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Normative optical coherence tomography measurements in children

Gadi Wollstein¹ and Joel S Schuman^{1,2}

¹UPMC Eye Center, Eye & Ear Institute, Ophthalmology and Visual Science Research Center, Department of Ophthalmology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania, USA

²Department of Bioengineering, Swanson School of Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Optical coherence tomography (OCT) has gained popularity in clinical ophthalmic management by providing detailed visualisation and quantification of ocular structures. The most common clinical use of this technology is in glaucoma, retina diseases, neuro-ophthalmology and anterior segment applications. Recent technological improvement leads to the introduction of spectral-domain OCT (SD-OCT) that offers higher scanning speeds, higher scan densities and better resolution than earlier generations of this technology. The ability to visualise areas of interest with a high acquisition rate SD-OCT imager along with the ability to quantify structures expands the utility of OCT to new clinical territories, such as children and other poorly compliant populations. In order to make full use of the OCT information, a comparison with population-derived normative data is needed to identify deviations from the normal range. Unfortunately, only limited information is available for persons <18 years of age for any of the commercially available OCTs.

Several studies have demonstrated that the retina and optic nerve change with ageing. This finding was evident in histological sectioning of the optic nerve head where the axonal count was noted to decrease with age.¹ Similarly, the ageing effect was also found with the use of ocular imaging devices in the optic nerve head, peripapillary and macula regions.^{2–13} More specifically, a statistically significant decline with age has been reported for the total macular thickness, mainly attributed to thinning of the retinal ganglion cell layer and the macular retinal nerve fibre layer (RNFL), peripapillary RNFL and expansion of the optic nerve head cup. Although some reports indicated an accelerated rate of change above the age of 60 years, the overall trend of neural tissue loss is consistent throughout the adult lifetime. It should be noted that although all these studies report the rate of change over time, the data that were used in the studies were obtained through cross-sectional sampling of the population at different age groups. Therefore, the true nature of natural changes at the individual level is yet to be determined.

Other factors that have been reported to be statistically significant and associated with ocular neural tissue measurements are axial length, refraction and ethnicity.^{3,4,8,9,11,13} Longer axial length has been associated with thinner RNFL due to wider projection of the circular

Correspondence to Professor Joel S Schuman, UPMC Eye Center, Department of Ophthalmology, University of Pittsburgh School of Medicine, 203 Lothrop Street, Eye and Ear Institute, Suite 816, Pittsburgh, PA 15213, USA; schumanjs@upmc.edu.

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sampling location on the retina or to stretching of the retina in longer eyeballs. European Caucasians have been found to have smaller optic nerve heads compared with Indians and Hispanics, while the rim area is smaller in Indians.¹¹ Mean RNFL in Indians, Hispanics and East Asians is thicker than in European Caucasians.⁴¹¹

Taken together, one would expect that in accordance with the overall trend of neural tissue degradation, children would exhibit thicker retinas and smaller optic nerve cups compared with the adult population. Moreover, the rapid change in axial length during the growth spurt of childhood might further influence these measurements. In the May issue of *British Journal of Ophthalmology*, Elia *et al* report the optic nerve head and RNFL measurements from a carefully designed screen of healthy 6–13 year old children using a SD-OCT device.¹⁴ Unlike most other studies that sample children attending ophthalmic clinics that can lead to inadvertent selection bias, in this study the investigators evaluated 344 European Caucasian school children, and the only exclusion criteria were the objections of the parent to provide informed consent or inadequate SD-OCT scan quality. In this cohort, no statistically significant change with age was noted in any of the RNFL and optic nerve head parameters. These results are in agreement with previous studies that demonstrated lack of association between age and ocular structure measurements in children.^{15–19} On the other hand, most measurements were associated with axial length and therefore large deviations from the normal range of axial length should be taken into consideration when assessing retinal and optic nerve head measurements in children. These findings have been confirmed across various ethnicities. In addition, the statistically significant difference in ocular measurements among various ethnicities has been confirmed in children and therefore should be considered to ensure the most accurate reference measurements. It should be noted that although all these studies point to the same ocular measurement trend in children, the actual measurements provided by each of the commercially available devices differ, and measurements from one device cannot be used interchangeably with measurements from another device.

In light of the findings of Elia *et al* and the other studies mentioned above, while clinicians caring for children may use adult retinal and optic nerve head normative measurements provided by the devices, high axial myopia, marked hyperopia and ethnicity should be taken into consideration. Device manufacturers are encouraged to enhance the utility of their normative datasets by adding normative ranges by ethnicity.

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