

# Imaging 3D del Segmento Anteriore

Fabrizio Camesasca

UOC Oculistica

IRCCS Istituto Clinico Humanitas

*Responsabile: Dott. P. Vinciguerra*

Rozzano - Milano

*Non ho interessi economici  
pertinenti la relazione*

CMO CONGRESSI  
MEDICI  
OCULISTI



Società Oftalmologica Italiana  
11° CONGRESSO INTERNAZIONALE  
Milano, 15-18 maggio 2013 - MiCo

*...dove si incontrano i protagonisti dell'oftalmologia*



# Imaging 3D Del Segmento Anteriore

- Strumenti

- Scheimpflug
- OCT Time Domain
- OCT Spectral Domain
- OCT Swept Source Spectral Domain

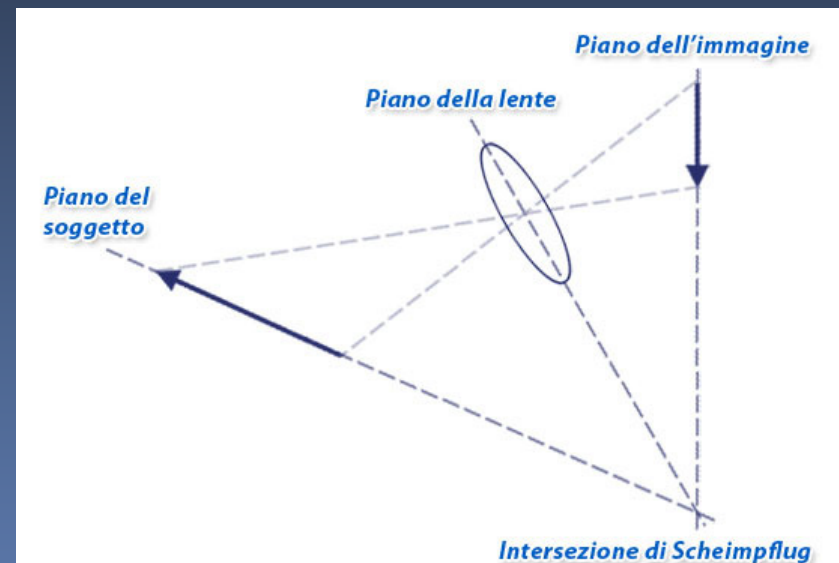
- Anatomia

- Valutazione alterazioni patologiche

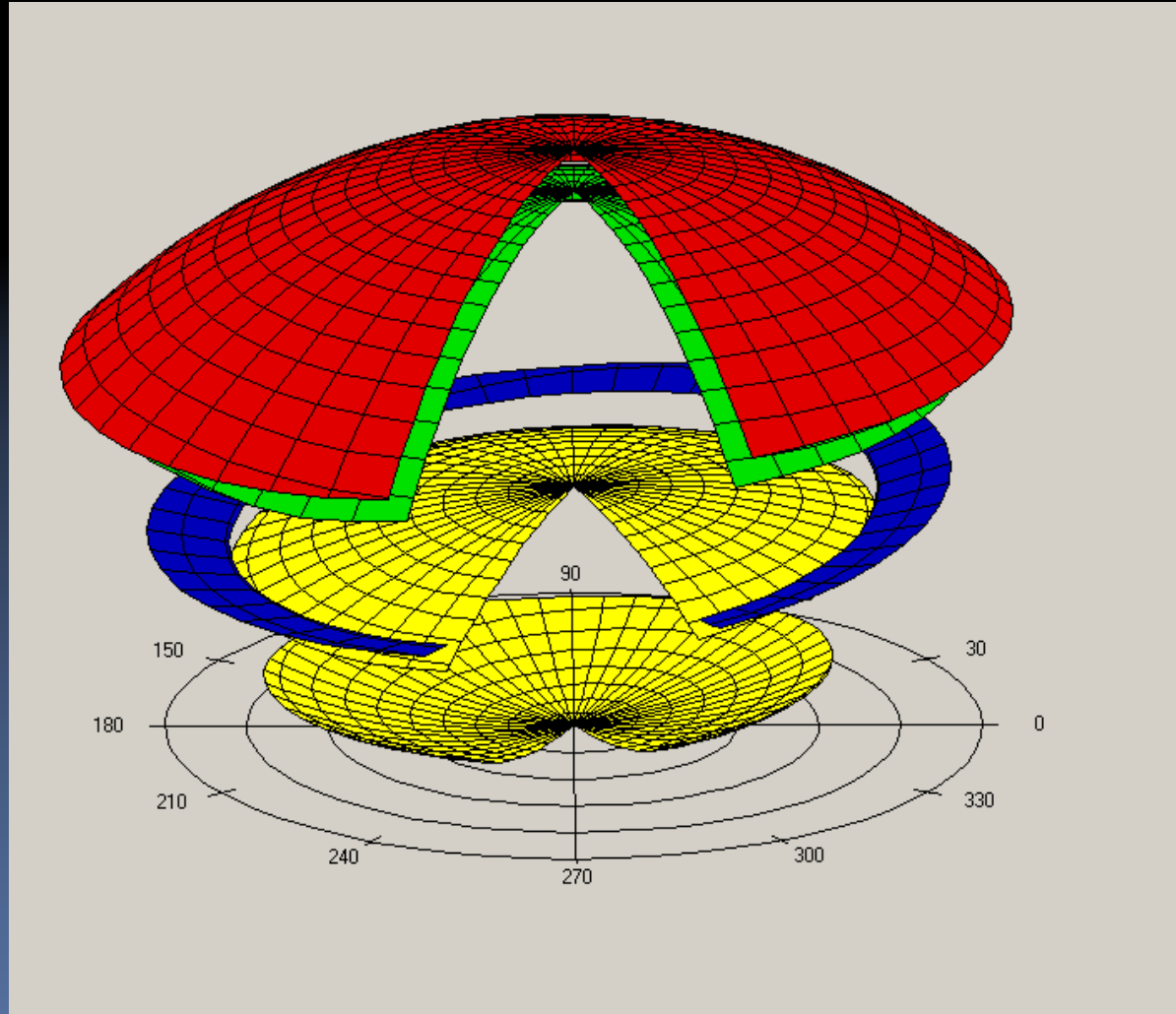
- Valutazione postintervento

# Scheimpflug Camera

- Optical cross sectioning
- 60 scansioni
- Calcolo immagine 3D mediante ray-tracing
- Software per l'identificazione dei bordi delle strutture
- Limitata velocità di acquisizione



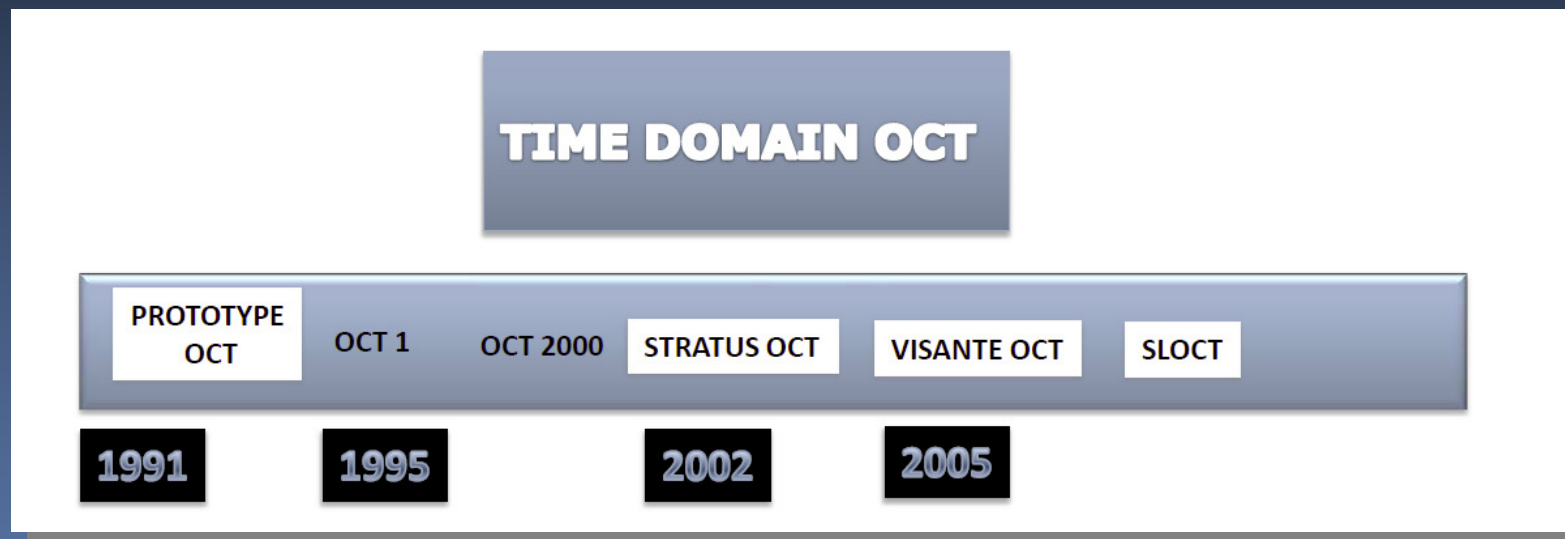
# 3D-Model



- Edge detection in Scheimpflug images:  
first calculation of ant. surface
- Calculation of the following refractive layers by Ray-Tracing
- Calculation of a complete 3D-Model of the anterior eye segment
  - cornea ant. surface
  - cornea post. surface
  - iris
  - crystalline lense (front)
  - crystalline lense (back)  
(dilated pupils)

# Time Domain OCT

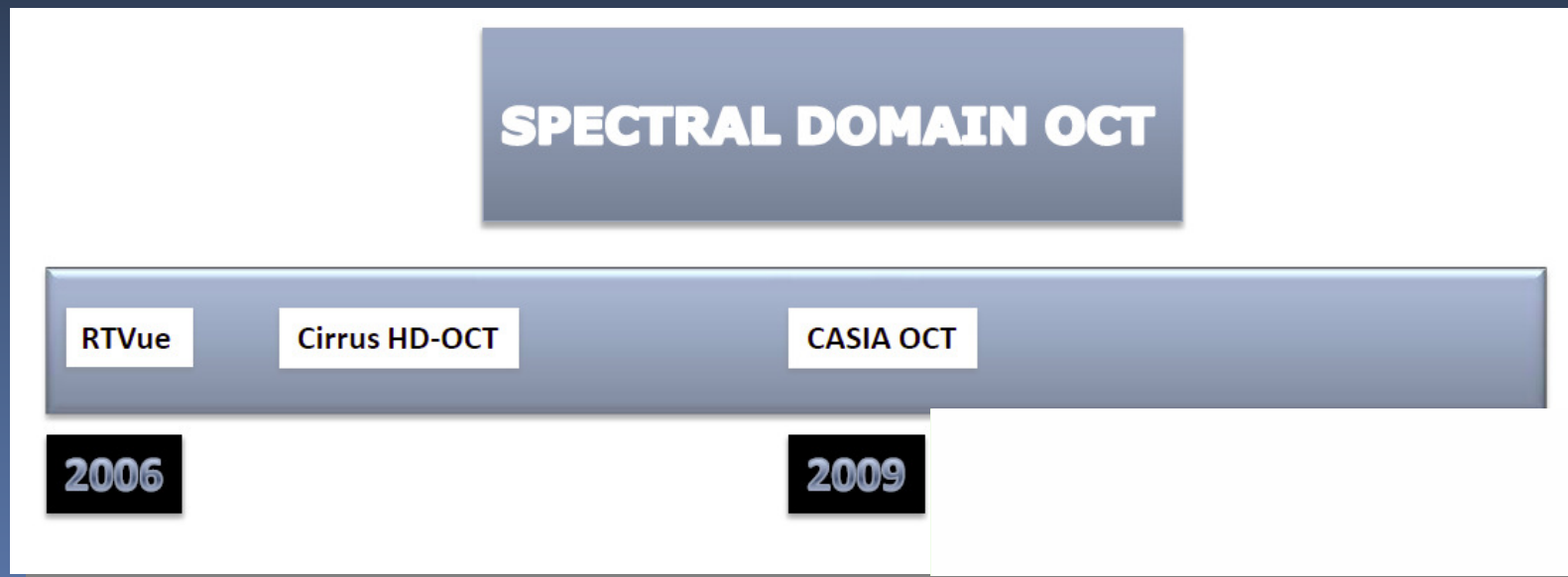
- **Visante** 2000 A-scans
- **SL OCT** 200 A-scans
- Imaging speed: 100–400 lines/s
- Con una lunghezza d'onda di 1310 nm risoluzione di 18–25 $\mu$ m e risoluzione , entrambe questi strumenti hanno ottenuto una maggior penetrazione attraverso la sclera



*Leung CKS, Weinreb RN, Eye 2011 March; 25(3): 261–267*

# Spectral Domain OCT

- Cirrus 840n spectrometer
- RTVue FD OCT 840nm
- Casia OCT **swept-source**
  - Monochromatic tunable fast scanning laser 1310nm
  - Aumento della velocità, 3-6  $\mu\text{m}$  risoluzione e imaging speed of 20,000-50,000 lines/s, miglior penetrazione nei tessuti



# Spectral Domain Swept-Source OCT

- CASIA OCT: swept-source OCT
- Scan-speed of 30.000 A scans/s
- Il segmento anteriore può essere scansionato radialmente in 64 cross-sections in 1.2 s.
- Valutazione degli angoli a 360°
- 3D imaging

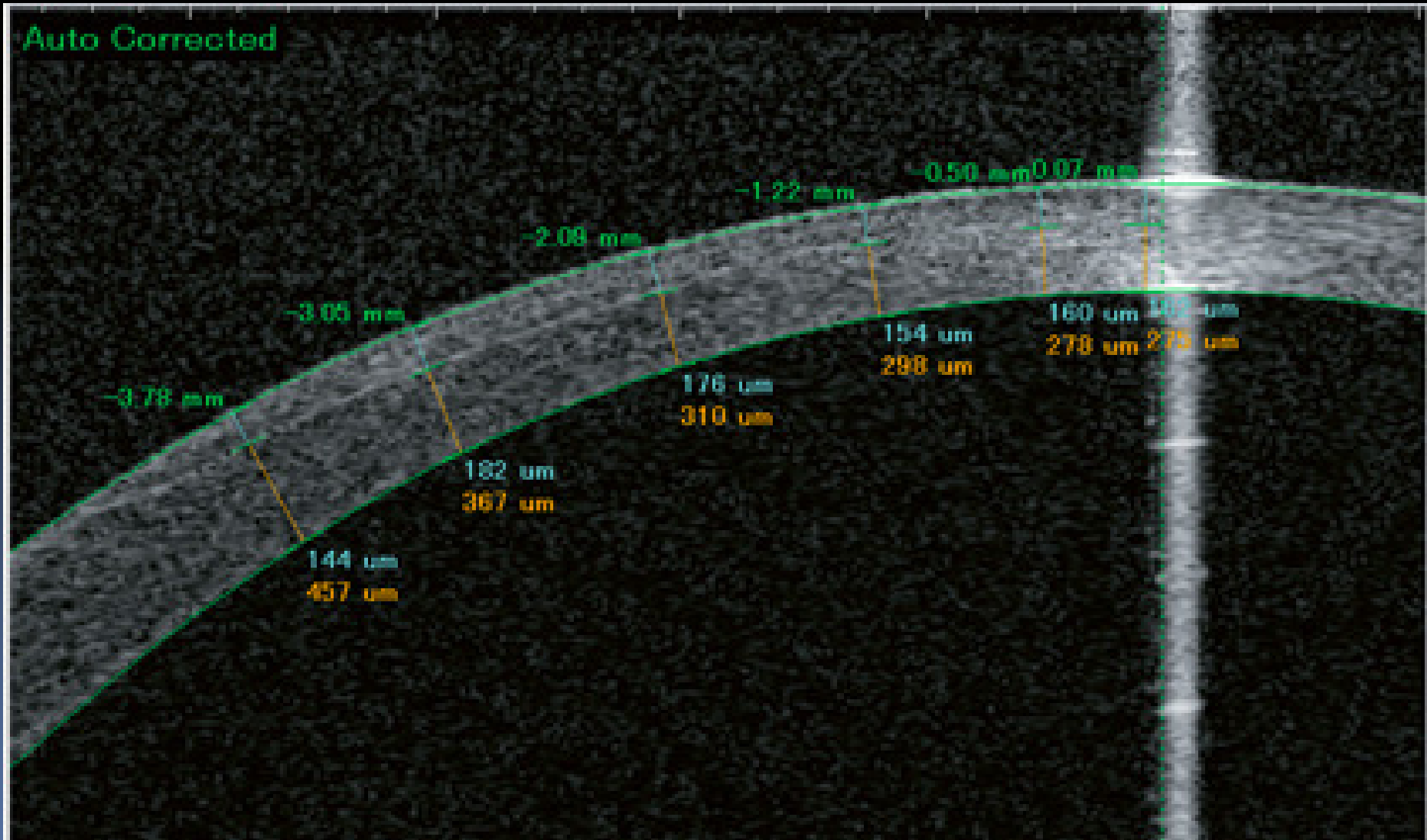


# Anatomia

- Valutazione di:
  - Cornea
  - Camera anteriore
  - Angolo irido-corneale
  - Iride
  - Cristallino
  - ...corpo ciliare ? UBM

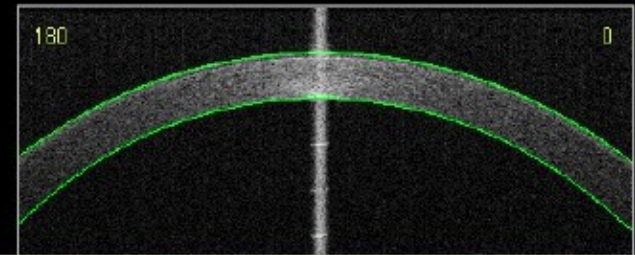
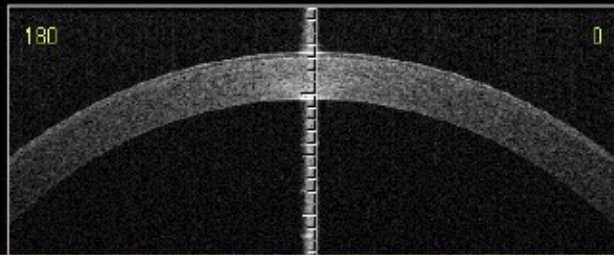


# Cornea

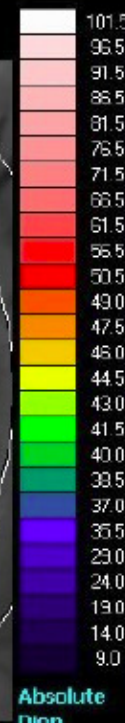
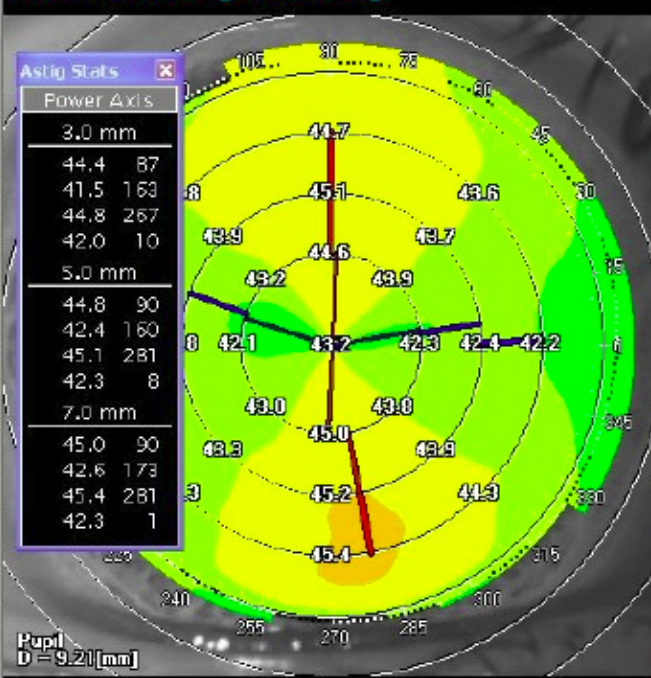


# Spessore Corneale e Misurazione del Potere Corneale (TCP)

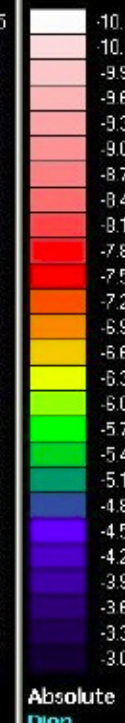
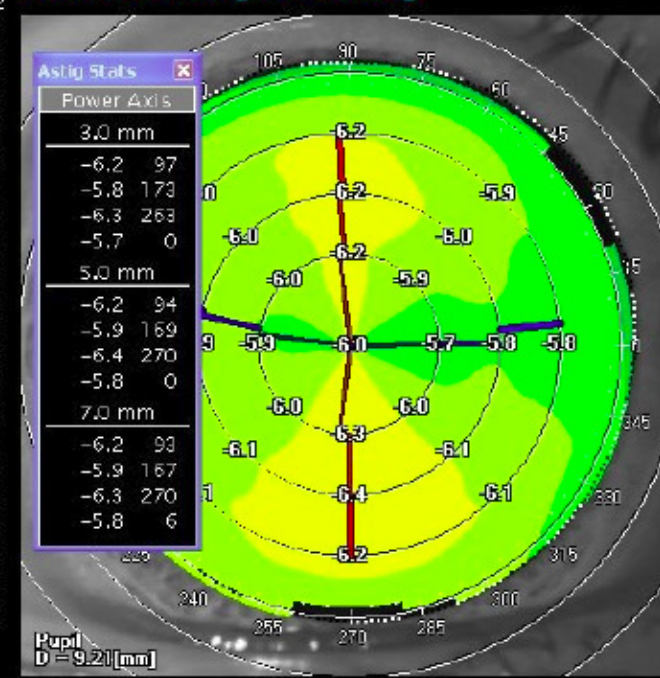
RTView



**Axial Power [Anterior]**



**Axial Power [Posterior]**



Anterior	
Ks: 44.8 @ 91°	Kf: 42.2 @ 1°
CYL: 2.6	AvgK: 43.5
AA: 96.8 [%]	

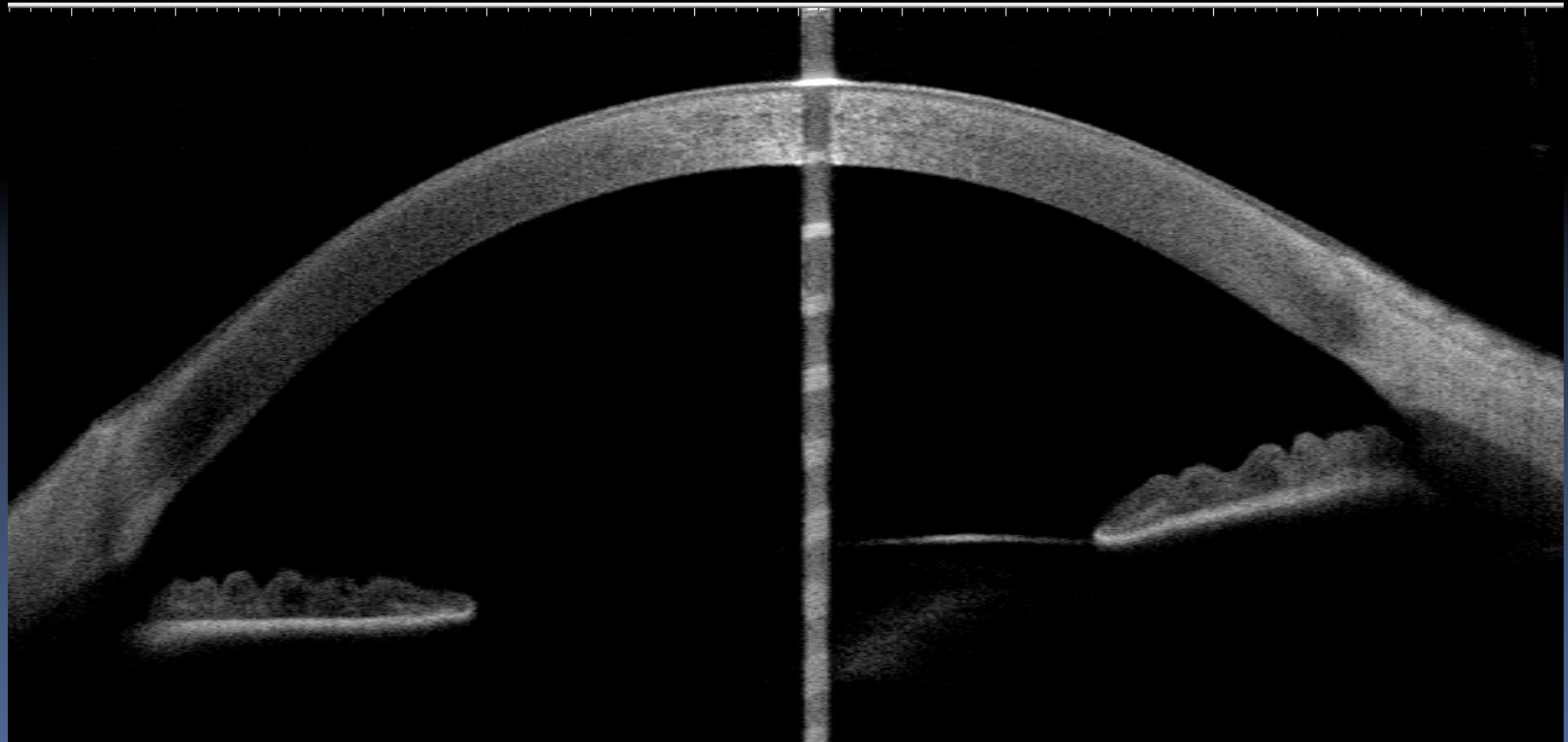
Posterior	
Ks: -6.3 @ 91°	Kf: -5.8 @ 1°
CYL: 0.5	AvgK: -6.0
AA: 91.1 [%]	

Pachymetry		
	X	Y
Apex:	545 [um]	0.0 [mm]
Thinnest:	542 [um]	-0.7 [mm]

# TCP

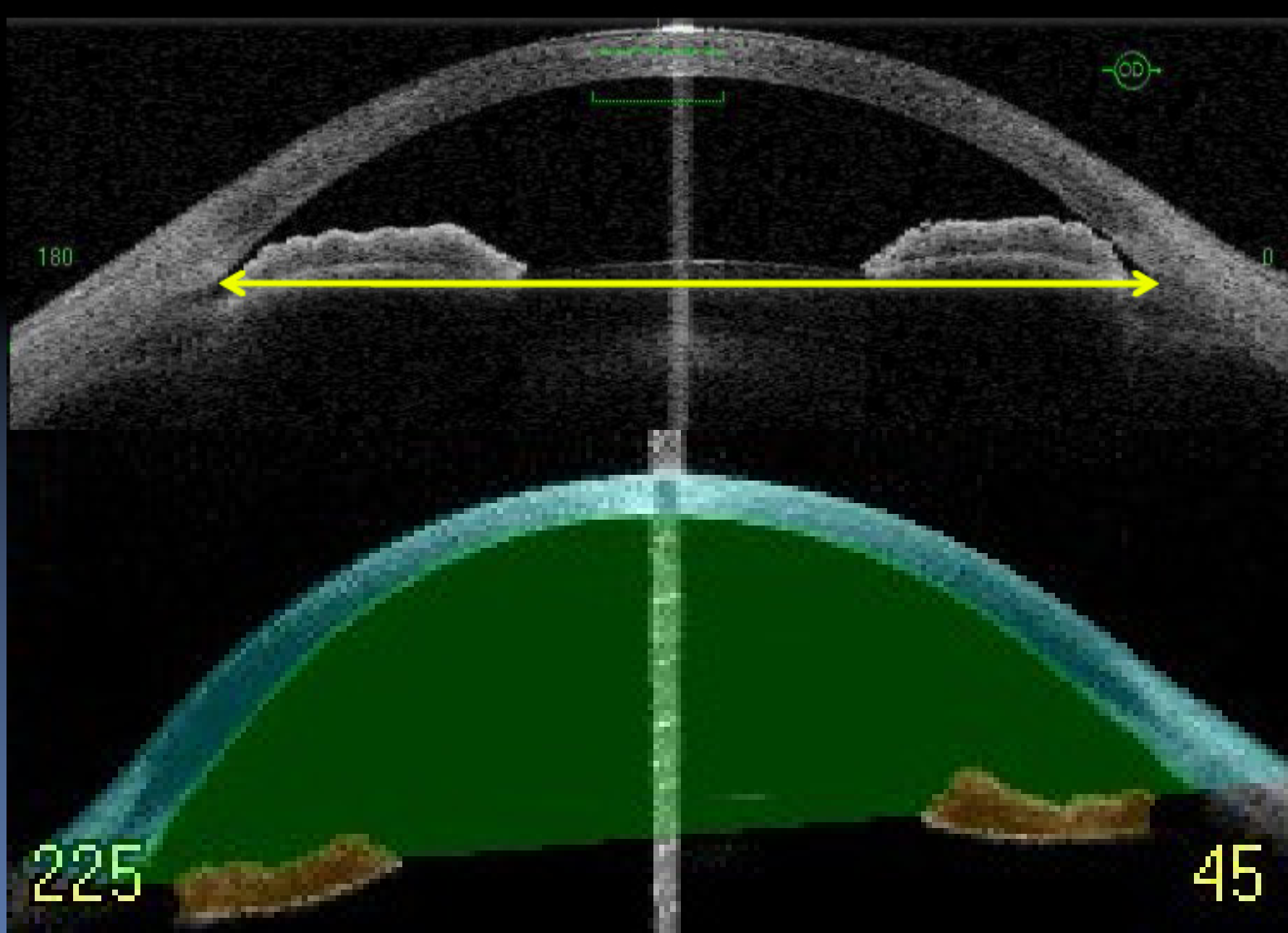
- I cheratometri ed i topografi misurano la superficie corneale **anteriore**
- **Estrapolano** la superficie posteriore
- Il cambiamento di curvatura e spessore della cornea post-chirurgia refrattiva porta ad una variazione in curvatura – e quindi anche in potere – della cornea posteriore
- Rischio di errore aumentato in pazienti sottoposti a chirurgia refrattiva.
- **TCP** misura direttamente le superfici anteriore e posteriore fornendo un **potere corneale più accurato** utile, ad es., nel calcolo delle IOL

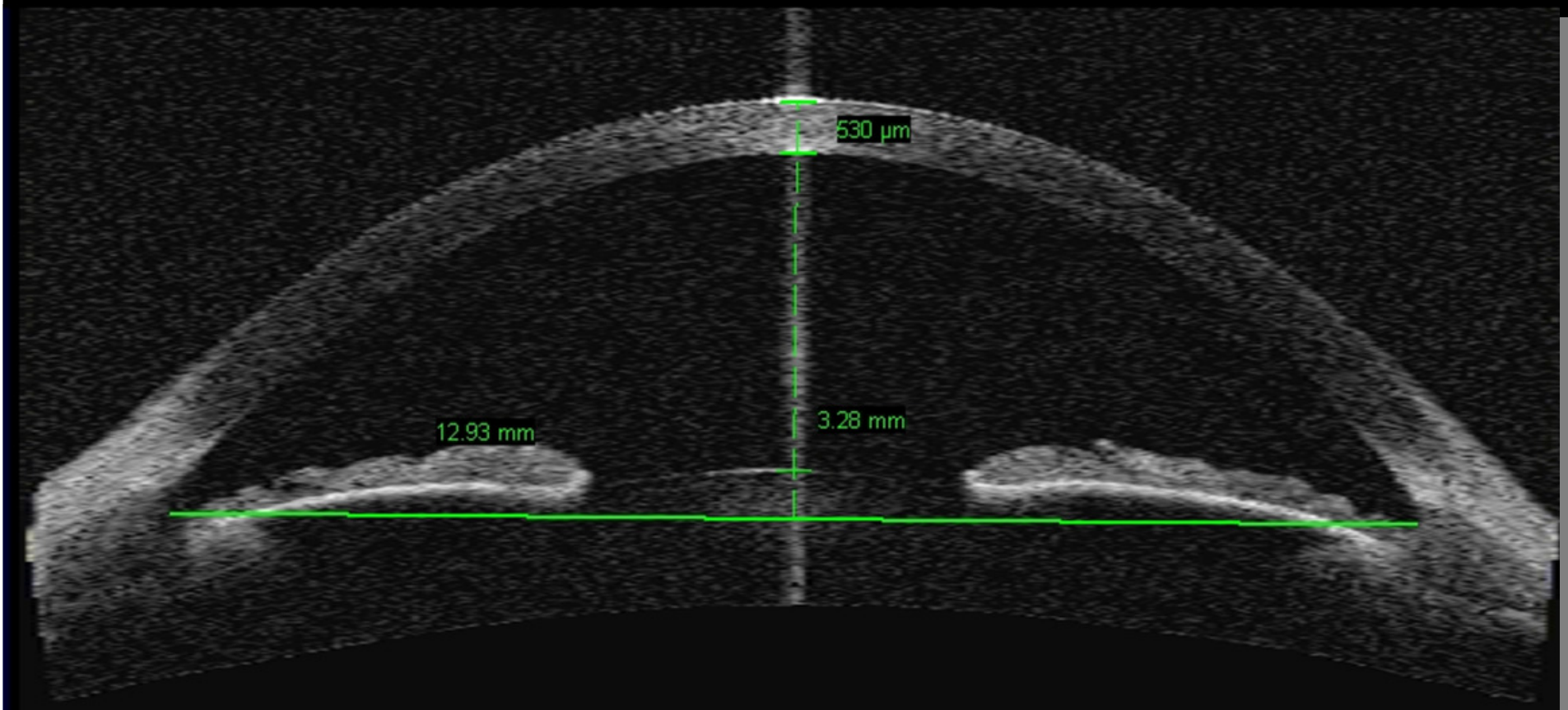
# Camera Anteriore





# Ampiezza e Volume della Camera Anteriore

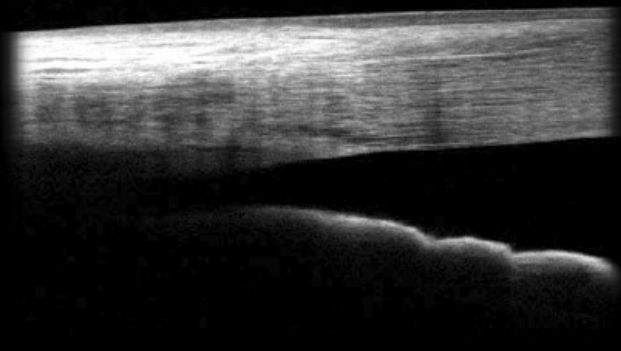




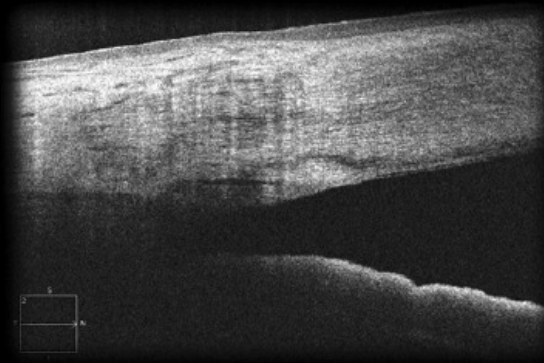
# Visante

# Angolo Irido-Corneale

Linea di Schwalbe, Canale di Schlemm,  
Sperone Sclerale



RTVUE

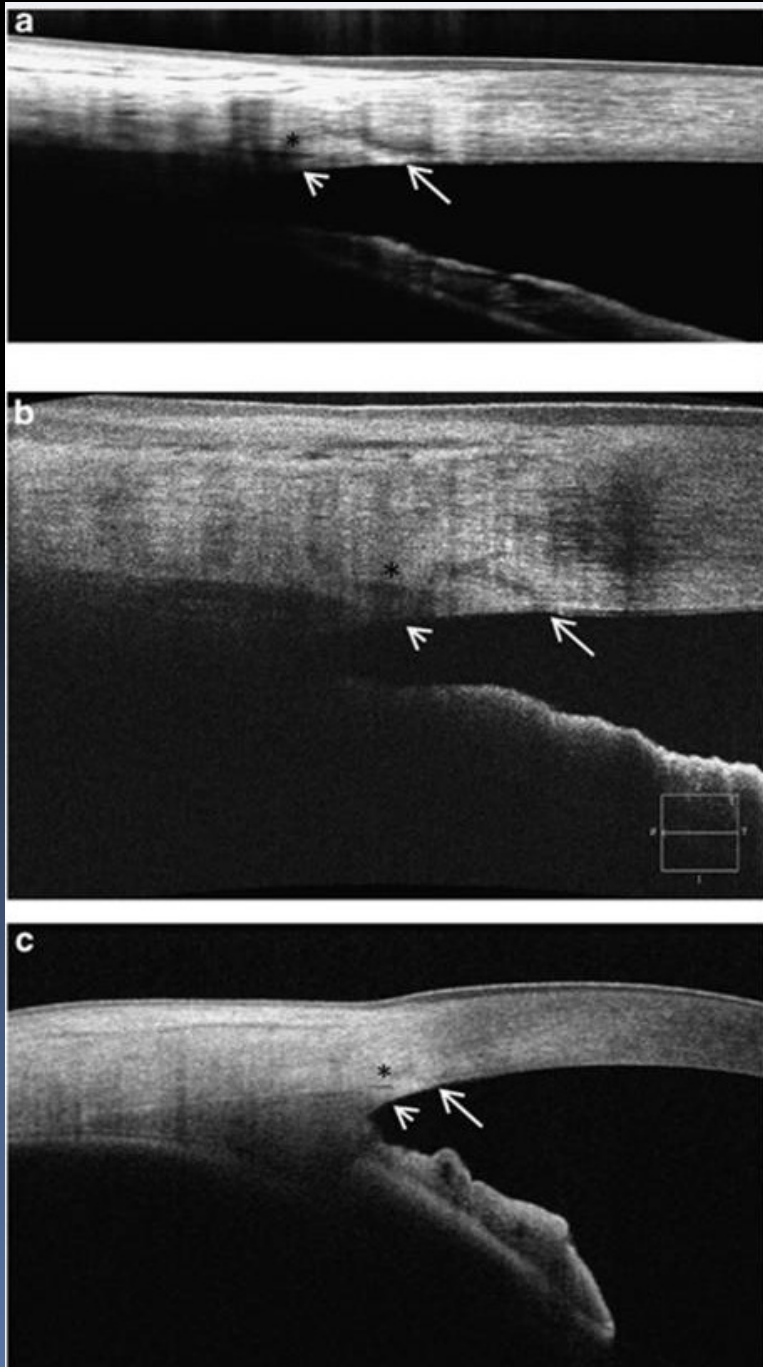


CIRRUS HD-OCT



CASIA OCT





An open anterior chamber angle imaged by:

1. **RTVue FD-OCT** (2 × 2 mm)  
(Optovue)

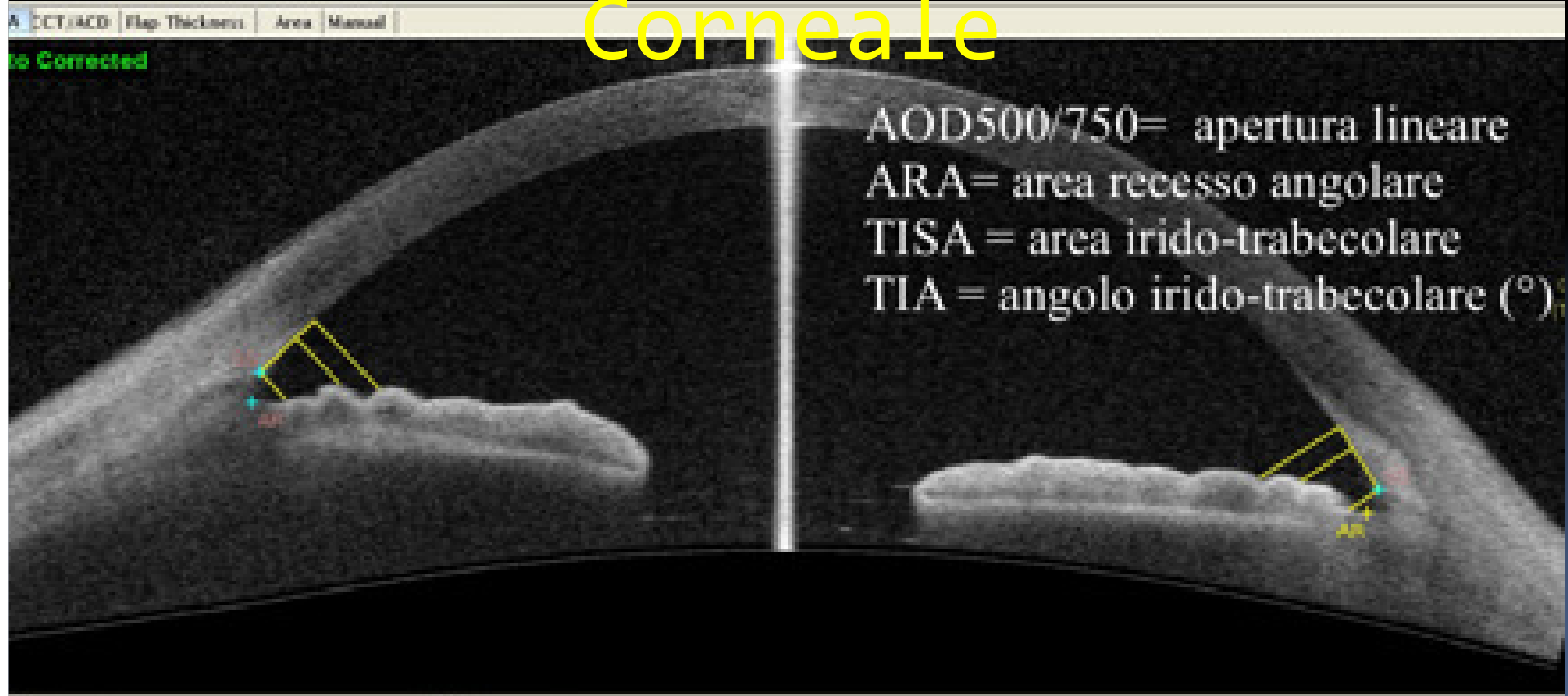
2. **Cirrus HD-OCT** (3 × 1 mm)  
(Carl Zeiss Meditec)

3. **CASIA OCT** (8 × 4 mm)  
(Tomey; c).

• Multiple B-scan averaging was performed in RTVue FD-OCT (16 B-scans) and CASIA OCT (3 B-scans).

**Schwalbe's line**-long arrow, **scleral spur**-short arrow, **Schlemm's canal**-\*.

# Ampiezza Angolo Irido- Corneale

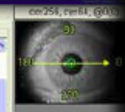


angle-opening distance (**AOD**), trabecular  
iris angle (**TIA**), angle recess area (**ARA**),  
and trabecular iris space area (**TISA**)

Casia

External Segment

ADD500: 0.606 [mm]  
ADD750: 0.663 [mm]  
ARA500: 0.257 [mm^2]  
ARA750: 0.406 [mm^2]  
TISA500: 0.213 [mm^2]



Auto Move Cursor

- TMPLANE
- SS-IF
- ADD500-T
- ADD500-IF
- ARAT
- ARA-IF
- AR

Paint

X: 276  
Y: 677

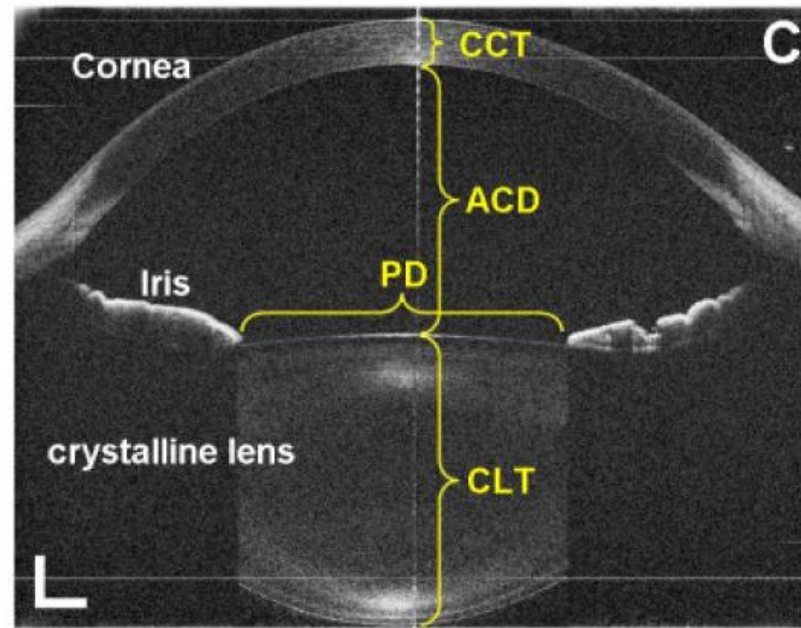
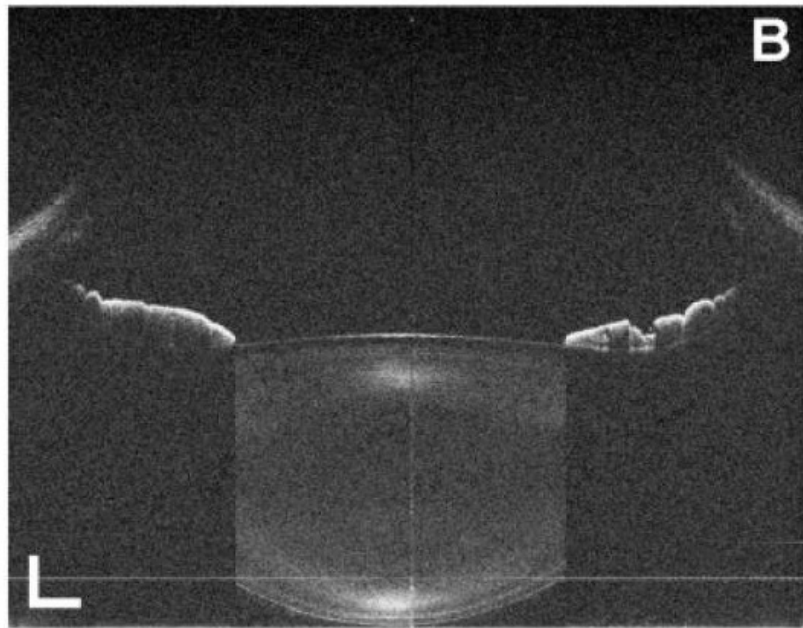
Mouse Pos

Transparent

ADD500: 0.606 [mm]  
ADD750: 0.663 [mm]  
ARA500: 0.257 [mm^2]  
ARA750: 0.406 [mm^2]  
TISA500: 0.213 [mm^2]  
TIA500: 35.0 [deg]

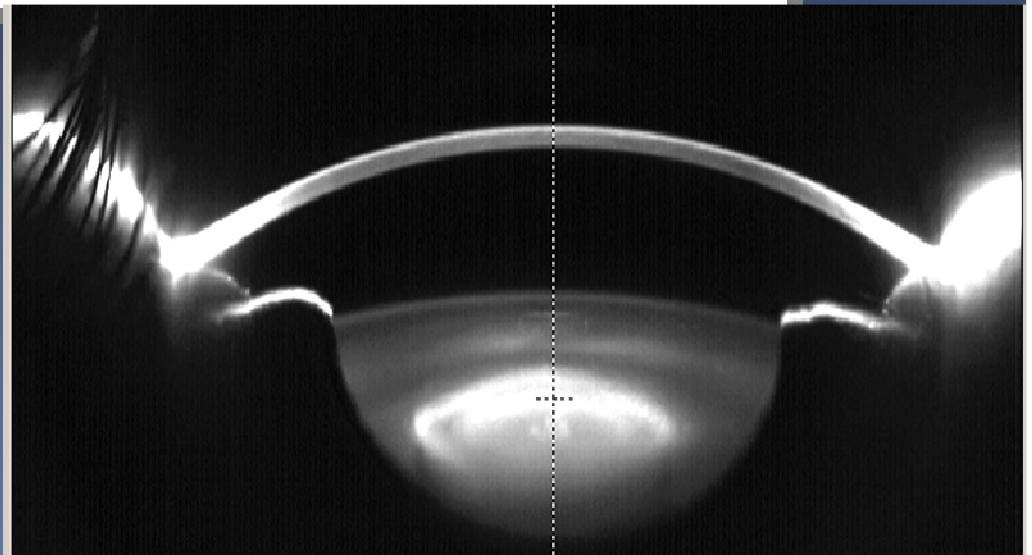
ADD500: 0.440 [mm]  
ADD750: 0.819 [mm]  
TISA500: 0.122 [mm^2]  
TISA750: 0.278 [mm^2]  
TIA500: 44.2 [deg]  
TIA500: 44.2 [deg]

# Cristallino



Casia

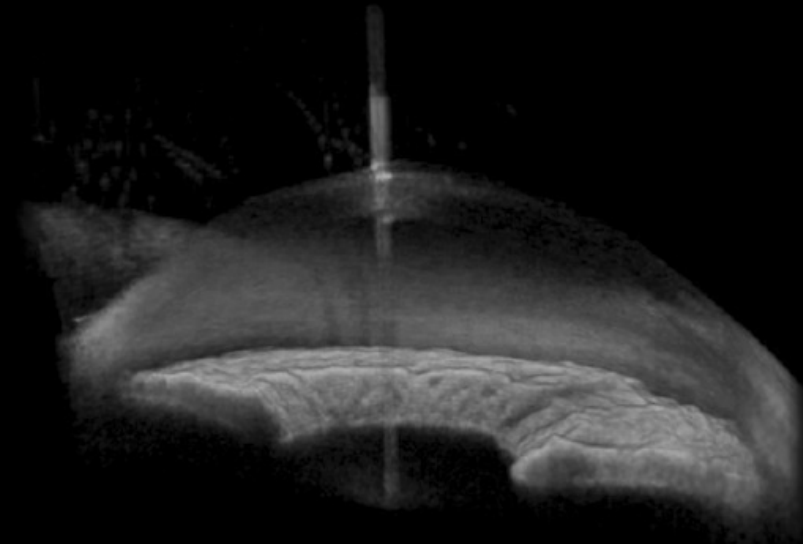
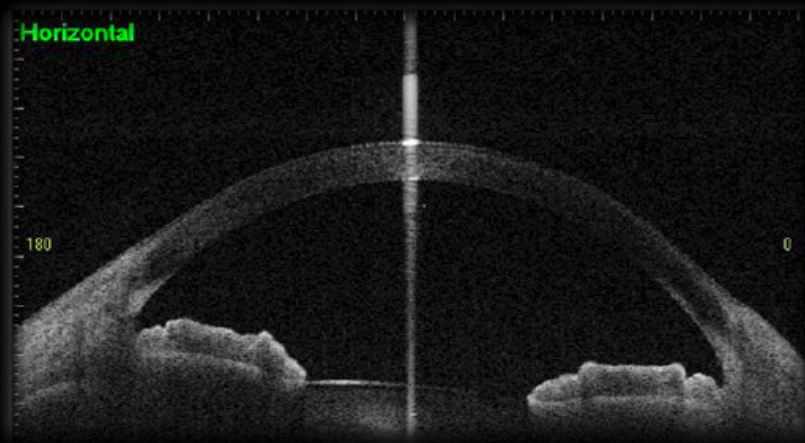
Pentacam



# Valutazione Alterazioni Patologiche

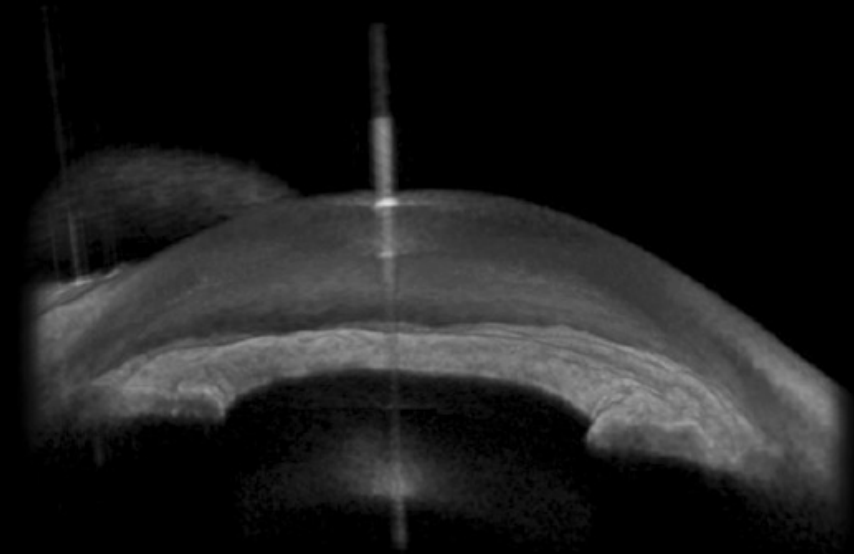
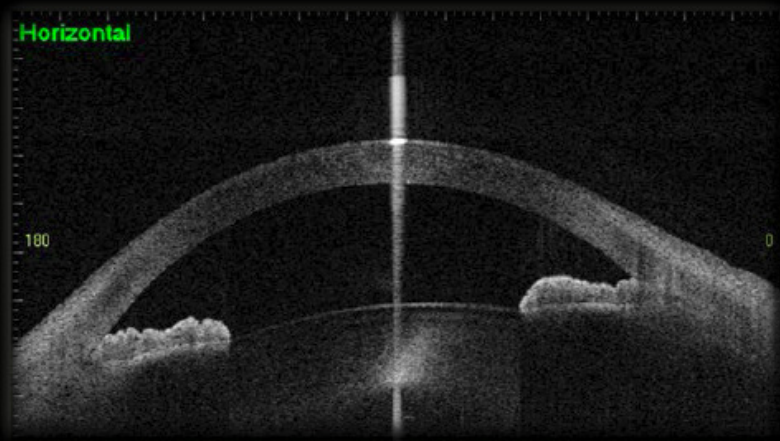
- Cornea
- Iride
- Glaucoma
  - Anatomia dell'angolo
    - Angolo aperto
    - Angolo chiuso
    - Plateau iris
    - Phacomorfico

# Angolo Aperto



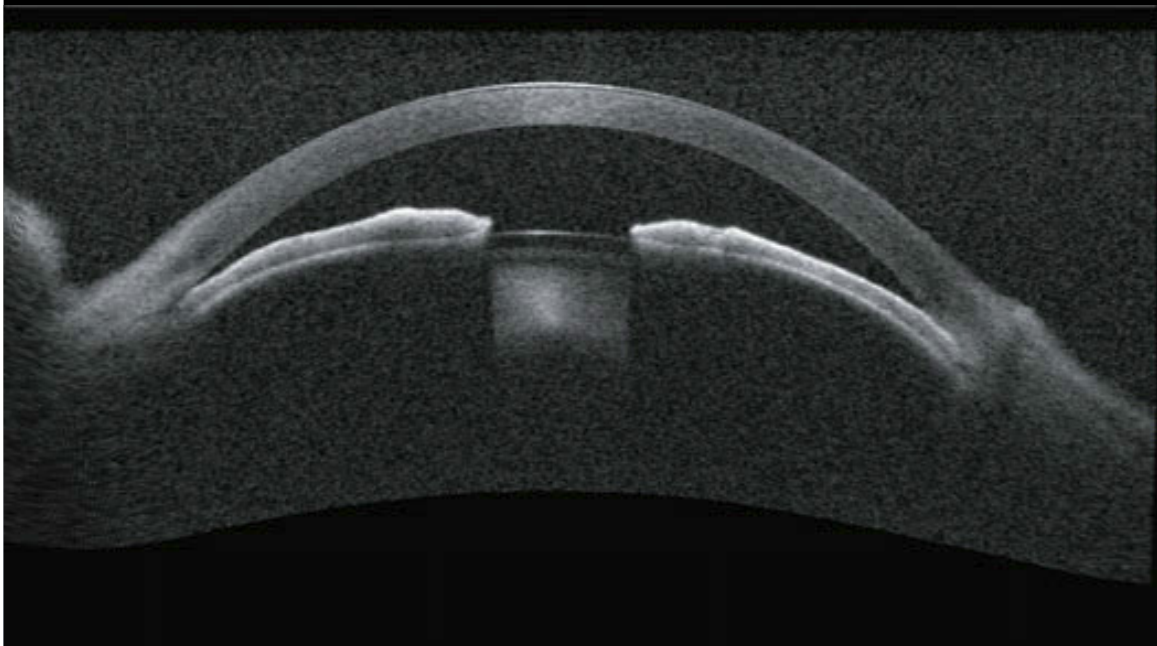
Casia

# Angolo Stretto

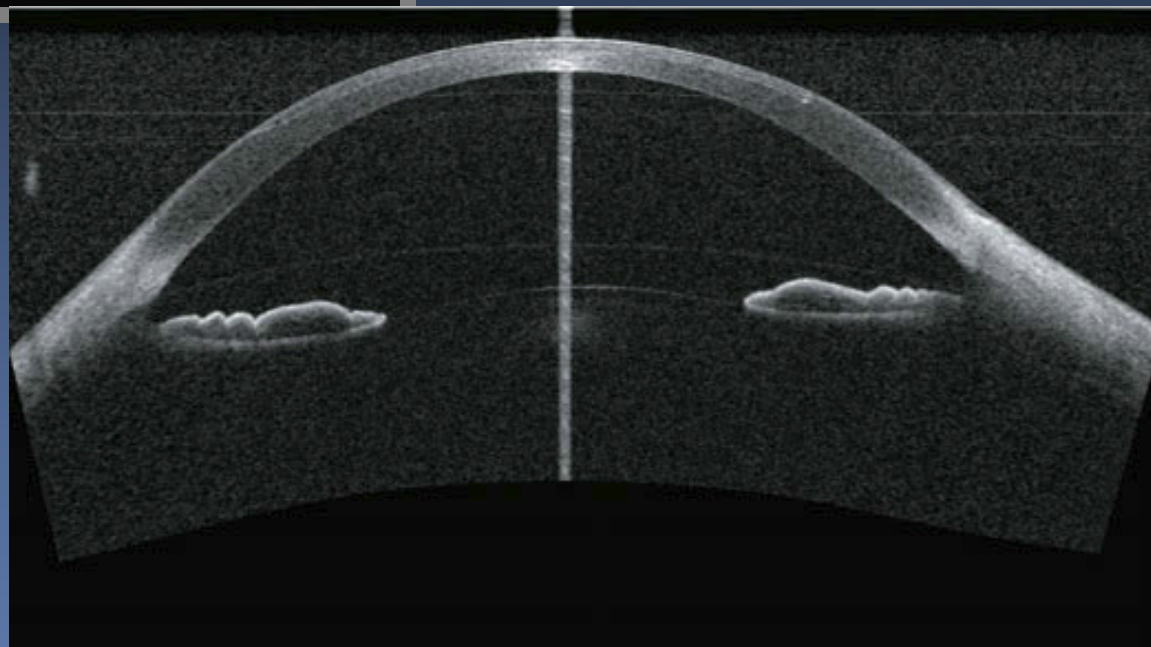


Casia

Angolo

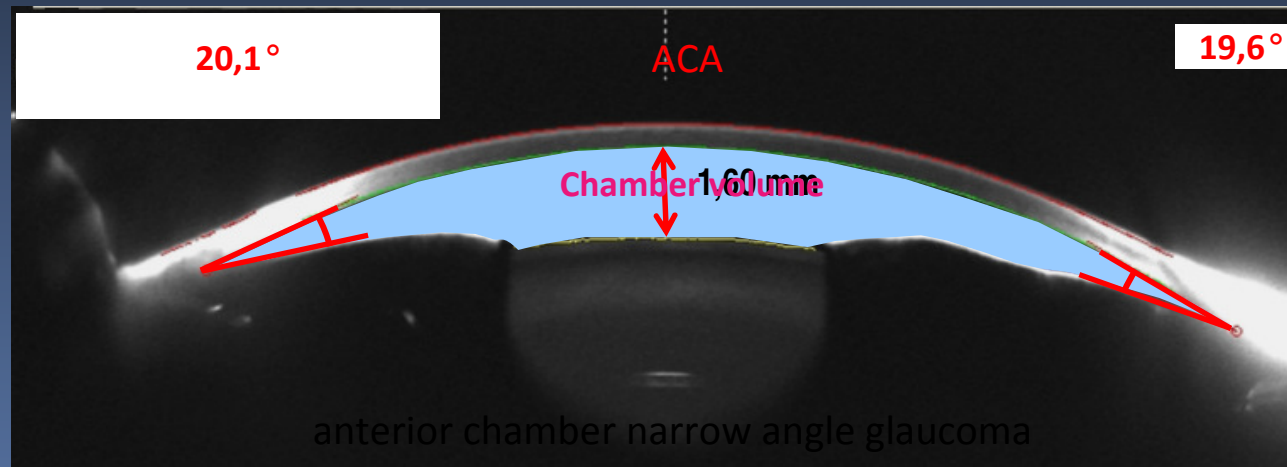
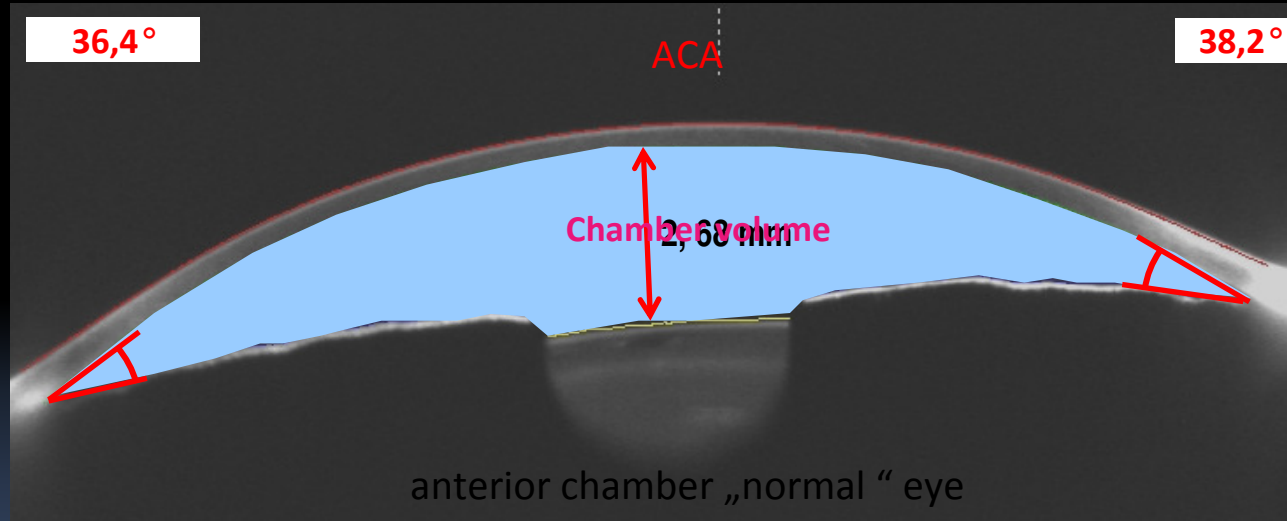


Casia





# Angolo Irido-Corneale



Automatic Calculation of:

- Anterior chamber depth (ACD): internal/external
- Anterior chamber angle (ACA): in all sectional planes
- Chamber volume (ACV)

Pentacam

# Valutazione Postintervento

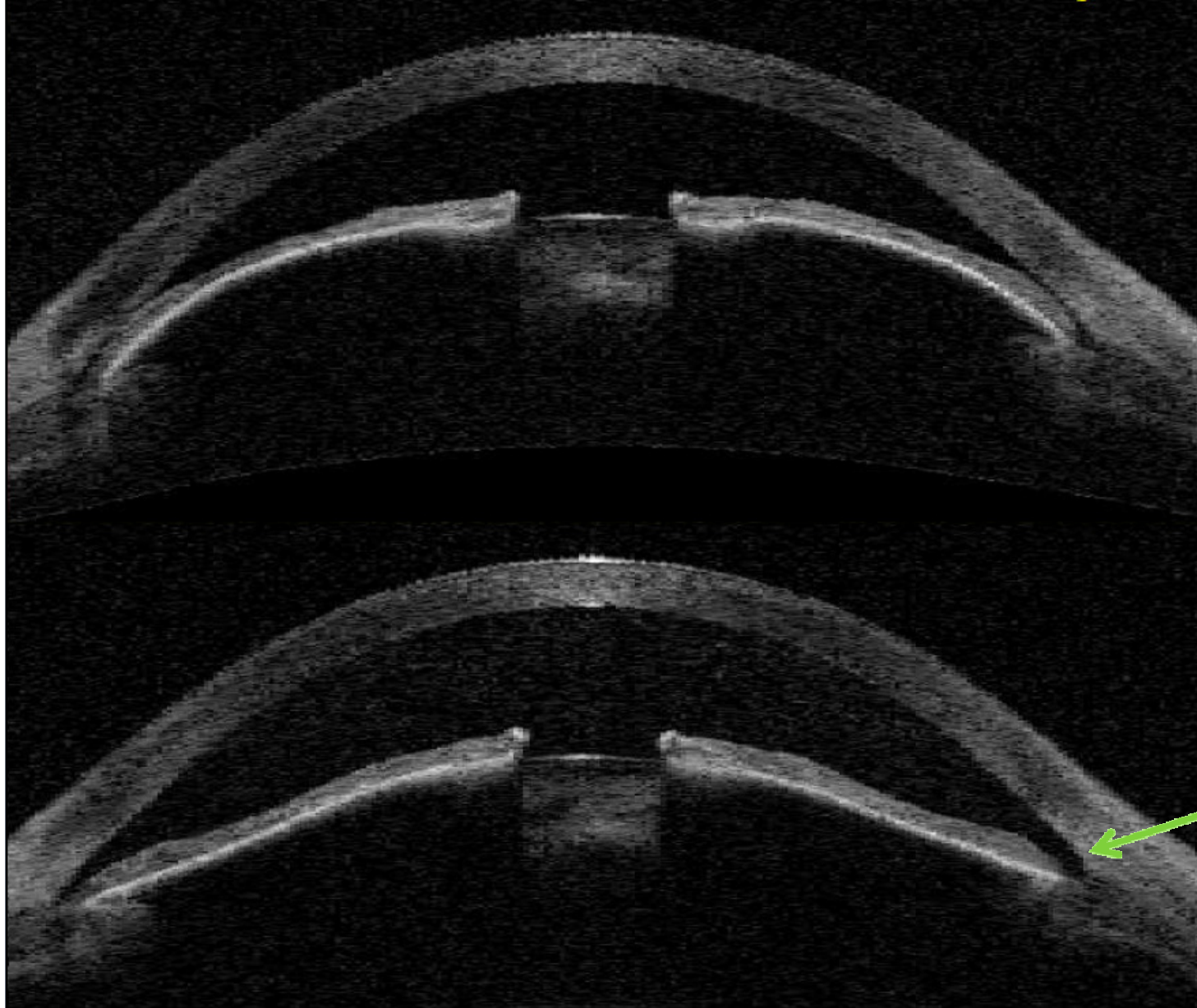
- Valutazione postoperatoria  
anatomia:

1. Cornea

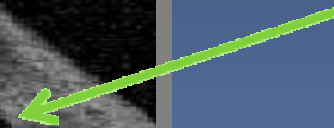
2. Camera Anteriore

3. Angolo

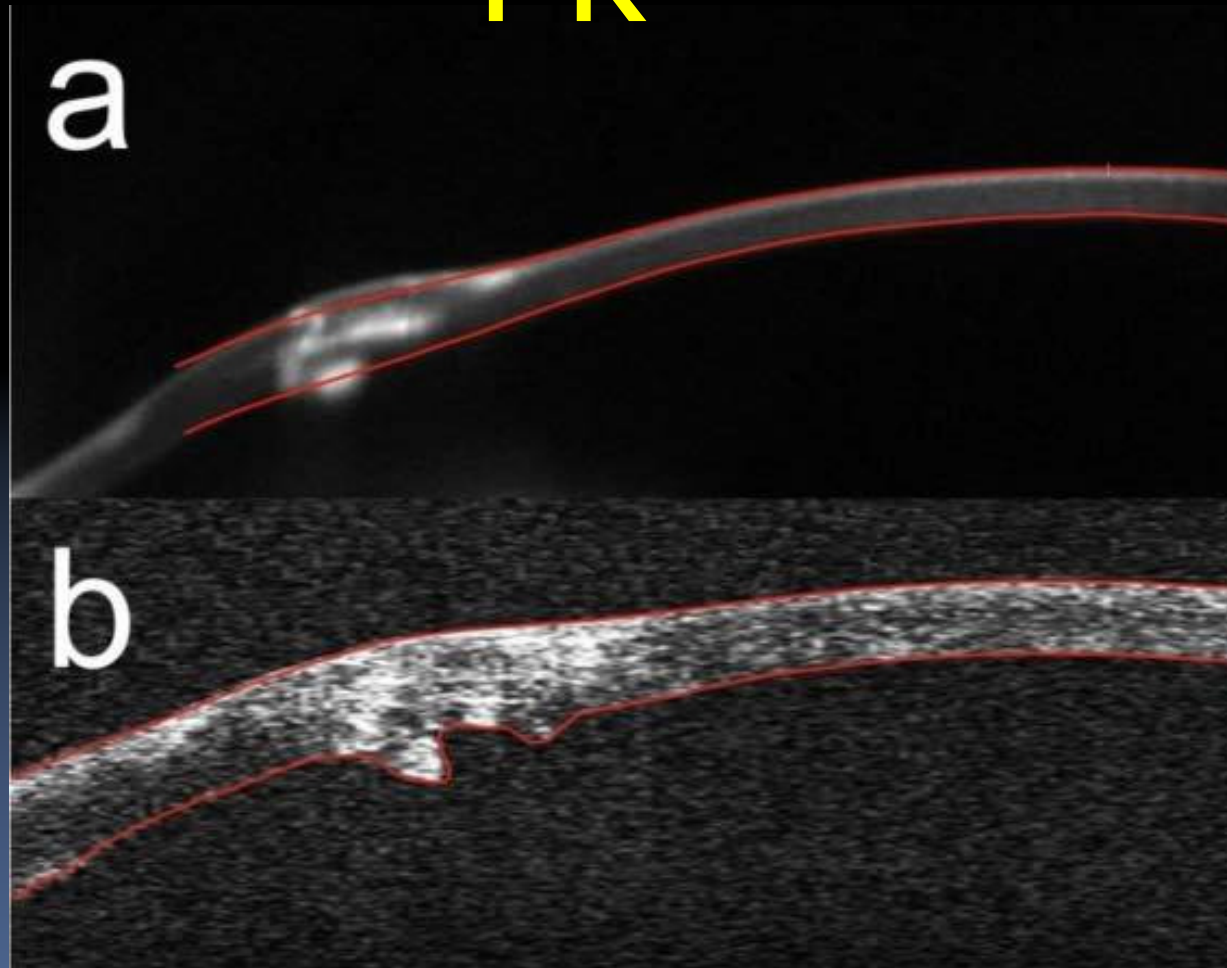
# Iridotomia YAG



Visante

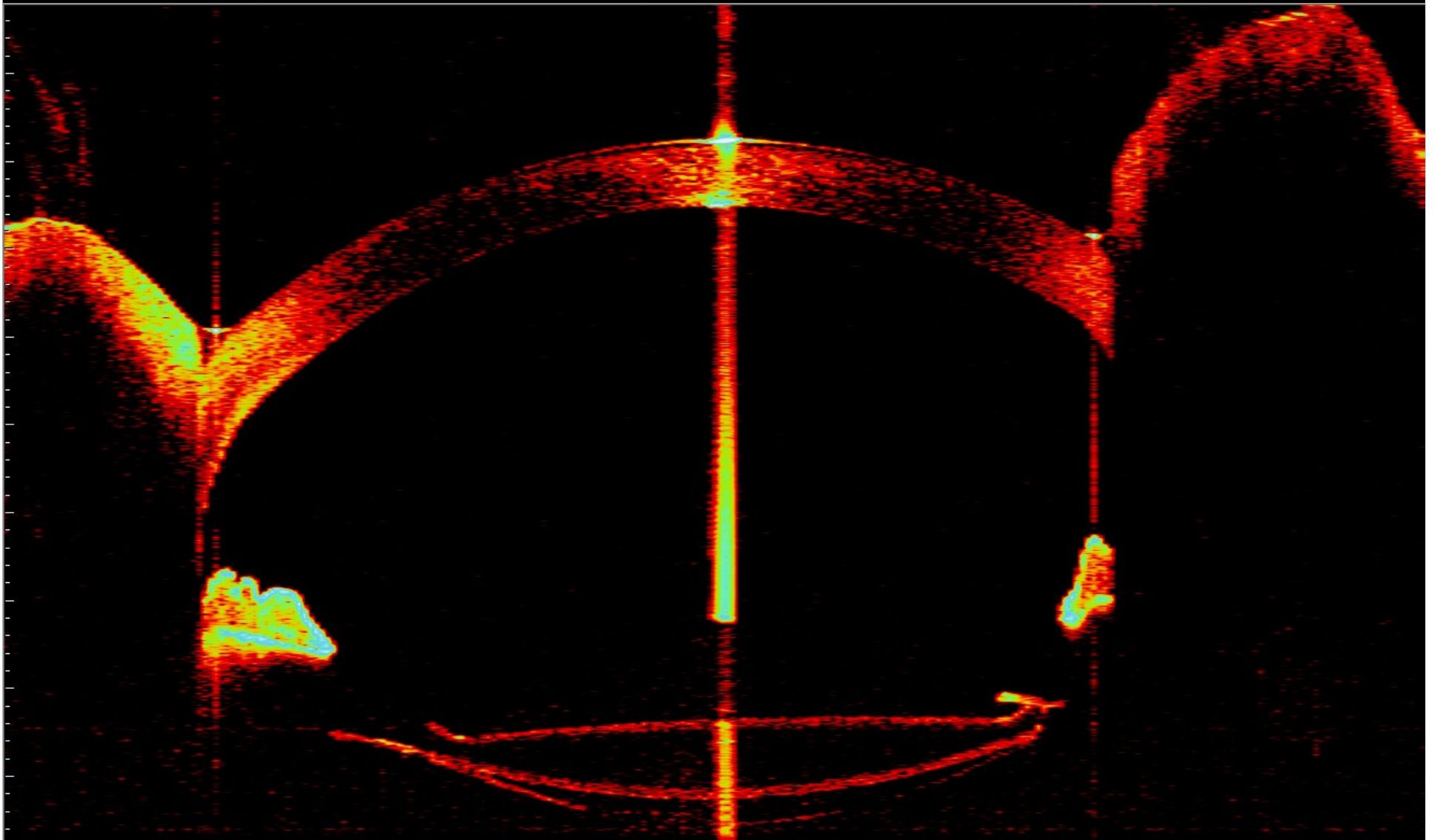


# PK



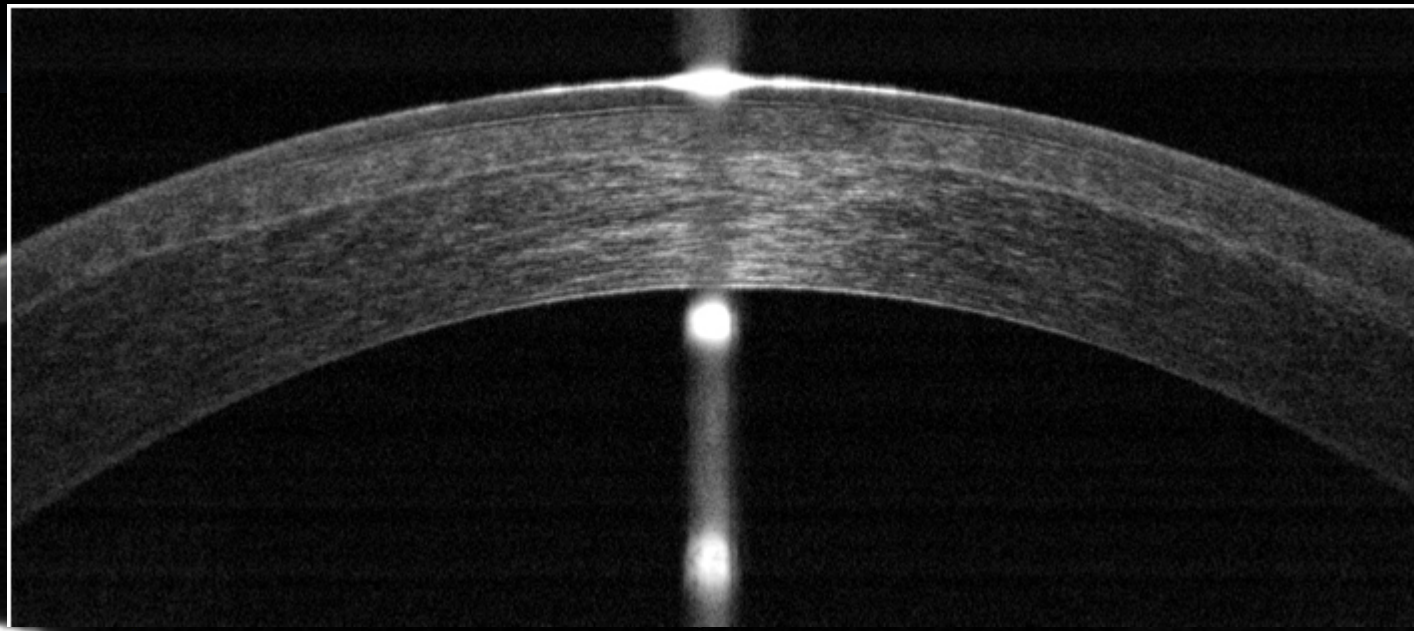
Cross-sectional images of the cornea after PK:  
(a) Scheimpflug image measured by Pentacam HR  
(b) SS OCT cross-sectional image. Red lines delineate the segmented corneal boundaries.

# PC IOL

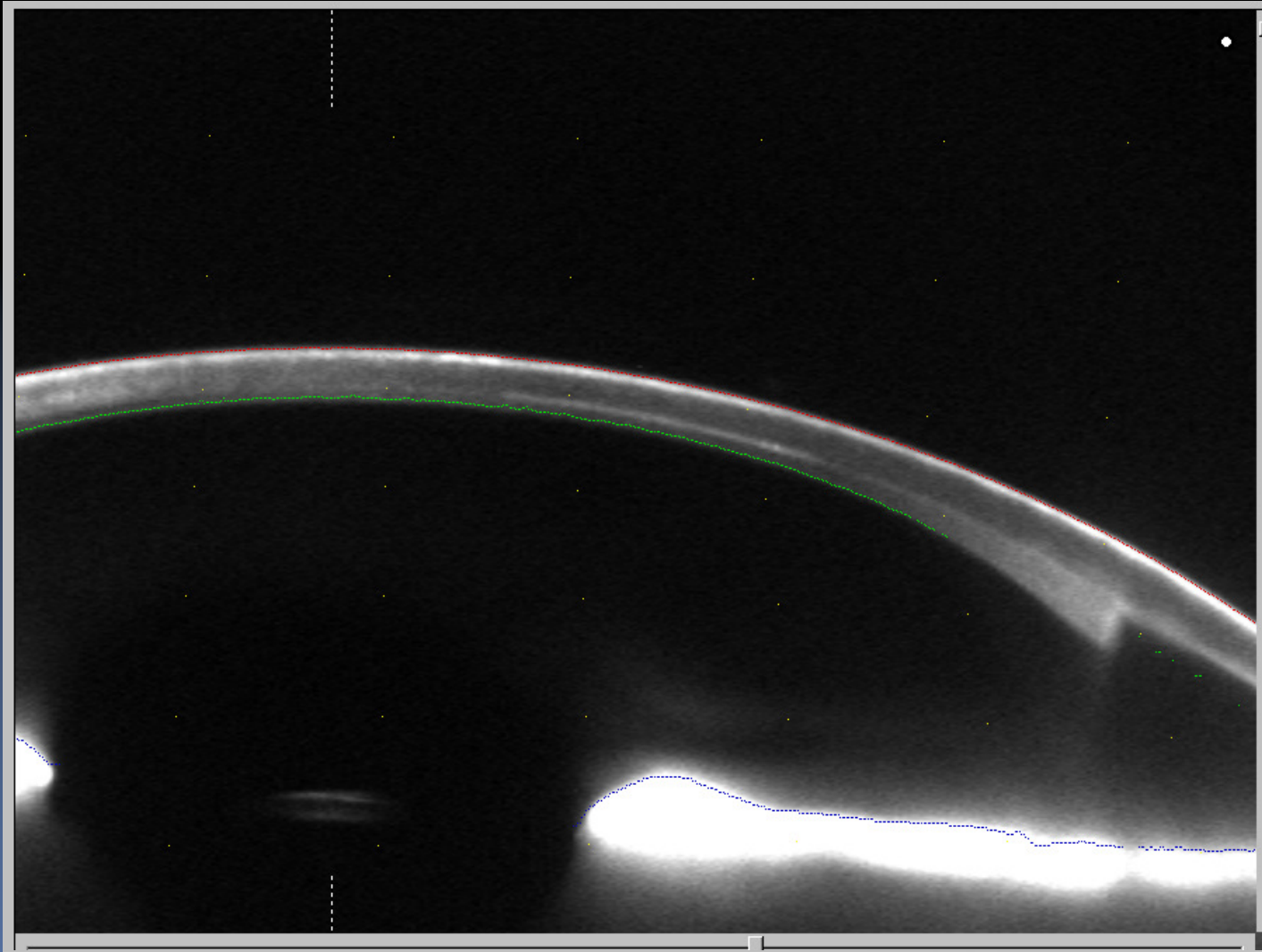


# Flap Lasik

## Pentacam vs RTVue

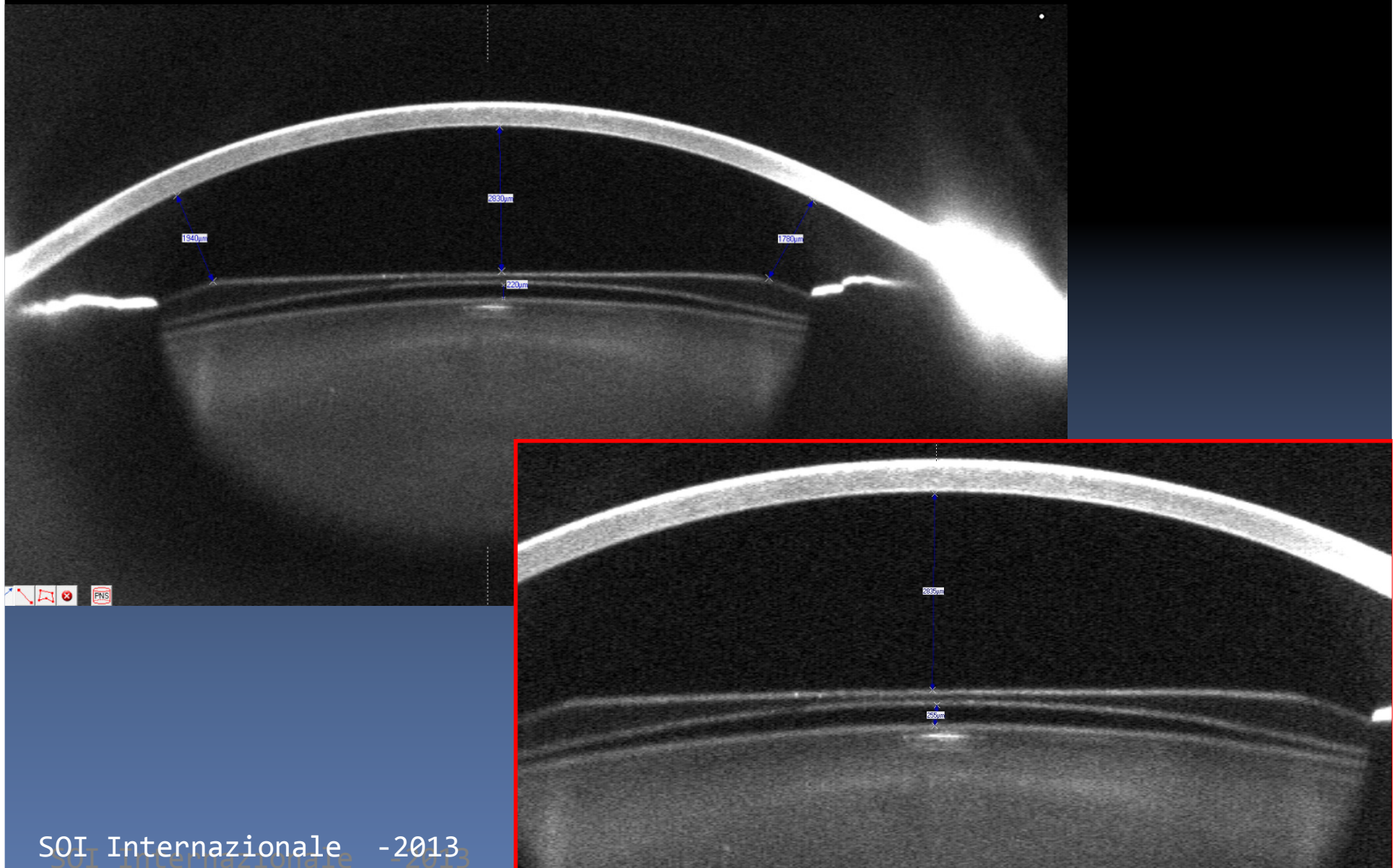


# DSAEK

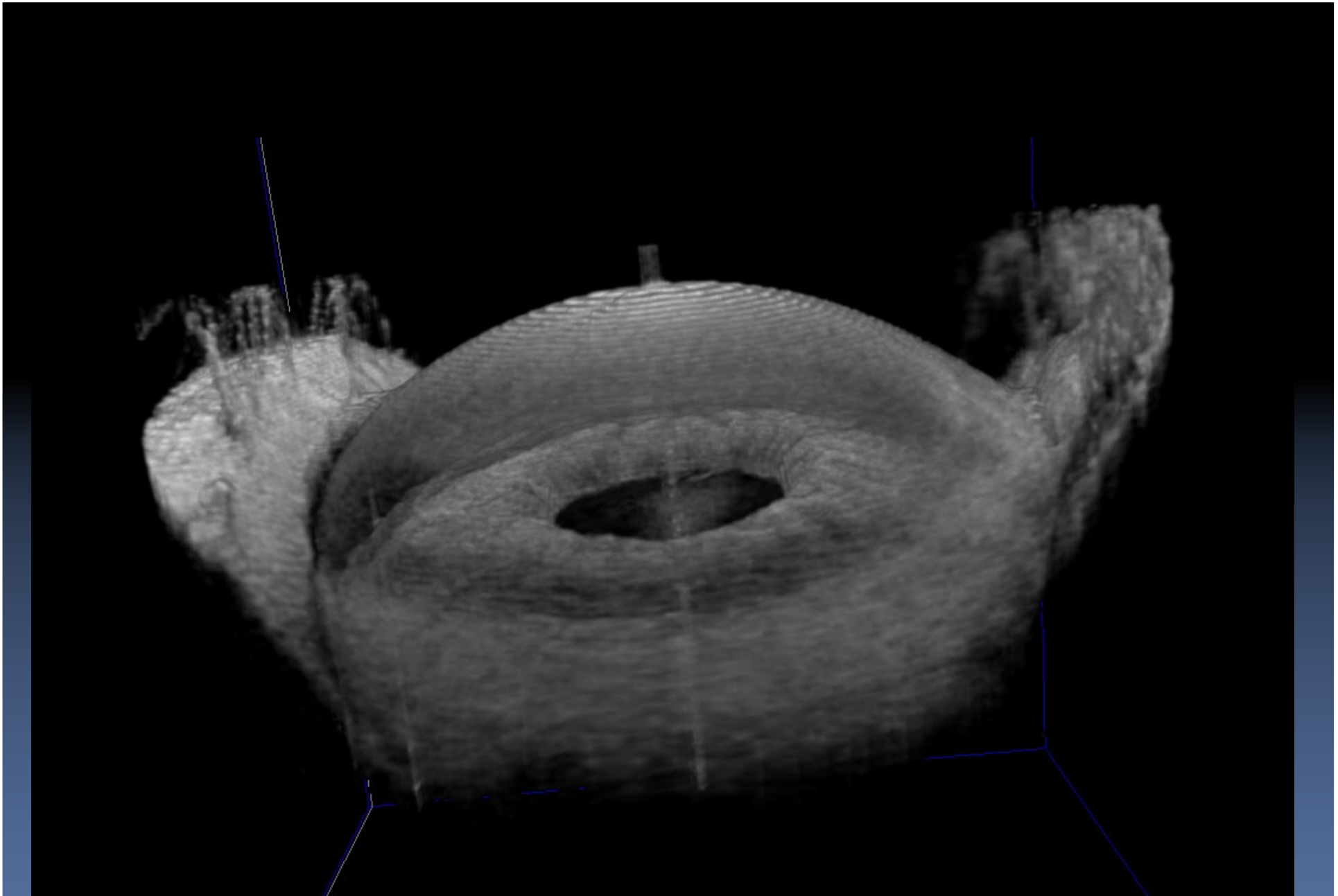


With courtesy from Prof. Michael Belin

# Phakic IOL, PC









Grazie per  
L'Attenzione !