




***Ultrasound Biomicroscopy in
Glaucoma***

By

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➤ ***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.***



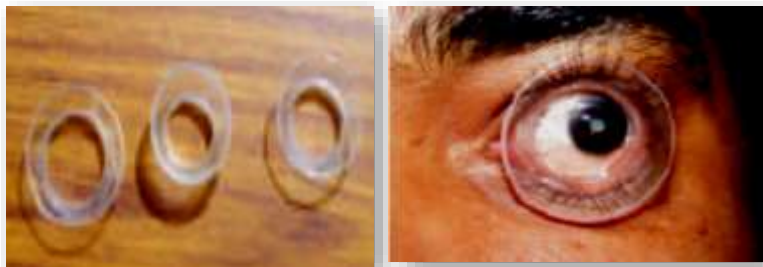
➤ ***UBM has many advantages including easy, non-invasive, inexpensive and reproducible.***


➤ ***Glaucoma is an eye disorder in which the optic nerve suffers damage. It is often, but not always, associated with increased IOP .***

- *There are four major types of glaucoma each of them is subdivided into primary and secondary categories; angle closure glaucoma, open angle glaucoma, combined-mechanism glaucoma and developmental glaucoma.*

examination procedures:


- The patient is usually examined in a supine position looking up at the ceiling.
- **Series of eye cups have been designed; they have a smooth flanged inferior margin that fits between the eyelids and hold them open.**





➤ **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".**



➤ **The best images are obtained in any ultrasound examination when the ultrasound beam is perpendicular to the structures being examined.**

➤ **the front of the transducer corresponds to the top of the screen.**

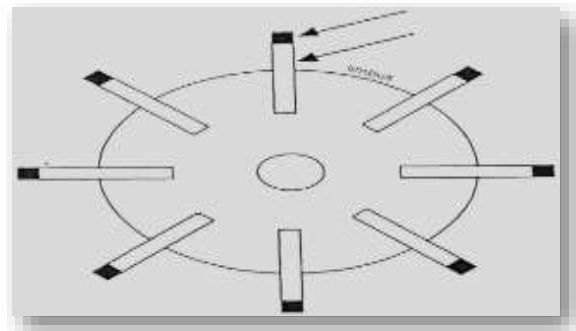
➤ **There is a mark on the probe that indicates the plane of the scanning motion.**

➤ This mark coincides with the left side of the screen.

➤ Thus if the probe is held with the mark oriented toward the temporal aspect of the eye, the left side of the screen would display pathology located in the temporal side of the globe.

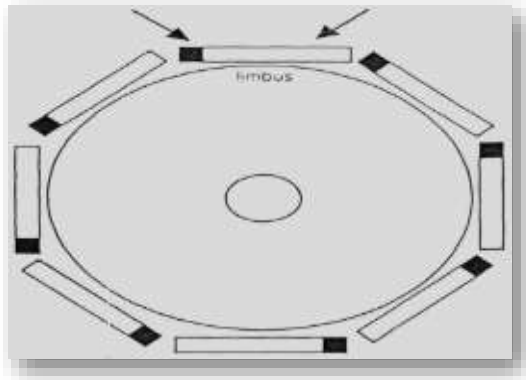
Examination Conventions

Radial Section Of The Globe:



Radial sections of the globe are performed with the probe marker on the scleral side

Transverse Section Of The Globe:

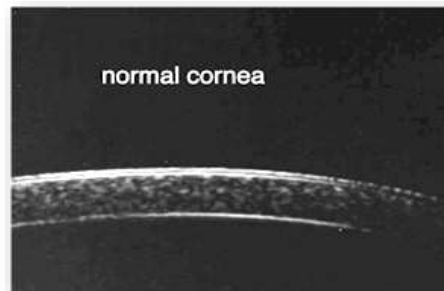


Transverse sections of the globe are performed with the probe marker on the counterclockwise side

- ***The UBM images were evaluated for; central corneal thickness, anterior chamber depth, anterior chamber angle parameters, iris, ciliary body, visibility of a route under the scleral flap, reflectivity inside the bleb and formation of a cavernous fluid filled space inside the bleb.***

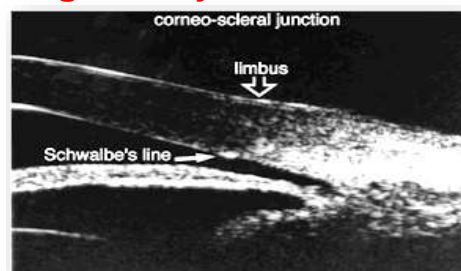
The Cornea:

- The superficial location of the cornea permits the use of higher frequency transducers.
- Higher frequency transducers allow a better definition of small distances such as epithelial thickness.



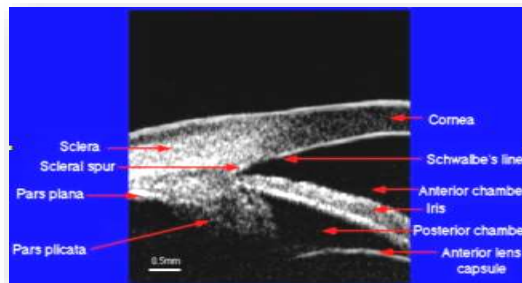
The Corneoscleral junction:

- The corneoscleral junction can be differentiated because of the lower internal reflectivity of the cornea compared to the sclera.
- The inner junction is generally referred to as schwalbe's line.



➤ The corneoscleral junction and scleral spur can be distinguished consistently with ultrasound biomicroscopy.

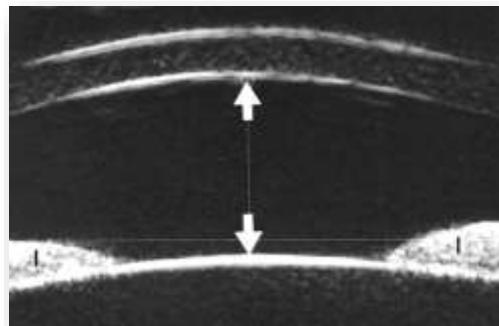
➤ The scleral spur is a useful landmark presenting a constant reference point for measurement in the angle region.



Anterior Chamber:

➤ The axial distance is measured from the internal corneal surface to the lens surface.

➤ The average axial anterior chamber depth measurement is $3128 \pm 372 \text{ um}$.



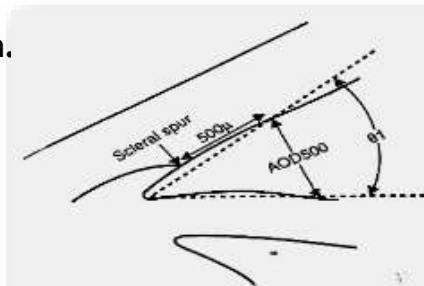
The Angle:

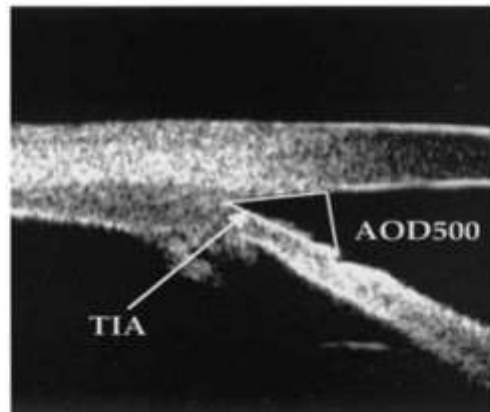
- The angle can be visualized by orienting the probe in a radial fashion above the limbal region.



How to measure the angle width:

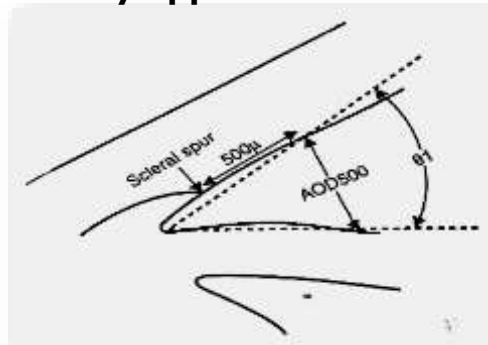
angle opening distance (AOD): is a distance between a point on the internal ocular wall 500 um anterior to the scleral spur perpendicular to the plane of the trabecular meshwork, to the opposing iris. Normally, it measures 347 ± 181 um.





Trabecular iris angle (TIA) – Angle formed with the apex at the iris recess and the arms passing through the TM at a point 500 microns from scleral spur and the point on iris perpendicularly opposite.
(30 ± 11 degrees)

Trabecular-iris angle (θ_1): The angle formed with the apex at the iris recess, and the arms passing through the point on the meshwork 500 μm from the scleral spur and the point on the iris perpendicularly opposite.





Angle recess area –
triangular area bordered
by the anterior iris
surface corneal
endothelium and a line
perpendicular to the
endothelium drawn to
the iris surface at a point
750 microns from the
scleral spur. Iris
irregularity accounted
for

The Iris:

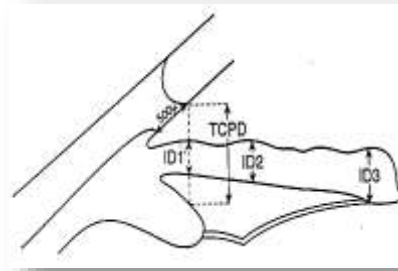
- **The iris shows variations in thickness.**
- there are variations in thickness depending on the presence of crypts and the state of dilation or constriction of the pupil.
- **The iris epithelium forms a constant highly reflective layer on the posterior iris surface.**



How to measure the iris thickness

Trabecular-ciliary process distance (TCPD):

A line is run from the point on the trabecular meshwork 500 μm from the scleral spur, perpendicularly through the iris, extended to the ciliary process (average distance = $1122 \pm 232 \mu\text{m}$)



How to measure the iris thickness

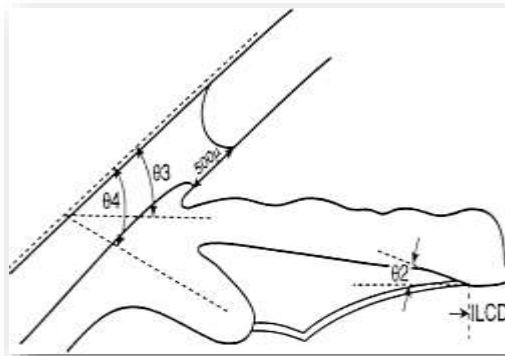
➤ **ID1:** is the Iris thickness along TCPD line (average thickness = $372 \pm 58 \mu\text{m}$).

➤ **ID2:** is measured 2 mm from the iris root (average thickness = $457 \pm 80 \mu\text{m}$).

➤ **ID3:** is measured near the pupil (average thickness = $645 \pm 103 \mu\text{m}$).

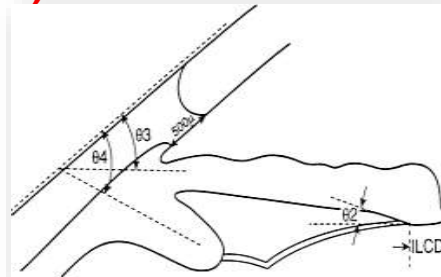
➤ The zone of iris-lens contact distance (ILCD) is 1388 ± 370 μm , normally.

➤ The angle at which the iris leaves the lens named θ_2 (average = $12 \pm 3^\circ$).

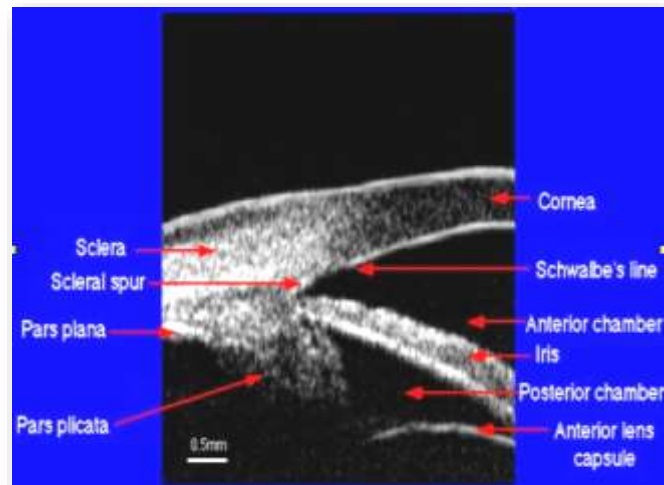


➤ The angle the iris makes to a tangent to the scleral surface named θ_3 (average of $30 \pm 7^\circ$).

➤ The angle the ciliary processes make to the scleral surface can also be defined θ_4 (average = $52 \pm 18^\circ$).



Normal anatomical angle

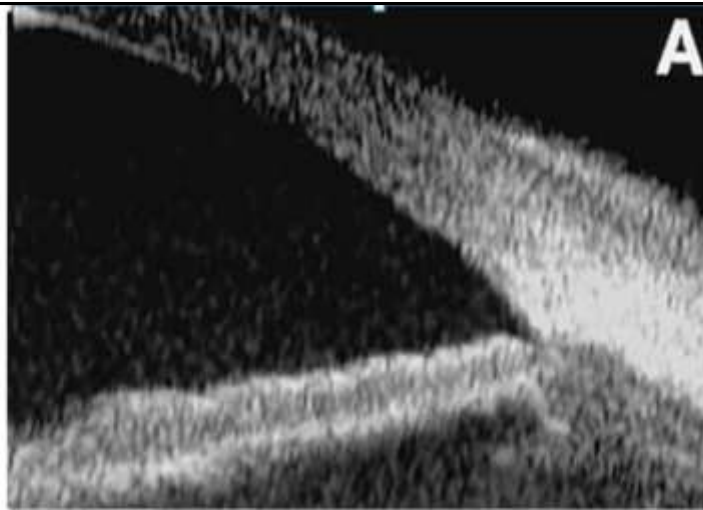


UBM in Glaucoma

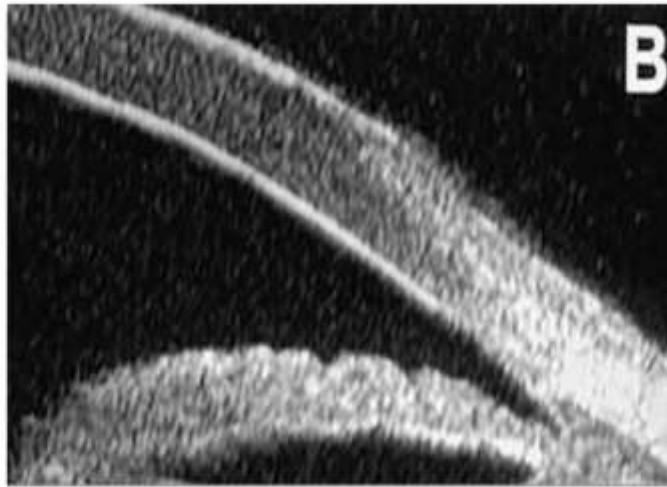
Open angle glaucoma

Open-angle glaucoma

- Can measure the anterior chamber angle in degrees
- Assess the configuration of the peripheral iris
- Evaluate the iris insertion in relation to the trabecular meshwork



WIDE OPEN ANGLE WITH FLAT IRIS PLANE



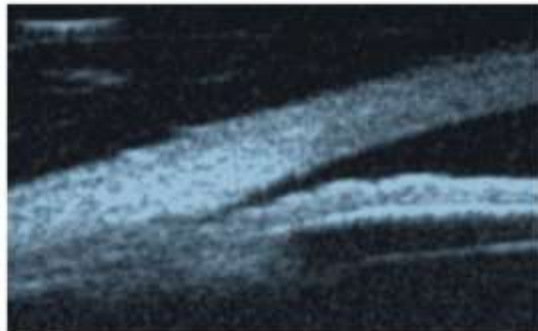
OPEN ANGLE WITH ANTERIORLY BOWED
IRIS PLANE

Closed angle glaucoma

Determination of the Occludability of the Angle

Dark room provocative testing

- Studies the spontaneous occlusion of the angle under conditions of decreased illumination
- Provides useful qualitative information about angle recess anatomy.



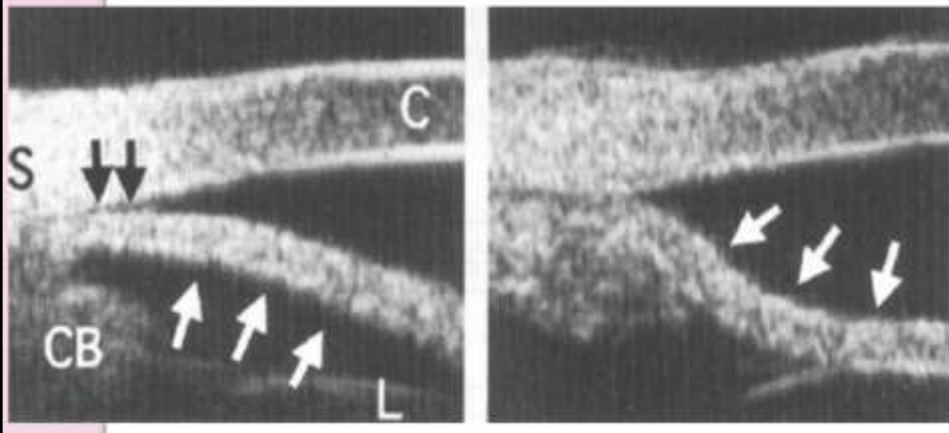
Before

After



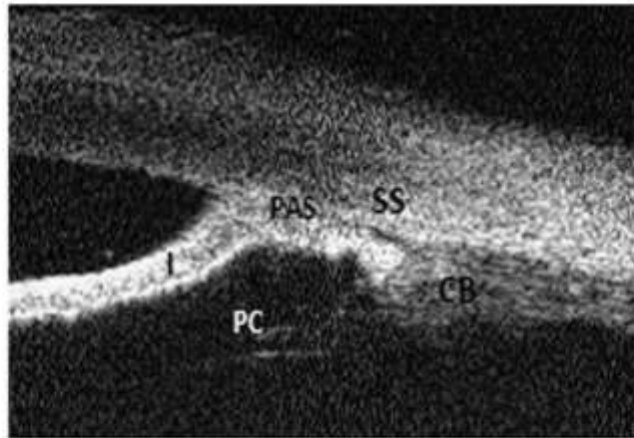
Indentation UBM

Apposition closure-angle opens on indentation



- Indentation UBM gonioscopy, new method for assessing the angle
- Angles widened with indentation.
- The angle changes in eyes with relative pupillary block were significantly greater than in eyes with peripheral anterior synechie (PAS) or plateau iris configuration (PIC).
- Useful for diagnosing relative pupillary block, PAS, and PIC.

Peripheral anterior synechiae

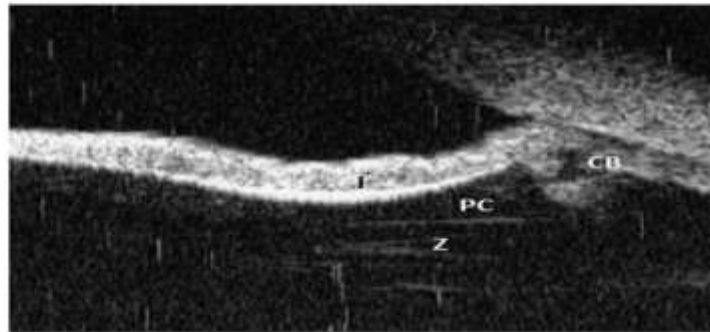


Secondary glaucoma

Determination of the Mechanism of Secondary Glaucoma

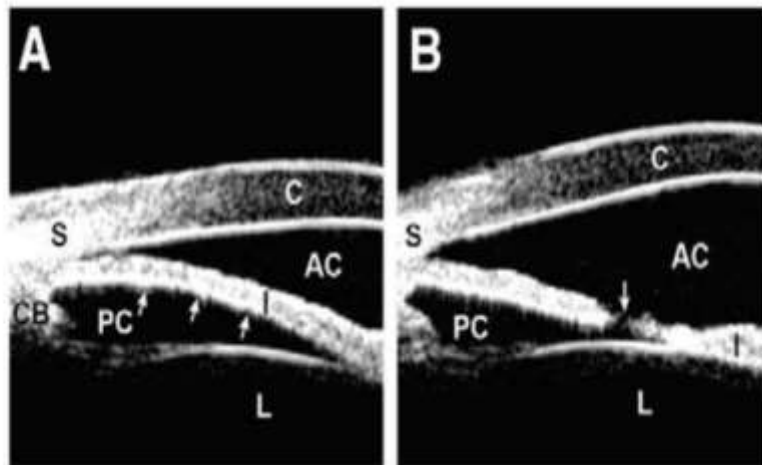
Pigment Dispersion Syndrome

- Wide open angle and typical posterior bowing of the peripheral iris causing reverse pupillary block



IRIS BOMBE





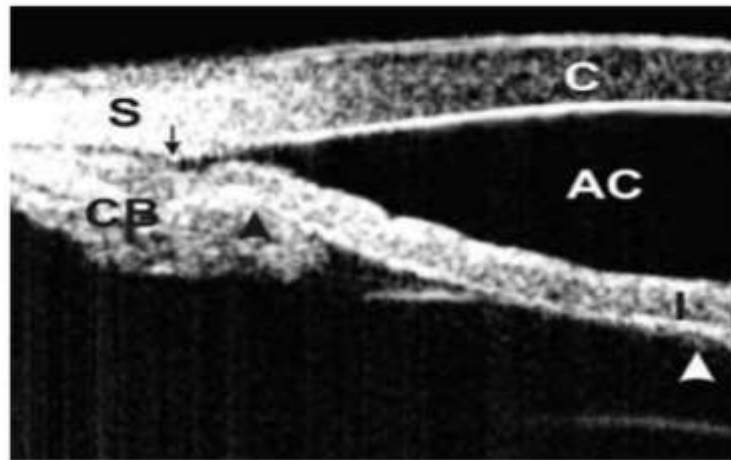
Pupillary block

(A) The angle shows appositional closure owing to anterior bowing of the iris.

(B) The angle is open with a flattened iris after laser peripheral iridotomy.

Plateau iris syndrome

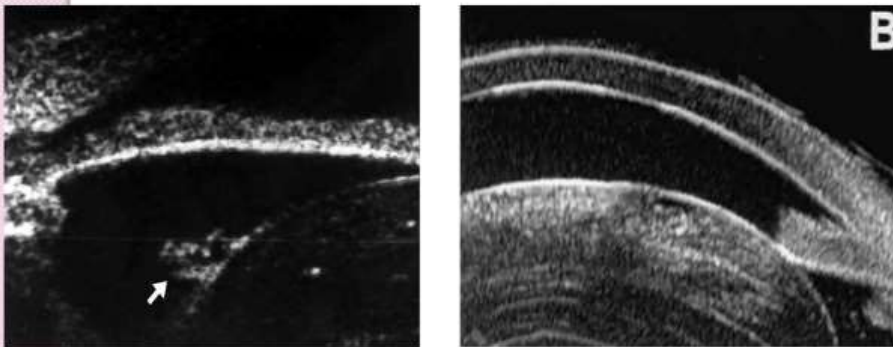
- Abnormally steep anterior angulation of the peripheral iris.
- Anterior insertion of the iris on to the anterior ciliary body.
- Can also confirm the double hump sign by use of indentation UBM, a special technique that applies mild pressure on peripheral cornea with the skirt of the eyecup.



Indentation UBM on an eye with a plateau iris

PSEUDOPHAKIC AND LENS INDUCED GLAUCOMA

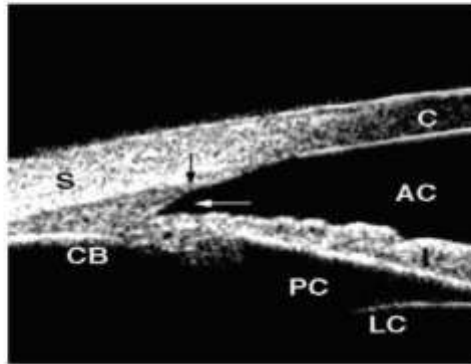
- Phacomorphic glaucoma
- Glaucoma due to anterior subluxation of lens.
- Circumference of intact zonules and the extent of zonular dialysis in pseudoexfoliation syndrome




POST TRAUMATIC GLAUCOMA

Angle recession:


- Posterior displacement of the point of attachment of the iris to the sclera
- Widening of the ciliary body face with no disruption of the interface between the sclera and ciliary body.



UBM after trabeculectomy

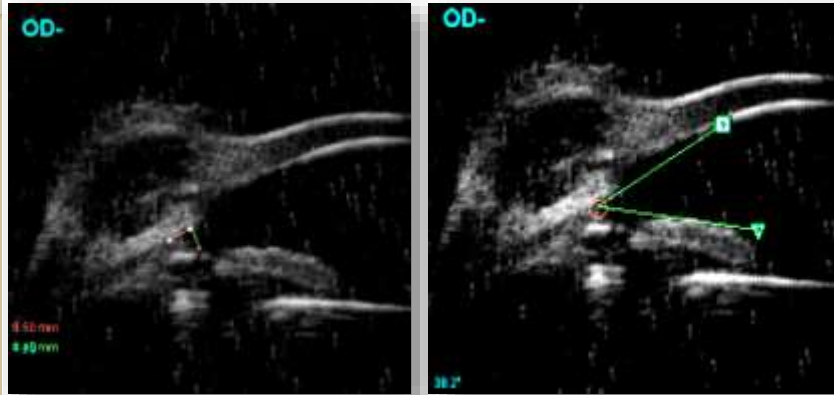


➤ ***The UBM images of eyes with good IOP control are characterized by better visibility of the route under the scleral flap and a low reflectivity inside the bleb, the internal structure displayed variable internal reflectivity and a clear fluid space was also sometimes found.***

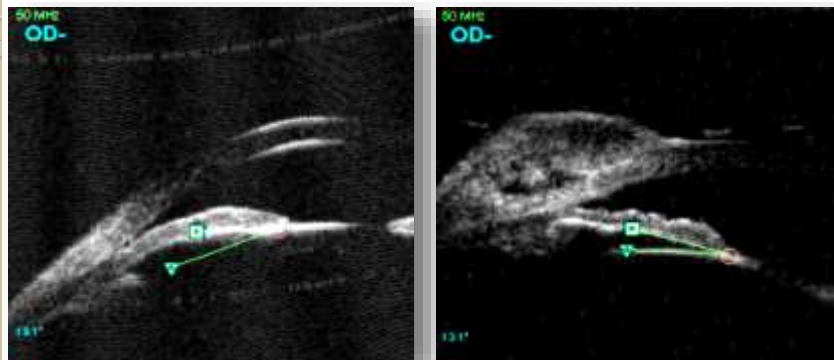


➤ ***The UBM images of eyes with poor IOP control are characterized by lesser visibility of the route under the scleral flap, higher reflectivity inside the bleb or the formation of a cavernous fluid filled space surrounded by a bleb wall of high reflectivity.***

AOD/ θI



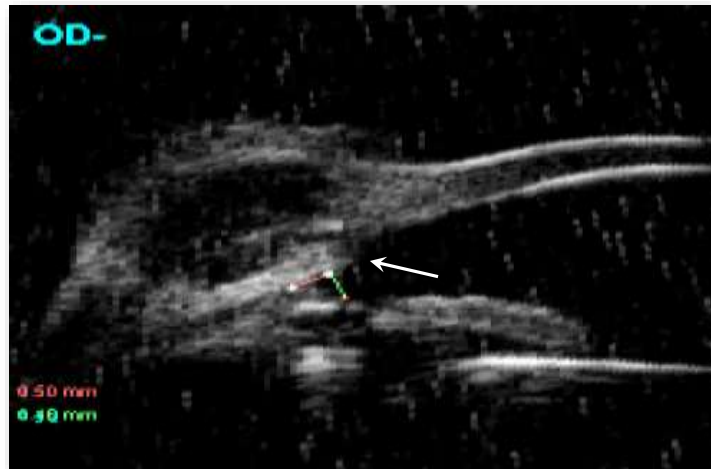
Iris-lens angle ($\theta 2$)



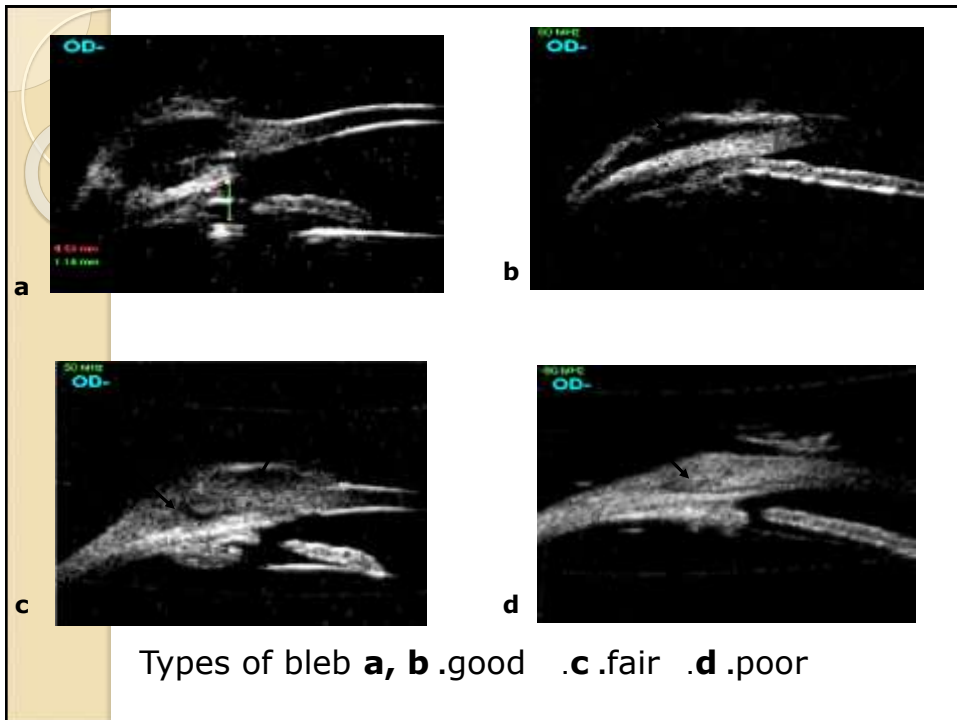
a. preoperative (19.1 D).

b. postoperative (13.1 D).

Ostium



Types of Blebs



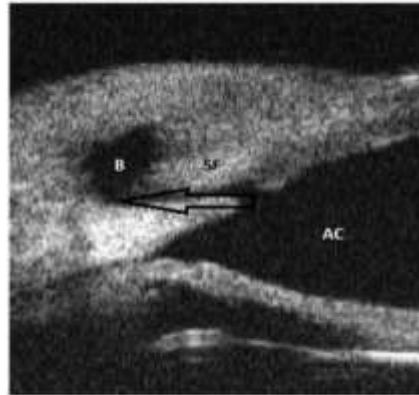
Determining Functional Status of a Filtering Surgery

After trabeculectomy-

- Patency of sclerostomy aperture
- Patency of peripheral iridectomy
- Filtering bleb - flat, shallow, or deep
- The grading of the bleb is done according to intrableb reflectivity, visibility of the route under the scleral flap, formation of cavernous fluid filled space, and bleb height.

4 grades :

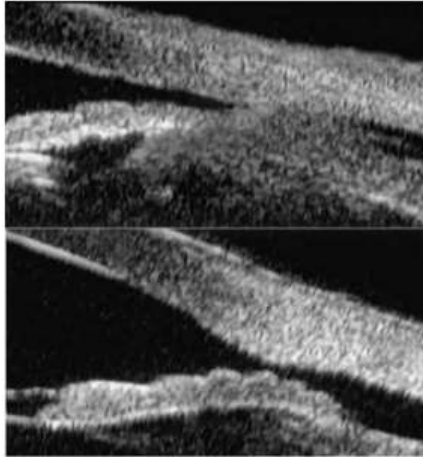
- low reflective (L)
- high reflective (H)
- encapsulated (E)
- flat (F).



- Eyes with good IOP control mainly have L type blebs. These have low to moderate intrableb reflectivity, a visible intrascleral route and higher intrableb height. F and E blebs generally denote a surgical failure.

Evaluation of Postoperative Complications after Trabeculectomy

- UBM can be used to detect and evaluate the extent of postoperative complications such as ciliochoroidal effusion and cyclodialysis.
- In ciliochoroidal effusion UBM shows the ciliary body to be edematous and separated from the sclera by a sonolucent collection of supraciliary fluid



Malignant glaucoma

- Extremely shallow anterior chamber
- Occluded angle
- Forward rotation of the ciliary body with or without fluid in the suprachoroidal space



