

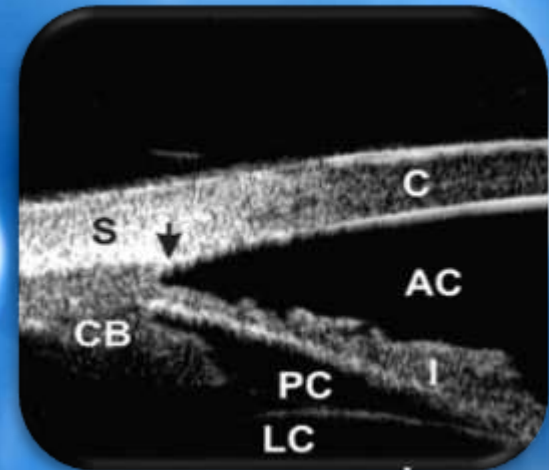
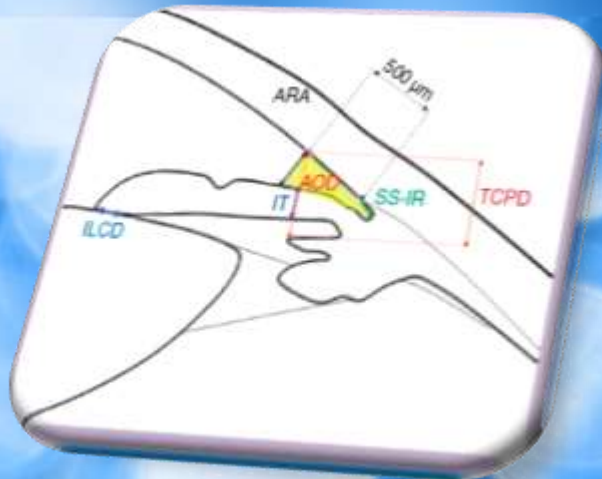
*In The Name of God the Most Kind and Merciful*

# *UBM in Glaucoma*

*Mitra Akbari, M.D*

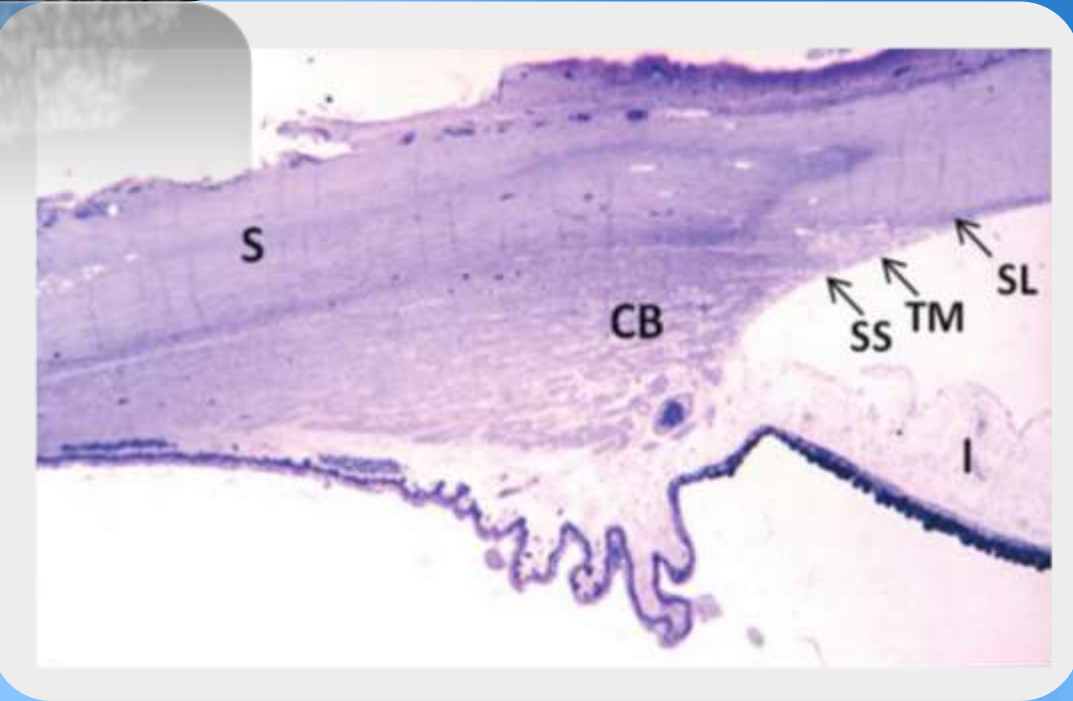
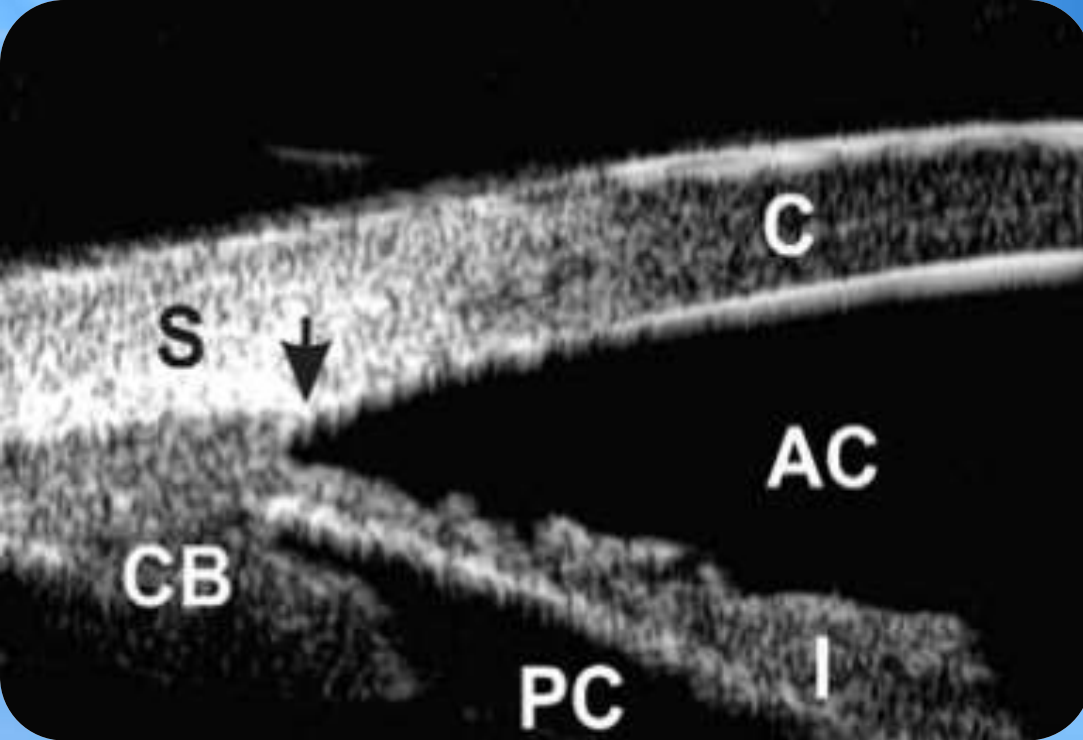
*Associate Professor of Cornea & Anterior Segment*

*GUMS*



# *UBM Technology*

*Ultrasound biomicroscopy is a imaging technique that uses high frequency ultrasound to produce images of the eye at near microscopic resolution*



# ***UBM Technology***

- ✓ *Ultrasound biomicroscopy (UBM) is a noninvasive diagnostic tool for in vivo imaging of the anterior segment.*
- ✓ *The low resolution of the 10-MHz system is inadequate for diagnostic utility in the anterior segment.*





# ***Basic of Ultrasound Biomicroscopy***

- ✓ *Is based on 40 to 100 MHz transducers incorporated into a B- mode clinical scanner*
- ✓ *Image resolution is approximately 50  $\mu\text{m}$*
- ✓ *Reduced depth of penetration to approximately 5 mm*



# *UBM versus Other Modalities*

*Gonioscopy* , structures that are posterior to the iris cannot be viewed.



*AS-OCT* can not acquire images behind the heavily pigmented posterior surface of the iris.



*UBM*, can be used to image not only the anterior chamber angle but also structures posterior to the iris such as the ciliary body, ciliary sulcus, peripheral lens, zonules, ..



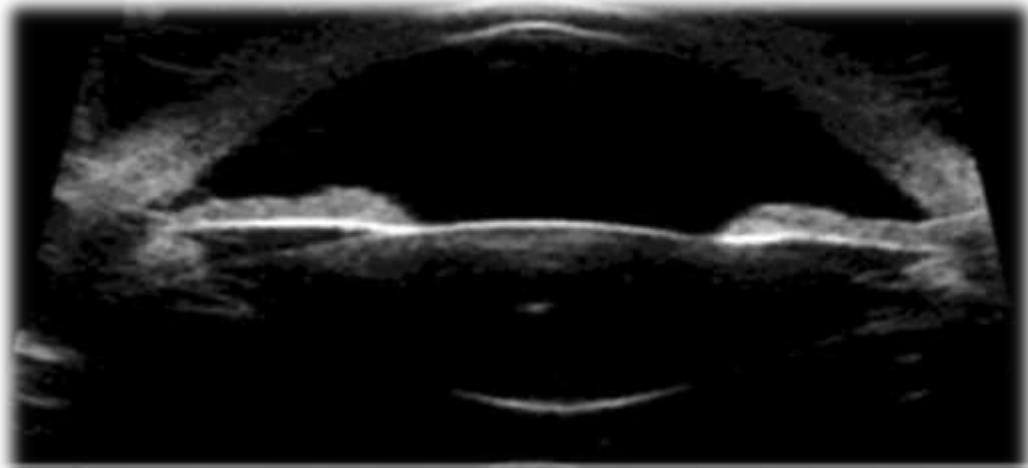
*UBM is the ideal imaging modality for evaluating abnormalities in the;*

- ✓ *Ciliary body's position, as can occur with plateau iris configuration and syndrome*
- ✓ *Malignant glaucoma*
- ✓ *Anteriorly located annular choroidal effusions*

# *Qualitative ultrasound biomicroscopy*

## *The normal eye*

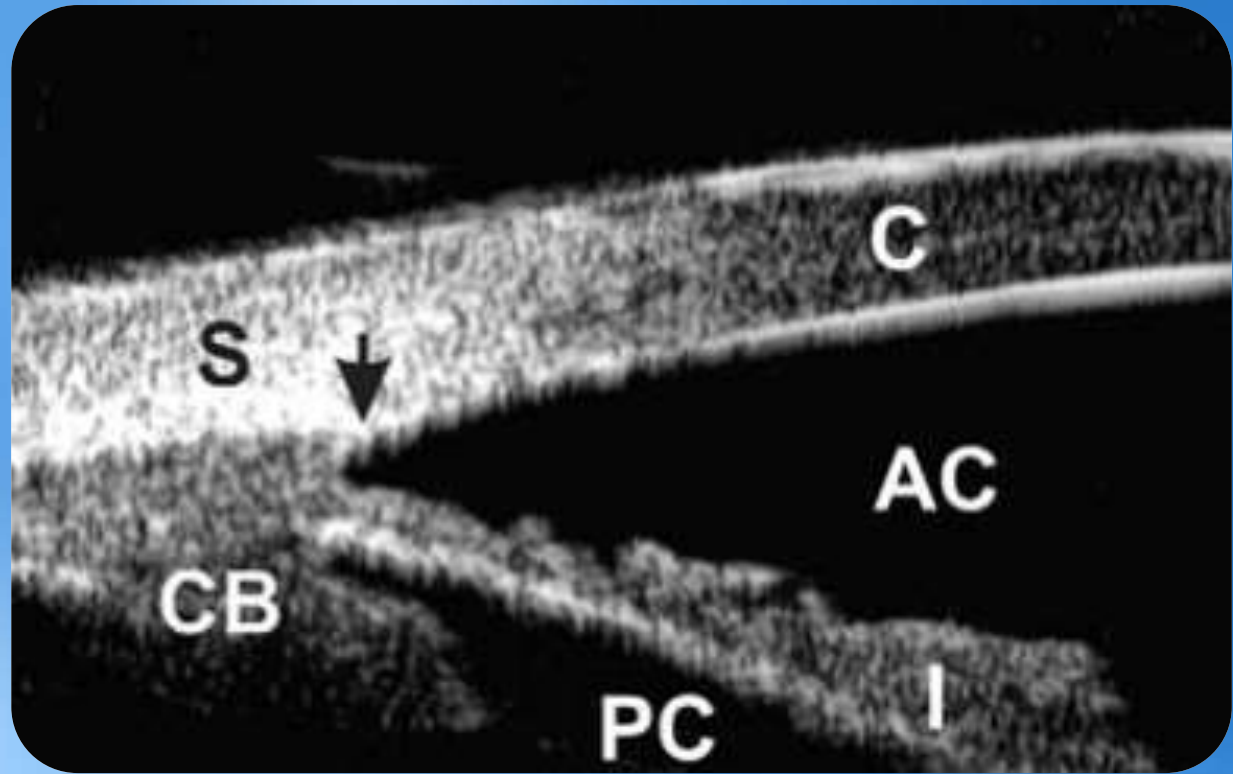
- ✓ *In the normal eye, the cornea, anterior chamber, posterior chamber, iris, ciliary body, and anterior lens surface can be recognized easily.*
- ✓ *The scleral spur is the only constant landmark allowing one to interpret UBM images and the key for analyzing angle pathology.*





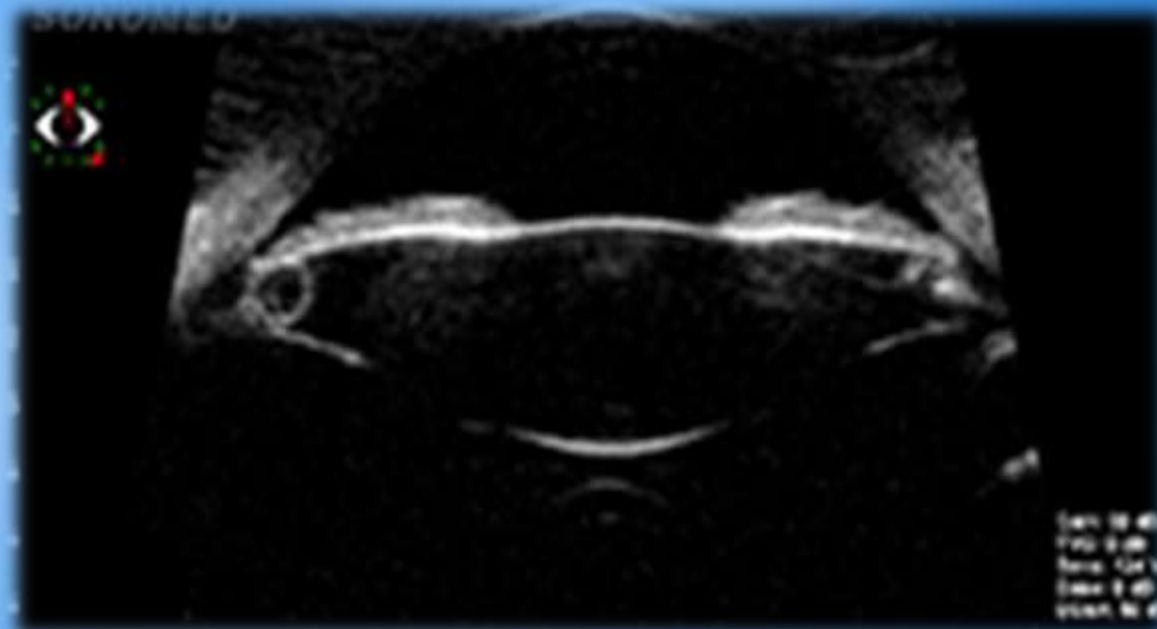
# *Ultrasound biomicroscopic appearance of a normal eye*

*The scleral spur (black arrow) is an important landmark to assess the morphologic relationships among the anterior segment structures.*



# *Pupil movement during dilation and miosis*

- ✓ *Changes in ambient lighting cause identifiable anatomical alterations in the iridocorneal angle.*
- ✓ *Imaging with UBM has revealed a narrowing of the angle in scotopic compared to photopic conditions.*
- ✓ *When evaluating patients who are at risk for angle closure, imaging should be done in low-level, mesopic light.*



# *Angle-closure glaucoma*

*Causes angle closure in four anatomic sites:*

- ✓ *Iris (pupillary block)*
- ✓ *Ciliary body (plateau iris)*
- ✓ *Lens (phacomorphic glaucoma)*
- ✓ *Behind the iris by a combination of various forces (malignant glaucoma and other posterior pushing glaucoma types)*



*Differentiating these affected sites is the key to provide effective treatment*



*UBM is extremely useful for achieving this goal*

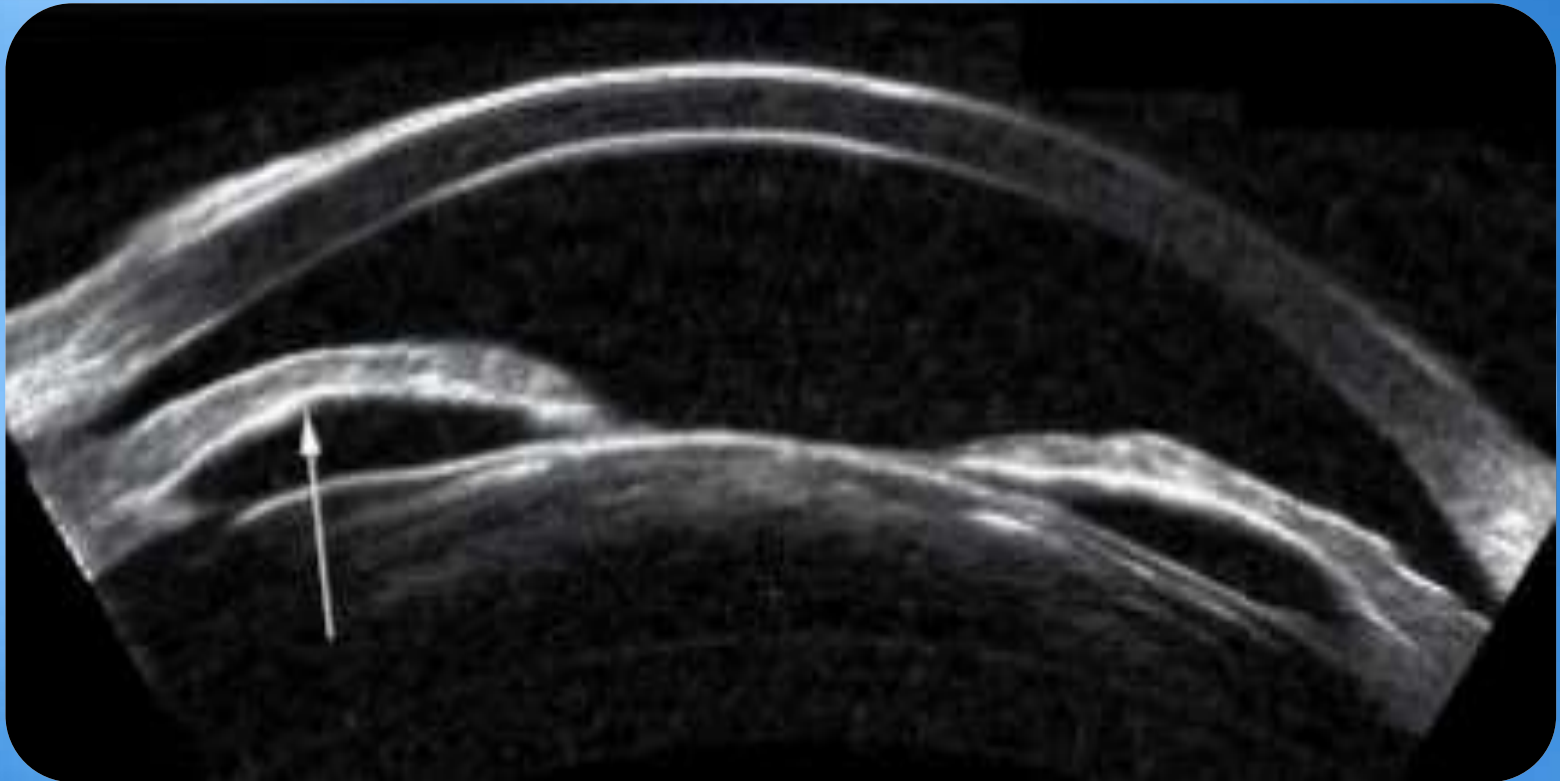
- ✓ *One of the most useful roles of UBM is in differentiating the causes of angle closure.*



- ✓ *If their angles do not open sufficiently after only iridotomy, clinicians can reexamine these patients with UBM to help decide if they also need an iridoplasty to prevent an angle-closure attack.*

# *Pupillary block*

*Ultrasound biomicroscopy image of pupillary block  
The pressure differential between the anterior and posterior  
chamber causes bowing forward*

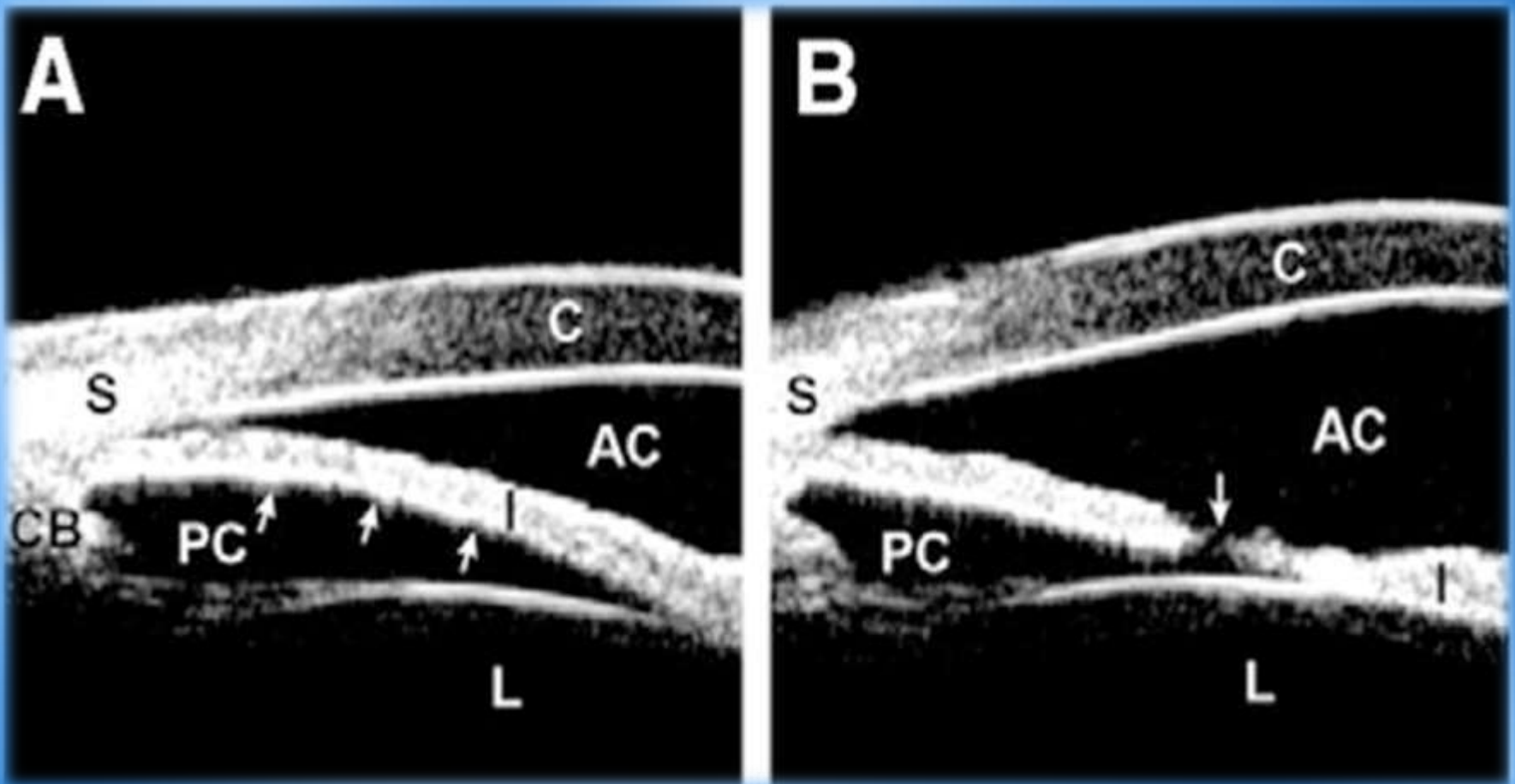




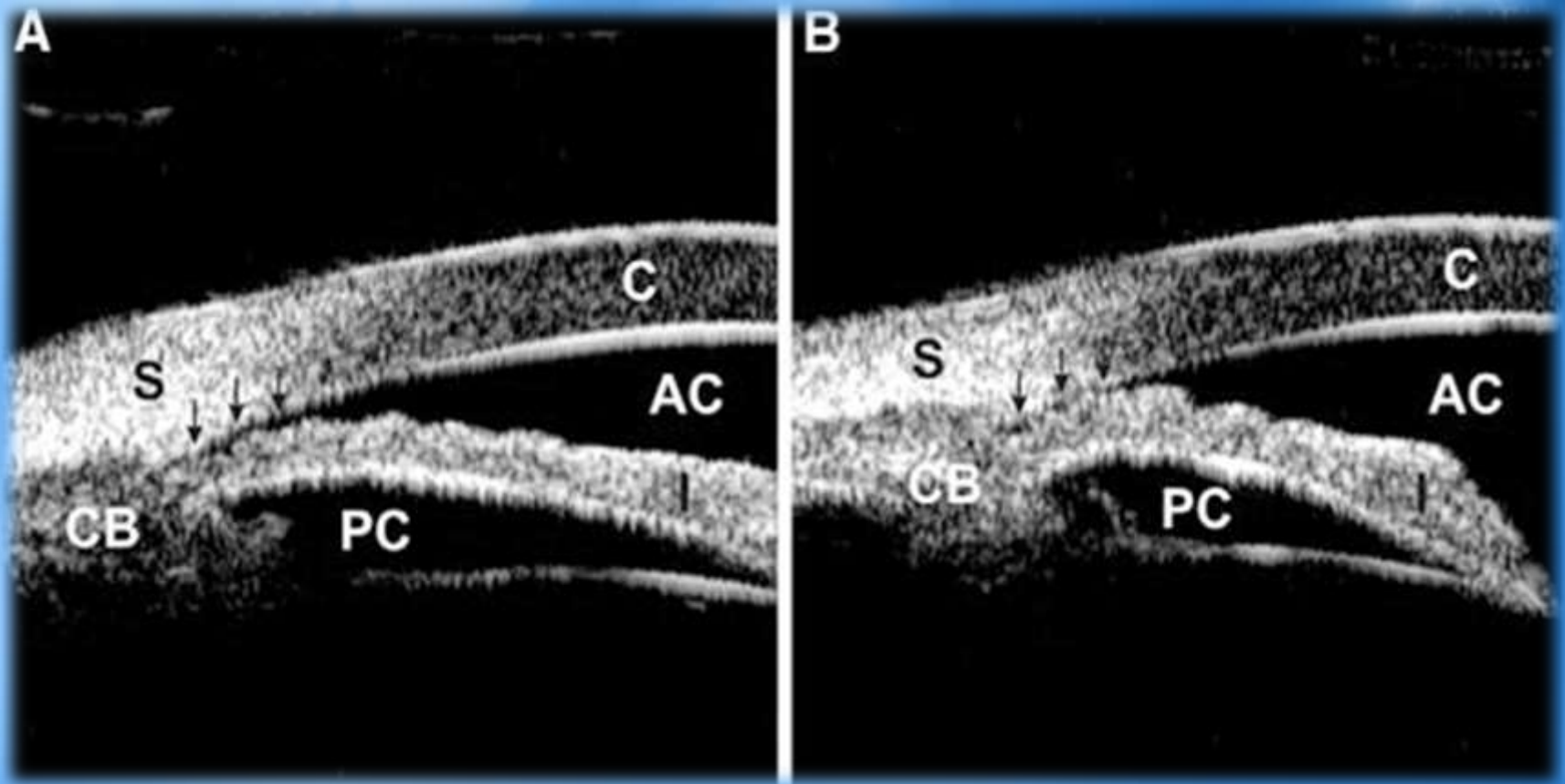
# ***Pupillary block***

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

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



## *Occludable angle with dark room provocative test*



*(A) The anterior chamber angle is slit-like opened (arrows) under a lighted condition.*

*(B) The angle is completely occluded (arrows) under a dark condition.*

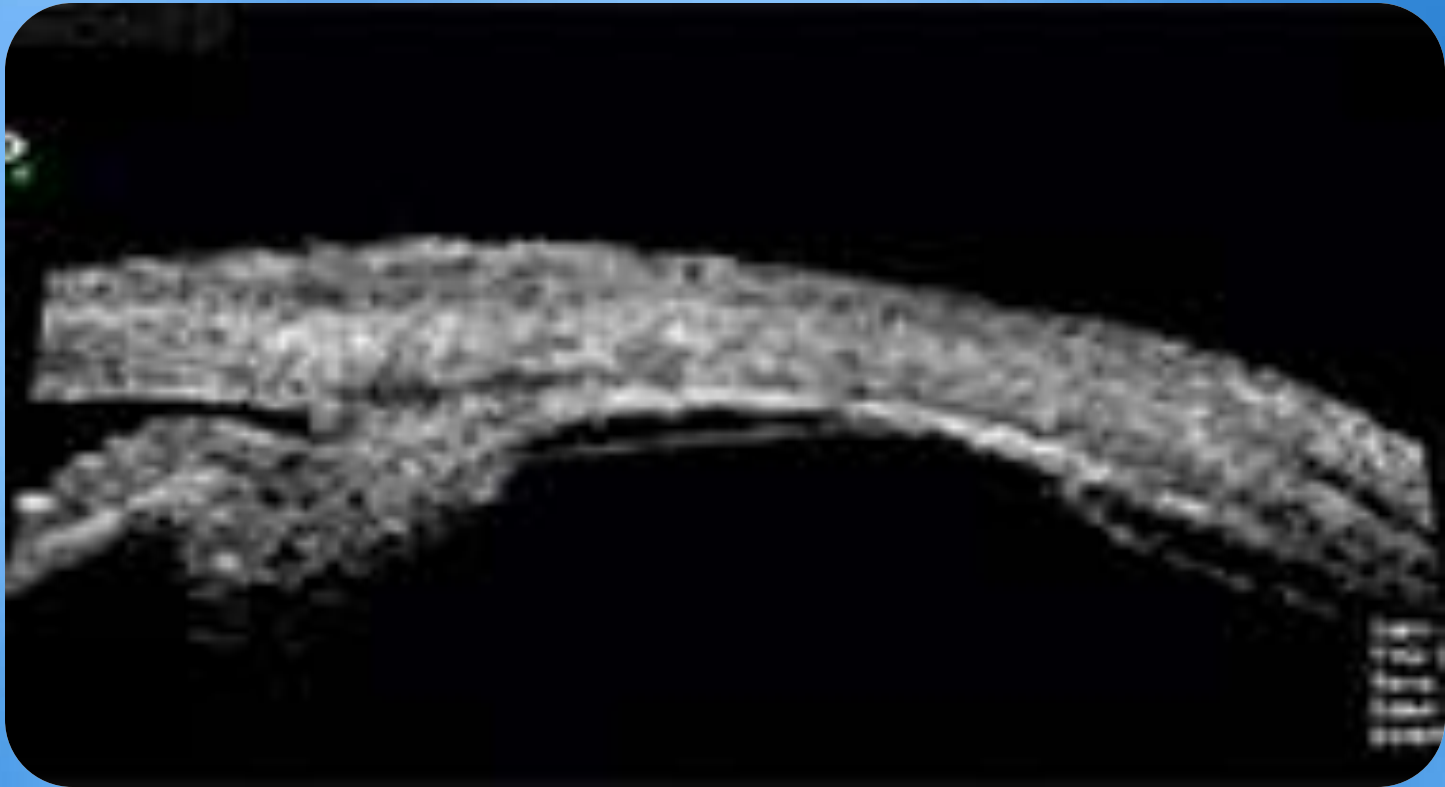


## ***Plateau iris***

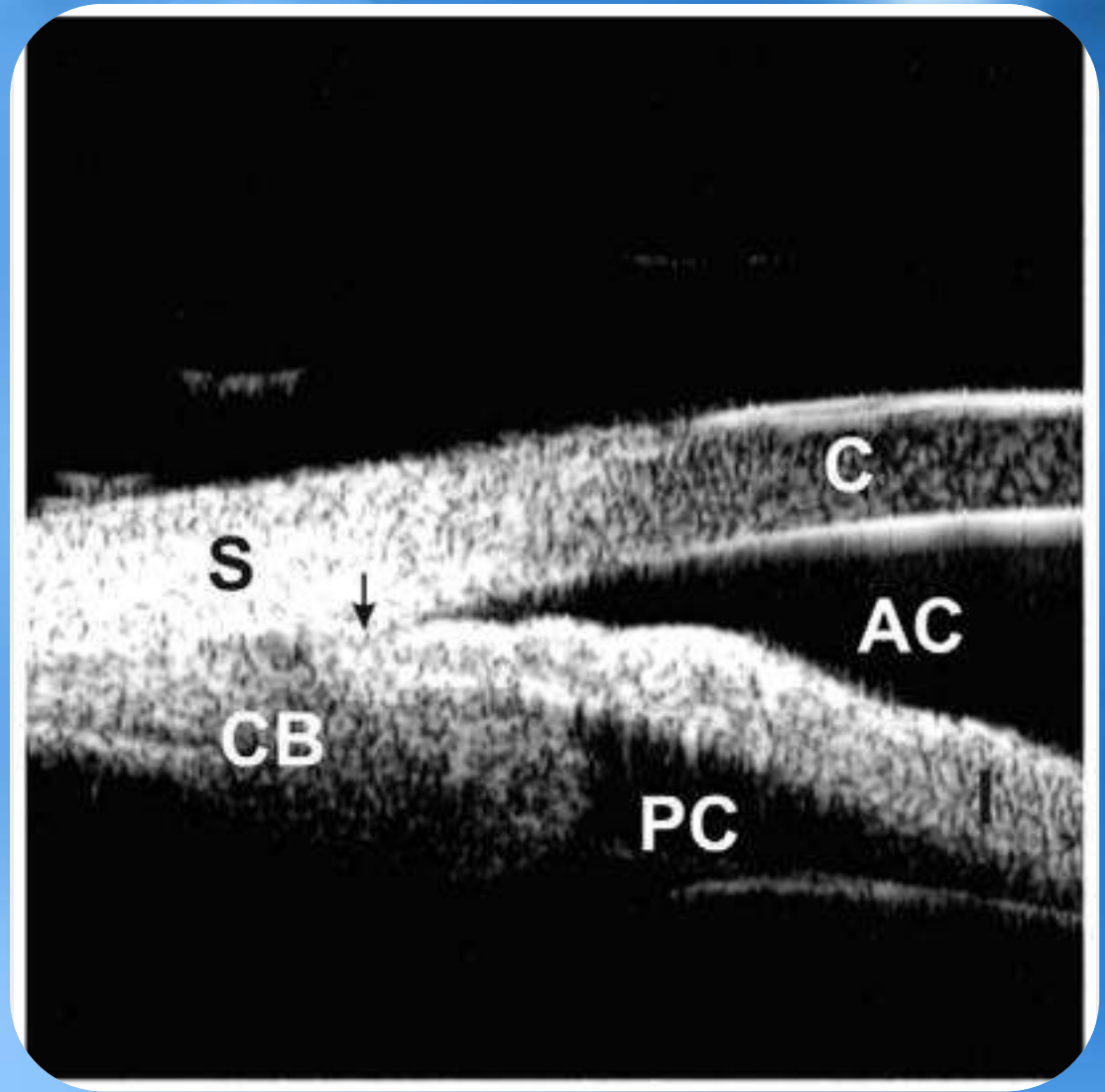
- ✓ *In plateau iris syndrome, the ciliary body is anteriorly positioned and possibly enlarged.*
- ✓ *Compressing the iridocorneal angle and placing the peripheral iris in apposition to the trabecular meshwork, impairing outflow.*

# *Plateau iris syndrome*

- ✓ *UBM demonstrates an anteriorly rotated ciliary body with obliteration of the ciliary sulcus.*
- ✓ *Only through UBM imaging can this condition be definitively diagnosed.*



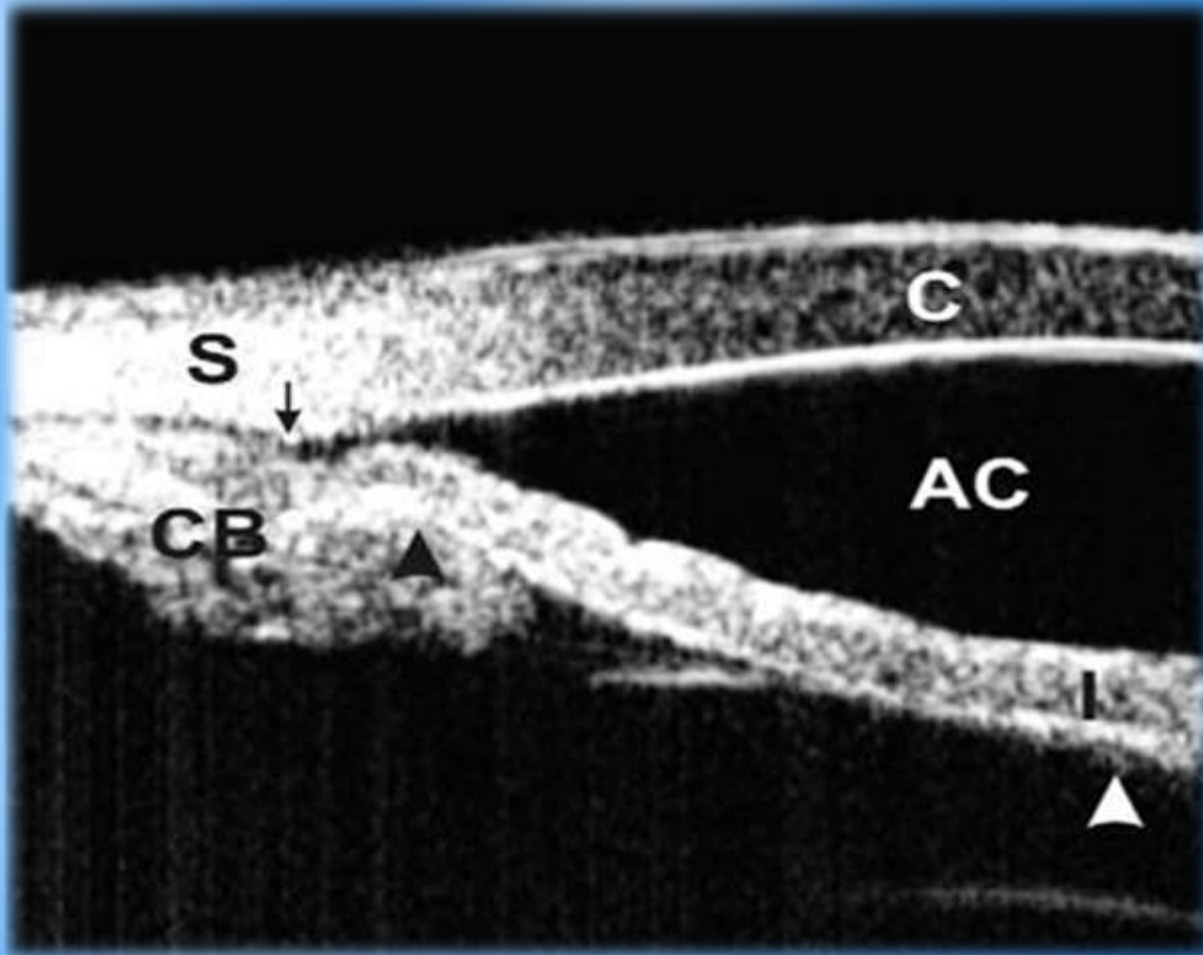
- *A large and anteriorly positioned ciliary body holds the iris root up against the cornea.*
- *The arrow represents the location of the scleral spur.*

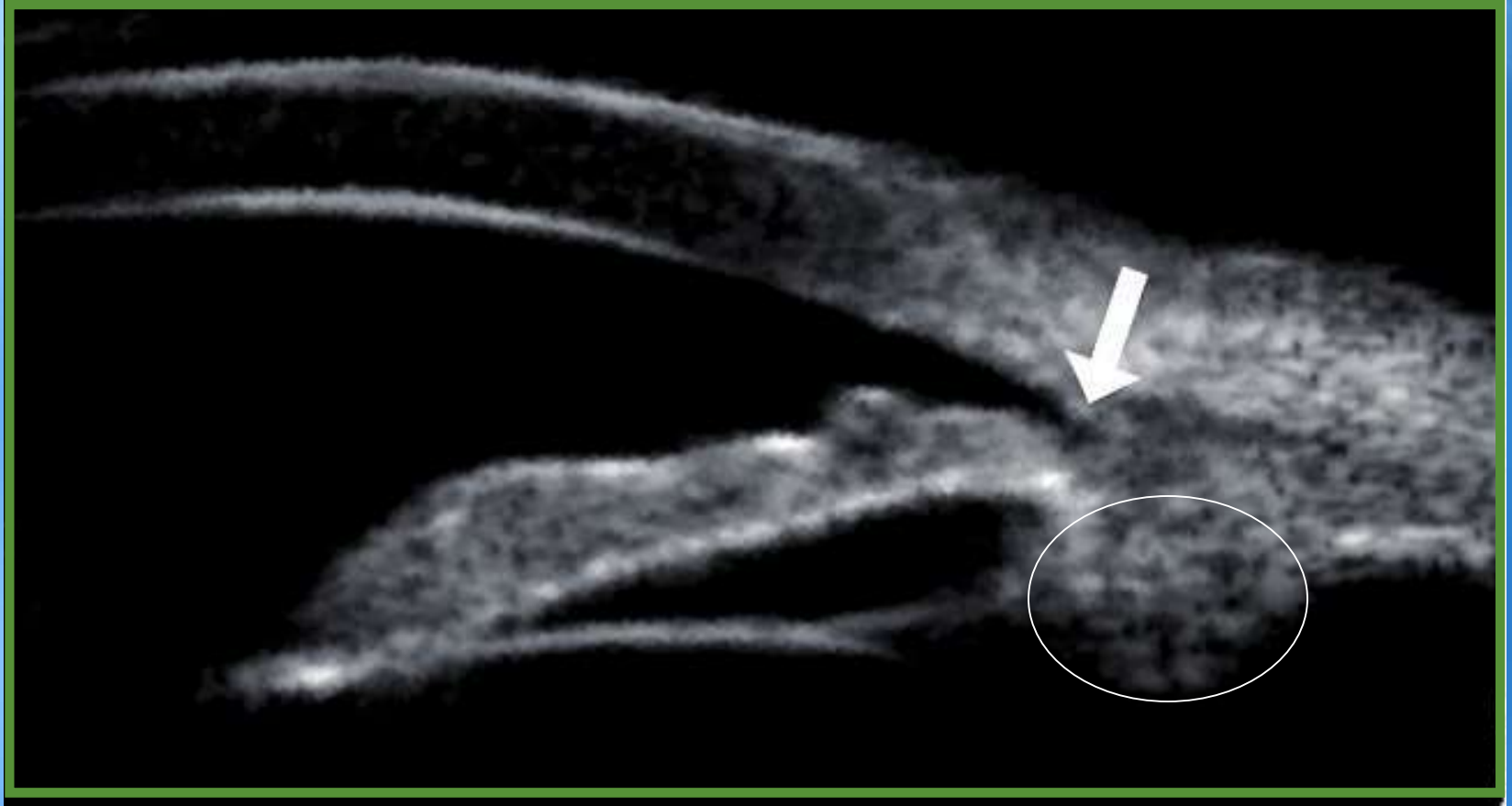


*Plateau iris*



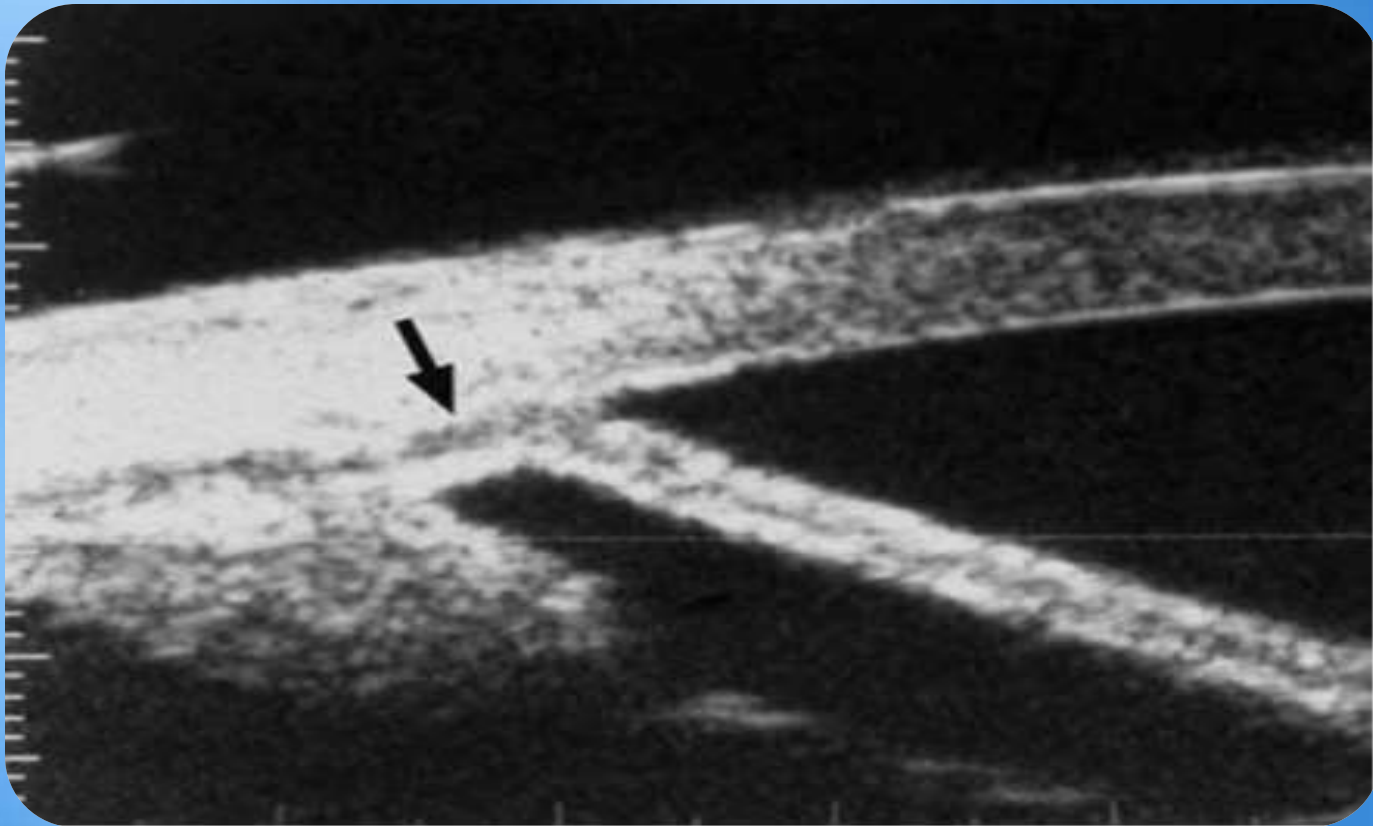
*Indentation UBM on an eye with a plateau iris. The angle is slit-like opened. The “double-hump” sign*





Closed iridocorneal angle without plateau iris picture: the ciliary processes are positioned behind the scleral spur (white arrow).

*In eyes with peripheral anterior synechiae,  
UBM can reveal the extent of iridocorneal  
adhesions, even if the cornea is hazy or  
opaque*



***Anterior Synechia***

A vertical decorative bar on the left side of the slide featuring a blue bokeh effect with out-of-focus light circles and starburst patterns.

# *ICE Syndrome*

- *Zhang M et al compared UBM findings of anterior segment between normal subjects and three clinical types of ICE syndrome.*
- *UBM was found to be more effective in detecting peripheral anterior synechiae (PAS) and iris atrophy than slit-lamp microscopy and gonioscopy, mainly because of corneal edema.*

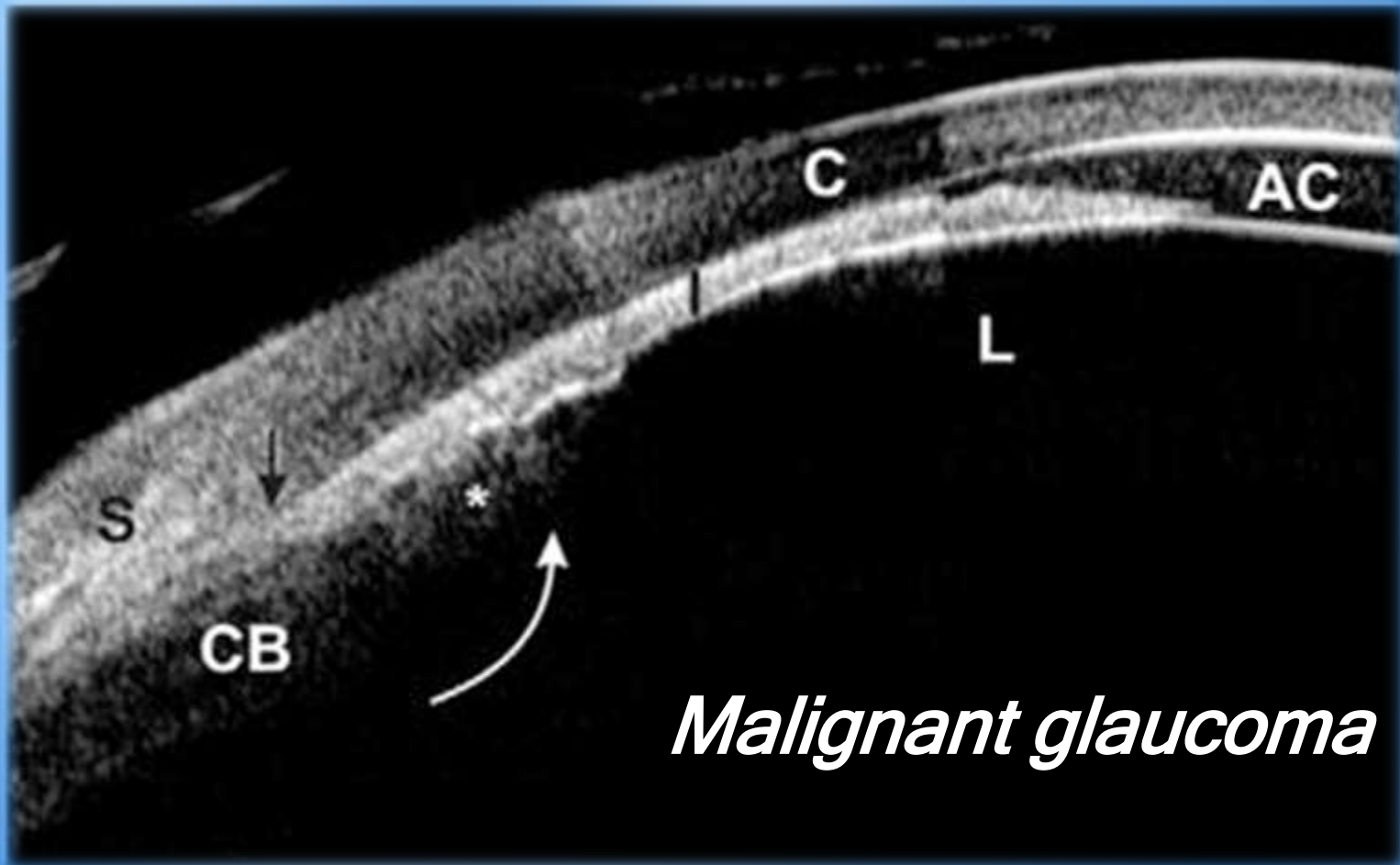
A vertical decorative bar on the left side of the slide featuring a blue bokeh effect with out-of-focus light circles and starburst patterns.

# ***Malignant glaucoma***

- ✓ *Ciliary block or aqueous misdirection, presents the greatest diagnostic and treatment challenge.*
- ✓ *Forces posterior to the lens push the lens–iris diaphragm forward, causing angle closure.*
- ✓ *UBM clearly shows that all anterior segment structures are displaced and pressed tightly against the cornea.*



- ✓ *The lens, iris, and ciliary process are all pushed forward, resulting in an extremely shallow anterior chamber and totally occluded angle.*

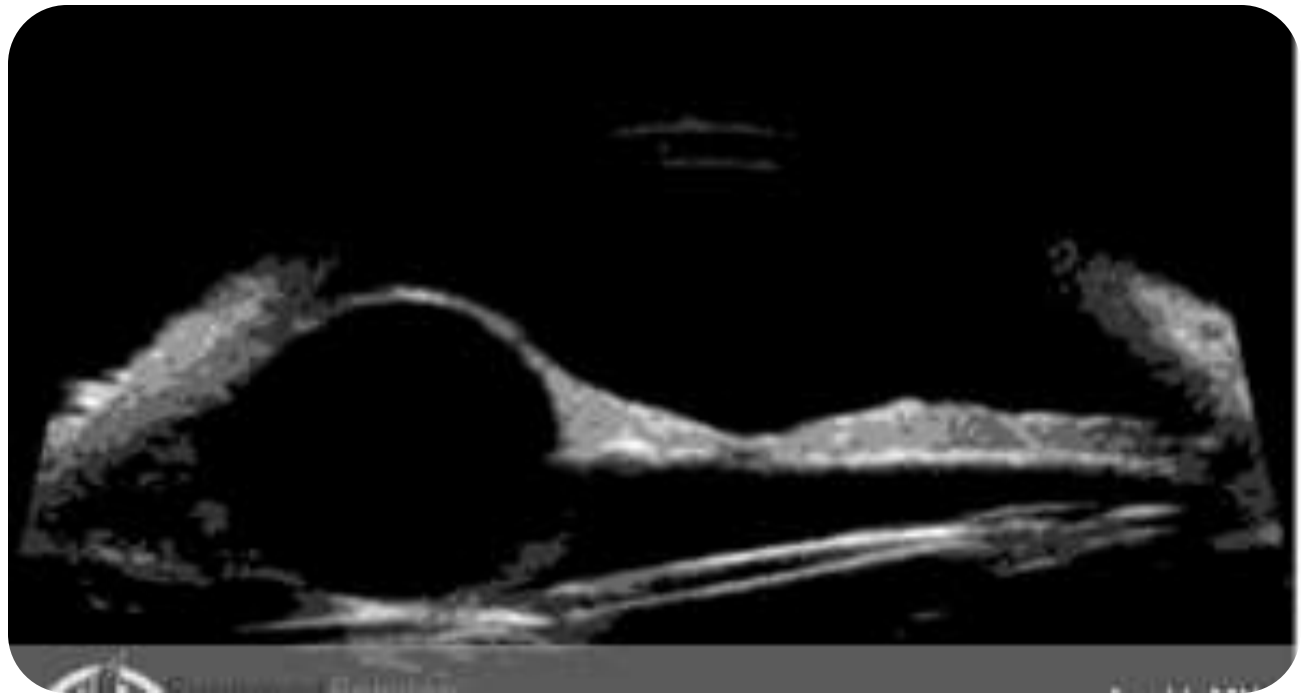


# *Other causes of angle closure*

- ✓ *Iridociliary body cysts can produce angle-closure glaucoma.*
- ✓ *The anterior chamber angle is occluded partially or intermittently owing to singular or multiple cysts .*
- ✓ *Iridociliary tumor, enlargement of the ciliary body owing to inflammation or tumor infiltration.*

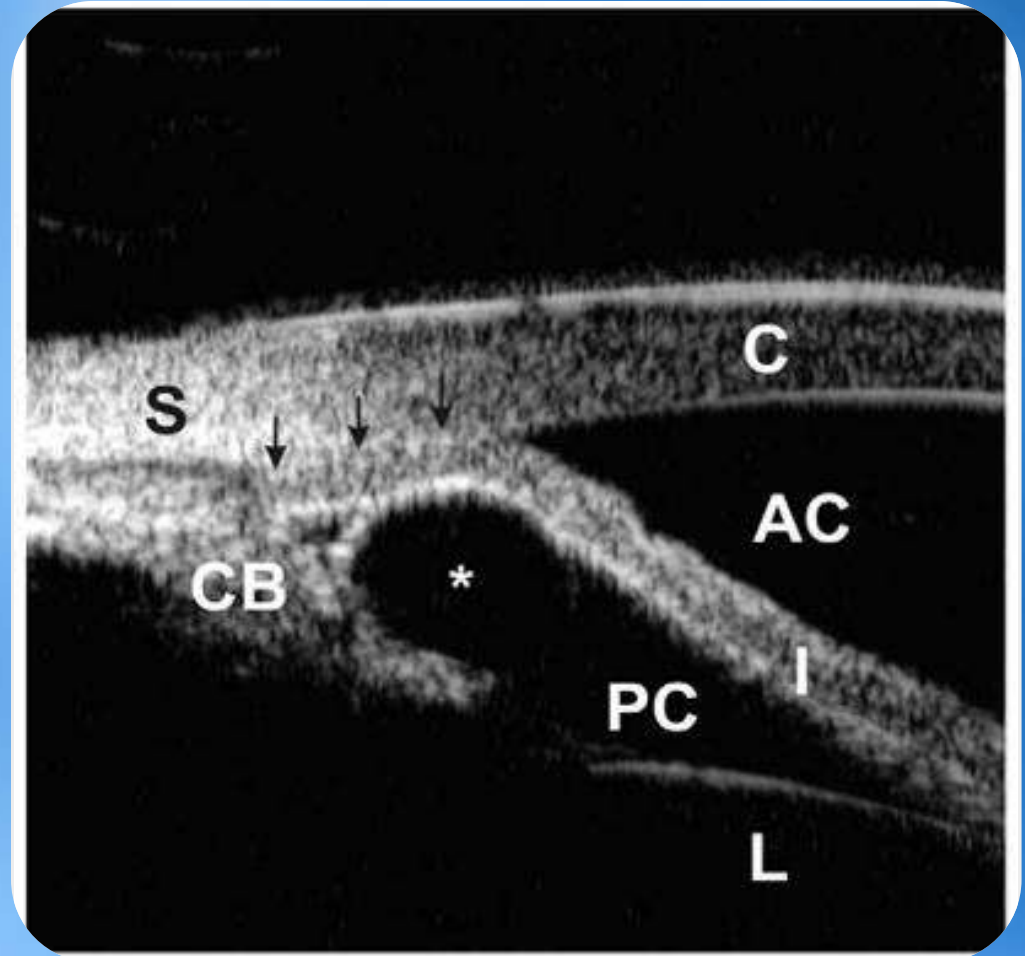
# *Iridociliary cyst*

- ✓ *When an iridociliary cyst is detected, management should include UBM examination of both eyes over 360° to rule out any potential angle compromise.*
- ✓ *Patients with multiple bilateral cysts compromising the angle should be followed as glaucoma suspect.*



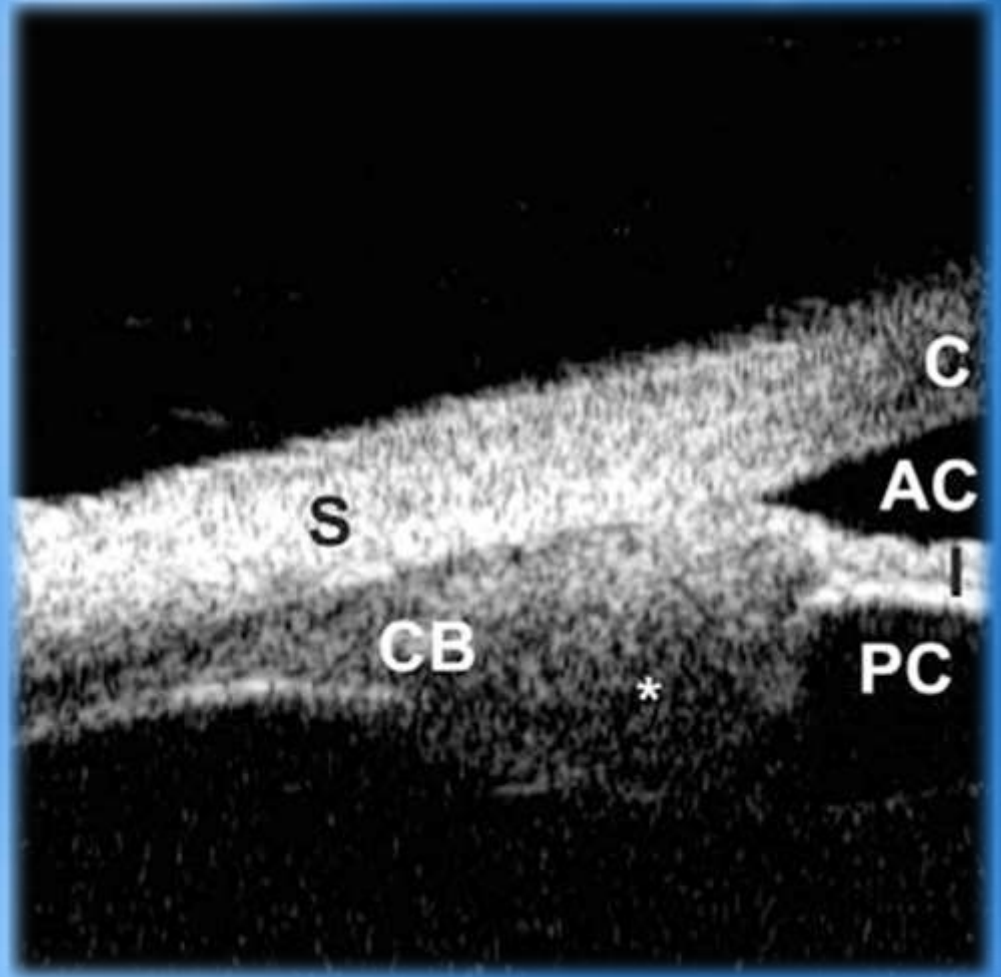
# *Iridociliary cyst*

- ✓ Angle closure owing to an iridociliary cyst.
- ✓ An iridociliary cyst (asterisk) pushes the iris root toward the cornea, resulting in total occlusion of the angle.



# *Iridociliary tumor*

*Abnormally large  
ciliary process  
(asterisk) involving  
the iris root and pars  
plana is visualized.*





# *Open-angle glaucoma*

- ✓ *The only type of open-angle glaucoma that shows characteristic findings on UBM*

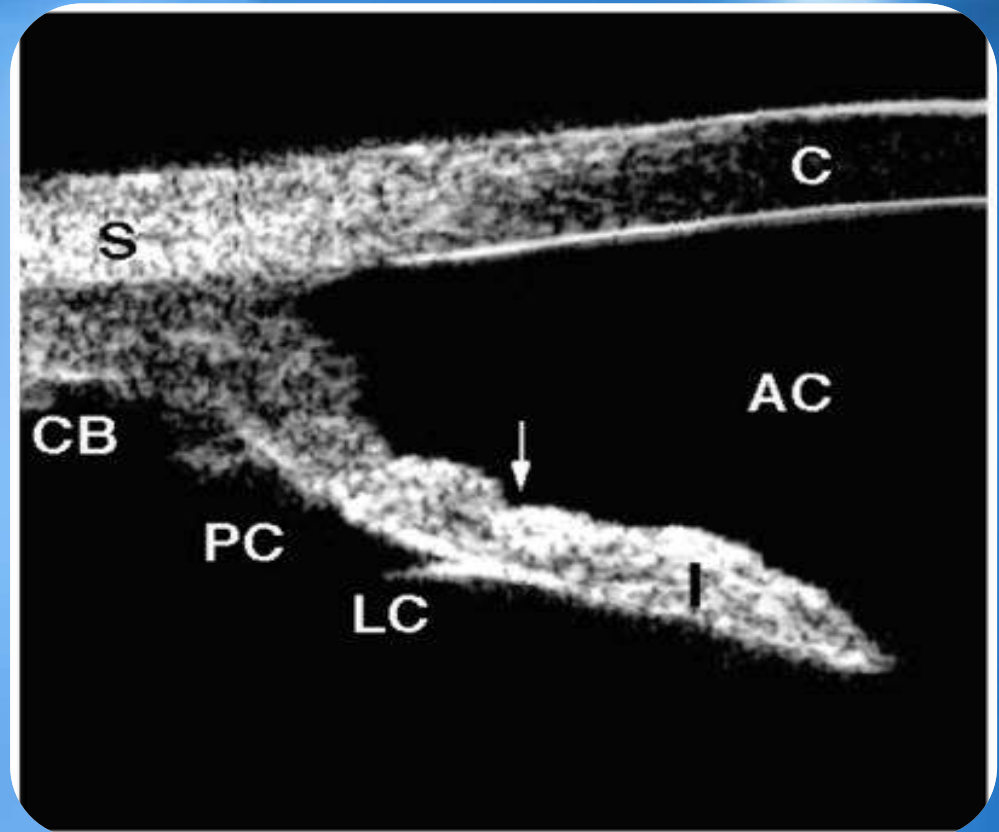


- ✓ *Pigment dispersion syndrome*



- ✓ *Mechanical friction between the posterior iris surface and anterior zonular bundles releases iris pigment particles into aqueous flow*

- ✓ *The angle is wide with a concave iris*
- ✓ *Extremely wide iridolenticular contact*
- ✓ *Iridolenticular contact decreases following laser iridotomy*



# *Pigment dispersion syndrome*

# *Postpenetrating keratoplasty glaucoma*

- ✓ *Major cause of graft failure and the most common cause of irreversible visual loss after keratoplasty.*



- ✓ *UBM allows imaging of anterior-segment anatomy in the presence of corneal opacity.*

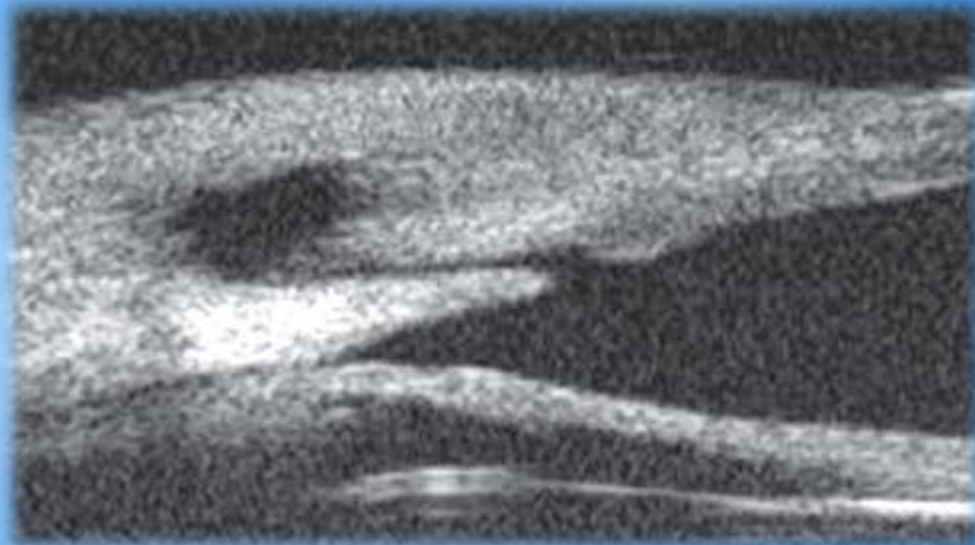


- ✓ *Valuable tool for planning filtering surgery or the implantation of drainage devices.*

# *Determining Functional State of a Filtering Surgery*

*After trabeculectomy UBM can show whether ;*

- ✓ *Sclerostomy aperture is patent or blocked internally*
- ✓ *Whether the peripheral iridectomy is patent*
- ✓ *Whether the filtering bleb is flat, shallow, or deep*

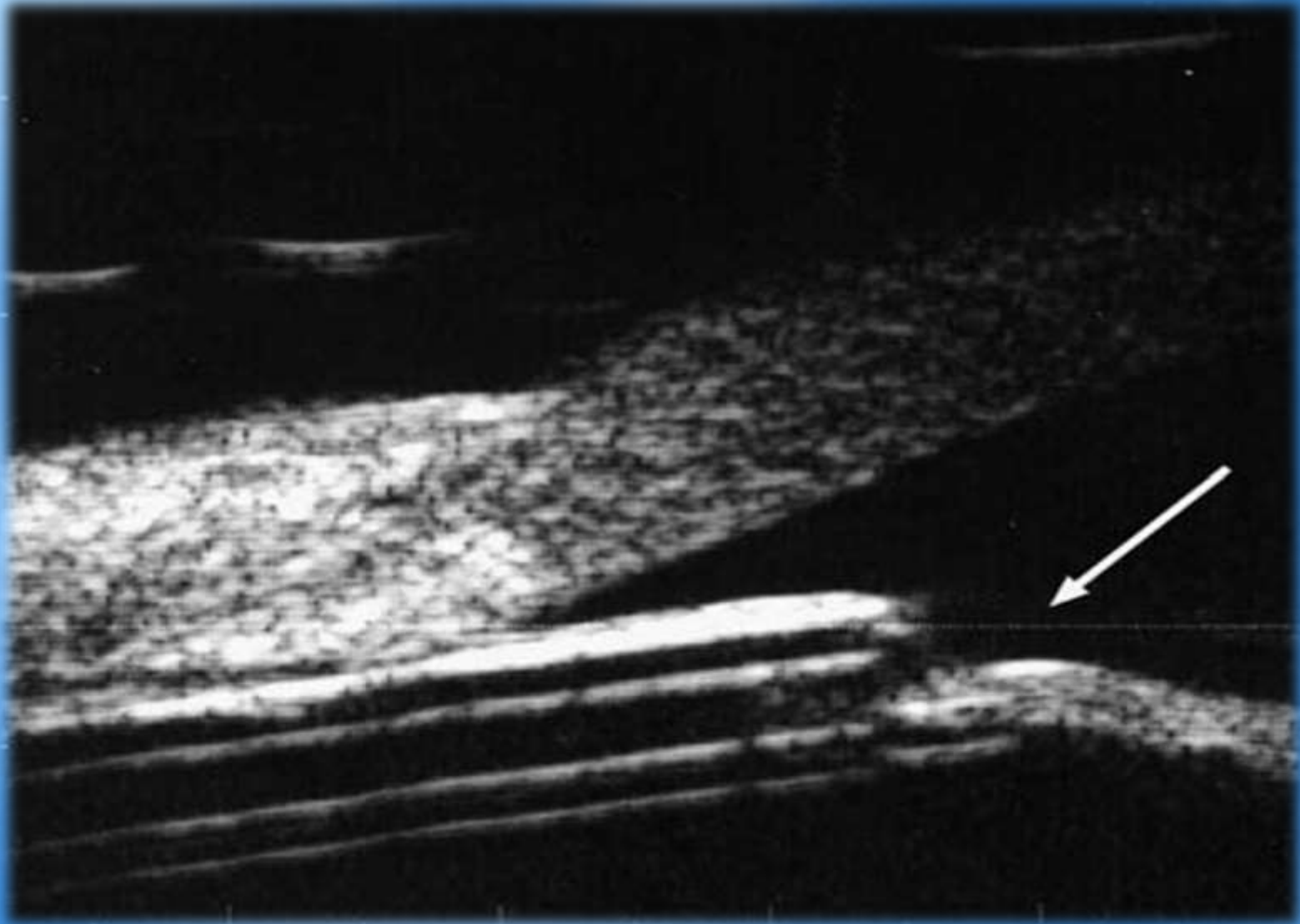




*Eyes with good IOP control mainly have (L) type blebs, these have low to moderate intrableb reflectivity, visible intrascleral route and higher intrableb height. Flat and encapsulated blebs generally denote a surgical failure.*

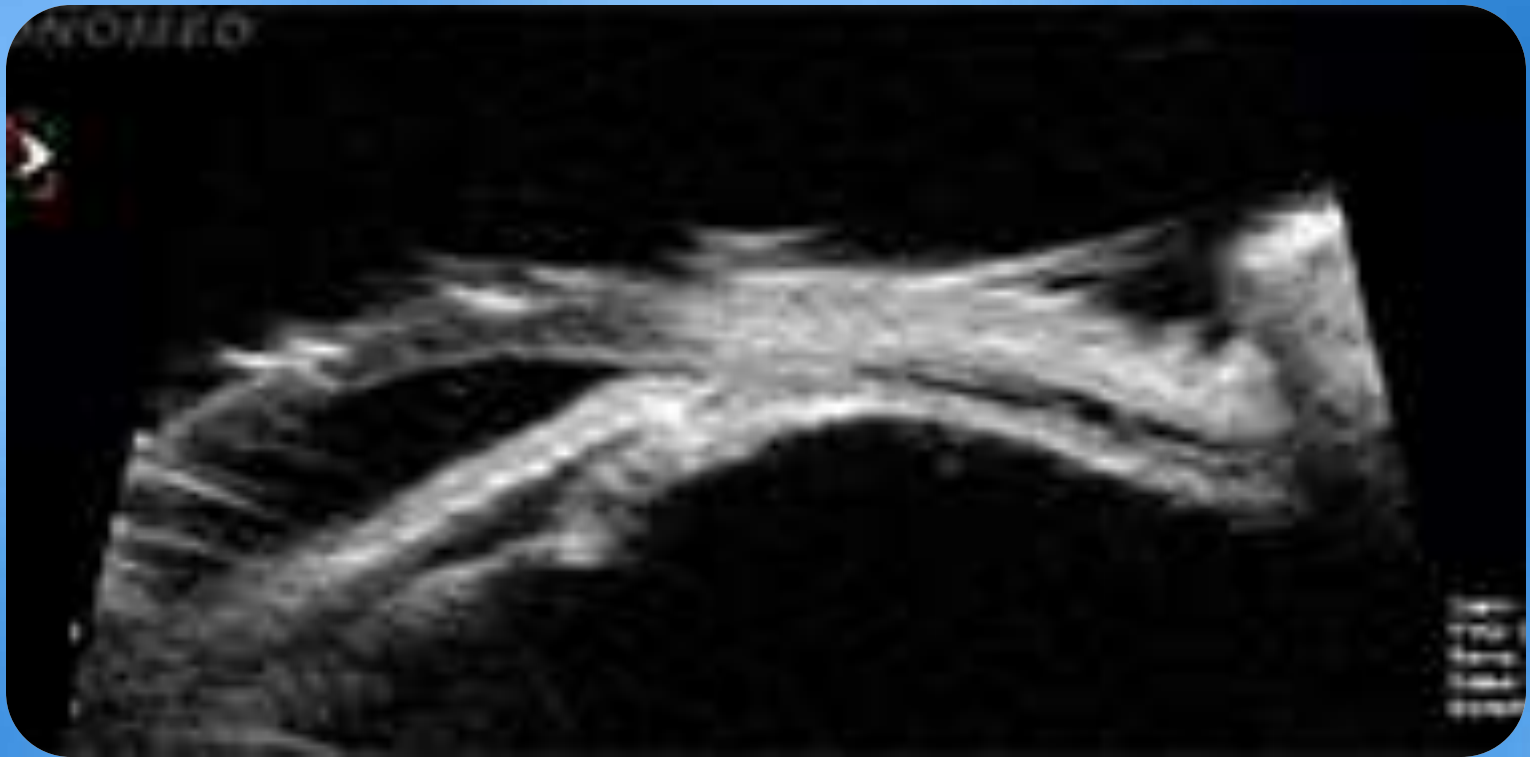


*The UBM is also useful in diagnosing the presence and cause of occlusion of aqueous drainage devices*



# *Anterior choroidal effusion following glaucoma implant surgery*

- ✓ *Anterior suprachoroidal effusions may be difficult to identify by indirect ophthalmoscopy.*
- ✓ *They can easily be found with UBM, however, especially when the placement of the hand piece posterior to the limbus.*



*In case of IOL induced glaucoma, it can clearly delineate the position of the optic and haptic and is especially helpful in pseudophakic bullous keratopathy cases to determine the cause for glaucoma*



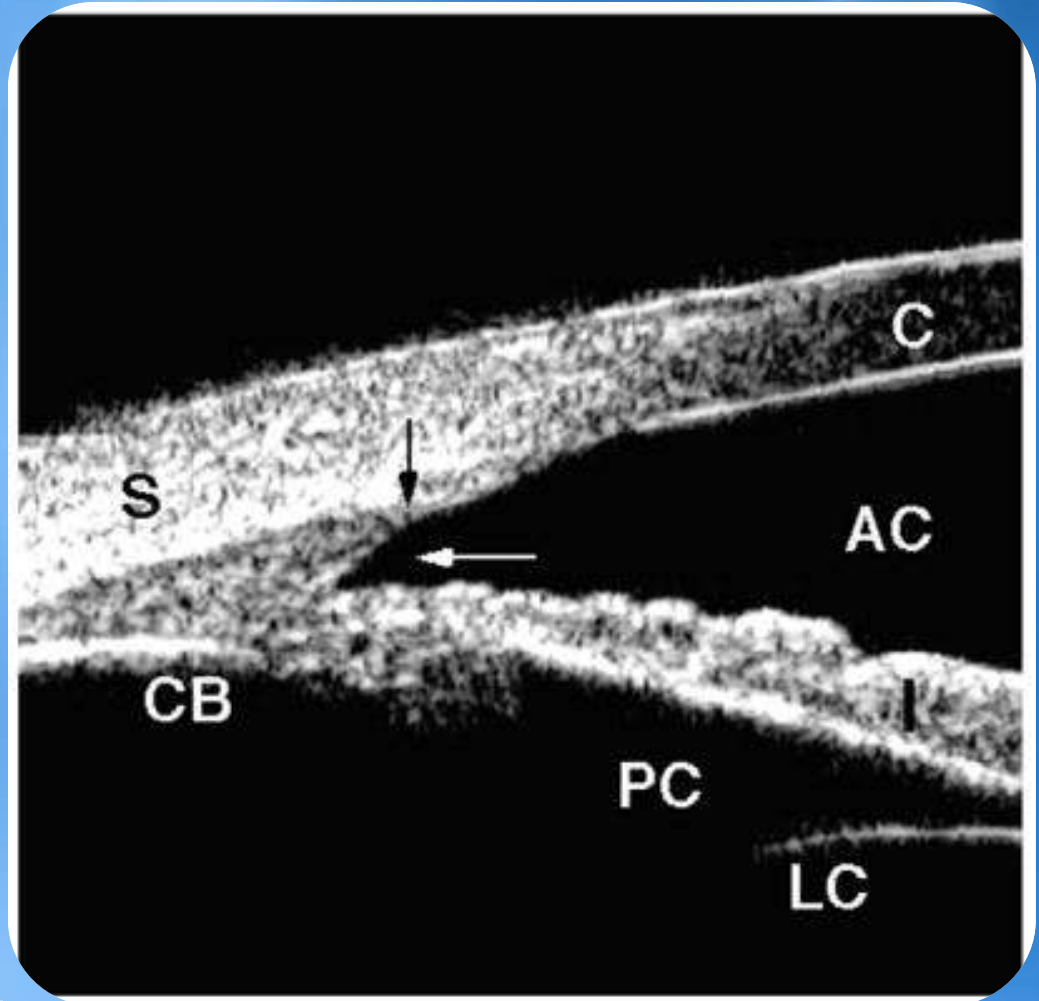
**PSEUDOPHAKIC AND LENS INDUCED GLAUCOMA**



# *Ocular trauma*

- ✓ *With the help of UBM, angle recession can be differentiated from cyclodialysis.*
- ✓ *In angle recession, the ciliary body face is torn at the iris insertion, resulting in a wide-angle appearance.*
- ✓ *In cyclodialysis, the ciliary body is detached from its normal location at the scleral spur.*

- ✓ *Blunt trauma caused a tear into the ciliary body face (white arrow).*
- ✓ *Remained attached to the scleral spur (black arrow).*
- ✓ *There is no direct communication between the anterior chamber and the supraciliary space.*



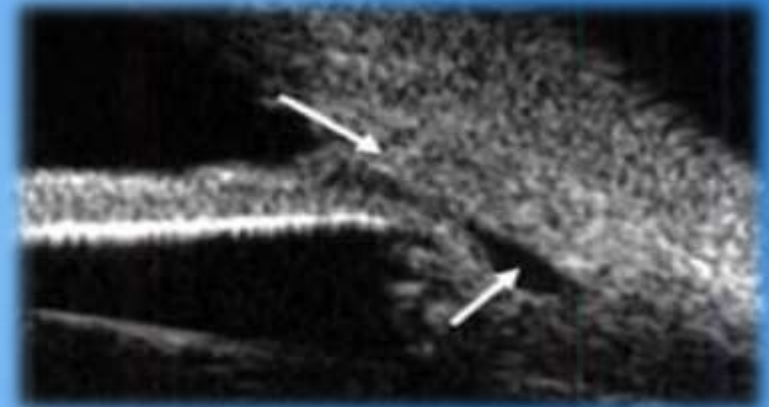
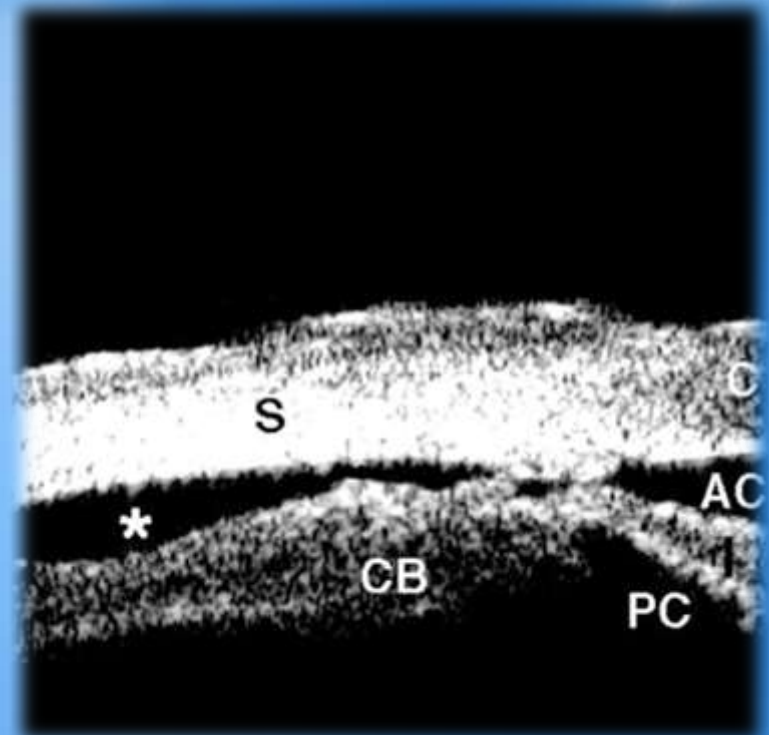
## *Angle recession*





*Cyclodialysis cleft  
ciliary body is disinserted from the scleral spur*

*The ciliary body is avulsed from the sclera, resulting in free aqueous flow from the anterior chamber through the cleft into the supraciliary space (asterisk).*



***Cyclodialysis***



# ***Quantitative ultrasound biomicroscopy***

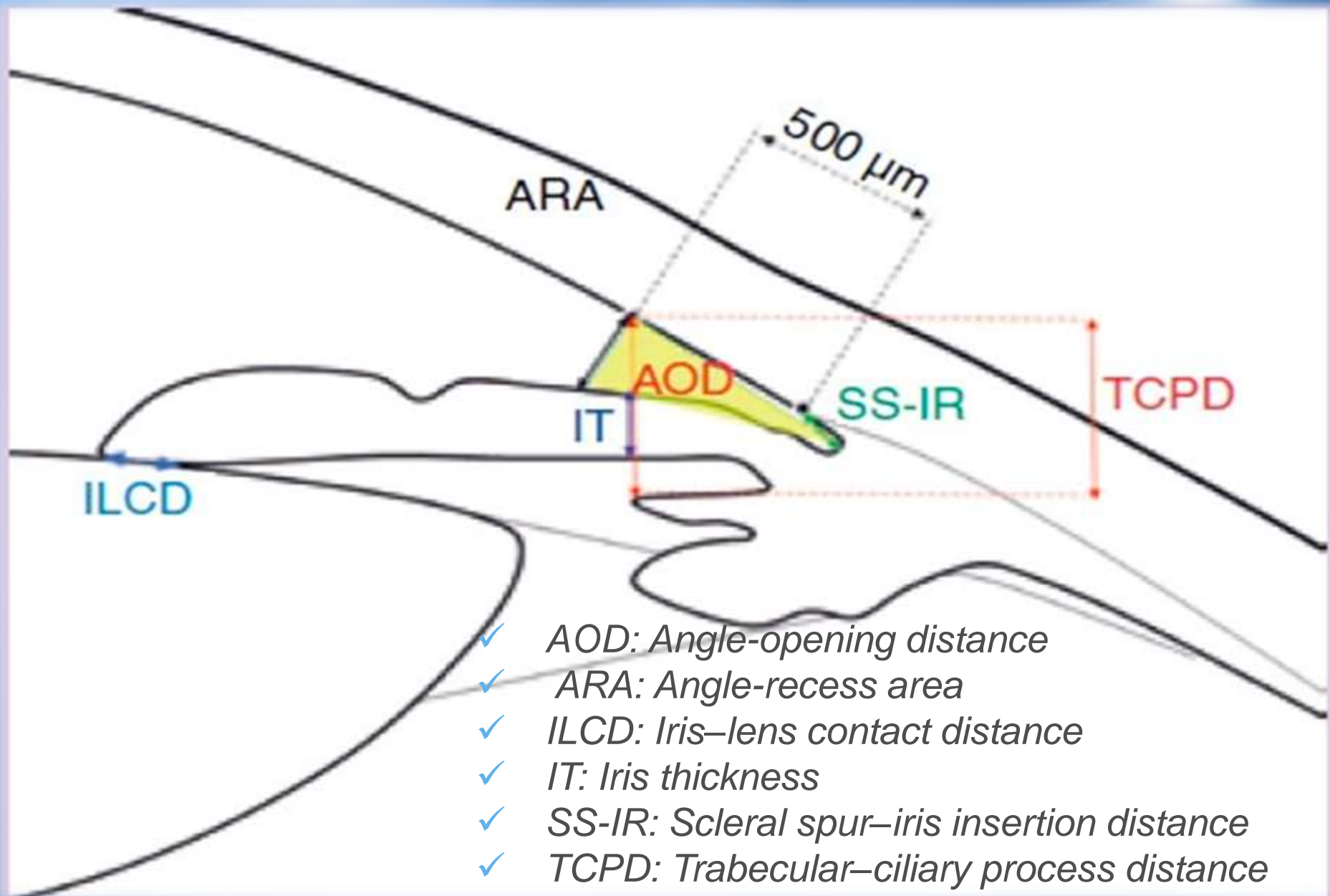
*The UBM measurement software calculates distance and area by counting the number of pixels along the measured line or inside the designated area and multiplies the pixel counts by the theoretical size of the pixel.*



# *Methods proposed by Pavlin and colleagues*

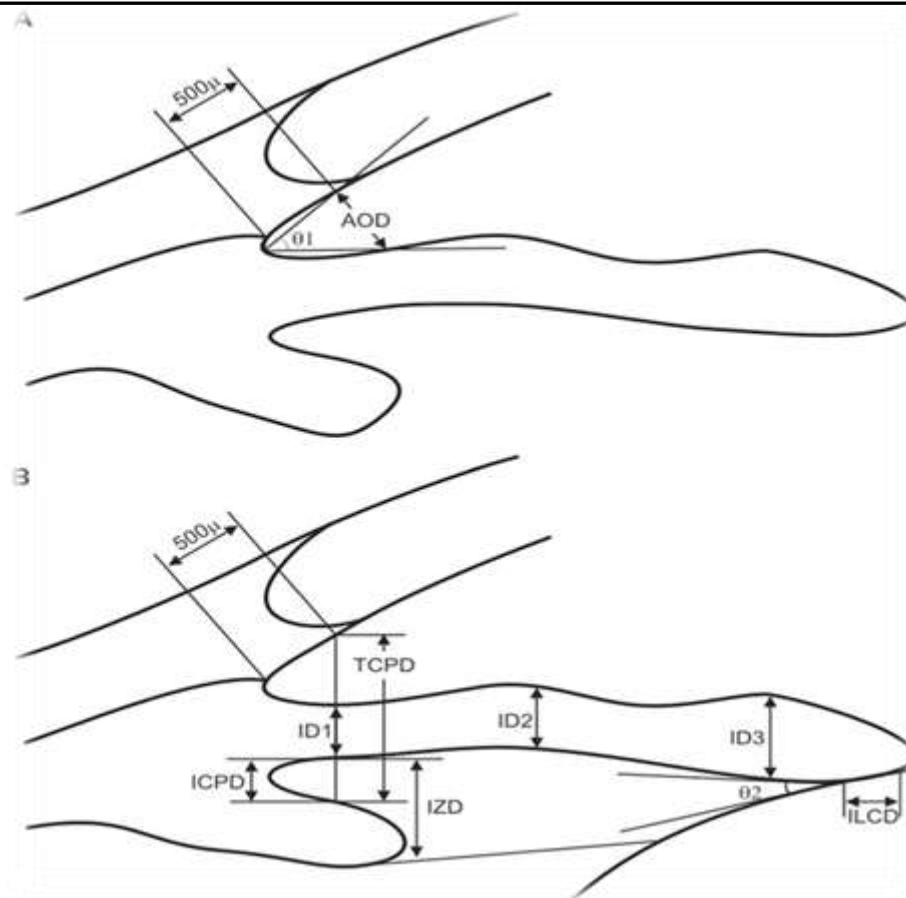
- ✓ *Pavlin et al established various quantitative measurement parameters as standards .*
- ✓ *The position of the scleral spur is used as a reference point for most of their parameters, because this is the only landmark that can be distinguished consistently in the anterior chamber angle region.*

# Diagram illustrating several biometric descriptors of the angle



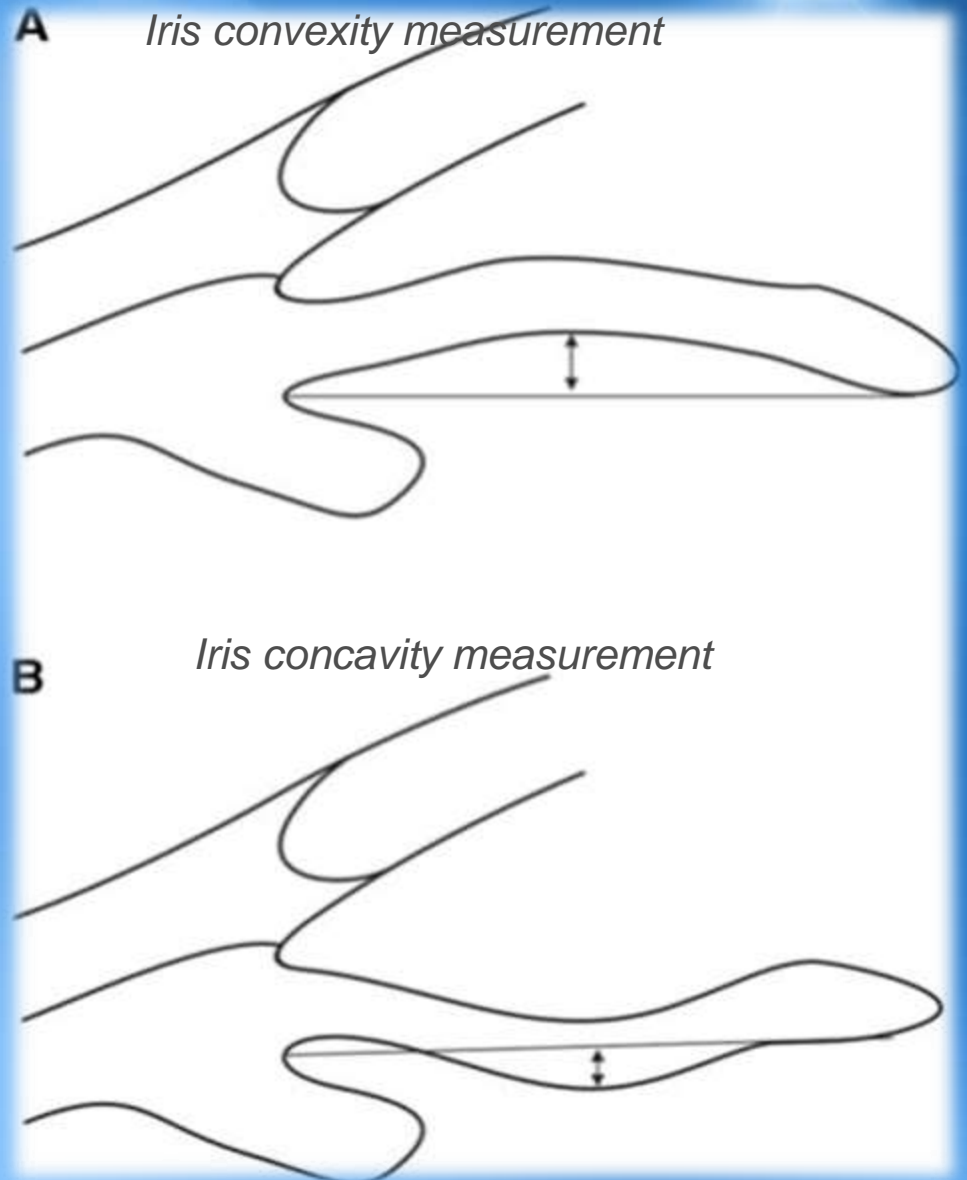


Name	Abbreviation	Description
Angle opening distance	AOD	Distance between the trabecular meshwork and the iris at 500 $\mu\text{m}$ anterior to the scleral spur
Trabecular–iris angle	TIA $\theta$ 1	Angle of the angle recess
Trabecular–ciliary process distance	TCPD	Distance between the trabecular meshwork and the ciliary process at 500 $\mu\text{m}$ anterior to the scleral spur
Iris thickness	ID1	Iris thickness at 500 $\mu\text{m}$ anterior to the scleral spur
Iris thickness	ID2	Iris thickness at 2 mm from the iris root
Iris thickness	ID3	Maximum iris thickness near the pupillary edge
Iris–ciliary process distance	ICPD	Distance between the iris and the ciliary process along the line of TCPD
Iris–zonule distance	IZD	Distance between the iris and the zonule along the line of TCPD
Iris–lens contact distance	ILCD	Contact distance between the iris and the lens
Iris–lens angle	ILA $\theta$ 2	Angle between the iris and the lens near the pupillary edge



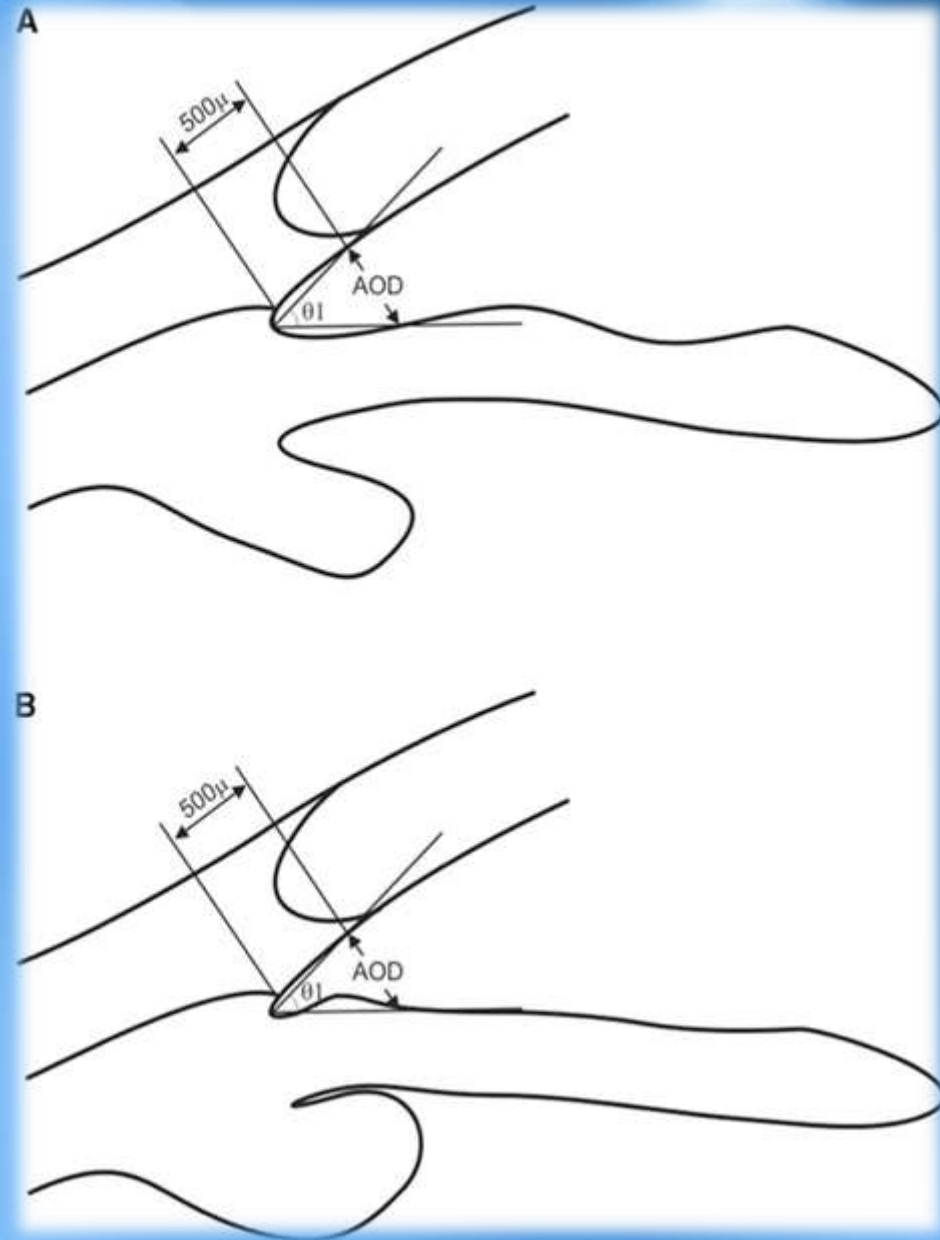
- ✓ Iris configuration is determined first by creating a line from the most peripheral to the most central points of iris pigment epithelium.
- ✓ A perpendicular line is then extended from this line to the iris pigment epithelium at the point of greatest concavity or convexity.

*Iris concavity  
convexity*



## ***Limitation of the conventional angle opening distance (AOD) measurement.***

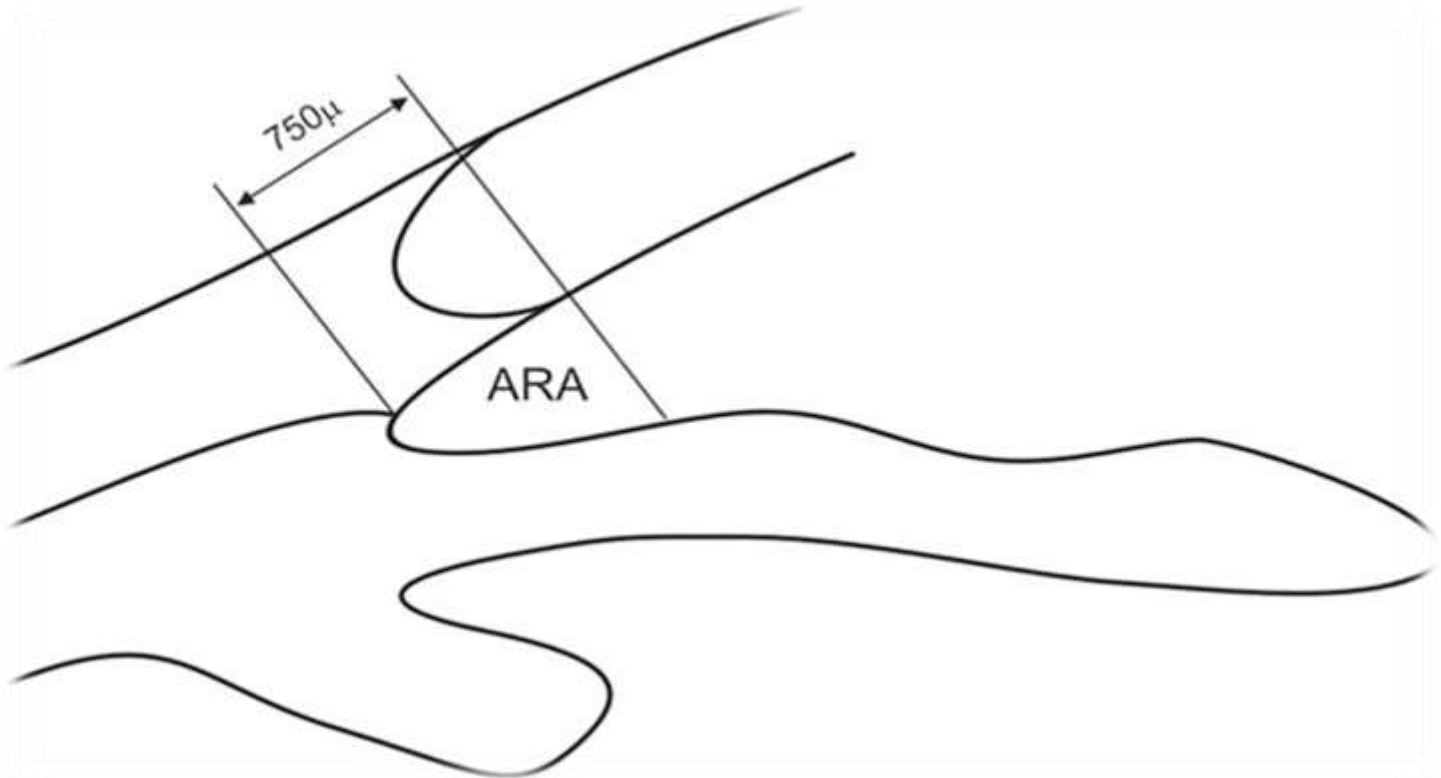
- *(A) and (B) have exactly the same value for the AOD and trabecular–iris angle (TIA,  $\theta$  1).*
- *The angle in (B) is gonioscopically narrower and is more likely to be occludable than the normal-appearing angle in (A).*
- *Therefore, irregularities of iris contour and curvature need to be taken into account.*

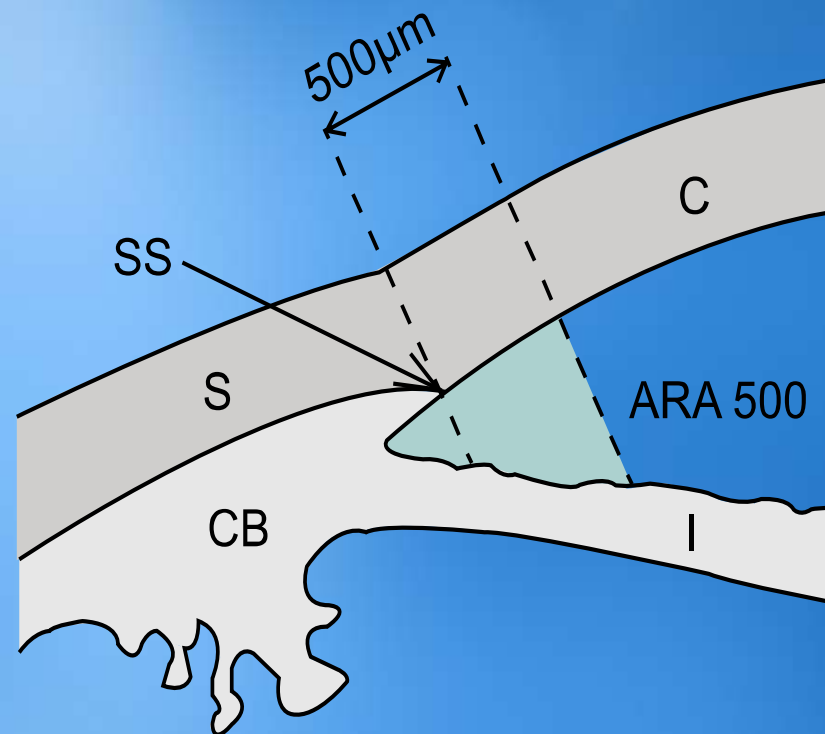
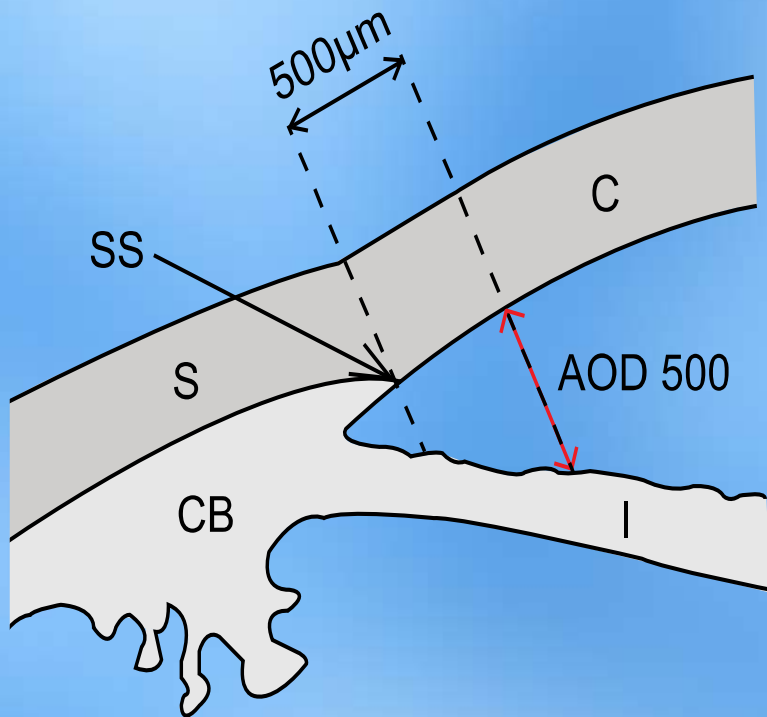


# *An improved method for assessing the anterior chamber angle*

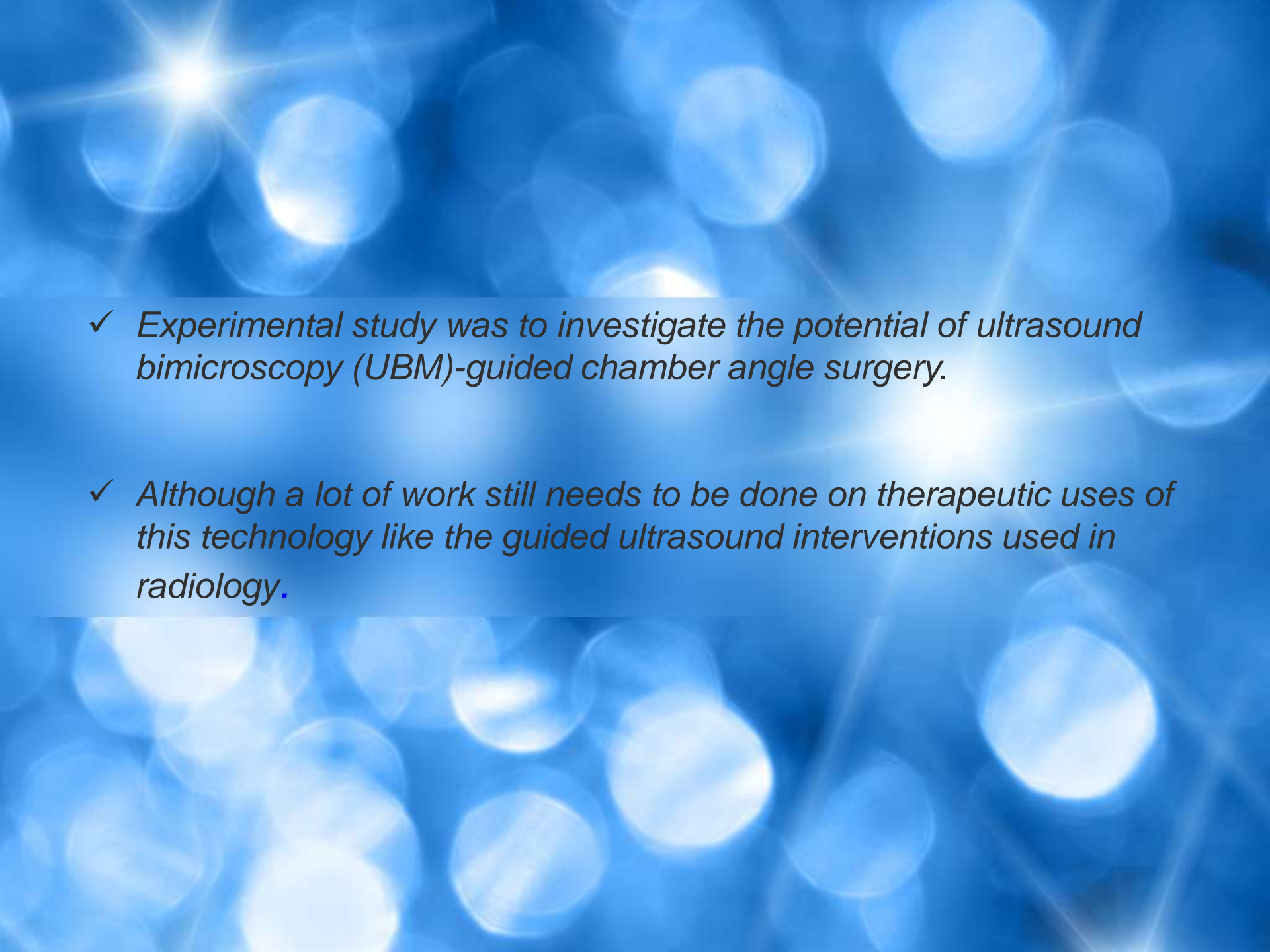
## *Angle recess area (ARA)*

*The ARA is defined as a triangular area bordered by the anterior iris surface, corneal endothelium, and a line perpendicular to the corneal endothelium drawn from a point 750  $\mu\text{m}$  anterior to the scleral spur to the iris surface.*







- 
- ✓ *Experimental study was to investigate the potential of ultrasound bimicroscopy (UBM)-guided chamber angle surgery.*
  - ✓ *Although a lot of work still needs to be done on therapeutic uses of this technology like the guided ultrasound interventions used in radiology.*



*Thank You*