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**Abstract Title:** Refractive Error and Eye Shape by MRI

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**Purpose:** Our aim is to relate refractive error to 2-D eye shape in humans. Myopia, epidemic in some Asian countries, is related to excessive eye growth, thought to have an axial bias, based largely on histological and clinical observations of highly myopic eyes and eye shape data derived from refractive errors at peripheral retinal sites. However, the only published MRI study of eye shape (Cheng et al, *Optom Vis Sci*, 1992, 69: 698-701), finds axial dimensions to be smaller than equatorial dimensions.

**Methods:** Refraction data and MRI images (high-resolution, T1-weighted, GE Signa 1.5T) collected from 78 subjects with controlled fixation were analyzed retrospectively. Subject mean age was 38y (range 2 to 77y); 55% (n=43) were strabismic. Subjects were divided into hyperopic (spherical equivalent refractive error > +0.5 D; n=9), myopic (SER error  $\hat{\leq}$  -0.5 D; n=37), and emmetropic (n=32) groups. For each eye, we selected the serial transverse MRI slice with the largest cross-section, traced the inner retinal surface, and measured axial and transverse dimensions.

**Results:** This population showed the expected relationship of refractive error to axial length: hyperopes had short eyes and myopes had long eyes ( $r^2 = 0.324$ ;  $p < 0.001$ ). Myopic eyes also had the largest equatorial dimensions, although the differences between the 3 refractive groups were less dramatic than for axial length. Differences in axial length (AL;  $F_{2,66} = 11.101$ ,  $p < 0.001$ ), equatorial diameter (ED;  $F_{2,66} = 4.533$ ,  $p < 0.01$ ) and eye shape (AL  $\hat{\leq}$  ED;  $F_{2,66} = 3.141$ ,  $p < 0.05$ ) were related to refractive error. Similar trends were found when the youngest and oldest subjects were removed from the analysis to reduce the effect of age as a confounding variable.

**Conclusions:** We confirm the axial bias to myopic eye growth, and add that eyes with low to moderate myopia also show abnormal equatorial growth. This differential growth pattern may reflect regional differences in the rates of scleral growth, or anatomical constraints on equatorial scleral expansion imposed by surrounding tissues.

Parameter	Hyperopes	Emmetropes	Myopes
Refractive error (diopters)	$\hat{\leq}$ -3.16 $\hat{\pm}$ 2.12	0.01 $\hat{\pm}$ 0.17	2.29 $\hat{\pm}$ 1.53
Axial length (AL, mm)	22.39 $\hat{\pm}$ 1.36	23.01 $\hat{\pm}$ 1.05	24.11 $\hat{\pm}$ 1.35
Equatorial diameter (ED, mm)	21.39 $\hat{\pm}$ 1.20	21.62 $\hat{\pm}$ 1.30	22.39 $\hat{\pm}$ 1.37
AL $\hat{\leq}$ ED (mm)	1.00 $\hat{\pm}$ 1.04	1.39 $\hat{\pm}$ 0.76	1.72 $\hat{\pm}$ 0.67

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