Getting Fewer Refractive Surprises.

ZEISS IOLMaster 700

2022-11-10

Camilla Arnesson
Regional Sales Manager Nordics

- **IOLMaster 500**

- **IOLMaster 700**

Picture source: Carl Zeiss Meditec Media Database

Defining biometry for 20 years – ZEISS IOL Master

History of Optical Biometry

Passion & Commitment

Since 1999 ZEISS has

- Performed >800.000 simulated biometry test measurements
- Invested >1 million hours of development
- Released >50 software versions

Innovative Strengths

Key Innovations ZEISS IOLMaster

- Telecentric Keratometry Automatic Measurement
- Composite Signals
- On-board post refractive surgery calculation
- First fully integrated markerless toric workflow

Key Innovations ZEISS IOLMaster 700

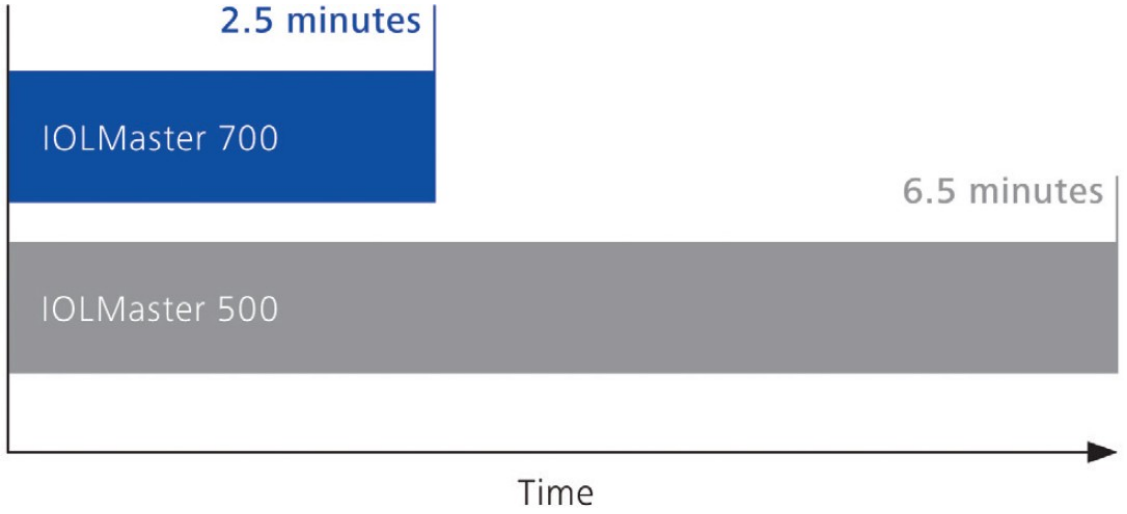
- First SWEPT Source Biometry®
- Unique fixation check
- Patented Cornea-to-Retina Scan
- Up to 99% cataract penetration rate
- On-board toric IOL calculation
- Total Keratometry (TK®)
- Central Topography

Technology and Benefits
Speed and Precision

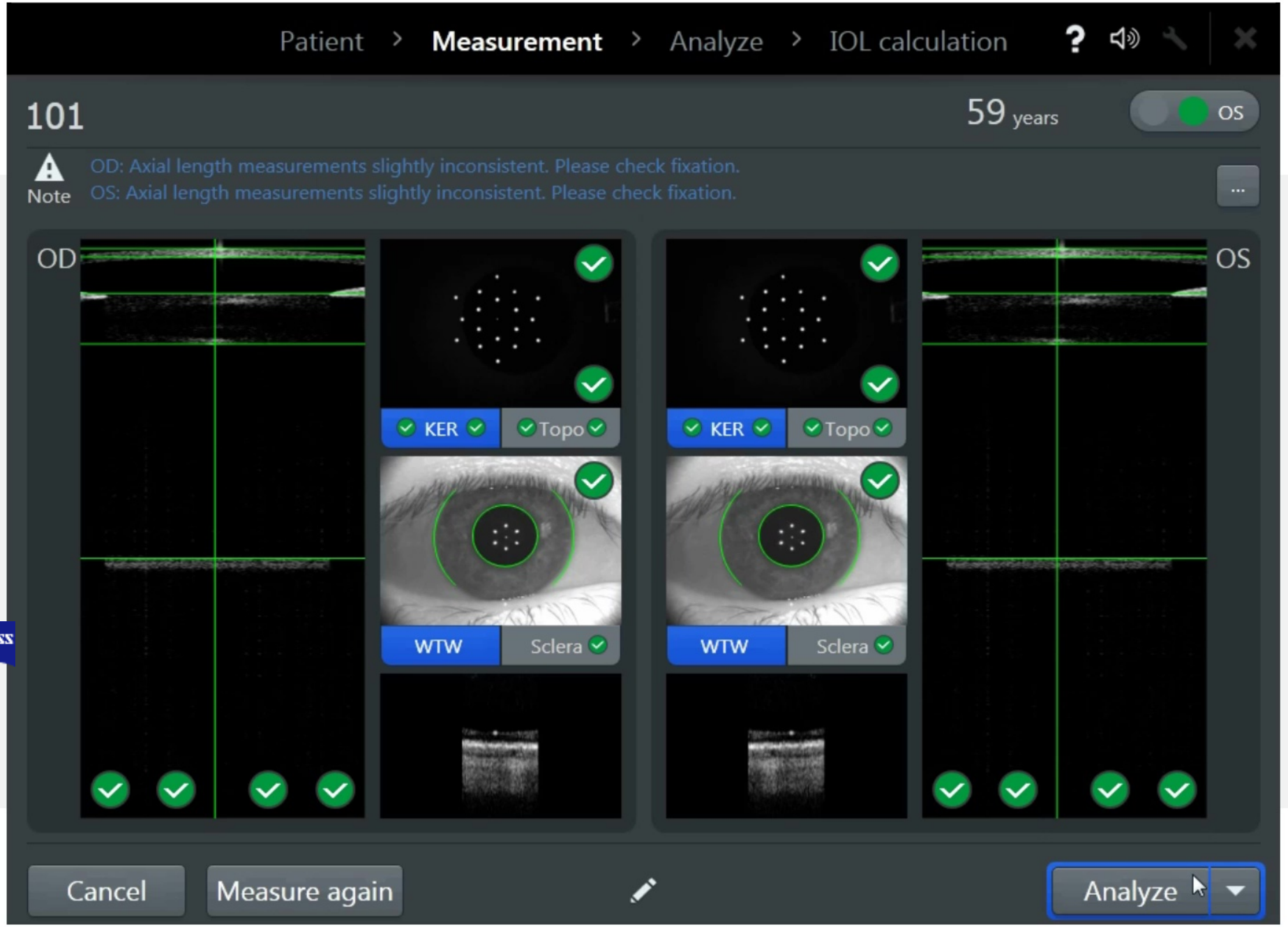
This case study gives indication that ZEISS IOLMaster 700 cuts tech time by 60%.

Singh, CRSTE 2017

- 42 patients.
- ZEISS IOLMaster 500 vs, ZEISS IOLMaster 700
- Biometry from time the technician began entering data into the computer and instructing patients until the technician completed the scan on the second eye.



Singh, IP, *Saving 5 Minutes Per Cataract Patient with SWEPT Source Biometry. CRSTE 2017*

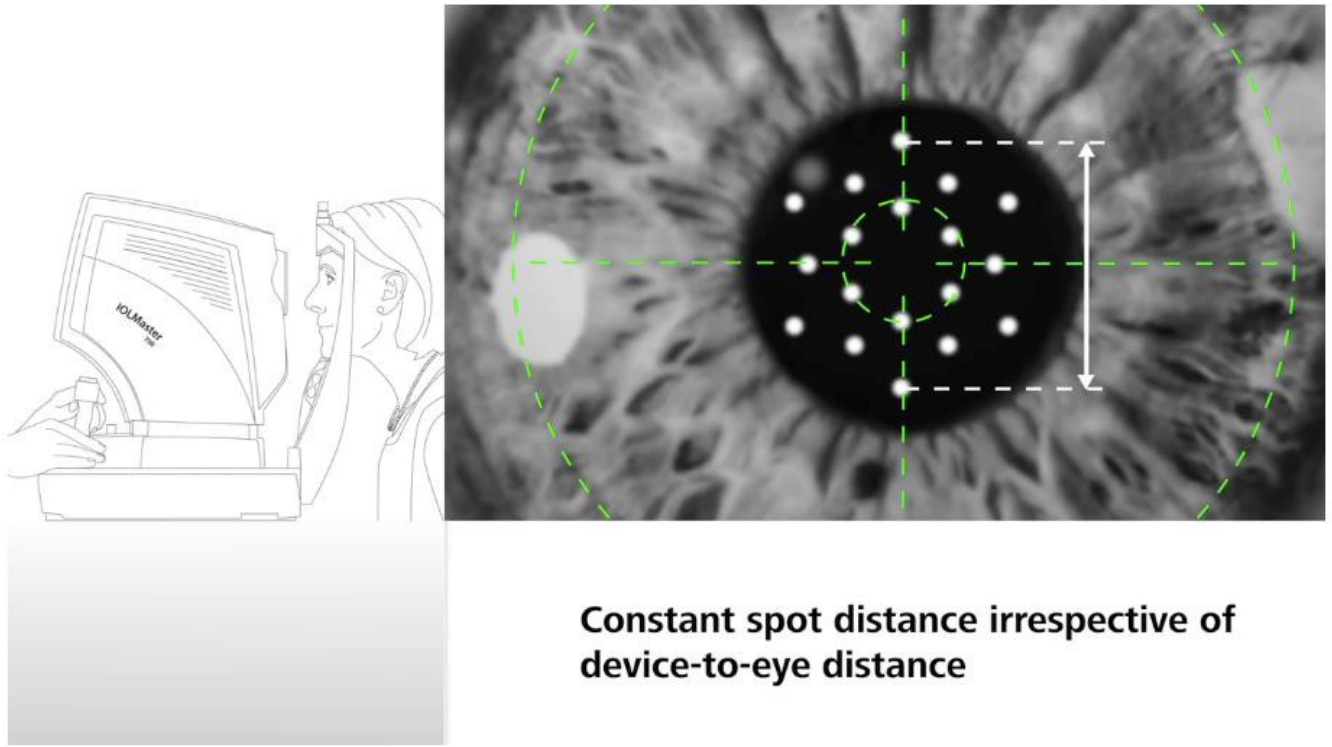


- Check quality of measurements in the **'Quality check'** screen.
- Check quality of Central Topography maps by tapping on 'Topo'.
- Refer to the *IOLMaster 700_Plausability & Quality Check Guide_EN_32_012_0030I* for further information on evaluation of measurements.

Technology and Benefits Overview

ZEISS IOLMaster 700 with 3-zone telecentric keratometry

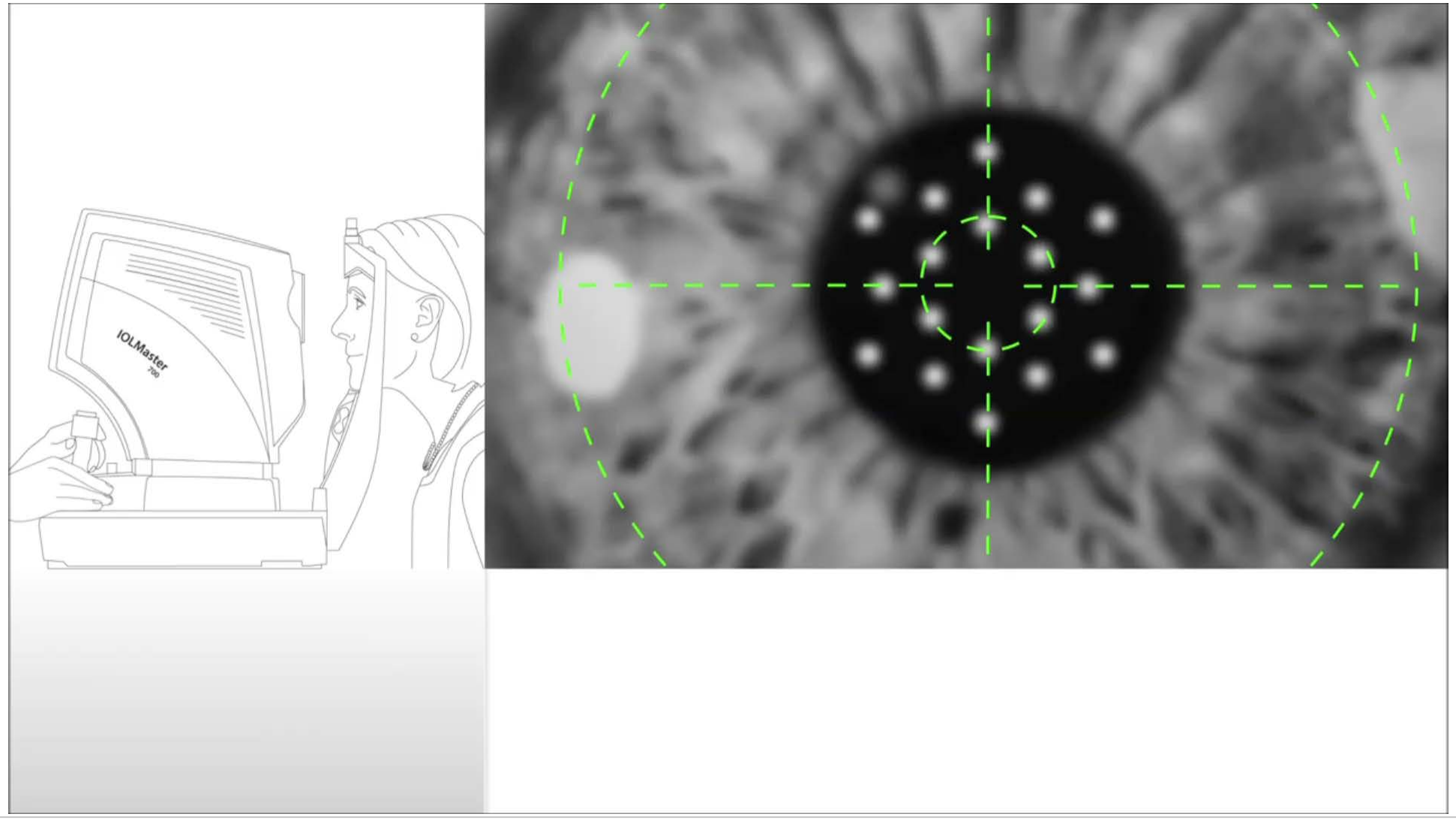
- Distance-independent Telecentric Keratometry
- Utilizes 18 telecentric points
- Shows excellent agreement with manual keratometry while achieving higher precision



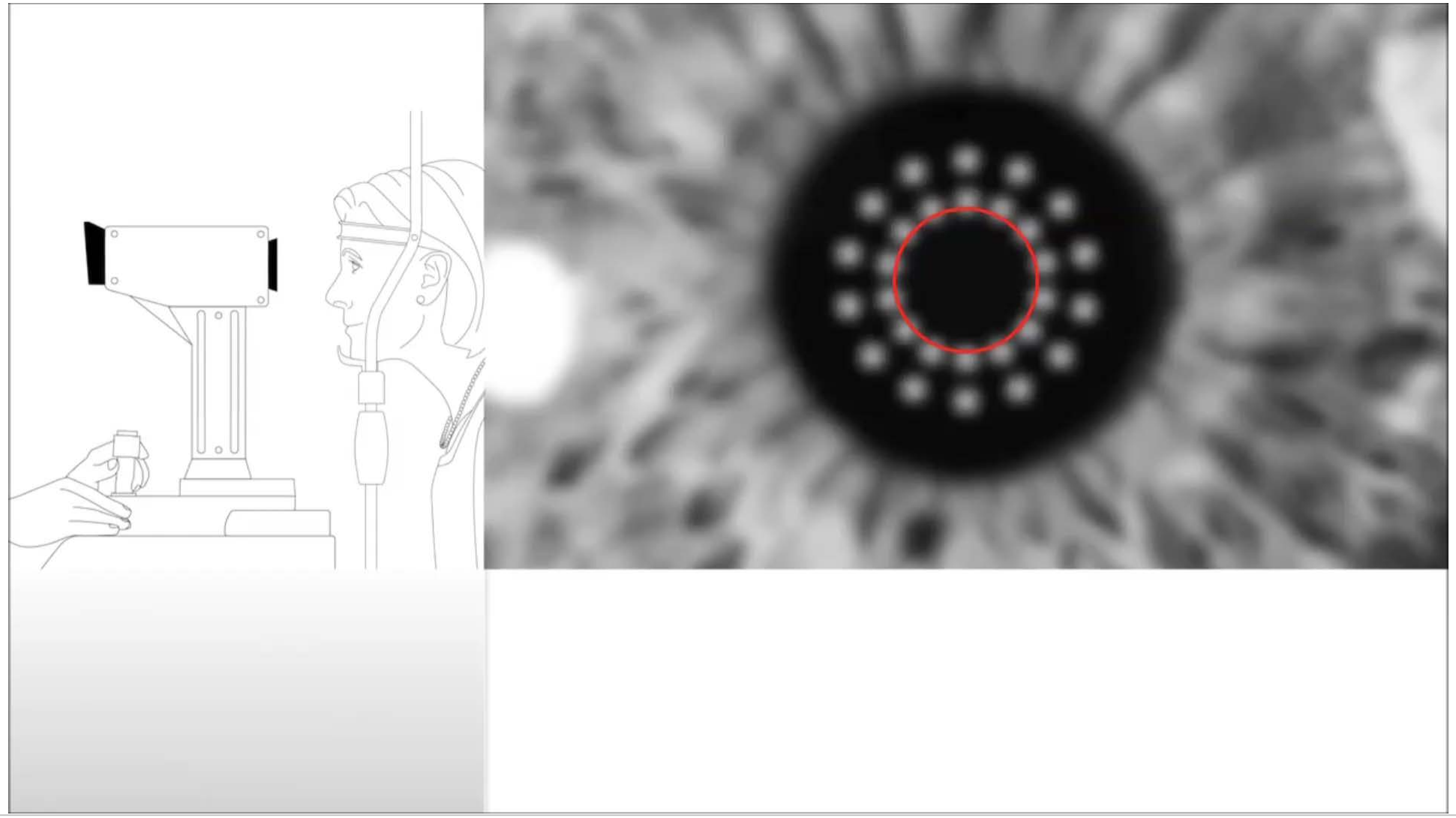
Constant spot distance irrespective of device-to-eye distance

Shirayama M, Wang L, Weikert MP, Koch DD. *Comparison of corneal powers obtained from 4 different devices. Am J Ophthalmol. 2009*

3-zone telecentric keratometry



3-zone telecentric keratometry

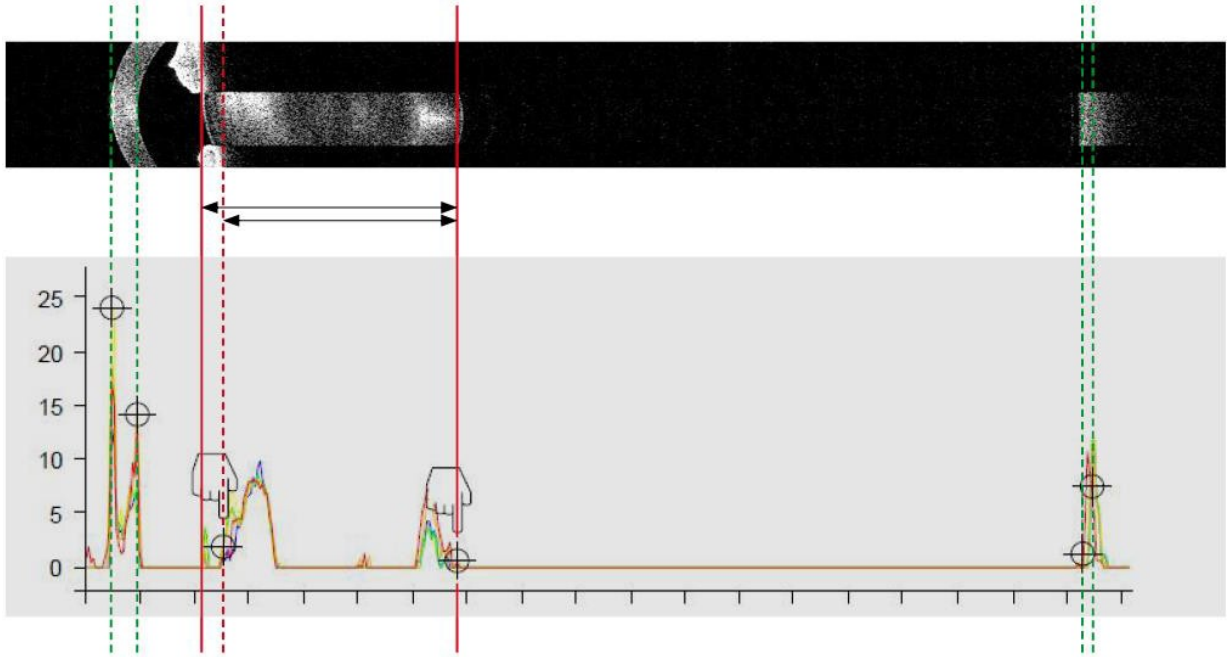


Technology and Benefits Overview

SWEPT Source Biometry Measurements

Biometry measurements are based on SWEPT SOURCE OCT images

- Complex interpretation of graphs become obsolete
- Sources of errors caused by incorrect measurements and leading to refractive surprises can be eliminated



Technology and Benefits Overview

SWEPT Source Biometry Measurements

SWEPT Source Biometry

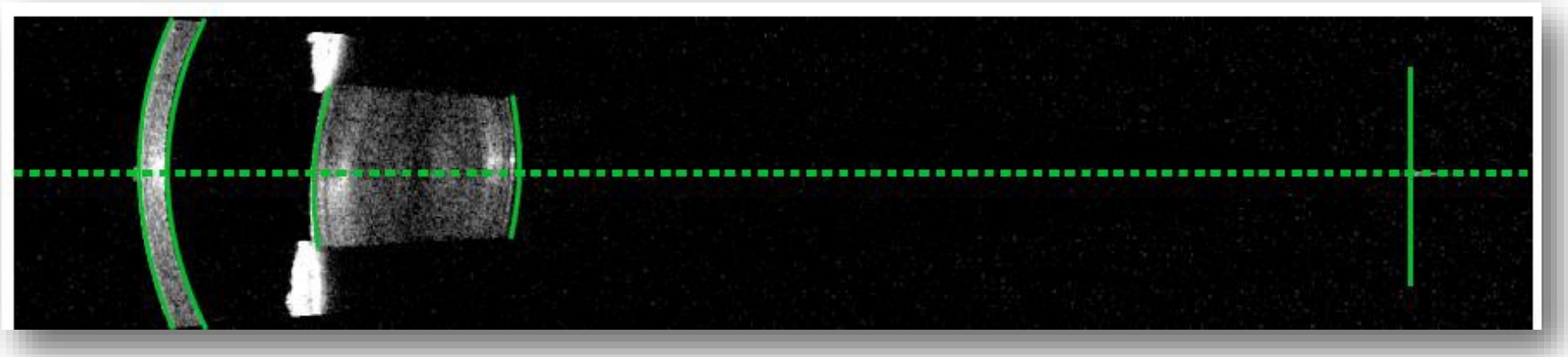
Scan depth:	44 mm
Scan width:	6 mm
Fixation check width:	~1 mm (on retina)
Resolution in tissue:	22 µm
Speed:	2,000 scans/s

Standard Deviation of Repeatability

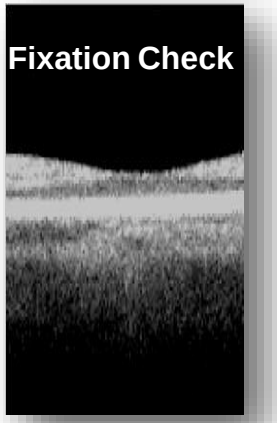
Central cornel thickness	±2 µm
Anterior chamber depth	±10 µm
Lens thickness	±19 µm
Axial length measurement	±9 µm
Keratometry (SE)	±0.07 D

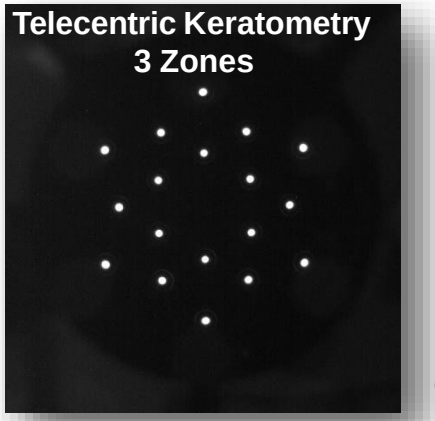
Technology and Benefits Overview

SWEPT Source Biometry



SWEPT Source Biometry® facilitates a Full-Length OCT Scan for visually verifying measurements and detecting unusual eye geometries





Fixation Check and Telecentric Keratometry for robust measurements

Date

Patient	Cölestin Cecile		
Date of birth	1/17/1954	Gender	Female
Patient ID	000000014		
Physician	Surgeon	Operator	Surgeon

Date of calibration test: by: Result:
Date of measurement: 3/1/2016 n: 1.3375 CVD: 12.00 mm

!

OD right

Analyze

Eye status

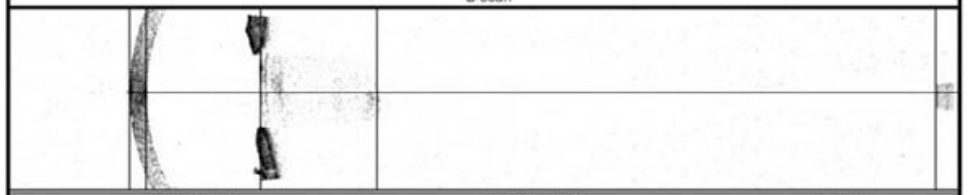
LS: Phakic
Ref: -2.25 D -0.75 D @ 34°
VS: Vitreous body
VA: 20/25
LVC: LASIK

Biometric values

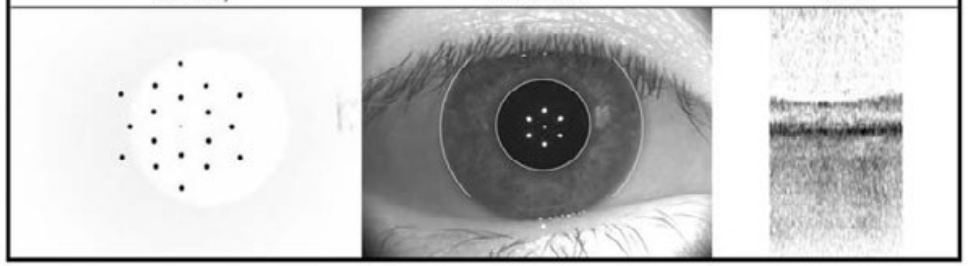
AL:	25.24 mm	SD:	5 µm	WTW: 11.3 mm	lx: +0.2 mm ly: +0.0 mm
CCT:	489 µm	SD:	7 µm	P: 5.2 mm	CW-Chord: 0.2 mm @ 121°
ACD:	4.03 mm	SD:	9 µm		
LT:	3.59 mm	SD:	2 µm		

SE:	45.98 D	(!)	SD: 0.15 D	TSE:	37.76 D			SD: 0.38 D
K1:	44.84 D	@ 173°	SD: 0.75 D	TK1:	37.66 D	@	0°	SD: 1.02 D
K2:	47.18 D	@ 83°	SD: 0.10 D	TK2:	37.87 D	@	90°	SD: 0.75 D
ΔK:	-2.34 D	@ 173°		ΔTK:	-0.21 D	@	0°	

B scan



Keratometry | White-to-white | Fixation



(!) Borderline value (*) Value was edited manually --- No value measured

Comment

Technology Deep Dive
Dense Cataracts Penetration

Rate of successful scans with ZEISS IOLMaster 700 was estimated to be 99.5 %

Hirnschall et al. Ophthalmol Ther, 2018

- 1,226 eyes of 613 patients (23 unsuccessfully measured eyes included into the study)
- Biometrical examination with ZEISS IOLMaster 500 and ZEISS IOLMaster 700
- *91.3 % (21/23) of the eyes that were measured unsuccessfully with ZEISS IOLMaster 500 were measurable with the ZEISS IOLMaster 700*
- The estimated overall rate of unsuccessful scans with the SS-OCT device was 0.5% (6/1226)

Successful (top) and unsuccessful (bottom) longitudinal SS-OCT scan. The arrow depicts the macula

***Hirnschall N, Varsits R, Doeller B, et al**. Enhanced Penetration for Axial Length Measurement of Eyes with Dense Cataracts Using Swept Source Optical Coherence Tomography: A Consecutive Observational Study. Ophthalmol Ther 2018;126(4):524*

Technology Deep Dive

Dense Cataracts Penetration

Cataract penetration rate of up to 99%, Reduction in need for ultrasound of up to 92%

Varsits et al, ESCRS 2016

- The ZEISS IOLMaster 700 with SWEPT Source OCT is designed to optimize workflow efficiency, even when handling dense cataracts.
- A comparative clinical study with more than 1,200 eyes

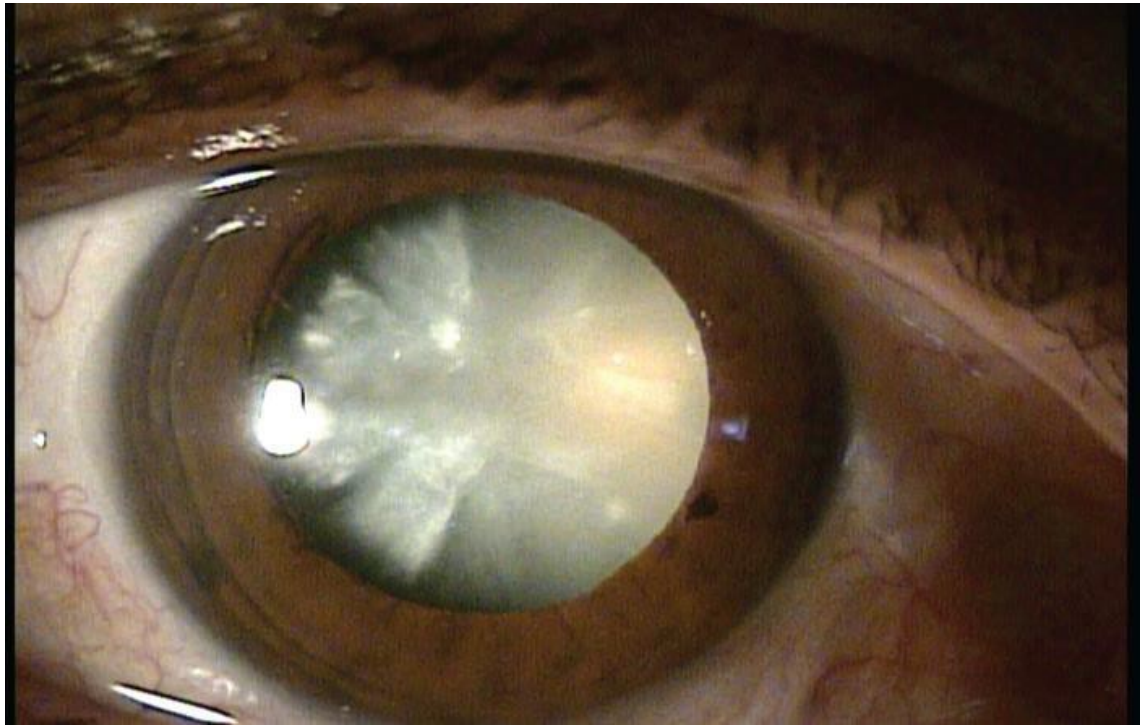


Image: Prof de la Torre Estremadoyro M. Case Study: IOLMaster 700 in extreme cataract. CRSTE 2015:700

R. Varsits, N. Hirnschall, B. Doeller, O. Findl; *Increasing the number of successful axial eye length measurements using swept-source optical coherence tomography technology compared to conventional optical biometry; presented at ESCSR 2016.*

Technology Deep Dive
Dense Cataracts Penetration

In this case study ZEISS IOLMaster 700 could measure axial length in very dense nucleous cataracts

De La Torre, CRSTE 2015

- 2 Patients with very dense nucleous cataracts, including brunescent, rubra, nigra and white
- axial length measurements with previous optical biometry devices weren't possible

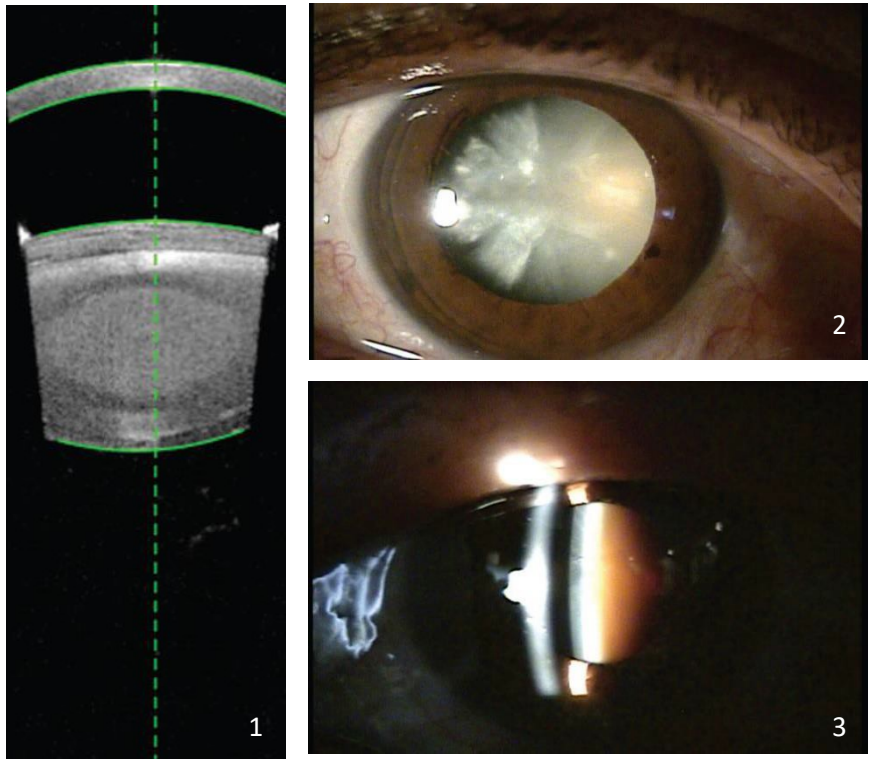


Fig. 1: IOLMaster 700 OCT image with measurement calipers
Fig. 2: White instumescent cataract
Fig. 3: Slit lamp image of the cataracta ruba eye

Prof de la Torre Estremadoyro M. *CASE STUDY : IOLMASTER 700 IN EXTREME CATARACT. 2015:700.*

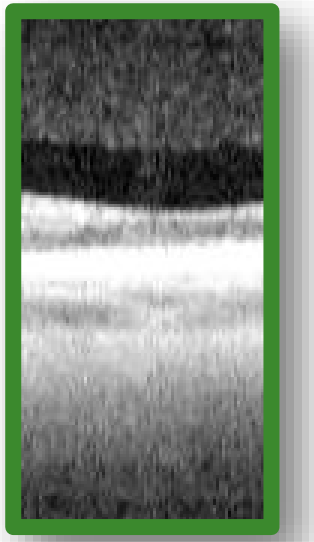
Technology Deep Dive
Fixation Check

Fixation check will allow you to detect poor fixation during measurement

- 1 mm Foveal scan helps verify if the patient has fixated correctly
- Incorrect fixation can lead to incorrect axial length measurement and wrong keratometry data and thus refractive surprises

Helps to reduce the risk of refractive surprises

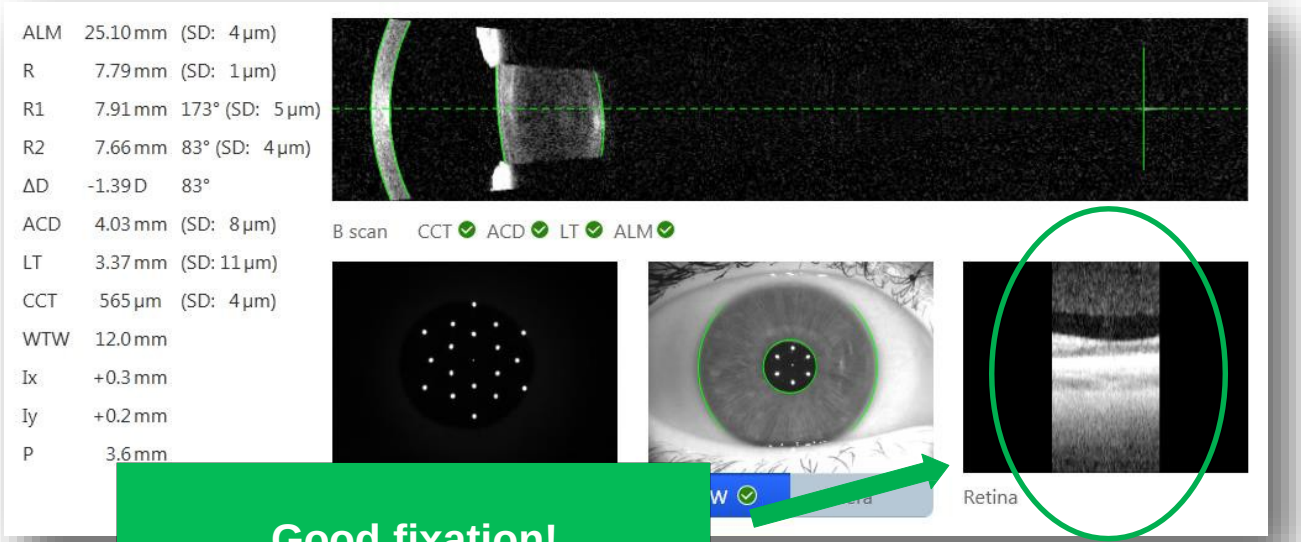
See the foveal pit?
Good fixation!



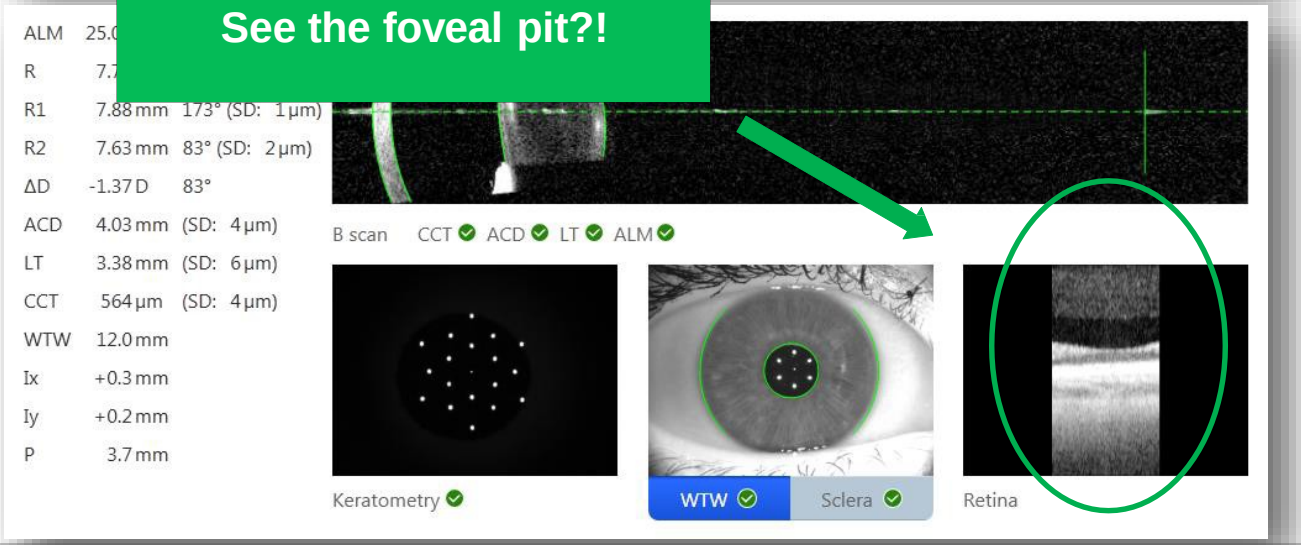
No foveal pit visible!
Poor fixation!

Example: More accurate & repeatable measurements

Measurement 1



Measurement 2

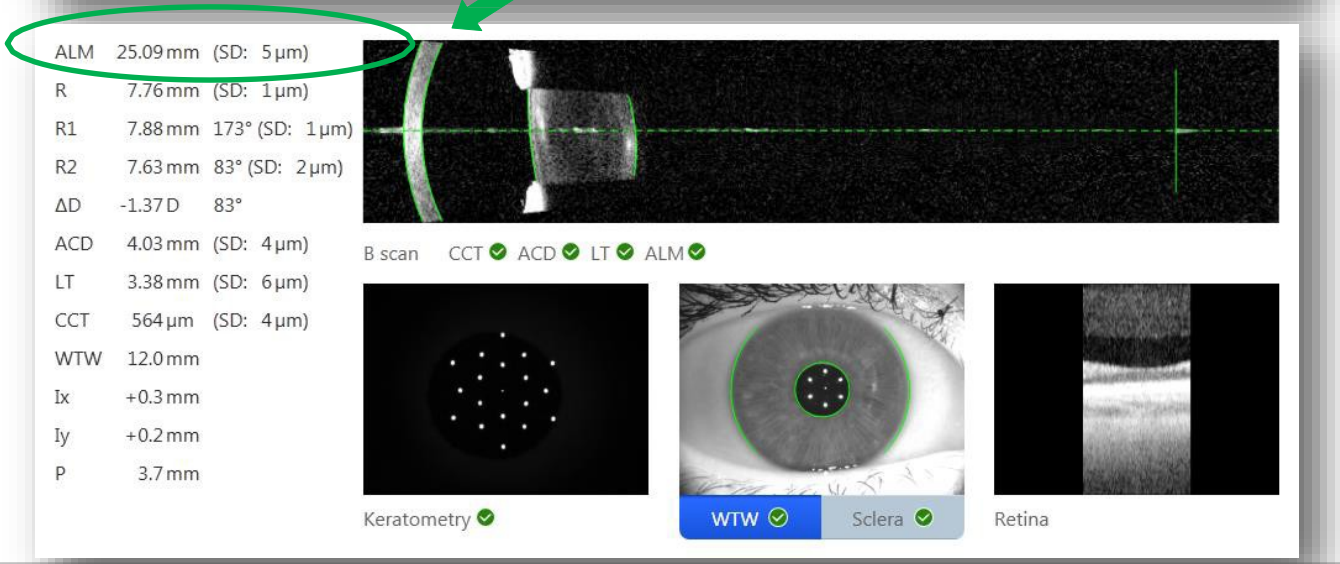


Good fixation!
See the foveal pit?!

Example: More accurate & repeatable measurements

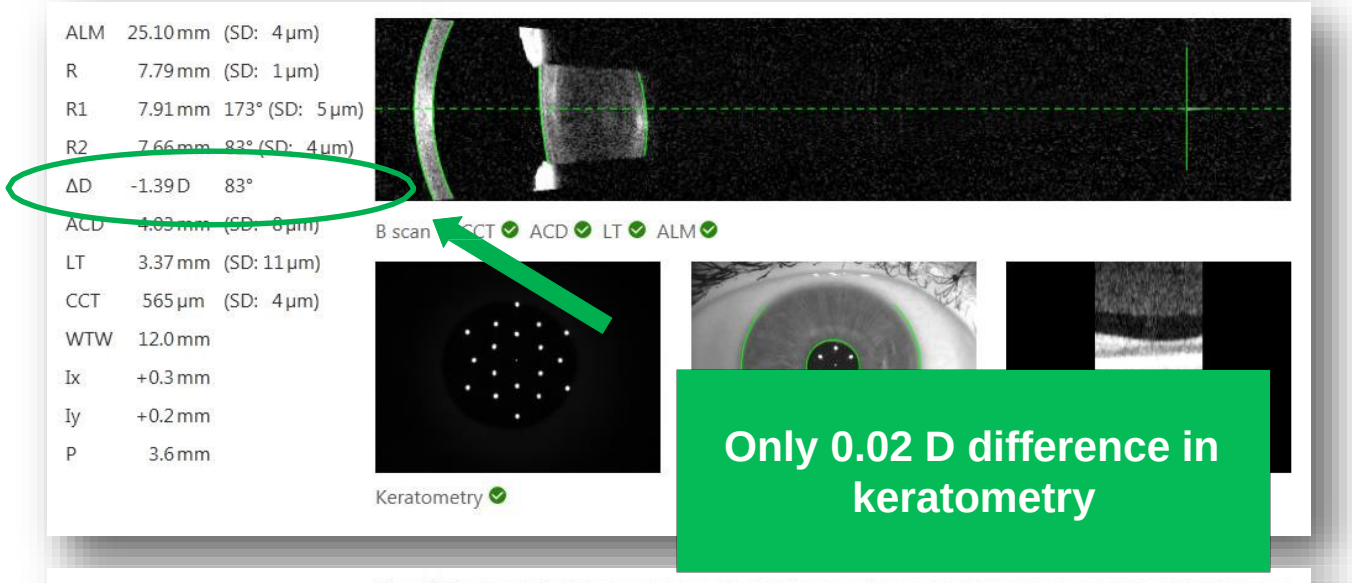
Measurement 1

Measurement 2

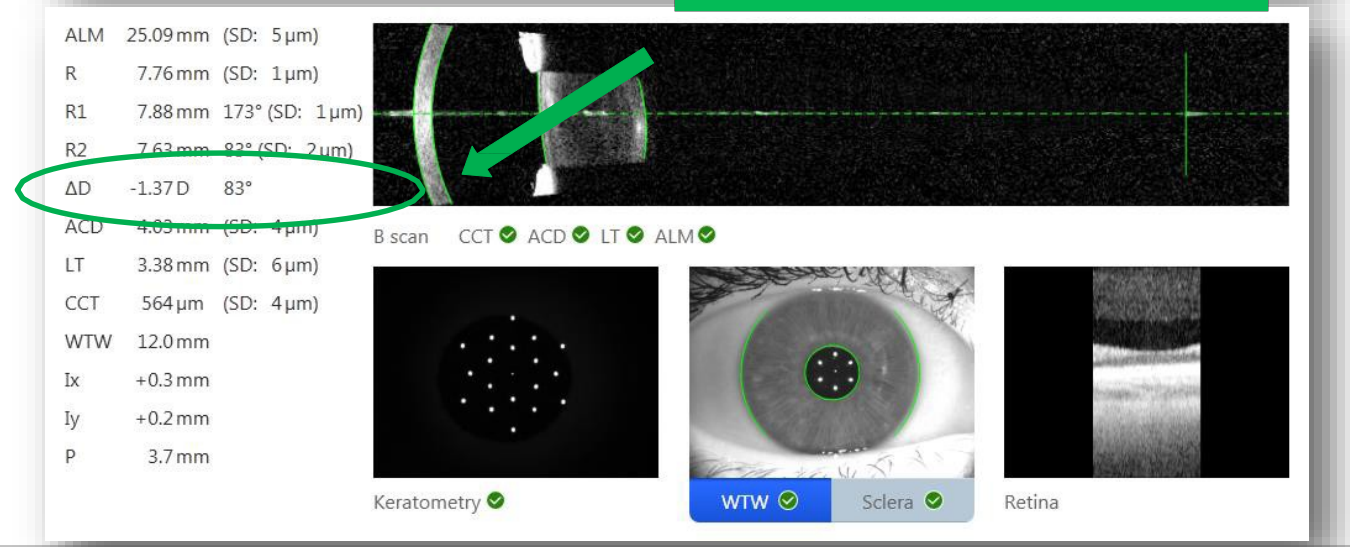


Example: More accurate & repeatable measurements

Measurement 1

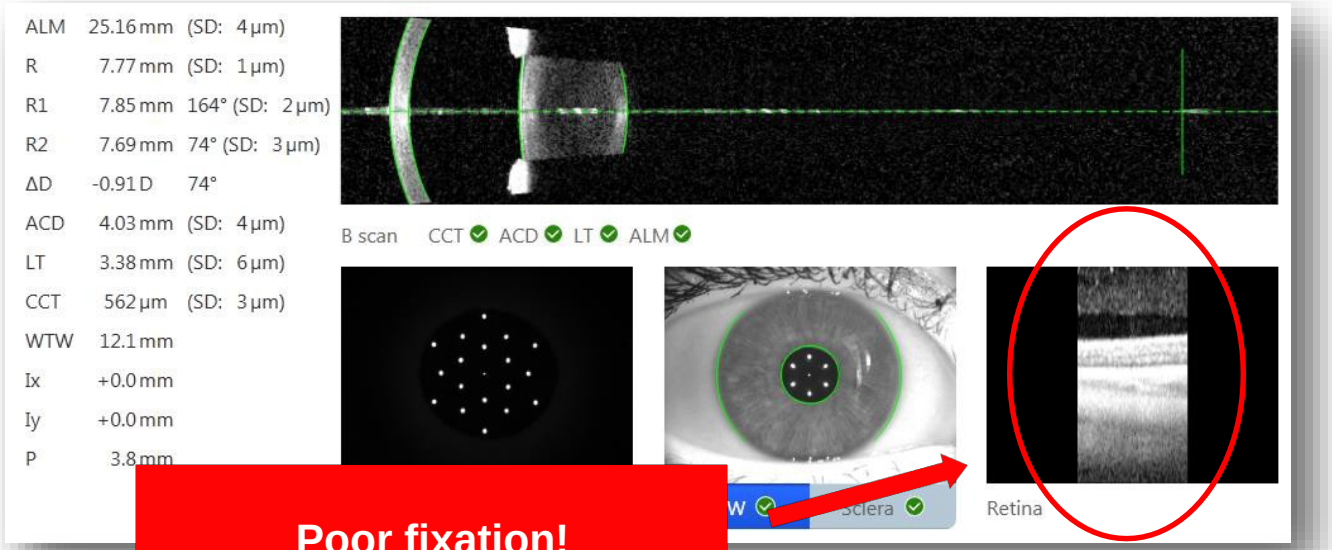


Measurement 2

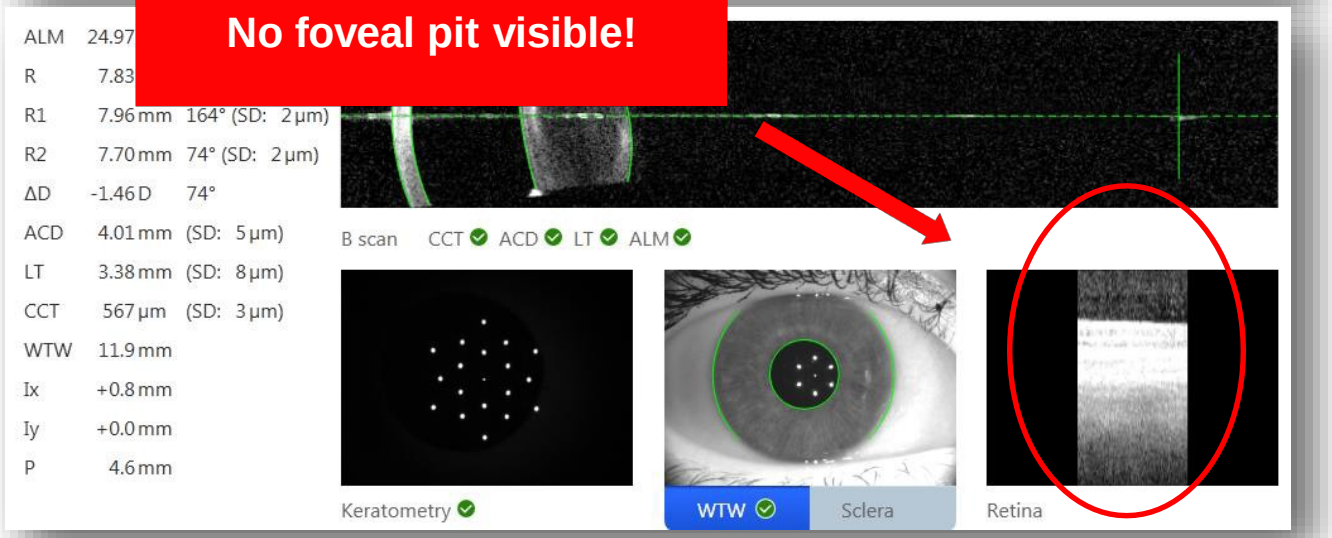


Example: helps to identify measurement errors

Measurement 1



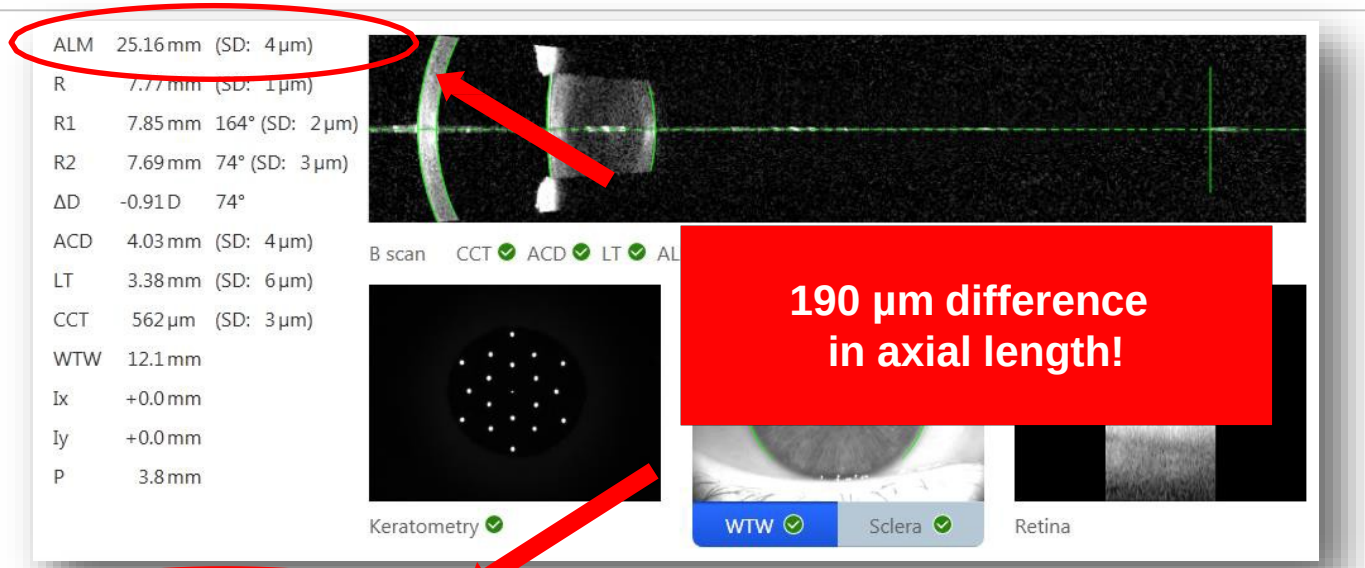
Measurement 2



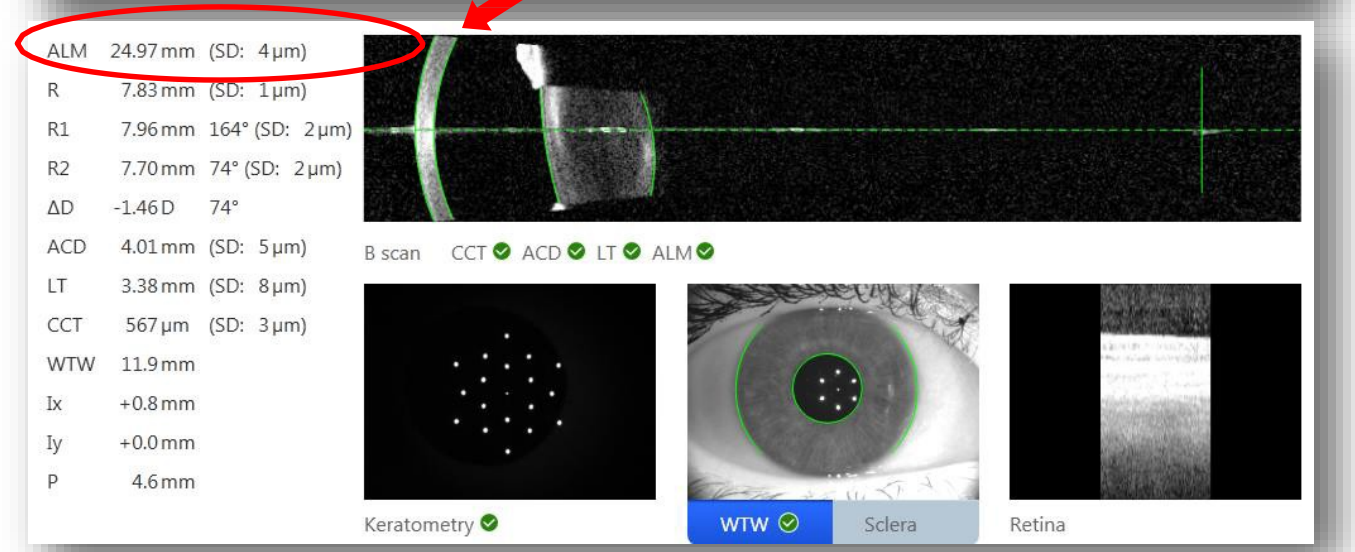
Poor fixation!
No foveal pit visible!

Example: helps to identify measurement errors

Measurement 1

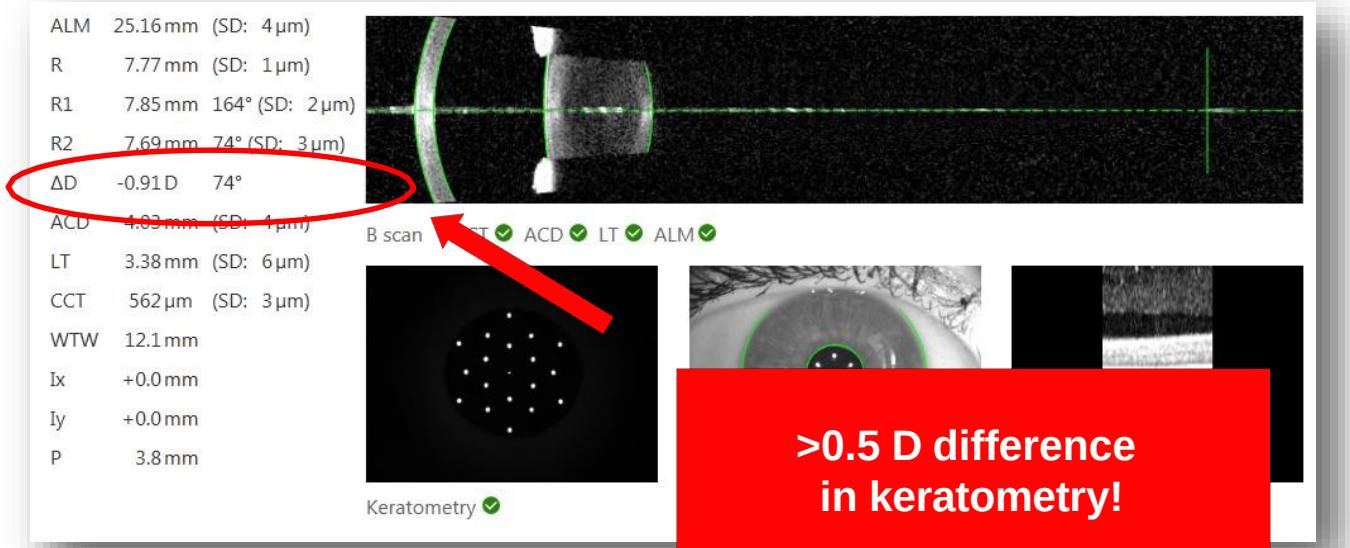


Measurement 2

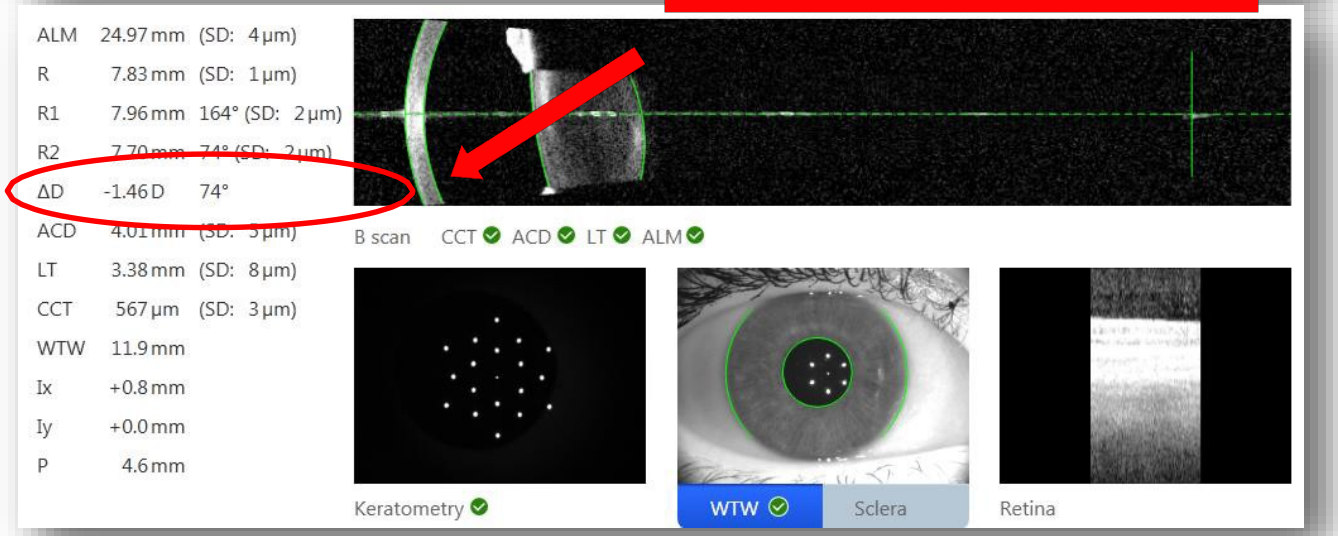


Example: helps to identify measurement errors

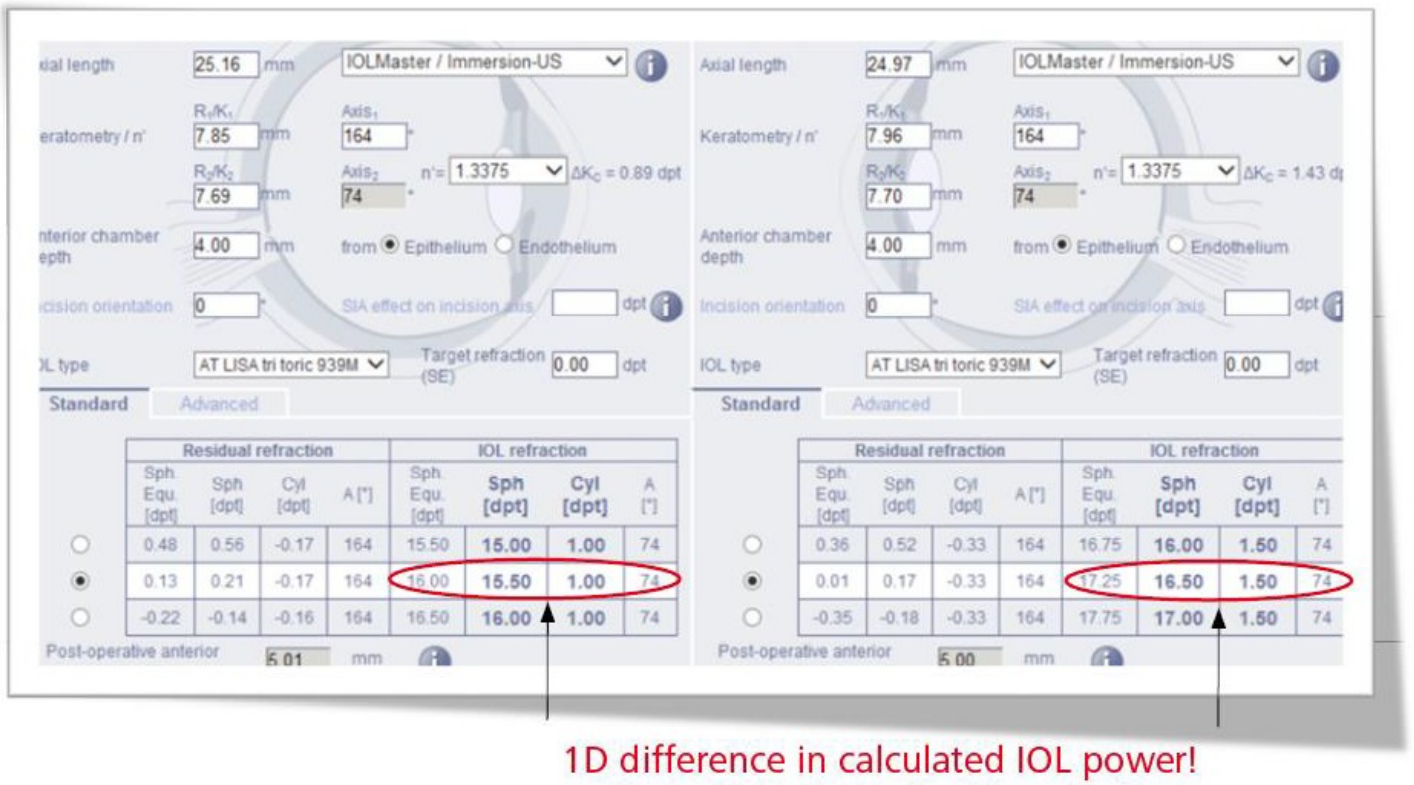
Measurement 1



Measurement 2



Example: Influence on K-values

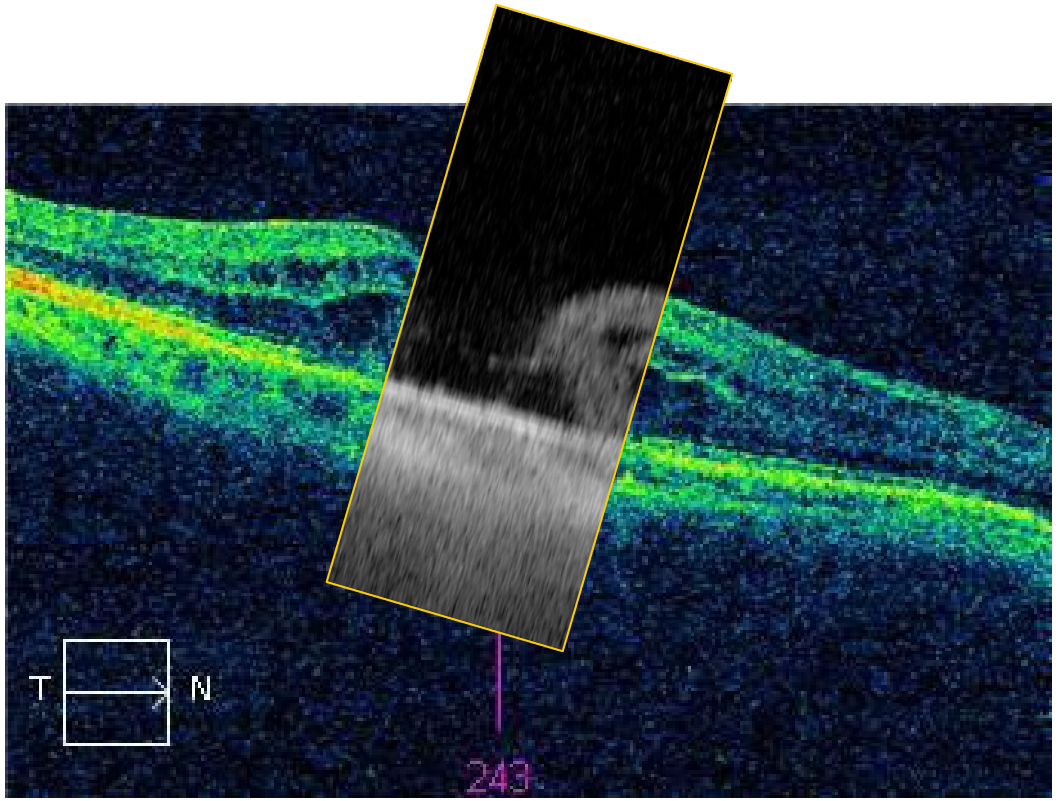


Technology Deep Dive
Fixation Check

In this case of Srivannaboon a macular hole could be observed with ZEISS IOLMaster 700 before cataract surgery was performed

Srivannaboon, CRSTE 2015

- SS-OCT enabled observation of abnormal macula morphology* in this case
- Additional OCT examination was needed



Fixation check of ZEISS IOLMaster 700 overlaid CIRRUS 4000 retina OCT

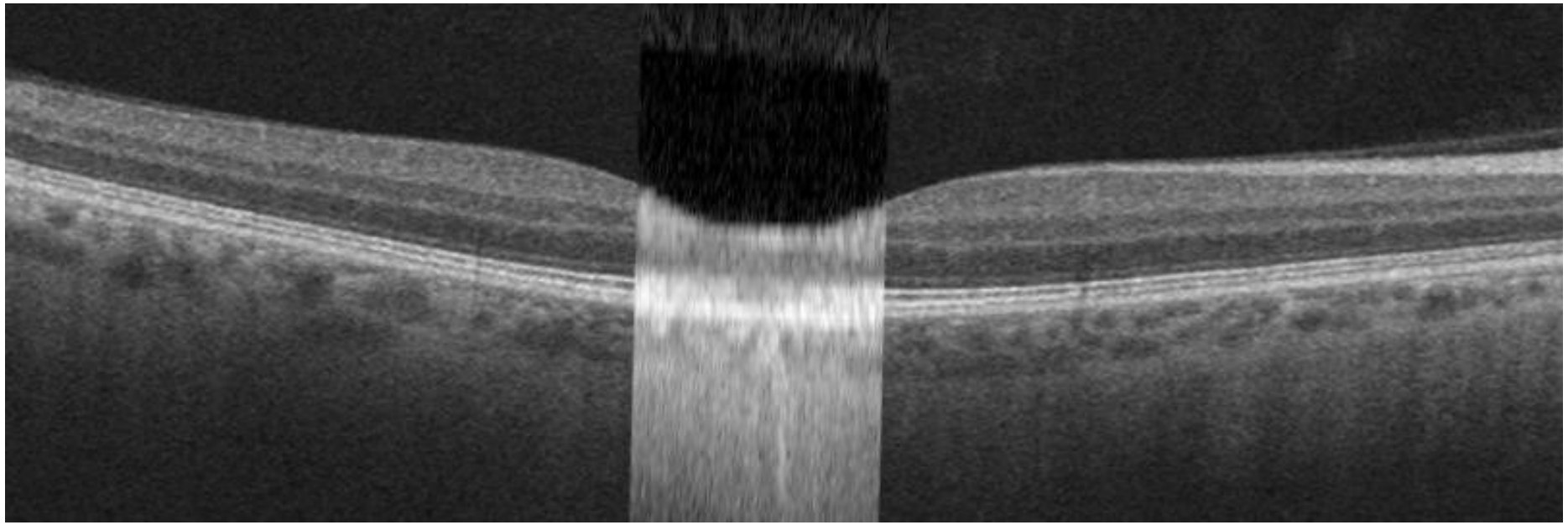
***Srivannaboon**, Case Study: IOLMaster 700, CRSTE, June 2015*

** Findings need to be verified and pathologies diagnosed with a dedicated retina OCT or other clinical standard methods.*

Technology Deep Dive

Fixation Check

Regular Fixation Check



Technology Deep Dive
Fixation Check

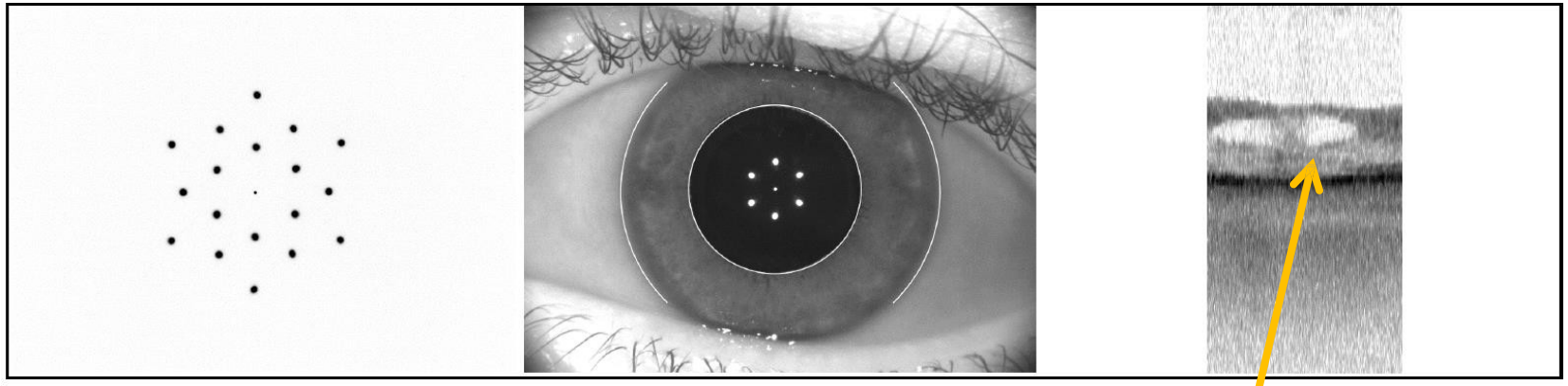


Figure 1. SWEPT Source Biometry of our patient with the IOLMaster 700 showing intraretinal fluid (Fixation Check image on the right)*

- The unique Fixation Check supports to detect poor patient fixation
- It may also help to indicate unusual eye structures for better patient selection[1]
- An incidential finding (e.g. BRVO as shown here) may prompt for a comprehensive OCT examination.

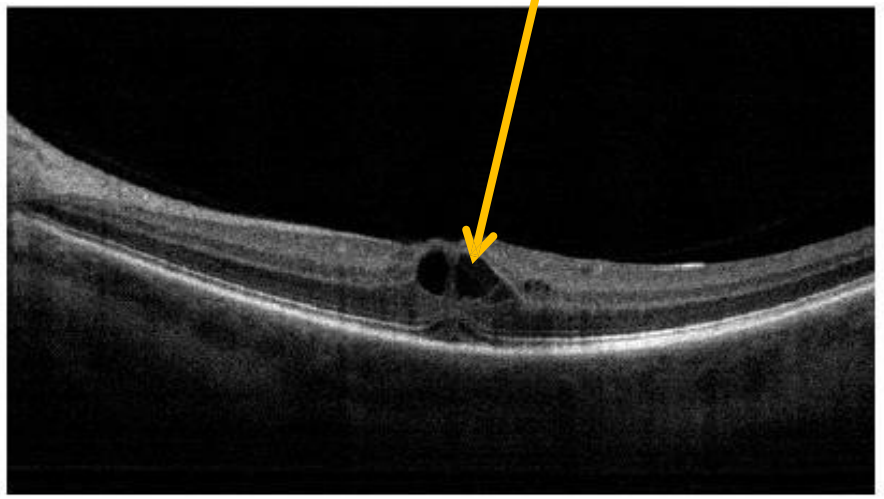


Figure 2. SD-OCT image of the left eye of our patient*

1 As the ZEISS IOLMaster 700 is clearly not intended to be used for diagnostics, findings need to be verified and pathologies diagnosed with a dedicated retina OCT
Image courtesy of Prof. O. Findl, Hanusch Hospital Vienna, Austria

Technology Deep Dive
Fixation Check

Retinal Pathology: Macular Foramen

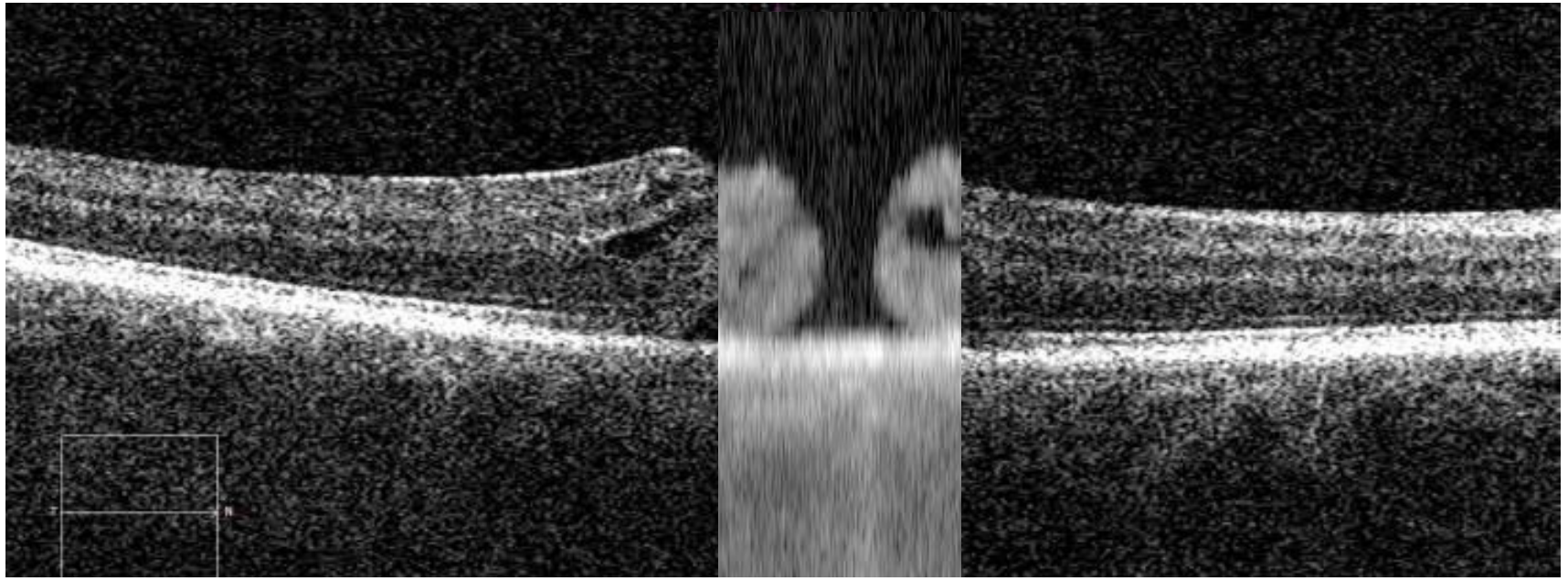


Image courtesy of Prof. W. Sekundo, Philipps University Hospital Marburg, Germany

Retinal Pathology: Macular Pucker

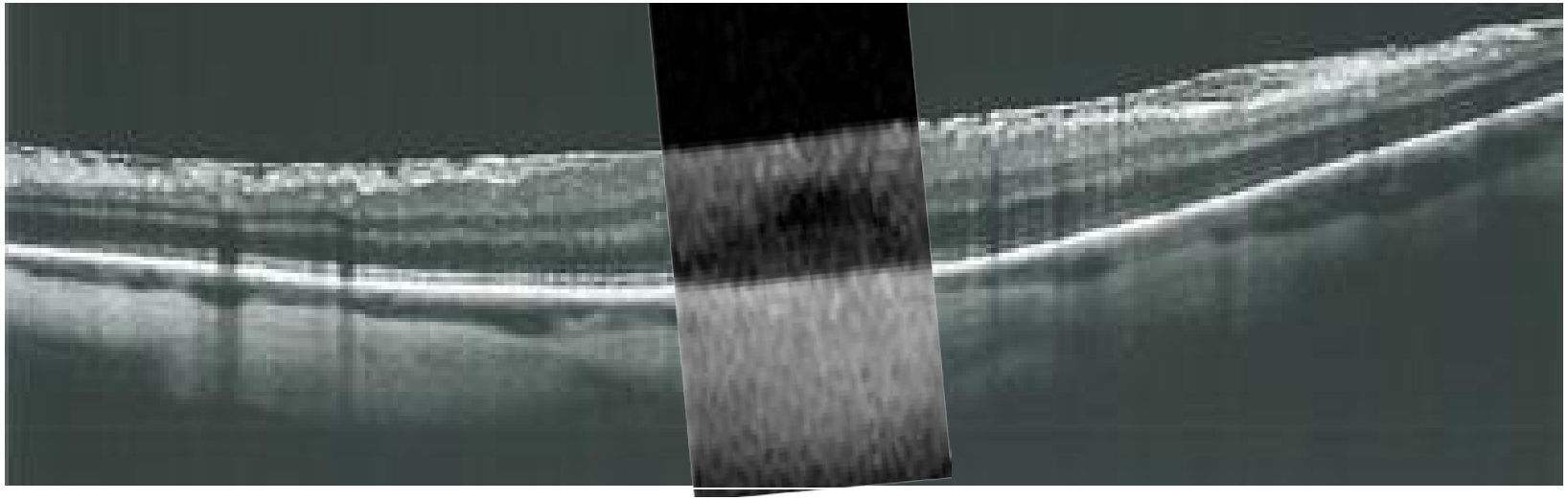


Image courtesy of Prof. W. Sekundo, Philipps University Hospital Marburg, Germany

Technology Deep Dive
Fixation Check

Retinal Pathology: AMD, RPE detachment

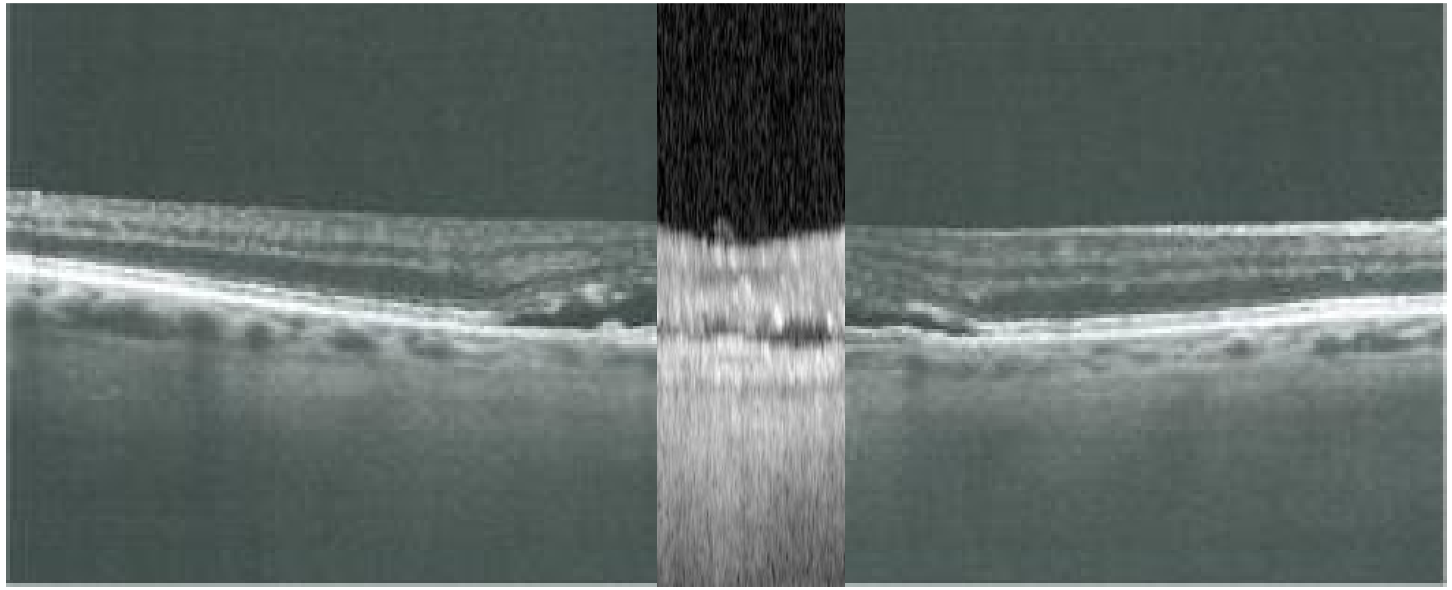


Image courtesy of Prof. W. Sekundo, Philipps University Hospital Marburg, Germany

Technology Deep Dive
Total Keratometry

No second device
No change in exams

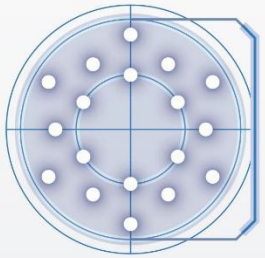
Precise keratometry and SWEPT Source OCT imaging

Compatible with classic keratometry

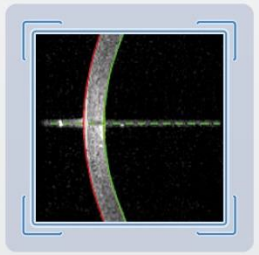
New Barrett formulas designed for TK

IOLMaster 700

Telecentric Keratometry



SWEPT Source OCT



Anterior Corneal Surface

Posterior Corneal Surface

TK®

- Barrett Universal II **TK**
- Barrett Toric **TK**
- Barrett True-K with **TK**
- Hoffer Q
- Holladay 1
- Holladay 2
- Haigis
- Haigis-T
- SRK/T
- Z CALC

Total Keratometry (TK)

Replacing assumptions with measurements

- **Total Keratometry(TK®)** is a new measurement that combines telecentric keratometry and SWEPT Source OCT technology for the assessment of anterior and posterior corneal curvature.

- The purpose of TK is to replace standard keratometry, aiming to help to reduce outliers and improve refractive outcomes of IOL calculation in cataract surgery.

- TK is ULIB-compatible, therefore existing standard formulas and IOL constants may be applied.

Picture source: Carl Zeiss Meditec media database

Remarkable IOL Calculation Results Observed

Improve toric IOL calculation

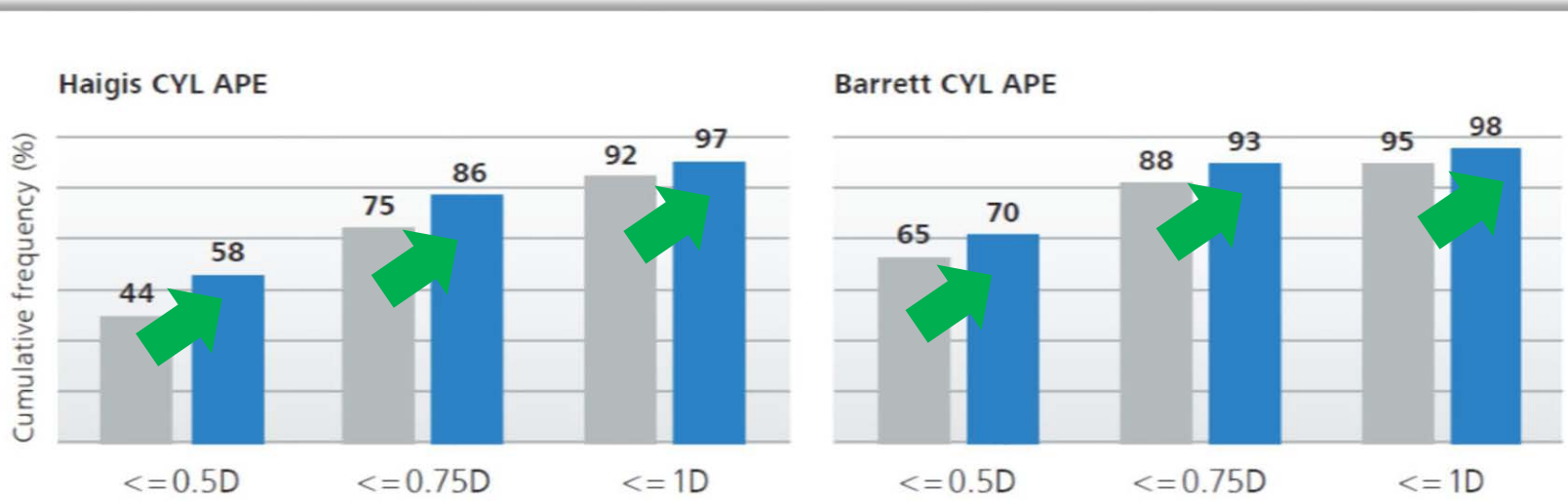


Figure 3: Outcomes of toric IOL calculations with the Haigis-T formula. CYL APE: Absolute prediction error for cylinder; frequency of eyes in respective CYL APE diopter ranges; N=145 eyes.*

Figure 4: 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.*

Improve toric IOL calculation.

Source: Total Keratometry Compendium
Fabian and Wehner 2018
** *Retrospective post-hoc analysis of 145 normal cataract eyes implanted with aspheric IOL, 6 weeks post-op.*

Total Keratometry (TK)

Replacing assumptions with measurements

"I don't recall ever seeing such a dramatic improvement, by simply adding an additional parameter."

„Despite the minimal change **(in the formula)** ***the spherical prediction is definitely improved with BUII-TK"***

Graham Barrett

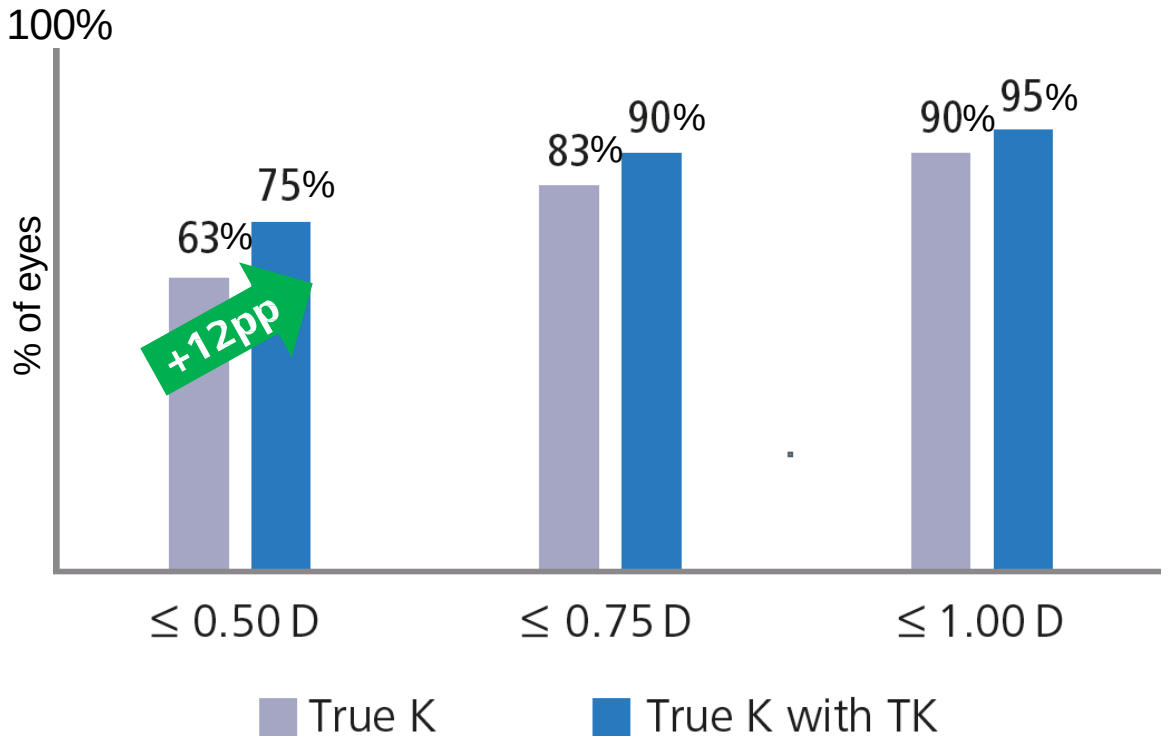
Total Keratometry (TK)

Replacing assumptions with measurements

In this study in post-myopic LASIK eyes, Barrett True-K with TK improved the outcome prediction compared to Barrett True-K with classic K's within ±0.5 D by >12% (p = 0.04)

Lawless et al., Clin Experiment Ophthalmol 2020

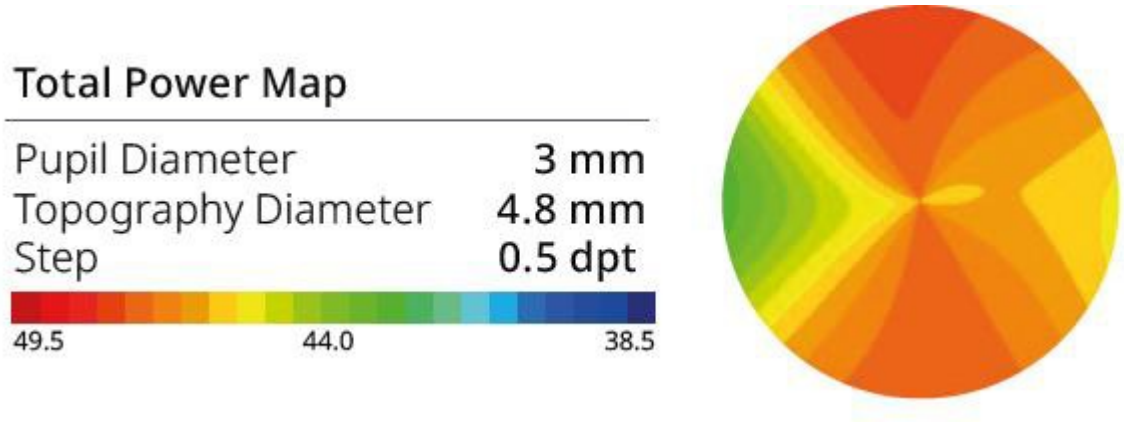
- 72 eyes of 50 patients
- The Barrett True-K TK provided the lowest mean refractive prediction error and variance for both prior myopes and hyperopes undergoing cataract surgery



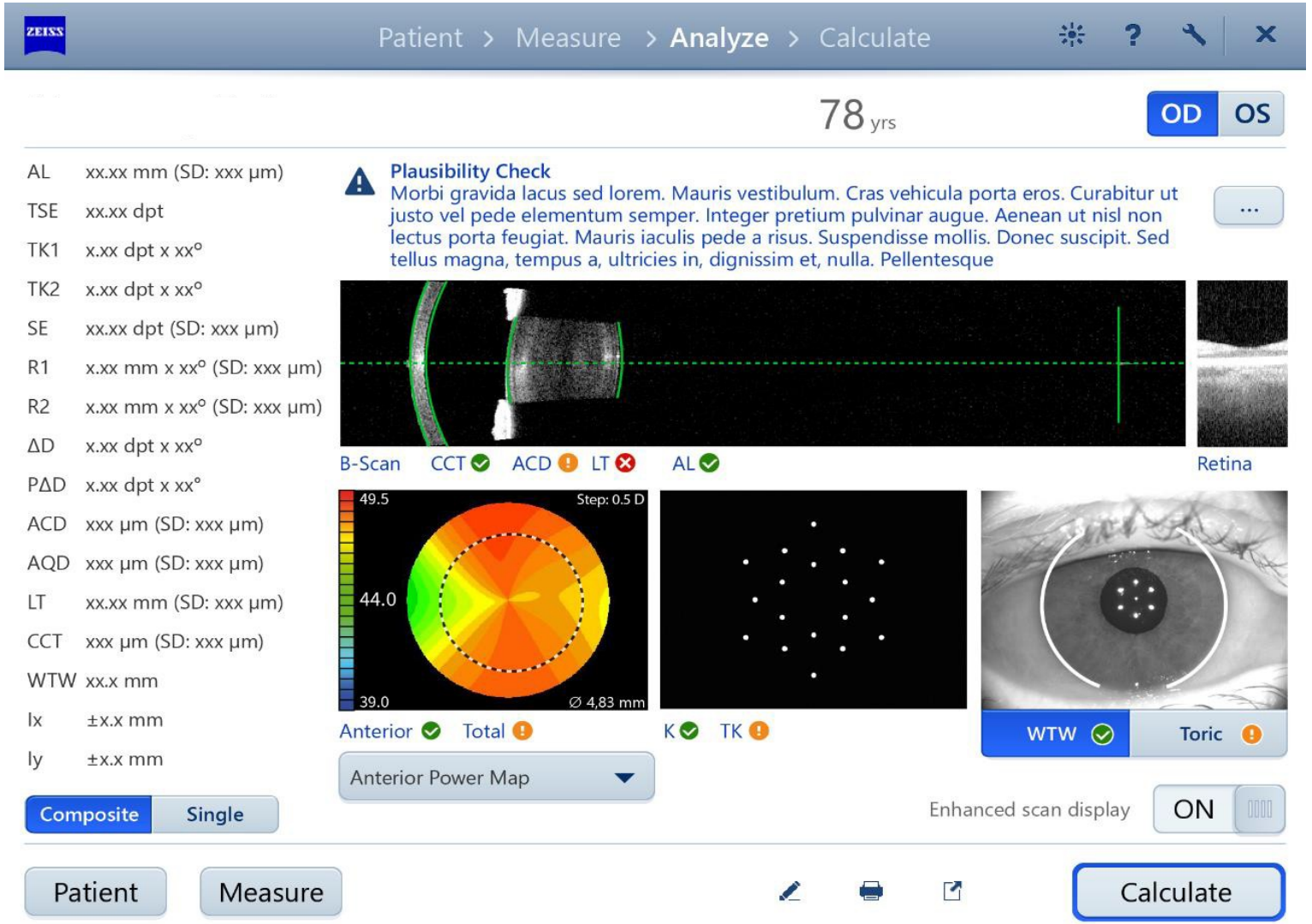
Lawless M, Jiang JY, Hodge C, Sutton G, Roberts T V., Barrett G. *Total keratometry in intraocular lens power calculations in eyes with previous laser refractive surgery. Clin Experiment Ophthalmol. April 2020.*

Technology Deep Dive
Central Topography

- Toric and multifocal IOL implantation requires exclusion of irregular corneas.
- Corneal asymmetries in a central optical zone of 4-5 mm are regarded as clinically relevant in this regard.
- With no changes in workflow the ZEISS IOLMaster 700 measures central corneal topography.
- It provides **anterior and total axial power maps**, **designed to detect visually relevant central corneal asymmetries**.



Technology Deep Dive
Central Topography

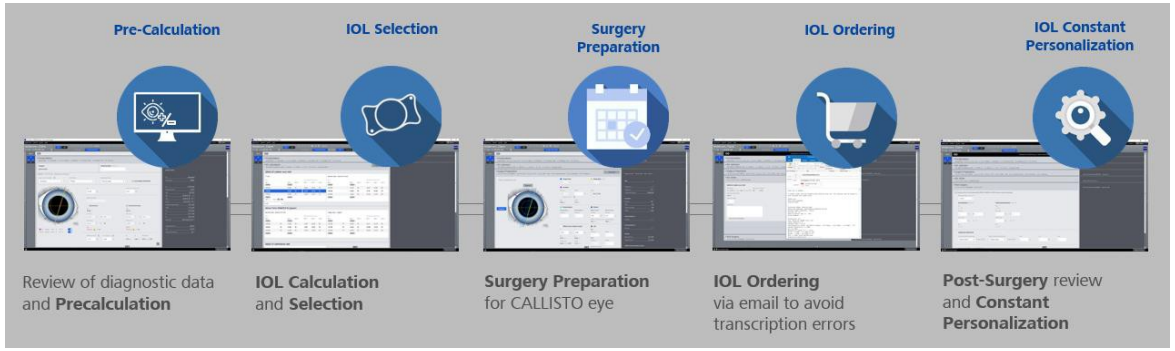


Connectivity Deep Dive
ZEISS EQ WORKPLACE

With ZEISS EQ Workplace you get access to your biometry data anytime, anywhere

The new “heart” of the ZEISS Cataract Workflow

- Remotely calculate IOLs and plan surgeries, facilitating the exchange of data between diagnostics and the OR.
- Connect the ZEISS IOLMaster and other devices in the cataract workflow to ZEISS FORUM and ZEISS CALLISTO eye, allowing a seamless toric and premium cataract workflow.
- A new level of protection against never-events: ZEISS IOLMaster data is transferred automatically to the ZEISS EQ Workplace, to populate the relevant fields for IOL calculation and selection.



Save time, increase efficiency and reduce residual astigmatism

Computer assisted cataract surgery

- Manual marking steps can be skipped altogether for an efficient and precise toric IOL alignment to reduce residual astigmatism.
- Starting with a biometry reference image from the ZEISS IOLMaster, data is transferred smoothly to ZEISS CALLISTO eye. This data is used to create overlays in the eyepiece.

Seeing beyond