Keratometry Readings With SS-OCT Biometers and Their Impact on IOL Power Calculations

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INTRODUCTION

Keratometry readings are important parameters needed to determine the exact IOL power. Different SS-OCT biometers employ different approaches to measure the corneal curvature, which leads to slightly different readings.

The question is, how do these different approaches in measuring the corneal power affect IOL power calculations in standard cataract in normal eyes? This article summarizes literature that compared keratometry readings between the available SS-OCT biometers and discusses the impact on monofocal and toric IOL power calculations.

COMPARISON OF KERATOMETRY MEASUREMENTS

There are a number of studies that compared the ARGOS® (Alcon) and IOLMaster 700 (ZEISS) (Table). Overall, differences in keratometry readings were generally small and did not exceed 0.16 D. In many cases, however, comparisons reached statistical significance.[1-5] A significant trend toward flatter K-readings for the IOLMaster 700[1-4] in comparison to ARGOS® can be noted. These differences are likely caused by the different measurement approaches.

IMPACT ON MONOFOCAL IOL POWER CALCULATIONS

The largest sources of error that influence monofocal IOL power calculations and refractive outcomes include: predicted postoperative anterior chamber depth (35%), predicted postoperative refraction (27%), axial length (17%), and pupil size (8%) measurements.[7] The influence of keratometry is small. Anterior corneal keratometry measurements contribute approximately 2%, and the ratio of anterior/posterior corneal keratometry readings contributes approximately 4% to the error sources.[7]

The outcomes of monofocal IOL power calculations therefore do not seem to show differences between the ARGOS® and IOLMaster 700 biometers. Omoto et al[8] identified significant differences in the mean anterior corneal radius curvature between these biometers, but the percentage of eyes within ± 0.5 D prediction error was similar for various IOL power calculation formulas. A similar conclusion was drawn by Yang et al[4] assessing the effect of IOL power calculations using the Haigis formula. Authors did find significant differences in the average keratometry readings (Table), but these changes are not considered to be clinically significant to influence the final refraction.

| References		Sabatino JCRS 2019[3]	Yang PLOS one 2019[4]	Romanek Cesk Slov Oftalmol 2021[6]	Melendez Clin Opthalmol 2022[1]	Montes-Mico JCRS 2022[2]	Galzignato JCRS 2023[5]
TABLE. COMPARISON OF KERATOMETRY VALUES IN DIOPTERS (D)							
Sample size (eyes)		n = 218	n = 143	n = 106	n = 59	n = 150	n = 56
ARGOS®	Mean/Avg K ± SD	43.76 ± 1.77	43.99 ± 2.10	44.03 ± 1.65			43.62 ± 1.62
	K flat ± SD				42.87 ± 1.60	43.22 ± 1.48	43.20 ± 1.59
	K steep ± SD				44.90 ± 1.71	44.26 ± 1.59	44.05 ± 1.26
IOLMaster 700	Mean/Avg K ± SD	43.71 ± 1.70	43.92 ± 2.14	43.95 ± 1.64			43.49 ± 1.59
	K flat ± SD	K flat ± SD			42.75 ± 1.59	43.19 ± 1.48	43.07 ± 1.58
	K steep ± SD	K steep ± SD			44.74 ± 1.70	44.14 ± 1.60	43.90 ± 1.67
P values ARGOS® vs IOLMaster 700		0	<0.001	0.773	0.0021 for flat K; <0.0001 for steep K	0.099 for flat K; <0.001 for steep K	
K: keratometry, SD: standard deviation							
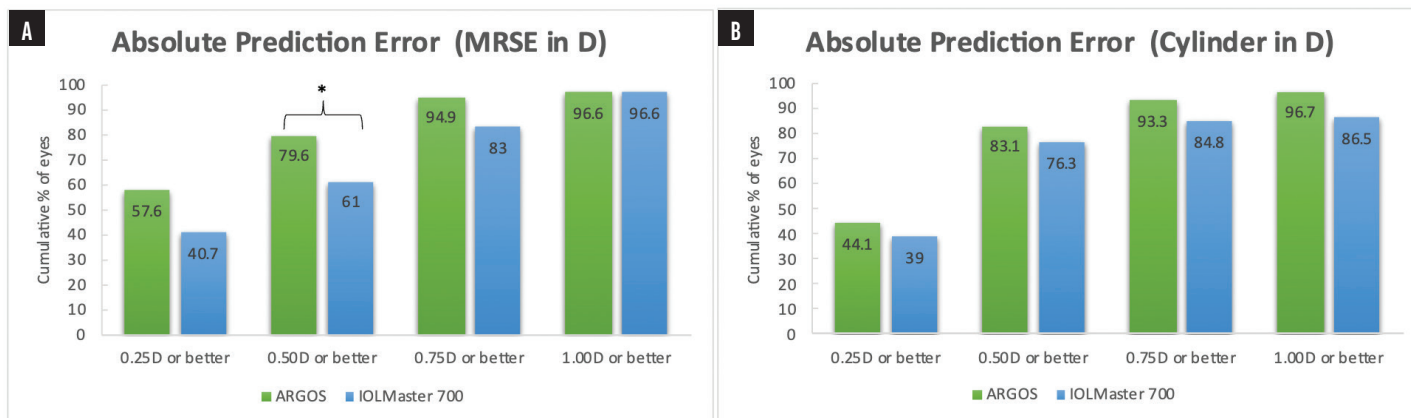
Figure. Absolute prediction error for (A) manifest refractive spherical equivalent (MRSE) in diopters and (B) cylinder in diopters. [1]

*Percent of eyes with MRSE of 0.5 D or better was statistically higher with ARGOS® as compared to IOLMaster 700 (P = 0.016)

IMPACT ON TORIC IOL POWER CALCULATIONS

The contribution of individual error sources shifts significantly when we investigate toric IOL power calculations. The largest error source is derived from the corneal measurement contributing 0.59 D (27% of the total error sum).[9] Within the corneal measurement error source, 0.26 D are the result of differences between devices (including posterior corneal surface), 0.14 D corneal radii, 0.10 D diurnal changes, and 0.09 D central corneal thickness.[9]

As such, a comparison of predicted clinical outcomes utilizing SS-OCT biometers to calculate the toric IOL power may reveal some differences. A study conducted by Melendez et al[1] compared clinical outcomes using ARGOS®, the Barrett Universal II formula and the Barrett toric calculator to the predicted clinical outcomes from the IOLMaster 700 with Total Keratometry (TK) measurements and the Barrett TK Toric calculator (Figure). The cylinder prediction error of 0.5 D or less was 83.1% for ARGOS® and 76.3% for the IOLMaster 700.[1] This difference however was not statistically significant. A similar, but significant, trend was noted for the refractive spherical equivalent. Using the ARGOS® resulted in a refractive prediction error of 79.7%, while that of the IOLMaster 700 was 61% (P = 0.016).[1]

Of note, the IOLMaster 700 does not directly measure the posterior corneal curvature; instead it uses the anterior corneal curvature and corneal thickness to model the posterior cornea. In this study, the extrapolated posterior corneal surface of the IOLMaster 700 did not show an improvement in refractive outcomes over using the predicted posterior cornea in the Barrett formulas.[1]

CONCLUSIONS

Norrby et al[7] and Hirnschall et al[9] examined common error sources that influence refractive outcomes in monofocal and toric IOL power calculations. While keratometry readings have a small impact on refractive outcomes in monofocal IOL power calculations,[4,7,8] it constitutes the largest source for inaccuracies in toric IOL power calculations.[1,9] ■

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