The influence of axial length upon the retinal ganglion cell layer of the human eye

SUPPLEMENTARY MATERIAL

Measurements from the vertical meridian

The main manuscript describes analyses of OCT data measured along the horizontal meridian. Measurements were also made for the vertical meridian. The vertical meridian data were analyzed in parallel with the horizontal meridian data. We present the results of these analyses here as they serve as a replication of our findings on the horizontal meridian, and support a complete set of measurements for the cardinal meridians of the human retina.

These data were acquired and analyzed in the same manner as was pursued for the horizontal meridian except in two respects. First, only a single acquisition of 30° width was made along the vertical meridian, centered on the fovea. As there was only a single image, it was not necessary to montage multiple measurements. Second, the manual labelling of the ganglion cell and inner plexiform layers was performed by a different research specialist, although following the same written protocol as was used for the horizontal meridian.

Results

Relationship between GCL thickness, volume and axial length

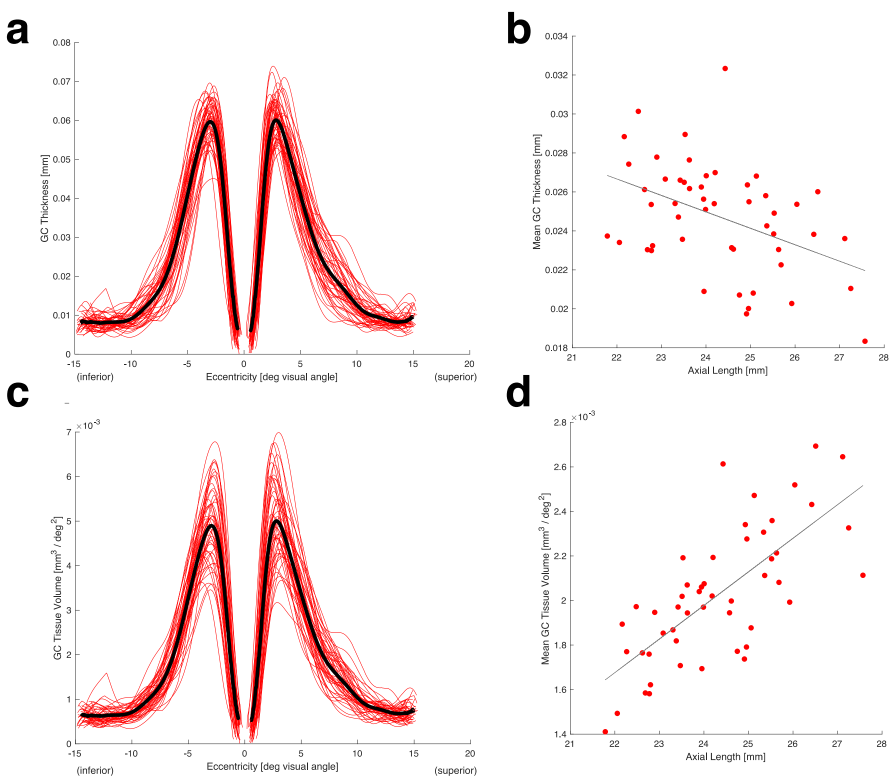

Figure S1. Relationship between GC layer thickness, volume, and axial length [Compare with Figure 2]. (a) GC thickness profiles on the vertical meridian for 50 subjects (red) and the population mean (black), extending from –15 degrees (inferior) to 15 degrees (superior). (b) The relationship between axial length and the mean GCL thickness from each participant. (c) The volume of GC tissue per square degree of visual angle as a function of retinal eccentricity for the 50 participants (red) and the population *mean (black). (d) The relationship between axial length and the mean GC tissue volume per square degree across eccentricity from each participant.*

Figure S1a presents the GCL thickness profiles along the vertical meridian for each of the 50 participants, along with the group mean. We obtained the mean thickness of the GCL profile across eccentricity for each participant, and compared this thickness value to axial length (Figure S1b). We find a negative correlation (R=–0.43).

We obtained the profile of the volume of GCL tissue (in mm^3) that subtends a square degree of visual angle (Figure S1c), expressed as a function of eccentricity in visual degrees. There was a strong, positive correlation between axial length and tissue volume (R=0.72) (Figure S1d).

Characterization model for GCL volume profiles

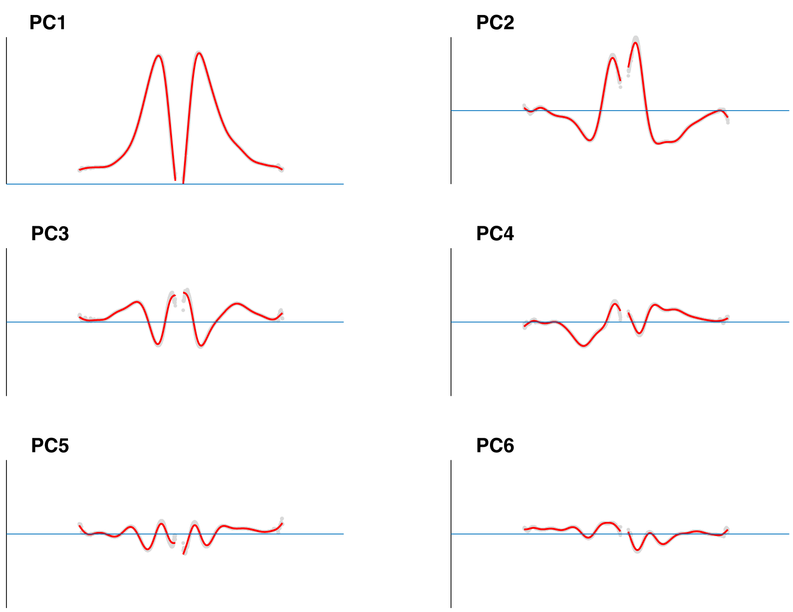

Figure S2. The first six principal components derived from an analysis of vertical meridian GCL tissue volume profiles across the 50 participants. The initial (gray) components were smoothed (red) to reduce the influence of noisy regions of the measurement. length [Compare with Figure 3]

We conducted a principal components analysis upon the vertical meridian tissue volume profiles of our 50 participants. We found that the first 6 components (Figure S2) were sufficient to explain 99.8% of the variance in the data. The first two components had a significant and substantial correlation with axial length (R = 0.79 and 0.60, respectively).

Relation to optic chiasm volume

We first examined the relationship between mean GCL thickness on the vertical meridian (Fig S1b) and optic chiasm volume, and found a significant relationship (R = 0.35 ± 0.19 SEM obtained by bootstrap resampling across the participants, p = 0.0268). Next, we examined this relationship for mean GCL tissue volume, unadjusted for axial length (Fig 2f). This correlation was substantially higher (R = 0.56 ± 0.11

SEM, p = 1.5e-4), indicating that the volume of ganglion cell tissue is a better predictor of the size of the optic chiasm than is the thickness of this retinal layer. We then examined individual differences in the volume of ganglion cell tissue, after adjusting for the modeled effects of axial length, and found that this measure is also strongly related to optic chiasm size (R = 0.49 ± 0.16 SEM, p = 1.3e-3).

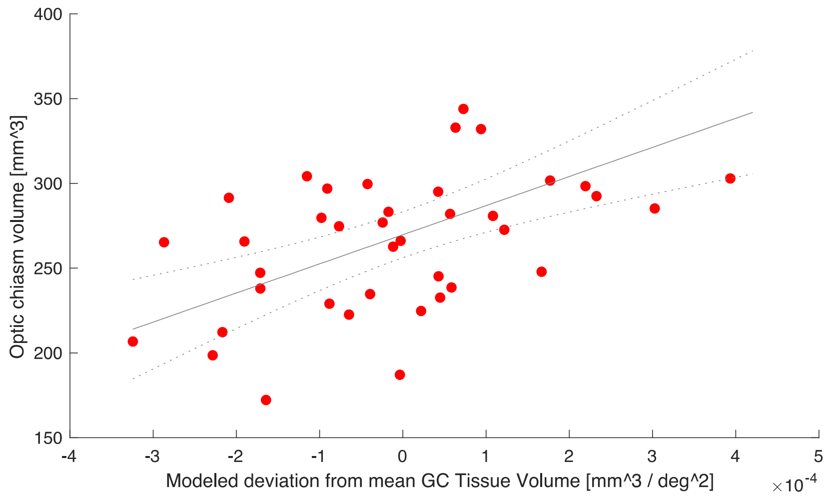

Figure S3. Relation of modeled GCL tissue volume to optic chiasm volume. [Compare with Figure 7]. Optic chiasm volume was measured from an anatomical MRI image in each of forty participants. The optic chiasm volume (y-axis) for each participant was related to individual variation in measured GC tissue volume (x-axis) on the vertical meridian. Variation in GC tissue volume was modeled as the weighted and combined influence of measured mean GCL tissue volume, with and without adjustment for the effects of variation in axial length. The best fit line (with 95% confidence intervals) of the model is shown.

We included both measures (adjusted and unadjusted volume) in a linear model of optic chiasm size (Figure S3). Overall, this model explained significant variance in the optic chiasm measurements [F(2,37) = 9.41, p = 4.95e-4].