Role of Anterior Segment OCT in Corneal Imaging

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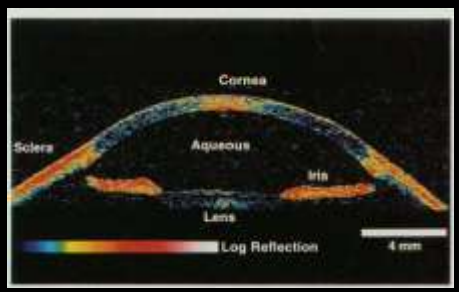
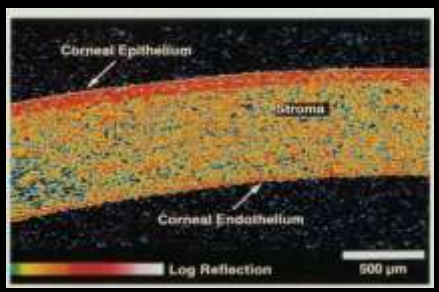
- OCT is a noninvasive imaging technique first introduced in 1991.
- The first visualization of the cornea and anterior segment by OCT was reported in 1994 by Izatt et al





Anterior Segment OCT Systems

Systems have wide scan ranges (16 mm width & 7 mm depth)

- Zeiss Visantie

- Heidelberg SL-OCT

- Tomey CASIA

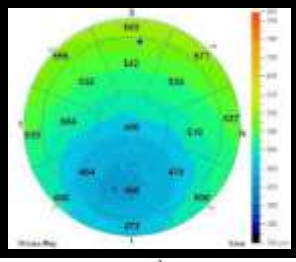
Systems have limited scan ranges (~6 mm width & 2 mm depth)

- Optovue

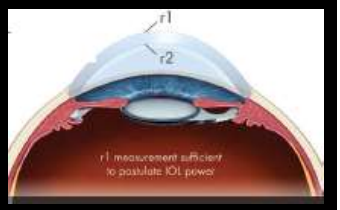
- Zeiss Cirrus

- Heidelberg Spectralis

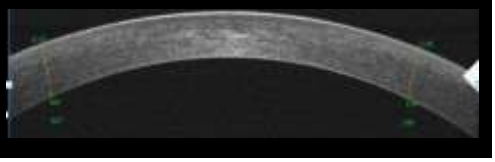
Anterior Segment OCT scanning of the cornea can provide:



- **Pachymetry maps**



- **Corneal diopteric power**

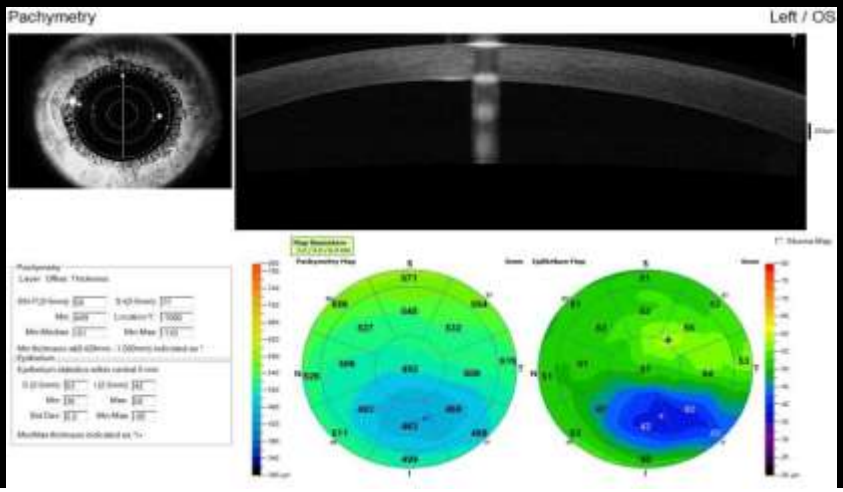


- **Corneal line scans**

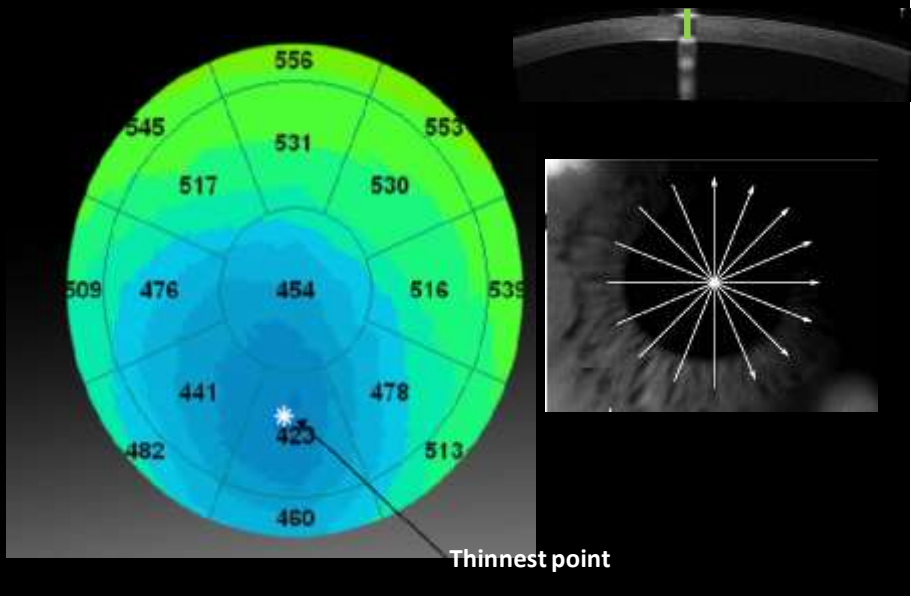
Corneal Thickness Measurement

(Pachymetry)

- As-OCT creates a pachymetry map that provides thickness readings across 6 mm of cornea.



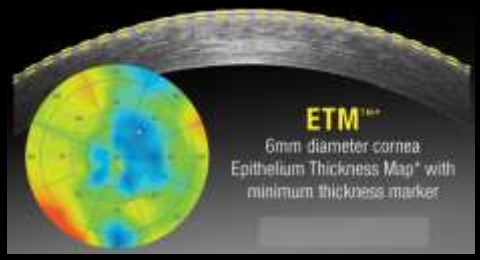
Corneal thickness map

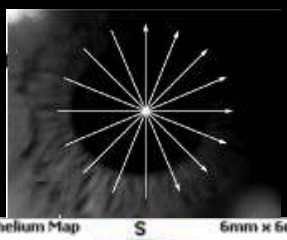


Epithelial thickness map

- 8 radial scans with automated boundary detection: tear film to Bowman's
- Normal Thickness:

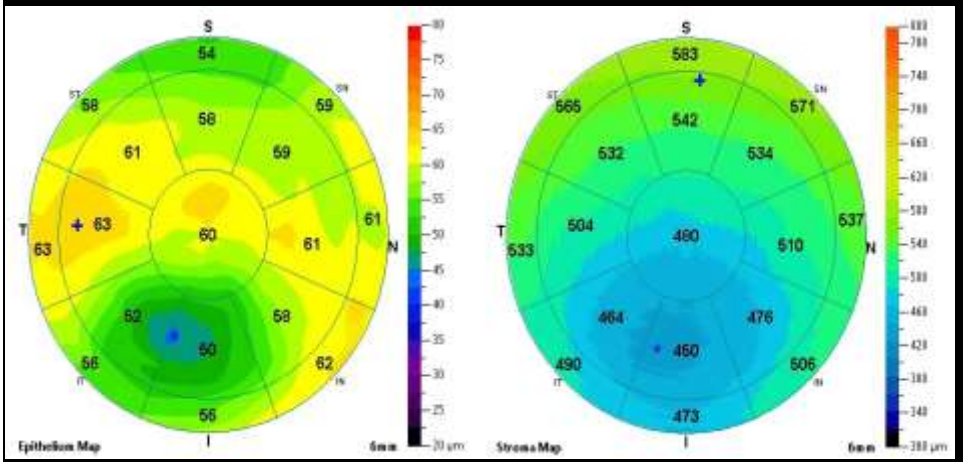
  Central >Inferior >Superior

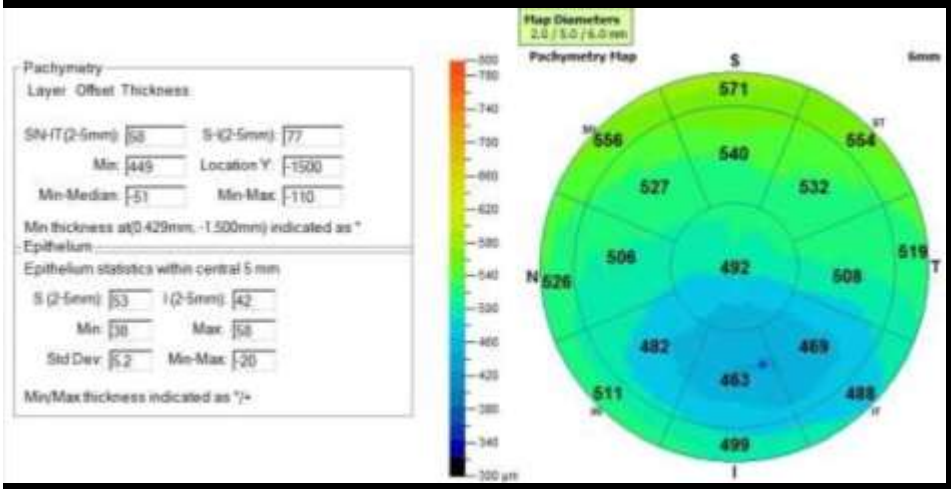




Stroma map

- AS-OCT has the ability to differentiate between stromal and epithelial layers



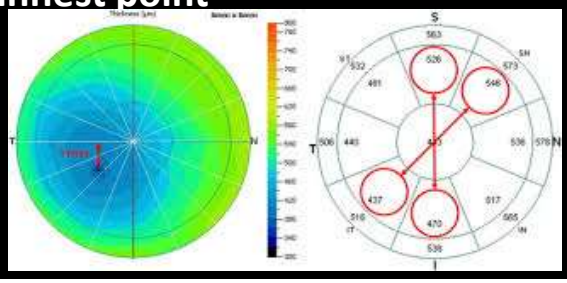


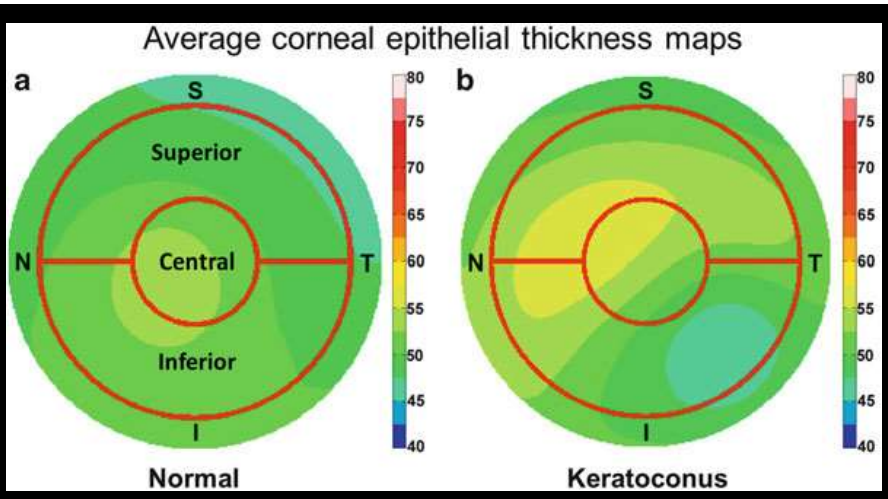
AS-OCT and LASIK

- As-OCT is a valuable tool for LASIK surgeons, both before and after surgery
- AS-OCT can detect early forme fruste keratoconus

AS-OCT signs of keratoconus

- Abnormal focal epithelial thinning.
- Thinning displaced inferior
- Greater difference between mean thickness and thinnest point



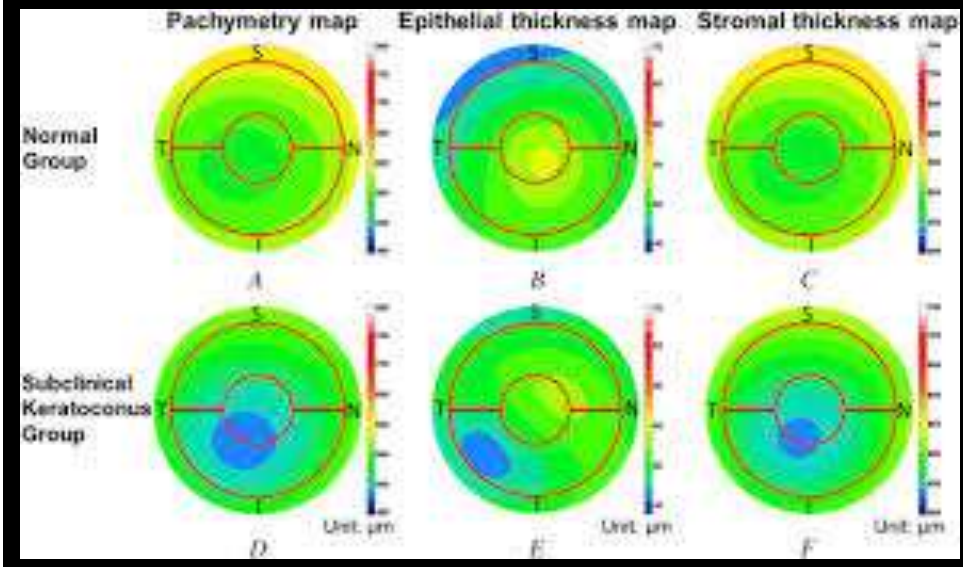


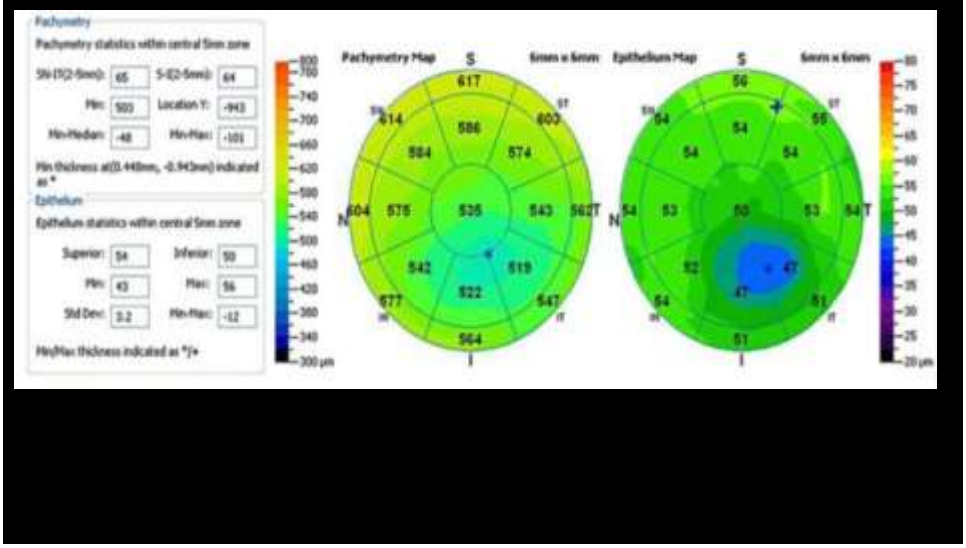
- Keratoconus shows a focal thinning, typically infero-temporally.

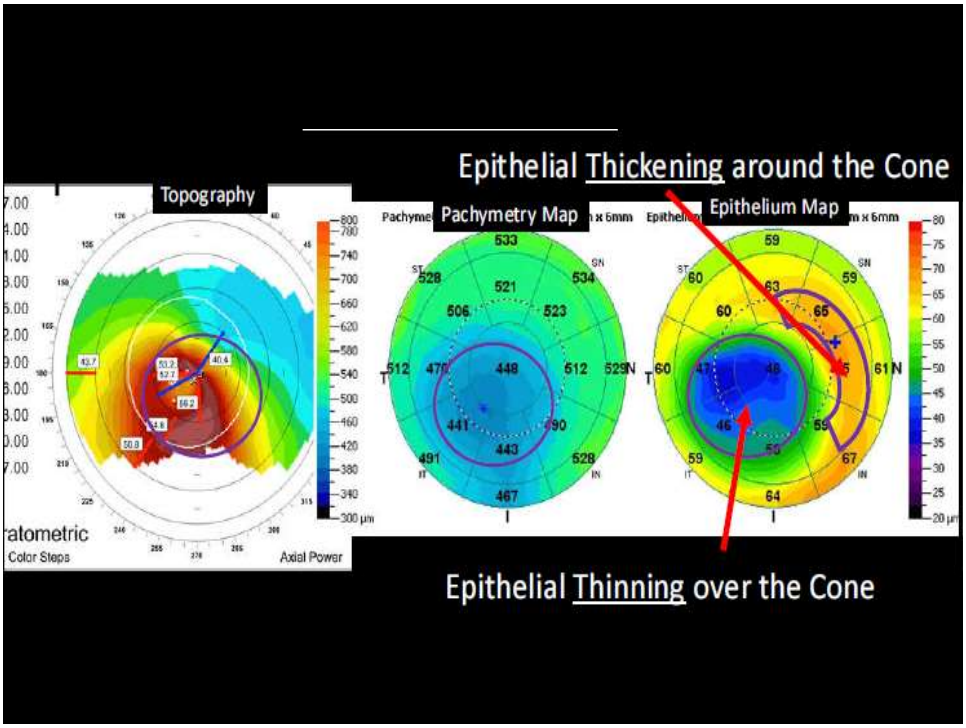
Cutoff values for OCT pachymetric parameters

Pachymetric parameters	Minimum	Minimum–maximum	I-S	IT-SN
Cutoff (unit: μm)	472	−62	−52	−51

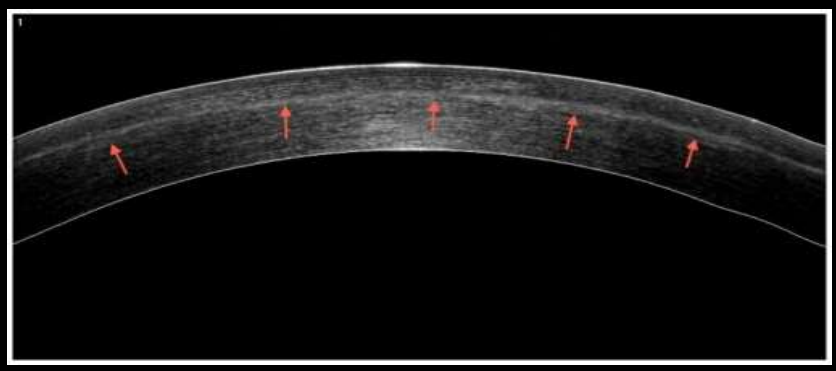
- If one parameter is abnormal, the cornea is likely to have keratoconus.
- If two or more parameters are abnormal, then the eye is very likely to have keratoconus



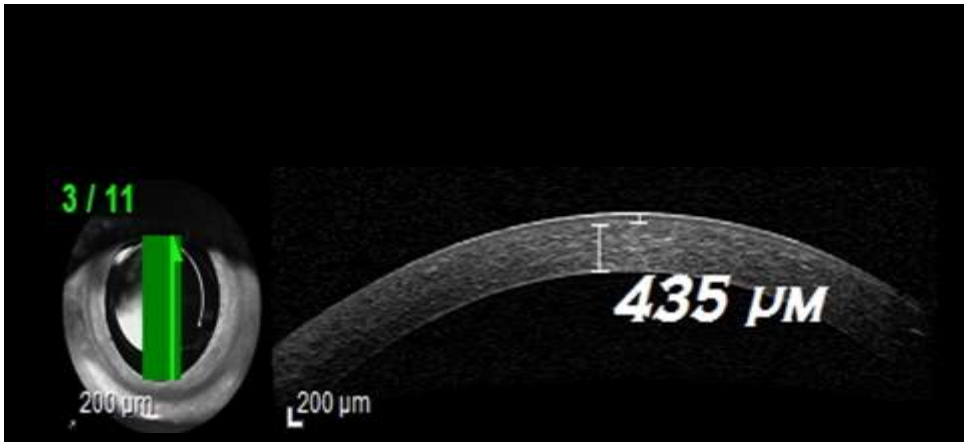

Pachymetry
Pachymetry statistics within central 5mm zone
Epithelium
Epithelium statistics within central 5mm zone
Pachymetry Map
Epithelium Map
6mm x 6mm


Epithelial Thickening around the Cone
Topography
Pachymetry Map
Epithelium Map
Axial Power
Epithelial Thinning over the Cone

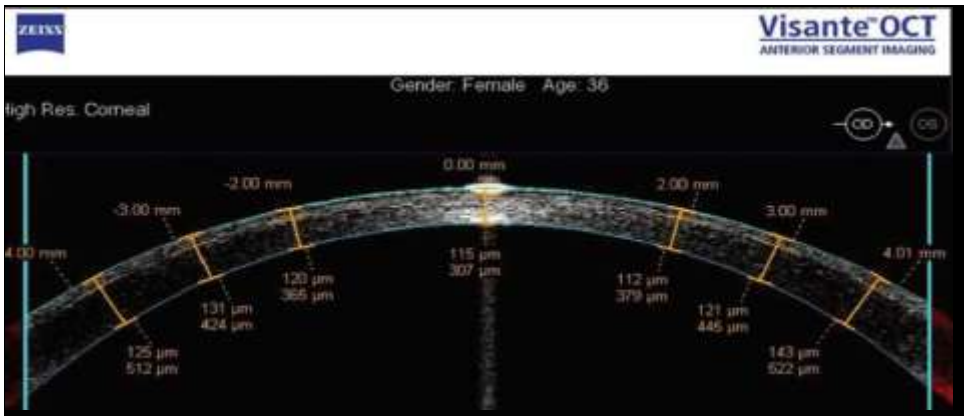
- A second important use for AS-OCT in LASIK patients is as a way to evaluate the cornea when a LASIK patient needs an enhancement



- Evaluation of the Flap and Stromal Residual Bed in the Postoperative and Prior to Deciding on a Retreatment



Residual stroma measure

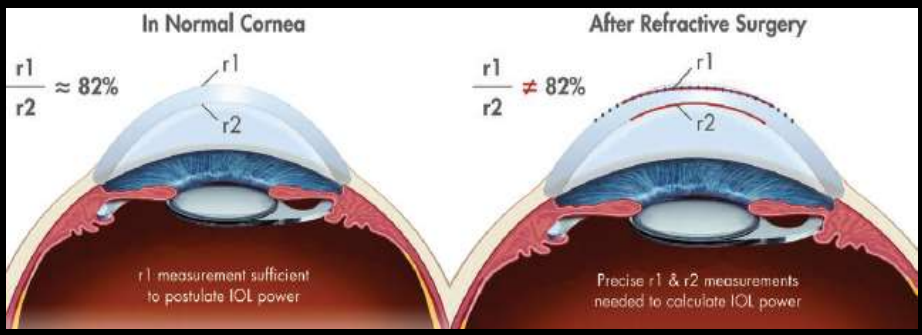


- **OCT Visante evaluates flap dimensions along all points and its length. In addition, it can give an accurate measurements of the stromal residual bed post-LASIK.**

Corneal Power Measurement

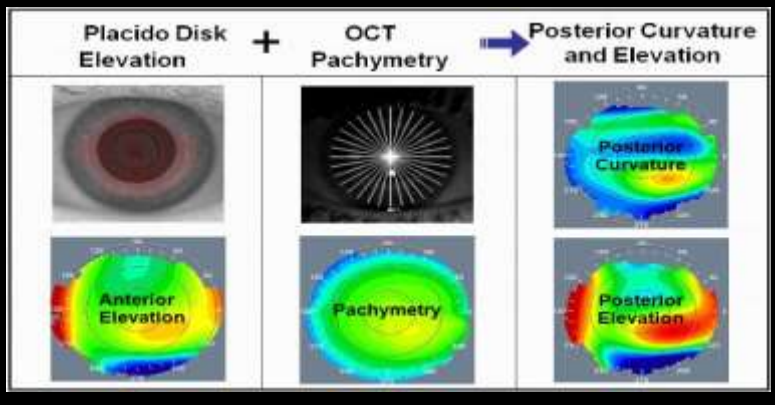
- OCT can be used to measure corneal power, so improve the calculation of IOL power in cataract surgeries after corneal refractive surgery

- In post-LASIK cataractous patients, the relationship between the anterior and posterior corneal curvature are altered by LASIK



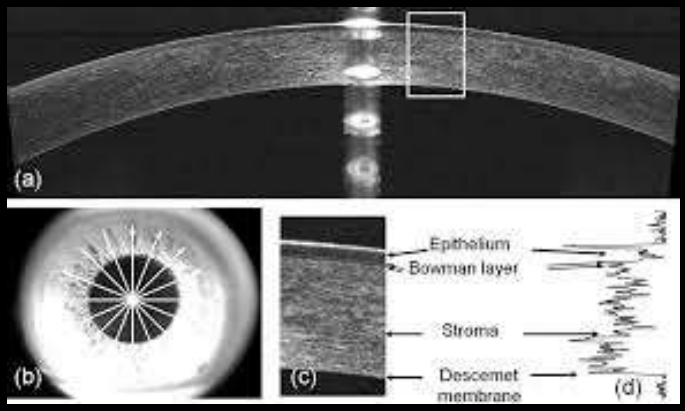
- The investigation of OCT corneal power started with the use of TD-OCT.
- Due to the slow speed of TD-OCT, the direct measurement of anterior and posterior corneal powers was imprecise.

- It was necessary to combine OCT pachymetry with Placido-ring topography to obtain acceptable measurement of net corneal power

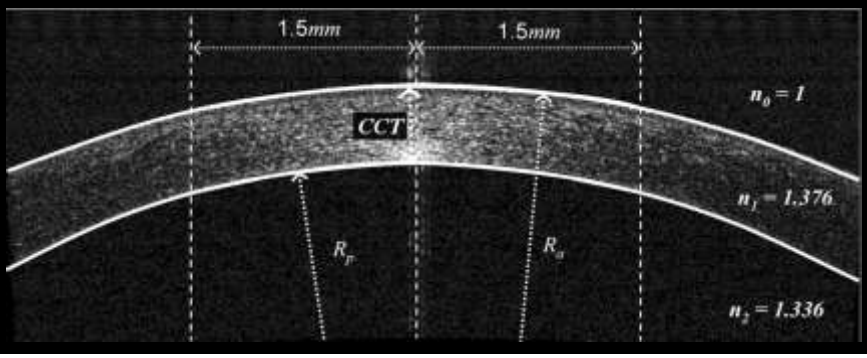


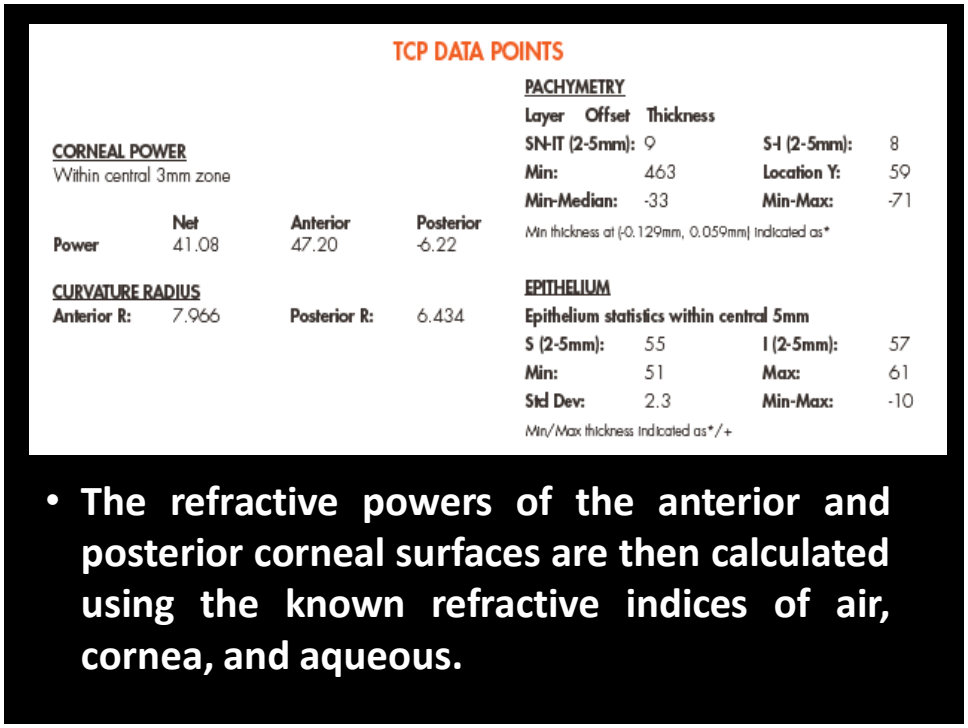
- With SD-OCT, the speed of OCT corneal mapping became much faster.
- The measure of net corneal power can be done without any supplemental information from Placido-ring topography

- **The cornea is scanned with a mapping pattern (Pachymetry + Power) that consisted of 6-mm lines on eight evenly spaced meridians with centration on the pupil.**



- **On each meridional cross-sectional OCT image, the software identifies the anterior and posterior corneal boundaries.**
- **The anterior and posterior corneal radii of curvature *(Ra and Rp)* are calculated by fitting within the central 3mm-diameter zone**





TCP DATA POINTS

CORNEAL POWER
Within central 3mm zone

	Net	Anterior	Posterior
Power	41.08	47.20	-6.22

CURVATURE RADIUS

Anterior R:	7.966	Posterior R:	6.434

PACHYMETRY

Layer	Offset	Thickness		
SN-IT (2-5mm):	9		S-I (2-5mm):	8
Min:	463		Location Y:	59
Min-Median:	-33		Min-Max:	-71

Min thickness at (-0.129mm, 0.059mm) indicated as*

EPITHELIUM

Epithelium statistics within central 5mm

S (2-5mm):	55	I (2-5mm):	57
Min:	51	Max:	61
Std Dev:	2.3	Min-Max:	-10

Min/Max thickness indicated as*/+

- **The refractive powers of the anterior and posterior corneal surfaces are then calculated using the known refractive indices of air, cornea, and aqueous.**

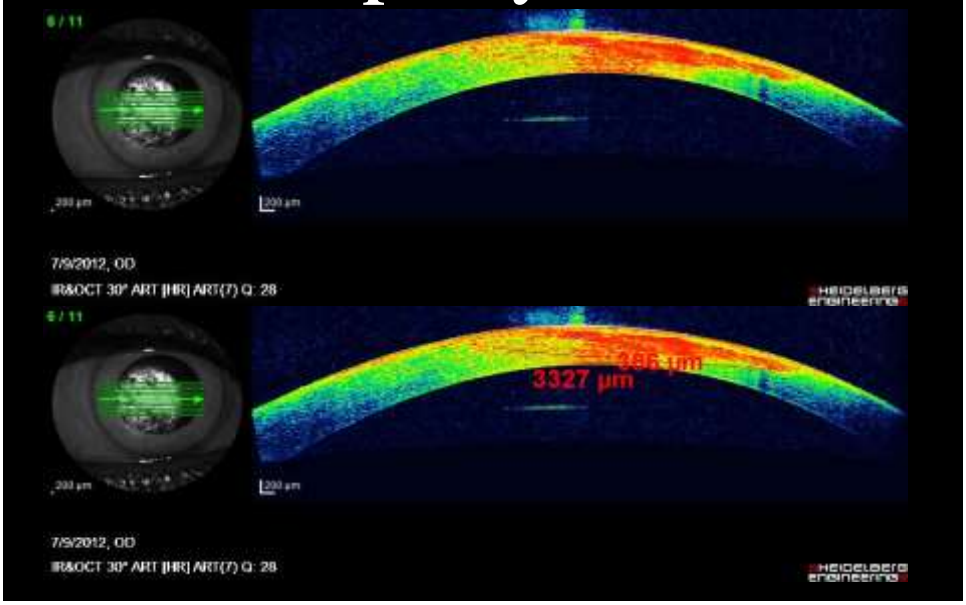
Corneal Line Scans

AS-OCT In corneal opacities detection

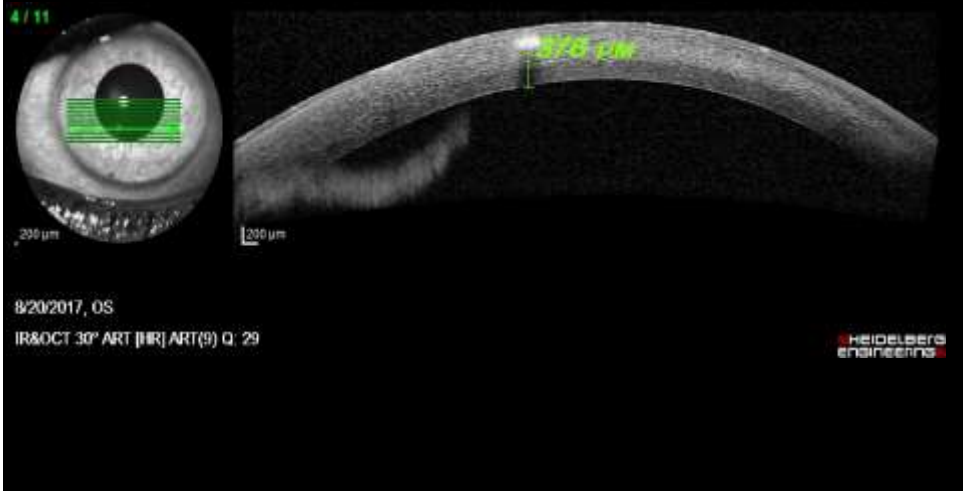
- Corneal opacities can be seen on the slit lamp.
- However, the depth at which they can be accurately determined only by AS-OCT.
- This is important in assessment of proper technique for its management

Corneal Opacity

Corneal Opacity Measures



Depth of Corneal Opacity

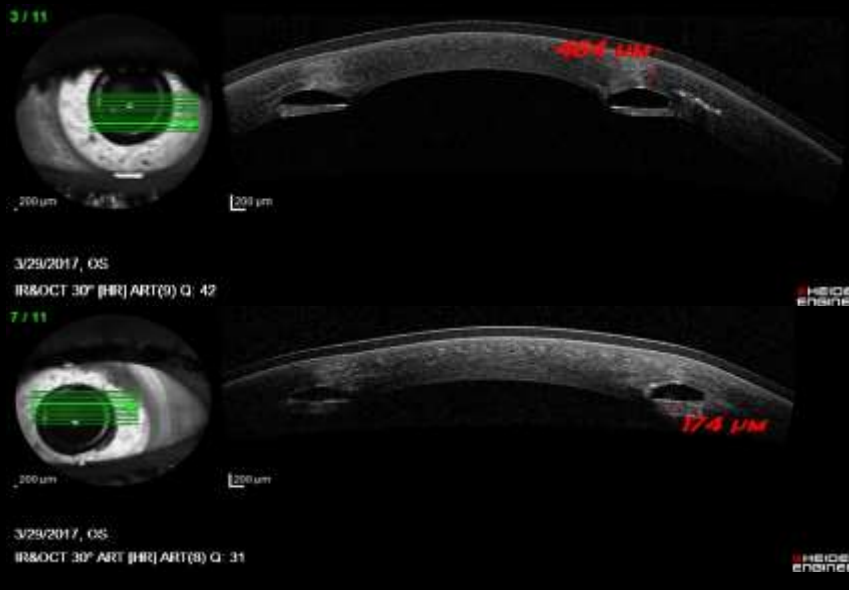


Superficial corneal opacity

Intra-corneal Ring Segments

- AS-OCT allows the evaluation of precise depth of implantation of the segment and in this way have a clearer view of the potential risk of extrusion or perforation.

Corneal rings

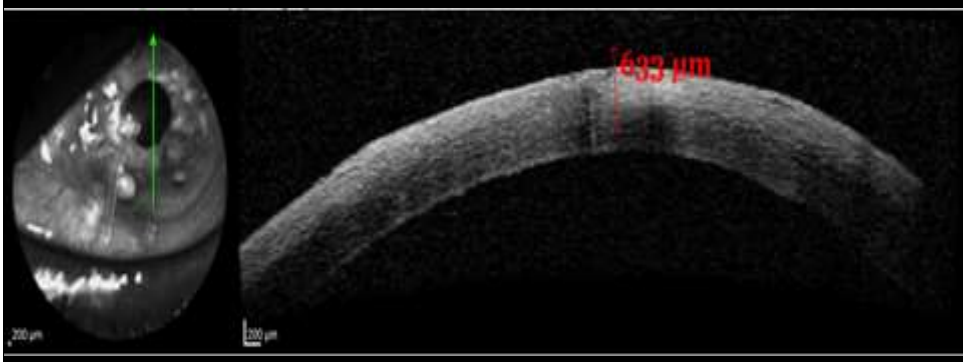


AS-OCT in Postoperative Evaluation

AS-OCT is helpful after many surgical procedures:

- Cataract surgery
- DALK surgery
- DSEK surgery

Post-operative Corneal Edema

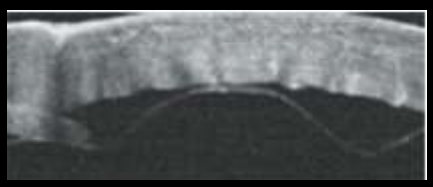


Descemet's Membrane Detachment

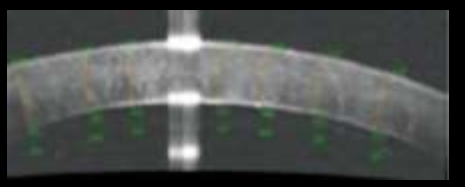
DALK surgery

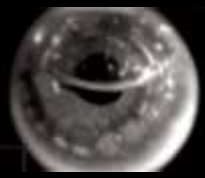
- In DALK, complications like Descemet's membrane (DM) perforation and double anterior chamber formation can be better recorded and managed using AS-OCT.

- AS-OCT image of double anterior chamber post-DALK



- Attached DM after injection of air in the anterior chamber

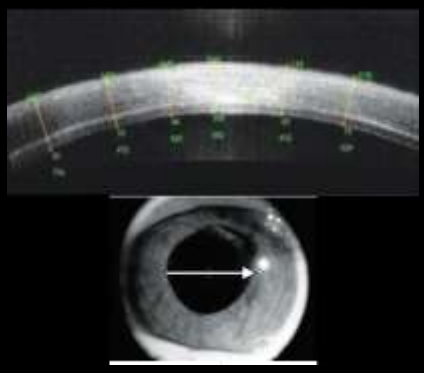




DSEK Surgery

- In DSEK, AS-OCT can help to monitor the position and attachment of the graft to the recipient, and the quality of the interface.
- The corneal thickness can be measured over a period of time related to the endothelial function.

- Measurement of the corneal and donor graft thickness following DSEK



- Donor graft dislocation after DSEK


THANK YOU