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ORIGINAL RESEARCH

A Retrospective Trial Comparing Prediction Accuracy of Three Biometers in Short, Medium, and Long Eyes

Sam Multack[1], Nellie Plummer[1], Athanasios Marneris[1], Brad Hall[2]

[1]Multack Eye Care, Frankfort, IL, USA; [2]Sengi, Penniac, NB, Canada

Correspondence: Sam Multack, Multack Eye Care, 22200 Wolf Road, Frankfort, IL, 60423, USA, Tel +1-815-889-3333, Email smultack@mecvision.com

Purpose: To assess the non-inferiority of mean absolute prediction error (APE) of the Argos (Movu, a Santec company) compared with the IOL Master 700 (Carl Zeiss Meditec AG) and Lenstar LS900 (Haag-Streit AG) biometers utilizing the Barrett Universal II (BUII) formula for power calculations in short, medium, and long axial length eyes.

Methods: This was a retrospective chart review of prediction error from 3 biometers (Argos, IOLMaster 700, and Lenstar LS900). Biometer measurement order was determined using blocked randomization. Eligible charts were from eyes 50–85 years old, axial length between 20.00 mm and 30.00 mm, and had IOL implantation with the AcrySof IQ monofocal IOL (SN60WF) and AcrySof toric IOL (SN6AT3, SN6AT4). Preoperative planning was done with the BUII formula on all biometers, with a target of plano. The primary outcome measure was the mean absolute prediction error for each biometer using BUII. Specifically, the non-inferiority of Argos compared to the IOLMaster 700 and Lenstar LS900 using a non-inferiority margin of 0.25 D.

Results: The chart review identified 203 eyes from 123 patients. Mean APE for Argos overall and for each axial length group was non-inferior to that of IOLMaster 700 and Lenstar LS900. The overall mean APE was 0.25 ± 0.20 D for Argos compared to 0.25 ± 0.20 D for IOLMaster 700, and 0.25 ± 0.19 D for Lenstar LS900. The differences were not significant ($p > 0.05$). The percentages of eyes with APE 0.5 D or less were 90% for Argos, 89% for IOLMaster 700, and 89% for Lenstar LS900. The differences were not significant ($p > 0.05$).

Conclusion: Overall mean APE was not significantly different with the Argos compared to IOLMaster 700 and Lenstar LS900 using the BUII formula, suggesting that the use of any of these devices can achieve good outcomes.

Plain Language Summary: During cataract surgery, the natural lens inside the eye is removed and replaced with an artificial intraocular lens (IOL). A surgeon must select the most appropriate power for the IOL to maximize postoperative outcomes. Devices called biometers measure the eye and provide surgeons with built-in formulas to calculate the IOL power of implants. However, it can be challenging to determine the optimal IOL power to implant in eyes that are longer or shorter than average. The purpose of this study was to compare the predictive accuracy of three different biometers in long, medium, and short eyes. The results of this study indicate that the three biometers performed similarly well in long, medium and short eyes, suggesting that the use of any of these devices can achieve good outcomes.

Keywords: argos, IOLMaster 700, Lenstar LS900, biometry

Introduction

Patient expectations for clear vision following cataract surgery are high. Hitting the refractive target is crucial for good clinical outcomes. Biometry data and accurate intraocular lens (IOL) calculations are arguably the most important steps in achieving the desired refraction. This is especially true for eyes with short (<22.5 mm) or long (>24.5 mm) axial lengths. For short eyes, the residual refractive error is affected by small changes in the final position of the implanted IOL.[1] For long eyes, there is often residual hyperopia if the refractive target is missed.[2,3]

Optical biometry remains the standard methodology to collect preoperative biometry data. The Lenstar LS900 (Haag-Streit AG) is an optical low coherence reflectometry (OLCR) biometer, which measures axial length using an 820 nm

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superluminescent diode.[4] The IOLMaster 700 (Carl Zeiss Meditec AG) was the first available biometer that utilized swept source optical coherence tomography (SS-OCT),[5] and uses the same refractive index for all segments. The Argos (Movu, a Santec company) also applies SS-OCT to measure the eye; however, a sum-of-segment methodology is used to adjust the axial length calculation based on variability in the length of each segment.[6] Each segment has a specific refractive index for conversion from the optical to physical lengths. These are 1.375 for the cornea, 1.336 for the aqueous and vitreous, and 1.41 for the lens.[6] The Lenstar LS900, IOLMaster 700, and Argos have been observed to provide good refractive outcomes.[4,7,8]

Optical biometers are available preprogrammed with IOL power formulas, such as the Barrett Universal Formula II "K" (BUII).[9] The BUII formula is an update to the Barrett Universal I formula,[10] and is frequently used to determine IOL power. Studies have reported good refractive accuracy using the BUII formula in eyes with long, medium, and short axial lengths.[11–13] However, there are limited data comparing outcomes of eyes with short, medium, and long axial lengths between different biometers using the BUII formula. The purpose of this study was to assess the non-inferiority of mean absolute prediction error (spherical equivalent) of the Argos compared with the IOL Master 700 and Lenstar LS900 biometers utilizing the BUII formula for IOL calculations in short, medium, and long axial length eyes.

Methods

This was a retrospective chart review of the prediction accuracy of three biometers. An institutional review board (Salus IRB) reviewed and approved the study (approval 75237653) and granted a waiver of informed consent for the use of anonymized chart data. All data were maintained with confidentiality. The study was conducted in private practice, therefore an independent IRB was used. The study followed the tenets of the Declaration of Helsinki, International Harmonization (ICH) guidelines, and Good Clinical Practice.

Charts were reviewed from patients who had cataract surgery between January 2021 and January 2022. Eligible charts were from eyes 50–85 years old, axial length between 20.00 mm and 30.00 mm, and had IOL implantation with the AcrySof IQ monofocal IOL (SN60WF) and AcrySof toric IOL (SN6AT3, SN6AT4). Charts were excluded from eyes with corneal astigmatism >+2.00 D, central corneal thickness <450 μm or >650 μm, prior refractive surgery, history of contact lens use within 2 months of surgery, corneal disease, retinal disease, uveitis, or severe dry eye.

Three different biometers were used, the Argos, IOLMaster 700, and Lenstar LS900. Subjects received measurements with each of the three biometers, and the biometer measurement order was pre-determined using blocked randomization. This is standard practice at the site for all patients. Preoperative planning was done with the Barrett Universal II (BUII) formula on all biometers, with a target of plano. If there were differences in the IOL power suggested by each biometer, the power suggested by the Argos device was preferred. Axial length measurements with the Argos device were used for subsequent analyses. Exploratory back-calculations were done using the Barrett Universal II Total Keratometry (BUII.TK) formula with the IOLMaster 700 and the Barrett True Axial Length (BTAL) formula with the Argos. The BUII.TK makes use of direct measurement of both the anterior and posterior corneal surfaces.[14] The BTAL formula is able to take advantage of measurements from sum-of-segments optical biometry. Refractive outcomes were determined one month postoperatively by subjective assessment with the same optometrist who was blinded to preoperative biometry data.

The primary outcome measure was the mean absolute prediction error for each biometer using BUII. Specifically, the non-inferiority of Argos compared to the IOLMaster 700 and Lenstar LS900 using a non-inferiority margin of 0.25 D. Other outcome measures included the percentage of eyes with an absolute prediction error ≤0.5D and a sub-analysis looking at differences in different axial lengths: short (22.0 to 22.49 mm), medium (22.50 to 24.50 mm), and long (24.51 to 24.99). The results from very short (<22.0 mm) and very long (>25.0 mm) axial lengths were summarized descriptively only. An exploratory outcome measure is compared to mean absolute prediction error using BUII (all three biometers), BTAL (Argos), and BUII.TK (IOLMaster 700).

The software program R (version 4.3.1; The R Foundation for Statistical Computing, Vienna, Austria) was used for statistical analysis. Comparisons for the primary and exploratory outcome measures were done using linear mixed effects models that were adjusted for biometer order, axial length, and for cases where more than 1 eye was included for a patient. Comparisons for the secondary outcome measures were done using generalized estimating equations (GEE) that were adjusted for biometer order, axial length, and for cases where more than 1 eye was included for a patient.

Tukey's Method was used to adjust the confidence intervals to 97.5% to account for multiple comparisons. It was estimated that a sample size of 180 eyes would be required to establish non-inferiority with 95% power, assuming a non-inferior delta of 0.25 D and standard deviation of 0.165 D.

Results

The chart review identified a total of 203 eyes from 123 patients that met the inclusion and exclusion criteria. Of the 203 eyes, 133 (66%) were from female subjects and 70 (34%) were from male subjects. The average age of subjects was 70.0 ± 8.0 years (range 50 to 92). The Argos and IOLMaster 700 were able to scan all 203 of 203 eyes; however, the Lenstar LS900 was not able to scan 5 of 203 eyes.

Table 1 summarizes the postoperative absolute prediction errors for the BUII formula. In all study eyes, Argos was non-inferior to IOLMaster and Lenstar as the 97.5% confidence intervals did not include 0.25 D (the non-inferiority margin). Mean absolute prediction error was similar between biometers ($p > 0.05$). The percentage of eyes with ≤0.5 D of

Table 1 Absolute Prediction Error for BUII

Device and Formula	Mean ± SD (Range)	Median	≤ 0.25D	≤ 0.50D	≤ 0.75D	≤ 1.00D
All Study Eyes (n = 203)						
Argos.BUII	0.25 ± 0.20 (0 to 1.08)	0.20	60.6	89.7	97.5	99.5
IOLMaster.BUII	0.25 ± 0.20 (0 to 1.14)	0.20	61.6	88.7	98.0	99.5
Lenstar.BUII	0.25 ± 0.19 (0 to 0.92)	0.20	56.6	88.9	98.0	100.0
Medium Eyes (n = 128)						
Argos.BUII	0.25 ± 0.20 (0 to 1.08)	0.22	60.2	88.3	96.9	99.2
IOLMaster.BUII	0.25 ± 0.20 (0 to 0.89)	0.19	61.7	86.7	97.7	100.0
Lenstar.BUII	0.24 ± 0.20 (0 to 0.92)	0.20	59.7	87.9	97.6	100.0
Long Eyes (n = 54)						
Argos.BUII	0.22 ± 0.17 (0.01 to 0.71)	0.20	66.7	92.6	100.0	100.0
IOLMaster.BUII	0.25 ± 0.18 (0.00 to 0.70)	0.20	57.4	90.7	100.0	100.0
Lenstar.BUII	0.27 ± 0.20 (0.01 to 0.83)	0.30	46.3	88.9	98.1	100.0
Very Long Eyes (n = 37)						
Argos.BUII	0.23 ± 0.18 (0.01 to 0.71)	0.20	70.3	91.9	100.0	100.0
IOLMaster.BUII	0.23 ± 0.19 (0.00 to 0.70)	0.20	67.6	89.2	100.0	100.0
Lenstar.BUII	0.25 ± 0.21 (0.01 to 0.83)	0.20	56.8	89.2	97.3	100.0
Short Eyes (n = 21)						
Argos.BUII	0.29 ± 0.21 (0.02 to 0.89)	0.30	47.6	90.5	95.2	100.0
IOLMaster.BUII	0.22 ± 0.24 (0.01 to 1.14)	0.20	71.4	95.2	95.2	95.2
Lenstar.BUII	0.21 ± 0.13 (0.04 to 0.52)	0.20	65.0	95.0	100.0	100.0
Very Short Eyes (n = 10)						
Argos.BUII	0.39 ± 0.20 (0.12 to 0.89)	0.40	20.0	90.0	90.0	100.0
IOLMaster.BUII	0.32 ± 0.31 (0.08 to 1.14)	0.20	60.0	90.0	90.0	90.0
Lenstar.BUII	0.24 ± 0.12 (0.04 to 0.42)	0.20	55.6	100.0	100.0	100.0

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absolute prediction error was also similar between biometers. A GEE model, adjusting for baseline axial length, biometer order, and eyes from the same patient did not find any significant differences for percentage of eyes with ≤0.5 D of absolute prediction error ($p > 0.05$).

For the long eyes, mean absolute prediction error for Argos was non-inferior to IOLMaster and Lenstar. Mean absolute prediction error for Argos was also significantly lower than IOLMaster and Lenstar ($p < 0.03$). The percentage of eyes with ≤0.5 D of absolute prediction error was also similar between biometers. A GEE model, adjusting for baseline axial length, biometer order, and eyes from the same patient did not find any significant differences for percentage of eyes with ≤0.5 D of absolute prediction error ($p > 0.05$).

For the short eyes, mean absolute prediction error for Argos was non-inferior to IOLMaster and Lenstar. There were no significant differences between biometers. The percentage of eyes with ≤0.5 D of absolute prediction error was also similar between biometers. A GEE model, adjusting for baseline axial length, biometer order, and eyes from the same patient, did not find any significant differences for percentage of eyes with ≤0.5 D of absolute prediction error.

Exploratory Outcomes

Table 2 summarizes the postoperative absolute prediction error for the Argos BTAL and IOLMaster BUIITK. In all study eyes and for each AL group, Argos BTAL was non-inferior to IOLMaster (BUII and BUIITK) and Lenstar (BUII) as the 97.5% confidence intervals did not include 0.25 D (the non-inferiority margin). Argos BTAL also performed similarly to the Argos BUII for mean absolute prediction error all study eyes, long AL, and very long AL. For short and very short AL, mean absolute prediction error for Argos BTAL was lower than Argos BUII.

Table 2 Absolute Prediction Error for Back-Calculated Formulas

Device and Formula	Mean ± SD (Range)	Median	≤ 0.25D	≤ 0.50D	≤ 0.75D	≤ 1.00D
All Study Eyes (n = 203)						
Argos.BTAL	0.24 ± 0.18 (0 to 0.98)	0.20	65.5	93.6	98.0	100.0
IOLMaster.BUIITK	0.25 ± 0.20 (0 to 1.14)	0.20	60.1	88.7	97.0	99.0
Medium Eyes (n = 128)						
Argos.BTAL	0.24 ± 0.19 (0 to 0.98)	0.2	64.8	93.0	96.9	100.0
IOLMaster.BUIITK	0.25 ± 0.21 (0 to 1.02)	0.2	60.9	88.3	96.1	99.2
Long Eyes (n = 54)						
Argos.BTAL	0.24 ± 0.17 (0.01 to 0.75)	0.20	64.8	94.4	100.0	100.0
IOLMaster.BUIITK	0.26 ± 0.17 (0.01 to 0.75)	0.20	53.7	88.9	100.0	100.0
Very Long Eyes (n = 37)						
Argos.BTAL	0.24 ± 0.17 (0.01 to 0.75)	0.20	64.9	94.6	100.0	100.0
IOLMaster.BUIITK	0.24 ± 0.17 (0.01 to 0.75)	0.20	59.5	91.9	100.0	100.0
Short Eyes (n = 21)						
Argos.BTAL	0.22 ± 0.16 (0.01 to 0.75)	0.20	71.4	95.2	100.0	100.0
IOLMaster.BUIITK	0.22 ± 0.26 (0.01 to 1.14)	0.10	71.4	90.5	95.2	95.2
Very Short Eyes (n = 10)						
Argos.BTAL	0.27 ± 0.20 (0.10 to 0.75)	0.20	60.0	90.0	100.0	100.0
IOLMaster.BUIITK	0.27 ± 0.33 (0.01 to 1.14)	0.20	60.0	90.0	90.0	90.0

Discussion

In this study, we aimed to assess the non-inferiority of the BUII formula with the Argos, compared to the BUII formula on the IOLMaster 700 and the Lenstar LS900. Generally, the absolute prediction error for Argos BUII was non-inferior to IOLMaster 700 BUII and Lenstar LS900 BUII overall and for sub-analyses at different axial lengths. Overall, the mean absolute prediction error was 0.25 D for these 3 biometers using the BUII formula. In a retrospective study, Blehm and Hall[15] compared the BUII on the Argos and Lenstar LS900 and reported an overall absolute prediction error of 0.35 D and 0.42 D, respectively, which is slightly higher than that reported in our study. Omoto et al[16] reported minor differences in absolute prediction error overall between Argos and IOLMaster 700 with the BUII formula. Other studies have observed similar outcomes between the Argos and IOLMaster or Argos and Lenstar LS900 when using other IOL power formulas.[17–20] The only significant differences noted between the biometers in our study were for long eyes, where the absolute prediction error for Argos BUII was lower compared to IOLMaster BUII and Lenstar LS900 BUII. Omoto et al[16] observed a similar outcome for long eyes between Argos and IOLMaster 700 with the BUII formula. The results of our study and others suggest that BUII on the Argos, IOLMaster 700, and Lenstar LS900 leads to similar mean absolute prediction error.

A secondary outcome measure was to compare the percentage of eyes with absolute prediction error ≤0.5 D. The percentages were similar (89% or greater) for Argos BUII, IOLMaster 700 BUII, and Lenstar BUII, when comparing all eyes in the study and when comparing only long or short eyes. This differs from the results reported by Blehm and Hall,[15] who observed a larger percentage of eyes with absolute prediction error ≤0.5 D for Argos compared to Lenstar LS900 for all study eyes. Omoto et al[16] reported no significant differences between the Argos and IOLMaster 700 for the percentage of eyes with absolute prediction error ≤0.5 D overall and for long eyes, however, their reported percentages were lower than our study. The results of our study and others suggest that BUII on the Argos, IOLMaster 700, and Lenstar LS900 lead to similar percentages of eyes with absolute prediction error ≤0.5 D.

In addition to the BUII formulas, we back-calculated and compared Argos BTAL and IOLMaster 700 BUII.TK as an exploratory outcome measure. The BTAL formula is designed to take advantage of the sum-of-segments methodology. In our study, Argos BTAL performed well in both long and short eyes. We also observed that the BTAL may perform better than the BUII in short eyes, however the sample size is too small to draw definitive conclusions. This is similar to the results reported by Blehm and Hall.[21] However, in a large retrospective study, Shammas et al[11] observed that the Argos BTAL performed better in long eyes than in short eyes. The IOLMaster 700 BUII.TK formula can make use of measurements from both the anterior and posterior corneal surface. In our study, the IOLMaster 700 BUII.TK formula performed similarly to the other biometer/formula combinations. This would make sense given that charts were excluded that had high corneal astigmatism. Fabian and Wehner[22] reported similar results between BUII and BUII.TK with the IOLMaster 700. In a retrospective study, Multack et al[23] compared the prediction error for Argos BUII and IOLMaster 700 BUII.TK and reported minimal differences in absolute prediction error. However, Melendez et al[24] reported that the Argos BUII performed significantly better than the IOLMaster 700 in eyes that received a toric IOL. The results of our study and others suggest that BTAL on the Argos and BUII.TK on the IOLMaster 700 can lead to good clinical outcomes. Future research could directly compare the BUII and BTAL formulas with the Argos device in medium long, very long, short, and very short eyes with a large sample size.

We acknowledge that this study had a few limitations. First, the design was retrospective and a prospective study would provide more robust data. However, a prospective study may require at least 400 eyes,[11,25] thus the retrospective design may offer advantages for cost and time. Second, using the same eye for each biometer/formula combination could introduce bias since the power chosen by Argos BUII was preferred. However, given the minimal differences between the absolute prediction errors that our study and other studies reported, our results appear robust. Third, there were no comparisons of preoperative biometry data. This was not the objective of the study, and these comparisons have been reported elsewhere.[4,16,17,19,20,22]

In conclusion, overall mean APE was not significantly different with the Argos compared to IOLMaster 700 and Lenstar LS900 using the BUII formula, suggesting that the use of any of these devices can achieve good outcomes.

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Disclosure

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References

1. Hoffer KJ, Savini G. IOL power calculation in short and long eyes. *Asia Pac J Ophthalmol*. 2017;6:330–331. doi:10.22608/APO.2017338
2. Zaldivar R, Shultz MC, Davidorf JM, Holladay JT. Intraocular lens power calculations in patients with extreme myopia. *J Cataract Refract Surg*. 2000;26:668–674. doi:10.1016/S0886-3350(00)00367-9
3. Wang L, Shirayama M, Ma XJ, Kohnen T, Koch DD. Optimizing intraocular lens power calculations in eyes with axial lengths above 25.0 mm. *J Cataract Refract Surg*. 2011;37:2018–2027. doi:10.1016/j.jcrs.2011.05.042
4. Montes-Mico R. Evaluation of 6 biometers based on different optical technologies. *J Cataract Refract Surg*. 2022;48:16–25. doi:10.1097/j.jcrs.0000000000000690
5. Grulkowski I, Liu JJ, Zhang JY, et al. Reproducibility of a long-range swept-source optical coherence tomography ocular biometry system and comparison with clinical biometers. *Ophthalmology*. 2013;120:2184–2190. doi:10.1016/j.ophtha.2013.04.007
6. Wang Q, Chen M, Ning R, et al. The precision of a new anterior segment optical coherence tomographer and its comparison with a swept-source oct-based optical biometer in patients with cataract. *J Refract Surg*. 2021;37:616–622. doi:10.3928/1081597X-20210610-02
7. Shammas HJ, Ortiz S, Shammas MC, Kim SH, Chong C. Biometry measurements using a new large-coherence-length swept-source optical coherence tomographer. *J Cataract Refract Surg*. 2016;42:50–61. doi:10.1016/j.jcrs.2015.07.042
8. Rocha-de-Lossada C, Rodriguez-Vallejo M, Rachwani-Anil R, Burguera N, Fernandez J. Predicted refraction variability due to reliability of nine optical biometers for intraocular lens power calculation. *J Refract Surg*. 2022;38:120–127. doi:10.3928/1081597X-20211122-01
9. Barrett GD. An improved universal theoretical formula for intraocular lens power prediction. *J Cataract Refract Surg*. 1993;19:713–720. doi:10.1016/S0886-3350(13)80339-2
10. Barrett GD. Intraocular lens calculation formulas for new intraocular lens implants. *J Cataract Refract Surg*. 1987;13:389–396. doi:10.1016/S0886-3350(87)80037-8
11. Shammas HJ, Taroni L, Pellegrini M, Shammas MC, Jivrajka RV. Accuracy of newer intraocular lens power formulas in short and long eyes using sum-of-segments biometry. *J Cataract Refract Surg*. 2022;48:1113–1120. doi:10.1097/j.jcrs.0000000000000958
12. Cooke DL, Cooke TL. A comparison of two methods to calculate axial length. *J Cataract Refract Surg*. 2019;45:284–292. doi:10.1016/j.jcrs.2018.10.039
13. Kane JX, Van Heerden A, Atik A, Petsoglou C. Accuracy of 3 new methods for intraocular lens power selection. *J Cataract Refract Surg*. 2017;43:333–339. doi:10.1016/j.jcrs.2016.12.021
14. Akman A, Asena L, Gungor SG. Evaluation and comparison of the new swept source OCT-based IOLMaster 700 with the IOLMaster 500. *Br J Ophthalmol*. 2016;100:1201–1205. doi:10.1136/bjophthalmol-2015-307779
15. Blehm C, Hall B. Comparing predictive accuracy of a swept source optical coherence tomography biometer and an optical low coherence reflectometry biometer. *Clin Ophthalmol*. 2023;17:2125–2131. doi:10.2147/OPTH.S421504
16. Omoto MK, Torii H, Masui S, Ayaki M, Tsubota K, Negishi K. Ocular biometry and refractive outcomes using two swept-source optical coherence tomography-based biometers with segmental or equivalent refractive indices. *Sci Rep*. 2019;9:6557. doi:10.1038/s41598-019-42968-3
17. Yang CM, Lim DH, Kim HJ, Chung TY. Comparison of two swept-source optical coherence tomography biometers and a partial coherence interferometer. *PLoS One*. 2019;14:e0223114. doi:10.1371/journal.pone.0223114
18. Cummings AB, Naughton S, Coen AM, Brennan E, Kelly GE. Comparative analysis of swept-source optical coherence tomography and partial coherence interferometry biometers in the prediction of cataract surgery refractive outcomes. *Clin Ophthalmol*. 2020;14:4209–4220. doi:10.2147/OPTH.S278589
19. Choi JY, Choi A, Kwon H, Jeon S. Accuracy of IOL power calculation formulas for quadrifocal Acrysof IQ PanOptix TFNT implantation in patients with previous corneal refractive surgery: comparison of SS-OCT-based biometers. *J Refract Surg*. 2021;37:836–841. doi:10.3928/1081597X-20210812-02
20. Tamaoki A, Kojima T, Hasegawa A, et al. Clinical evaluation of a new swept-source optical coherence biometer that uses individual refractive indices to measure axial length in cataract patients. *Ophthalmic Res*. 2019;62:11–23. doi:10.1159/000496690
21. Blehm C, Hall B. Refractive predictability of a swept source optical coherence tomography biometer in long and short eyes implanted with extended depth of focus intraocular lenses. *Clin Ophthalmol*. 2023;17:3525–3530. doi:10.2147/OPTH.S430535
22. Fabian E, Wehner W. Prediction accuracy of total keratometry compared to standard keratometry using different intraocular lens power formulas. *J Refract Surg*. 2019;35:362–368. doi:10.3928/1081597X-20190422-02
23. Multack S, Plummer N, Smits G, Hall B. Randomized trial comparing prediction accuracy of two swept source optical coherence tomography biometers. *Clin Ophthalmol*. 2023;17:2423–2428. doi:10.2147/OPTH.S407538

24. Melendez RF, Smits G, Nguyen T, Ruffaner-Hanson CD, Ortiz D, Hall B. Comparison of astigmatism prediction accuracy for toric lens implantation from two swept-source optical coherence tomography devices. *Clin Ophthalmol*. 2022;16:3795–3802. doi:10.2147/OPTH.S378019
25. Shammas HJ, Shammas MC, Jivrajka RV, Cooke DL, Potvin R. Effects on IOL power calculation and expected clinical outcomes of axial length measurements based on multiple vs single refractive indices. *Clin Ophthalmol*. 2020;14:1511–1519. doi:10.2147/OPTH.S256851