

Angle Closure



Western
University
OF HEALTH SCIENCES

David M Cale, OD, FAAO

Disclaimer

- ▶ This lecture has been independently developed by the lecturer.
- ▶ Dr. Cale has no financial relationship or conflict of interest with any referenced authors, studies, or business related to topics discussed in this lecture



Learning Objectives

- ▶ **At the end of this lecture the attendee will be able to:**
- ▶ Identify patients at risk for angle closure
- ▶ Discuss the mechanisms of angle closure
- ▶ Confidently manage patients with narrow angles, acute and chronic angle closure
- ▶ Discuss arguments (including risk/benefit) for prophylactic iris iridotomy and other treatment options of patients with various levels of risk for angle closure.
- ▶ Identify safe dilation criteria and protocol.



Primary Angle Closure (PAC)

- ▶ **Suspect (PACS)**

- ▶ Possibility of contact between peripheral iris and posterior trabecular meshwork (PTM)

- ▶ **Closure (PAC)**

- ▶ Evidence of PTM apposition by peripheral iris and/or synechia
- ▶ “Creeping angle closure” = anteriorly advancing PAS making iris insertion appear more anterior

- ▶ **Glaucoma (PACG)**

- ▶ Evidence of glaucomatous optic neuropathy



Further Classification of PAC

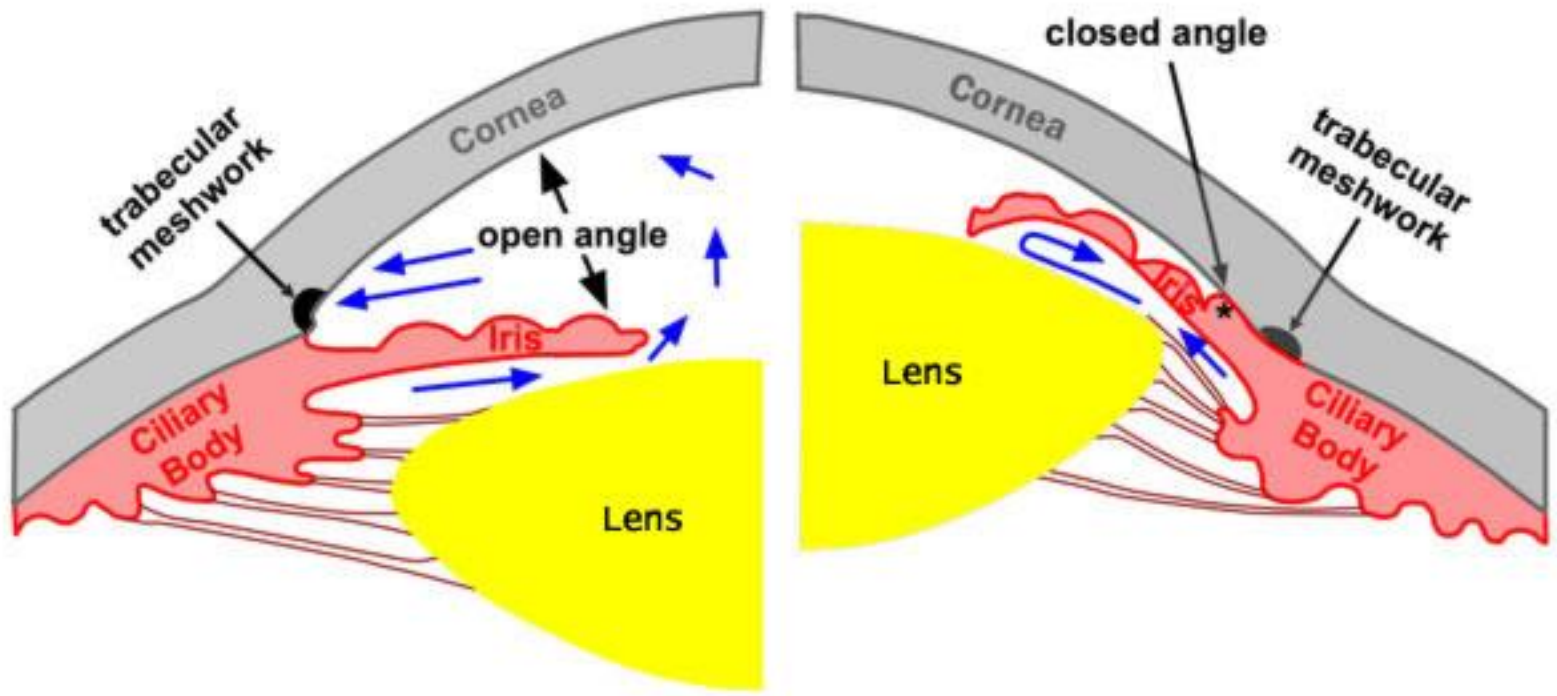
▶ Acute

- ▶ Generally considered caused by pupillary block
- ▶ Symptomatic
- ▶ Rarely encountered

▶ Subacute

- ▶ Partial apposition or PAS
- ▶ Partial obstruction of aqueous outflow with or without symptoms
- ▶ Can be intermittent or chronic
- ▶ Relief may come with bright lights or sleep





Secondary Angle Closure

- ▶ **Phacomorphic**
 - ▶ Including subluxation
- ▶ **Plateau Iris**
- ▶ **Aqueous misdirection, Malignant Glaucoma**
 - ▶ Ciliary block due to forward rotation of the lens-iris diaphragm
 - ▶ Increased pressure posterior to lens
 - ▶ Flat A/C
 - ▶ Transient myopia
 - ▶ Choroidal effusion syndrome, Supraciliary Detachment
 - ▶ Associated with hypotony, inflammation/vasodilation
 - ▶ Some systemic meds (acetazolamide, sulfa)
 - ▶ Post op complication (filtering, buckle, PRP, cataract)
- ▶ **Multi-mechanism: one of the above combined w/ pupillary block**
- ▶ **Mixed or Combined –Mechanism**
 - ▶ Elevated IOP despite LPI or absence of PAS
 - ▶ POAG patient's angles narrow with age or chronic miotic tx



Plateau Iris

- ▶ Ciliary body rotated forward forcing iris root against TM
 - ▶ Difficult to open with dynamic gonioscopy or indentation
- ▶ Iris flat centrally
- ▶ Anterior chamber moderate depth
- ▶ Angle narrow
- ▶ Gonioscopy “double hump” sign
 - ▶ Peripheral iris drapes over anteriorly displaced ciliary processes
- ▶ Identify w/ UBM or Anterior OCT (Visante)
- ▶ Young female most likely
- ▶ Pupil block risk
- ▶ LPI and CE not as useful
- ▶ Treatment:
 - ▶ Argon iridoplasty to widen angle
 - ▶ Pilocarpine to pull iris out of angle



Plateau Iris UBM



▶ From *Ocular Disease: Mechanisms & Management*; Saunders 2010

Choroidal effusion syndromes

(supraciliary choroidal detachment)

- ▶ Accumulation of fluid in suprachoroidal space
- ▶ Anterior rotation of ciliary body and anterior lens displacement
 - Can result in aqueous misdirection/malignant glaucoma
- ▶ Following surgery or inflammatory disease or medical
 - Scleritis
 - Sulfa drugs
 - PRP
 - Hypotony (cause or effect) or rapid IOP changes
- ▶ Treat with cycloplegics, hyperosmotics, ocular hypotensives, vitrectomy



Secondary Angle Closure

non-pupillary block

- ▶ Neovascular glaucoma
- ▶ ICE syndromes (iridocorneal endothelial)
 - ▶ Endothelial membrane occludes PTM
 - ▶ Iris nevus syndrome
 - ▶ Chandler's
 - ▶ Essential iris atrophy
- ▶ Epithelial ingrowth following surgery
- ▶ Aniridia
- ▶ Posterior polymorphous dystrophy
- ▶ Iris/CB cysts
- ▶ Silicone oil
- ▶ Scleral buckle (increased ESVP and resultant effusion)



Prevalence PAC

- ▶ Inaccurate diagnosis confounds data
- ▶ Beaver Dam Study 0.04%
- ▶ Baltimore Eye Study 0.9%
- ▶ European study composite 0.1-0.2% (40+yo)
- ▶ Japanese 0.31%
- ▶ Chinese: PAC 3X > POAG



Epidemiology

- ▶ Risk increases with age
- ▶ Females > male (2:1 in general population?)
- ▶ Hyperopia
- ▶ Highest rates in Inuits, East Asian
 - ▶ Predominantly asymptomatic, non-acute form
- ▶ Genetics (polygenic)



Assessment Angle Closure Risk

- ▶ An open angle is when the entire TM is visible (this requires being able to identify the first structure posterior to this = scleral spur). *G. Gorin 1986*
- ▶ Gonioscopy compared to UBM, AS-OCT
 - ▶ AS-OCT tends to over-identify subjects with closed angles
- ▶ Provocative test
 - ▶ Dark room, prone, dilation
 - ▶ Inconsistent identification of those at risk

Arch Ophthalmol, 123 (2005), pp. 1053–1059. S Radhakrishnan, J Goldsmith, D Huang, *et al.*



The Eye at Risk

PAC w/ pupillary block

- ▶ Narrow angle
- ▶ **Anterior chamber depth shallow (ACD)** (hyperopia)
 - ▶ Short axial length (hyperopia)
- ▶ Anterior position or increased thickness of lens
 - ▶ Lens-iris plane
- ▶ Prior evidence of angle closure

- ▶ It has been suggested that all asymptomatic hyperopes >50yo should have a gonioscopy exam



Look for evidence of prior attacks

- ▶ Posterior synechia
- ▶ Peripheral anterior synechia
- ▶ Iris atrophy (sectoral or general loss of pigment due to ischemia)
- ▶ Glaukomflecken (anterior subcapsular lens opacities)
- ▶ Optic neuropathy, VF loss

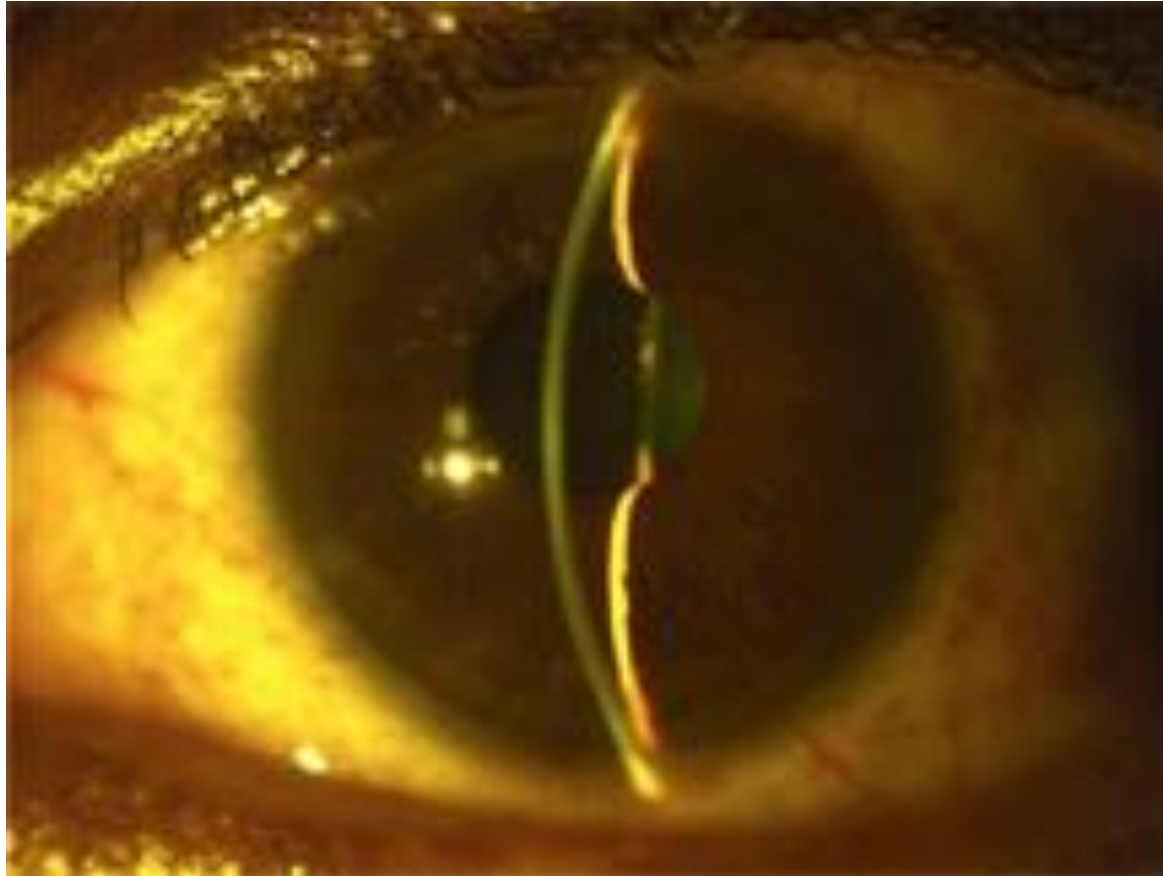


How does angle closure present clinically?

- ▶ Ocular pain possible with nausea/vomiting
- ▶ Ciliary flush
- ▶ Elevating IOP
- ▶ Blurred vision possibly
- ▶ Dilated and unreactive pupil
- ▶ A/C reaction
- ▶ Corneal edema (haze, halos)
- ▶ Iris bombe, closed angle, shallow A/C



Iris Bombe



Pathophysiology Angle Closure

- ▶ **Four mechanisms and management strategies**
 - ▶ Pupillary block is most common (less in Asians)
 - ▶ Restricted flow and pressure gradient develops between posterior & anterior chambers. Iris bombe and narrowing angle occurs
 - ▶ LPI relieves pressure differential, iris bombe, and therefore the block
 - ▶ Anteriorly rotated ciliary body (plateau iris)
 - ▶ Treat with argon iridoplasty
 - ▶ Lens induced
 - ▶ “swollen” or anteriorly subluxated (phacomorphic)
 - ▶ Treat with lensectomy
 - ▶ Malignant (retrolenticular)
 - ▶ Aqueous misdirection into vitreous causes anterior lens displacement
 - ▶ Treat with vitrectomy



Precipitating Factors in “at risk population”

▶ Dilation

- ▶ Pharmaceutical
- ▶ Physiological
 - ▶ Emotion
 - ▶ Darkness

▶ Cholinergic activity

- ▶ Pharmaceutical or physiological
- ▶ Anterior lens displacement with risk of pupillary block
- ▶ Stimulating iris sphincter creates a resultant vector pushing iris posteriorly

▶ Prone position

- ▶ Anterior lens displacement with risk of pupillary block



Making the decision whether to dilate

▶ Anatomical criteria

- ▶ At least 3 clock hours PTM visible
- ▶ Moderately deep anterior chamber
 - ▶ 2mm or shadow test (nasal shadow $< 1/2$)
- ▶ Iris-lens plane shows sufficient gap
- ▶ No evidence of previous angle closure (synechia)

▶ Protocol

- ▶ 0.5% tropicamide without stimulating dilator muscle
- ▶ Appropriate monitoring and follow up
- ▶ Patient education



Baltimore Eye Survey Report

AJO 1995. Patel, et al

- ▶ **5308 patients enrolled and screened**
 - ▶ 38 considered potentially occludable by gonioscopy (>3 clock hours PTM and/or evidence of prior angle closure)
 - ▶ 10 referred for LPI
 - ▶ **No incidence of angle closure following dilation**
- ▶ Screening criteria that were most predictive of occludability
 - ▶ 1. Anterior chamber depth determined by shadow test
 - ▶ 2. Positive history of glaucoma
 - ▶ Based on using the above two criteria alone 1:1000 risk of provoking angle closure with dilation



Risk of not dilating

- ▶ Data from the Baltimore Eye Survey suggest that concern about inducing acute angle closure is far outweighed by the potential benefits of a dilated eye exam
- ▶ Timely treatment of angle closure is highly successful in preventing permanent damage



Pharmaceutical Caution

- ▶ Antihistamines
- ▶ Anti-nausea
 - ▶ Including “sea sickness” suppressants
- ▶ Anti-spasmodics
- ▶ Appetite suppressants
- ▶ Parkinson’s drugs
- ▶ Tranquilizers
- ▶ Alpha-antagonists
- ▶ Bronchodilators (B2 blocker)
- ▶ Vasoconstrictors



Management – acute closure

- ▶ Goals are to reduce IOP, inflammation, reverse PAC
- ▶ Supine patient
 - ▶ Lens drop away from iris
- ▶ Symptomatic relief (antiemetic, analgesic)
- ▶ Medical
 - ▶ Know your patient's medical and ocular condition
 - ▶ Know drug mechanisms
- ▶ Laser Peripheral Iridotomy (LPI) when eye is quiet
 - ▶ ****Don't forget fellow eye (40-80% risk of PAC in 5-10 yr)**



Medical Management Acute Angle Closure

- ▶ Beta blocker (fast acting) 30m/peak 2h/ lasting 12hr
 - ▶ Timolol 0.5% (caution w/ asthma or COPD)
- ▶ Alpha-2 agonist (fast acting)
 - ▶ Apraclonidine 1%, brimonidine 0.2%
- ▶ Miotics (fast acting) 1h lasting 4h
 - ▶ Pilocarpine 2%
- ▶ Topical steroid (pred acetate 1%)
- ▶ Oral CAI 2hr lasting 4-6hr (IV faster)
 - ▶ 500mg non-sequel acetazolamide
 - ▶ Caution with CHF, K⁺ depletion, sulfa allergy
 - ▶ Topical not as effective peak 3h
- ▶ Systemic hyperosmotics 30-60m
- ▶ Prostaglandin analog may not be best choice (slow acting, may exacerbate inflammation)



Cholinergic agonist

- ▶ **Pilo 2%**
 - ▶ acts in 15 minutes
 - ▶ Apply q15mX2-4 doses
- ▶ **Ineffective if sphincter ischemic (IOP>50mmHg)**
- ▶ **Caution**
 - ▶ Can increase pupillary block
 - ▶ Stimulating sphincter along with already activated dilator stiffens iris, and places lens-iris diaphragm at risky position (shallowing A/C)
 - ▶ Reduces uveal-scleral outflow. Increase TM outflow facility w/ ciliary muscle stimulation
 - ▶ Aphakia, pseudophakic block use phenyl + cyclopentolate (*Wills Eye*)
 - ▶ Cholinergic toxicity
 - ▶ Nausea & vomiting, diarrhea, sweating, bradycardia, hypotension



Hyperosmotics

IOP > 50 mmHg and vision loss severe* (*Will's Eye*)

- ▶ **Isosorbide (Ismo) (45%)** 30-60min lasting 5-6hr
 - ▶ 1.5-2g/kg
 - ▶ Better choice for diabetics (not metabolized)
 - ▶ Less nausea/vomiting
- ▶ **Oral glycerin (Osmoglyn) 50%**
 - ▶ 1.0-1.5g/kg
 - ▶ Give with crushed ice & citrus juice for palatability
- ▶ **If vomiting**
 - ▶ IV mannitol (Osmitol) 20%
 - ▶ 2.0-7.0 ml/kg over 30-45 minutes



Success has been achieved when:

- ▶ Sustained reduced IOP
- ▶ Pupil reduced beyond mid-dilation
- ▶ Corneal edema reduced and gonioscopy shows open angle
 - ▶ Anhydrous glycerin applied to cornea may reduce haze/edema
 - ▶ Note that an acute attack with persistence of angle closure can result in hyposecretion of aqueous so that reduced IOP alone may be a deceiving indicator of successful management



Discharging patient (*Will's Eye*)

(before LPI can be performed)

- ▶ Acetazolamide 500 mg sequel po bid
- ▶ Topical beta-blocker or alpha agonist bid
- ▶ Pilocarpine 2% (if phakic) 1-2% qid
- ▶ Pred acetate 1% may be helpful

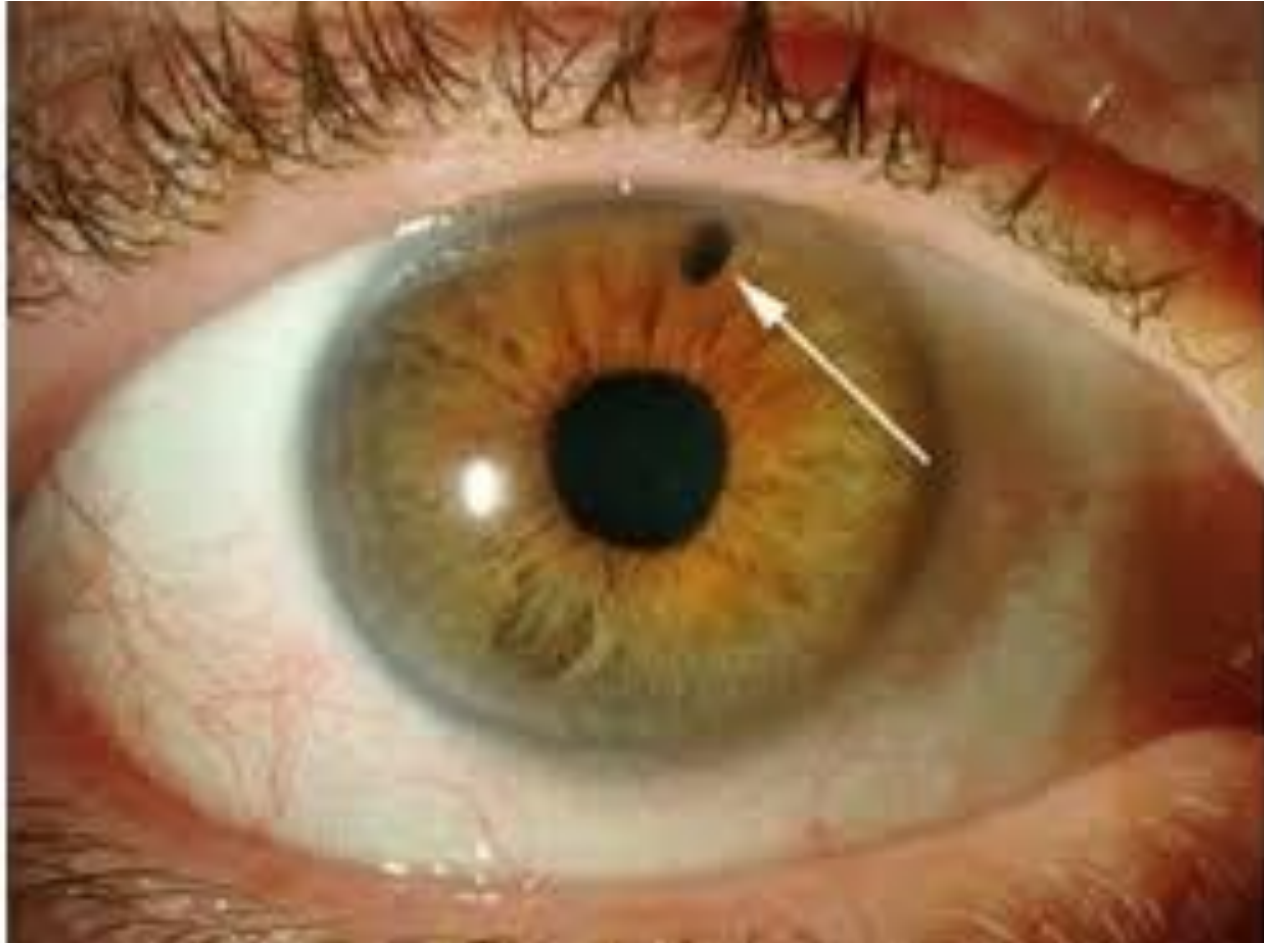


Risk Management - LPI

- ▶ **U.S. prevalence**
 - ▶ Narrow angle 5%: PACG 0.5%
- ▶ **Laser Peripheral Iridotomy (LPI)**
 - ▶ Place at 1:00-11:00
 - ▶ Argon laser and/or Nd:YAG
 - ▶ Goal is to eliminate pupillary block
 - ▶ Frequent need for additional medical or surgical intervention
- ▶ **Complications are few and rare**
 - ▶ Hemorrhage at laser site
 - ▶ Acute temporary IOP increase (in 10%)
 - ▶ Mild iritis
 - ▶ Lens damage, macular burn
- ▶ **Post-acute angle closure**
 - ▶ IOP lowering topicals may need to be continued due to damaged TM



LPI



Willseye.org

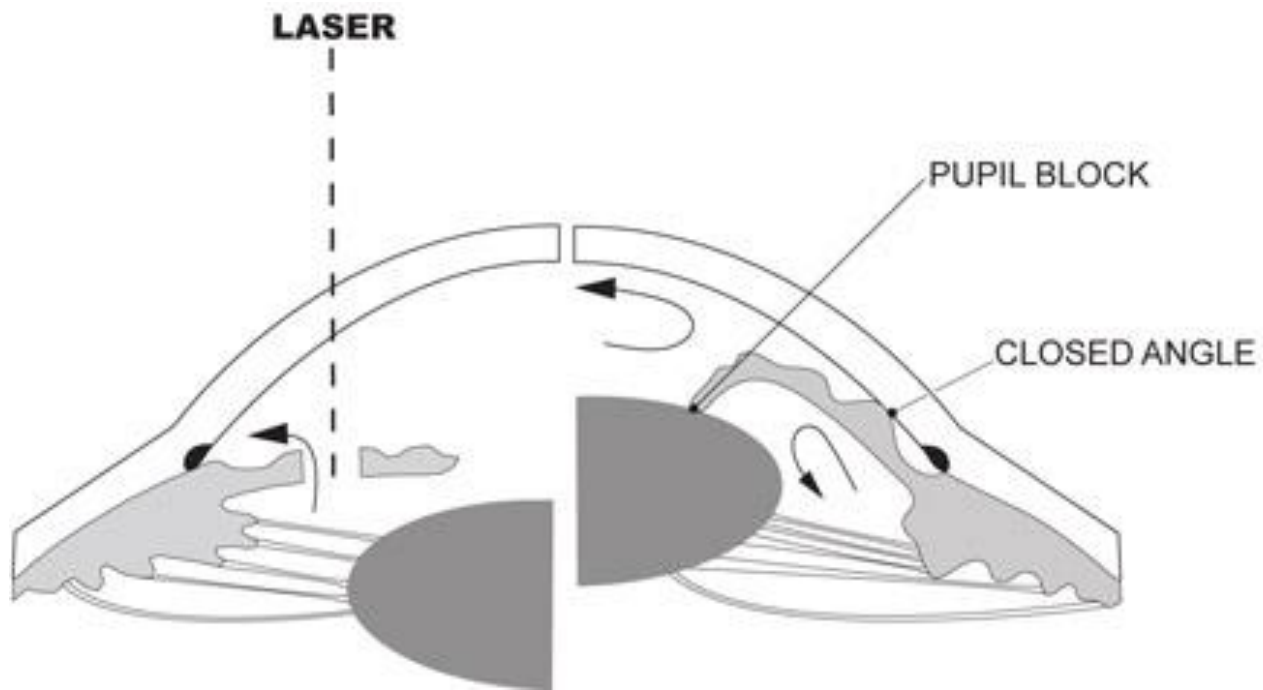


LPI effect

- ▶ Eliminates risk of pupillary block
- ▶ Equalize pressure gradient (posterior-anterior)
- ▶ Iris flattens
- ▶ AC depth unchanged



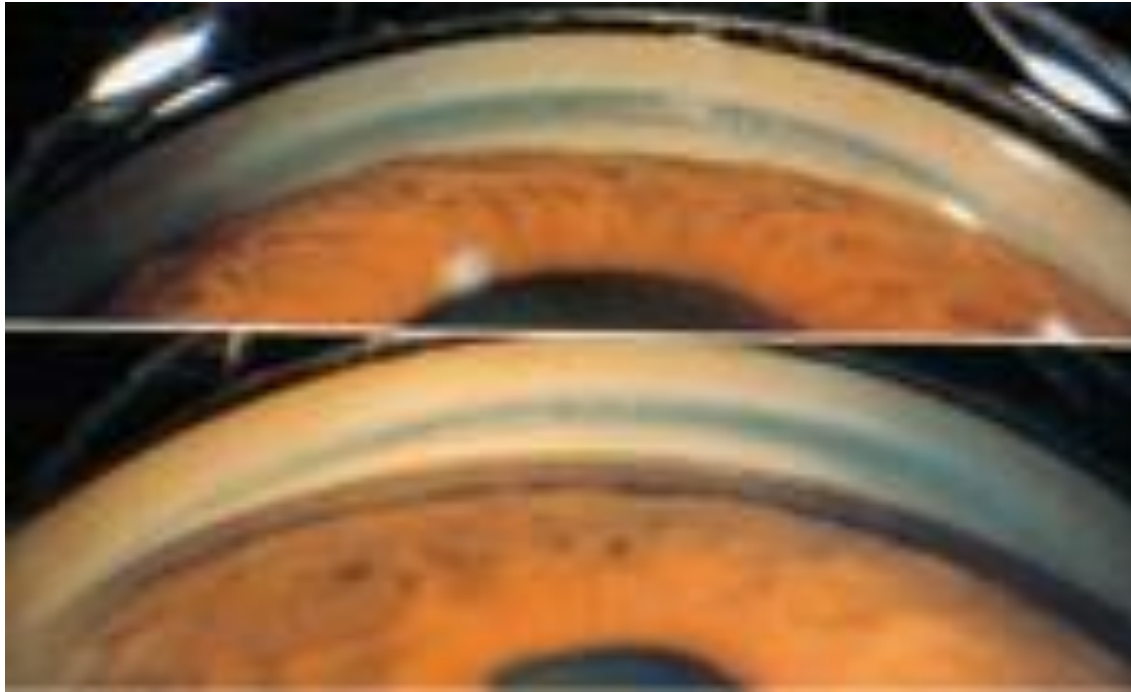
Why an LPI can be effective



Theglaucomaguide.com



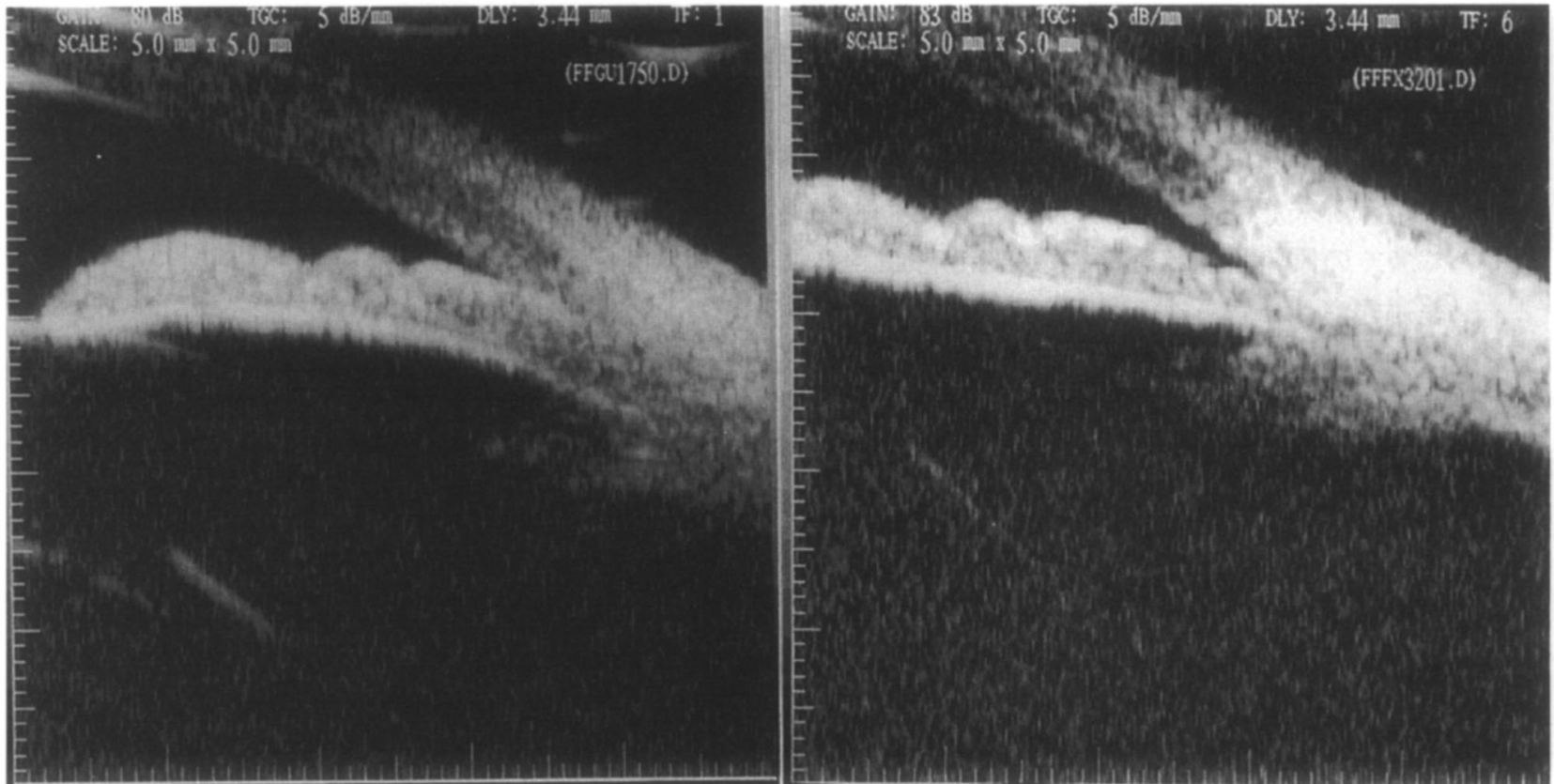
Before and After LPI



Reviewofophthalmology.com



Efficacy of Peripheral Iridotomy



Before iridotomy

After iridotomy

Who should get an LPI?

- ▶ Post-acute PAC and all fellow eyes of individuals that have developed acute angle closure
- ▶ Evidence of prior angle closure (intermittent apposition)
- ▶ Patients “at risk” and with family history
- ▶ Eyes requiring frequent mydriasis (diabetic retinopathy)
- ▶ Those with apparent significant risk per judgment of the doctor following dark room gonioscopy



Additional risk indicator

- ▶ **Failed provocative test**
 - ▶ Positive dark room prone test (for symptomatic individuals who otherwise show no evidence of appositional closure)
 - ▶ One study showed this was no more predictive of angle closure than good clinical examination (Wilensky et al, AJO 1993)



Follow up study on angle-closure suspects

Wilensky et al. AJO. 1993

- ▶ N=129 multicenter MD prospective study
- ▶ Risk assigned based on SLE and gonioscopy
- ▶ This cohort demonstrated 30% risk of angle closure in 5 years.



Plateau Iris Syndrome

- ▶ Angle closure develops with plateau iris configuration despite the presence of patent iridotomy.
- ▶ The risk may progress with age due to lens changes.
- ▶ Argon laser iridoplasty
- ▶ Pilocarpine may help pull iris out of angle



Additional Risk Mgmt

▶ Medical

- ▶ Pilocarpine pulls iris away from TM
 - ▶ Can result in PAS, reduced vision at night, complicate CE, RD risk
- ▶ Should not be used in place of LPI

▶ Argon laser iridoplasty

- ▶ Creates greater gap between iris and angle structures
- ▶ Best with plateau iris

▶ Surgical

- ▶ Lens extraction

