

Estimation of optic disc size using indirect biomicroscopy

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Abstract

The use of the 90 dioptre fundus lens in conjunction with slit-lamp biomicroscopy as a method of estimating optic size was evaluated in a series of 37 patients. The measurements taken from the Haag-Streit slit-lamp were compared with values obtained planimetrically in order to assess a conversion factor and also the reliability of the method. This technique is a quick and easy method of obtaining an estimate of optic nerve head size in the clinic, but cannot replace more accurate methods of optic disc planimetry.

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It would be useful in clinical ophthalmic practice to be able to differentiate between small and large optic discs without having to resort to fundus photography and time consuming planimetric methods. Many patients with high cup-disc ratios are considered to be at risk from developing glaucomatous visual loss and are followed up in glaucoma clinics indefinitely on account of this finding, often despite normal intraocular pressures and visual fields. More recent evidence points towards the use of neuroretinal rim area as a more reliable index of glaucoma risk.^{1,2} Jonas and Quigley have both shown a correlation between nerve fibre count and disc size^{3,4} which means that even with high cup-disc ratios the actual amount of neural tissue is likely to be within normal limits.^{4,6}

Other methods of optic disc estimation have been described including recently a technique using the indirect ophthalmoscope in conjunction with a calliper device.⁵

Here, a simple and very quick method of estimating the approximate diameter of the optic nerve head is described. This utilises the method of indirect biomicroscopy in conjunction with the 90 dioptre fundus lens and can if necessary be done without mydriasis.

Patients and methods

Thirty seven eyes of 37 patients were investigated initially in order to determine the calibration. All patients had optic discs considered to be within normal limits clinically and had normal visual fields. Patients with refractive errors greater than plus or minus 5 dioptres were excluded.

The optic disc was viewed in the normal way using a narrow slit beam and focused onto the neuroretinal rim surface. Instructing the patient to fixate on the ear of the examiner (right ear for examining the right eye) brings the optic nerve head into the centre of view. The height of the slit beam can then be adjusted until it coincides with the disc edges. The width of the slit beam could have been used in a similar fashion. The size of

the slit beam is then read off the scale of the Haag-Streit slit-lamp to the nearest 0.5 mm. However, this measurement obviously does not relate to the actual size of the disc in millimetres, and a correction has to be made to account for this. In order to investigate the relation between the readings made in this way with those obtained by a more conventional planimetric method the results were compared with disc diameters measured planimetrically from optic disc photographs.

Patients underwent full mydriatic fundus photography using a Canon 60-U retinal camera. Photographs were analysed with a computer assisted planimetric device which utilises a modified Littman formula to allow for the Canon retinal camera (Discdata, Thot Informatique, Pr Bechetoille, Angers, France). This system has been shown to have good intraobserver variation.⁷ Measurements of vertical diameter were calculated using this system. The vertical height measurement obtained was used for comparison with the readings taken with the 90 D lens at the slit-lamp.

Each of the two measurements were taken independently without knowledge of the other measurement. All observations and measurements were made by the same person (SR).

Results

The results of the estimated disc diameter using the 90 D lens are plotted against the planimetrically determined diameters in Figure 1. There was a highly significant correlation between the two sets of results (Pearson's correlation coefficient $r=0.82$, $p<0.000001$). From this plot it is possible to determine a conversion factor for the estimated disc diameter obtained with the 90 D lens (equation of regression line: $Y=1.17X+0.24$).

Slit-lamp recordings of more than 1.4 mm correspond to a planimetrically measured size more than or equal to 1.9 mm. Using these parameters, 89% of discs estimated to be 1.9 mm or larger (that is, give a reading ≥ 1.4 mm) at the slit-lamp are found to measure ≥ 1.9 mm planimetrically. On the other hand, 100% of discs estimated to be smaller than 1.9 mm (giving a reading < 1.4 units at the slit-lamp) are found also to be smaller than 1.9 mm planimetrically.

A nomogram can be constructed (as in Fig 2) in order that the measurement made with the 90 D lens can be converted at a glance to a more reliable measurement in millimetres.

In order to establish the reproducibility and precision of this technique 10 further optic discs were examined and four estimates recorded for each one. The results are shown in Table 1. It can be seen that the standard deviations for repeat measurements are small and that the estimated

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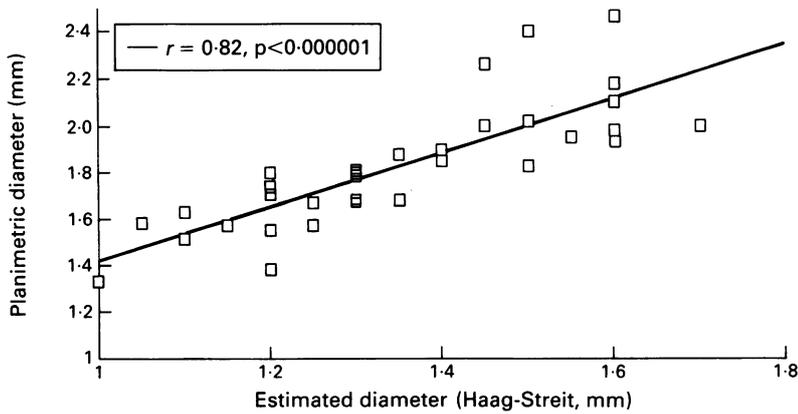


Figure 1 Scattergram of planimetrically measured diameters plotted against diameters estimated using a 90 D lens.

values are in close agreement with those measured planimetrically. This method appears to give a reliable estimate of disc size with adequate precision to allow the examiner to decide whether an optic disc is large or small.

Discussion

It can be seen from these results that it is possible to estimate quickly the size of optic discs in the clinic. Optic discs that are estimated at over 1.4 mm on the Haag-Streit slit-lamp are very likely to be more than 1.9 mm in size.

Previous investigators have reported a variety of methods for estimating optic disc size utilising direct ophthalmoscope, indirect ophthalmoscope, and the Goldmann contact lens at the slit-lamp.^{3,9} These methods depend on graticules and/or conversion constants based on the lens used, and refraction of the eye. With both direct and indirect techniques refractive error influences the size of the image unless the lens coincides with the anterior focus of the eye⁸ (which is very unlikely). The method described here requires no specialist equipment and is very quick to perform.

It has been shown that neuroretinal rim area increases with increasing disc size despite an increase in cup-disc ratio.^{10,11} Large discs with high cup-disc ratios are therefore likely to represent the upper end of the normal range and be considered 'physiological' in nature, as long as there are no other features to suggest abnormality such as the ovalness of cupping, focal rim defects, or vascular changes.

There is still some controversy over the significance of large discs. Chi *et al* support the

Figure 2 Nomogram for conversion of Haag-Streit units into corresponding millimetre measurements.

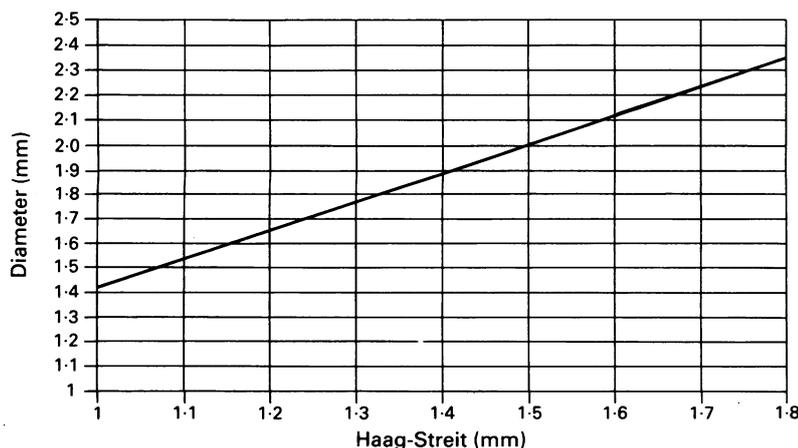


Table 1 Mean and standard deviation of four repeat estimates of vertical disc diameter in 10 eyes with measurements made planimetrically for comparison

	Vertical disc diameter estimated using 90 D lens (from nomogram) (mean of four readings)	SD	Vertical disc diameter measured planimetrically
1	1.77	0.098	1.8
2	1.93	0.03	1.95
3	1.72	0.057	1.68
4	1.8	0.035	1.88
5	1.74	0.035	1.62
6	1.65	0.094	1.8
7	1.78	0.057	1.65
8	1.85	0.057	1.85
9	1.92	0.055	1.88
10	1.69	0.03	1.8

view that larger discs predispose to glaucoma, based on the observation that black patients with glaucoma had significantly larger discs than matched white patients.¹² However there may be other racial differences to account for this finding. This view is not supported by Jonas *et al* who found no correlation between disc size and severity of glaucoma, but propose that smaller discs are at greater risk because of their smaller number of nerve fibres.¹³

A similar estimation of disc size could be performed using the 78 D lens, but its greater magnification gives larger values for the readings taken from the Haag-Streit slit-lamp. The distance that the lens is held from the eye does not appear to be critical (as shown by the reproducibility) as in other techniques as the measured length of the slit beam remains relatively constant as long as the disc remains in focus.

The technique described here is a quick and easy method for estimating optic disc size in the clinical setting and may help in making decisions concerning the follow up of patients with large cup-disc ratios or of patients with discs of asymmetrical size. It is not intended to give precise measurements of disc parameters nor to replace other methods used for accurate analysis of the optic disc.

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