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Morphological And Morphometric Characteristics Of The Optic Disc And Retinal Nerve Fiber Layer In Healthy Patients Evaluated By Optical Coherence Tomography At Clínica La Luz

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ABSTRACT

***Objective**: To characterize the morphological and morphometric parameters of the optic disc and retinal nerve fiber layer (RNFL) in healthy patients studied using optical coherence tomography.*

***Materials and Methods**: Descriptive, prospective, cross-sectional study. 252 eyes of 126 patients who attended ophthalmological evaluation at Clínica La Luz in Lima, Peru, from October 2022 to July 2023 were evaluated. Using the ZEISS CIRRUS TM HD OCT Model 5000 optical coherence tomography (Carl Zeiss Inc., Dublin, CA, USA), morphological and morphometric parameters of the optic disc and RNFL thickness were measured. Megalopapilla was defined as an optic disc area > 2.5mm2 and larger than the mean plus 2 standard deviations.*

***Results**: In patients without megalopapilla, the optic disc area was 2.05 ± 0.29mm2, rim area 1.29 ± 0.19mm2, cupping 0.63 ± 0.48 mm2; average cup/disc ratio 0.58 ± 0.13, vertical cup/disc ratio 0.55 ± 0.12, and RNFL thickness 95.99 ± 8.63mm2. The prevalence of patients without megalopapilla was 67% considering an optic disc area <2.5mm2.*

In patients with megalopapilla, the optic disc area was 2.87 ± 0.30mm2, rim area 1.36 ± 0.21mm2; average cup/disc ratio 0.71 ± 0.07, vertical cup/disc ratio 0.67 ± 0.07, and RNFL thickness 99.13 ± 8.71mm2. The prevalence of megalopapilla was 33%, considering an optic disc area > 2.5mm2. When comparing megalopapillae with normal discs, the rim area (p < 0.001) and RNFL thickness (p = 0.78) showed no statistically significant differences.

Conclusion: *The results showed that the disc area was 2.05 ± 0.29mm2, with CFNR thickness 95.99 ± 8.63mm2. The prevalence of megalopapilla was 32% and 8%, with disc area > 2.5mm2 and 3.07mm2 respectively. The values in terms of ring area and CFNR thickness are similar in megalopapilla and normal discs.*

Keywords: Megalopapilla, Optical coherence tomography, Optic disc.

INTRODUCTION

Glaucoma is the leading cause of irreversible blindness worldwide[1]. It is characterized by a progressive loss of retinal ganglion cells, along with structural changes in the optic nerve head and corresponding defects in visual function[2]. Previous randomized controlled trials have shown that early glaucoma can present with functional and structural defects[3]. Optical coherence tomography (OCT) is the tool used to evaluate the glaucomatous structural deterioration of the optic nerve head, along with the assessment of retinal nerve fiber layer (RNFL) thickness and its ganglion cells. OCT serves as a sensitive indicator of changes in early glaucoma.[4]

The quantitative measurement of the optic nerve obtained by OCT provides a normative database for a given population and provides value on the average size of the optic disc, considering that not all ethnic groups handle the same measurements. Therefore, disc size should be considered in the evaluation of the optic nerve for progressive optic neuropathies such as glaucoma.

Measurement techniques can provide different estimates of disc size, limiting comparison between studies. Additionally, there is a large variation in disc size within a population[5], and also between populations. In the field of ophthalmology, there are several ways to measure the optic nerve and thus have a more precise and objective result for the early detection of optic disc abnormalities, determining its progressive damage or simply confirming that they are megalopapillae, which do not involve any damage to the disc itself, defined as an optic nerve with a surface area greater than 2.5 mm2. Various imaging modalities have been used in clinical practice to obtain an objective and quantitative estimation of optic nerve topography[6,7].

OCT evaluates the optic disc and macular area, being able to reveal preperimetric glaucoma with high sensitivity and specificity[8]. Therefore, for diagnosing all types of glaucoma, it is best to use OCT data from both the disc and macula.

It is of utmost importance to identify a classification model that combines information from numerical and color data in OCT of the macular area and optic disc to objectively classify healthy eyes and megalopapillae in the early detection of glaucoma, given its variability among different ethnic groups[9].

MATERIALS AND METHODS

A descriptive, prospective, cross-sectional study was conducted in which 252 eyes of 126 mestizo patients were evaluated at Clínica la Luz, Lima, Peru, in an outpatient setting, from October 2022 to July 2023. Patients over 18 years of age were included, without media opacity, intraocular pressure <21 mmHg, optic disc without evidence of pathological signs on fundoscopy, or visual field alterations. Patients with pathological fundoscopy were excluded, as well as those with a history of previous ocular pathology, family history, and underlying comorbidities. All patients underwent a complete medical history, including systemic and ocular pathological antecedents. A comprehensive ophthalmologic evaluation was performed, including visual acuity measurement with Snellen chart in each eye separately, best-corrected refraction, slit-lamp biomicroscopy, Goldmann applanation tonometry (HAAG-STREIT AG © 3098 Koeniz, Switzerland), gonioscopy (mirror 4 mini gonioscope), fundoscopy, ultrasonic pachymetry, Humphrey 24-2 SITA FAST visual field (Humphrey® Analyzer II-i, Carl Zeiss Inc., Dublin, CA, USA), and OCT with ZEISS CIRRUS TM HD-OCT Model 5000 (Carl Zeiss Inc., Dublin, CA, USA), taking optic discs cube 200 x 200 and macular cube 512x128 protocols.

The following variables were studied: age, sex, RNFL thickness, average RNFL symmetry, disc area, border area, average C/D ratio, vertical C/D ratio, and cup volume. Megalopapilla is defined as an optic nerve with a surface area greater than 2.5 mm^2,[6] and a disc area greater than the mean plus 2 standard deviations. Various imaging modalities have been used in clinical practice to obtain an objective and quantitative estimation of optic nerve topography.

RESULTS

A total of 126 patients were evaluated, of which women accounted for 65.9% and men for 33.3%, with age ranges of 20-83 years (standard deviation 55.8 ± 14.6), of which 169 had healthy eyes and 83 had megalopapilla. **(Table 1)**.

Table 1: EPIDEMIOLOGICAL CHARACTERISTICS

		N = 126	**Mean**	**SD**	**Range**
AGE			55.8	14.6	20 - 83
SEX	Female	83	65.9 %		
	Male	43	34.1 %		
Ethnic Group: Mestizo					

[a] Percentage of the study population.

Source: Data recorded by the researchers

The characteristics of the optic disc discovered through OCT measurement were as follows: Disc area: 2.32 mm² (SD = 0.48), Border area: 1.31 mm² (SD = 0.48), Cup-to-disc ratio (C/D ratio): 0.63 (SD = 0.13), Vertical C/D ratio: 0.59 (SD = 0.12), Cup volume: 0.34 (SD = 0.23). **(Table 2)**

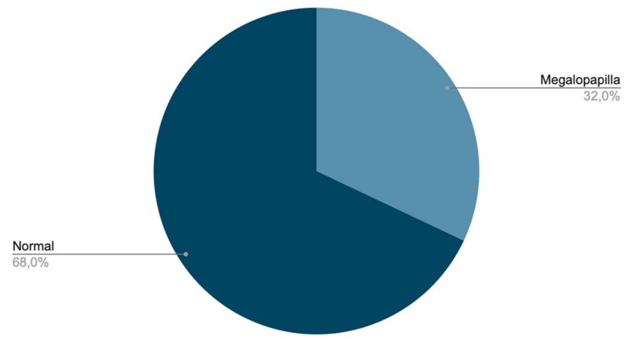

Figure 1 - Prevalence of megalopapilla with disc area > 2.5 mm²

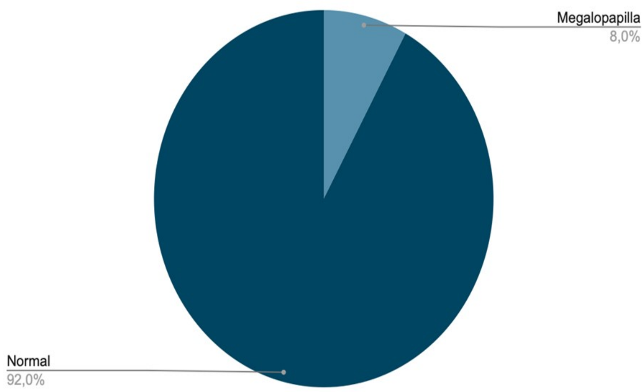

Figure 2 - Prevalence of megalopapilla with disc area > 3.07 mm²

The prevalence of megalopapilla was 32.9% when considering an optic disc > 2.5 mm² and 8% when the disc area is > 3.07 mm². **(Figures 1 and 2)**

Table 3: CHARACTERISTICS OF THE VALUES OF THE OPTICAL DISC AND RNFL IN MEGALOPAPILLAE		Mean ± SD	p. value
Table of Values	Border Area	1.36 ± 0.21	0.001
	Average C/D Ratio	0.71 ± 0.07	0,365
	Vertical C/D Ratio	0.67 ± 0.07	0,508
	Average	99.13 ± 8.71	0,365
	Symmetry	88 ± 5.19	0,278
	Cup volume	0.54 ± 0.23	0,029
	Disc area	2.87 ± 0.30	0,011
RNFL Thickness	Inferior	131.99 ± 14.89	< 0.001
	Nasal	77.54 ± 13.28	< 0.001
	Superior	121.57 ± 11.61	< 0.001
	Temporal	65.30 ± 8.06	< 0.001
GCL Thickness	Minimum	79.25 ± 5.80	< 0.001
	Average	83.07 ± 4.81	< 0.001

Source: Data recorded by the researchers

The characteristics of optic disc parameters measured by OCT in the population with megalopapilla were as follows: optic disc area: 2.87 mm² (SD = 2.87 ± 0.30), border area: 1.36 mm² (SD = 1.36 ± 0.21), average C/D ratio: 0.71 mm^2 (DE= 0.71 ± 0.07), vertical C/D ratio: 0.67 mm^2 (DE= 0.67 ± 0.07), and cup volume: 0.54 mm² (DE= 0.54 ± 0.23). **(Table 3)**.

Upon comparing the parameters of the optic disc and RNFL thickness between normal-sized optic discs and megalopapilla, it was observed that the optic disc area (p = 0,011), excavation area (p = 0,278), average C/D ratio (p = 0,365), vertical C/D ratio (p = 0,508), and excavation volume (p = 0,029) were significantly different. However, the annulus area (p = 0,365) and RNFL thickness (p < 0,001) showed statistically significant differences.

DISCUSSION

Although new technologies have had a positive impact on the diagnosis of various ophthalmic pathologies worldwide, it is crucial to understand the specific characteristics of each population to optimize diagnostic tools such as OCT, establishing reference values and other relevant data, such as the percentage of megalopapillae and the average RNFL thickness, which would allow for more precise diagnoses.

In the present study, OCT was used to analyze the parameters and characteristics of the optic disc in healthy eyes. An optic disc area of 2.32±0.48 mm² was found, which was similar to the area described by Sharifipour et al.[10] (2.29±0.36 mm²) in a United States population. Compared to a broader population, there was a close approximation in the values found in the study by Yarmohammadi et al., where the optic disc area was 1.9 mm² (95% reference range: 1.6-2.2 mm²) using the SD-OCT system (Avanti).[11] In our population, the optic disc area was found to be larger than that found in previous studies. Strouthidis et al. found an area of 1.96±0.06 mm² in an American population using OCT CIRRUS 5000[12], while Corredor et al. obtained a value of 2.1 ± 0.4 mm² in a Colombian population using SD-OCT (AVANTI RTVUE XR) [13]. These findings highlight the variability in optic disc size according to the studied population and its ethnic characteristics, which is a factor of great relevance in this context.

The measurement of the RNFL thickness was 97.02±8.77 µm, in agreement with the findings reported by Sharifipour et al. and Gopalakrishnan et al. in the Indian population and those reported by Y. Ozcan et al.[14] and Jia et al. in studies conducted in the Hispanic-American population. However, Corredor et al. reported an RNFL thickness of 105.9 ± 8.6 µm in a study with Hispanic-Americans, which is higher than in our study. It is important to note that the studies compared included relatively few subjects of Hispanic origin, suggesting the need to implement ethnicity-specific databases to expand the population sample.[17,18,19]

In our study, the prevalence of megalopapillae was 32%, considering an optic disc area >2.5 mm², which agrees with the study by Vasquez et al. in a similar population where they reported a prevalence of 24%.[20] This could be due to a high prevalence of megalopapillae associated with ethnic characteristics.

When comparing the ring area and RNFL thickness between normal optic discs and megalopapillae, no significant differences were found, unlike Budenz et al.[21] who, using SD-OCT, found greater RNFL thickness associated with optic disc size, and Kayaarasi et al.[22] also reported disparities in megalopapillae parameters compared to normal optic discs in terms of ring area and RNFL thickness; these characteristics would allow differentiation from discs with glaucomatous neuropathy[23,24,25]. However, in a histological study by Varma et al., it was demonstrated that there is no association between disc area and RNFL.[26,27,28] Similarly, as in the present study, Rao et al. show that there is no statistically significant difference in the average RNFL thickness in eyes with megalopapillae and normal optic discs[28].

CONCLUSIONS AND RECOMMENDATIONS

In conducting this study using SD-OCT to identify optic nerve size parameters and RNFL thickness in a Peruvian population, it is possible to conclude that it differs compared to the Indian, North American, and other Hispanic-American populations. Additionally, a higher prevalence of megalopapillae was identified compared to various Latin American countries, considering an optic disc area > 2.5 mm²; however, no relevant differences in the studied parameters were found compared to normal optic discs. Nevertheless, it is important to note that the sample size should be expanded to conduct a more specific study and thus reduce biases.

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Conflict of interests

The authors deny having any conflict of interest in the realization of this work.

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