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. 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. 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 formulae to circular or linear measurements of the disc and cup made during indirect ophthalmoscopy. This simple and inexpensive technique relies on an approximation which considers 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 minimal and maximal diameters of both the disc and cup.

The optic disc was defined as the area within the peripapillary sceral 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, in mm or mm^2, 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

<table>
<thead>
<tr>
<th></th>
<th>Normal group (n=1171)</th>
<th>Glaucoma group (n=2635)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractive error (D)</td>
<td>-0.13 (2.09)</td>
<td>-0.94 (2.95)</td>
</tr>
<tr>
<td>Min-age (years)</td>
<td>20 (8.2)</td>
<td>46 (16.9)</td>
</tr>
<tr>
<td>Max-age (years)</td>
<td>74 (9.5)</td>
<td>78 (14.7)</td>
</tr>
<tr>
<td>Disc area (measured) (mm^2)</td>
<td>2.69 (0.64)</td>
<td>2.74 (0.70)</td>
</tr>
<tr>
<td>Disc area (calculated) (mm^2)</td>
<td>2.70 (0.64)</td>
<td>2.75 (0.71)</td>
</tr>
<tr>
<td>Difference (mm^2)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Min-max (mm^2)</td>
<td>0.00 - 21.7</td>
<td>0.00 - 21.7</td>
</tr>
<tr>
<td>Maximal disc diameter (mm)</td>
<td>1.95 (0.23)</td>
<td>1.98 (0.25)</td>
</tr>
<tr>
<td>Minimal disc diameter (mm)</td>
<td>1.74 (0.21)</td>
<td>1.75 (0.22)</td>
</tr>
<tr>
<td>Cup area (measured) (mm^2)</td>
<td>0.87 (0.61)</td>
<td>1.67 (0.79)</td>
</tr>
<tr>
<td>Cup area (calculated) (mm^2)</td>
<td>0.88 (0.61)</td>
<td>1.69 (0.79)</td>
</tr>
<tr>
<td>Difference (mm^2)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Min-max (mm^2)</td>
<td>0.00 - 27.0</td>
<td>0.00 - 27.0</td>
</tr>
<tr>
<td>Error (%)</td>
<td>1.6 (2.0)</td>
<td>1.9 (2.5)</td>
</tr>
<tr>
<td>Max-min (%)</td>
<td>0.00 - 42.5</td>
<td>0.00 - 50.3</td>
</tr>
<tr>
<td>Maximal cup diameter (mm)</td>
<td>1.04 (0.46)</td>
<td>1.54 (0.38)</td>
</tr>
<tr>
<td>Minimal cup diameter (mm)</td>
<td>0.89 (0.41)</td>
<td>1.31 (0.34)</td>
</tr>
<tr>
<td>Neuroretinal rim area (measured) (mm^2)</td>
<td>1.82 (0.40)</td>
<td>1.06 (0.53)</td>
</tr>
<tr>
<td>Neuroretinal rim area (calculated) (mm^2)</td>
<td>1.82 (0.41)</td>
<td>1.06 (0.54)</td>
</tr>
<tr>
<td>Difference (mm^2)</td>
<td>0.03 (0.03)</td>
<td>0.04 (0.04)</td>
</tr>
<tr>
<td>Min-max (mm^2)</td>
<td>0.00 - 21.7</td>
<td>0.00 - 21.7</td>
</tr>
<tr>
<td>Error (%)</td>
<td>1.8 (2.0)</td>
<td>5.5 (26.4)</td>
</tr>
</tbody>
</table>

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 area 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 mm^2, the error for the rim area was 3.9% (7.4%) (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 might be estimated in the normal and glaucoma group 1:1 on 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 topography, the optic nerve head analyser, other planimetric examinations, and the method described by Montgomery.

This study is part of a project of the Deutsche Forschungsgemeinschaft (Klinische Forschergruppe ‘Glaukom’, DFG Na 55/6-1).

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Ophthalmoscopic signs 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 Bowman and Knapp) 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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1 Bowman R. The case showing the microscopical structure of the trephined apex of conical cornea. Lancet 1875; 4: 287-8.

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 enquire 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
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 keratoconic 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 disease influenced survival 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) of the patients who 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 1980–82. As in the previous analysis the final aim was also possible to incorporate prior knowledge of the social class distribution of patients attending the clinic.

For males, the expected number of deaths based into 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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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 292 patients (mean age 66) were analysed. Preoperative visual acuity was light perception in 224 (77%) eyes; 85 (28·6%) of the lenses were hypermature (Morgan young’s 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 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 (the case in light perception cataracts). Attempts to tear or puncture a tough capsule with a cytostome frequently lead to tears in the zones.

Although not associated with vitreous loss, the posterior capsule neovascularisation in 15 (18%) eyes with hypermature cataracts because it was flaming 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,14 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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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 preclude 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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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 clouded 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 lymosine were all elevated, alluding to the possibility of other conditions such as liver disease or haematological maligancy which can be associated with a pro-thrombic tendency.

In our case as well as the case reported by Tiech et al,2 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 relationship between AIDS and CRVO.

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BOOK REVIEW


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