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Analysis between two optical biometric devices in patients with cataract

Análise entre dois dispositivos de biometria óptica em pacientes com catarata

Francisco Wellington Rodrigues[1], Luiz Alberto Rosa Barbalho[2], Marcus Vinícius Batista Machado[2], Cícero Ricarte Bezerra[1], Rodrigo Egídio da Silva[1]

ABSTRACT

Objective: *To evaluate the correlation of optical biometry and target with variable ages, anterior chamber depth, axial length, R1/K1 and R2/K2 established by two optical biometry devices in patients with cataract.* ***Methods:*** *The study included the analysis of 348 medical records, from which 503 cataract eyes were selected, which underwent evaluation by the optical biometric devices IOL Master 700 and Lenstar LS 900 in the period of April to July 2017. Data collected were: age, anterior chamber depth, axial length, R1/K1 and R2/K2.* ***Results:*** *The average of the biometrics obtained using Lenstar was 21.02, varying 3.46, more or less, with an average target of -0.02, varying 0.45. In relation to the IOL Master it was 21.19, with a variation of 3.40 and average target of -0.01, a variation of 0.11. It can be observed that despite close values in relation to the mean, there was significance (p<0.001). Axial length (p<0.001) and R1/K1 (p<0.001) had an influence on the difference of the biometric values between the devices.* ***Conclusion:*** *A high degree of clinical and statistical correspondence was observed between the results obtained by the biometry devices in patients with cataract.*

Keywords: *Biometry; Cataract; Intraocular lenses; Reproducibility; Refraction, ocular.*

RESUMO

Objetivos: Avaliar a correlação da biometria óptica e target com as variáveis idade, profundidade da câmara anterior, comprimento axial, R1/K1 e R2/K2 estabelecidos por dois dispositivos de biometria óptica em pacientes com catarata. **Métodos:** O trabalho abrangeu a análise de 348 prontuários dos quais foram selecionados 503 olhos com catarata ,que passaram pela avaliação nos dispositivos de biometria óptica IOL Master 700 e Lenstar LS 900 no período de abril a julho de 2017. Os dados colhidos foram: idade, profundidade da câmara anterior, comprimento axial, R1/K1 e R2/K2 . **Resultados:** A média da biometria obtida utilizando o Lenstar foi de 21,02, variando 3,46 para mais ou para menos, com target médio de -0,02, variando 0,45. Já em relação ao IOL Master foi de 21,19, com variação de 3,40 e target médio de -0,01, variação de 0,11. Pode-se observar que apesar de valores próximos em relação à média, houve significância ($p < 0,001$). Houve a concordância da biometria em relação ao comprimento axial ($p < 0,001$) e R1/K1($p < 0,001$). **Conclusão:** Observou-se alto grau de correspondência clínica e estatística entre os resultados obtidos pelos dispositivos de biometria em pacientes com catarata.

Descritores: Biometria; Catarata; Reprodutibilidade; Refração ocular.

[1] SEE Excellence in Ophthalmology, Goiânia, GO, Brazil.
[2] Graduate Medical Course, Pontifícia Universidade Católica de Goiás, Goiânia, GO, Brazil.

Study carried out at Pontifícia Universidade Católica de Goiás, Goiânia, GO, Brazil.

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Introduction

According to data from the latest WHO survey on blindness, in 2010, 285 million people with visual disabilities worldwide were identified, 90% live in developing countries and out of 5 individuals with this problem, 4 derive from avoidable causes,[1] such as glaucoma, trachoma, uncorrected refractive errors, diabetic retinopathy and cataract, which is considered the greatest avoidable condition of blindness in the world. [2]

In Brazil, according to data from the Brazilian Council of Ophthalmology (CBO) published in 2012 on ocular health conditions, it is estimated that there are 1,158 million people with reversible blindness in Brazil, with a higher prevalence in the age group over 50 years. Cataract is responsible for approximately 350,000 new cases of reversible blindness per year, and is considered the main cause for the worsening of this condition in our nation. [3]

Cataract is defined as any congenital or acquired opacity of the lens, regardless of its effect on vision. [4] The treatment of this condition is imminently surgical, [5] and a detailed preoperative evaluation is essential for a good postoperative visual acuity. [6]

The development of new technologies has implemented the results obtained in cataract surgery over the last few years, highlighting the procedure that previously had an exclusive role of visual rehabilitation to a panorama of true refractive surgery, [7] in which the main purpose would not be to overcome morbidity, but rather to obtain a precise postoperative target refraction, clinically translating this result into optimized visual acuity. [8]

Optical biometry is one of the main tools available in the preoperative evaluation of cataract surgery, and one of the ones that has undergone more technological improvements, having as a functional feature in the surgical planning the establishment of an effective site in relation to which the intraocular lens (IOL) would be inserted, in order to increase the power of the lens, reaching a postoperative refraction capable of providing visual acuity probably better for the individual submitted to the procedure. [8,9]

In the calculation of this measurement, biometers released in recent years such as the Lenner LS 900 produced by Alcon and the IOL Master 700 produced by Zeiss, have similar variables that compose the analysis of these ocular parameters, the main ones being: axial length (AL - axial length), anterior chamber depth (ACD – anterior chamber depth), thickness of crystalline lens (LT- lens thickness), central corneal thickness (CCT – central corneal thickness) and corneal rays (R1 - radius of anterior corneal curvature; R2 - radius of the posterior curvature of the cornea). Besides this analysis, some researchers consider other variables, such as the age and gender of the individual, that subjectively influence the final computation. [10]

In the devices under analysis it is important to establish some intrinsic differences to each device, already identified in previous studies. [9,11-13]

• The IOL Master 700: non-contact optical biometer, which uses as a physical principle the partial coherence interferometry (PCI) and an analysis of its variables from 3 scans on each of the 6 reference meridians

• The Lenstar LS 900: non-contact optical biometer, which uses low coherence optical reflectometry (LCOR) as its physical principle, an analysis of its variables from 32 reference points

In view of these different ways of measuring the same measurement, we consider it important to establish the correlation between optical and target biometrics with age, anterior chamber depth, axial length, R1/K1 and R2/K2 variables, observing the possibility that, despite a similar purpose, statistically significant different results could be found. Noting that disagreements between the devices under analysis, and generally only one of them is used in the preoperative assessment of cataract surgery, may re-signify the individual's visual acuity in order to establish a standard of excellence that is increasingly required in this surgical procedure.

Methods

This cross-sectional observational study followed the guidelines of the Declaration of Helsinki, and all patients signed an informed consent form approved by the Ethics and Research Committee of the Pontifícia Universidade Católica de Goiás The study covered 348 electronic medical records in a hospital of reference in ophthalmology in the city of Goiânia (Brazil) from April to July 2017 of which 279 adult patients with cataract (total of 503 eyes) underwent evaluation in the devices of optical biometrics IOL Master 700 and Lenstar LS 900 at the same opportunity. The biometric formula used to calculate the intraocular lens of the entire sample in this study was Haigis. The examinations were performed by the same physician in the two biometric devices.

The inclusion criteria were: patients over 18 years of age with cataract, patients without previous surgeries and/or ophthalmologic diseases or associated systemic diseases.

Patients with less than 18 years of age, absence of cataracts, patients with previous ocular and/or systemic diseases, and/or eyes previously submitted to ophthalmologic surgeries did not participate in this study.

Data were typed and handled in Excel for further analysis of data using the Windows Statistical Package for Social Science (SPSS) program (version 21.0). The variables were evaluated by the Kolmogrov-Smirnov test and the Wilcoxon test. Linear regression analysis was used to verify the existence of biometrics and target correlation with age, anterior chamber depth, axial length, R1/K1 and R2/K2 variables. For all tests a 95% confidence level was considered, that is, $p<0.05$ was considered significant.

Results

In the present study, 503 eyes were evaluated involving 279 patients, 39.4% were male and 60.6% female. In all, 304 right eyes and 199 left eyes were analyzed. Table1 shows the distribution of patients by gender and the eye.

Table 1
Distribuition by sex and age

Parameter	f	%
Sex		
Male	110	39.4
Female	169	60.6
Total	**279**	**100.0**
Eye		
Right	304	60.4
Left	199	39.6
Total	**503**	**100.0**

The mean age was 63 years with a standard deviation of 15 years. Among the several analyzed parameters, we cite the depth of the anterior chamber, the axial length, R1/K1, R2/K2, biometrics and target of Lenstar and IOL Master. The mean value obtained with respect to the depth of the anterior chamber was 3.16 millimeters (mm), while the observed mean value of the axial length was 23.45 mm and of R1/K1, 43.29 mm and R2/K2, 44.53mm. The value of the means obtained can be observed in table 2.

Table 2
Parameters of 503 days

Parameters	Mean ± SD	Medium	IC 95%
Age	63.62 ± 15.89	67.00	62.23 - 65.02
ACD (mm)	3.16 ± 0.44	3.14	3.12 - 3.20
AL (mm)	23.45 ± 1.27	23.14	22.34 - 23.56
R1/K1 (mm)	43.29 ± 2.09	43.48	43.11 - 43.48
R2/K2 (mm)	44.53 ± 2.02	44.47	44.35 - 44.71
Biometry*	21.02 ± 3.46	21.50	20.71 - 21.32
Target*	- 0.02 ± 0.45	0.00	- 0.06 - 0.02
Biometry**	21.19 ± 3.40	21.50	20.89 - 21.49
Target**	- 0.01 ± 0.11	0.00	- 0.01 - 0.01

*Lenstar; ** IOL Master.

The average of the biometrics obtained using Lenstar was 21.02, varying 3.46 more or less, with an average target of -0.02, varying 0.45. On the other hand, in relation to the IOL Master it was 21.19, with a variation of 3.40 and average target of -0.01, variation of 0.11. It can be observed that despite close values in relation to the mean, there was a significance ($p<0.001$). These data can be seen in table 3.

Table 3
Correlatiom among the devices (biometry and target)

Parameters	Lenstar	IOL Master	P value
	Mean ± SD	Mean ± SD	
Biometry*	21.02 ± 3.46	21.19 ± 3.40	< 0.001
Target*	- 0.02 ± 0.45	- 0.01 ± 0.11	0.692

Tested used: Wilcoxon - p value < 0,05

Using linear regression to study the variables used, we observed that there was concordance of the biometry in relation to the axial length ($p<0.001$) and R1/K1 ($p<0.001$), the only parameters analyzed that demonstrated statistically significant correlations (Table 4).

Table 4
Linear regression of difference between biometrics (Lenstar - IOL Master) and parameters

Parameters	R2	b	P value
Age	0.005	-0.003	0.105
ACD (mm)	0.007	0.126	0.053
AL (mm)	0.042	0.104	<0.001
R1/K1 (mm)	0.047	0.067	<0.001
R2/K2 (mm)	0.016	-0.041	0.004

R2 - determination coefficient, b - coefficient angular/slope of the line, probability p value < 0.05

Applying linear regression of the target difference in relation to the variables, no statistically significant values were exhibited (Table 5).

Table 5
Linear regression of difference between target (Lenstar - IOL Master) and parameters

Parameters	R2	b	P value
Age	0.000	0.000	0.970
ACD (mm)	0.000	0.011	0.803
AL (mm)	0.000	0.005	0.756
R1/K1 (mm)	0.000	-0.001	0.875
R2/K2 (mm)	0.000	-0.004	0.677

R2 - determination coefficient, b - coefficient angular/slope of the line, probability p value < 0.05

A positive concordance of the biometrics in relation to the axial length was observed, shown in figure 1, that is, the larger the axial length, the greater the difference between the biometrics.

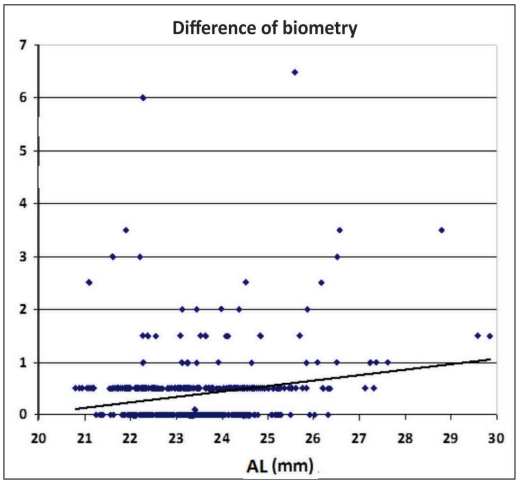

Figure 1: Difference of biometry (Lenstar - IOL Master) and axial lenght

Regarding R1/K1, there was a negative agreement, that is, the higher R1/K1, the smaller the differences between the biometrics (Figure 2).

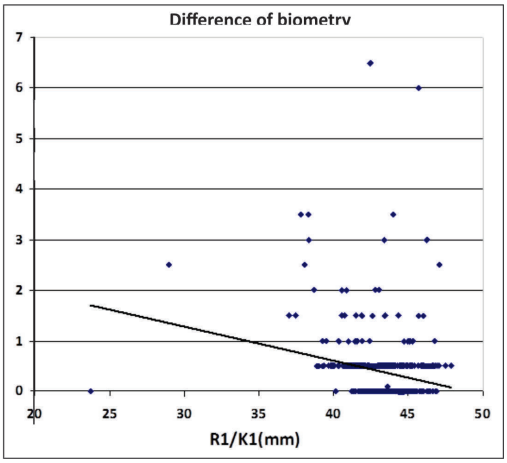

Figure 2: Diference of biometry (Lenstar - IOL Master) and R1/K1 (mm)

Discussion

In this study, we evaluated the correlation of biometry and target with the variable ages, anterior chamber depth, axial length, R1/K1 and R2/K2 established by two optical biometric devices. This is one of the first studies to evaluate these parameters using the devices in question and to correlate them with each other, taking as reference individuals living in Brazil.

Cataracts are an important cause of blindness that affects the world, and with the demographic transition, there are projections that demonstrate the relevance of its incidence and prevalence in the Brazilian territory. [3] With the development of machinery and the refinement of surgical techniques, the search for accurate postoperative target refraction became a reality, not only a visual rehabilitation. [8]

In our study, we observed a predominance of the female gender (60%) with similar percentage of impairment in the right eye. A similar result was found in a recent study in the Indian population, [14] with the prevalence of women being referred to the fact that they sought more medical care, a relationship that is repeated in our country, and the predominance on the right did not establish causal relationship.

In relation to the continuous variables, the mean values obtained for anterior chamber depth, axial length, R1/K1, and R2/K2 were similar, even in comparison to recent studies in populations that evade the constitutional and morphological characteristics of Brazilians, such as the population of South Korea[15] and France. [16] However, mean age is a distinct factor, especially in the French sample, where the age was 73.3 years, while in our evaluation the age found was 63.62 years.

Due to the lack of work encompassing a large number of population and the scarcity of data on Brazilian averages of the continuous variables under analysis, the comparisons with data from our own country are given by methodology of inference in comparison with other studies conducted in Brazil. As is the case of the work developed in São Paulo by Crispim et al.,[17] in which 31 patients also showed similarity with the data found in our study, in this case, even finding an average age of 63 years in his sample.

Our study found that the value of the biometry between the Lenstar LS 900 and the IOL Master 700 was statistically significant but clinically non-significant. The axial length in the linear regression analysis when correlated with the biometry obtained positive agreement, ie, the longer the axial length, the greater the difference found. In turn, the value of R1/K1 obtained negative agreement, the higher the value of K, the smaller the difference.

Goebels et al. [18] evaluated three biometric devices, among them an IOL Master and a Lenstar, analyzing a number of 74 patients, trying to establish correlation between the continuous variables in Germany. They also found statistical difference in axial length values when compared to these devices, differences attributed to internal calibrations of the devices. As in a normal eye, a difference of 1 mm in axial length leads to a difference of about 3.4 D in the calculation of IOL potency using the Haigis formula[19]; The difference found in this study of 0.01 / 0.06 mm would result in a difference of approximately 0.003 / 0.02 D, clinically unimportant.

Other studies also found small differences in the values of R1/K1, but did not translate into clinical differences and no definitive theoretical or practical substrates were found to explain them. [20,21]

Ventura et al. [22] performed similar work to ours in the city of Recife with 88 patients, but with different devices and other technological generations. They observed that the continuous variables and the biometric data were similar between the Lenstar LS 500 and Galilei G6 handsets, with no statistical difference between the variables.

In view of the analysis and related studies we can infer the high degree of clinical and statistical correspondence of the results obtained by the biometric devices under analysis. It is also evident that there is the need for more studies that use similar devices and that contemplate the relevant population, so that they can compare the corresponding or different samples and results, contributing to the refinement not only of the preoperative biometric evaluation, but also directly influencing the postoperative result of cataract surgeries.

Conclusion

A high degree of clinical and statistical correspondence was observed between the results obtained by the biometry devices in patients with cataract. However, there is a need for a larger number of studies that use similar devices and that contemplate the relevant population, so that we can compare samples and results, contributing to the refinement of the preoperative biometric evaluation.

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Corresponding Author:
Rodrigo Egidio da Silva
Av, Universitária 1.440, Setor Universitária, Goiânia (GO),Brazil.
Zip code: 74605-010
E-mail: rodrigoegidio@ver.med.br