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Sir,

Errors in intraocular lens power calculation after photorefractive keratectomy

An increasing number of patients who have undergone an excimer laser photorefractive keratectomy (PRK) are now requiring cataract surgery. We present a case in which the calculation of intraocular lens (IOL) power was presumably affected by the preceding PRK. The possible reasons for the resulting error and how to avoid such a complication are described.

Case report

A 66-year-old man with a refractive error of -4.50 dioptres (D) in his right eye and -7.00 D in the left underwent an excimer laser PRK to the left eye resulting in a final refraction of -1.50 D. A routine 5 mm diameter ablation zone was employed. Thirteen months later he was referred for consideration of cataract surgery after noticing a gradual deterioration in his vision. The left visual acuity was reduced from the post-PRK level of 6/6 to 6/24 and the acuity in the right eye corrected to 6/9 with a -3.75 DS. There was a mixed nuclear sclerotic, cortical and posterior subcapsular lens opacity in the left eye, with mild central corneal haze. Fundoscopy showed typical myopic changes, but no other ocular pathology was observed.

A routine phacoemulsification with an 11.0 D posterior chamber lens implant was carried out in September 1995. The IOL power was derived via the SRK II formula to give a desired post-operative refraction of -1.50 D. Standard keratometry (Topcon OM-4 Ophthalmometer) and biometry (Storz) techniques were employed. All available pre-operative measurements are displayed in Table 1.

Two months later his refraction was $+4.5/-1.00 \times 045$ in the left eye, giving an acceptable visual acuity of 6/9 but with intolerable anisokonia. To correct his problem, he underwent replacement of the IOL in February 1996. The procedure was complicated by difficulties freeing adhesions between the original IOL and anterior capsule. There was a suspected zone of zonule dehiscence and the new 16.0 D IOL was placed in the ciliary sulcus. Six months post-operatively his left visual acuity was 6/9 with a plano/ $+1.00 \times 145$ DC correction. Subsequently, he has become more myopic in the right eye requiring a -5.00 DS to achieve a visual acuity of 6/9. A nuclear sclerotic cataract suggests an element of index myopia. He presently wears a contact lens in the right eye to overcome troublesome anisokonia.

Discussion

Over the next few years there will be an increasing demand for cataract extraction following PRK. All ophthalmologists, including those who do not have a specialist knowledge of refractive surgery, should be aware that the calculation of IOL power in such cases is not straightforward.

A change in refraction due to cataract formation prior to PRK may be a source of error in subsequent IOL calculation. Two years before PRK the refraction in this man's left eye was -6.00 D; however, if there is evidence of a large myopic shift and cataract surgery is likely in the foreseeable future then PRK should be postponed.

IOL calculation errors following refractive surgery were first reported in the 1980s, when some patients who had previously undergone a radial keratotomy (RK) were left unintentionally hyperopic. This has been attributed to the keratometry power being falsely high after RK.^{1,2} The keratometer measures a 3 mm zone of cornea, which is often not as flat as the smaller optical zone following RK.² A higher keratometry power will produce a lower calculated IOL power.

Table 1. Patient data

Timing of measurement	Eye	Visual acuity	Refraction	Axial length (mm)	Keratometry power
Pre-PRK	R	6/6	-3.75 DS	—	—
	L	6/6	-7.00 DS	—	—
Two months post-PRK	L	6/6	-1.50 DS		
Pre-cataract surgery	R	6/9	-3.75 DS	26.18	40.50/41.00 D
	L	6/24	-1.50 DS	28.87	38.50/40.00 D
Two months post-surgery	L	6/9	$+4.50/-1.0 \times 045$ DC		
Six months post-IOL replacement	R	6/9	-5.00 DS		
	L	6/9	Plano/ $+1.0 \times 145$ DC		

This case suggests that a similar phenomenon can occur following PRK. The main reason for the error, as with RK, probably relates to erroneous keratometry readings. PRK involves the excimer laser ablation of a disc of superficial corneal tissue. To correct myopia more tissue is removed from the centre than the periphery. As a result the ablation zone becomes aspherical causing the keratometry power to be higher than that of the central cornea.

Miscalculations of IOL power may also result from the unknown refractive effect of the abnormally distributed tear film, and from the use of an incorrect estimation of corneal refractive index in the corneal radius to power conversion. One suggestion has been to use a higher refractive index for PRK corneas,³ however, this would result in a lower predicted IOL power and hence an even greater hypermetropic error following IOL implantation. Axial length measurement is a well-known source of error, particularly in myopic eyes. In the case described biometry was performed twice pre-operatively in order to reduce the risk of error; we also checked the axial length after the cataract surgery and found it to be consistent.

Several approaches can be adopted in post-PRK patients to minimise the risk of such problems occurring. Firstly, as suggested by Koch *et al.*² a more accurate keratometry power may be derived by subtracting the refractive change induced by PRK from the pre-PRK readings. Two other reports of cataract extraction after myopic refractive procedures^{4,5} address the question of IOL calculation. In the first, the authors observed a successful outcome after using post-PRK keratometry values and the SRK/T formula.

Secondly, videokeratography can be used to measure corneal power. This technique may be more helpful than keratometry because it can take measurements from the flatter central area of cornea nearer the visual axis.⁶ However, its accuracy in such cases is not known. Thirdly, it has been suggested that some of the more recently devised theoretical formulas (e.g. Hoffer Q, Holladay and SRK/T) are more accurate than the regression formulas in eyes with flatter corneas.⁷

The ideal approach in such patients may be to use the highest IOL power predicted by all the techniques described above. It would be helpful if keratometry or topography readings were routinely obtained prior to PRK and were made available for subsequent cataract extraction and IOL implantation.

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Sir,

Nasal epipapillary membrane causing visual field loss following macular hole surgery: Does it throw fresh light on the retinotopic arrangement of the nerve fibre layer?

Visual field defects in patients following vitrectomy for macular holes have been well reported.^{1–4} Characteristically the visual field defects are peripheral and temporal. Various suggestions have been offered to account for the mechanism and pattern of the visual field

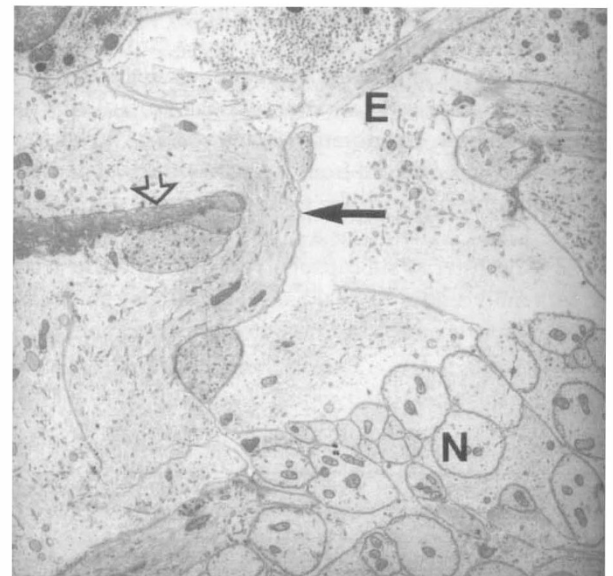


Fig. 1. A transmission electron micrograph of parapapillary retina. There is an epiretinal membrane (E) overlying the internal limiting lamina (open arrow) of the retina. A discontinuity in the internal limiting lamina is seen with a Müller cell process extending through the defect (filled arrow). N, Nerve fibre layer. (x5000)