UBM versus AS-OCT in anterior segment disorders

Ahmed Salah Abdel Rehim, MD
Al-Azhar University

Introduction

- Ultrasound Biomicroscopy (UBM) has brought about improvements in viewing the anterior chamber, allowing for a high level of spatial resolution and objective measuring capacity of the anterior chamber structures.
- UBM is a contact exploration technique with an immersion system which requires patients to be in recumbent position.

Introduction

- Optical coherence tomography (OCT) is a non-contact high resolution (2 to 20 µm) imaging technology that provides detailed cross-sectional images (tomography) of internal structures.

UBM

Principle of UBM

- Ultrasound biomicroscopy (UBM) is a recent technique to visualize anterior segment with the help of high frequency ultrasound transducer.
- UBM is capable to show the structures of anterior segment that are relevant to glaucoma and provides a system of measurements.

Principle of UBM

- Fluid is required to produce a coupling medium between the transducer and the eye.
- The main rule for making fine probe movements is "if the image is getting better, keep going; if it is getting worse, go to the opposite way".

AS-OCT

Principle of OCT

AS-OCT at 1310 nm wavelength of light is better suited for AC angle imaging due to:

**** Reduced scattering**

Thus ensures better penetration through ocular structures like the sclera and the iris and hence a more detailed AC angle morphology.

**** More dissipation/absorption**

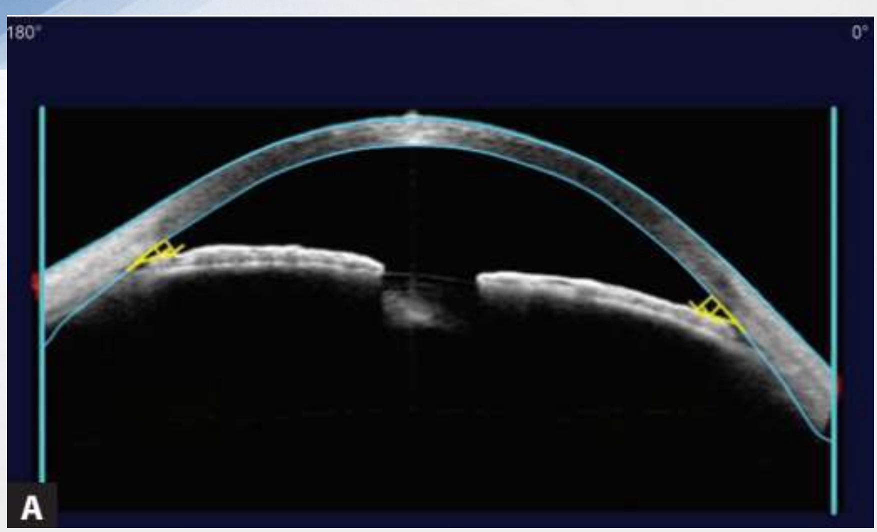
The higher (1310 nm) wavelength light is strongly absorbed by water in ocular media(vitreous) and therefore, only 10% of the light incident on the cornea reaches the retina causing no damage to the retina

Principle of OCT

The high-speed imaging helps in various ways:

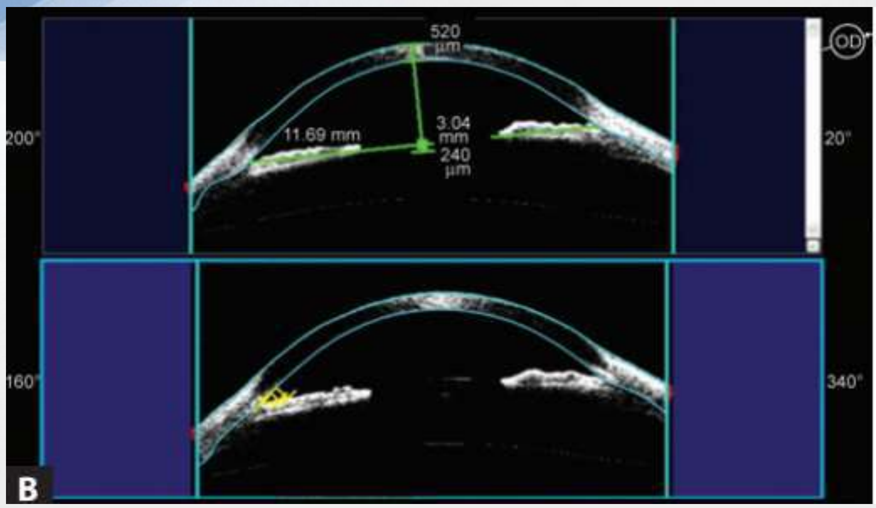
1. Reduces examination time
2. Eliminates motion artifacts
3. Enables imaging of dynamic ocular events
4. Allows for rapid survey of relatively large areas.

Modes of AS-OCT



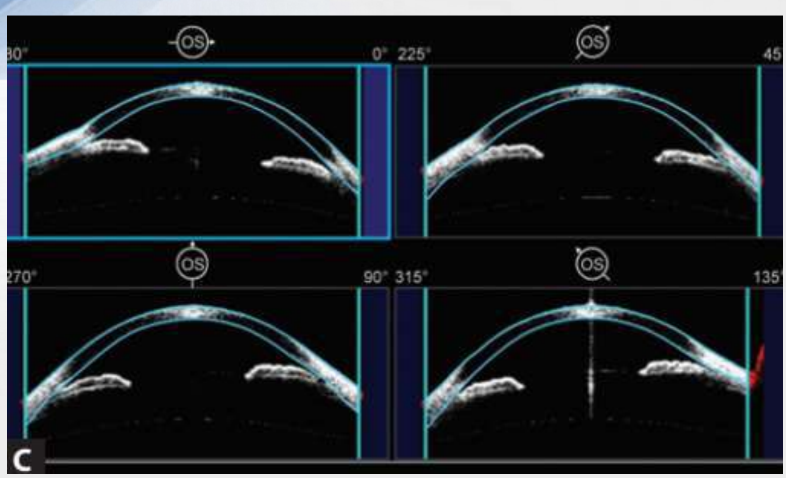
single mode, only a single image will be obtained at the desired angle.

Modes of AS-OCT



Double mode takes images at the preset angles of 20 to 200 &160 to 340

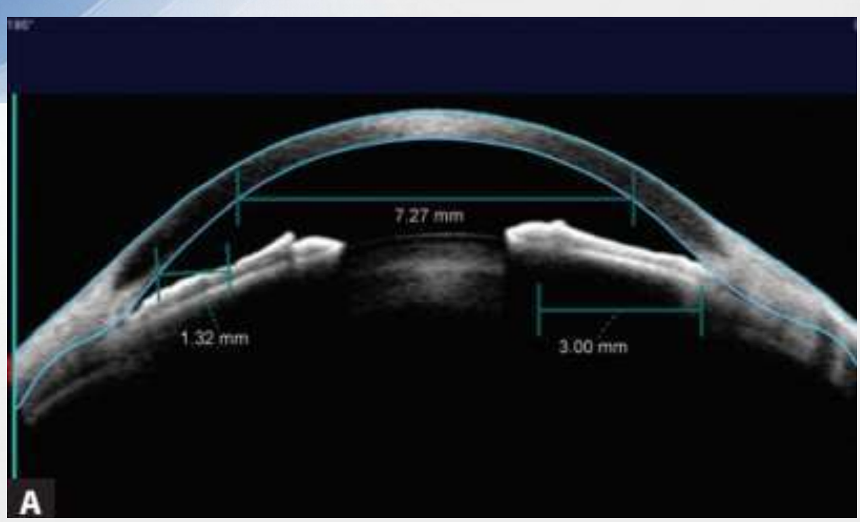
Modes of AS-OCT



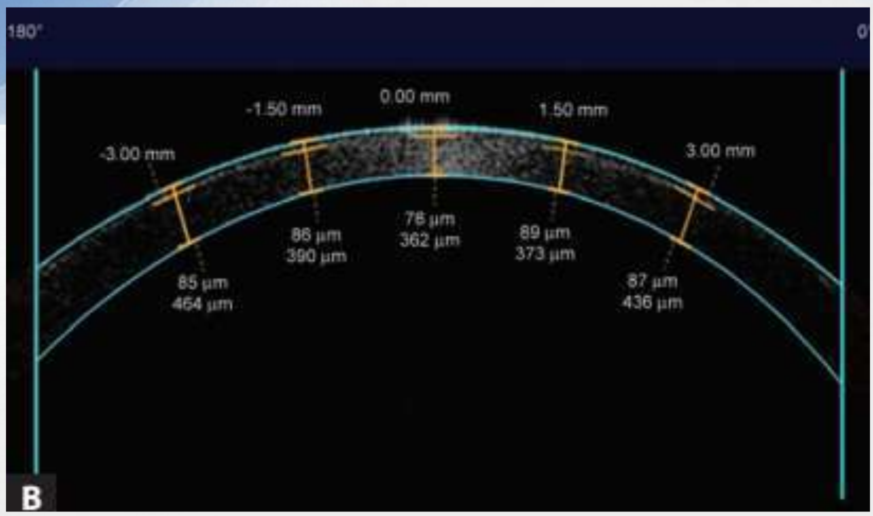
Quad mode ...... 4 cross-sectional images are taken at 0 to 180, 45 to 225, 90 to 270, and 135 to 315 degrees,respectively

Resolution modes

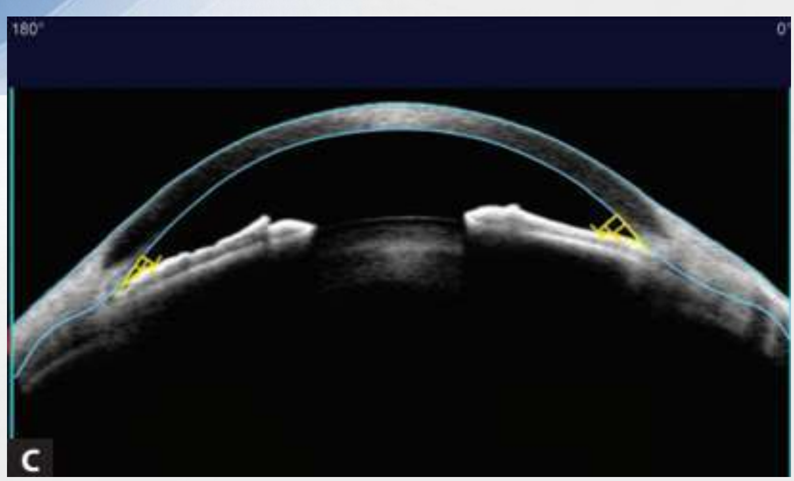
Standard resolution imaging	High/enhanced resolution imaging
Broader view of AS 16 mm width /6 mm depth	More detailed imaging 10 mm width/3 mm depth
Full overview of AS: Cornea, anterior chamber, iris and both angles	Cornea and ant. segment needing detailed evaluation
256 scans 0.125 seconds	512 scans 0.250 seconds



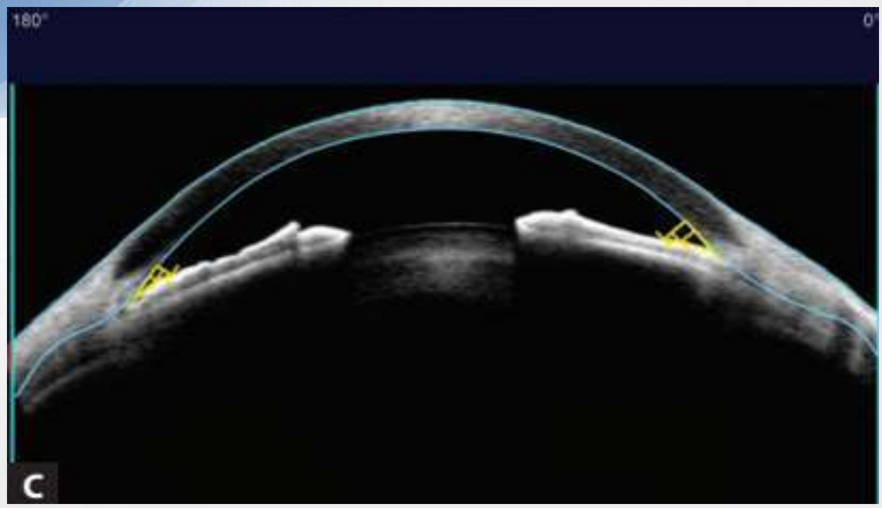
(1) The caliper tool



(B) The flap tool



(3) The iridocorneal angle tool



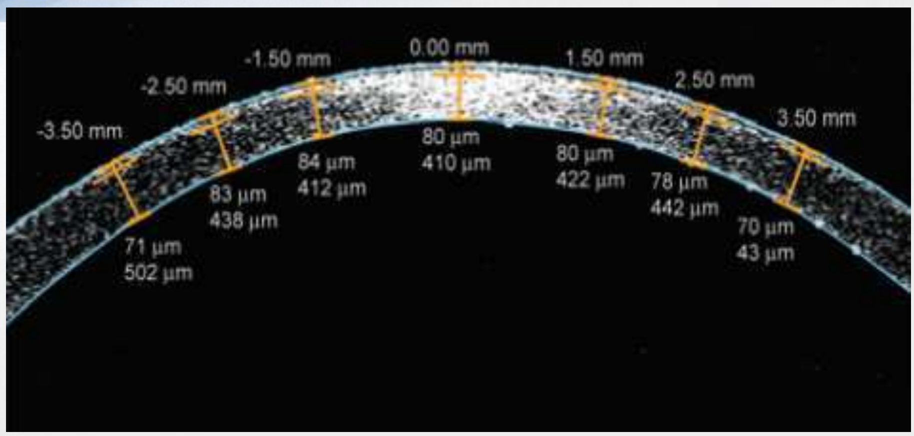
(4) The chamber tools:

* Central corneal thickness.
* Anterior chamber depth.
* Angle to angle distance.
* Crystalline lens rise

Applications of AS-OCT in Cornea

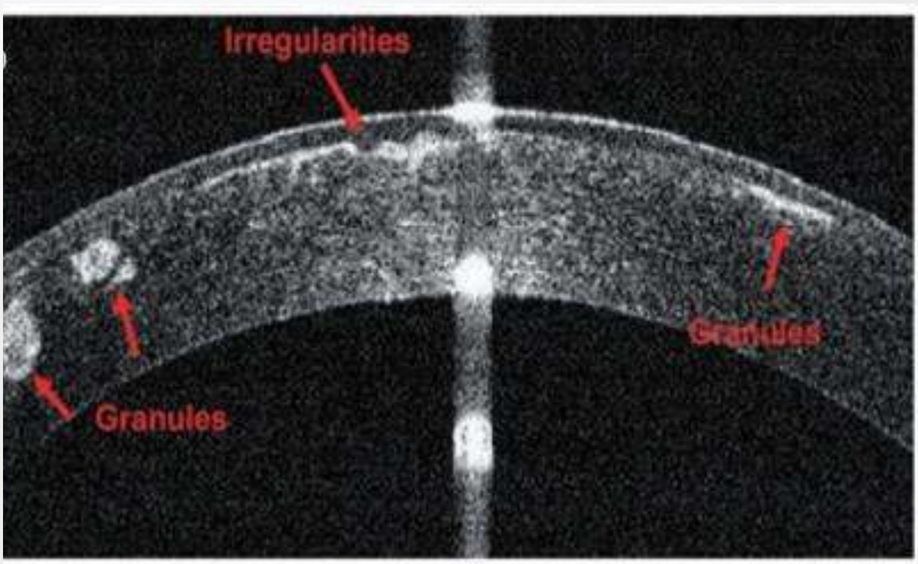
1. LASIK
2. DSAEK
3. Dystrophies and degenerations
4. Corneal inflammatory and infltrative disorders
5. Keratoplasty
6. Keratoconus
7. Intacs
8. Descemet´s detachment

LASIK

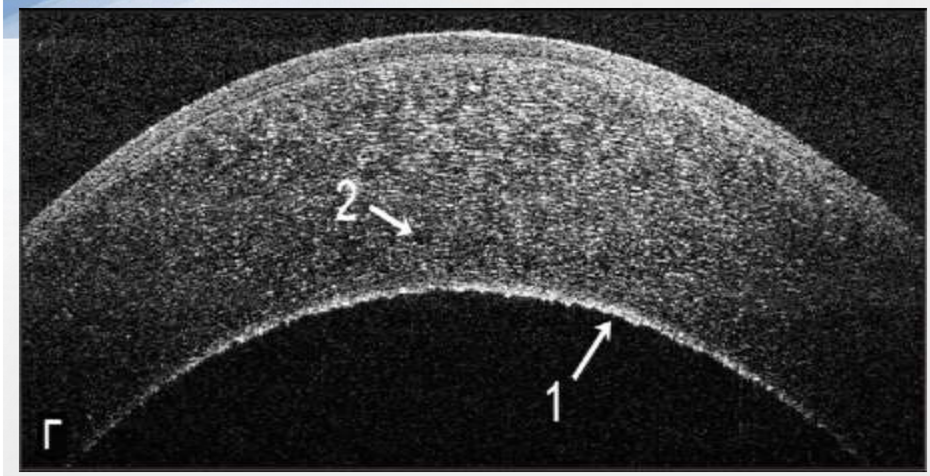


The use of the "flap tool" in post-LASIK cases to measure the precise thickness;

Granular Dystrophy

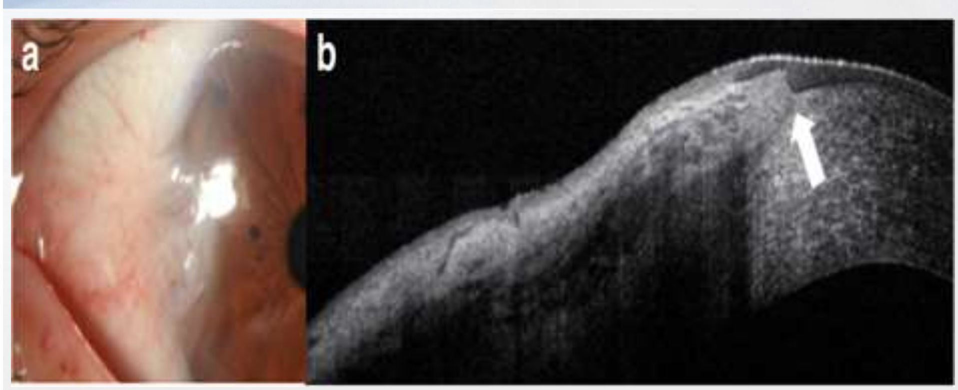


Fuchs' endothelial dystrophy



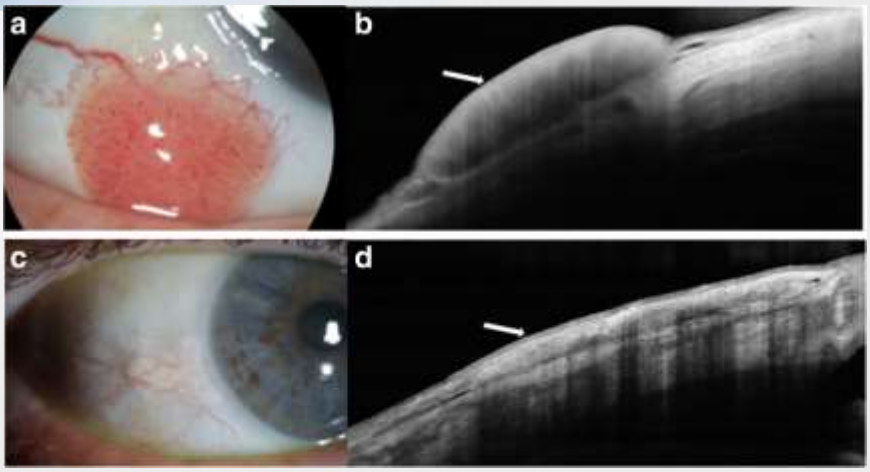
* Arrow 1 points to guttae, arrow 2 to the area of intrastromal fluid. Bars correspond to 100 µm.

Ocular surface lesions



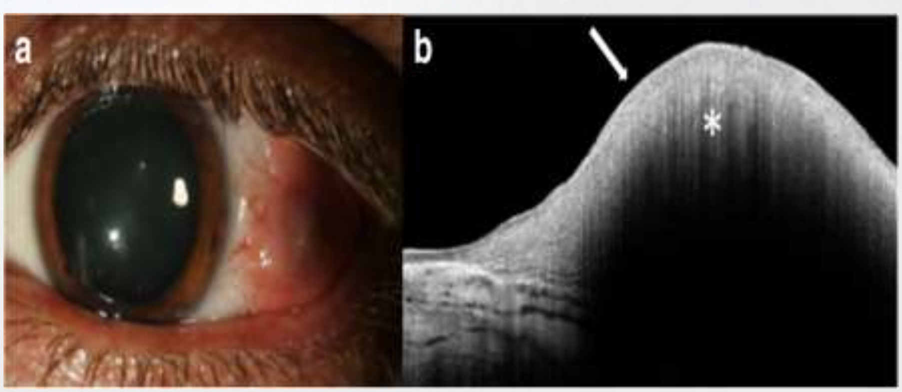
AS-OCT image of the pterygium shows a dense, hyper-reflective, fibrillary subepithelial lesion that is between the corneal epithelium and Bowman's layer (arrow)

Ocular surface lesions



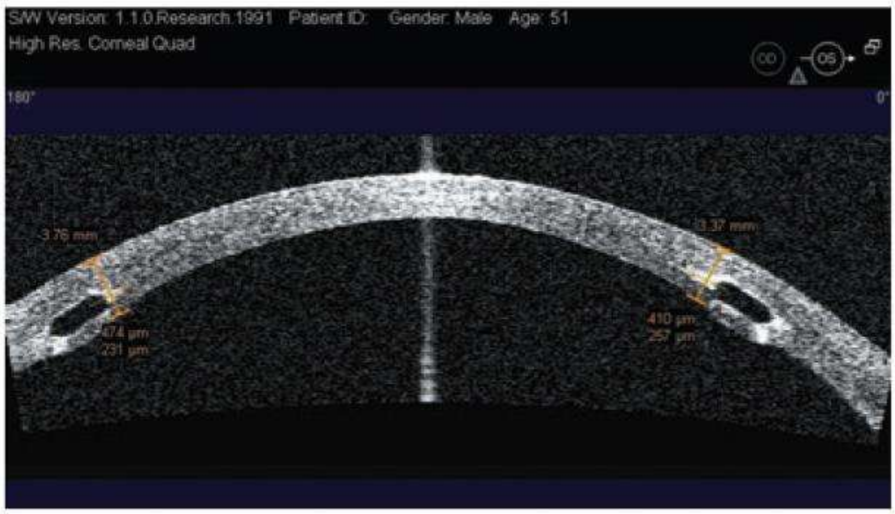
Ocular surface squamous neoplasia pre and post treatment.

Ocular surface lesions

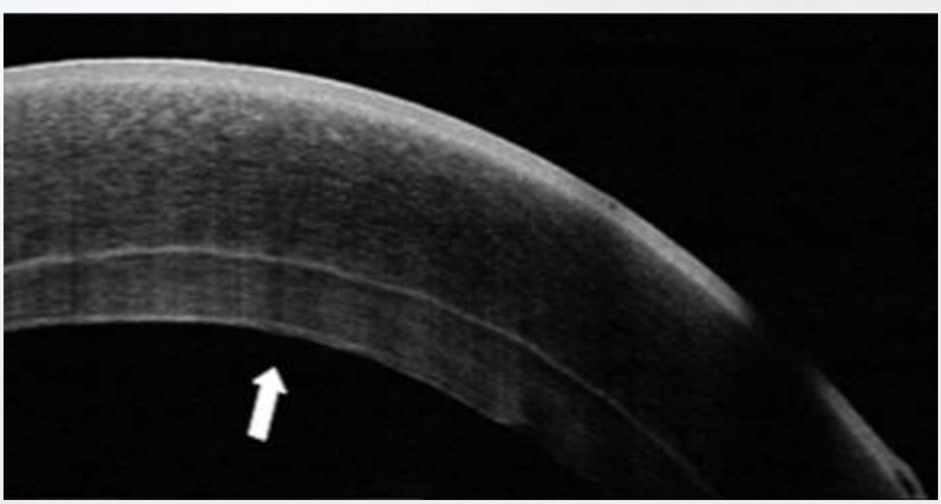


Conjunctival melanoma

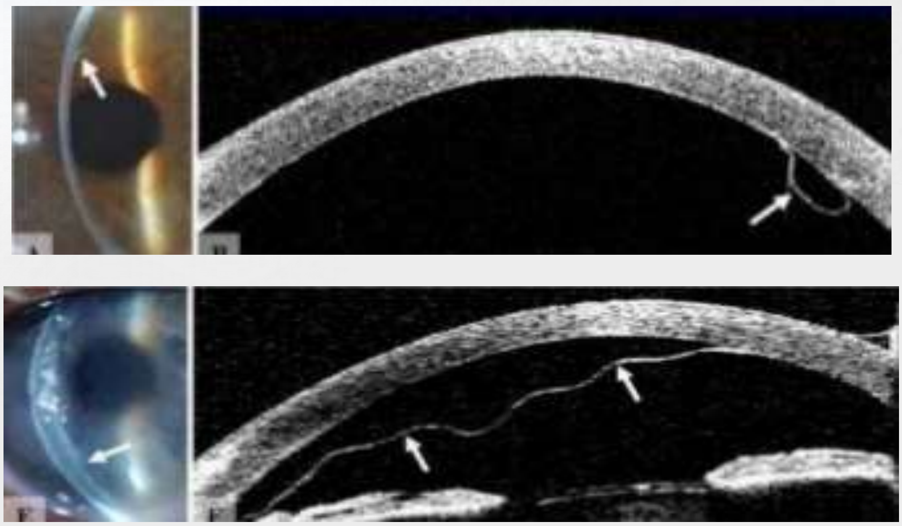
INTACS



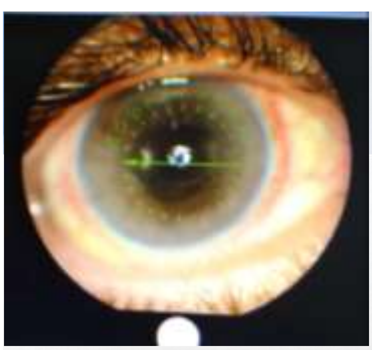
DSAEK

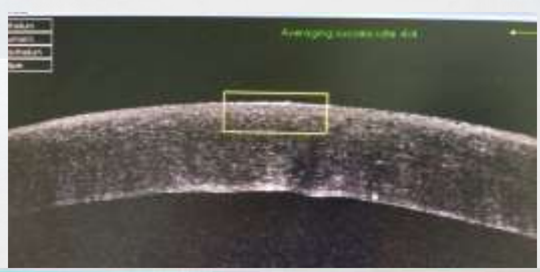


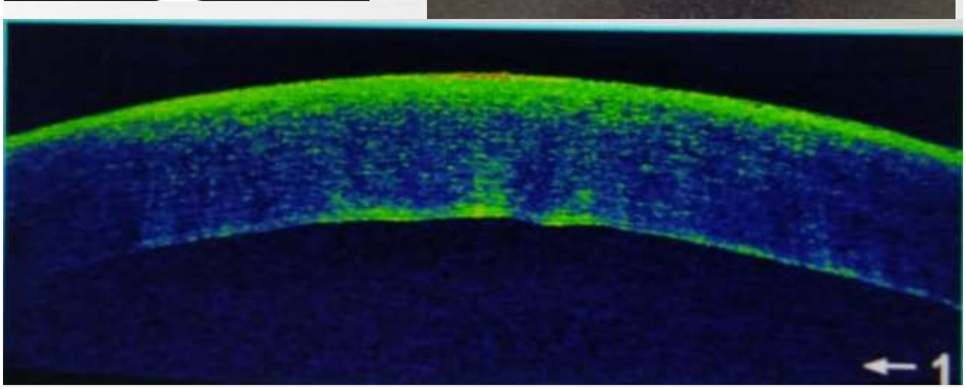
Descemet membrane detachment



Corneal oedema







Applications of AS-OCT in Glaucoma

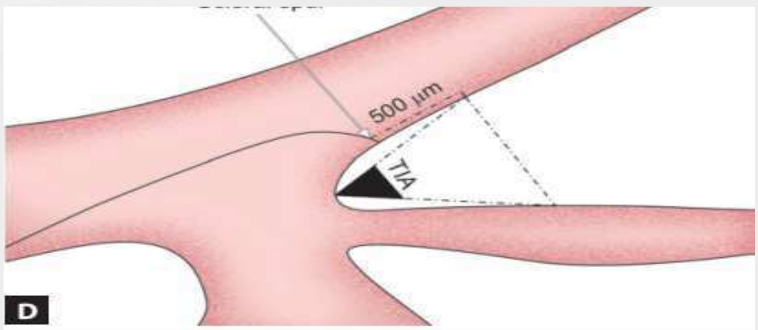
- **To study the normal anatomy and physiology.**
- **For screening of the spectrum of angle-closure glaucoma.**
- **To study mechanism of malignant glaucoma.**
- **To test the efficacy of laser peripheral iridotomy.**
- **To test the patency of glaucoma drainage device.**

Angle Opening Distance

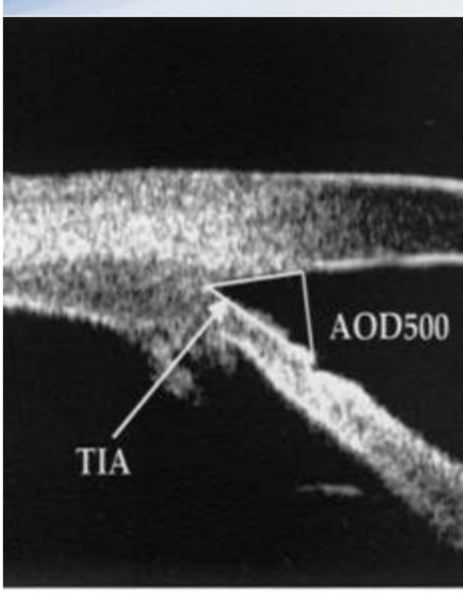
Angle opening distance is calculated as the perpendicular distance measured from the TM at 500 μm anterior to the scleral spur to the anterior iris surface.

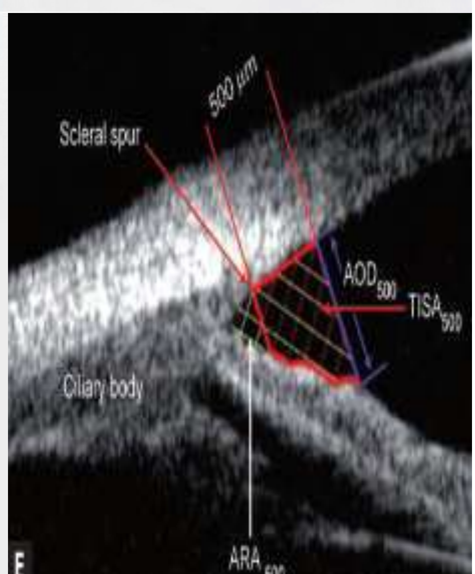
Trabecular iris angle

An angle measured with the apex in the iris recess and the arms of the angle passing through a point on the TM 500 µm from the scleral spur and a point on the iris perpendicularly

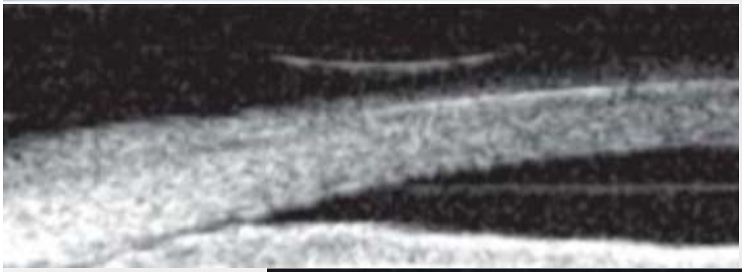


UBM **AS-OCT**

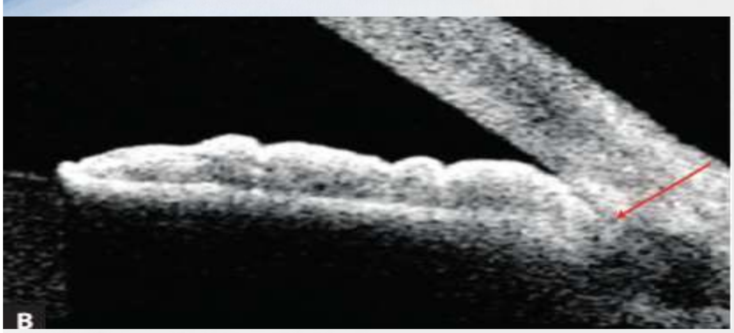


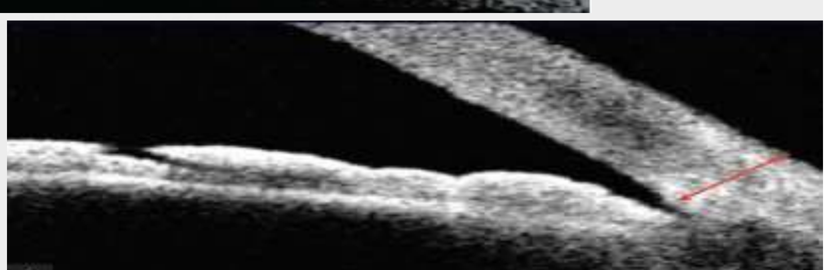


Angle-closure
UBM

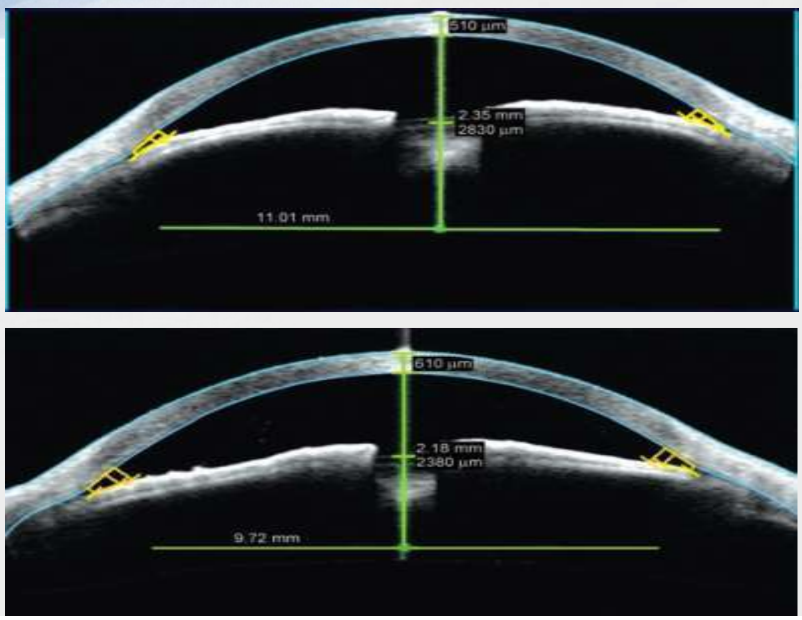


Angle-closure
AS-OCT

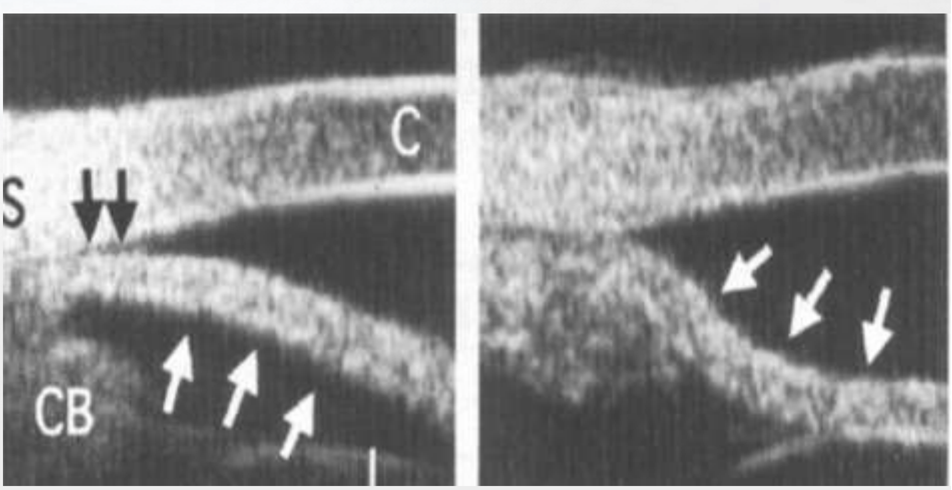




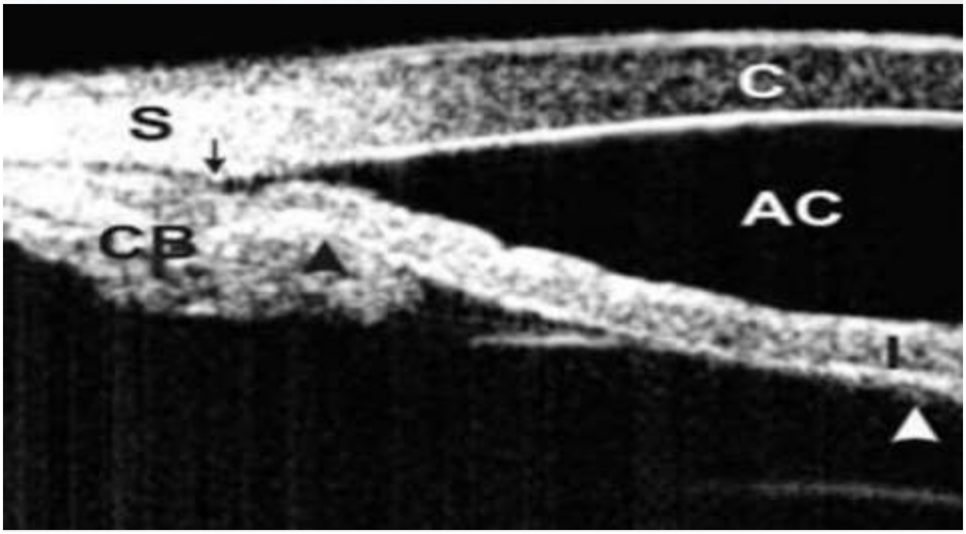
Laser Iridotomy



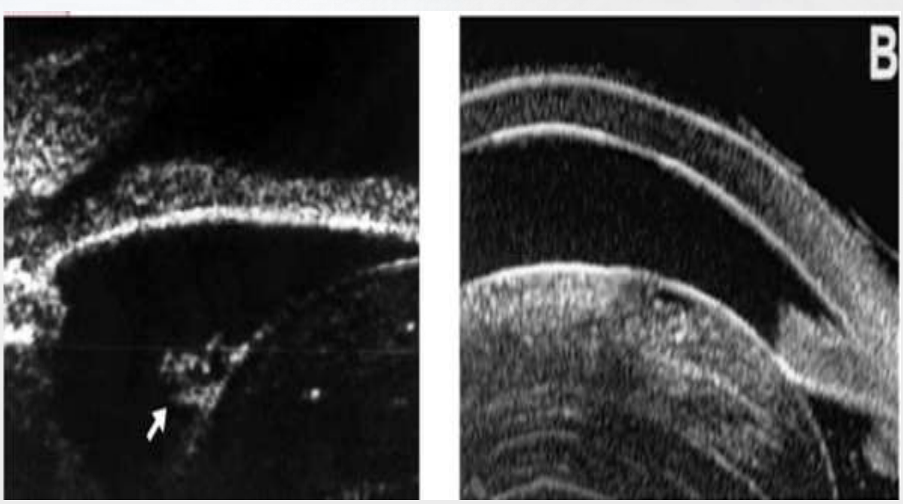
Indentation UBM



UBM
Plateau Iris



Phacomorphic glaucoma



Bleb morphology

1. it is an indicator of bleb function and a predictor of bleb-related complications such as bleb leak, blebitis, and bleb-related endophthalmitis.
2. Bleb morphology indicates the function of the filtration shunt created by the trabeculectomy procedure and guides the ophthalmologist in performing interventions such as needling and suture lysis in order to optimize shunt function.

Bleb morphology

3. ASOCT has been used to image trabeculectomy bleb to provide information about internal structure that is not available at the slit lamp.
4. It is able to provide clear images of the bleb wall, cavity, flap and ostium as displayed below.
5. Successful blebs display conjunctival thickening as a hallmark of success, regardless of degree of bleb elevation. This reflects facility of transconjunctival aqueous flow.

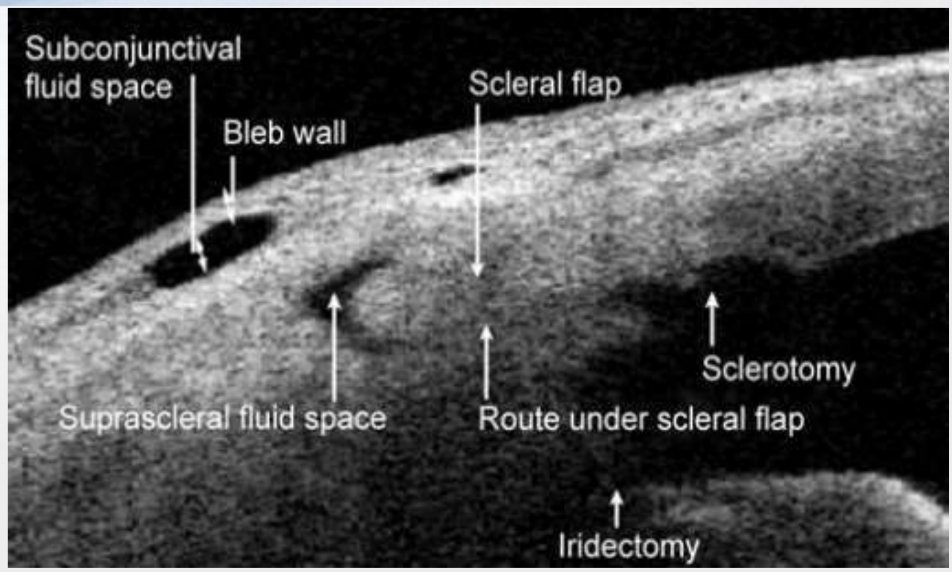
Bleb morphology

5. Highly elevated blebs sometimes display marked conjunctival thickening and only a small cavity.
6. In failed blebs, ASOCT is particularly useful in imaging failed blebs to demonstrate the level of failure.
7. Ostial closure, flap fibrosis and presumed episcleral fibrosis in the absence of the former two situations are all clearly demonstrated.

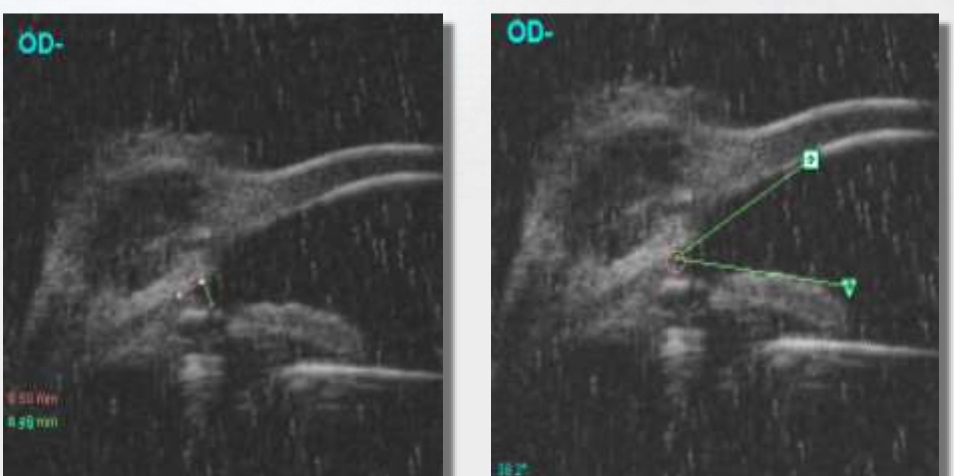
Bleb morphology

8. In the early postoperative period, a failing bleb with a closely apposed scleral flap may be resuscitated by suture lysis, resulting in a more expanded bleb.
9. It can also image the intrascleral lake and implant used in nonpenetrating glaucoma surgery (deep sclerectomy) and glaucoma drainage devices

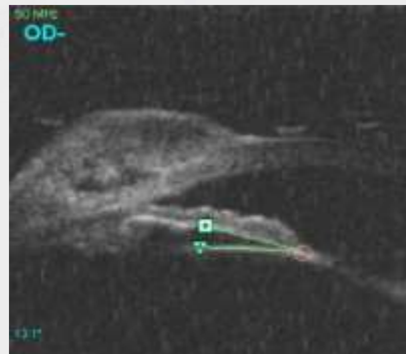
Bleb morphology



Bleb morphology

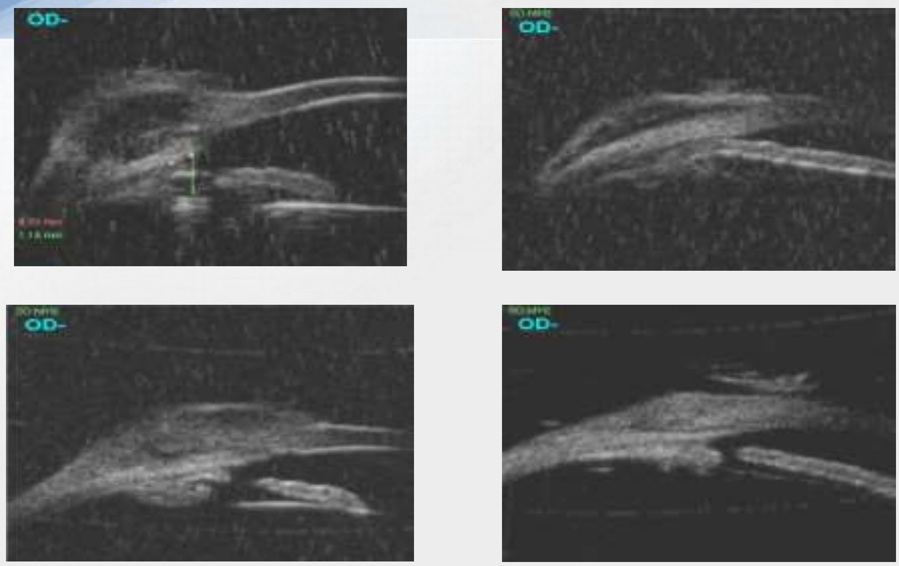


Iris-lens angle



Ostium

Types of Bleb



To summarize: .....

Characteristics	UBM	AS-OCT
Image property	Acoustic impedance variation	Refractive index variation
Axial resolution (um)	30	5
Lateral resolution (um)	60	10
Penetration depth (mm)	6	1
Vectors/sec	1000	50000
Coupling mode	Fluid	Air


Thank you!