scanner (Biovision B-Scan, Chiron Vision, UK) differs from its predecessors in that its probe is focused 27 mm from the concave transducer, allowing greater image resolution of structures at the posterior pole. Using this instrument, the probe is oriented in the appropriate plane until a satisfactory image is achieved. The ultrasound software calculates the distance between two markers placed on the monitor with the aid of a cursor, thus allowing the operator to measure cup depth and horizontal and vertical cup diameters.



**Axial B-scan display** showing the optic cup as a posterior concavity to the acoustically clear area of the optic nerve.

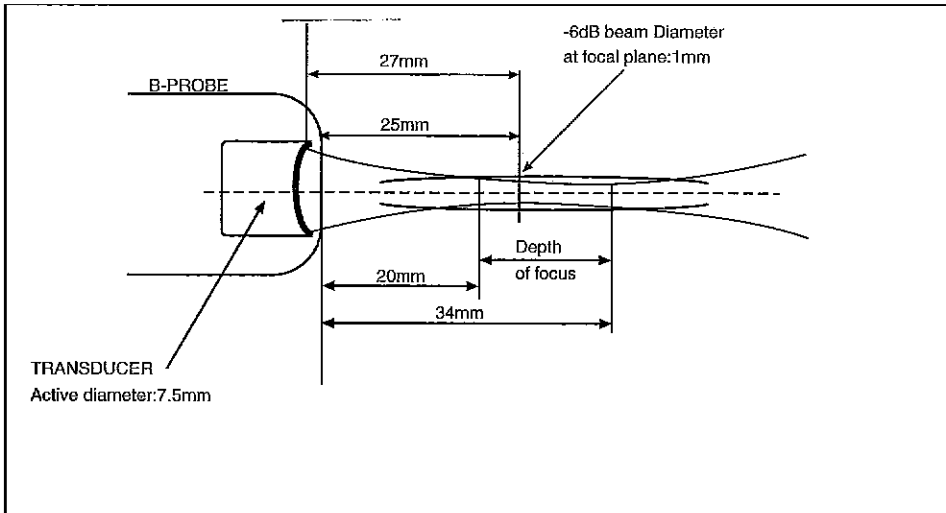
### Accuracy

There was a high degree of correlation between ultrasound and HRT estimates of all two-dimensional cup parameters ( $r > 0.77$ ). In 95% of cases, echographic horizontal and vertical cup diameter readings were within 200  $\mu\text{m}$  of corresponding HRT measurements, and cup depth was within 300  $\mu\text{m}$ .

### Reproducibility and test-retest variability

Indices of reproducibility and inter-session variability were comparable for the two instruments.

Ultrasonic measurements of the optic cup can be taken in the presence of media opacities without expensive specialist equipment or a highly trained technician. The main disadvantage of echographic optic cup evaluation is that the disc edge cannot be discerned, and therefore a cup/disc ratio cannot be measured.



**Diagrammatic representation** of the Biovision B-Scan probe. The radius of concavity of the transducer is approximately equal to its focal distance (27 mm). As the transducer is 2 mm inside the probe, this ensures an external focus of 25 mm.

However, it is worth noting that all previous investigators have failed to show a positive correlation between glaucomatous field loss and the cup/disc ratio.

Echographic cup measurements are reproducible and are not subject to

clinically meaningful test-retest variability. The accuracy of ultrasonic cup measurements is also encouraging and is reflected in the high degree of correlation between ultrasound and HRT readings. However, the echo-

graphic readings are not so precise that the instrument could be used to monitor subtle optic disc changes over time associated with glaucoma.

Nevertheless, substantial increases in the ultrasonic measurements of two-dimensional optic cup parameters can be considered objective evidence of glaucomatous progression. In addition, measurements can be made in the presence of dense media opacities, allowing the surgeon to provide the patient with dense cataracts awaiting surgery with a more guarded visual prognosis if large asymmetric cups are found. ■

#### **For Your Information:**

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