

LETTERS TO THE EDITOR

Calculation of the optic disc and cup area by the minimal and maximal diameters

EDITOR.—Quantification of optic disc morphology, particularly the neuroretinal rim area, has increasingly been recognised to be of importance in the diagnosis of anomalies and diseases of the optic nerve. This is especially true in glaucomatous optic neuropathy.^{1,2} The area of the neuroretinal rim is usually determined by measuring the disc and cup areas planimetrically using photographs, by sophisticated videographic techniques or by scanning laser ophthalmoscopy.^{1,3} The rim area is then calculated as the difference between the disc and cup areas. It has recently been suggested that the disc and neuroretinal rim areas might be estimated clinically by applying geometric formulas to linear diameter measurements of the disc and cup made during indirect ophthalmoscopy.^{4,5} This simple and inexpensive technique relies on an approximation which considers both the disc and cup to be regular ellipses. We have performed this study to determine the magnitude of error that this approximation might introduce.

Sequential stereo colour optic disc diapositives of 1171 normal eyes and of 2635 eyes with glaucoma were included in the study. In each case the disc and cup areas were measured planimetrically and linear measurements were made of the maximal and minimal diameters of both disc and cup.

The optic disc was defined as the area within the peripapillary scleral ring while the optic cup was defined on the basis of contour rather than colour. To obtain the measurements in absolute size units — that is, mm or mm² Littmann's formula was used to correct the magnification of the Zeiss fundus camera and the ocular magnification. We compared the area measurements obtained planimetrically with those estimated from the formula:

$$\text{Area} = (\pi \times \text{maximal diameter} \times \text{minimal diameter}) / 4$$

Table 1 Optic disc, cup, and neuroretinal rim determinations

	Normal group (n=1171)	Glaucoma group (n=2635)
Refractive error (D)	-0.13 (2.09)	-0.94 (2.95)
Min/max	-7.9/+8.5	-16.1/+8.75
Age (years)	45.6 (16.9)	58.8 (14.7)
Disc area (measured) (mm ²)	2.69 (0.64)	2.74 (0.70)
Disc area (calculated) (mm ²)	2.70 (0.64)	2.75 (0.71)
Difference (mm ²)	0.03 (0.03)	0.03 (0.03)
Min-max (mm ²)	0.0-0.41	0.0-0.38
Error (%)	1.1 (1.1)	1.1 (0.9)
Min-max (%)	0.0-21.7	0.0-11.5
Maximal disc diameter (mm)	1.95 (0.23)	1.98 (0.25)
Minimal disc diameter (mm)	1.74 (0.21)	1.75 (0.22)
Cup area (measured) (mm ²)	0.87 (0.61)	1.67 (0.79)
Cup area (calculated) (mm ²)	0.88 (0.61)	1.69 (0.79)
Difference (mm ²)	0.01 (0.02)	0.03 (0.03)
Min-max (mm ²)	0.0-0.27	0.0-0.38
Error (%)	1.6 (2.0)	1.8 (2.5)
Min-max (%)	0.0-42.5	0.0-50.3
Maximal cup diameter (mm)	1.04 (0.46)	1.54 (0.38)
Minimal cup diameter (mm)	0.89 (0.41)	1.31 (0.34)
Neuroretinal rim area (measured) (mm ²)	1.82 (0.40)	1.06 (0.53)
Neuroretinal rim area (calculated) (mm ²)	1.82 (0.41)	1.06 (0.54)
Difference (mm ²)	0.03 (0.03)	0.04 (0.04)
Min-max (mm ²)	0.0-0.41	0.0-0.43
Error (%)	1.8 (2.0)	5.5 (16.4)
Min-max (%)	0.0-21.7	0.0-448

For each case the error was determined as the difference between the values obtained by the two methods divided by the average of the two methods.

In the normal group, the mean errors for the areas of the optic disc and cup, respectively, were 1.1% (SD 1.1%) and 1.6% (2.0%), respectively. Similar values were found for the glaucoma group (Table 1). The mean error for the neuroretinal rim area was larger in the glaucoma group (5.5% (16.4%)) than in the normal cohort (1.8% (2.0%)). It increased significantly with decreasing neuroretinal rim area ($p < 0.0001$). The regression line had an exponential form with a steep increase for the small neuroretinal rim areas. Correspondingly, in glaucoma eyes with a neuroretinal rim area larger than 0.40 mm², the error for the rim area was 3.9% (4.7%) (median 2.4%). Generally, the errors were smaller in eyes with a regular disc shape than in eyes with an irregular form of the optic nerve head as indicated by an oblique orientation of the maximal disc diameter and a low ratio of the minimal to the maximal disc diameter.

The results indicate that for clinical disc biometry the optic disc, cup, and neuroretinal rim areas can be determined using the values of the minimal and maximal diameters and the formula of an ellipse. The resulting error is smaller for eyes with a regular optic disc shape than for eyes with an irregular disc form. For the optic disc it measures in the normal and glaucoma group 1.1% on an average. The mean error for the neuroretinal rim area is 1.8% (2.0%) for normal eyes and 5.5% (16.4%) for eyes with glaucoma. In glaucomatous eyes the error increases as neuroretinal rim decreases. This may be due to the decreasing size of the denominator in the equation 'difference between the values obtained by the two methods divided by the average of the two methods'. In the early stages of rim loss the error is relatively low.

This study suggests that, for clinical purposes, simple linear measurements of the disc and cup are sufficient to allow the neuroretinal rim area to be estimated reliably. It does not determine, however, by which method the diameters and areas of the optic disc and cup should be measured. It remains the purpose of further investigations to evaluate the reasons why the mean optic disc size differs between various methods such as the Heidelberg retina

tomograph,³ the optic nerve head analyser,² other planimetric examinations,¹ and the method described by Montgomery.^{4,5}

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Ophthalmoscopic sign of early keratoconus

EDITOR.—Although the diagnosis of early keratoconus is often easy because of visual symptoms and refractive and slit-lamp signs, it can be missed completely in some patients who may have normal visual acuities and almost normal slit-lamp appearances.

In these patients a simple clinical sign (probably first described by Bowman¹ and Knapp²) may be useful even today.

If the eye is viewed from about 1 metre through a direct ophthalmoscope a dark central disc or an annular shadow will be seen disturbing the normal red reflex.

This can be compatible with a visual acuity of 6/6 unaided and a normal Placido disc reflection and it is probably as sensitive a test of corneal asymmetry as is corneal topography.

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Survey of the complications associated with current practice of cataract surgery under local anaesthesia

EDITOR.—In July 1993 I sent questionnaires to 500 consultants in England and Wales to inquire into their current practice, particularly the complications they had encountered over their professional life time. The response rate was 66.7%.

Twelve surgeons reported deaths which they felt might have been the result of local anaesthesia. Only 78 surgeons reported that they had encountered what they interpreted as life threatening complications which they felt might have been attributable to local

anaesthesia. It could be argued that the low incidence of complications in the survey reflects inadequate monitoring but a serious complication would be hard to miss.

The survey suggested that most surgeons performing intraocular surgery under local anaesthesia did not have an anaesthetist present. Fifty per cent of surgeons did not secure intravenous access. Of the surgeons who reported that they had encountered life threatening situations only 56% routinely had intravenous access.

The opinion was divided on the need for an anaesthetist to be present. While 55% thought that an anaesthetist should be present, in practice only 68% of those who did, had cover available. Several surgeons pointed out that they were practising cataract surgery in a district general hospital where the eye theatre was part of a much larger theatre suite and anaesthetists and the crash team were always available. The situation may be different in a dedicated eye hospital.

I conclude that in the UK the incidence of life threatening complications of local anaesthesia in cataract surgery is probably lower than that reported by Hamilton *et al.*¹ It would seem that a comprehensive long term prospective survey of experience in the UK might be helpful in providing guidance on this subject.

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- 1 Hamilton RC, Gimbel HV, Strunin L. Regional anaesthesia for 12 000 cataract extraction and intraocular lens implantation procedures. *Canadian Journal of Anaesthesia* 1988; 615-23.

Life expectancy in keratoconus - correction to data used

EDITOR,—In 1992 we published a paper in the journal¹ on life expectancy in keratoconus. Since publication it has become apparent that the most appropriate analysis of the data was not used. Additionally, information became available for some patients who were originally classified as untraceable. Thus, it has been appropriate to reanalyse the augmented data.

Patient records from the keratoconus clinic at Moorfields Eye Hospital were used to identify 313 patients (193 male and 120 female), born before 1951, who were known to be alive in 1982. These patients were followed up during 1991 to identify the number of deaths within the sample; in order to investigate the hypothesis that underlying connective tissue disorder shortens the lives of patients with keratoconus. Actuarial techniques for constructing life tables were used to calculate the expected number of deaths within the sample (separated by sex) if the patients had experienced the mortality indicated in English Life Tables number 14 (ELT14). These tables are based on the mortality experience in England and Wales during 1980-2. As in the previous analysis for males, it was also possible to incorporate prior knowledge of the social class distribution of patients attending the clinic.²

For males, the expected number of deaths based on ELT14 was 7.6 and incorporating prior knowledge about social class reduced the expected number of deaths to 6.2. There were seven actual deaths recorded. For females, the expected number of deaths was 3.7 and five deaths were recorded. In each case the predicted number of deaths is very close to the number of deaths observed. Thus, the data do not suggest that patients with keratoconus

suffer higher mortality than the general population.

The results of our new analysis are entirely consistent with the conclusions drawn in the original paper.

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- 1 Moodaley LCM, Woodward EG, Liu CSC, Buckley RJ. Life expectancy in keratoconus. *Br J Ophthalmol* 1992; 76: 590-1.
2 Haberman S, Bloomfield DSF. Social class differences in mortality in Great Britain around 1981. *J Inst Actuaries* 1988; 115: 495-517.

ECCE for advanced cataracts in Africa

EDITOR,—Cataract surgery in developing countries has received increasing attention over the past few years with controversy over appropriate methods. We conducted a prospective audit to determine the success of routine extracapsular cataract extraction (ECCE) for age-related cataract in Malawi. All patients presenting to a central hospital with age-related uncomplicated cataract underwent ECCE by one surgeon. A total of 295 eyes of 295 patients (mean age 66) were analysed. Preoperative visual acuity was light perception in 224 (77%) eyes; 85 (28.8%) of the lenses were hypermature (Morgagnian or lenses with dense plaques on the anterior capsule).

The overall vitreous loss rate was 8.8% (95% confidence interval 5.6-12.0%). There was a significant association ($p=0.002$) between vitreous loss and maturity of the cataract. An improvement in preoperative visual acuity, from light perception to hand motion was associated with a decrease in vitreous loss from 11% to 1.5%. The risk of vitreous loss with hypermaturity was 10.2 times that of vitreous loss if preoperative vision was better than light perception. We believe this is related to changes in the capsule which do not occur until all the cortex is opacified (usually the case in light perception cataracts). Attempts to tear or puncture a tough capsule with a cystotome frequently lead to tears in the zonules.

Although not associated with vitreous loss, the posterior capsule needed removal in 15 (18%) eyes with hypermature cataracts because it was flapping in the visual axis or had unremovable central opacities.

These findings may have relevance to policy recommendations for appropriate surgical techniques in populations with very advanced cataracts. Although there are reports of success with routine ECCE with posterior chamber intraocular lenses in large populations in Asia,^{1,2} the patients had significantly fewer light perception and hypermature lenses than ours. Asian patients with cataract may also be younger than African, and age may contribute to zonule fragility. In addition, there are important socioeconomic, manpower, and infrastructure differences between Asia and Africa; what is possible in one area may be inappropriate in another.

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- 1 Ruit S, Robin AL, Pokhrel RP, Sharma A, DeFaller J. Extracapsular cataract extraction in Nepal: 2-year outcome. *Arch Ophthalmol* 1991; 109: 1761-3.
2 Naichiar G, Robin AL, Nalgiar AR, Krishnadas R. Posterior capsule tears during extracapsular cataract surgery in India. *Arch Ophthalmol* 1993; 111: 706-8.

Visual loss in AIDS patients

EDITOR,—In a recent case report, Ismail *et al* describe what they believe to be the second reported case of central retinal vein occlusion (CRVO) in a patient with AIDS and speculate as to whether or not the CRVO may precede significant AIDS related illness.¹ I would like to point out that we have previously published a case of CRVO in an HIV positive male without AIDS defining illness.² Extensive evaluation failed to reveal any other systemic abnormality which might be contributory.

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- 1 Ismail Y, Nemechek PM, Arsura EL. A rare cause of visual loss in AIDS patients: central retinal vein occlusion. *Br J Ophthalmol* 1993; 77: 600-1.
2 Roberts SP, Haefs TM. Central retinal vein occlusion in a middle-aged adult with HIV infection. *Optometry Vis Sci* 1992; 69: 567-9.

Reply

EDITOR,—We thank Sara Roberts for supporting our belief that there is an association between the occurrence of central retinal vein occlusion (CRVO) and AIDS and for her reference to the case report published by Roberts and Haefs.¹ There is one difficulty in that case that clouds the relation between AIDS and CRVO. In the patient presented by Roberts and Haefs, the patient's prothrombin as well as serum angiotensin converting enzyme level and lysozyme were all elevated, alluding to the possibility of other conditions such as liver disease or haematological malignancy which can be associated with a prothrombotic tendency.

In our case² as well as the case reported by Tiech *et al*,³ CRVO occurred in young AIDS patients without any evidence of additional diseases that might lead to a hypercoagulable state. This fact suggests a cause and effect relation between AIDS and CRVO.

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- 1 Roberts SP, Haefs TM. Central retinal vein occlusion in a middle-aged adult with HIV infection. *Optometry Vis Sci* 1992; 69: 567-9.
2 Ismail Y, Nemechek PM, Arsura EL. A rare cause of visual loss in AIDS patients: central retinal vein occlusion. *Br J Ophthalmol* 1993; 77: 600-1.
3 Tiech SA, Sonnabend J. Central retinal vein occlusion in a patient with AIDS. *Arch Ophthalmol* 1988; 106: 1508-9.

BOOK REVIEW

Basic Ophthalmology for Medical Students and Primary Care Residents. By Frank G Berson. Pp 168. £13.50. San Francisco: American Academy of Ophthalmology, 1993.

This American textbook is well laid out. Each of its nine chapters starts by defining its 'objectives' and the skills required to attain