Multidisciplinary Ophthalmic Imaging

Macular Choroidal Thickness Profile in a Healthy Population Measured by Swept-Source Optical Coherence Tomography

Jorge Ruiz-Medrano,1 Ignacio Flores-Moreno,2 Pablo Peña-García,3 Javier A. Montero,4 Jay S. Duker,5 and José M. Ruiz-Moreno2,6

1Clinico San Carlos University Hospital, Ophthalmology Unit, Madrid, Spain
2Department of Ophthalmology, Castilla La Mancha University, Albacete, Spain
3Division of Ophthalmology, Miguel Hernández University, Alicante, Spain
4Pio del Río Hortega University Hospital, Ophthalmology Unit, Valladolid, Spain
5New England Eye Center, Tufts Medical Center, Boston, Massachusetts, United States
6Alicante Institute of Ophthalmology, Vissum, Vitreo-Retinal Unit, Alicante, Spain

Correspondence: Jorge Ruiz-Medrano, c/ Meléndez Valdés, 38, 28015 Madrid, Spain; jorge.ruizmedrano@gmail.com.

Submitted: January 1, 2014
Accepted: May 10, 2014


PURPOSE. To determine choroidal thickness (CT) profile in a healthy population using swept-source optical coherence tomography (SS-OCT).

METHODS. This was a cross-sectional, noninterventional study. A total of 276 eyes (spherical equivalent ±3 diopters [D]) were scanned with SS-OCT. Horizontal CT profile of the macula was created measuring subfoveal choroidal thickness (SFT) from the posterior edge of retinal pigment epithelium (RPE) to the choroid–sclera junction. Three determinations were performed at successive points 1000 μm nasal and five more temporal to the fovea. Subjects were divided into five age groups.

RESULTS. The mean SFT was 301.89 ± 80.53 μm (95% confidence interval: 292.34–311.43). The mean horizontal macular choroidal thickness (MCT) was 258.69 ± 64.59 μm (95% confidence interval: 251.04–266.35). No difference in CT was found between men and women. Mean SFT of the different study groups was 325.6 ± 51.1 (0–10 years), 316.7 ± 90.1 (11–20 years), 313.9 ± 80.3 (21–40 years), 264.6 ± 79.3 (41–60 years), and 276.3 ± 88.8 μm in subjects older than 60 years (P < 0.001; ANOVA test). Mean horizontal MCT was 286.0 ± 43.5, 277.7 ± 68.2, 264.0 ± 61.9, 223.4 ± 62.2, and 229.7 ± 66.1 μm, respectively (P < 0.001; ANOVA test). The CT profile was different for each age group.

CONCLUSIONS. To our knowledge, this is the first population study of CT of healthy eyes across a broad range of age groups using SS-OCT. As has been determined using spectral-domain OCT, CT decreases with advancing age, especially after age 40. There were no differences due to sex. The greatest CT variation takes place in temporal sectors.

Keywords: choroidal thickness, healthy population, SS-OCT, swept-source OCT

In recent years the choroid and its role in posterior segment disease has become an increasing subject of study. Ultrasound,1 magnetic resonance imaging (MRI),2 and Doppler laser have been employed to study the choroid, but due to insufficient resolution are of limited use. On the other hand, indocyanine green (ICG) angiography reveals useful clinical information but does not provide cross-sectional images of the choroid for in vivo study.3,4

The introduction of optical coherence tomography (OCT) and its continuous development represent a clear breakthrough in choroidal imaging as it provides deeper, higher-resolution imaging of the eye layers with brief acquisition times.5,6 Initially, time-domain OCT (TD-OCT) was the technology available to study the posterior segment, but because of poor penetration below the retinal pigment epithelium (RPE) and relatively low resolution, TD-OCT could not be employed for choroidal imaging. In 2006, spectral-domain OCT (SD-OCT) became commercially available. Despite its obvious advantages over TD-OCT, signal roll-off with depth and signal attenuation by pigmented tissues or media opacities still precluded choroidal imaging in most eyes. Spaide et al.7 introduced a technique to allow choroidal imaging using SD-OCT devices: enhanced depth imaging OCT (EDI-OCT), which provides consistent choroidal visualization in most eyes and allows quantitative and reproducible thickness measurements. The most recent innovative technology available for OCT imaging is high-penetration, swept-source longer-wavelength OCT (SS-OCT).8–11 Copete et al.12 and Ruiz-Moreno et al.13 affirmed that reliable measurement of CT was possible in 100% of eyes using an SS-OCT device.

As advancements in technology allow extensive studies of the choroid to be performed, variations in CT and morphology have been associated with conditions such as central serous chorioretinopathy,4,14–16 age-related macular degeneration,4,16–22 polypoidal choroidal vasculopathy,4,16–18,21 myopic maculopathy,23–27 posterior uveitis,3,15,16,28–51 and choroidal tumors.4,32,33
Age-related thinning of the choroid of healthy patients studied by SD-OCT has been well documented,34–39 as well as differences in CT between adult and pediatric eyes.13 A paper by Ikuno et al.36 described the CT in healthy subjects ranging from 23 to 88 years of age with SS-OCT technology and CT changes according to change in subjects’ age. To our knowledge, however, no previous report has determined the age at which the choroid is thickest, or the normal evolution or changes in thickness with age or sex across a wide span of ages. If choroidal variations do play a role in retinal diseases, the normal CT profile must be known so that it is possible to point out variations as they appear. The aim of this study was to determine CT profile in a large population with healthy eyes using SS-OCT.

PATIENTS AND METHODS

This was a cross-sectional, noninterventional study, performed at Vissum Alicante, Spain. The study followed the tenets of the Declaration of Helsinki. The institutional review board of Vissum Alicante approved the study. All examinations were obtained in the afternoon to avoid diurnal variations (16:00–20:00).40–42 We manually measured the CT in 276 eyes from 154 patients. Ninety-three patients (60.4%) were male (164 eyes, 78 right and 86 left), and 61 patients (39.6%) were female (112 eyes, 57 right and 55 left). Their macular area was studied with an SS-OCT system (Topcon Corporation, Tokyo, Japan) after they provided informed consent. Inclusion criteria were best-corrected visual acuity (BCVA) between 20/20 and 20/25, spherical equivalent (SE) between +3 and –3 diopters (D), and no systemic or ocular diseases. Eyes with any history of any retinal disease in the fellow eye were not included. Eyes with SE beyond ±3 D were excluded.

The SS-OCT device used to image the full-thickness choroid and sclera,43 which uses a tunable laser as a light source, operated at 100,000-Hz A-scan repetition rate in the 1-μm wavelength region. The device can do image averaging of up to 96 B-scans at each location. For this study, the reference mirror was placed at the deeper position of the retina so that the sensitivity was higher at the choroidal area in macular imaging. A line scanning mode, which produces an OCT image containing 1024 axial scans with a scan length of 12 mm, was employed. This sampling space in object space corresponds to 11.7 μm/pixel. Lateral resolution is set at 20 μm with 24-mm axial eye length, while axial resolution is 8 μm in the retina.44 Lateral and axial resolution are independent. Acquisition time was 1 second. This allowed us to obtain good-quality images even in 3-year-old children. A horizontal CT profile of the macula was manually created measuring CT (from the posterior edge of RPE to the choroid-sclera junction) under the fovea using the prototype software. The outer aspect of the lamina fusca, rather than the outer limit of the choroidal vessels, was the landmark used to determine the most distal aspect of the choroid.

Five further determinations were performed every 1000 μm temporal (T1, T2, T3, T4, and T5) and three more nasal (N1, N2, and N3) to the fovea (Fig. 1).

An experienced technician determined refractive errors and BCVA using an autorefractometer (Nidek, Gamagohri, Japan) that was later checked by a certified optometrist.

To study the possible evolution of the CT, the study group was divided into five subgroups according to age distribution: 0 to 10 (eyes, n = 75), 11 to 20 (n = 48), 21 to 40 (n = 50), 41 to 60 (n = 40), and older than 60 years (n = 63). Mean age was 33.5 ± 24.9 years (from 3 to 95). Mean SE was 0.10 ± 1.36 D (from +3 to –3).

Two observers determined CT independently and in a masked fashion.
For statistical treatment of the data, the program used was version 17.0 of SPSS for Windows (SPSS, Chicago, IL, USA). Interobserver reproducibility was evaluated using intraclass correlation coefficient (ICC) for each variable measured (mean and 95% confidence interval), coefficient of variation between graders, and Bland-Altman plots. The means of the measures obtained by the two observers were the data used for the rest of the calculations. Kolmogorov-Smirnov test was applied for all data samples in order to check normality. Comparison between groups was performed using Student’s t-test when samples were normally distributed or Mann-Whitney test when parametric statistics were not possible. The level of significance used was always the same (P < 0.05). Homogeneity of variances was checked using the Levene test. For comparison of several independent samples, analysis of variance (ANOVA) or Kruskal-Wallis test was used depending on whether normality could be assumed. Bivariate correlations were evaluated using Pearson or Spearman correlation coefficients, depending on whether normality could be assumed or not. For the development of predictive models, linear regression was used.

RESULTS
Swept-source OCT allowed both independent observers clear visualization of both the RPE and scleral-choroidal junction and therefore accurate measurement of CT in all eyes (100%). Mean subfoveal choroidal thickness (SFCT) was 301.89 ± 80.53 µm (from 99.50 to 539.50; 95% confidence interval: 292.34–311.43). Mean macular horizontal CT was 258.69 ± 64.59 µm (from 99.00 to 455.28; 95% confidence interval: 251.04–266.35). The horizontal CT profile can be seen in Figure 2.

No statistically significant difference in CT was found in men compared to women. The two sexes showed a similar choroidal profile (Fig. 3), although women were found to have a trend toward thinner temporal choroids. Mean SFCT was 303.9 ± 70.9 µm in men versus 296.4 ± 94.1 µm in women (P = 0.483; Student’s t-test). Mean horizontal MCT was 260.8 ± 60.9 µm in men versus 255.0 ± 70.7 µm in women (P = 0.227; Mann-Whitney U test). Mean age was 30.39 ± 25.37 in men versus 37.48 ± 23.86 in women (P = 0.006; Mann-Whitney test). Mean SE was 0.15 ± 1.38 D in men versus 0.09 ± 1.34 D in women (P = 0.796; Mann-Whitney test) (Table 1).

FIGURE 2. Choroidal thickness profile in general population (microns/measurement locations).

FIGURE 3. Choroidal thickness profile comparison, men (red) versus women (blue) (microns/measurement locations).
Mean SFCT of the different study groups (Table 2) was 325.6 ± 51.1 μm in subjects 0 to 10 years, 316.7 ± 90.1 μm in those 11 to 20 years, 313.9 ± 80.3 μm in those 21 to 40 years, 264.6 ± 79.3 μm in those 41 to 60 years, and 276.3 ± 88.8 μm in those older than 60 years, differences that were statistically significant (P < 0.001; ANOVA test). Mean horizontal MCT was 286.0 ± 43.5, 277.7 ± 68.2, 264.0 ± 61.9, 223.4 ± 62.2, and 229.7 ± 60.1 μm for subjects 0 to 10, 11 to 20, 21 to 40, 41 to 60, and >60 years, respectively (P < 0.001; ANOVA test). The CT profile was different in each age group (Figs. 4, 5, 6), showing an evident statistically significant difference; CT was thicker as age decreased except in the group older than 60 years, where it was thicker than among those 41 to 60 years (Table 3). However, differences in mean MCT and SFCT were not significant between subjects ages 41 to 60 versus those older than 60 years (P = 0.629 and 0.502; Student’s t-test, respectively).

Spherical equivalent was not different between groups except for the group 0 to 10 years (P = 0.016; Kruskal-Wallis test), with 0.51 ± 1.49 D in this group. Mean SE of the other
The SE is not statistically significant, so the equation to calculate MCT would then be
### Table 3: Choroidal Thickness Values According to Age Group in All Measurement Locations

<table>
<thead>
<tr>
<th>Age</th>
<th>N3 Mean (μm)</th>
<th>N2 Mean (μm)</th>
<th>N1 Mean (μm)</th>
<th>SF Mean (μm)</th>
<th>T1 Mean (μm)</th>
<th>T2 Mean (μm)</th>
<th>T3 Mean (μm)</th>
<th>T4 Mean (μm)</th>
<th>T5 Mean (μm)</th>
<th>SE, D (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>161.06</td>
<td>221.63</td>
<td>280.65</td>
<td>325.68</td>
<td>330.51</td>
<td>326.75</td>
<td>320.81</td>
<td>313.57</td>
<td>293.8</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>45.02</td>
<td>49.10</td>
<td>54.33</td>
<td>51.13</td>
<td>54.33</td>
<td>56.12</td>
<td>59.72</td>
<td>57.72</td>
<td>54.55</td>
<td>1.49</td>
</tr>
<tr>
<td>95% CI</td>
<td>150.80–171.52</td>
<td>210.34–232.93</td>
<td>268.15–293.15</td>
<td>313.92–337.44</td>
<td>318.01–343.01</td>
<td>313.84–339.87</td>
<td>307.07–334.55</td>
<td>298.91–328.22</td>
<td>279.85–307.75</td>
<td>0.13–0.81</td>
</tr>
<tr>
<td>11–20</td>
<td>159.21</td>
<td>219.79</td>
<td>279.14</td>
<td>316.73</td>
<td>319.23</td>
<td>312.14</td>
<td>300.49</td>
<td>295.02</td>
<td>297.74</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>61.58</td>
<td>80.94</td>
<td>90.61</td>
<td>90.18</td>
<td>80.54</td>
<td>72.16</td>
<td>80.49</td>
<td>209.02</td>
<td>276.06</td>
<td>1.76</td>
</tr>
<tr>
<td>95% CI</td>
<td>141.33–177.09</td>
<td>196.29–243.30</td>
<td>252.83–305.44</td>
<td>290.54–342.91</td>
<td>295.84–342.62</td>
<td>291.18–333.09</td>
<td>280.29–320.69</td>
<td>271.76–318.28</td>
<td>259.17</td>
<td>0.15</td>
</tr>
<tr>
<td>21–40</td>
<td>156.37</td>
<td>218.03</td>
<td>277.86</td>
<td>313.94</td>
<td>313.12</td>
<td>298.25</td>
<td>283.55</td>
<td>264.92</td>
<td>250.17</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>54.56</td>
<td>65.16</td>
<td>73.41</td>
<td>80.35</td>
<td>81.79</td>
<td>87.39</td>
<td>77.35</td>
<td>77.35</td>
<td>71.11</td>
<td>1.04</td>
</tr>
<tr>
<td>95% CI</td>
<td>140.87–171.88</td>
<td>199.51–236.55</td>
<td>257.00–298.72</td>
<td>291.11–345.77</td>
<td>289.38–340.36</td>
<td>273.63–320.67</td>
<td>261.57–305.90</td>
<td>243.94–285.90</td>
<td>229.76–270.38</td>
<td>0.50–1.00</td>
</tr>
<tr>
<td>&gt;40</td>
<td>123.99</td>
<td>156.57</td>
<td>218.03</td>
<td>277.86</td>
<td>313.94</td>
<td>298.25</td>
<td>283.55</td>
<td>264.92</td>
<td>250.17</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>58.35</td>
<td>65.16</td>
<td>73.41</td>
<td>80.35</td>
<td>81.79</td>
<td>87.39</td>
<td>77.35</td>
<td>77.35</td>
<td>71.11</td>
<td>1.04</td>
</tr>
<tr>
<td>95% CI</td>
<td>105.33–142.65</td>
<td>150.10–204.65</td>
<td>204.26–256.87</td>
<td>239.31–290.36</td>
<td>223.28–286.55</td>
<td>210.97–249.18</td>
<td>203.65–255.60</td>
<td>194.48–250.74</td>
<td>192.54–250.74</td>
<td>0.27–1.00</td>
</tr>
</tbody>
</table>

### Table 4: Correlations of CT With Age and Spherical Equivalent

<table>
<thead>
<tr>
<th>N3</th>
<th>N2</th>
<th>N1</th>
<th>SF</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>MCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Spearman’s Rho</td>
<td>P-value</td>
<td>Age</td>
<td>Spearman’s Rho</td>
<td>P-value</td>
<td>Age</td>
<td>Spearman’s Rho</td>
<td>P-value</td>
<td>Age</td>
</tr>
<tr>
<td>0–10</td>
<td>0.182</td>
<td>&lt;0.001</td>
<td>0.180</td>
<td>&lt;0.001</td>
<td>0.207</td>
<td>&lt;0.001</td>
<td>0.287</td>
<td>&lt;0.001</td>
<td>0.344</td>
</tr>
<tr>
<td>11–20</td>
<td>0.178</td>
<td>&lt;0.001</td>
<td>0.174</td>
<td>&lt;0.001</td>
<td>0.173</td>
<td>&lt;0.001</td>
<td>0.141</td>
<td>&lt;0.020</td>
<td>0.104</td>
</tr>
<tr>
<td>&gt;60</td>
<td>0.064</td>
<td>0.294</td>
<td>0.147</td>
<td>&lt;0.015</td>
<td>0.143</td>
<td>&lt;0.018</td>
<td>0.135</td>
<td>&lt;0.038</td>
<td>0.133</td>
</tr>
</tbody>
</table>

---

**Notes:**
- SS-OCT and CT in a Healthy Population
- IOVS | Month 2014 | Vol. 55 | No. 0 | 6
The decrease in MCT is calculated to be $9.4 \, \mu m$ per decade (versus $10 \, \mu m$ when both eyes are included).

Correlation between mean SFCT and age was $R = 0.275$, $r^2 = 0.076$. As before, the dependence found is subtle but highly significant ($P < 0.001$).

$$SFCT(\text{microns}) = 331.61 - 0.887 \times \text{Age(years)}.$$

This model predicts a loss of $8.87 \, \mu m$ of SFCT per decade.

If only one eye is evaluated per patient (taking right or left randomly), a more accurate calculation yields a SFCT in microns of $333.27 - 0.852 \times \text{Age (years)}$; $R = 0.266$, $r^2 =$

### Table 5. ICC in Different Measurement Locations

<table>
<thead>
<tr>
<th></th>
<th>ICC</th>
<th>Confidence Interval 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>N3</td>
<td>0.973</td>
<td>0.966, 0.978</td>
</tr>
<tr>
<td>N2</td>
<td>0.981</td>
<td>0.976, 0.985</td>
</tr>
<tr>
<td>N1</td>
<td>0.981</td>
<td>0.976, 0.985</td>
</tr>
<tr>
<td>SF</td>
<td>0.987</td>
<td>0.984, 0.990</td>
</tr>
<tr>
<td>T1</td>
<td>0.986</td>
<td>0.982, 0.989</td>
</tr>
<tr>
<td>T2</td>
<td>0.981</td>
<td>0.977, 0.985</td>
</tr>
<tr>
<td>T3</td>
<td>0.984</td>
<td>0.979, 0.987</td>
</tr>
<tr>
<td>T4</td>
<td>0.982</td>
<td>0.978, 0.986</td>
</tr>
<tr>
<td>T5</td>
<td>0.981</td>
<td>0.976, 0.985</td>
</tr>
</tbody>
</table>
Figure 8. Bland-Altman plots for interobserver correlation in every measurement location, from N3 (upper left) to T5 (bottom).
Ikuno et al. 36 performed a similar study in which they described the CT in healthy Japanese subjects, their study has been shown in papers by Copete et al. 12 and Ruiz-Moreno et al. 13 comparing both pediatric and adult subjects. Ruiz-Moreno et al. compared both SD-OCT and SS-OCT, finding a mean SFCT of 287 μm, similar to the results of Flores-Moreno et al. and those of Manjunath et al. who published a mean SFCT of 272 μm in 54 eyes of 51.1-year-old patients.

Xu et al. compared diabetic with nondiabetic patients, finding a mean SFCT of 266 μm in the control group (1795 subjects).

The choroid has also been studied in pediatric population using SS-OCT. Ruiz-Moreno et al. compared both pediatric (85 eyes, 10-year-old patients with mean SE of 0.3 D) and adult (75 eyes, 53-year-old patients with mean SE of 0.16 D) healthy patients, finding a mean SFCT of 312 and 302 μm, respectively. Park and Oh, in a recent study with pediatric subjects, found a mean SFCT of 348.4 μm in the 48 eyes studied.

In the present study, the mean SFCT was found to be 301.89 μm. This figure is approximately 10 μm greater than that found by other authors using SD-OCT. 37–39,45–49 It is likely that the introduction of pediatric eyes into the study group resulted in a slight increase in the mean SFCT. Interestingly, these results match those of Ruiz-Moreno et al., who with the same device found almost the same CT in their patient group consisting of adults only. Swept-source OCT may result in a CT measurement slightly greater than that seen with SD-OCT. This may be explained by the higher quality of the images and by the fact that the measures were taken from the posterior edge of the RPE to the outer aspect of the lamina fusca, rather than the outer limit of the choroidal vessels.

Ruiz-Moreno et al. with SS-OCT and Flores-Moreno et al. with SD-OCT provide data about mean MCT. Ruiz-Moreno found it to be 275 μm in adults compared to 285 μm in pediatric subjects. Flores-Moreno obtained a result of 257 μm in healthy patients and 115 μm in highly myopic patients. We found that mean MCT was 258.69 μm, similar to these authors’ results. Nevertheless, the present study is the first employing a subfoveal 8mm line of the macula compared to the 6 mm studied by other authors. This was possible due to SS-OCT technology, which provides a more robust imaging of the temporal choroid, as this 2-mm increase was performed on this sector. This may prove to be a clinically important measure, as it is in the temporal sector that greater variations of CT with age take place.

We found no statistically significant difference when comparing men to women. Subjects of both sexes showed almost identical choroidal profiles with a minimal difference in the temporal sector (Fig. 3), in which the females usually had slightly thinner choroids. Mean SFCT was 303.9 μm in men versus 296.4 μm in women. These slight, nonstatistically significant differences can be explained by the age differences of the two groups. 30.39 years for men and 37.48 years for women. Choroidal thickness was approximately 7 μm greater in men on average, but the men in this study were, on average, 7 years younger. According to the correlation formulas established by this database, CT in a sex- and age-matched group would likely have been almost identical.

A few studies have been previously performed in adults using high-penetration OCT 40,45–51 but without comparing different age groups. We analyzed CT comparing several ranges of age with a 20-year gap. The first two age groups spanned from age 0 to 10 and age 10 to 20 years. These ranges were
selected because eye growth undergoes two phases, the first up to age 6 years, reaching emmetropization, and the second from 7 to 19 years, when global expansion of the eye takes place.\textsuperscript{52} Park and Oh\textsuperscript{30} (mean age of subjects 86.4 months, from 52 to 131 months) and Ruiz-Moreno et al.\textsuperscript{13} studied CT in pediatric subjects, with only the latter comparing CT simultaneously with adults. The CT profile changed in every group (Figs. 4, 5, 6) and the choroid measured thinner as age increased, showing statistically significant differences. This decrease was found to be progressive until 40 years, at which point the most significant variation took place, from 513.9 μm in the 21- to 40-year-old group to 264.6 μm in the 41- to 60-year-old group (49-μm difference). Interestingly, from 40 years on (41–60 vs. >60 years) the differences in CT were not found to be statistically significant, either mean MCT or SFCT. Variations when only one eye per patient (as in Ray and O’Day\textsuperscript{53}) or both were taken into account were minimal, showing calculated decreases of 9.4 vs. 10 μm per decade in MCT and 8.5 vs. 8.87 μm per patient in SFOCT.

One of the limitations of this study is the fact that the CT was manually determined. There is now an automated software commercially available, Topcon DRI OCT-I software (version 9.01.003.02), for automated segmentation and thickness measurements in three-dimensional or radial scan mode; however, its accuracy in clinical practice has yet to be widely tested.

According to our results, the macular CT profile in a healthy population is similar between different age groups, with the choroid in healthy eyes getting thinner with age, particularly when adults older than 40 years are compared to children and younger adults. There were no differences due to sex. The greater CT variation due to age takes place in temporal sectors.

Acknowledgments

Supported in part by a grant from the Spanish Ministry of Health, Instituto de Salud Carlos III, Red Temática de Investigación Cooperativa en Salud (“Prevención, detección precoz y tratamiento de la patología ocular prevalente, degenerativa y crónica”) (RD12/0043/0011) and a Research to Prevent Blindness unrestricted grant to the New England Eye Center/Department of Ophthalmology, Tufts University School of Medicine and the Massachusetts Lions Clubs.

Disclosure: J. Ruiz-Medrano, None; I. Flores-Moreno, None; P. Peña-García, None; J.A. Montero, None; J.S. Duker, Carl Zeiss Meditec, Inc. (F); Optovue, Inc. (F); J.M. Ruiz-Moreno, None

References


Queries for iovs-55-05-63

1. Author: This article has been lightly edited for grammar, style, and usage. Please compare against your original document and make changes on these pages. Please limit your corrections to substantive changes that affect meaning. If no change is required in response to a question, please write “OK as set” in the margin. Copy editor

2. Author: Carefully check the spelling and order of the author names and check the affiliations for all of the authors.

3. Author: Make sure that ALL funding/financial support is listed in the information following the Acknowledgments.

4. Author: Please confirm wording of précis: Horizontal macular choroidal thickness in a healthy population decreases with advancing age, especially after age 40. The study showed no differences in choroidal thickness due to sex. The greatest choroidal thickness variation due to age takes place in temporal sectors. Copy editor

5. Author. Heading “Correlation Analysis and Linear Regression Models” is the only subheading in the Results section. Any section that has one subhead must have at least two. Please either add another subhead to section or delete this one and incorporate the content into the text instead. Copy editor

6. Author. Sentence starting “Interestingly”: Please insert Ref. number after author name. Copy editor

7. Author. Sentence starting “This was possible”: Wording at end of sentence doesn’t seem accurate – is the meaning “was observed in this sector”? Copy editor

8. Author. Support paragraph, ending: Should that say “. . . School of Medicine and an unrestricted grant from the Massachusetts Lions Clubs”? Copy editor