

ORIGINAL ARTICLE

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Correlation of optic-disc area and refractive error

ABSTRACT

Objective

This study measured the optic-disc area using optical coherence tomography (OCT) and correlated it with the type of refractive error.

Methods

A cross-sectional study was conducted involving 73 healthy Filipinos aged 20 to 60 years. All underwent a full ophthalmologic examination including visual acuity, automated refraction, Goldmann applanation tonometry, and dilated-fundus examination. Fast optic-nerve-head imaging was performed with 6 radial linear scans centered on the optic-nerve head.

Data were tabulated and the association between optic-disc measurements and refractive error was analyzed using analysis of variance and linear regression.

Results

A total of 142 eyes of 73 patients were included, of which 39 (27.5%) were classified as emmetropia or hyperopia, 47 (33%) as low myopia, 37 (26.2%) as moderate myopia, and 19 (13.4%) as high myopia. The mean refractive error was $-9.2 \pm 2.98\text{D}$ for those with high myopia, $-4.7 \pm 0.74\text{D}$ for moderate myopia, $-1.7 \pm 0.78\text{D}$ for low myopia, and $1.1 \pm 2.55\text{D}$ for emmetropia and hyperopia. The mean optic-disc area for all groups was $2.70 \pm 0.59 \text{ mm}^2$ (range, 1.6 to 4.7 mm^2); the mean optic-disc area was similar for high myopia ($2.7 \pm 0.57 \text{ mm}^2$) and low myopia ($2.7 \pm 0.52 \text{ mm}^2$). There was no significant difference in the optic-disc area of the different types of refractive errors ($p = 0.30$).

Conclusion

This study showed that the optic-disc area is statistically independent of the refractive error.

Keywords: *Optic-disc area, Emmetropia, Hyperopia, Myopia, Optical coherence tomography*

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MEASUREMENT and characterization of the optic disc have an important role in the evaluation of optic-nerve diseases. Several studies have indicated that optic-disc morphology varies significantly with the type of refractive error. Specifically, the area and diameter of the optic discs were significantly greater in the group with myopia than in the nonmyopic group.¹ Myopia has been repeatedly reported to be a risk factor for developing primary open-angle glaucoma (POAG).^{2,3} The World Health Organization estimates that worldwide 2.4 million new cases of POAG are diagnosed yearly.⁴ An estimated 5.2 million individuals are blind because of glaucoma, 3 million of them because of POAG.⁵

Theories about myopia as a risk factor for developing POAG include bigger optic discs and weaker supporting structures because of a wider optic-disc area. The question is whether optic-disc area in relation to refractive error is a predictive factor for the development of glaucoma.

This study measured the optic-disc area of the subjects

using optical coherence tomography (OCT), and correlated the area with the type of refractive error.

METHODOLOGY

Seventy-three healthy Filipinos aged 20 to 60 years were recruited into the study from January 2008 to July 2008 during routine eye examination at the University of the Santo Tomas Hospital. All had best-corrected visual acuity of at least 20/40. Those with intraocular pressure (IOP) higher than 21 mm Hg, history of intraocular surgery, cataract, retinal pathology, and neurologic diseases were excluded. All subjects underwent a full ophthalmologic examination including visual acuity, automated refraction, IOP measurement with Goldmann tonometry, and dilated-fundus evaluation.

OCT (Stratus OCT, Carl Zeiss Meditec Inc., Dublin, CA, USA) was performed by a single operator. Fast optic-nerve-head imaging was performed with 6 radial linear scans centered on the optic-nerve head. All scans had a signal strength of at least 7.

Table 1. Distribution of patients by gender and refractive error.

Refractive Error	Refractive Error				Gender		
	Mean (D)	Median (D)	Minimum (D)	Maximum (D)	Female (%)	Male (%)	Total Number (%)
High myopia	-9.2 ± 2.98	-7.5	-6.5	-15.3	16 (18.2)	3 (5.6)	19 (13.4)
Moderate myopia	-4.7 ± 0.74	-4.5	-3.5	-6.0	18 (20.5)	19 (35.2)	37 (26.1)
Low myopia	-1.7 ± 0.78	-1.5	-0.8	-3.0	27 (30.7)	20 (37.0)	47 (33)
Emmetropia and hyperopia	1.1 ± 2.55	0.3	11.3	+0.05	27 (30.7)	12 (22.2)	39 (27.5)

Table 2. Distribution of optic-disc area.

Refractive Error	N	Mean (mm ²)	Median (mm ²)	Minimum (mm ²)	Maximum (mm ²)
High myopia	19	2.7 ± 0.57	2.6	1.9	4.2
Moderate myopia	37	2.6 ± 0.73	2.6	1.7	4.4
Low myopia	47	2.7 ± 0.52	2.6	1.8	4.7
Emmetropia and hyperopia	39	2.5 ± 0.52	2.6	1.6	4.1
Total	142	2.7 ± 0.59	2.6	1.6	4.7

Data were tabulated using Microsoft Excel (Microsoft Corp., Redmond, WA, USA). The association between optic-disc measurements and refractive error was analyzed using analysis of variance (ANOVA) and linear regression.

RESULTS

A total of 142 eyes of 73 participants were included in this study. Their mean age was 39.03 ± 14.25 years. There were more females (62%) than males.

Using the refractive-error grouping used in the Beijing Eye study,⁶ 39 (27.5%) of the eyes were classified as emmetropia (-0.5 to <2D) or hyperopia (>2D), 47 (33%) as low myopia (<-0.5 to -3D), 37 (26.1%) as moderate myopia (<-3 to -6D), and 19 (13.4%) as high myopia (>6D) (Table 1). Patients with high, moderate, and low myopia had a mean refractive error of -9.2D, -4.7D, and -1.7D respectively (Table 1).

The mean optic-disc area for all groups was 2.70 ± 0.59 mm² (range, 1.6 to 4.7 mm²). The mean optic-disc area was similar for those with high myopia and low myopia (Table 2). Although emmetropic and hyperopic patients had slightly smaller optic-disc area overall, there was no significant difference in the optic-disc area of the different types of refractive errors (Figure 1).

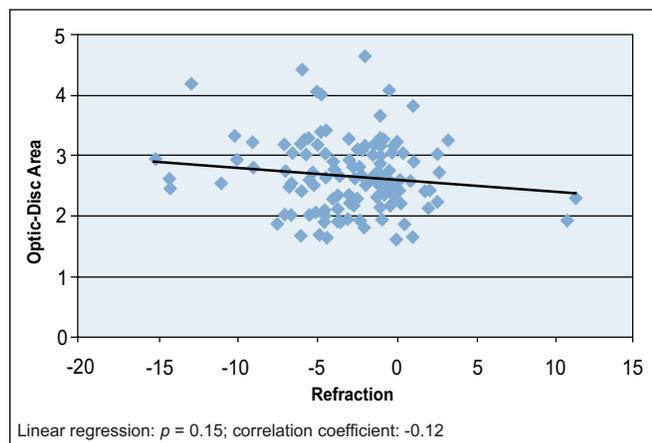


Figure 1. Scatterplot of refraction vs. optic-disc area.

DISCUSSION

Aside from perimetric changes, evaluation of the optic-nerve head constitutes an important part of glaucoma diagnosis. Controversy, however, exists regarding the relationship between optic-disc size/area and refractive error.⁷ The study by Jonas and Dichtl reported that the optic-disc area among patients with POAG enlarged with increasing myopic refractive error.¹ Similar results were seen in nonglaucomatous eyes with high myopia.⁸ Jonas⁹ and Wang⁶ et al. found that the optic-disc area was statistically independent, with refractive error within the range of -8 to +4D. The results of this study also showed no significant relationship between the optic-disc area and the different groups of refractive error. The Rotterdam study, however, found that the disc area increased by 0.33 mm² linearly for each diopter increase toward myopia, and these increases were not significantly different in eyes with refractive error between -4 and +4D.¹⁰

The mean optic-disc area of 2.7 ± 0.59 mm² in this study was similar to that of the Chinese population in the Beijing Eye study⁶ (2.65 ± 0.57 mm²). This is to be expected as Filipinos and Chinese are of Asian descent. However, differences in ethnicity may still account for differences in susceptibility of myopic patients to glaucoma, but which is outside the scope of this study. The question arises whether the relation between high myopia and the degree of glaucomatous optic-nerve damage can be applied to Filipinos.

The role of OCT in the assessment of structural damage to the optic nerve and retinal-nerve-fiber layer (RNFL) has revolutionized the assessment of glaucoma. Diagnostic-capability studies¹¹⁻¹⁵ demonstrated moderate sensitivity with high specificity and reproducibility, making it a useful tool in this study. Limitations included possible algorithm difference in eyes with huge peripapillary atrophy in which the borders may not correspond to the actual disc margin.⁷ Moreover, much of the disc information could be missed by extrapolating the disc measurements from 6 linear cross-sectional scans.⁷

Jonas and Dichtl¹ noted that optic-disc morphology showed increasing optic-disc area with increasing myopic refractive error greater than 8D. While it was found in this

study that those with high myopia have bigger optic-disc area, significant relationship was not established possibly because of the small number of subjects in this category. Further studies with bigger sample in each category may indicate stronger relationships. Measuring the axial lengths of each subject will further confirm the relationship of axial myopia with optic-disc area.

In summary, this study showed that optic-disc area is independent of refractive error and may not be a predictive factor in determining whether myopia is associated with glaucoma.

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