Angle Closure Glaucoma

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Financial Disclosure

- I have received consulting and/or speaking fees from:
  - Carl Zeiss Meditec
  - Aerie
  - Allergan
  - Bausch & Lomb

Ultrasound biomicroscopy (UBM) images used with permission from The Ocular Imaging Center of the New York Eye & Ear Infirmary

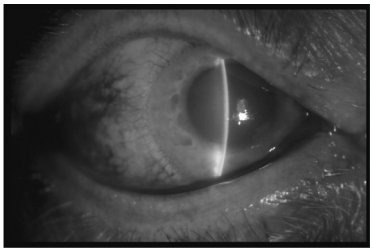
Epidemiology of Angle Closure

- Accounts for ~25% of glaucoma cases
  - 60.5 million people worldwide with glaucoma
  - 44.7 million with open angle glaucoma
  - 15.7 million with angle closure glaucoma
    - 21 million angle closure by 2020
  - Asymptomatic disease in 75% of cases
- Accounts for ~ 50% of blindness due to glaucoma
  - In China, primary angle closure glaucoma accounts for 91% of bilateral blindness from glaucoma

Differing Presentations of Angle Closure: SYMPTOM-BASED

- Acute
- Sub-acute
- Chronic

- Problems with symptom-based classification



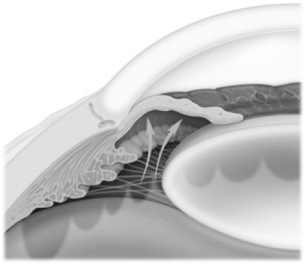
Etiology/Mechanism of Angle Closure

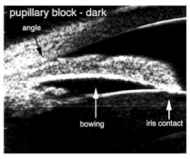
- Physical crowding of anterior segment and resultant contact between iris and trabecular meshwork (TM) leads to increased IOP
  - Physical obstruction of TM: rapid rise in IOP
  - Prolonged iridotrabecular contact (ITC) may result in PAS
  - Intermittent frictional contact over prolonged period of time may damage TM architecture and function

What causes ITC? (i.e. where is the problem?)

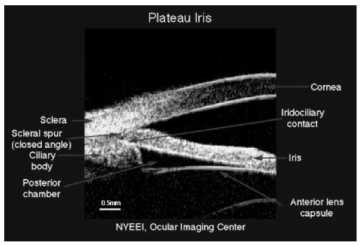
- Pupil block (major contributor)
- Anterior, non-pupillary block (ciliary body)
  - Plateau iris configuration
  - Plateau iris syndrome
  - Pseudo-plateau iris
- Lens-induced
  - Phacomorphic
  - Subluxation of lens
- Retro-lenticular forces
  - Malignant glaucoma
  - Choroidal effusion/ciliary body rotation

Pupillary Block

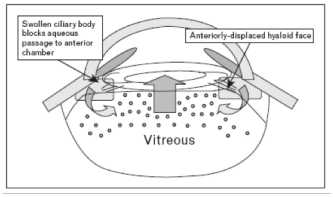




Plateau Iris Configuration



Retrolenticular forces



- Forces posterior to the lens push the lens-iris diaphragm forward
- "Aqueous misdirection" following cataract or glaucoma drainage surgery
- Swelling or anterior rotation of CB with subsequent forward movement or rotation of lens-iris diaphragm (shallow supraciliary detachment, ciliary effusion, etc)

Risk Factors for PRIMARY Angle Closure (Pupillary Block)

- Demographic
  - Older age
  - Female
  - Asian heritage
- Ocular Biometry
  - Shorter axial length
  - Shorter anterior chamber depth*
  - Lens position
  - Hyperopia

Classification of Angle Closure (Old)

- <u>Primary Angle Closure</u>
  - With Pupillary Block
    - Acute/Subacute/Chronic
  - Without Pupillary Block (Iris Plateau)
- <u>Secondary Angle Closure</u>
  - With Pupillary Block
    - Lens-induced
    - Complete posterior synechiae
  - Without Pupillary Block
    - Anterior Pulling (NVG, ICE syndrome)
    - Posterior Pushing (Drug-induced/Choroidal Expansion, malignant glaucoma/aqueous misdirection)

Classification of Angle Closure (newer)

- Primary Angle Closure Suspect (PACS)
  - 3+ quadrants of ITC
  - No symptoms
  - No elevated IOP
  - No PAS
  - No disc or field changes
- Primary Angle Closure (PAC)
  - 3+ quadrants of ITC
  - Symptoms, elevated IOP, and/or PAS
  - No disc or field changes
- Primary Angle Closure Glaucoma (PACG)
  - ITC with structural and/or functional changes

Diagnosis of Angle Closure

- Key Questions:
  - Is pathologic AC present?
  - Has it occurred previously?
  - Could it occur in the future?
- If yes to above:
  - Why is the angle narrow? (*where* is the problem)
  - Has there been damage to ocular tissue?
  - Is the damage a threat to vision?

Detection of Angle Closure

- Gonioscopy
- Ultrasound biomicroscopy
- Anterior segment OCT
- Provocative testing

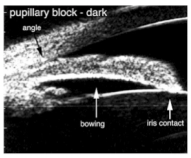
Gonioscopy

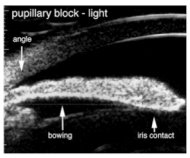
- The reference standard for dx of angle closure
- Advantages:
  - Inexpensive
  - Quick
  - Dynamic (synechiae vs appositional closure)
- Disadvantages:
  - Subjective
  - Patient cooperation
  - Direction of gaze
  - Not quantifiable
  - Different classification systems

Gonioscopy

- Tips:
  - Room lights OFF
  - Minimal light needed to see structures
  - Don't indent eye
  - Observe the corneal wedge
- Four Questions:
  1. Does the iris touch the TM?
  2. If not, is there evidence it has before?
  3. If so, is the contact reversible?
  4. If not, how much synechial closure is there?

Ambient Illumination – It Makes a Difference!!!

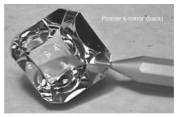




Gonioscopy

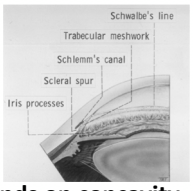
- Indirect Gonioscopy lenses






Gonioscopy

- Clinical Landmarks
  - Schwalbe's Line
  - Trabecular Meshwork
  - Scleral Spur
  - Ciliary Body

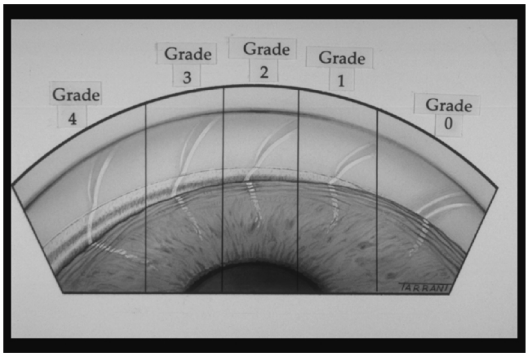


- Visibility of landmarks depends on concavity of angle, depth or angle, and insertion point of iris

Gonioscopy Classification

- Shaffer System
  - IV: iris/TM angle is 45 degrees
  - III: iris/TM angle is 20-45 degrees
  - II: iris/TM angle is 20 degrees
  - I: iris/TM angle is 10 degrees
  - Slit: iris/TM angle less than 10 degrees
  - O: Iris is against the TM

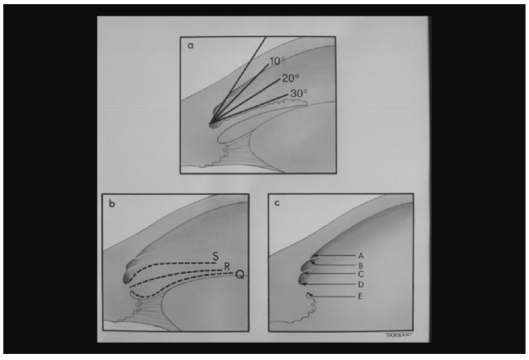
Shaffer Grading System



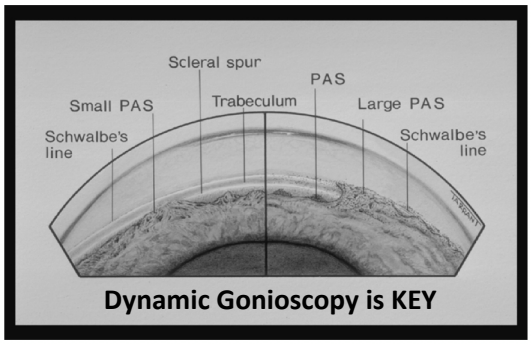
Gonioscopy Classification

- Spaeth Grading System:
  - Expands Shaffer system to describe peripheral iris contour & insertion of the iris root as well as the effect of indentation

Spaeth Grading System

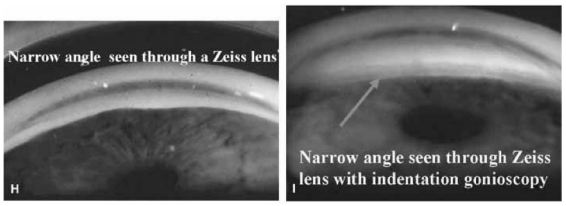


Peripheral Anterior Synechiae

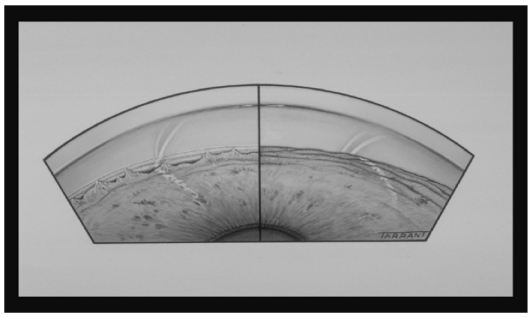


Dynamic Gonioscopy is KEY

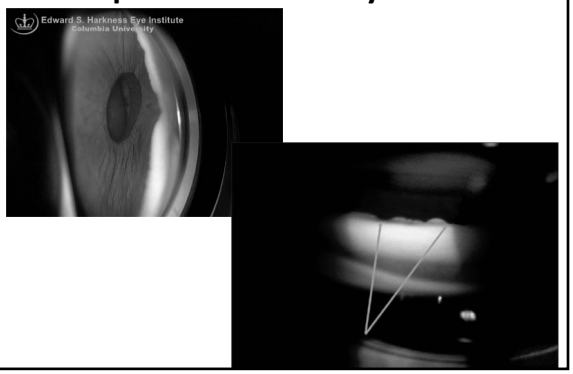
Indentation Gonioscopy



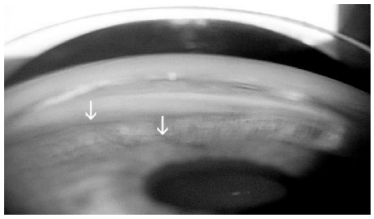
Peripheral Anterior Synechiae



Peripheral Anterior Synechiae

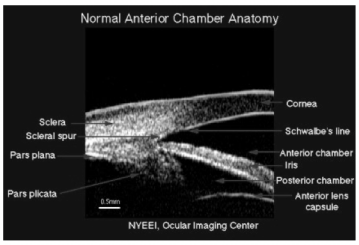


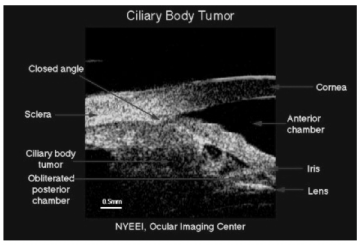
"Double-Hump" Sign in Plateau Iris Configuration

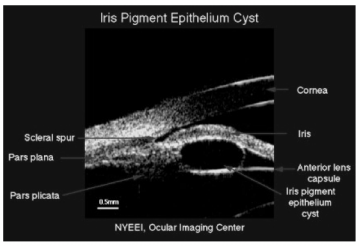


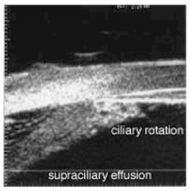
Ultrasound Biomicroscopy

- **Advantage:**
  - **Excellent delineation of structures behind iris pigment****
  - **Excellent in detecting plateau or pseudo-plauteau**
- **Disadvantage:**
  - **Requires patient in supine position**
  - **Requires water bath (older instrumentation)**
  - **Highly dependent on technician skill**



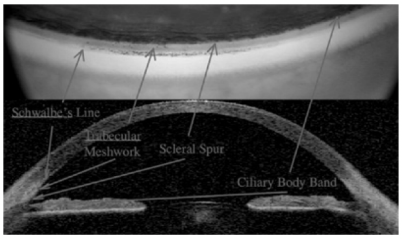


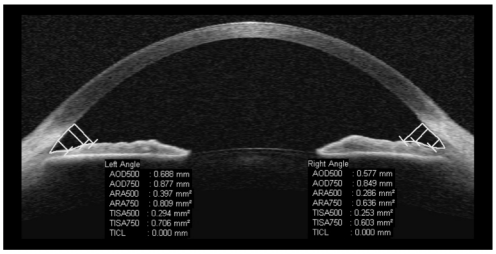


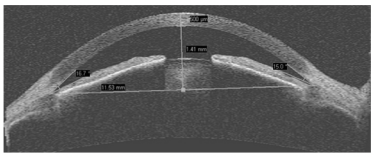


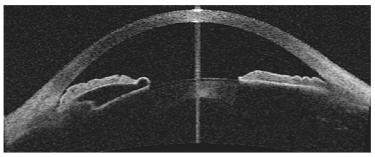
Anterior Segment OCT

- **Advantage:**
  - **Very high resolution**
  - **Rapid technique**
  - **No contact required**
- **Disadvantage:**
  - **No / limited imaging behind the iris pigment**







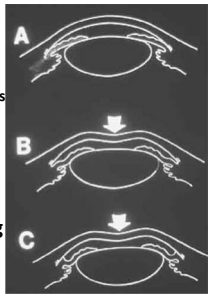


Management of Angle Closure

- **Goals**
  - **Reduce IOP**
  - **Re-open AC (if possible)**
  - **Prevent recurrence of AC**
  - **Control residual IOP if irreversible TM dysfunction**

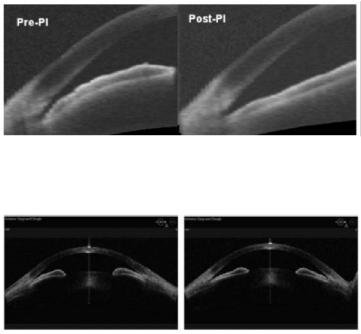
Acute <u>Primary</u> Angle Closure

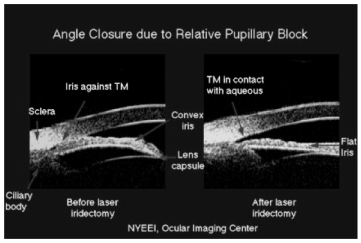
- **Reduce IOP/Re-open AC**
  - **Medicine:**
    - **Topical BB**
    - **Topical brimonidine/apraclonidine**
    - **Oral CAI (Diamox 500 mg – NOT Sequels**
    - **Possibly oral hyperosmotic**
    - **Topical low dose pilocarpine**
    - **Compression gonioscopy**
- **Prevent recurrence of AC**
  - **LPI**
- **Repeat gonioscopy and monitoring of IOP is very important**



Laser Iridotomy

- **WGA consensus:**
  - **LPI mandatory in these eyes :**
    - **with acute angle closure**
    - **Fellow eyes of acute angle closure**
    - **PAC patients**
  - **LPI optional in PACS patients**
- **Complications:**
  - **AC bleed**
  - **Corneal endothelial damage**
  - **IOP elevation**
  - **Accelerated cataract formation**



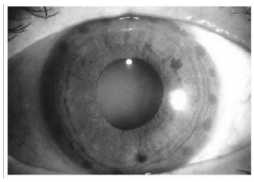


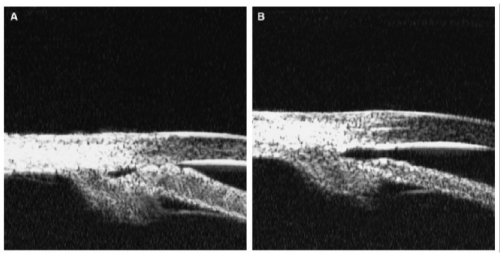
Alternatives to LPI

- **Laser iridoplasty**
- **Lens removal**

Laser Iridoplasty

- **Large spot size, low energy argon laser burns**
- **Placement 360˚ in most peripheral portion of the iris possible**
- **As effective as medications in acute angle closure**
- **Very effective in plateau iris syndrome**
- **Effective in AAC patients unresponsive to treatment or in whom an iridotomy cannot be performed**





Lens Extraction

- Can be difficult in eye with increased IOP and shallow AC
- Should follow medical/laser therapy in eyes with cataract
- Clear lens extraction more controversial but gaining popularity

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Initial Management of Acute Primary Angle Closure

A Randomized Trial Comparing Phacoemulsification with Laser Peripheral Iridotomy

Rahat Husain, MD(Res), FRCOphth,[1] Gus Gazzard, MD, FRCOphth,[1,2] Tin Aung, PhD, FRCOphth,[1,3] Yuming Chen, PhD,[4] Vishusunath Padmanabhan, FRACO,[1] Francis T. S. Oen, FRCS(Ed), FRCOphth,[1] Steve K. L. Seah, FRCS(Glasg), FRCOphth,[1] Sek-Tien Hoh, FRCS(Ed)[1]

Treatment of Residual Elevated IOP

- Prostaglandin analogs very effective in lowering IOP
- Typically treat similarly to POAG
  - Miotic therapy ineffective in eyes with significant PAS
- Filtration surgery and/or tube shunts may be needed in cases with extensive PAS

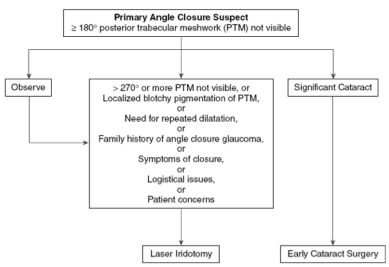
What About "Occludable" Angles?

- Only a small number of PACS patients will develop PAC
- Prophylactic LPI can result in over treatment
- Studies currently underway studying the natural history of PACS patients may give us needed information
- Potential Risks

Clinical & Experimental Ophthalmology
Clinical and Experimental Ophthalmology 2013; 41: 282–292 doi: 10.1111/j.1442-9071.2012.02885.x

Review

Management algorithms for primary angle closure disease



Provocative Testing for Angle Closure

- **Dark/prone test**
  - **45 minutes in dark room, prone position**
    - **CANNOT sleep**
  - **Immediate check of IOP without turning on lights**
  - **Patient at risk: >6mm Hg increase in IOP**
  - **Problems:**
    - **Cumbersome**
    - **Impractical**
    - **Won't detect all cases**
- **WGA Consensus: Not practical or predictable**

Aqueous Misdirection/Malignant Glaucoma

- **More common in patients with narrow angles and/or PAS, following intraocular surgery**
- **See uniform flattening of AC and increased IOP**
- **Treatment: aggressive use of cycloplegics, alpha-agonists, carbonic anhydrase inhibitors; YAG the anterior vitreous in pseudophakic patients**
  - **50% of patients can be managed medically or with laser; remainder will need surgical intervention**

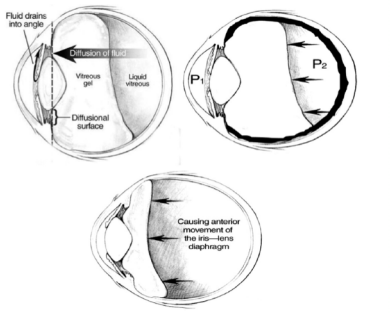
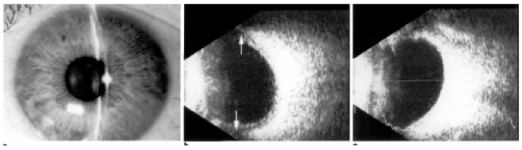


FIGURE 10. Schematic descriptions of ocular fluid movement. (Top left) An eye with posteriorly detached vitreous is shown indicating that fluid normally moves through the vitreous gel and exits the anterior chamber (AC) through the trabecular meshwork and uveoscleral pathways. (Top right) The black shaded area represents choroidal expansion, which immediately increases intraocular pressure. As aqueous humor exits the AC, the pressure differential from the posterior vitreous fluid compartment (P2) to the AC (P1) is responsible for a net movement of fluid anteriorly. This would be associated with some forward movement (toward the cornea) of the lens, intensifying resistance at the iris-lens channel (relative pupil block). In this manner, choroidal expansion could contribute to producing angle-closure in predisposed eyes. (Bottom) Choroidal expansion leads to differential pressure across the vitreous gel, as in top right figure, but in an eye with poor vitreous fluid conductivity, the pressure difference is not adequately equilibrated, as the vitreous compresses and moves forward, causing both iris and lens to flatten the AC in typical malignant glaucoma.

Quigley HA, Am J Ophthalmol 2009; 148: 657-669

Topiramate-Induced Angle Closure



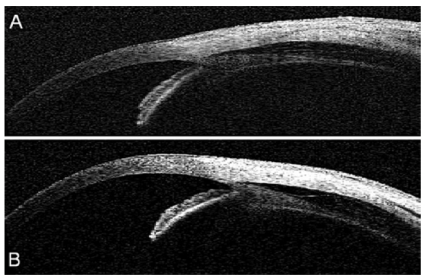
TOPIRAMATE (TOPAMAX®, TROKENDI XR®)

- FDA approved for:
  - Various Epileptic Disorders
  - Migraines
  - Pain
  - Weight loss
    - phentermine with topiramate (Qsymia®)
- Sulfa-based with carbonic anhydrase inhibition

Topiramate-induced Angle Closure

- **May cause myopic shift and acute angle closure – occurs in 3/100,000**
- **Usually occurs within the first two weeks – one case was after only two doses at 25mg/day**
- **Pathophysiology:**
  - **Unknown what triggers reaction:**
    - **Possible blood-eye barrier disruption?**
    - **Hypersensitivity reaction?**
    - **Change in membrane potential?**
  - **1) Choroidal effusion**
  - **2) Anterior displacement of Iris/CB/Lens diaphragm**
  - **3) Zonules relax**
  - **4) Lens thickens**
  - **5) Induced Myopia**
  - **6) Acute angle closure**
- **IOP: usually below 40**
  - **Some degree of CB shutdown with detachment**
  - **Carbonic Anhydrase inhibition**

OCT



- **Fig. 2** - *Anterior segment optical coherence tomography shows bilateral, shallow, anterior ciliochoroidal detachments and angle closure with anterior rotation of the ciliary body (***A,** *right eye,* **B,** *left eye). van Issum et al.* "Topiramate-induced acute bilateral angle closure and myopia: pathophysiology and treatment controversies."

Treatment – DIFFERENT THAN PRIMARY ANGLE CLOSURE!!!

- Discontinuation of Topamax
- Strong, short course of cycloplegic:
  - 1 or 2 doses generally sufficient
  - 1) Relaxes ciliary muscles
  - 2) Iris/Lens/CB diaphragm displace posteriorly
  - 3) Zonules tighten
  - 4) Angle opens/Myopia reduced
- Pilocarpine contraindicated:
  - Causes ciliary spasm, exacerbating choroidal detachment
  - Slightly pro-inflammatory

Treatment continued

- IOP – lowering agents:
  - Beta-blockers and Alpha-agonists typically first choice
  - Prostaglandins effective but not first choice due to pro-inflammatory properties & because of delayed onset of effect
  - Topical CAIs also effective but not commonly used since they are Sulfa-based, and thus chemically related to Topiramate (although no incidences of angle closure have been reported with topical CAIs)
- Steroids:
  - Tighten capillary junctions as well as decrease CB swelling
- Surgical:
  - LPI is not effective because mechanism is not pupillary block
  - Drainage of suprachoroidal fluid – very rarely done (usually medical therapy is sufficient)
  - Trabeculectomy/Filtering surgery - only if PAS formed after resolution

Topamax-induced Angle Closure - Treatment

- NO PILO
- NO DIAMOX
- NO INDENTATION
- YES: AQUEOUS SUPPRESSANTS, CYCLOPLEGICS, STEROID

Management of Secondary AC

- **With pupillary block:**
  - **Lens-induced**
  - **Posterior synechiae**
- **Without pupillary block:**
  - **Anterior pulling:**
    - **NV: immediate treatment of retina**
    - **ICE: medical management, filter/tube**
  - **Posterior pushing:**
    - **Drug-induced: D/C drug**
    - **Choroidal effusions: IOP-lowering meds, steroids, atropine**
    - **Aqueous misdirection: mydriatics, acetazolamide, vitrectomy and/or nd:YAG to anterior vitreous face**

Conclusion

- **Angle closure and angle closure glaucoma are more common that we may think**
- **Acute angle closure is *not* the most common presentation of angle closure**
- **The optometrist must be alert to the possibility of angle closure in your practice**
  - **Become proficient at gonioscopy with compression**
  - **Remember to re-gonio patients**
- **LPI is not the end of the story…**

Thank you for your attention!

Questions?

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