# Angle Assessment – Gonioscopy and Imaging

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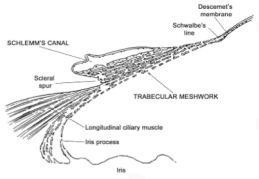
## Financial disclosure

- Netra Systems, Inc.
  - Consultant

## Angle assessment

- Gonioscopy
- Anterior segment imaging devices
  - Anterior segment OCT
  - Ultrasound biomicroscopy (UBM)

## Gonioscopy




## Gonioscopy

Direct

Koeppe

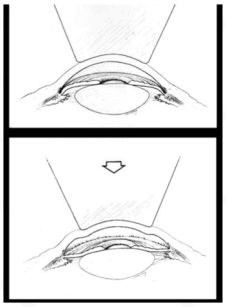
Indirect

Goldmann

Indentation

Posner/Zeiss

Sussman



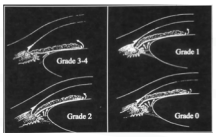
## Gonioscopy procedure

- Dim room illumination
- Short and narrow slit beam at slight angle
- Lens should barely touch the cornea
- Examine angle in primary gaze first
  - If peripheral iris has steep approach, slightly tilt lens or ask patient to look towards the gonio mirror

## What to look for?

- What angle structures are visible?
- Profile of peripheral iris
  - Convex / Flat / Concave
- Degree of TM pigmentation
- Abnormal findings
  - Excessive TM pigment
  - PAS
  - Abnormal blood vessels
  - Inflammatory nodules
  - Foreign bodies

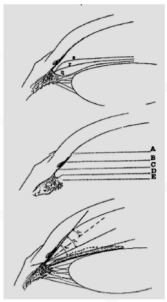
## Gonioscopy grading




Shaffer


Spaeth

Scheie



## Gonioscopy grading

**Most posterior angle structure visible**

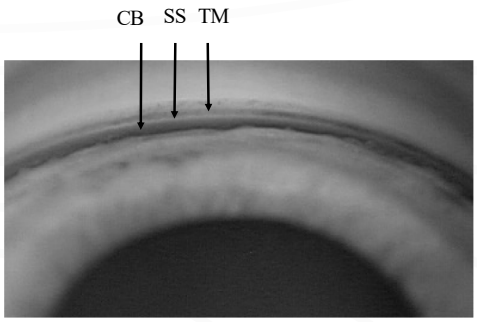
None

Schwalbe's line and anterior TM

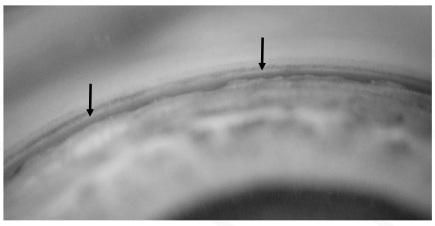
Posterior pigmented TM

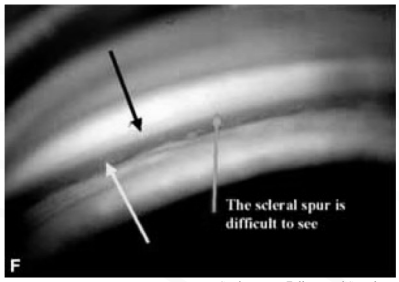
Scleral spur

Ciliary body

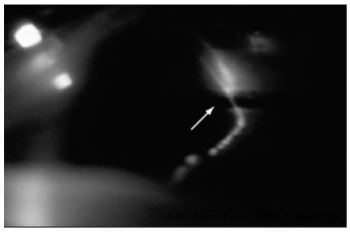


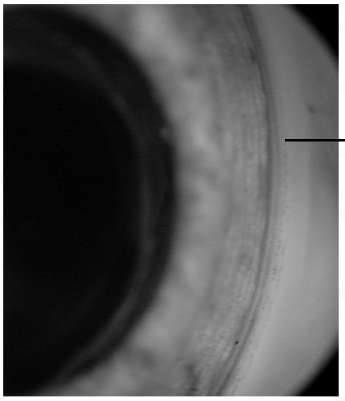

## First locate the scleral spur






Gonioscopy – Fellman and Spaeth
Duane's textbook of ophthalmology

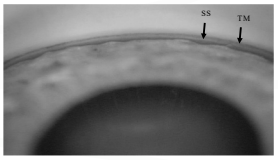


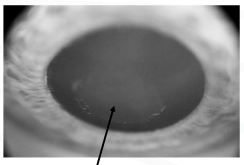


Schwalbe's line

74 y.o male with
Exfoliation glaucoma

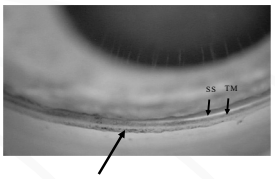
Superior



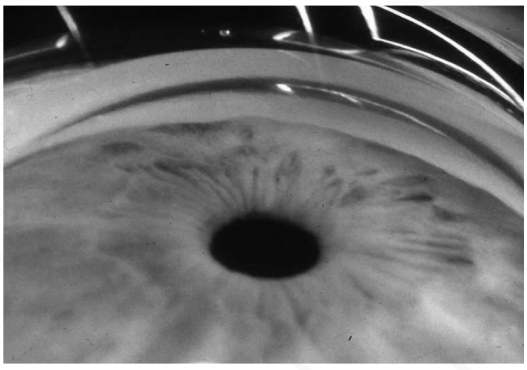



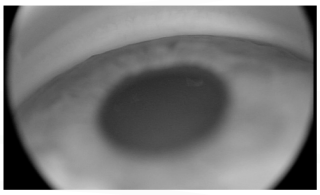
Exfoliation material on
anterior lens capsule

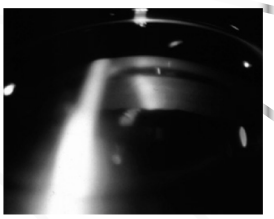
Inferior

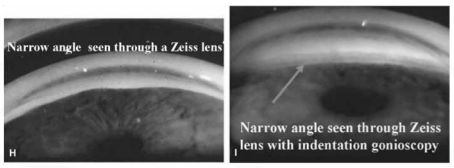



Sampaolesi's line



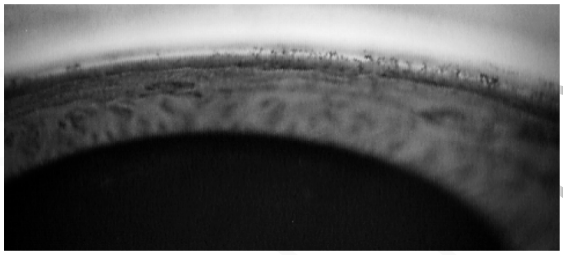




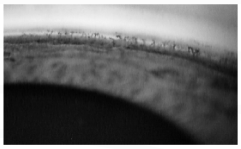



Gonioscopy – Fellman and Spaeth, Duane's textbook of ophthalmology

## Normal versus abnormal

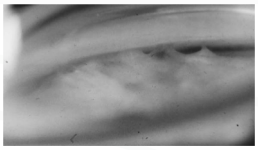


Iris processes



- Fine
- Follow concavity of recess
- Underlying structures visible

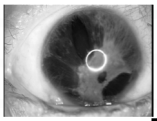
Peripheral anterior synechiae
PAS



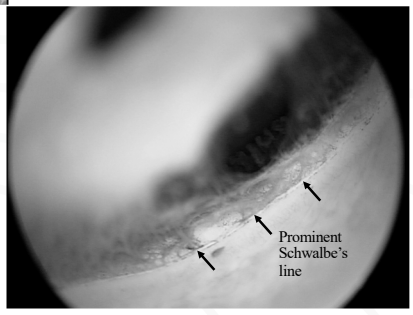
- Broad
- Bridge angle recess
- Obscure angle structures

## Causes of PAS

- Primary angle closure
- Secondary angle closure
  - Neovascular glaucoma
  - Prolonged shallow/flat AC (even in previously open angle)
  - Iridocorneal endothelial syndrome
- Inflammation
  - Uveitis
  - Post laser/surgery
- Axenfeld-Rieger syndrome

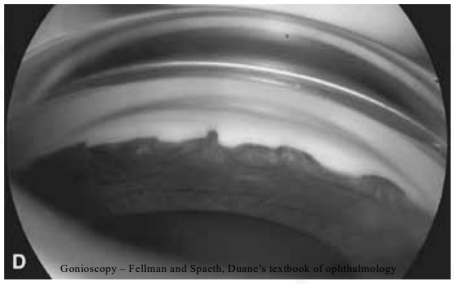


## Axenfeld-Rieger syndrome

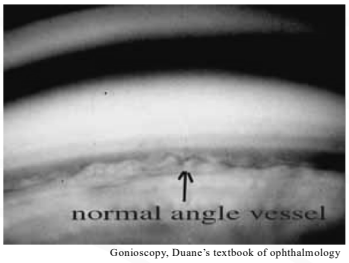


## Iridocorneal endothelial syndrome

PAS extend beyond Schwalbe's line

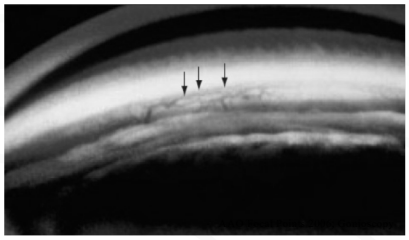


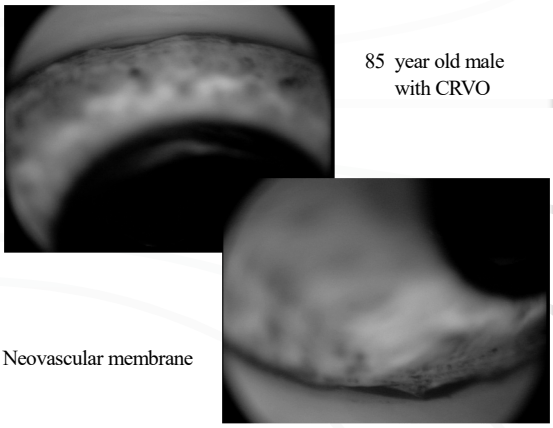

Gonioscopy – Fellman and Spaeth, Duane's textbook of ophthalmology




Gonioscopy, Duane's textbook of ophthalmology

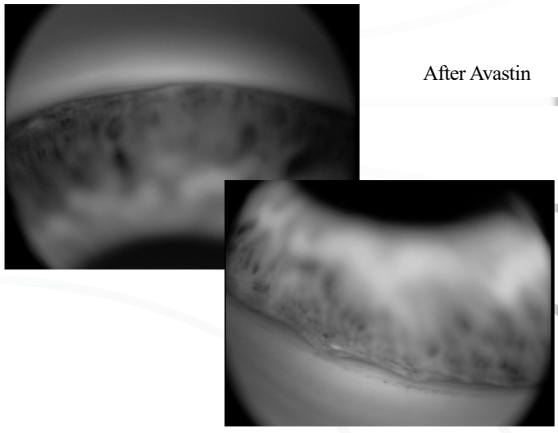
## Neovascularization of angle





85 year old male with CRVO

Neovascular membrane



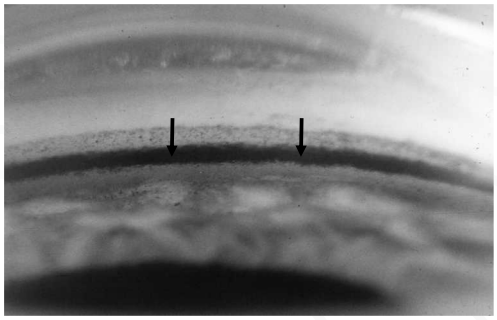
After Avastin

## Other abnormal findings in the AC angle

- Excessive pigment in the TM
- Inflammatory nodules
- Retained lens fragment
- Foreign bodies

## Pigment dispersion syndrome

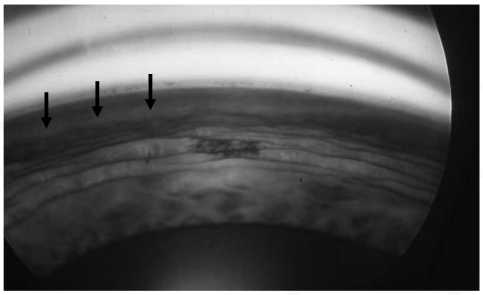
Dense pigmentation of TM

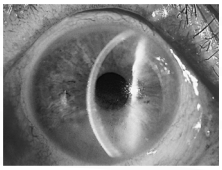


## Excessive pigment in TM

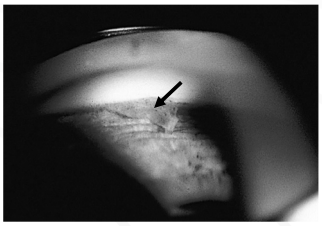
- Exfoliation syndrome
  - Patchy TM pigmentation
- Ciliary body melanoma is a rare cause

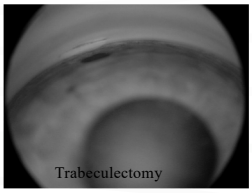
## Angle recession



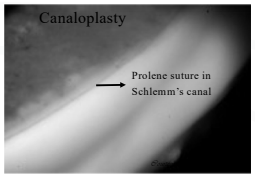


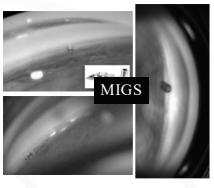
Retained nuclear fragment in the anterior segment
Gedde et al. Arch Ophthalmol Nov 1998

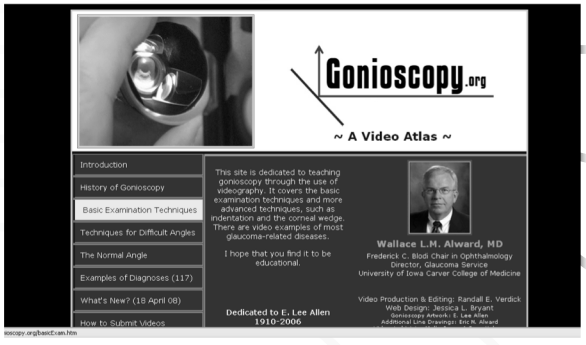








https://www.aao.org/clinical-video/intraoperative-gonioscopy

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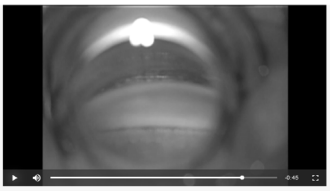
**Intraoperative Gonioscopy**



**Written By: Shakeel Shareef, MD**

2nd Annual Global Video Contest

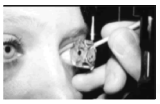
## Intraoperative gonioscopy

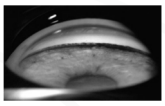
- Surgical goniolens (mostly direct lenses)
- Microscope is tilted 30 degrees toward the surgeon and the patient's head is tilted 30-40 degrees away from the surgeon
- Coupling agent on cornea
- Working distance increases

## Imaging of the AC angle

## Limitations of gonioscopy

- Subjective
- Requires highly skilled observer
- Potential sources of error
  - Illumination
  - Contact





## Anterior segment imaging devices

- Ultrasound biomicroscopy
- Anterior segment OCT

## Ultrasound biomicroscopy

- Developed in the early 1990s
- High frequency ultrasound transducer
  - 50 MHz
- Resolution – 40µm (less than OCT)
- Depth of penetration – 5mm

## Ultrasound Biomicroscopy

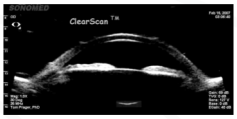
- Advantages
  - Good delineation of anterior and posterior chamber anatomy
  - Quantitative analysis

## UBM

- Disadvantages
  - Requires supine positioning and water bath
  - Highly skilled operator
  - Time consuming
  - Patient discomfort
  - No internal fixation
  - Small-field scan


## Newer UBM devices

- Increased scan width
- Clear Scan bag/balloon system
  - Imaging in upright position
  - More comfortable
- Multifunctionality




## Anterior segment OCT

- 'Optical ultrasound'
  - 1310 nm wavelength light
- High resolution
  - ~ 15 µm
- Limbus to limbus scanning

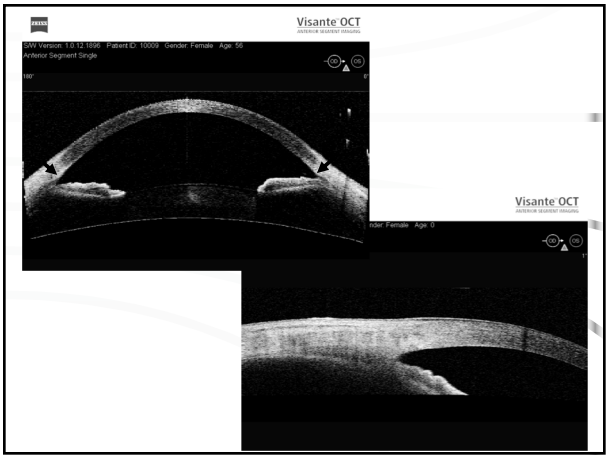
## Anterior segment OCT

### Advantages

- Non-contact
- Assessment of angle status in dark
- Minimal technical expertise required
- Quantitative analysis

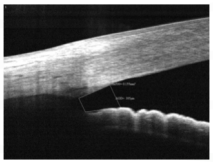
### Limitations

- Cannot image posterior chamber or ciliary body

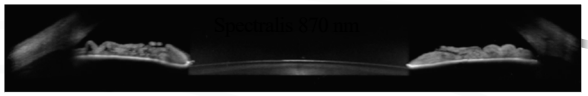


## Anterior segment imaging with fourier domain OCT

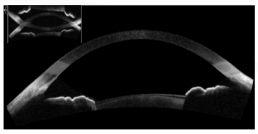
- Retinal OCT devices
  - Optovue
  - Cirrus
  - Spectralis
- Dedicated anterior segment OCT devices
  - Tomey



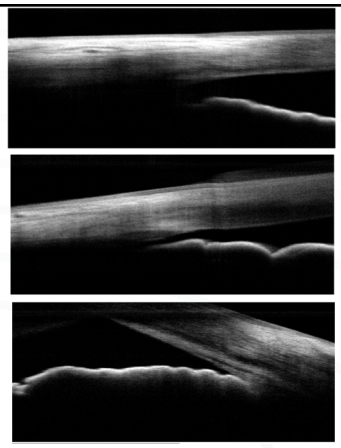
Optovue Avanti ~ 830nm



Spectralis 870 nm

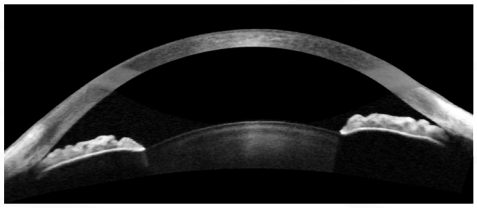


Cirrus 840nm

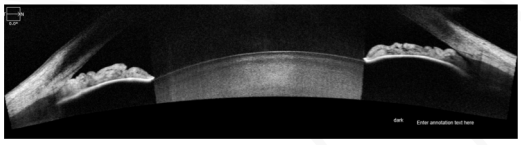


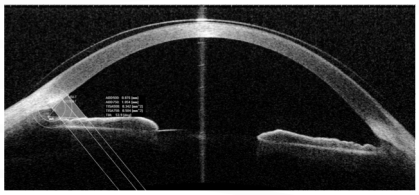
## Cirrus OCT anterior segment external lens kit


Anterior Chamber Scan



Wide Angle to Angle Scan

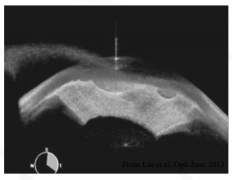




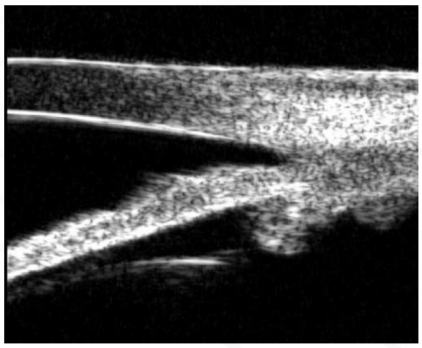
Swept Source OCT
Casia- SS 1000
1310nm

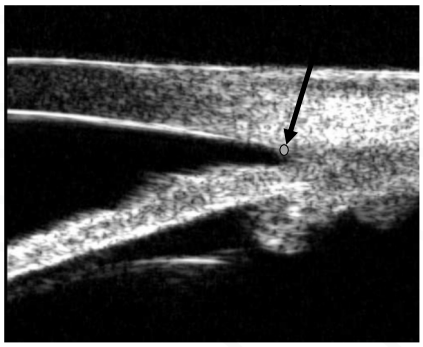
Open angle

PAS

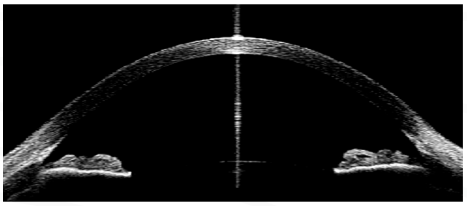


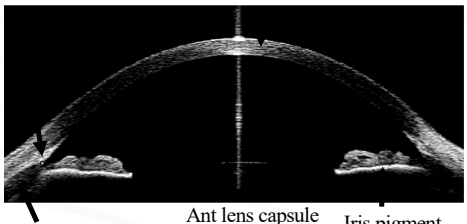
Anatomical landmarks





ASOCT image of open angle





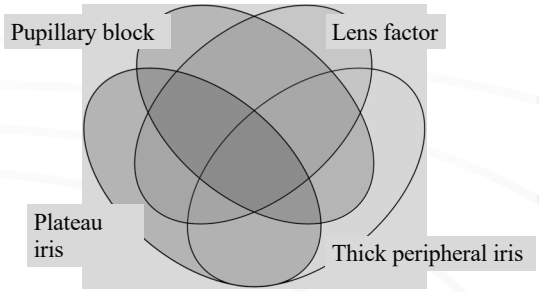

## How I use imaging devices

- To understand mechanisms of primary and secondary angle closure
- Patient education
- Assess adequacy of LPI
- Angle assessment when gonioscopy is not possible – No view/poor patient cooperation

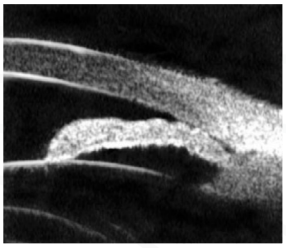
## How I use imaging devices

- OCT first line device in most cases due to ease of use and patient comfort
- UBM when assessment of structures posterior to iris is required

## Mechanisms of primary angle closure



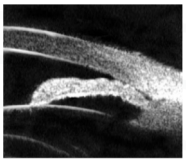

## Pupillary block

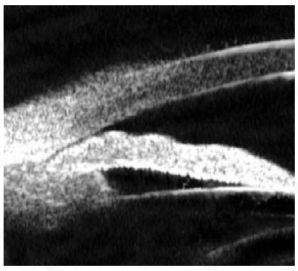


M. He et al, Eye Jan 2006

## Plateau iris

Pupillary block

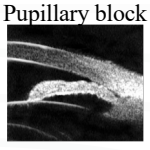




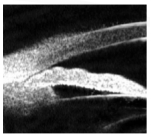
M. He et al, Eye Jan 2006

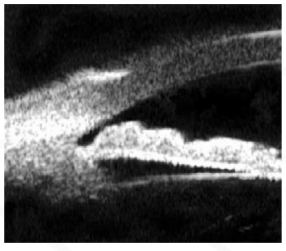
## Thick peripheral iris

Pupillary block



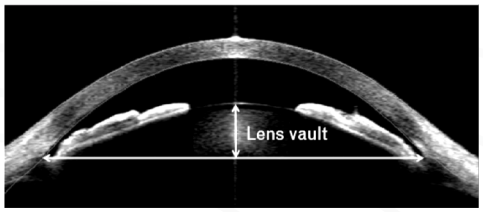
Plateau iris





M. He et al, Eye Jan 2006

## Anterior lens position




Radhakrishnan and Yarovoy. Curr Opin Ophthalmol March 2014

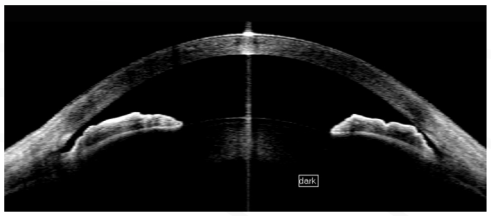
68 y.o WM with angle closure and elevated IOP


Note iris convexity and high lens vault
Pupillary block and Lens mechanisms of angle closure

47 y.o WM with newly diagnosed PACG (baseline IOP in 30s OU)

Note nearly flat iris profile and thick peripheral iris
Gonioscopy: Plateau iris configuration

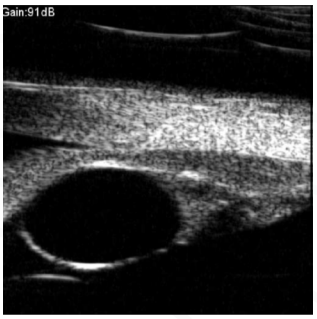
## 49 y.o male PACS

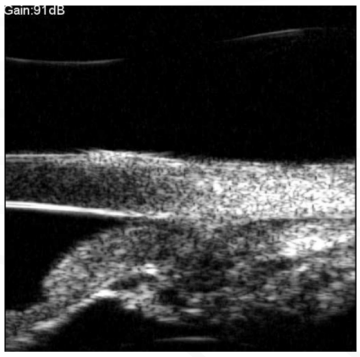


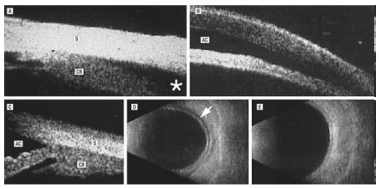
## Imaging for secondary angle closure – posterior 'pushing' mechanism

## 13 y.o female

- Mild myope
- Focal elevation of iris noted at slit lamp examination and gonioscopy shows closed angle in that region





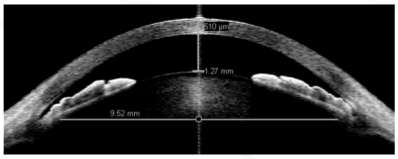



**Uveal Effusion and Secondary Angle-Closure Glaucoma Associated With Topiramate Use**

Sankar P et al. Arch Ophthalmol 2001;119:1210-11

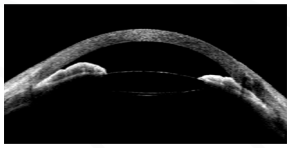
## 62 y.o Chinese female

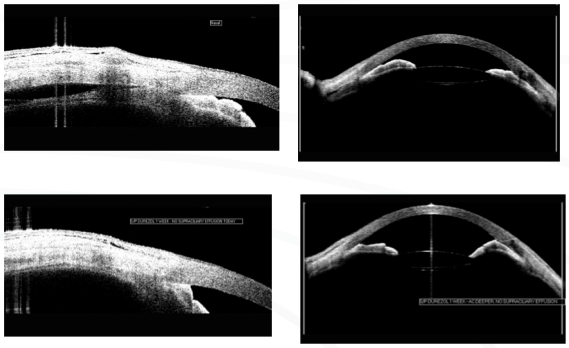
- PACG OS > OD: Uncontrolled IOP OU
- Cataracts OU
- Sph equivalent: OD +5.00 OS +5.25
- Axial length: OD 20.61 OS 20.46




## 1 month s/p laser suturelysis

- VA: 20/200 ph 20/40
- IOP: 9
- AC still shallow
- On Atropine tid, Pred tid





## 54 y.o female

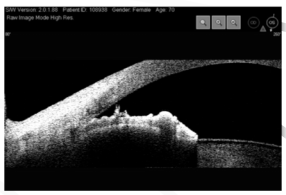
- Second opinion regarding laser peripheral iridotomy
- Wears glasses for reading
- No significant POH

## Patient education

## Enlarge LPI or not?

OD

OS



## ASOCT when gonioscopy view is limited

- 67 y.o male with POAG
- Diffuse moderate corneal haze due to severe ABMD
- Central AC – moderate depth
- Van Herick < ½ CT deep
- 2+ nuclear sclerosis


## Conclusions

- Gonioscopy is the primary method for angle assessment
- Imaging devices are a useful adjunct
  - Can provide unique information useful in clarifying pathogenesis of primary and secondary angle closure