Compendium

ZEISS IOLMaster 700

An overview of essential peer-reviewed literature.

Seeing beyond

Compendium ZEISS IOLMaster 700

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1. Swept-source biometry measurements

Click on a title to access

Repeatability of two swept-source optical coherence tomography biometers and one optical low coherence reflectometry biometer

Key takeaway

In this study, the ZEISS IOLMaster 700 showed higher repeatability in K, AL, ACD than Lenstar 900.

Authors

Fisus AD, Hirnschall ND, Ruiss M, Pilwachs C, Georgiev S, Findl O

Journal

Journal of Cataract & Refractive Surgery 2021; 47:1302–1307. **PubMed link**

Methods

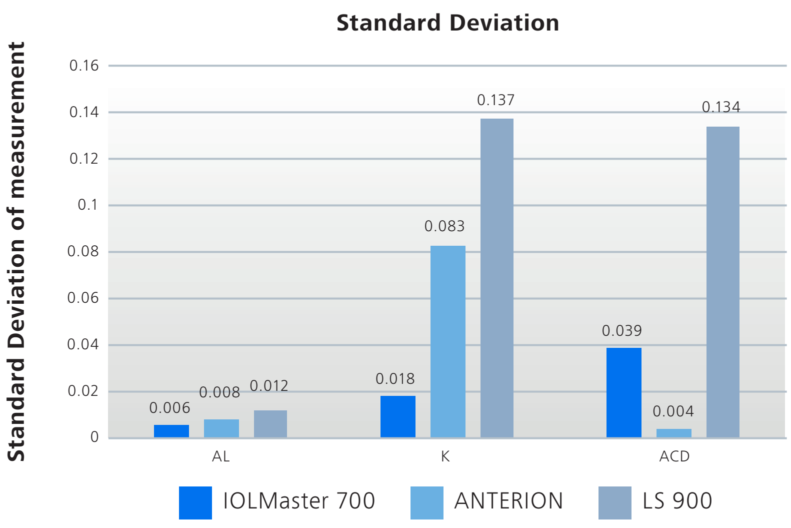
Prospective study of 50 eyes of 50 patients.

Comparison of repeatability of ZEISS IOLMaster 700, Heidelberg Engineering ANTERION, and Haag-Streit Lenstar 900 for axial length (AL), keratometry (K), central corneal thickness (CCT), anterior chamber depth (ACD), lens thickness (LT).

The repeatability was measured as within-subject standard deviation (Sw) and coefficient of variation (CoV)

Study results

- The within-subject standard deviation for mean keratometry was 0.018, 0.083, 0.137 for ZEISS IOLMaster 700, Anterion, and Lenstar 900, respectively.
- For the AL and ACD, the within-subject standard deviation was smaller for the ZEISS IOLMaster 700 and the Anterion.
- Overall, all the biometry devices presented a high repeatability.



Graphic: Within-subject standard deviation of AL, K and ACD of three biometers

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

An evaluation of the IOLMaster 700

Key takeaway

"The repeatability of the IOLMaster 700 for axial measurements matches or exceeds that of the IOLMaster 500 or Lenstar 900."

Authors

Bullimore MA, Slade S, Yoo P, Otani T

Journal

Eye Contact Lens. 2019 Mar;45(2):117-123. **PubMed link**

Methods

Prospective study of 100 eyes of 51 cataract patients and 49 patients with clear lenses.

Comparison of repeatability* and reproducibility* in biometric measurements between: ZEISS IOLMaster 700; Lenstar LS900; and ZEISS IOLMaster 500.

Study results

- Very good agreement in AL between the ZEISS IOLMaster 700, IOLMaster 500, and Lenstar LS900 for CCT and LT.
- Excellent reproducibility of the ZEISS IOLMaster 700 with narrow LoA.
- Better or similar repeatability of the ZEISS IOLMaster 700 compared to the IOLMaster 500 or Lenstar LS900.
- Some differences were noted but not considered clinically meaningful.

Biometry values	ZEISS IOLMaster 700 (Mean ± SD)	ZEISS IOLMaster 500 or LS 900 (Mean ± SD)	Difference (Mean ± SD)	95% CI for Mean Difference	p	95% LoA for Mean Difference
AL (mm)	24.01 ± 1.29	23.99 ± 1.28	+0.03 ± 0.02	+0.02 to +0.03	<0.001	-0.01 to +0.06
ACD (mm)	3.26 ± 0.34	3.27 ± 0.33	-0.01 ± 0.09	-0.03 to +0.02	0.63	-0.18 to +0.17
LT (mm)	4.55 ± 0.39	4.47 ± 0.42	+0.08 ± 0.17	+0.03 to +0.13	0.003	-0.27 to +0.42
CCT (µm)	552 ± 30	548 ± 31	+4.5 ± 4.3	+3.3 to +5.7	<0.001	-4.2 to +13.1
R1 (mm)	7.74 ± 0.25	7.72 ± 0.24	+0.02 ± 0.04	+0.00 to +0.03	0.007	-0.07 to +0.10
R2 (mm)	7.60 ± 0.26	7.58 ± 0.26	+0.02 ± 0.04	+0.01 to +0.03	0.005	-0.06 to +0.09
SE (D)	44.06 ± 1.41	44.15 ± 1.42	-0.09 ± 0.18	-0.14 to -0.04	0.001	-0.44 to +0.27
Astigmatism (D)	-0.83 ± 0.62	-0.83 ± 0.60	+0.00 ± 0.24	-0.07 to +0.07	0.96	-0.49 to +0.49
WTW (mm)	12.1 ± 0.4	12.1 ± 0.4	-0.0 ± 0.1	-0.1 to +0.0	0.60	-0.3 to +0.3

Table: Limits of Agreement (LoA) between the ZEISS IOLMaster 700 and the ZEISS IOLMaster 500 or Lenstar LS900 for cataract eyes (N=50)

*Repeatability (comparing measurements made by the same operator and instrument) and reproducibility (comparing measurements made by different operators and instruments)

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Macular disease detection with a swept-source optical coherence tomography-based biometry device in patients scheduled for cataract surgery*

Key takeaway

"The SS-OCT macular scan is useful information concerning the macula*."

Authors

Hirnschall N, Leisser C, Radda S, Maedel S, Findl O

Journal

Journal of Cataract & Refractive Surgery 2016; 42:530–536. **PubMed link**

Methods

Comparative study of 121 successful macular SD-OCT scans of 121 patients. Because 5 cases were not evaluable, 120 cases were further analyzed.

Patients were measured by the ZEISS IOLMaster 700 and spectral domain OCT device (RTVue). Scans were exported and presented to 3 independent examiners to assess macular disease.

Study results

- Pathological macular findings were observed in the SD-OCT scan in 65 cases (54.2%), whereas 55 cases (45.8%) were found to show a normal macula.
- The sensitivity of the ZEISS IOLMaster 700 was between 42% and 68%, and the specificity was relatively higher between 89% and 98%.
- The ZEISS IOLMaster 700 biometry device was beneficial in terms of detecting macular holes and intraretinal fluid; however, other macular pathologies, such as atrophy and epiretinal membranes, were missed in several cases.

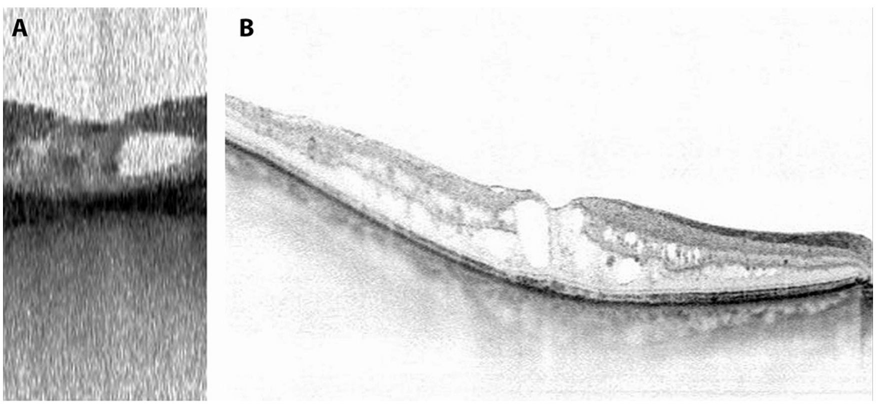


Figure: (A) The biometry device scan (ZEISS IOLMaster 700 with SS-OCT) and (B) the SD-OCT scan in inverted color for intraretinal fluid

*Findings need to be verified and pathologies diagnosed with a dedicated retina OCT or other clinical standard methods.
*Content only for outside the US

2. Speed and dense cataract penetration

Click on a title to access

Enhanced penetration for axial length measurement of eyes with dense cataracts using swept-source optical coherence tomography: A consecutive observational study

Key takeaway

ZEISS IOLMaster 700 SS-OCT improves the rate of AL measurements in eyes with subcapsular and dense nuclear cataracts.

Authors

Hirnschall N, Varsits R, Doeller B, Findl O

Journal

J Ophthalmol Ther. 2018;7(1):119-124.

PubMed link

Methods

1126 eyes of 613 patients were measured 1 week prior to cataract surgery using ZEISS IOLMaster 500 partial coherence interferometry (PCI). The data were analyzed retrospectively. If the SNR of the composite scan (of at least 5 scans) was <2.0, patients were invited to participate in the study and to be measured with the SS-OCT IOL Master 700 by ZEISS.

At maximum of 5 measurements (i.e. 30 scans) were performed with the ZEISS IOLMaster 700. A scan was considered successful if the device was able to give a value for AL.

Study results

- 23 patients were included in the study, 21 of them were measured successfully with SS-OCT technology (21/23; 91.3%). 2 unsuccessful scans in patients with nuclear cataract.
- All patients with posterior subcapsular cataract (PSC) were measured successfully with ZEISS IOLMaster 700.

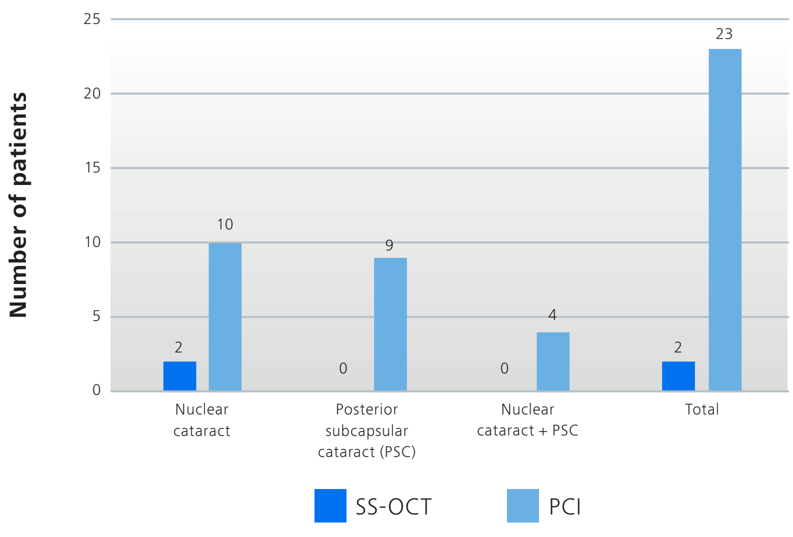


Figure: Reasons that lead to unsuccessful scans using the SS-OCT and the PCI device

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Comparison of agreement and efficiency of a swept-source optical coherence tomography device and an optical low-coherence reflectometry device for biometry measurements during cataract evaluation

Key takeaway

In this study, ZEISS IOLMaster 700 is 73% faster than Lenstar 900.

Authors

Passi SF, Thompson AC, Gupta PK

Journal

OPTH 2018; Volume 12:2245–51.

PubMed link

Methods

Retrospective chart review of biometry measurements that were performed in 64 eyes of 32 patients on the same day. The total image acquisition time per subject was compared between the two machines using a Wilcoxon rank-sum test. Bland-Altman plots showing the mean difference and 95% limits of agreement were graphed.

Patients with significant corneal or retinal pathology which may limit the generalizability of the results of the study were excluded.

Comparison of agreement and speed (both eyes) between ZEISS IOLMaster 700 and Lenstar LS 900.

Study results

- In the study the average measurement time was significantly shorter for the ZEISS IOLMaster 700 compared to the Lenstar LS 900 (44.5±12.4 seconds with the ZEISS IOLMaster 700 vs 168.8±67.2 seconds with the Lenstar 900, P<0.001).
- For all mean AL, ACD, LT, K1, and K2 , was a high degree of agreement between the ZEISS IOLMaster 700 and Lenstar LS 900 (ICCs>0.90).
- No evaluation as to whether the shorter time for image acquisition impacted clinic flow or patient experience was performed.

	ZEISS IOLMaster 700	LENSTAR LS 900	P-value
Mean ± SD (Acquisition time in seconds)	44.5 ± 12.4	168.8 ± 67.2	<0.001

Note: P-value calculated with Wilcoxon signed-rank test.

Table 1: Mean acquisition times of the ZEISS IOLMaster 700 and LENSTAR LS 900

Parameter	ZEISS IOLMaster 700 (Mean ± SD)	LENSTAR LS 900 (Mean ± SD)	Intraclass correlation coefficient (95% confidence interval)
AL (mm)	23.7 ± 1.24	23.7 ± 1.25	0.9999 (0.9998–0.9999)
ACD (mm)	3.14 ± 0.38	3.16 ± 0.38	0.9993 (0.9989–0.9996)
LT (mm)	4.66 ± 0.71	4.52 ± 0.67	0.9571 (0.9268–0.9750)
Flat meridian K1	43.7 ± 1.93	43.7 ± 1.90	0.9922 (0.9869–0.9954)
Steep meridian K2	44.8 ± 1.92	44.8 ± 1.90	0.9926 (0.9874–0.9956)

Table 2: ICCs (intraclass correlation coefficients) between the mean biometry values of the ZEISS IOLMaster 700 and LENSTAR LS 900

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

3. Total Keratometry

Click on a title to access

Accuracy of intraocular lens power calculation based on Total Keratometry in patients with flat and steep corneas

Key takeaway

This study suggests a better trend towards the prediction of residual spherical equivalent with ZEISS IOLMaster 700 TK, sometimes significantly better than with K.

Authors

Qin Y, Liu L, Mao Y, Ding Y, Ye S, Sun A, Wu M

Journal

Am J Ophthalmol. 2023. 11;247: 103-110. **PubMed link**

Methods

Retrospective study of 231 eyes of 231 patients.

- 55 eyes with flat corneas (mean K < 42 D)
- 116 eyes with average corneas (42 D < mean K < 46 D)
- 60 eyes with steep corneas (mean K > 46 D)

Spherical equivalent prediction errors (PE) were calculated for the IOL calculation formulas EVO, Barrett Universal II (BUII), BUII TK, Kane, Haigis, Hoffer Q, SRK/T, and Holladay 1 with keratometry (K) and Total Keratometry (TK). The BUII formula was only used with K, while the BUII TK formula was used with TK.

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Study results

Entire cohort:

- The EVO formula with TK showed the lowest standard deviation (SD) (0.383) and mean absolute error (MAE) (0.30) and the highest percentage of eyes with PE within ±0.5 D.
- Hoffer Q (p= 0.014) and Holladay 1 (p=0.046) using TK had a significantly higher percentages of PEs within ±0.5 D than using K.

Average keratometry group:

- The Kane formula with TK showed the lowest median absolute error (MedAE) (0.21) in the average K group.

Flat keratometry group:

- EVO (p = 0.042), Haigis (p = 0.043), Hoffer Q (p = 0.038), and Holladay 1 (p = 0.013) formulas using K had significantly higher SD than using TK.

Steep keratometry group:

- Hoffer Q (p = 0.036) and SRK/T (p = 0.029) formulas using K had significantly higher SD than using TK.
- Kane with TK showed a significantly (p = 0.046) higher proportion of eyes with PE within ±0.5 D (89.1%) than with K.
- BUII with TK showed the lowest SD, MedAE, and MAE. And The EVO with TK showed the highest percentage of eyes with a PE within ±0.5 D (81.7%).

IOL calculation formula	TK			K		
	MedAE	MAE	Hyperopia, %	MedAE	MAE	Hyperopia, %
EVO	0.25	0.30	48.9	0.25	0.31	49.4
Kane	0.24	0.30	47.6	0.24	0.31	51.1
BUII	0.25	0.31	46.3	0.25	0.32	49.4
Haigis	0.28	0.35	48.9	0.31	0.36	49.4
Hoffer Q	0.36	0.43	48.5	0.36	0.44	50.6
Holladay 1	0.37	0.44	45.9	0.38	0.45	48.5
SRK/T	0.38	0.46	49.8	0.38	0.46	50.2

Table: Prediction errors in the entire cohort for each formula for the TK and K group

Comparison of refractive outcomes using conventional keratometry or Total Keratometry for IOL power calculation in cataract surgery

Key takeaway

In this study, the conventional K and TK for IOL calculation showed strong agreement with a trend towards better refractive outcomes using TK.

Authors

Srivannaboon S, Chirapapaisan C

Journal

Graefe's Archive for Clinical and Experimental Ophthalmology 2019.

PubMed link

Methods

Prospective study of 60 eyes of 60 patients.

The refractive outcomes mean absolute errors (MAEs), median absolute errors (MedAEs), and percentage of eyes within ±0.25, ±0.50, and ±1.00 D of predicted refraction) were compared following cataract surgery of all current standard IOL formulas including SRK/T, HofferQ, Haigis, Holladay 1, Holladay 2, Barrett Universal II (BUII), BUII TK, using conventional keratometry and TK. The BUII TK formula only used TK values.

Study results

- Proportion of eyes within ±0.25, ±0.50, and ±1.00 D of predicted refraction were slightly higher in the TK group. However, differences were not statistically significant.
- Mean difference between K and TK was 0.03 D, showing excellent agreement.
- Emmetropic IOL powers calculated with TK, showed a trend towards lower MAEs and MedAEs.
- The Barrett Universal II TK formula demonstrated the lowest MAEs, with no statistically significance compared to the other formulas.

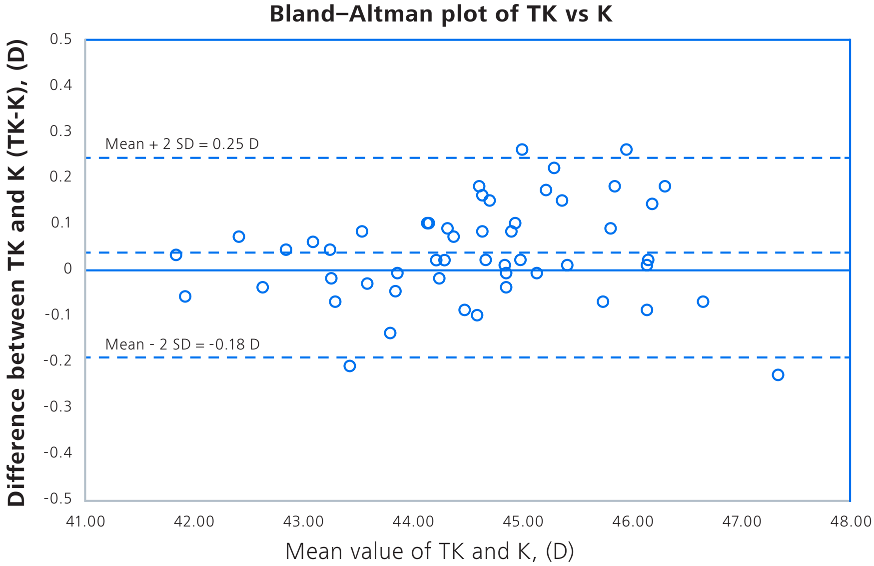


Figure: Agreement between conventional K and TK in normal range of keratometry

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Prediction accuracy of conventional and Total Keratometry for intraocular lens power calculation in femtosecond laser-assisted cataract surgery

Key takeaway

In this study the TK group showed a trend towards a greater proportion of eyes within ± 0.25 D and ± 0.50 D compared to K.

Authors

Ryu S, Jun I, Kim TI, Seo KY, Kim EK

Journal

Sci Rep. 2021 Jun 18;11(1):12869.

PubMed link

Methods

Retrospective study with 91 eyes of 62 patients.

Evaluation of the accuracy of TK and K on 6 IOL formulas (IOL formulas: SRK/T, Hoffer Q, Haigis, Holladay 1, Holladay 2, BUII) in eyes undergoing femtosecond laser-assisted cataract surgery.

Study results

- TK and K exhibit comparable performance for refractive prediction.
- In this study TK and K values exhibit comparable performance in IOL calculations for femtosecond laser-assisted cataract surgery.
- The Barrett Universal II formula yielded the lowest percentage of eyes with a prediction of .5 D in both the TK and K groups when compared with other formulas. Results, however, were not statistically significant.

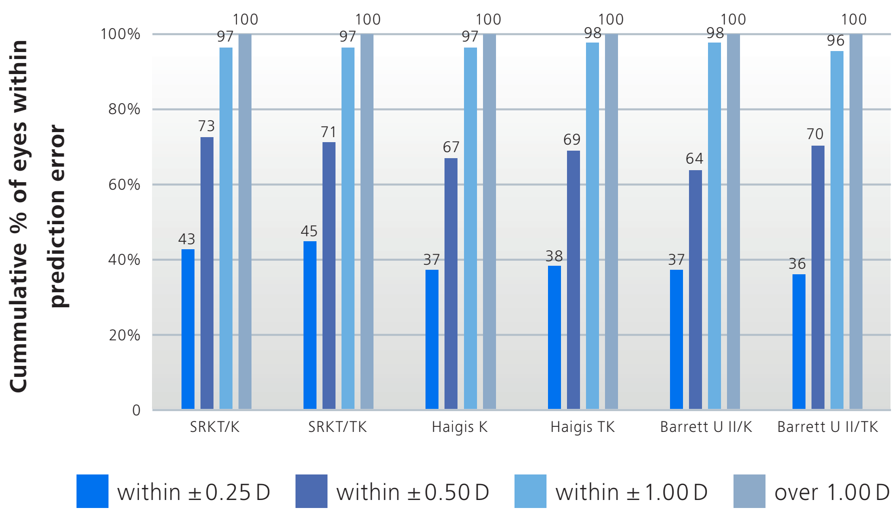


Figure: Histogram comparing the percentages of eyes within ± 0.25 D, ± 0.50 D, ±1.00 D, over 1.00 D of predicted postoperative spherical equivalent refraction (SE) between all formulas using keratometry and TK.

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Comparison of accuracy of a toric calculator with predicted vs. measured posterior corneal astigmatism

Key takeaway

This study suggests that using the Barrett Toric calculator with ZEISS IOLMaster 700 TK leads to lower residual astigmatism than with predicted PCA.

Authors

Wang L, Koch DD

Journal

Journal of Cataract & Refractive Surgery 2023 49(1):p 29-33. **PubMed link**

Methods

Retrospective analysis of 602 eyes implanted with monofocal non-toric IOLs. Biometry, keratometry, and posterior corneal astigmatism (PCA) were measured with the ZEISS IOLMaster 700. The pre- and post-operative data was collected via ZEISS Veracity* Surgical.

As non-toric IOLs were implanted in all eyes, the results are not affected by any effect arising from toric IOL misalignment.

The postoperative residual astigmatism was calculated using both the Barrett Toric formula with predicted PCA and with measured PCA. Astigmatism prediction errors were calculated using vector analysis.

Study results

- The mean cylinder prediction error was significantly ($p<0.05$) lower for the Barrett Toric calculator using measured PCA versus predicted PCA.
- The measured PCA method predicted 5.1% more eyes with a cylinder prediction error ≤ 0.5 D than the predicted PCA method ($p<0.05$).

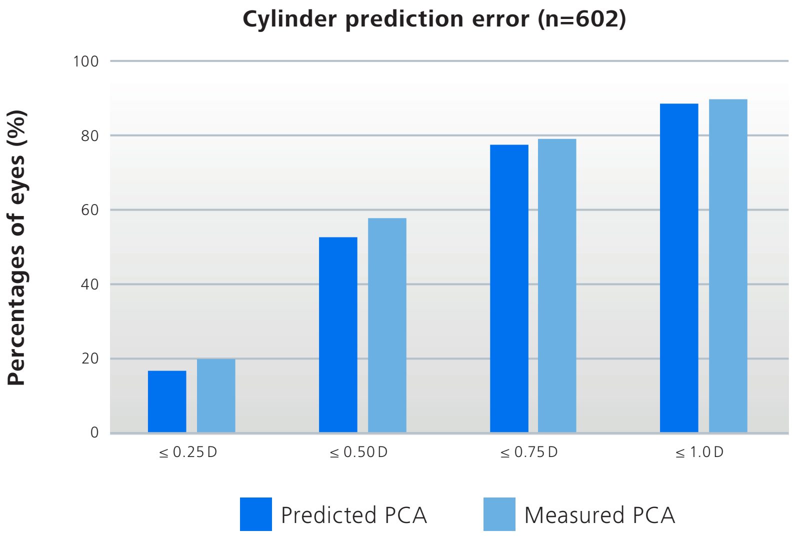


Figure: Percentage of eyes within ±0.25 D, ±0.50 D, ±0.75 D, ±1.00 D of cylinder prediction error

*This product is only available in the US market
(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Prediction accuracy of Total Keratometry compared to standard keratometry using different intraocular lens power formulas

Key takeaway

This study shows 5 percentage points more patients within 0.5D of absolute cylinder prediction error (Barrett Toric TK vs. Barrett Toric K)

Authors

Fabian E, Wehner W

Journal

Journal of Refractive Surgery 2019.

PubMed link

Methods

Post-hoc analysis of study data based on 145 pseudophakic astigmatic eyes implanted with non-toric IOLs.

Absolute prediction error (APE) of spherical equivalent (SE) and cylinder (CYL) was calculated based on K and TK data recorded 6 weeks after IOL implantation.

The IOL formulas included in this study were: Haigis/Haigis-T, Barrett Universal II (BUII), BUII TK, Barrett Toric, Barrett Toric TK. The BUII and Barrett Toric formulas were only used with K values, while the BUII TK and the Barrett Toric TK formulas were used with TK.

Study results

- Absolute prediction error (APE) in CYL was within ±0.50 D in 58% (Haigis from TK) versus 44% (Haigis from K) and 70% (Barrett Toric TK) versus 65% (Barrett Toric K) of eyes.
- Compared to K, mean APE in SE and CYL was lower calculated with TK values.

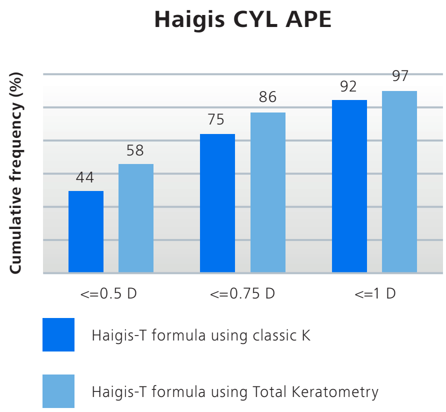


Figure 1: Outcomes of toric IOL calculations with the Haigis-T formula. CYL APE: Absolute prediction error for cylinder: frequency of eyes in respective CYL APE diopter ranges; N=145 eyes.*

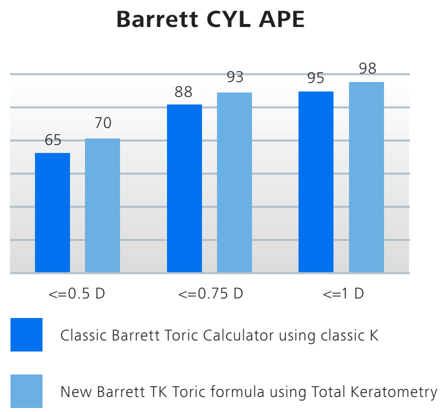


Figure 2: Outcomes of toric IOL calculations with classic Barrett Toric Calculator and the new Barrett TK Toric formula; CYL APE: Absolute prediction error for cylinder: frequency of eyes in respective CYL APE diopter ranges: N=145 eyes.*

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Comparing IOLM700 TK, Berdahl and Hardten astigmatism fix calculator, Barrett Rx formula in managing residual astigmatism due to toric intraocular lens misalignment

Key takeaway

According to this study, TK gives the precise axis of placement for repositioning a toric IOL and can be further supported by CALLISTO eye.

Authors

Sharma AC, Khetan A

Journal

Indian Journal of Ophthalmology: February 2022 - Volume 70 - Issue 2 - p 413-419. **PubMed link**

Methods

Retrospective study: Realigning the misaligned toric IOL in 10 eyes of 10 patients with residual refractive astigmatism after cataract surgery. The alignment was assisted by the image guidance feature of ZEISS CALLISTO eye.

Comparison of the astigmatism reduction using: ZEISS IOLMaster 700 TK steep axis; Berdahl and Hardten (B-H) astigmatism fix calculator; and Barrett Rx formula at days 4, 7/8 and 10/11 post-repositioning.

Study results

- Realigning the toric IOL on the ZEISS IOLMaster 700 steep TK axis with the assistance of ZEISS CALLISTO eye results in a lower residual astigmatism than using the predicted axis of the B-H or Barrett Rx.
- Reduction of astigmatism from 2.00 ± 0.78 D to 0.18 ± 0.12 D (90.5 ± 7.6%) in comparison to the estimated 0.57 ± 0.31 D (68.4 ± 21.9%) by Berdahl and Hardten astigmatism fix and 0.61 ± 0.33 D (66.4 ± 23.5%) by Barrett Rx formula.

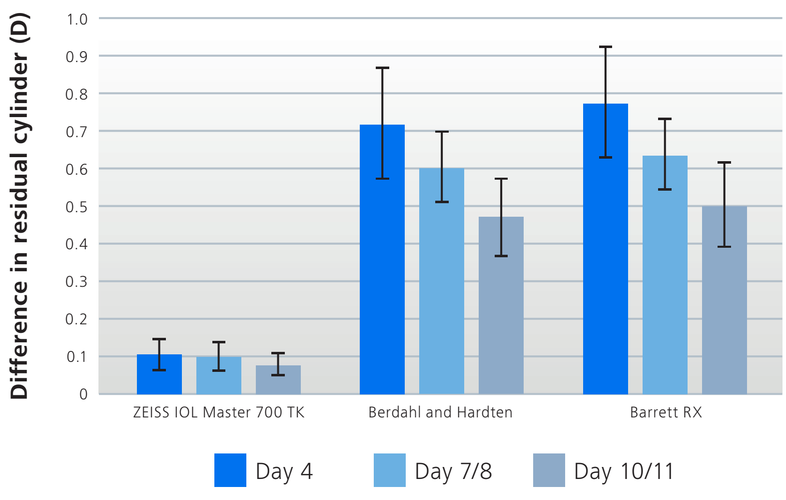


Figure: The difference between the ideal residual cylinder and predicted residual cylinder on repositioning the toric IOL on the axis suggested by the Berdahl and Hardten astigmatism fix calculator (B-H), Barrett Rx formula, and measured steep TK axis of ZEISS IOLMaster 700 at days 4, 7/8, and 10/11 after primary cataract surgery.

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Accuracy of intraocular lens formulas using Total Keratometry in eyes with previous myopic laser refractive surgery

Key takeaway

Barrett True-K, EVO, Haigis formulas with TK tend to improve accuracy of predictions after myopic laser refractive surgery compared to Barrett True-K, Haigis-L, Shammas-PL.

Authors

Yeo TK, Heng WJ, Pek D, Wong J, Fam HB

Journal

Eye 2020. **PubMed link**

Methods

64 eyes of 49 patients with previous myopic laser refractive surgery.

Comparison of prediction error between no history post-laser refractive formulas, and conventional formulas using TK values and Barrett True-K TK.

Study results

- Formulas combined with TK achieve similar or better results compared to existing no-history post-myopic laser refractive surgery formulas.
- EVO TK and Barrett True-K TK achieved the highest proportion of patients with absolute prediction error within 0.50 and 1.00 D (68.75%, 92.19%, and 64.06%, 92.19%, respectively).
- The following comparisons were statistically significant for the mean absolute error:
  - Barrett True-K TK (0.512) vs. Haigis-L (0.671)
  - Barrett True-K TK (0.512) vs. Shammas-PL (0.638)
  - Haigis TK (0.424) vs. Haigis L (0.671)
- Without the use of TK, all formulas had a higher MAE and lower percentage of eyes within 0.5 D of prediction error.

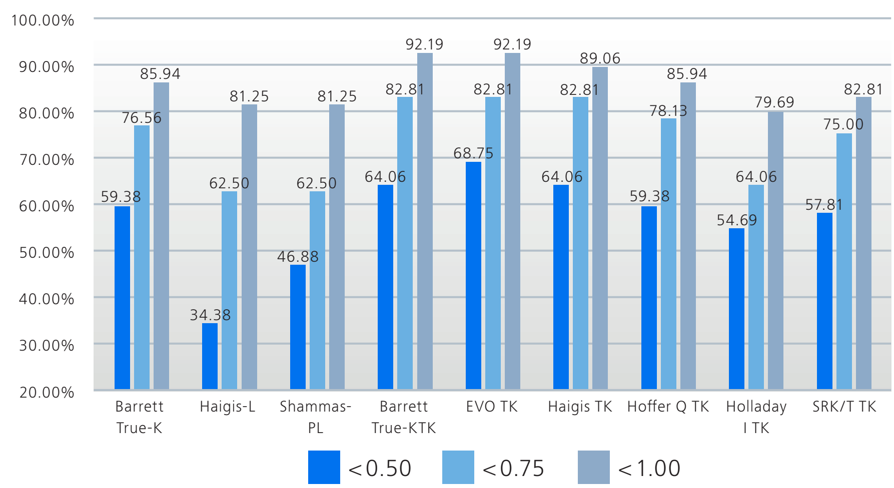


Figure: Percentage of eyes within 0.50 D, 0.75 D, and 1.00 D of absolute prediction error; no-history formulas followed by formulas using TK.

(The figure was created by ZEISS based on the published study results.
A complete presentation of the results can be found in the referenced publication.)

Comparison of corneal power calculation by Standard Keratometry and Total Keratometry in eyes with previous myopic FS-LASIK

Key takeaway

This study suggests that TK can be considered for IOL power calculation after myopic excimer laser surgery.

Authors

Lupardi E, Savini G, Taroni L, Hoffer KJ, Schiano-Lomoriello D

Journal

Journal of Refractive Surgery 2021.

PubMed link

Methods

Prospective study of 25 eyes of 25 patients with previous myopic FemtoLASIK.

The difference between post-LASIK and pre-LASIK K (ΔK) and difference between post-LASIK and pre-LASIK TK (ΔTK) were compared to the ΔSE. (ΔSE = defined as the difference between preoperative target and postoperative cycloplegic refraction SE).

Study results

- The mean ΔK (-3.82 ±1.60 D) revealed a statistically significant underestimation of the laser induced refractive change (p <0.0001), whereas the mean ΔTK (-4.36 ±1.78 D) did not show any significant difference (p = 0.45).
- The difference between the postoperative values of K and TK increased with higher refractive corrections of patients' myopic FemtoLASIK.

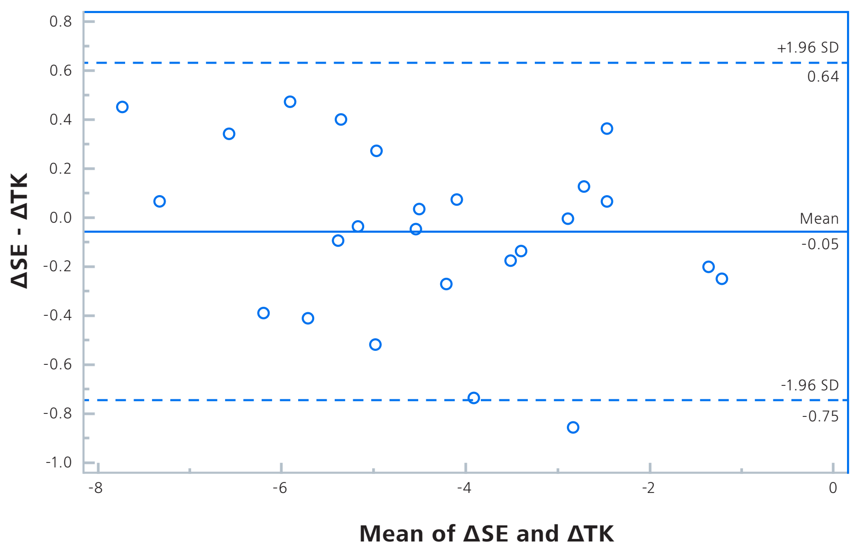


Figure: Bland–Altman plots showing difference between ΔSE and ΔTK

ΔSE: difference between refractive change in spherical equivalent at the corneal plane.

(The figure was created by ZEISS based on the published study results.
A complete presentation of the results can be found in the referenced publication.)

Determining the type of previous laser vision correction using keratometry measurements obtained from an SS-OCT biometer

Key takeaway

TK values can help differentiating whether a patient went through myopic or hyperopic laser vision correction.

Authors

Kamran M. Riaz, David L. Cooke, Jascha A. Wendelstein

Journal

Journal of Cataract & Refractive Surgery 49(4):p 438-439, April 2023.

PubMed link

Methods

Retrospective study from 5 international centers of 547 eyes with known laser vision correction (LVC), myopic LVC (M-LVC) and hyperopic LVC (H-LVC).

The patients were measured with the ZEISS IOLMaster 700 for both TK and K. The difference between the average TK and K values were calculated and associated with the type of the LVC the eye underwent.

Study results

- From retrospective data of 547 eyes, for $TK_{ave} - K_{ave} \leq 0$, the eyes likely had M-LVC (99.6%); for the value in the range between 0 and 0.06, 67.7% of the eyes had M-LVC. For the value > 0.06, the measured eye possibly had H-LVC (93.5%).
- According to the current authors' recommendation: The $TK_{ave} - K_{ave}$ value can be used to define the state of eyes with previous multiple sequential or compensatory LVC undercorrection or overcorrection treatments . If it is < 0, treat as a post-M-LVC cornea; if it is between 0 and 0.06, treat as a non-LVC cornea; if it is > 0.06, treat as post-H-LVC.

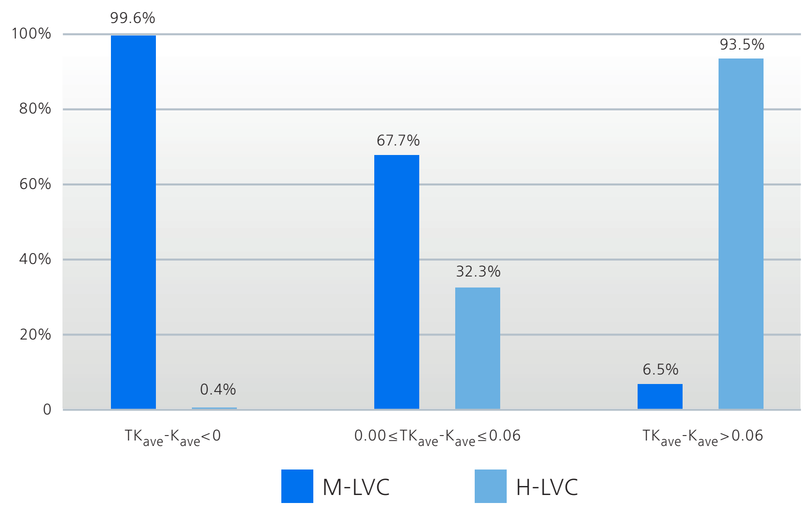


Figure: $TK_{ave} - K_{ave}$ formula application to determine the type of LVC

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

IOL power calculations in keratoconus eyes comparing Keratometry, Total Keratometry, and newer formulae

Key takeaway

TK and PK values can improve refractive accuracy in keratoconus eyes

Authors

Michael T. Heath , Lakshman Mulpuri , Eden Kimiagarov , Raj P. Patel , David A. Murphy , Harry Levine , Rahul S. Tonk , David L. Cooke , Kamran M. Riaz

Journal

American Journal of Ophthalmology, April 2023. **PubMed link**

Methods

Retrospective study of 67 eyes of 67 keratoconus (KCN) patients. IOLMaster 700 with K and TK measurements.
Two subgroups:

- Severe KCN: one meridian >50D (19 eyes)
- Non-severe KCN: both meridians < 50D (52 eyes)

Refractive prediction errors, including root mean square error (RMSE), were calculated for 13 formulas: SRK/T, Holladay 1, Haigis, Hoffer Q, Barrett Universal II (BUII), Kane, EVO 2.0, K6, and Pearl-DGS, BUII KCN with measured PCA (M-PCA), BUII with predicted PCA (P-PCA), Kane KCN, Holladay 1 with equivalent keratometry reading (EKR).

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

* referred to as Barrett II Universal True-K Keratoconus M-PCA in the paper

** referred to as Barrett II Universal True-K Keratoconus P-PCA in the paper

Study results

- In the study, the KCN formulas had the lowest RMSE.
- BUII KCN M-PCA was statistically superior to the BUII KCN P-PCA (p=0.003) and Kane KCN (p=0.021).
- In the subgroup "severe" KCN eyes, the top-ranked KCN formula (BUII KCN: M-PCA) analyzed by mean errors was superior to the top-ranked non-KCN-specific formula with TK (SRK/T (TK)) (p = 0.017) and with K values (SRK/T K) (p=0.04).
- In the subgroup "non-severe" KCN eyes, no statistically significant differences between BUII KCN: M-PCA, EVO TK, and EVO K were observed.

KCN eyes (K: mean = 45.59 +/– 3.88 D; from 35.43 to 53.6 D; with 18 eyes > 50 D) n = 67			
IOL calculation formula	**MAE**	**RMSE**	**% +/– 1.0 D**
Barrett True-K KCN (**TK**)*	0.779	1.043	**74.6%**
Barrett True-K KCN (K)**	0.834	1.147	64.2%
Barrett Univ. II (**TK**)	0.864	1.207	**67.2%**
Barrett Univ. II (K)	0.905	1.298	62.7%
EVO 2.0 (**TK**)	0.799	1.141	**68.7%**
EVO 2.0 (K)	0.833	1.219	65.7%
Kane KCN (K)	0.844	1.170	70.1%
Kane (**TK**)	0.848	1.186	**68.7%**
Kane (K)	0.884	1.268	64.2%
Cooke K6 (**TK**)	0.868	1.208	**65.7%**
Cooke K6 (K)	0.895	1.289	62.7%
Pearl DGS (**TK**)	0.885	1.233	**65.7%**
Pearl DGS (K)	0.925	1.305	67.2%
SRK/T (**TK**)	0.932	1.258	**61.2%**
SRK/T (K)	0.956	1.322	59.7%
Holladay 1 (**TK**)	0.987	1.354	**56.7%**
Holladay 1 (K)	1.043	1.460	58.2%
Haigis (**TK**)	0.967	1.355	**65.7%**
Haigis (K)	1.022	1.439	65.7%
Hoffer Q (**TK**)	1.084	1.451	**55.2%**
Hoffer Q (K)	1.144	1.541	53.7%

Table: Refractive prediction errors from 67 eyes of 67 patients for unilateral analysis. Keratoconus-specific formulas are shaded light gray. Excerpt from original. For the complete table/figure, please refer to the publication.

4. Markerless astigmatism management

Click on a title to access

Toric outcomes: Computer-assisted registration versus intraoperative aberrometry

Key takeaway

In this study, the use of ZEISS CALLISTO eye markerless yield less remaining refractive cylinder than toric IOL placement guided by intra-operative aberrometry.

Authors

Solomon JD, Ladas J.

Journal

J Cataract Refract Surg. 2017;43(4):498-504. **PubMed link**

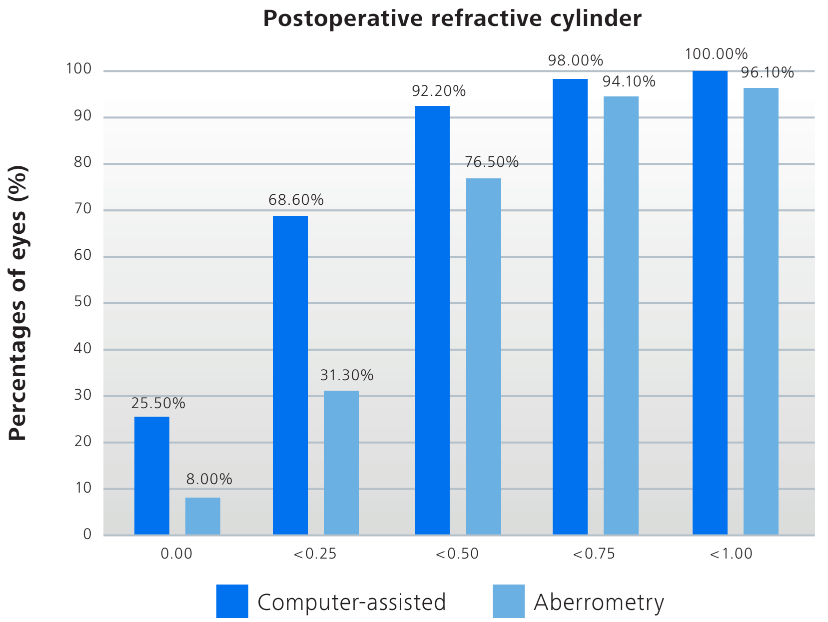
Methods

Prospective study of 104 eyes of 52 patients.

Comparison of refractive outcomes of intraoperative computer-assisted registration and intraoperative aberrometry.

Study results

- Median absolute error in predicting cylindrical correction is 0.35D with ZEISS CALLISTO eye and 0.39D with ORA (P=0.91).
- More than double the number of patients < 0.25D post-op cylinder with ZEISS CALLISTO eye compared with ORA.
- Mean residual refractive astigmatism was significantly different
  0.29 ± 0.22 D with ZEISS CALLISTO eye,
  0.46 ± 0.25 D in Group 2 (P = .0003).



Distribution of postoperative magnitude of refractive cylinder.

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

Comparison of visual outcomes, alignment accuracy, and surgical time between 2 methods of corneal marking for toric intraocular lens implantation

Key takeaway

ZEISS CALLISTO eye provided significantly lower toric IOL misalignment, better refractive outcomes, and significantly shortened surgical time compared with manual marking techniques.

Authors

Mayer WJ, Kreutzer T, Dirisamer M, et al.

Journal

J Cataract Refract Surg. 2017; 43(10):1281-1286. **PubMed link**

Methods

Prospective comparative study of 57 eyes of 29 patients.

All patients went through an ophthalmologic examination preoperatively, including optical coherence tomography (OCT)–assisted biometry by ZEISS IOLMaster 700.

Evaluation of the efficiency of ZEISS markerless workflow CALLISTO eye compared with manual marking techniques for toric IOL.

Study results

- Mean toric IOL misalignment from intended target axis is significantly better at the 3-month visit with ZEISS CALLISTO eye: 2.0°+/- 1.86 vs. 3.4° +/-2.37° with manual marking (P= 0.026)
- Mean overall surgery process time was significantly reduced by > 6 minutes with ZEISS CALLISTO eye (727.2 +/- 198.4 seconds versus 1110.0 +/- 382.2 seconds; P < .001)

Technique	Mean (Seconds) ± SD		P value
	Digital marking group (n=29)	Manual marking group (n=28)	
Preoperative			<0.001
Bubble marking instrument			
Marker assembling	-	31.6 ± 8.6	
Horizontal 0* axis marking	-	61.4 ± 9.4	
Computer-assisted marker system			
Import biometry data from forum, including patient activation	11.6 ± 2.8	-	
Reference image matching	16.3 ± 5.8	-	
Intraoperative			<0.001
IOL alignment	37.2 ± 11.9	59.4 ± 15.3	
Manual toric axis control measurement (n)	Not necessary	2.7 ± 0.6	
IOL realignment after manual toric axis control	Not necessary	38.9 ± 16.4	

Table. Between-group comparison of time to complete surgical procedures

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)

5. Central Topography

Click on a title to access

Comparison of central topographic maps from a swept-source OCT biometer and a Placido disk-dual Scheimpflug tomographer

Key takeaway

In this study, ZEISS IOLMaster 700 with Central Topography*
provided similar overall shape and comparable symmetries to predicate topography maps in most cases.

Authors

Wang L, Canedo ALC, Wang Y, Xie KC, Koch DD.

Journal

Journal Cataract Refract Surg. 2020; October. **PubMed link**

Methods

Prospective comparative case series of 105 eyes with various corneal conditions.
Comparison between ZEISS IOLMaster 700 Central Topography (CT) with predicate topographic (PT) maps from Galilei Placido disk–dual Scheimpflug tomographer.

Three observers compared the CT and PT maps and answered a questionnaire for each eye. The questionnaire focused on the overall shape similarity between CT and PT and the decision-making for premium IOL implantation based on CT and PT.

Study results

- Comparing CT and PT in the same zone: Similar shape was observed in 68.6% to 89.5% of cases, and comparable map symmetries were reported in 60.0% to 83.8%.
- There were significant interobserver agreements among 3 observers for decision regarding premium IOL implantation.
- Same decision for premium IOL selection was made based on ZEISS IOLMaster 700 CT and the Placido device was made in 75.2% to 97.1% of cases.
- Peripheral corneal steeping or flattening was the primary finding that was visible on PT but not on CT.

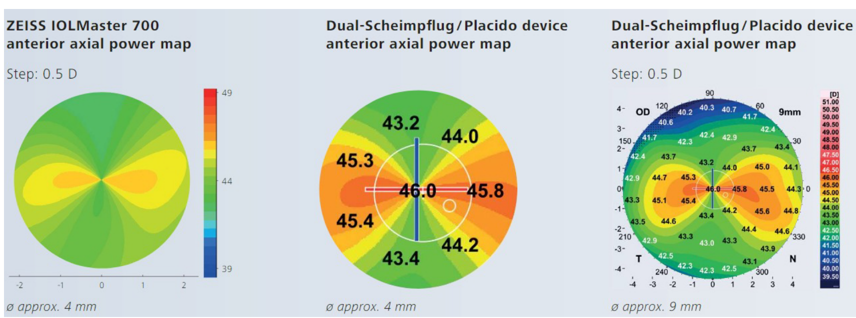


Figure: Comparison of Central Topography (left) to predicate topography from Placido-dual-Scheimpflug Topographer (right) in a sample case (Case 3: Astigamatism against the rule, ZEISS IOLMaster 700 Central Topography Compendium)

*Central Topography does not replace a full topography. For any further diagnosis please use a topographer such as the ZEISS Atlas topographer.

Acquisition time for swept-source optical biometry plus corneal power measurement during cataract evaluation

Key takeaway

The ZEISS IOLMaster 700 with CT* is 3 times faster than the use of a corneal topographer combined with the ZEISS IOLMaster 700.

Authors

Ruiz-Mesa R, Ruiz-Santos M,
Blanch-Ruiz J, Jiménez-Nieto A.

Journal

Clin Ophthalmol. 2022;16:661-668.
PubMed link

Methods

Prospective observational of 96 eyes of 96 cataracts patients.
Comparison of acquisition time for one complete measurement using: ZEISS IOLMaster 700 with Central Topography (CT); Standard IOLMaster 700 (without CT); Standard IOLMaster 700 + Cassini; Standard IOLMaster 700 + Pentacam HR.
Additionally, the agreement between Keratometry (K), Total Keratometry (TK), equivalent K reading (EKR) parameters using the three devices was performed.

Study results

- ZEISS IOLMaster 700 with Central Topography is statistically faster than ZEISS IOLMaster 700 combined with Cassini or Pentacam ($p<0.001$).
- CT did not significantly increase the acquisition time of the ZEISS IOLMaster ($p=0.501$).
- The lowest mean differences in agreement were found for the comparison between the ZEISS IOLMaster 700 and Cassini in the parameters of K, TK, EKR.
- For all possible comparison, the post hoc Tukey's test showed statistically significant differences for all possible comparisons ($p < 0.001$) except for the comparison between the ZEISS IOLMaster 700 and the Cassini for K, TK, and EKR ($p > 0.05$).

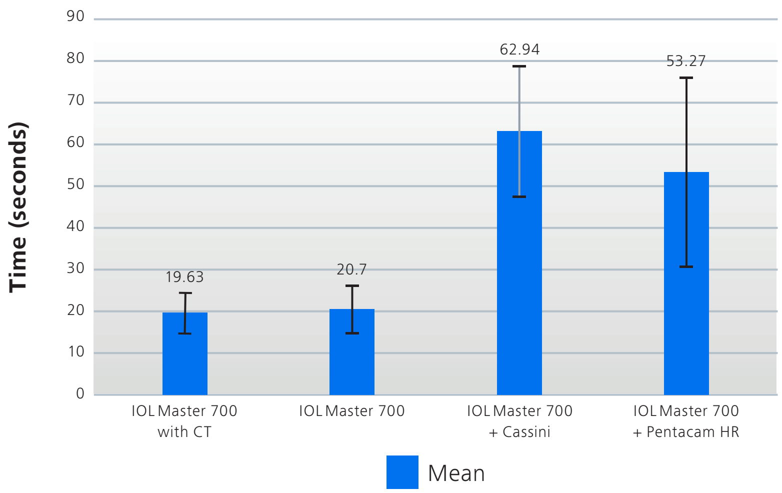


Figure: Mean acquisition time for the different devices

(The figure was created by ZEISS based on the published study results. A complete presentation of the results can be found in the referenced publication.)
This study has been funded by an IIT Grant from Carl Zeiss (ESP-000101). Carl Zeiss did not have any role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
*Central Topography does not replace a full topography. For any further diagnosis please use a topographer such as the ZEISS Atlas topographer.

Abbreviations

ACD: anterior chamber depth
AL: axial length
BUII: Barrett Universal II
CCT: central corneal thickness
CI: confidence interval
CoV: coefficient of variation
CP: corneal power
CT: Central Topography
Cyl: cylinder
D: diopter
EKR: equivalent K reading
H-LVC: Hyperopic laser vision correction
Kave: average keratometry values
ICC: intraclass correlation coefficients
IOL: intraocular lens
K: keratometry
KCN: keratoconus
LoA: limits of agreement
LT: lens thickness
LVC: laser vision correction
MNE: mean numerical error
M-LVC: myopic laser vision correction
MAE: mean absolute error
MedAE: median absolute error
OCT: optical coherence tomography
OLCR: optical low-coherence reflectometry
PCA: posterior corneal astigmatism
PCI: partial coherence interferometry
PE: prediction error
PRK: photorefractive keratectomy
PSC: posterior subcapsular cataract
PT: predicate topographic
RK: radial keratotomy
RMSE: root mean square error
RPE: refractive prediction error
SD-OCT: spectral domain optical coherence tomography
SE: spherical equivalent
SNR: signal-to-noise-ratio
SS-OCT: swept source optical coherence tomography
Sw: Within subject standard deviation
TK: Total Keratometry
TKave: average total keratometry values
WTW: white to white

CE 0297

IOLMaster 700

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