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Letter to the Editor

Multicenter macular ganglion cell analysis: normative paediatric reference range

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Editor,

Recent advances in segmentation algorithms have made possible the visualization and measurement of individual retinal layers with spectral-domain optical coherence tomography (SD-OCT). The ganglion cell-inner plexiform layer (GCIPL) analysis in the macula has become a relevant examination in the assessment of different optic neuropathies (Syc et al. 2012; Renard et al. 2013). The GCIPL thickness has been measured with Cirrus SD-OCT in healthy adults (Mwanza et al. 2011; Koh et al. 2012). Likewise, analysis of discrete retinal layers in 83 healthy children using manual segmentation with Heidelberg Spectralis SD-OCT has recently been published (Yanni et al. 2013).

The aim of the present study is to provide reference ranges for GCIPL thicknesses in children using the automatic segmentation algorithm available with the latest version of Cirrus SD-OCT software (version 6.0; Carl Zeiss Meditec, www.meditec.-zeiss.com). This study is part of an observational, multicenter and cross-sectional study, among 283 healthy Caucasian children aged 4–17 years and recruited at three Spanish centres. Detail study methods have been described elsewhere (Barrio-Barrio et al. 2013). All caregivers provided written informed consent before study enrolment. To compile the database, each child underwent five axial length measurements (IOL Master, Carl Zeiss Meditec), a cycloplegic refraction and two macular scans using the ganglion cell analysis: macular cube 512 × 518 protocol with the Cirrus SD-OCT. With this protocol, the average, minimum and sectoral thicknesses of the GCIPL are measured in an elliptical annulus around the fovea. Detailed description of sectors dimensions and magnification correction is described elsewhere (Mwanza et al. 2011). Images with signal strength <7 and those with visible eye motion or blinking artefacts were discarded. One eye of each subject was selected randomly for analysis. The average of the two macular scans was used in the statistical analysis. Univariate and multivariate regression analyses were used to analyse the effects of age, gender, axial length and spherical equivalent on the macular GCIPL thickness measurements.

Two hundred and seventy-six children were finally included in this study. The mean ± SD age was 9.6 ± 3.13 years, and 114 (41.3%) were boys. The mean spherical equivalent was +0.62 ± 1.68 dioptres (D), and mean axial length was 22.95 ± 1.10 mm. The mean average macular GCIPL was 84.76 ± 5.46 μm (range, 71–98), whereas the minimum thickness was 81.20 ± 5.95 μm (range, 63–95). Table 1 shows the mean and percentiles of GCIPL thickness values, and each macular sector stratified by age groups. In the multivariate regression analysis, a positive significant association between the average GCIPL thickness and both the spherical equivalent (b = 0.75; CI 95%: 0.24–1.27, p = 0.004) and age (b = 0.26; CI 95% 0.02–0.49, p = 0.032) was found. A negative significant association between the GCIPL thickness and axial length was found (b = −0.97; CI 95%: −1.87–−0.07, p = 0.034). No significant association with sex was found.

The mean GCIPL thickness measured by Cirrus SD-OCT and reported in adults has been similar even among different ethnicities: 82.1 ± 6.2 μm (Mwanza et al. 2011) and 82.78 ± 7.0 μm (Koh et al. 2012). On the contrary, the children in our series had a thicker mean GCIPL thickness (84.76 μm ± 5.46 μm). Remarkably, in these three studies, of the six macular sectors, the superonasal had the thickest, whereas the inferior had the thinnest GCIPL. The GCIPL thickness analysed with the Heidelberg Spectralis SD-OCT in children using manual segmentation at 2 mm from the foveal centre was 84.6 μm nasally and

Table 1. Distribution of macular ganglion cell-inner plexiform layer (GCIPL) analysis using Cirrus HD-OCT in eyes of normal children.

Age groups	Total (*n* = 276) Percentile				4–7 years (*n* = 76) Percentile				8–12 years (*n* = 145) Percentile				13–17 years (*n* = 55) Percentile			
GCIPL Analysis	Mean	1st	5th	95th	Mean	1st	5th	95th	Mean	1st	5th	95th	Mean	1st	5th	95th
Average (μm)	84.7	71.8	75.0	94.0	85.5	72.0	75.4	95.5	84.5	72.3	75.0	94.3	84.4	71.5	74.6	93.2
Minimun (μm)	81.2	66.2	70.4	91.0	80.7	63.0	68.2	73.9	81.2	67.7	71.1	91.7	81.6	69.5	70.9	90.4
Supero-Temporal (μm)	83.9	70.0	74.0	94.1	84.8	73.0	73.9	95.7	83.5	69.7	74.0	93.0	83.4	71.5	73.6	95.3
Superior (μm)	85.9	70.7	74.8	97.0	87.0	71.0	74.0	97.5	85.5	69.4	74.6	97.0	85.3	71.5	74.6	94.8
Supero-Nasal (μm)	86.5	72.8	76.0	96.5	87.7	75.0	77.8	96.5	86.0	72.7	75.6	96.7	86.0	72.5	74.8	98.1
lnfero-Nasal (μm)	84.7	68.2	74.9	95.0	85.0	60.0	72.9	95.1	84.6	72.4	75.6	95.8	84.0	72.0	74.6	95.2
Inferior (μm)	83.0	68.5	72.0	94.0	83.5	65.0	70.7	94.5	82.8	68.7	74.5	93.8	82.7	70.0	71.7	92.8
lnfero-Temporal (μm)	84.3	71.3	74.4	94.5	84.9	72.0	74.0	97.0	84.1	70.6	75.5	94.0	84.1	71.0	74.2	93.3

79.7 μm temporally (Yanni et al. 2013).

In adults, the independent factors associated with thinner GCIPL include thinner RNFL, older age, longer ocular axial length and male sex (or female in other series) (Mwanza et al. 2011; Koh et al. 2012). On the other hand, in the children of the present study, thinner GCIPL was associated with younger age, longer axial length and lower spherical equivalent.

In summary, we have reported normative reference range of the macular GCIPL thickness in normal children. The effects of age, axial length and spherical equivalent should be taken into account when interpreting GCIPL thickness measurements with SD-OCT in children.

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