Influence of axial length on ganglion cell complex (GCC) thickness and on GCC thickness to retinal thickness ratios in young adults.

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Running title: Influence of axial length on *G/T* ratio

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Abstract

Purpose

The present study was designed to investigate the influence of axial length on macular ganglion cell complex (GCC) thickness and two ratio parameters—the GCC thickness to macular total retinal thickness (*G/T*) ratio and the GCC thickness to macular outer retinal thickness (*G/O*) ratio—using spectral-domain optical coherence tomography (OCT)

Methods

In this prospective case series, 74 eyes of 74 healthy Japanese study participants with varying degrees of myopia were recruited. GCC, outer retinal, and total retinal thicknesses were measured with the RTVue-100 system. The *G/T* and *G/O* ratios were also calculated. The axial length was determined using the IOLMaster. The correlation between the OCT measurements and axial length was evaluated.

Results

The average axial length was 25.05 ± 1.38 mm. The GCC thickness was significantly correlated with axial length ($r = -0.384$, $P = 0.001$). The outer retinal thickness and the total retinal thickness were significantly correlated with axial length ($r = -0.444$, $P < 0.001$ and $r = -0.493$, $P < 0.001$, respectively), but the *G/T* and *G/O* ratios were not ($r = -0.093$, $P = 0.428$ and $r = -0.091$, $P = 0.440$, respectively).

Conclusions

GCC thickness is affected by axial length. Because the prevalence of myopia is high in Japan, when determining the GCC thickness of Japanese individuals, it seems necessary to consider the axial length as well. To take account of individual variation in axial length, we propose the ratio parameters as a suitable parameter.

Keywords: Axial length, Ganglion cell complex, Optical coherence tomography, Ratio, Refractive error

Introduction

The prevalence of myopia is high in East Asian countries [1, 2]. An association between myopia and glaucoma has been recognized, and the prevalence of myopia is increased in patients with ocular hypertension, primary open-angle glaucoma, and normal-tension glaucoma [2]. However, the appearance of the optic disc in myopic patients is often difficult to interpret and may mask early glaucomatous damage. The visual field test also has limitations when used to detect glaucoma: it is less sensitive for early glaucoma, and abnormal results frequently occur in patients with severe myopia due to myopic macular degeneration. Optical coherence tomography (OCT) studies have shown that decreases in the circumpapillary (cp) retinal nerve fiber layer (RNFL) thickness start from the early stages of glaucoma [3–5]. Measurement of cpRNFL thickness has emerged as an important diagnostic technology for glaucoma [6–9]. However, with increasing myopia, the superotemporal and inferotemporal RNFL thickness bundles tend to converge temporally, thereby reducing the angle bounded by the bundles. The cpRNFL thickness is not useful in highly myopic eyes because the area coded as ‘‘abnormal’’ in the cpRNFL thickness deviation map indicates not only a decrease in cpRNFL thickness in eyes with glaucoma but also the RNFL distribution in highly myopic eyes [10].

The diagnostic potential of the macular ganglion cell complex (GCC) thickness in the highly myopic eye has been reported to be higher than that of the cpRNFL thickness [11, 12]. However, those previous studies carried out with spectral domain OCT (SD-OCT) revealed that axial length influences not only the cpRNFL thickness but also the GCC thickness [13–21]. Recently, we reported that new macular parameters— the GCC thickness to total retinal thickness (*G/T*) ratio and the GCC thickness to outer retinal thickness (*G/O*) ratio— are useful for diagnosing glaucoma with myopia [22, 23].

The *G/T* ratio represents the relative amount of the GCC thickness included in the total retinal thickness. In the present study, we evaluated the influence of axial length on GCC, cpRNFL measurements, and these ratio parameters.

Study participants and methods

This was a prospective case series. Healthy Japanese study participants with myopia were recruited through an advertisement from September 2012 to January 2013. All participants were examined in

the Department of Ophthalmology, Toho University Ohashi Medical Center, Tokyo, Japan. The Toho University Ohashi Medical Center Institutional Review Board approved all protocols, and the study adhered to the tenets of the Declaration of Helsinki. The study protocols were thoroughly explained to all participants, and written informed consent was obtained from each participant.

All participants underwent complete ophthalmologic examinations and assessments of their medical and family histories. Ophthalmologic procedures performed included visual acuity testing with refraction, slit-lamp biomicroscopy, Goldmann applanation tonometry, and dilated stereoscopic fundus examination. Visual field sensitivity was determined using Humphrey field analyzer (Humphrey-Zeiss Systems, Dublin, CA, USA) 24-2 Swedish interactive threshold algorithm standard automated perimetry. Axial length was measured using partial laser interferometry performed with the IOLMaster (Carl Zeiss Meditec, Jena, Germany). Noncycloplegic refraction was measured with an auto ref-keratometer (ARK-530A; Nidek, Aichi, Japan). The refraction data were converted to the spherical equivalent, which was calculated using the spherical diopter (D) plus one-half of the cylindrical dioptric power.

Normal participants were healthy individuals who had an intraocular pressure (IOP) of <21 mmHg, a normal optic nerve head (ONH) appearance without glaucomatous damage (i.e., no disc hemorrhage, notching, thinning of the neural rim, or visible RNFL defect), normal open anterior chamber angles, normal visual field testing results for the Glaucoma Hemifield Test (GHT), and a best-corrected visual acuity of at least 1.0, with a spherical refractive error of between +3.00 and -12.0 D and a cylinder correction within 3.0 D. Exclusion criteria were an IOP of ≧22 mmHg, evidence of a reproducible visual field defect with abnormal or borderline results in the GHT, an unreliable visual field test (>15 % false positives or false negatives or >20 % fixation losses), intraocular surgery, history of ocular trauma, diabetes mellitus or neurologic diseases, vitreoretinal disease, evidence of macular abnormality, myopic tilted disc, myopic disc with saucer-like cupping, and evidence of optic nerve or RNFL abnormality.

OCT measurements

OCT was performed with the RTVue-100 (software version 4.0.5.39; Optovue, Fremont, CA, USA).

After achieving pupil dilation by instillation of 1 % tropicamide and 2.5 % phenylephrine hydrochloride to the eye over a 20-min period, a well-trained operator obtained goodquality OCT images. Images were excluded when the signal strength indicator was <45 owing to media opacity, patient positioning, or excessive eye movement.

The RTVue-100 system uses a scanning laser diode to emit a scan beam of 840 ± 10 nm and provides images of ocular microstructures. In this study, the GCC scanning protocol was used to determine the macular total retinal thickness [measured from the inner limiting membrane (ILM) to the outer retinal pigment epithelium (RPE)], GCC thickness [measured from the ILM to the outer inner plexiform layers (IPL)], and outer retinal thickness (measured from the outer IPL to the outer RPE; Fig. 1). The GCC protocol consists of 15 vertical line scans that cover a 7×7-mm region. To achieve the best coverage possible within the temporal region, the GCC protocol centered the scan at 1 mm temporal to the center of the fovea. During the total scanning period, the GCC protocol captured 15,000 data points within 0.6 s. Three types of data (average, superior, and inferior thicknesses) were used to analyze the GCC, outer retinal, and total retinal thicknesses.

The ONH scanning protocol was used to measure the cpRNFL thickness. The total acquisition time for a single scan was 0.55 s. Using the fundus picture generated by the OCT, we were able to manually trace the contour of the ONH. Using the existing software, the RNFL thickness was automatically measured at a diameter of 3.45 mm around the center of the optic disc. A total of 775 A scans were obtained at this circumference. The cpRNFL thickness parameter was designed to evaluate the mean thickness of a 360° area that includes the superior and inferior hemispheres and the temporal, superior, nasal, and inferior quadrants. Cases with parapapillary atrophy that extended beyond the OCT RNFL scan measurement circle were excluded. No corrections for magnification were made in any of the cases.

G/T ratio and *G/O* ratio

We created two new macular parameters: the *G/T* ratio and the *G/O* ratio. These ratio parameters were calculated using the following published formulae [22, 23]: *G/T* ratio (%) = (GCC thickness/macular total retinal thickness) × 100, and *G/O* ratio (%) = (GCC thickness/macular outer retinal thickness) ×

100.

Statistical analysis

Pearson's correlation coefficients and partial correlation analysis were calculated to evaluate the relationships between the SD-OCT measurements and the demographic and clinical variables. Multiple regression analysis was used to evaluate the relationship between the GCC and age, sex, axial length, and outer retinal thickness. Statistical analysis was performed using IBM SPSS Statistics for Windows (version 19.0; SPSS, Chicago, IL, USA). Probability values of <0.05 were considered significant.

Results

Seventy-eight study participants were initially enrolled in the study. We excluded 4 participants because of poor image analysis quality. We assessed eyes of Japanese individuals. We included 74 normal participants in the final analysis (47 men and 27 women; age range 22–51 years; mean age 34.88 ± 7.02 years). The mean axial length and spherical equivalent were 25.05 ± 1.38 mm (22.25–28.76 mm) and -3.47 ± 2.96 D (+1.00 to -11.00 D), respectively. As expected, axial length and refractive error were significantly correlated (r = -0.806, $P < 0.0001$). The participants' characteristics are presented in Table 1.

Table 2 shows the OCT parameter measurements obtained using the RTVue-100. The average GCC thickness was 93.07 ± 5.84 lm. The average *G/T* ratio and average *G/O* ratio were 35.64 ± 1.34 and 55.43 ± 3.30 %, respectively.

Table 3 shows the relationships between the OCT parameters and the demographic and clinical variables. The average cpRNFL thickness was significantly correlated with both the axial length (r = -0.512, $P < 0.001$) and the spherical equivalent (r = 0.514, $P < 0.001$). The average GCC thickness was not correlated with age (r = 0.028, $P = 0.810$). The average GCC thickness was correlated with both axial length (r = -0.384, $P = 0.001$) and spherical equivalent (r = 0.436, $P < 0.001$; Fig. 2). A 1-mm increase in axial length resulted in a decrease in the average GCC thickness of approximately 1.62μm. The average outer retinal thickness was correlated with both the axial length (r = -0.444, $P <$

0.001) and the spherical equivalent (r = 0.406, $P < 0.001$; Fig. 2).

Table 4 shows the relationships between the ratio parameters and the demographic and clinical variables. The average G/T ratio and the average G/O ratio were not correlated with age (r = 0.013, $P = 0.914$ and r = 0.014, $P = 0.904$, respectively). The average *G/T* ratio and *G/O* ratio were not significantly correlated with either the axial length (r = -0.093, $P = 0.428$ and r = -0.091, $P = 0.440$, respectively) or the spherical equivalent (r = 0.173, $P = 0.140$ and r = 0.172, $P = 0.144$, respectively; Fig. 2).

Table 5 shows the results of the multiple linear regression analysis of the effects of age, sex, axial length, and macular outer retinal thickness on the GCC thickness. Significant positive relationships between the GCC thickness and the axial length and between the GCC thickness and the outer retinal thickness were found ($P = 0.03$ and $P = 0.02$, respectively). No significant relationship was found between the GCC thickness and either age or sex.

Partial correlation analysis was conducted. A significant correlation was found between the average GCC thickness and the average outer retinal thickness (partial correlation analysis adjusted by axial length: r = 0.312, $P = 0.007$). Also, a significant correlation was found between the average GCC thickness and the axial length (partial correlation analysis adjusted by the outer retinal thickness: r = -0.239, $P = 0.042$) and between the average outer retinal thickness and the axial length (partial correlation analysis adjusted by the average GCC thickness: r = -0.335, $P = 0.004$).

Discussion

In the present study, we assessed the relationships between the demographic and clinical variables and the GCC thickness in moderately myopic eyes. We found that GCC thickness is affected by axial length, but that the *G/T* and *G/O* ratios are not.

SD-OCT is a recent technique that has enabled the imaging of ocular structures with a higher resolution and a faster scan rate than before. Thus, over the past few years, SD-OCT has progressively replaced time-domain OCT for the evaluation of glaucoma. Imaging modalities such as OCT may be effective in these types of cases. The RTVue-100 is an available OCT device that utilizes SD-OCT technology. The RTVue-100 has made it possible to perform automatic measurements of GCC

thickness, which is the sum of the nerve fibers, ganglion cells, and IPL [24]. Studies using this instrument have demonstrated that when the early stages of glaucoma were closely monitored, an improved diagnostic ability was associated with these changes [25–31]. However, GCC thickness in healthy eyes has been shown to vary from 76.6 to 119.8μm [25], in addition to being influenced by axial length, age, and ethnicity [20, 21, 32].

Previous OCT studies in myopic patients have focused on the cpRNFL thickness distribution [13–19, 33]. Hoh et al. [33] reported no correlation between myopia and cpRNFL thickness. Their study may have been limited by the poorer resolution of the earlier generation OCT (OCT-1). Many other researchers have reported that the average cpRNFL thickness decreased with myopia in conjunction with an increase in the axial length. Using Stratus OCT, Budenz et al. [13] found that the mean cpRNFL thickness was significantly associated with axial length ($P < 0.001$). They found a reduction of 2.2 lm per extra 1 mm of axial length. In other studies of Stratus OCT, Leung et al. [14] and Rauscher et al. [15] found that the mean cpRNFL thickness was significantly associated with axial length (r = -0.314, $P = 0.001$ and r = -0.70, $P < 0.001$, respectively). A SD-OCT study by Wang et al. [16] that used Cirrus HD-OCT determined that the average cpRNFL thickness decreased as the degree of myopia increased. These findings can be explained by the fact that globe elongation is associated with thinning of the globe wall, which results in a thin cpRNFL [34, 35], or by the axial length-induced magnification effect [19]. In our study, we found that the average cpRNFL thickness decreased with the spherical equivalent and increased with axial length.

The thicknesses of the cpRNFL and the GCC significantly decrease with age [20, 32, 36, 37]. However, Zhao et al. [21] and our current work showed no correlation between age and GCC thickness.

Our study demonstrated a significant negative correlation between GCC thickness and axial length and a significant positive correlation between GCC thickness and the spherical equivalent. We found a reduction of 1.62μm per extra 1 mm of axial length. The relationship between the GCC and axial length was similar to that found for the cpRNFL thickness and axial length. This can be explained by the fact that globe elongation is associated with thinning of the globe wall, which results in a relatively thin GCC. Very few studies have examined the relationship between GCC thickness and axial length

[20, 21]. Kim et al. [20] used the same OCT and investigated the relationship between the GCC thickness and the axial length. Using multiple linear regression analysis, they found that the average and inferior GCC thicknesses were significantly correlated with axial length (P = 0.021 and P = 0.002; respectively). Zhao et al. [21] showed that the significant reduction in the average GCC thickness was correlated with the axial length (r = -0.280, P = 0.004). As there are wide variations in the refractive error [38], these variations should be considered when evaluating GCC thickness in myopic eyes. Furthermore, we found a significant correlation between the outer retinal thickness and the axial length (r = -0.444, P < 0.001), and between the average outer retinal thickness and the average GCC thickness (r = 0.429, P < 0.001). Our multiple regression analysis also indicated significant correlations between the average GCC thickness and the axial length (P = 0.03) and between the average GCC thickness and the outer retinal thickness (P = 0.02).

GCC thickness has been reported to decrease from the very early stages of glaucoma [24]. Therefore, GCC thickness decreases for both glaucoma and myopic eyes. In the case of glaucoma with myopia, it is difficult to determine whether the decrease in GCC thickness is due to myopia or glaucoma. Although previous studies have shown that the outer retinal thickness, which is measured by OCT, is not affected by glaucoma [9, 24, 30], another study has demonstrated that the outer retinal thickness is affected by myopia [20]. We created two new ratio parameters. In our study, we found the average *G/T* ratio to be 35.53 %, and the average *G/T* ratio was not significantly correlated with either the axial length or the spherical equivalent. That is, as the axial length increases, both the GCC and the total retinal thicknesses decrease, so the ratio does not change. The average *G/O* ratio was 55.43 %, and, similar to the *G/T* ratio, was not significantly correlated with either the axial length or the spherical equivalent. This indicates that, as the axial length increases, both the GCC and the outer retinal thicknesses decrease, so the ratio does not change. In addition, this latter finding is supported by our results that show a significant correlation between the GCC thickness and the outer retinal thickness (partial correlation analysis adjusted by axial length: r = 0.312, P = 0.007). Therefore, these findings demonstrate that these new ratio parameters are not affected by myopia.

With regard to glaucoma diagnostic ability, the GCC thickness has been shown to be comparable and complementary to the cpRNFL thickness [25, 27–31]. Also, it has been reported that in severely

myopic eyes, the diagnostic capability of the GCC thickness is better than that of the cpRNFL thickness [11, 12]. Based on these results, the goal of our study was to investigate whether the ratio parameters might be useful for diagnosing glaucoma. We previously reported finding that the *G/T* ratio was useful for diagnosing glaucoma with low myopia [22]. Therefore, an investigation of the glaucoma diagnostic capability in moderately and highly myopic eyes needs to be undertaken in the future.

Our study has a few limitations. Its relatively small sample size, inclusion of participants of a single ethnicity, and its range of mildly to highly myopic eyes may have resulted in some bias. Further investigation is needed to determine whether the ratio parameters and axial length in highly myopic eyes and in other ethnic groups are correlated. Also, it should be noted that the RTVue-100 cannot correct for magnification effects, so there is a chance that our results may have been different if this correction had been available.

In conclusion, the GCC thickness was significantly correlated with both the axial length and the spherical equivalent. Since the SD-OCT measurement of GCC thickness is affected by myopia, evaluation of GCC thickness should be interpreted in the context of axial length. Moreover, the *G/T* and *G/O* ratios are suitable parameters for taking into account variations in axial length.

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Figure legends

Fig. 1

A typical example of a vertical OCT scan. The image segmentation algorithm automatically detected the retinal layer boundaries (white lines) and measured the ganglion cell complex thickness (a), outer retinal thickness (b), and total retinal thickness (c). These retinal layers are marked by arrows

Fig. 2

Relationships between the macular parameters and the axial length. The GCC thickness is significantly associated with axial length ($r = -0.384$, $P = 0.001$): the regression formula is $y = -1.62x + 133.74$. The outer retinal thickness is significantly associated with axial length ($r = -0.444$, $P < 0.001$): the regression formula is $y = -2.32x + 226.07$. No significant association was observed between the *G/T* ratio and the axial length ($r = -0.093$, $P = 0.428$)

Table 1 Characteristics of the study participants (n = 74)

Variable	Mean ± SD	95%CI
Sex		
Male	47	
Female	27	
Age (years)	34.88 ± 7.02	33.25 to 36.50
IOP (mmHg)	14.15 ± 2.53	13.56 to 14.73
Spherical equivalent (D)	-3.47 ± 2.96	-4.15 to -2.78
Axial length (mm)	25.05± 1.38	24.73 to 25.37
MD (dB)	-0.66 ± 1.11	-0.92 to -0.40
PSD (dB)	1.40 ± 0.50	1.28 to 1.51

CI confidence interval, *IOP* intraocular pressure, *D* diopter, *MD* mean deviation, *PSD* pattern standard deviation

Table 2 Optical coherence tomography parameter measurements obtained using the RTVue-100

	Study participants (n = 74)	95% CI
	Mean ± SD	
GCC thickness (μm)		
Average thickness	93.07 ± 5.84	91.72 - 94.42
Superior thickness	93.28 ± 6.12	91.86 - 94.70
Inferior thickness	92.86 ± 6.13	91.44 - 94.28
G/T ratio (%)		
Average	35.64 ± 1.34	35.32 - 35.95
Superior	35.39 ± 1.40	35.07 - 35.71
Inferior	35.90 ± 1.47	35.56 - 36.24
G/O ratio (%)		
Average	55.43 ± 3.30	54.67 - 56.20
Superior	54.85 ± 3.41	54.06 - 55.64
Inferior	56.09 ± 3.61	55.25 - 56.92
Outer retinal thickness (μm)		
Average thickness	168.00 ± 7.21	166.33 - 169.67
Superior thickness	170.20 ± 7.49	168.46 - 171.93
Inferior thickness	165.69 ± 7.29	164.00 - 167.38
Total retinal thickness (μm)		

Average thickness	261.07 ± 11.05	258.51 - 263.63
Superior thickness	263.48 ± 11.51	260.81 - 266.15
Inferior thickness	258.55 ± 11.18	255.96 - 261.14
cpRNFL thickness (μm)		
Average thickness	102.67 ± 8.70	100.65 - 104.68
Superior thickness	103.23 ± 10.67	100.76 - 105.70
Inferior thickness	103.05 ± 13.06	100.02 - 106.08
Temporal quadrant	84.41 ± 13.34	81.32 - 87.50
Superior quadrant	125.68 ± 15.62	122.07 - 129.30
Nasal quadrant	68.25 ± 9.24	66.11 - 70.39
Inferior quadrant	131.03 ± 15.79	127.37 - 134.68

CI confidence interval, *GCC* macular ganglion cell complex, *G/T ratio* ganglion cell complex thickness to total retinal thickness ratio, *G/O ratio* ganglion cell complex thickness to outer retinal thickness ratio, *cpRNFL* circumpapillary retinal nerve fiber layer

Table 3 Correlations between OCT parameters and axial length, spherical equivalent, age, and outer retinal thickness

	Axial length		Spherical equivalent		Age		Outer retinal thickness	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*
GCC thickness								
Average thickness	–0.384	0.001*	0.436	< 0.001*	0.028	0.810	0.429	< 0.001*
Superior thickness	–0.346	0.002*	0.381	0.001*	–0.003	0.979	0.390	0.001*
Inferior thickness	–0.386	0.001*	0.450	< 0.001*	0.056	0.633	0.429	< 0.001*
Outer retinal thickness								
Average thickness	–0.444	< 0.001*	0.406	< 0.001*	0.024	0.842	NA	NA
Superior thickness	–0.477	< 0.001*	0.440	< 0.001*	–0.016	0.889	NA	NA
Inferior thickness	–0.402	< 0.001*	0.360	0.002*	0.071	0.547	NA	NA
Total retinal thickness								
Average thickness	–0.493	< 0.001*	0.495	< 0.001*	0.030	0.797	0.879	< 0.001*
Superior thickness	–0.495	< 0.001*	0.489	< 0.001*	–0.012	0.917	0.845	< 0.001*
Inferior thickness	–0.474	< 0.001*	0.482	< 0.001*	0.077	0.513	0.871	< 0.001*
cpRNFL thickness								
Average thickness	–0.512	< 0.001*	0.514	< 0.001*	0.029	0.804	0.337	0.003*
Superior thickness	–0.485	< 0.001*	0.503	< 0.001*	0.009	0.936	0.285	0.014*
Inferior thickness	–0.264	0.023*	0.187	0.110	0.138	0.243	0.322	0.005*
Temporal quadrant	0.018	0.882	–0.165	0.160	–0.165	0.160	0.004	0.971
Superior quadrant	–0.466	< 0.001*	0.491	< 0.001*	0.048	0.685	0.335	0.004*

Nasal quadrant	–0.448	< 0.001*	0.660	< 0.001*	0.188	0.110	0.254	0.029*
Inferior quadrant	–0.453	< 0.001*	0.506	< 0.001*	–0.082	0.489	0.139	0.236

r: Pearson correlation coefficient, *GCC* macular ganglion cell complex, *cpRNFL* circumpapillary retinal nerve fiber layer

*$P < 0.05$

Table 4. Correlations between ratio parameters and axial length, spherical equivalent, and age

	Axial length		Spherical equivalent		Age	
	r	*P*	*r*	*P*	*r*	*P*
G/T ratio						
Average	–0.093	0.428	0.173	0.140	0.013	0.914
Superior	–0.031	0.793	0.092	0.436	0.008	0.947
Inferior	–0.133	0.257	0.224	0.055	0.010	0.930
G/O ratio						
Average	–0.091	0.440	0.172	0.144	0.014	0.904
Superior	–0.033	0.783	0.095	0.419	0.007	0.953
Inferior	–0.127	0.281	0.219	0.061	0.013	0.909

r: Pearson correlation coefficient

G/T ratio ganglion cell complex thickness to total retinal thickness ratio, *G/O ratio* ganglion cell complex thickness to outer retinal thickness ratio

Table 5 Results of the multiple linear regression analysis of the relationships between ganglion cell complex thickness (dependent variable) and age, sex, axial length, and macular outer retinal thickness

Independent variable	Partial regression coefficient	95% CI		Standardized partial regression coefficient	*P* value
Age (years)	–0.03	–0.23	0.18	–0.04	0.77
Sex	–1.15	–4.20	1.90	–0.10	0.45
Axial length (mm)	–1.11	–2.14	-0.09	–0.26	0.03
Outer retinal thickness (μm)	0.24	0.05	0.44	0.30	0.02

CI confidence interval

Figure 1.

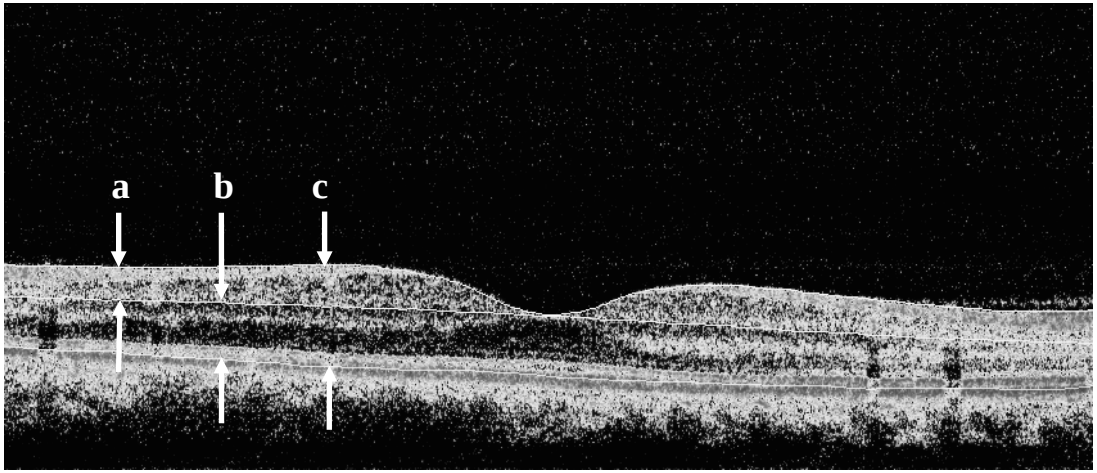
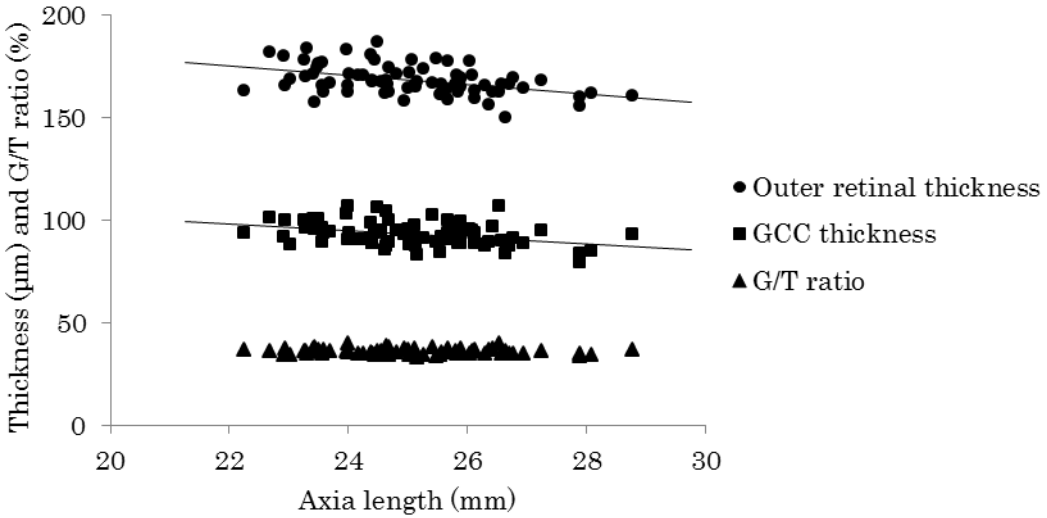


Figure 2.


Thickness (μm) and G/T ratio (%)
200
150
100
50
0
20
22
24
26
28
30
Axia length (mm)
Outer retinal thickness
GCC thickness
G/T ratio