

# A mode optic nerve ultrasonography for glaucoma diagnosis

## *Ultrassonografia do nervo óptico no modo A para o diagnóstico do glaucoma*

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### ABSTRACT

**Objectives:** Determine if retrobulbar optic nerve horizontal diameter measurement or reflectivity correlates with the optic disc excavation diameter relation in glaucoma, considering: measurements correlation, the sensitivity and specificity between the methods and which value has greater sensitivity and specificity to differentiate patients with and without glaucoma. **Methods:** In a masked study, the optic nerves of 38 patients with open angle primary angle glaucoma and 37 control patients were examined for retrobulbar echographic determination of their A mode (DNA) and their reflectivity (RNA) diameters. Biomicroscopically the relationships of the vertical or horizontal length of the excavation by the corresponding diameter of the optical discs (EV / DV or EH / DH) were established. These measures were evaluated for their correlations, consistencies, sensitivities and specificities. **Results:** Mean DNA was 2.93 mm in the control group and 2.72 mm in the glaucomatous group ( $p < 0.001$ ) and that of the RNA was 32.22% in the control group and 31.59% in the glaucomatous group ( $p = 0.577$ ). DNA was moderately and significantly correlated with EH / DH ( $-0.450$ ,  $p < 0.01$ ) and EV / DV ( $-0.463$ ,  $p < 0.01$ ) and RNA correlated insignificantly with DH / DH and EV / DV. DNA measurements was 0.6780 (95% CI: 0.5883-0.7561) and RNA was 0.6902 (0.6010-0.7640) and were lower than the consistency measurements of the disc. The measurement of 2.85 mm of DNA was the one of greater sensitivity (0.757) and specificity (0.714) for diagnosis of glaucoma. **Conclusion:** The standard method A of retrobulbar optic nerve diameter measurement was the most suitable for glaucoma diagnostic.

**Keywords:** Orbit; Ultrasonography; Glaucoma; Optic nerve; Optic disk

### RESUMO

**Objetivos:** Determinar se a medida do diâmetro horizontal ou refletividade do nervo óptico retrobulbar no modo A apresenta correlação com a relação da escavação pelo diâmetro do nervo óptico no glaucoma, considerando: a correlação das medidas, a sensibilidade e especificidade entre os métodos e qual a medida tem maior sensibilidade e especificidade para discriminar glaucomatosos. **Métodos:** Estudo mascarado, prospectivo e comparativo de nervos ópticos de 38 pacientes com glaucoma de ângulo primário de ângulo aberto e 37 pacientes controles, que foram examinados para determinação ecográfica retrobulbar de seus diâmetros no modo A (DNA) e das suas refletividades (RNA). Biomicroscopicamente foram estabelecidas as relações do comprimento vertical ou horizontal da escavação pelo diâmetro correspondente dos discos ópticos (EV/DV ou EH/DH). Estas medidas foram avaliadas quanto às suas correlações, consistências, sensibilidades e especificidades. **Resultados:** A média de DNA foi de 2,93 mm no grupo controle e de 2,72 mm no grupo glaucomatoso ( $p < 0,001$ ) e a do RNA foi de 32,22% no grupo controle e 31,59% no grupo glaucomatoso ( $p = 0,577$ ). DNA correlacionou-se moderada e significativamente com EH/DH ( $-0,450$ ,  $p < 0,01$ ) e EV/DV ( $-0,463$ ,  $p < 0,01$ ) e o RNA se correlacionou de forma insignificante com EH/DH e EV/DV. A consistência das medidas de DNA foi de 0,6780 (IC95%: 0,5883-0,7561) e de RNA foi de 0,6902 (0,6010-0,7640) e a elas foram inferiores às medidas de consistência do disco. A medida de 2,85 mm de DNA foi a de maior sensibilidade (0,757) e especificidade (0,714) para diagnóstico de glaucoma. **Conclusão:** A ecografia A Estandarizada da medida do diâmetro do nervo óptico retrobulbar foi a mais indicado para diagnóstico do glaucoma.

**Descritores:** Órbita; Ultrassonografia; Glaucoma; Nervo óptico; Disco óptico

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PhD thesis held at the Ophthalmology Service of Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.

The authors declare no conflicts of interests.

Received for publication 31/07/2018 - Accepted for publication 14/12/2018.

## INTRODUCTION

**G**laucoma is the second leading cause of irreversible blindness in the world. Estimates indicate that by 2020 there will be about 59 million individuals with primary open-angle glaucoma in the world.<sup>(1,2)</sup>

Glaucoma is usually diagnosed with intraocular pressure measurements<sup>(3)</sup>, optic disc morphometric evaluation,<sup>(4,5)</sup> and psychophysical examinations of visual perimetry.<sup>(6-8)</sup> The utility of conventional diagnostic methods may be restricted by the existence of different forms of glaucoma associated to elevated, normal or reduced blood pressure levels, opaque intraocular media, congenital anomalies, or pathologies affecting the normal appearance of the optic disc, in addition to physical or mental retardation of patients.<sup>(9,10)</sup> Consequently, an objective diagnostic method, regardless of intraocular pressure, optic disc morphology and the need of cooperation would be important in the propaedeutics of glaucoma.

In the medical literature, there are few papers describing positive correlations between the echographic measurements of the diameter and the sectional area of the retrobulbar optic nerve in mode A with the area of the neuroretinal ring of the optic disc,<sup>(11-13)</sup> although the ultrasound methods and measures used by the different authors were different. In the case of glaucomatous eyes, the values translating these correlations are reduced,<sup>(14)</sup> reflecting the loss of nerve fibers in the optic disc.

### **Objectives:**

Determining which of the ultrasound methods for examination of the retrobulbar optic nerve in mode A has greater correlation with excavation by the diameter of the optic nerve in glaucoma, considering:

1. Consistency of measures;
2. The sensitivity and specificity of the methods;
3. Which is the measure from which there is greater sensitivity and specificity for differentiation between patients with and without glaucoma

## METHODS

A masked, prospective and comparative study was carried out in 75 patients divided into 2 groups. Group glaucoma comprised 38 patients with primary open-angle glaucoma from the glaucoma department of Hospital Universitário Clementino Fraga Filho and Hospital da Piedade. Group control comprised 37 patients from the the ophthalmology ambulatory of Hospital Universitário Clementino Fraga Filho without diagnosis of glaucoma. The examinations were carried out at the specialized medical service of HUCFF in the second semester of 2000.

The study excluded:

- a) Patients with refractive errors greater than +5.00 or -5.00 because they presented different morphology of the optic disc or could hamper the ophthalmoscopic measurements due to the high degree of ametropia.
- b) Eyes with opacity of the means preventing the correct evaluation of the optic disc
- c) History or indication of any pathology compromising the optic disc.
- d) Patients who refused to sign the Informed Consent Form to be part of the study.

The patients underwent 3 biomicroscopic measurements of the vertical and horizontal length of the optic disc and 3 biomicroscopic measurements of the vertical and horizontal excavation of the optic disc using a Superfield® lens attached to a palpebral adapter of the manufacturer and whose end fell smoothly on the palpebral surface around the ocular globe.

Measurements were made on the BM900® “Haag Streit” slit lamp with a slot of 0.2 mm wide by 2 mm high. The slit was projected onto the optic disc vertically, and gradually reduced until its length corresponded to the vertical length or diameter of the disc (DVD). At this point, the length in millimeters of the slit was observed. The same procedure was carried out to measure the horizontal length or diameter of the disc (DHD) after the slit was projected horizontally over it.

In order to measure the vertical length of the optical disc excavation (EVD), the upper end of the slit was projected onto the lower edge of the excavation and then enlarged until its upper end matches the upper edge of the excavation. The difference in millimeters between the upper and lower edge of the excavation corresponded to the vertical length of the excavation.

In order to measure the horizontal length of the optical disc excavation (EHD), the end of the slit closest to the disc coincided with the nasal edge of the excavation, then the slit was enlarged horizontally until its nasal end matches the lateral edge of the excavation, and the difference in millimeters between the nasal and lateral edges of the excavation was considered as the horizontal length of the excavation.

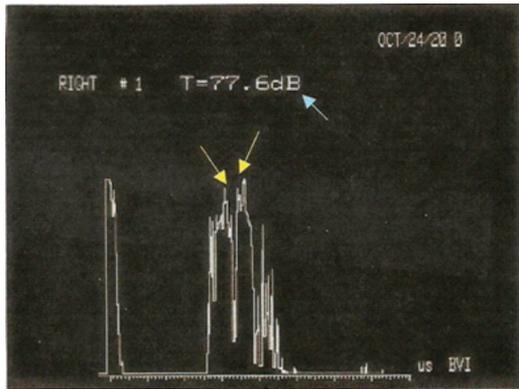
The average of the excavation measurements was divided by the average of the measurements of the diameter of the disk to determine the relation between the vertical length of the excavation and the vertical length of the disk (EV/DV), and the ratio between the horizontal length of the excavation and the horizontal length of the disk (EH/DH). All measurements were with pupillary diameter greater than or equal to 5 mm.

Then, an ophthalmologist experienced in orbital ultrasound had an ultrasound examination in both eyes. The exam finished after obtaining 5 ultrasound measurements of the retrobulbar optic nerve for its Diameter in mode A (DNA) and reflectivity in mode A (RNA). Measurements were carried out in the device by B. V. International - Biovision using the probe for standard measurements.

All subjects were guided to move their eyes for 3 minutes towards the extreme positions of the gaze, that is, to direct the eye to the maximum up, down, right and left, keeping their eyes fixed at each position for 20 seconds to induce redistribution of the subarachnoid fluid so that the surface of the arachnoid membrane of its optic nerves was applied to the surface of the pia-mater. Ultrasonic measurement of the interpial diameter in glaucomatous individuals is made difficult when there is subarachnoid fluid.

After the ocular movement described, the eye studied was anesthetized with 1 drop of proximetacaine 0.5% and kept at maximum abduction. The end of the standardized probe A was placed immediately behind the temporal limbus to the left in the right eye and to the right in the left eye. The ultrasonic beam was slowly directed anteriorly to the insertion tendon of the medial rectus muscle, and then posteriorly and superiorly through the ocular globe so that the echographic pattern of the optic nerve appeared distinctly in the echographic image and was then recorded in the device memory. This pattern is characterized as an ultrasound tracking of low to medium reflectivity limited by 2 reflections of high reflectivity at each end. The outermost reflections correspond to the membranes of the dura-mater,

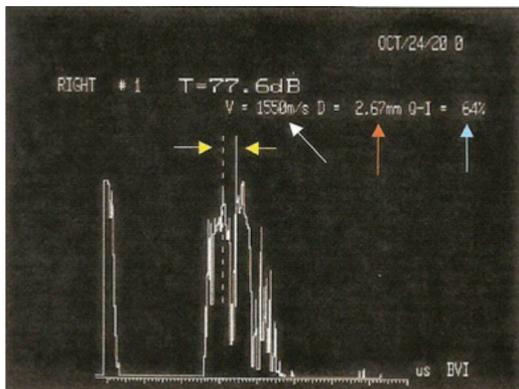
and are less reflective than the inner ones corresponding to the arachnoid applied to the pia-mater (Figure 1).



**Figure 1:** Retrobulbar echographic image of the optic nerve in tissue sensitivity (blue arrow) where the limits of its sheath (pia-mater, yellow arrows) are highlighted.

The reflectivity and interpial diameter of the retrobulbar optic nerve were automatically measured by electronic cursors positioned on the reflections corresponding to arachnoid and pia-mater (Figure 2)

The speed of the ultrasonic beam was constant for all measurements, and equivalent to 1550 m/s. The gain was adjusted for tissue sensitivity in all subjects examined. The measurement of the optic nerve was performed approximately 2 to 5 mm away from the ocular globe, where the echoes of the perineural membranes are more intense and easier to observe. After the



**Figure 2:** Echographic image in mode A of retrobulbar optic nerve diameter measurement (measurement cursors pointed by yellow arrows). The diameter of the retrobulbar optic nerve was 2.67 mm (red arrow), and its reflectivity was 64% (blue arrow).

initial measurement of the right eye, the left eye was examined using the same technique.

The programs Microsoft Excel 5.0<sup>®</sup> and SPSS 9.0<sup>®</sup> were used to process the statistical data.

The consistency between the ultrasound and biomicroscopic measures were evaluated with the intraclass correlation coefficient defined as the proportion of the total variability of a parameter due to the variability between individuals.

The form of distribution of the parameters measured was analyzed in histograms to determine the best correlation index to be used in the study. The ordinal correlation index was chosen based on a minimum significance level of 0.05 due to the non-parametric distribution of the biometrics performed.

For comparisons between the 2 groups studied, the non-parametric “Mann-Whitney” test was used, whose measures are used ordinally. The Operating Characteristic Curves (ROC) were created for each parameter evaluated to establish the sensitivity and specificity of the measures studied.

## RESULTS

Four of the 37 patients in the group control, and 2 of the 38 patients with glaucoma underwent the exams proposed in only one eye due to the opacity of the media in the contralateral eye.

The average age in the group control was 61.04 (SD: 11.08), and in the group glaucoma was 65.38 (SD: 8.48). There were 11 male patients and 26 female patients in the group control, and 14 male patients and 24 female patients in the group glaucoma. Twenty six patients in the group control were white, 6 black and 5 brown. In the group glaucoma, 22 six patients were white, 11 black and 5 brown.

The average DNA in the group control was 2.93 (SD: 0.16), and the average in the group glaucoma was 2.72 (SD: 0.21). The RNA in the group control was 31.22% (SD: 11.08), and in the group glaucoma was 31.59 (SD: 7.57%).

The average EV/DV in the group control was 0.375 (SD: 0.07), and in the group glaucoma was 0.67 (SD: 0.18). The average EH/DH in the group control was 0.4 (SD: 0.09), and in the group glaucoma was 0.62 (SD: 0.17).

The reliability and consistency of the measurements for the same examiner were evaluated by the intraclass correlation coefficient that is expressed in table 1.

The intraclass correlation coefficient measures the total sample variability ratio due to variability between individuals. It ranges from 0 to 1, and the larger the more consistent and reliable the measurements.

The values of the biomicroscopic measures were greater than or equal to 0.75, and therefore the consistency and reliability of these measures in the study can be considered excellent. On the other hand, the values of the ultrasonographic measures

**Table 1**  
**Intraclass Correlation Coefficient for the group control and the group glaucoma**

Parameters	Coeficiente de Correlação Intraclassa (IC 95%)		
	Group Control	Group Glaucoma	All Groups
DNA	0.5038 (0.2929 – 0.6663)	0.6235 (0.4661 – 0.7453)	0.6798 (0.5883 – 0.7561)
RNA	0.7467 (0.6391 – 0.8297)	0.6084 (0.4446 – 0.7351)	0.6902 (0.6016 – 0.7640)
EVD	0.9679 (0.9504 – 0.9800)	0.9889 (0.9832 – 0.9929)	0.9924 (0.9897 – 0.9945)
DVD	0.9700 (0.9536 – 0.9812)	0.9655 (0.9475 – 0.9780)	0.9689 (0.9579 – 0.9774)
DHD	0.9718 (0.9564 – 0.9824)	0.9752 (0.9624 – 0.9842)	0.9741 (0.9650 – 0.9812)
EHD	0.9679 (0.9503 – 0.9799)	0.9894 (0.9839 – 0.9932)	0.9894 (0.9857 – 0.9923)

were between 0.4 and 0.75, consequently of less consistency and reliability but which can be considered of satisfactory level.

The measurements were correlated by Spearman's correlation coefficient or ordinal correlation coefficient because data was not normally distributed. Correlation measures how much a variable changes along with another. It ranges from 1.00 to -1.00, and the higher the value the more associated the variables are. The results are shown in tables 2 and 3.

The highest correlation is observed in the association between the relation of the vertical excavation and the vertical diameter of the optic disc regarding the horizontal excavation in relation to the horizontal diameter of the optic disc. This correlation was strong for all groups, and statistically significant.

Regarding the echographic measurements, the reflectivity of the optic nerve showed correlation close to zero for the groups, with no statistical significance and therefore of negligible

**Table 2**  
**Ordinal correlation coefficient for the measurements carried out in each group**

Measures	Group Control				Group Glaucoma			
	DNA	RNA	EV/DV	EH/DH	DNA	RNA	EV/DV	EH/DH
<b>DNA</b>	1.00	-0.22	-0.02	-0.13	1.00	-0.12 *	-0.24 *	-0.22
<b>RNA</b>	-0.22	1.00	-0.25 *	-0.26 *	-0.17	1.00	0.02 *	0.09
<b>EV/DV</b>	-0.019	-0.25*	1.00	0.79 *	-0.24 *	0.02 *	1.00	0.83*
<b>EH/DH</b>	-0.127	-0.26*	0.79*	1.00	-0.22	0.09	0.83*	1.00

\*Correlation is significant at the level of 0.05 (two-tailed)

**Table 3**  
**Ordinal correlation coefficient for the measurements carried out in both group**

Measures	DNA	RNA	EV/DV	EH/DH
<b>DNA</b>	1.00	-0.166*	-0.463*	-0.450*
<b>RNA</b>	-0.166*	1.00	-0.027	-0.005
<b>EV/DV</b>	-0.463*	-0.027	1.00	0.894*
<b>EH/DH</b>	-0.450*	-0.005	0.894*	1.00

\*Correlation is significant at the level of 0.05 (two-tailed)

magnitude. On the other hand, the measurement of the optic nerve diameter in mode A presented a moderate and statistically significant correspondence when considered in relation to the vertical or horizontal excavation of the optic disc by its diameter. This moderate correspondence only occurred in the two groups of patients, being weak when only the group of glaucomatous patients was observed and negligible and insignificant when only the group control was observed.

The Operating Characteristic Curves (ROC curves) were drawn to analyze the specificity and sensitivity of the measurements performed as a function of differences in eyes with and without glaucoma. The area of the curve corresponding to 0.5 implies that the parameter tested did not differentiate the existence of glaucoma. The greater the area of the curve the greater the differentiation between patients with and without the disease.

For the RNA measurement, the area of the curve was 0.527 (95% CI - 0.432 to 0.622). Therefore, this measure indicated that the reflectivity is not able to adequately differentiate normal patients from the glaucomatous ones.

The area of the ROC curve for DNA was 0.773 (95% CI -0.707 to 0.859), showing that this measure presented a regular performance to identify patients with glaucoma and without the disease. The measurement of the diameter of the optic nerve presenting the highest sensitivity and specificity for the detection of glaucoma was 2.859 mm (sensitivity of 0.757 and specificity of 0.714), that is, below this value the diagnosis of glaucoma is more probable.

The ROC curve of EV/DV was the one presenting the largest area under the curve, being the best for the diagnosis of glaucoma in the sample. Its area was 0.970 (95% CI - 0.945 to 0.994). The ROC curve of EH/DH showed area under the curve of 0.893 (95% CI - 0.844 to 0.943). The measure with greater sensitivity and specificity for the diagnosis of EV/DV was 0.496 (sensitivity of 0.919 and specificity of 0.914), and for EH/DH was 0.4884 (sensitivity 0.851 and specificity 0.8). Above these values of vertical or horizontal relation of the excavation by the diameter of the disc, the diagnosis of glaucoma becomes more and more probable.

The Mann-U-Whitney test demonstrated that there was no statistically significant difference between the RNA in the groups control and glaucoma, but there was a statistically significant difference between the groups control and glaucoma for DNA, EV/DV and EH/DH (p <0.0001).

## DISCUSSION

Dichtl and Jonas(13) found that the measurement of the diameter of the retrobulbar optic nerve in standardized mode A presented sensitivity and specificity for the diagnosis of glaucoma, and it was statistically lower in relation to the measurements of patients in the group control. The ROC curve published by these authors is similar to that observed in our study. Despite the similar results, these authors did not indicate a cutoff point or reference value for the diagnosis of glaucoma in their work. In our study, this value was 2.85 mm.

Dichtl and Jonas(13) observed a Pearson correlation coefficient of 0.66 between DNA and the neuroretinal ring area of the optic disc. In the present study, we found an ordinal correlation coefficient of -0.483 of DNA with EV/DV, and -0.450 between DNA and EH/DH. Our statistical measure was different because we did not find a normal distribution of the measurements. Our correlation was also negative because the magnitude of the excavations tends to increase as nerve fibers are lost in glaucoma, that is, it is inversely proportional to the diameter of the optic nerve. On the other hand, the neuroretinal ring area tends to decrease as the optic nerve diameter decreases, which explains why the correlation of the Dichtl study was positive. Another

difference in the study by Dichtl and Jonas<sup>(13)</sup> is that they chose to use only the highest measure among those taken, and in our study we used the average of the measurements.

Ossoinig<sup>(14)</sup> reported that the optic nerve presents irregularities in the surface of the nerve fiber bundle comprising extensions and recesses with aspect of ridges and valleys. He suggested that the DNA measure to detect optic atrophy would include only ridges, so the highest ultrasound measurement obtained from a series is the one to be considered. In glaucoma, the loss of nerve fibers initially occurs locally, and consequently the determination of the average of the measurements for glaucomatous patients in the initial phase would be more useful as it would consider several diameters of a transverse section of the nerve.

Ramrattan et al.<sup>(15)</sup> described a variation in the optic disk area up to 2 times and the neuroretinal ring, and up to 3 times in the general population. Jonas et al.<sup>(16)</sup> have reported that larger optic discs have a positive correlation with a higher number of nerve fibers in their optic nerves. Varma et al.<sup>(17)</sup> reported that black individuals have a significantly larger optical disc area than white individuals, and Jonas et al.<sup>(18)</sup> stated that there is an increase of the area of the optic disc in relation to a greater pigmentation of skin, being the black people the one presenting the largest discs. Thus, the presence of black and brown individuals in our study may reduce the correlations obtained, since black and brown individuals would tend to have a higher number of nerve fibers and therefore a larger diameter of the optic disc for a given value of excavation than the white population analyzed in European studies.

Studies correlating the biometry of the optic disc to that of the optic nerve were carried out by Beatty et al.<sup>(11)</sup> using the Laser Scanning Tomography (Heidelberg Retina Tomography<sup>®</sup>) to analyse the parameters of the optic disc. They found correlation between the neuroretinal ring area and the DNA (ordinal correlation coefficient of 0.488), and the optic disc area (ordinal correlation coefficient of 0.619). However, no statistically significant correlation was found. Only 20 patients with glaucoma were examined in the present study, and the ratio of the disc-diameter excavation was not measured separately in the vertical or horizontal direction, but the area of the excavation was divided by the total area of the disc. This way, the authors did not consider the initial and highest increase of the excavation in the glaucoma occurring in the vertical direction of the disc.

The measurement of optic nerve reflectivity as a parameter to help diagnose glaucoma was tested in the present study without success. Ossoinig<sup>(14)</sup> reported that the acoustic structure of low and medium reflectivity of the optic nerve is due to the histological pattern where there is predominance of nerve fibers. When studying optic nerves atrophied by glaucoma, Jonas et al.<sup>(13)</sup> observed the almost complete loss of the nerve fibers replaced by a histological architecture based on fibrocytes and astrocytes. This modification in the histological structure of the nerve was expected to be gradually observed ultrasonographically as a progressive increase of the internal reflectivity of the cranial pair I. The results of our study did not corroborate this hypothesis. Most glaucoma patients who were examined did not present the disease in the terminal stage when there would be more fibrocytes and astrocytes in the neural tissue, which may have hampered the reflectivity discrimination between the group control and the group glaucoma.

After a bibliographic research in SciELO, Pubmed and LILACS databases, the authors did not find researches studying the association between optic nerve reflectivity and glaucoma diagnosis.

Garway-Heath et al.<sup>(19)</sup> observed that the area of the neuroretinal ring of the optic disc decreases from 0.28% to 0.39% per year of life. Balazsi et al.<sup>(20)</sup> found that there was a significant decrease in the number of nerve fibers in the optic nerve with age. Jonas et al.<sup>(16)</sup> and Britton et al.<sup>(21)</sup> described that there is great variability in the amount of nerve fibers of the optic nerves.

The age and normal variation in the number of nerve fibers of the optic nerve between individuals makes it difficult to establish a universal reference value for the diameter of the optic nerve below which there would certainly be the presence of optic neuropathy.<sup>(13)</sup>

Ossoinig<sup>(14)</sup> reported that maximal interpial diameter values of the optic nerve measured in standardized mode A of 2.8 mm or less were indicative of nerve atrophy. The present study showed that values of 2.86 mm or less were the ones best separating patients in the group control from those in the group glaucoma.

After examining thicknesses of the optic nerve by magnetic resonance imaging in patients with progressive visual loss with and without optic atrophy and patients in a group control, Parravano et al.<sup>(22)</sup> published that they found no statistically significant difference between the optic nerves of the 2 groups except when there was already fundus evidence of optic atrophy. Ultrasound outperforms in quality nuclear resonance for early determination of reduced optic nerve diameter values.

Serebriakova and Batmanov<sup>(23)</sup> described the continuity of the acoustic shadow of the optic nerve (in mode B) for the vitreoretinal space as a sign of increased excavation and glaucoma. Tongu et al.<sup>(24)</sup> reported that a safe differential was possible by echographic evaluation of the optic disc excavation if it was less than or equal to 0.3 or greater than or equal to 0.9. Winder and Atta<sup>(25)</sup> could detect optic disc excavations of 0.5 mm or higher. Byrne and Green<sup>(26)</sup> stated that it was possible to detect by ultrasound B r if an optical disc excavation was small, medium or large, but for medium or small excavations the reliability of the examination was reduced. Cohen et al.<sup>(27)</sup> reported that glaucomatous optic neuropathy could be detected on ultrasound examination when there was an optical disc diameter scan ratio of at least 0.7.

Bengtsson<sup>(28)</sup> concluded that the dimensions of the optic disc and the excavation co-vary to a large extent. Jonas et al.<sup>(29,30)</sup> observed the existence of optic discs with excavations greater than 2 standard deviations of the average in the normal population, and the existence of small optic discs with a proportion of the optic disc excavation of 0.42 or less in patients with glaucoma.

Considering only one increased excavation for suspected glaucoma is imprecise due to the large variation in its dimensions in the population, and due to its increased dimension or normal dimensions not necessarily indicate the presence or absence of glaucoma, respectively.

Several methods for evaluating and documenting the optic disc in glaucoma have been described. Methods based on direct and indirect ophthalmoscopy,<sup>(31,32)</sup> analysis of stereoscopic photographs,<sup>(10)</sup> and instruments generating computerized images.<sup>(33-35)</sup>

According to the Brazilian Glaucoma Consensus of 2009, there are no studies so far in a representative sample of the population to assess the ability of these instruments versus the clinical evaluation of the optic disc. Papillary biomicroscopic evaluation is recommended as a valid method by the Brazilian Society of Glaucoma for clinical diagnosis and follow-up of the disease.<sup>(36)</sup>

The utility of the echographic examination of the optic nerve is evidenced in the cases of the patient having opacity of the means or presenting pathological congenital alterations of the optic disc such as colobomas making it difficult or impossible to evaluate the disc correctly. The technology of the ultrasound devices has been improving more and more, and in the future we will be able to more accurately evaluate the diameter of the optic nerve (interpial) in order to make this method more effective for the detection of nerve fiber loss in the the initial stage of glaucoma.

## CONCLUSION

The correlation between the diameter of the retrobulbar optic nerve by the standardized mode A and the relation of the vertical or horizontal length of the retrobulbar optic nerve was inversely proportional and of moderate magnitude, being greater than that of the optical nerve reflectivity.

The diameter smaller than 2.85 mm of the retrobulbar optic nerve was the measure presenting greater sensitivity and specificity for the diagnosis of glaucoma in this sample.

The measurement of optic nerve reflectivity was not adequate for the diagnosis of glaucoma.

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