Original Article

Agreement between swept-source optical biometry and Scheimpflug-based tomography in eyes with previous myopic refractive surgery

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Abstract:

PURPOSE: The purpose of the study is to evaluate the comparability of corneal power measurements, anterior chamber depth (ACD), and white-to-white (WTW) distance between a high-resolution Scheimpflug-based tomography (Pentacam HR; Oculus GmbH, Wetzlar, Germany) and a swept-source optical biometry (IOL Master 700; Carl Zeiss Meditec AG, Jena, Germany) in patients having undergone a myopic refractive surgery.

METHODS: This prospective, interinstrument reliability analysis included 31 individuals with a previous myopic laser refractive correction. Standard keratometry and total keratometry (TK) of the flattest and steepest axis of the IOL Master 700 were compared with standard keratometry (simulated keratometry [SimK]), true net power (TNP), equivalent keratometer readings (EKR), and total corneal refractive power of the Pentacam. The Bland–Altman analysis evaluated the agreement between the measurements of both devices. A paired *t*-test was performed to compare the mean values of the variables obtained by the two devices.

RESULTS: Mean age of the participants was 31.87 ± 13.17 years. Ten patients (32.3%) had undergone laser *in situ* keratomileusis surgery, and 21 (67.7%) had undergone photorefractive keratectomy surgery. The two devices generated statistically significant differences in almost all the comparisons between their corneal keratometry values, ACD, and WTW. The two devices agreed in some of the flat axis values and more specifically on SimK1 and K1, EKR K1 along 1 mm-zone and K1, as well as on the comparison between the EKR keratometry values along 1, 2, and 3 mm-zone with their corresponding TKs.

CONCLUSION: IOL Master 700 and Pentacam HR do not show good concordance and cannot be used interchangeably when measuring keratometry values in postrefractive eyes, rendering the IOL power calculation in postrefractive eyes really challenging.

Keywords:

Equivalent keratometer readings, IOL Master 700, keratometry, Pentacam HR, refractive surgery, true net power

Introduction

Intraocular lens (IOL) power calculation following laser refractive surgery is one of the most challenging aspects of cataract surgery.[1] Several devices are available for precise corneal power measurements, including the Pentacam HR (Oculus GmbH, Wetzlar, Germany), which uses a rotating Scheimpflug camera and produces topographic maps and corneal power calculations of the anterior and posterior corneal surfaces, biometric measurements of the anterior segment, and complete corneal pachymetry.[2,3]

The IOL Master 700 (Carl Zeiss Meditec, AG, Jena, Germany) is based on the principle of swept-source optical coherence tomography (SS-OCT) and incorporates the influence of the posterior corneal curvature.[4,5]

We aimed to compare the keratometry readings of these devices in myopic eyes with previous refractive surgery.

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Methods

This prospective study was conducted in accordance with the Declaration of Helsinki and legal regulations. The study protocol was approved by our institutional review board and the local ethics committee. All participants signed written informed consent form after explanation of the study protocol.

We performed a standard ophthalmic examination on 62 myopic eyes who had undergone an uncomplicated refractive surgery at least 1 year before the examination. Individuals with a history of intraocular surgery, ocular trauma, uveitis, glaucoma, optic nerve disease, preexisting corneal pathology, and retinal disease were excluded. After recording age, gender, and medical history, each participant underwent best-corrected visual acuity examination with Snellen chart and anterior slit-lamp biomicroscopy, intraocular pressure measurement using Goldmann tonometer, and dilated pupil examination of the posterior segment. Before any manipulations to the eye, one of two experienced ophthalmologists performed three complete, device-specific automated independent measurements at the IOL Master 700 (software version 1.88.1.64861) and Pentacam HR (software version 1.20r98) under standardized conditions, and the averaged values were used for the statistical analysis. All the examinations were taken in the same dimly lit room, with a resting interval of 10 min between the examinations, from 11:00 to 13:00. All subjects were asked to perform a complete blink every time just before measurement, and they were told to sit back after each measurement to ensure the device was realigned before the next measurement. The measurements were considered acceptable only when they satisfied the quality criteria for each individual device according to the manufacturer's instructions. The order of measurement was chosen in a random way. Flat-axis measurements were notated with number 1 and steep-axis measurements with number 2.

Corneal power was measured and shown in the Power Distribution Display of the Pentacam HR. Apart from the standard simulated K (SimK) readings that are derived from images taken exclusively from the anterior corneal surface over a 3-mm ring,[3] the device provides the equivalent keratometer readings (EKRs), the total corneal refractive power map (TCRP), and the true net power (TNP). We recorded the values for SimK1 and SimK2, EKR K1 and EKR K2 in a 1-mm, 2-mm, 3-mm, and 4.5-mm zone centered on the pupil center, as well as TCRP K1 and TCRP K2 in a 4-mm zone and TNP K1 and TNP K2 in a 3-mm and 4-mm zone centered on the apex. The external anterior chamber depth (ACD) value, which is the distance from the corneal epithelium to the anterior lens surface, and white-to-white (WTW) distance were also recorded.

The IOL Master 700 is an optical biometer that additionally measures the total corneal power (total keratometry [TK]) which is influenced by the posterior corneal surface.[4,5] Using the IOL Master 700, standard K1, K2, TK1, TK2, ACD, and WTW measurements were taken.

Although both eyes were examined, measurement results of one eye from each participant were selected for the statistical analysis by generating random numbers using Microsoft Excel software, after ensuring an excellent intra-eye correlation between the two eyes of each participant for all the variables measured (intraclass correlation coefficient range: 0.918–0.993). The Kolmogorov–Smirnov test was used to confirm normal distribution of the data (all $P > 0.05$). The paired *t*-test was applied to evaluate statistical significance of differences between readings from the two devices. K1 and TK1 were compared with each other, and each one of them was compared with SimK1, EKR K1-1 mm, EKR K1-2 mm, EKR K1-3 mm, EKR K1-4.5 mm, TCRP K1, TNP K1-3 mm, and TNP K1-4 mm. Accordingly, K2 and TK2 from the IOL Master 700 were compared between them, and each one of them was compared with SimK2, EKR K2-1 mm, EKR K2-2 mm, EKR K2-3 mm, EKR K2-4 mm, EKR K2-4.5 mm, TCRP K2, TNP K2-3 mm, and TNP K2-4 mm. ACD and WTW of the Pentacam device were compared with their corresponding values of the IOL Master 700. Bland–Altman plots were used to graphically present agreement between the devices. The mean difference and 95% limits of agreement (LoAs) were calculated by mean difference ± 1.96 standard deviation of the differences, which provides an interval within which 95% of the differences between measurements were expected to lie.[6] Statistical analyses were performed using SPSS 20.0.0 software (IBM Corporation, Armonk, NY, USA). A $P < 0.05$ was considered statistically significant.

Results

Thirty-one eyes of 31 individuals were included in our study. Mean age of the participants was 31.87 ± 13.17 years (range: 17–70 years) and 21 (67.7%) of them were men. Ten patients (32.3%) had undergone a previous myopic-laser *in situ* keratomileusis (Lasik), uncomplicated surgery, and 21 (69.2%) had undergone a previous myopic-photorefractive keratectomy (PRK), uncomplicated surgery. Mean postoperative, best uncorrected visual acuity was 0.91 ± 0.16.

Table 1 shows the mean measurements, the *P* value, and the LoA of the comparisons between K1 and K2 obtained by IOL Master 700 and the keratometric variables obtained by Pentacam. The Pentacam exhibited significantly lower keratometry values than the corresponding variables of the IOL Master 700 for all the variables studied, except for the comparison between SimK1 and K1, as well as between EKR K1-1 mm and K1. Table 1 also shows the comparison between K and TK values of the IOL Master 700. K1 and K2 were significantly higher ($P < 0.001$) than TK1 and TK2, respectively.

Figure 1 shows the Bland–Altman plots for the SimK1, SimK2, EKR K1-1 mm, EKR K2-1 mm, EKR K1-4.5 mm, EKR K2-4.5 mm, TNP K1-4 mm, TNP K2-4 mm, and their corresponding Ks of the IOL Master 700. The mean difference was lowest for the comparison between SimK1

Table 1: Comparison of standard keratometry values of the flattest and the steepest axis of the IOL Master 700 with the keratometric variables obtained from Pentacam HR

Parameters	Mean±SD			*P* (paired *t*-test)	Upper LoA	Lower LoA
	Pentacam HR	IOL Master 700	Difference			
K1 (IOLMaster) versus TK1		39.82±2.22 (K1) 39.46±2.45 (TK1)	0.35±0.3	<0.001*	0.944	−0.234
K2 (IOLMaster) versus TK2		40.66±2.38 (K2) 40.24±2.6 (TK2)	0.42±0.28	<0.001*	0.987	−0.139
SimK1 versus K1 (IOLMaster)	39.8±2.03	39.82±2.22	−0.02±0.32	0.7	0.622	−0.654
SimK2 versus K2 (IOLMaster)	40.51±2.2	40.66±2.38	−0.15±0.35	0.02*	0.539	−0.833
EKR K1-1mm versus K1 (IOLMaster)	39.71±2.01	39.82±2.22	−0.11±0.72	0.4	1.315	−1.536
EKR K2-1mm versus K2 (IOLMaster)	40.17±2.04	40.66±2.38	−0.49±0.86	0.003*	1.204	−2.195
EKR K1-2mm versus K1 (IOLMaster)	39.53±2.06	39.82±2.22	−0.29±0.65	0.01*	0.983	−1.567
EKR K2-2mm versus K2 (IOLMaster)	40.14±2.11	40.66±2.38	−0.52±0.68	<0.001*	0.819	−1.842
EKR K1-3mm versus K1 (IOLMaster)	39.41±2.16	39.82±2.22	−0.4±0.5	<0.001*	0.58	−1.4
EKR K2-3mm versus K2 (IOLMaster)	40.01±2.17	40.66±2.38	−0.65±0.55	<0.001*	0.438	−1.742
EKR K1-4mm versus K1 (IOLMaster)	39.32±2.22	39.82±2.22	−0.49±0.42	<0.001*	0.348	−1.335
EKR K2-4mm versus K2 (IOLMaster)	39.91±2.2	40.66±2.38	−0.75±0.5	<0.001*	0.242	−1.755
EKR K1-4.5mm versus K1 (IOLMaster)	39.31±2.26	39.82±2.22	−0.5±0.42	<0.001*	0.315	−1.334
EKR K2-4.5mm versus K2 (IOLMaster)	39.88±2.25	40.66±2.38	−0.78±0.48	<0.001*	0.171	−1.742
TCRP K1 versus K1 (IOLMaster)	38.75±2.45	39.82±2.22	−1.06±0.55	<0.001*	0.032	−2.161
TCRP K2 versus K2 (IOLMaster)	39.4±2.54	40.66±2.38	−1.26±0.53	<0.001*	−0.212	−2.319
TNP K1-3mm versus K1 (IOLMaster)	38.38±2.27	39.82±2.22	−1.43±0.46	<0.001*	−0.535	−2.341
TNP K2-3mm versus K2 (IOLMaster)	39.05±2.36	40.66±2.38	−1.61±0.51	<0.001*	−0.595	−2.627
TNP K1-4mm versus K1 (IOLMaster)	38.24±2.3	39.82±2.22	−1.57±0.39	<0.001*	−0.804	−2.343
TNP K2-4mm versus K2 (IOLMaster)	38.88±2.36	40.66±2.38	−1.78±0.39	<0.001*	−1.017	−2.551

*Statistically significant. K1: Corneal power of the flat axis, K2: Corneal power of the steep axis, TK: Total keratometry obtained by IOL Master 700, SimK: Simulated K, SD: Standard deviation, LoA: Limits of agreement, EKR: Equivalent keratometer readings, TCRP: Total corneal refractive power, TNP: True net power, IOL: Intraocular lens

Table 2: Comparison of anterior chamber depth, white-to-white distance and the total keratomety readings of the flattest and the steepest axis of the IOL Master 700 with their corresponding variables obtained from Pentacam HR

Parameters	Mean±SD			*P* (paired *t*-test)	Upper LoA	Lower LoA
	Pentacam HR	IOL Master 700	Difference			
SimK1 versus TK1	39.8±2.03	39.46±2.45	0.33±0.53	0.001*	1.385	−0.708
SimK2 versus TK2	40.51±2.2	40.24±2.6	0.27±0.51	0.006*	1.289	−0.735
EKR K1-1mm versus TK1	39.71±2.01	39.46±2.45	0.24±0.86	0.1	1.932	−1.444
EKR K2-1mm versus TK2	40.17±2.04	40.24±2.6	−0.07±0.98	0.6	1.851	−1.994
EKR K1-2mm versus TK1	39.53±2.06	39.46±2.45	0.06±0.77	0.6	1.572	−1.446
EKR K2-2mm versus TK2	40.14±2.11	40.24±2.6	−0.09±0.79	0.4	1.462	−1.657
EKR K1-3mm versus TK1	39.41±2.16	39.46±2.45	−0.05±0.59	0.6	1.102	−1.213
EKR K2-3mm versus TK2	40.01±2.17	40.24±2.6	−0.22±0.65	0.06	1.051	−1.507
EKR K1-4mm versus TK1	39.32±2.22	39.46±2.45	−0.13±0.45	0.1	0.762	−1.04
EKR K2-4mm versus TK2	39.91±2.2	40.24±2.6	−0.33±0.58	0.004*	0.818	−1.482
EKR K1-4.5mm versus TK1	39.31±2.26	39.46±2.45	−0.15±0.4	0.04*	0.641	−0.95
EKR K2-4.5mm versus TK2	39.88±2.25	40.24±2.6	−0.36±0.53	0.001*	0.684	−1.406
TCRP K1 versus TK1	38.75±2.45	39.46±2.45	−0.7±0.43	<0.001*	0.143	−1.563
TCRP K2 versus TK2	39.4±2.54	40.24±2.6	−0.84±0.45	<0.001*	0.046	−1.731
TNP K1-3mm versus TK1	38.38±2.27	39.46±2.45	−1.08±0.48	<0.001*	-0.127	−2.04
TNP K2-3mm versus TK2	39.05±2.36	40.24±2.6	−1.18±0.56	<0.001*	-0.083	−2.291
TNP K1-4mm versus TK1	38.24±2.3	39.46±2.45	−1.21±0.38	<0.001*	-0.466	−1.972
TNP K2-4mm versus TK2	38.88±2.36	40.24±2.6	−1.36±0.41	<0.001*	-0.544	−2.177
ACD (mm)	3.71±0.34	3.67±0.33	0.03±0.02	<0.001*	0.092	−0.023
WTW (mm)	11.95±0.37	12.31±0.34	−0.36±0.12	<0.001*	-0.128	−0.607

*Statistically significant. ACD: Anterior chamber depth, WTW: White-to-white, TK: Total keratometry obtained by IOL Master 700, SD: Standard deviation, LoA: Limits of agreement, K1: Corneal power of the flat axis, K2: Corneal power of the steep axis, SimK: Simulated K, EKR: Equivalent keratometer readings, TCRP: Total corneal refractive power, TNP: True net power, IOL: Intraocular lens

and K1, with −0.02D (95% LoA, 0.622 and −0.654), and greatest for the comparison between TNP K2-4 mm and K2, with −1.78D (95% LoA, −1.017 and −2.551).

Table 2 demonstrates the mean measurements, the *P* value, and the LoA of the comparisons between TK and their corresponding keratometric variables obtained by Pentacam.

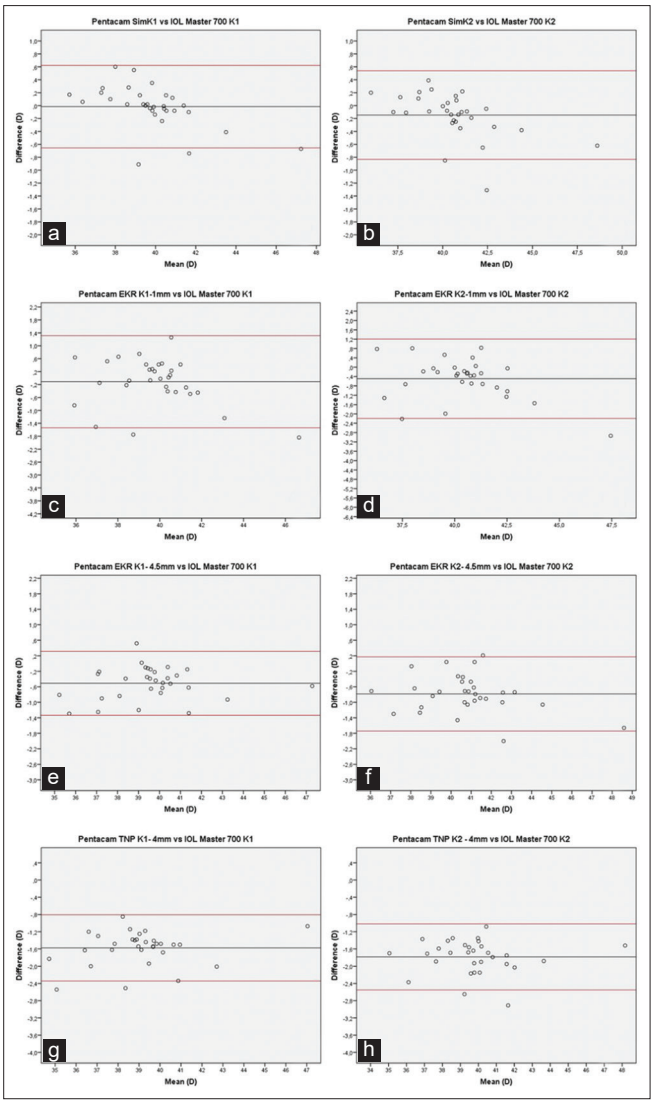

Figure 1: Bland-Altman plots for(a)SimK1 and K1,(b)SimK2 and K2,(c) EKR K1-1mm and K1,(d)EKR K2-1mm and K2,(e)EKR K1-4.5mm and K1,(f)EKR K2-4.5mm and K2,(g)TNP K1-4mm and K1,(h)TNP K2-4mm and K2.The middle line shows the mean difference, the top and bottom red lines show the upper and lower 95%LoA, respectively.The graphs of a and c show a mean difference near 0,implying that the measurements are somewhat comparable.The mean difference was lowest for the comparison in a and greatest for the comparison in h

SimK1 and SimK2 were statistically significantly higher than TK1 and TK2, respectively. However, EKR K1-4.5 mm, EKR K2-4.5 mm, TCRP K1, TCRP K2, TNP K1-3 mm, TNP K2-3 mm, TNP K1-4 mm, and TNP K2-4 mm were significantly lower than their corresponding TKs. No significant difference emerged in any of the other comparisons between the keratometry values as shown in Table 2. Table 2 additionally shows that Pentacam yielded statistically significantly lower mean value for WTW, while it showed statistically significantly higher external ACD.

Figure 2 shows the corresponding Bland–Altman plots for EKR K1-1 mm, EKR K2-1 mm, EKR K1-2 mm, EKR K2-2 mm, EKR K1-3 mm, EKR K2-3 mm, EKR K1-4.5 mm, EKR K2-4.5 mm, TNP K1-4 mm, TNP K2-4 mm, and the corresponding TKs. The plots for the comparison of all the EKR values showed high agreement and narrow 95% LoA, except for the comparison between EKR K1-4.5 mm, EKR K2-4.5 mm, and the TKs. The mean difference regarding the keratometry values was lowest for the comparison between EKR K1-3 mm and TK1, with −0.05D (95% LoA, 1.102 and −1.213), and greatest for the comparison between TNP K2-4 mm and TK2, with −1.36D (95% LoA, −0.544 and −2.177).

Figure 3 demonstrates all the keratometry values of the two devices. It clearly delineates that the standard Ks of IOL Master 700 were higher than any of the other keratometry values obtained from the two devices.

Discussion

Our study was designed to investigate the comparability between the corneal power measurements obtained from IOL Master 700 and the Pentacam HR. To the best of our knowledge, this is the first study to indicate that the two devices generate statistically significant differences regarding these measurements in postrefractive, myopic eyes. The devices agreed only on SimK1 and K1, EKR K1-1 mm and K1, as well as on the comparison between the EKR values along 1-, 2-, 3-mm zone with their corresponding TKs. We also observed that the standard K of the IOL Master 700 was overestimated when compared with TKs.

The need for precise measurements of anterior segment parameters has always promoted the innovation of reliable measurement devices, as well as the evaluation of their interchangeability in clinical practice. There are only a few studies in the literature comparing the corresponding anterior segment characteristics obtained by IOL Master 700 and the Pentacam device. Özyol and Özyol[7] observed lower SimK values along 2.0 mm obtained by Pentacam HR in comparison with standard K obtained by IOL Master 700 in healthy participants. In agreement with their results, Sel *et al*.[8] concluded that mean keratometry values obtained by IOL Master 700 were higher than the keratometry values obtained by Pentacam AXL in patients with no history of refractive surgery. In discordance with the previous studies, Shajari *et al*.,[9] who evaluated the agreement of standard keratometry values when measured with Pentacam AXL, IOL Master 700, and IOL Master 500 in surgically untreated eyes, concluded that the three devices showed no significant differences regarding the parameters that they studied. Asena *et al*.,[10] who assessed the agreement between WaveLight Oculyzer II, which is a Scheimpflug imaging device based on the Pentacam HR technology, IOL Master 500, and IOL Master 700 on untreated eyes, concluded that the standard K2 was statistically significantly higher in IOL Master 700 than the Scheimpflug device. However, none of these four studies evaluated TK or any of the other keratometry values obtained

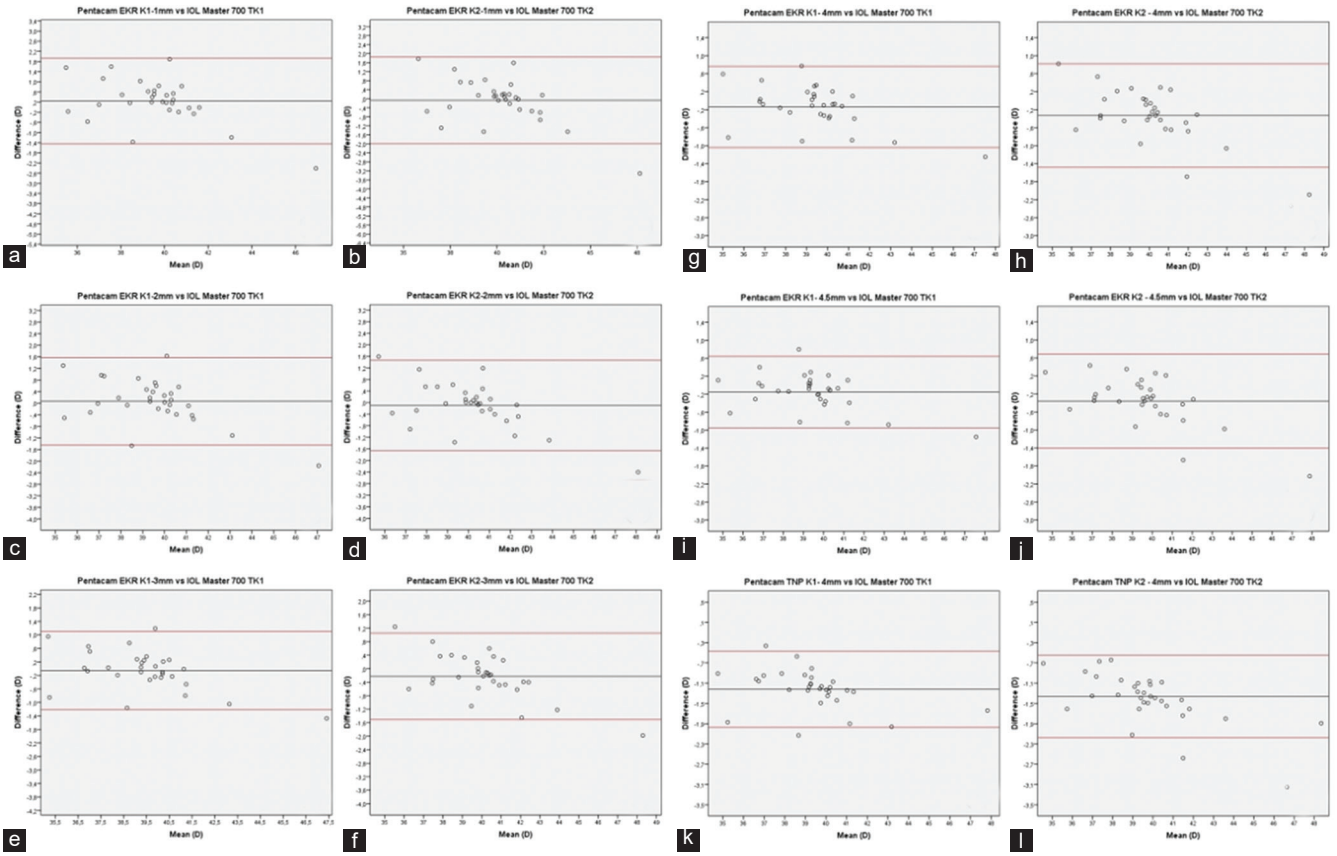

Figure 2: Bland–Altman plots for (a) EKR K1-1 mm and TK1, (b) EKR K2-1 mm and TK2, (c) EKR K1-2 mm and TK1, (d) EKR K2-2 mm and TK2, (e) EKR K1-3 mm and TK1, (f) EKR K2-3mm and TK2, (g) EKR K1-4 mm and TK1, (h) EKR K2-4 mm and TK2, (i) EKR K1-4.5 mm and TK1, (j) EKR K2-4.5 mm and TK2, (k) TNP K1-4 mm and TK1, (l) TNP K2-4 mm and TK2. The middle line shows the mean difference, the top and bottom red lines show the upper and lower 95% LoA. (a-g) The graphs show a mean difference of near 0, implying that the measurements are comparable. K1: Corneal power of the flat axis, K2: Corneal power of the steep axis, TK: Total keratometry obtained by IOL Master 700, LoA: Limits of agreement, EKR: Equivalent keratometer readings, TNP: True net power, IOL: Intraocular lens

from the Pentacam which are influenced by the posterior corneal curvature.

In 2020, Shajari *et al*.[11] additionally evaluated the validity of TK obtained with IOL Master 700 to a Pentacam device in surgically untreated eyes. They compared TK with standard K obtained by IOL Master 700, as well as SimK, TCRP, and TNP; however, they did not find any significant difference between the aforementioned variables, which is in discordance with our postrefractive patients' results.

In our study, K1 values from IOL Master 700 were comparable only with SimK1 and EKR K1–1 mm. A mean difference of 0.02 D was observed between K1 and SimK1 with 95% LoA of 0.622 and −0.654D, whereas K1 and EKR K1-1 mm had a mean difference of 0.11 D and a wider span of 95% LoA (2.851 D). All the other keratometry values were overestimated in IOL Master 700, with the greatest difference concerning the comparison between TNP K2–4 mm and the IOL Master 700 K2 at 1.78 D and 95% LoA, −1.017 and-2.551D. TK values were comparable with EKR K along 1 mm-, 2 mm-, 3 mm-zone. The lowest difference was observed between EKR K1-3 mm and TK1 at 0.05D with 95% LoA,1.102 and-1.213D, whereas the greatest difference was found when TNP K2–4 mm was compared with TK2 at 1.36D and 95% LoA,-0.544 and-2.177D. TK was significantly lower than the corresponding SimK and higher than the corresponding TCRP, TNP along 3-and 4-mm and EKR along 4.5 mm.

The overestimation of the keratometry values obtained by IOL Master 700 could be related to the smaller diameter of the region measured by IOL Master 700 and the difference in the number of data points used to make the calculation. IOL Master 700 provides corneal curvature data obtained from 18 reference points in hexagonal patterns at approximately 1.5, 2.4, and 3.2 mm optical zones around the center of the cornea,[12] whereas the Scheimpflug camera captures 138,000 data points from the whole cornea and calculates the conventional keratometric values from the central 3 mm to zone.[3,10] The posterior curvature of the cornea is directly considered in the algorithm of Scheimpflug imaging;[10] however, the IOL Master 700 calculates TK, which combines telecentric three-zone keratometry and SS-OCT technology to determine the anterior and posterior corneal surface.[13] Standard keratometry relies purely on measurements of the anterior corneal surface,[14]

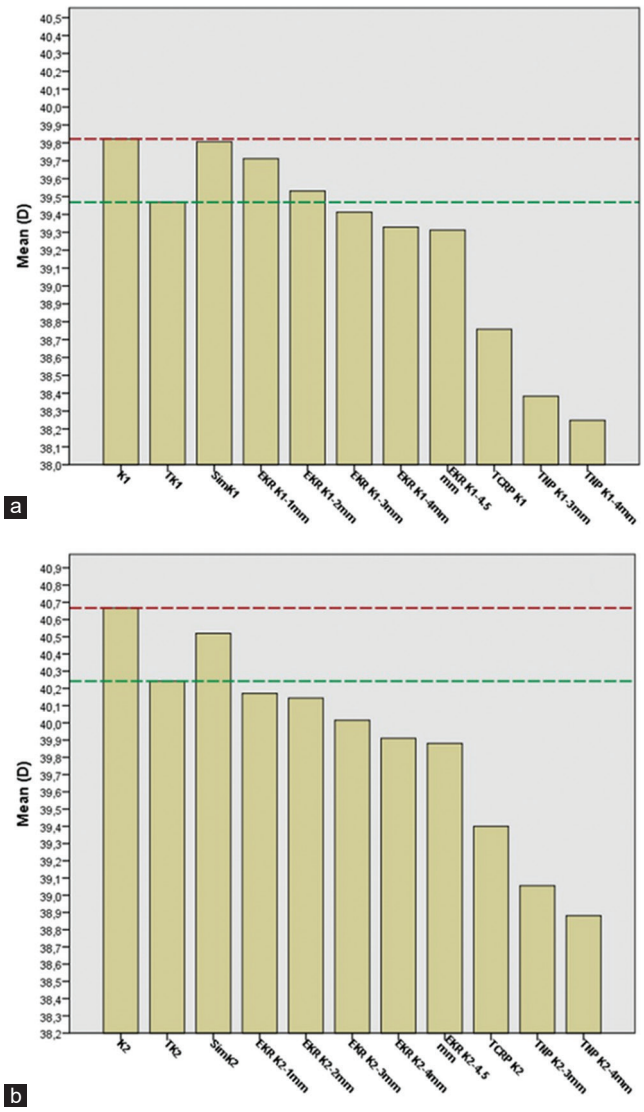

Figure 3: The mean keratometry values of the IOL Master 700 and the Pentacam HR for the (a) flattest and (b) steepest corneal axis. The red, dashed lines represent the mean values of the standard K, while the green dashed lines represent the mean values of the TK of the IOL Master 700. K1: Corneal power of the flat axis, K2: Corneal power of the steep axis, TK: Total keratometry obtained by IOL Master 700, SimK: Simulated K, EKR: Equivalent keratometer readings, TNP: True net power, IOL: Intraocular lens

while both the anterior, the posterior curvature and the corneal thickness contribute to the TK.[13-15] This can be advantageous for patients who need more accurate information about their total corneal power, like our study group of patients whose anatomic relationship between the relative curvature of the anterior and posterior corneal surfaces has changed.[16]

The greatest differences that we observed concerned the comparisons of the keratometry values of the IOL Master 700 with the TNP. That is because the TN*P* values were the lowest values observed regarding both the flat and the steep axis, as this is clearly delineated in Figure 3 and has also been suggested by Potvin and Hill.[16] The TNP K-4 mm was even lower than the TNP K-3 mm. Due to the contribution of the posterior surface, TNP is lower than the value reported by standard keratometry. The deviation between TNP and corneal power, as determined by SimK, becomes even greater when dealing with corneas after excimer laser ablation of the anterior surface. After refractive corneal surgery, it is no longer possible to calculate corneal refractive power based only on the anterior surface, as the ratio between the anterior and posterior radius of the cornea has changed considerably.[17] Accounting for both the anterior and posterior corneal surfaces, TNP may more accurately reflect the actual corneal refractive power than the other K values and is currently being used in the IOL Calculator for eyes with prior myopic Lasik/PRK offered online by the American society of cataract and refractive surgery.[18] The TNP K-4 mm centered on the corneal apex has also been used in a formula suggested by Potvin and Hill[16] to calculate IOL power in postmyopic Lasik eyes which were based on the no-history Shammas postmyopic Lasik formula.

Interestingly, we concluded that TK values were somewhat comparable with EKR along 1, 2, and 3 mm. The precision of EKR for the assessment of total corneal power after refractive surgery remains controversial. It has been reported that EKR is not accurate for the prediction of IOL power in both untreated and postoperative eyes.[19] However, Holladay *et al*.[20] observed that EKR of the 4.5 mm diameter zone yielded the highest correlation when compared with the historical method K-reading in eyes with prior corneal refractive surgery and proposed EKR as an alternative method for measuring the central corneal power before cataract surgery following refractive surgery, in the absence of any corneal refractive surgery data, or when crystalline lens changes are present confounding the exact source of the refractive change. Future studies are needed to clarify the role of EKR in IOL power calculation.

As highlighted above, we observed that the standard K obtained by IOL Master 700 was statistically greater than their corresponding TK. This is in line with the results of Wang *et al*.,[14] who found that in eyes with previous myopic Lasik/PRK, the mean TK was significantly lower than the mean K, while no significant difference between the two variables was observed in eyes with a previous hyperopic Lasik/PRK. On the other hand, as we have already mentioned, Shajari *et al*.[11] compared TK with standard K values of IOL Master 700 in surgically untreated eyes and found no statistically significant difference between the two variables. Similarly, Srivannaboon and Chirapapaisan.[15] compared the refractive outcomes following cataract surgery using K and TK for IOL calculation in eyes with no previous ocular surgery and concluded that the mean difference between them was 0.03 D, with excellent agreement. They also claimed that the refractive outcomes postoperatively when using TK appeared to be slightly better than when using standard K. However, being that TK is derived by combining telecentric keratometry and SS-OCT technology,[13-15] the confidence of its application to current IOL formulas requires validation. Interestingly, the new Barrett TK Universal II formula has been developed to

be used only with this new TK methodology, but the results require further evaluation.[15]

In addition, we observed that WTW measured by the IOL Master 700 was 0.36 ± 0.12 mm greater than the Pentacam measurement. The agreement between the two devices was not clinically acceptable (95% LoA, −0.128 and −0.607 mm). Our data are in accordance with two previous studies,[2,21] which concluded that IOL Master 700 overestimates WTW compared with the Pentacam HR in healthy corneas. The difference that we observed could be attributed to the method each device uses to define the limbus, as well as the quality of the anterior-segment images obtained.[2]

We also concluded that the external ACD measured by Pentacam was 0.03 ± 0.02 mm significantly greater than ACD measured by IOL Master 700 and the 95% LoA was 0.092 and − 0.023, respectively. This finding is in discordance with previous studies describing that ACD measured in untreated corneas did not statistically differ between these two devices.[7,9] On the contrary, Shajari *et al*.[11] concluded that ACD measured by IOL Master 700 in untreated eyes was 0.004 mm greater than ACD measured by a Pentacam device, while in line with our results, Sel *et al*.[8] proved that ACD measured by Pentacam in untreated eyes was 0.04 mm greater than ACD measured by IOL Master 700. However, these mean difference values are too small to have an impact on IOL power calculation as Olsen[22] suggested that every 0.1 mm of erroneous measurements of ACD can result in 0.15 D of refractive error in the spectacle plane. However, newer IOL calculation formulas such as Haigis, Olsen, and Holladay 2 consider the preoperative ACD.[23] Therefore, the role of ACD in correcting the postoperative refractive error deserves further study.

The uniqueness of the current study lies in the fact that this is the only study in the literature evaluating the agreement between IOL Master 700 and Pentacam HR in patients with a previous myopic Lasik/PRK. However, as in any study, there are some potential limitations that deserve comment. One is the relatively small sample size. The other is that we did not classify our cohort according to the surgical technique applied to them (Lasik or PRK). This could possibly lead to differences in their keratometry values and needs to be further studied. In addition, our study was not designed to explore the repeatability and reproducibility of the measurements of each device, which could influence the interpretation of interinstrument agreement. We neither performed a vector analysis nor evaluated corneal astigmatism.

Conclusion

Our results suggest that the Pentacam HR and IOL Master 700 do not show good concordance and cannot be used interchangeably when measuring keratometry values in postrefractive eyes. The optimal keratometry value that should be used for IOL power calculation in these patients should be further studied, as there seem to be great differences regarding the variety of the keratometry values provided by different devices. We also observed significantly higher standard K values compared with TK obtained by IOL Master 700 in our cohort; therefore the clinical significance of TK and its role in IOL power calculation should be further clarified. Future studies, with larger sample size, should additionally compare the keratometric measurements to the postoperative outcome after cataract surgery to evaluate the clinical relevance of the differences that we observed in postrefractive eyes.

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Conflicts of interest

There are no conflicts of interest.

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