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Correspondence

Is the vitreous necessary for accommodation in man?

SIR, The role of the vitreous in accommodation has long been in dispute. Helmholtz[1] from observations on excised eyes predicted that the zonule of the crystalline lens was relaxed when the eye accommodated. He ignored the detailed structure of the lens and any function that the vitreous might have in accommodation. Tscherning[2] disputed this 'zonular relaxation theory' because of the changes he observed in the lens when the living eye accommodated. He claimed that the zonule increased in tension. His theory was enthusiastically espoused, since it avoided the difficulties of a zonule becoming more tense as the eye returned to the resting state. The argument about whether the zonule was tensed or relaxed during accommodation was resolved by a clinician.

Graves[3] observed a unique case of traumatic aphakia and showed that the capsule of the lens, which was still present, became relaxed when the eye accommodated. In an endeavour to harmonise these 2 conflicting theories Fincham[4] proposed that changes in thickness of the capsule modified the shape of the lens as observed by Tscherning despite the relaxation of the zonule predicted by Helmholtz and confirmed by Graves. Fincham's theory was more recently refined by mathematical analysis,[5] but Fisher and Pettet[6] showed that the lens capsule did not have the thicknesses observed by Fincham until advancing age, long after the eye was able to accommodate. Furthermore, neither the intraocular pressure of the living eye nor the strength of its capsule would be sufficient to allow the changes in the lens to occur by this mechanism.[7]

Critics of the Fincham theory also questioned why the posterior surface of the lens did not bulge backwards as the zonule relaxed, since here the capsule was only $^1/_{10}$ the thickness of the anterior portion which bulged forwards. Moreover, because of this much smaller movement (about one-third) of the posterior pole when compared with the anterior pole of the lens, Coleman[8] emphasised that this was due to the vitreous preventing posterior polar movement and proposed a 'unified model of the accommodation mechanism,' giving an important role for changes in vitreous pressure.

Employing a new in-vitro experimental approach Fisher[9 10] has shown that these differences in polar movement result solely from an inherent difference in the elastic properties of the intact lens. If this is correct, it will follow that the movement of the lens and the amplitude of accommodation should be little changed by the absence of vitreous in an otherwise normal eye.

The purpose of this letter is to report on a case with vitreous present in one eye but not in the other. This has occurred because the patient (aged 32) has had a complete vitrectomy in the right eye for a persistent vitreous haemorrhage. The amplitude of accommodation in each eye was measured by determining the near point by the 'blur technique' and also by dynamic retinoscopy. No great difference in the amplitude of accommodation by either method was found, so the mean and standard deviation were calculated from the pooled results of 8 determinations of each eye. A similar number of slit-lamp photographs were taken following the instillation of a drop of 10% phenylephrine to each eye. The results are shown in Table 1.

Table 1 *Effect of absence of vitreous on amplitude of accommodation and movement of the lens*

	Right eye vitreous absent		*Left eye vitreous present*	
	Mean	*SD*	*Mean*	*SD*
Amplitude of accommodation (dioptres)	9·7±1·05		8·9±0·51	
Movement of anterior pole of lens (mm)	0·14±0·04		0·15±0·04	

From Table 1 it will be seen that there is no significant difference in the range of accommodation between each eye. The standard deviation in the eye without vitreous, however, is twice as great as in the normal eye. Without vitreous there appears to be a less precisely fixated maximum amplitude for a given accommodation effort than in the normal eye. However, anterior polar movements of the lens, like the accommodative amplitude, show no significant difference between the 2 eyes. From these observations, where the normal eye serves as a control in the same patient, it is clear that the vitreous is *not* essential either for the human eye to accommodate effectively or for the anterior pole of the lens to move forwards.

I am greatly indebted to Mr Ronald Marsh, FRCS, who kindly allowed me to examine this case under his care.

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