SECONDARY GLAUCOMA AS THE PRIMARY FOCUS

LILY ARENDT, OD, FAAO
ROSENBERG SCHOOL OF OPTOMETRY

1

WHEN ITS NOT POAG...

MANY SECONDARY GLAUCOMAS ARE EASILY MISTAKEN WITH POAG

2

FULL LENGTH ARTICLE · Volume 128, Issue 1, PP71-P150, January 2021 Download Full Issue

Primary Open-Angle Glaucoma Preferred Practice Pattern®

Steven J. Gedde, MD [1] · Kateki Vinod, MD [2] · Martha M. Wright, MD [3] · ... · Philip P. Chen, MD [6] · Tianjing Li, MD, MHS, PhD [7] · Steven L. Mansberger, MD, MPH [8] .. Show more

> "Primary open-angle glaucoma (POAG) is a chronic, progressive optic neuropathy in adults in which there is a characteristic acquired atrophy of the optic nerve and loss of retinal ganglion cells and their axons. This condition is associated with an open anterior chamber angle by gonioscopy. Primary open-angle glaucoma is a potentially blinding eye disease, but early diagnosis and treatment can generally prevent visual disability."

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POAG: Diagnosis of Exclusion?

Thorough history

- Systemic health conditions (diabetes, cardiovascular conditions, sleep apnea)
- Medications (steroids, topiramate, anticholinergics)
- Ocular surgeries
- Ocular trauma

Gonioscopy

- Confirm open or closed
- Pigment or blood vessels
- Structural changes

Slit lamp examination

- Cornea
- Iris (including TIDs!)
- Anterior chamber
- Lens
- Optic nerve
- Retina

..With DFE!

4

CASE

01

29YO MALE – ICL Pre-Op Exam

CC: BLURRY DISTANCE VISION - ALSO TIRED OF HOW DRY HIS EYES FEEL WITH CONTACT LENSES

-BCDVA: 20/20 OD,OS

-IOP 29/27mmHg OD,OS

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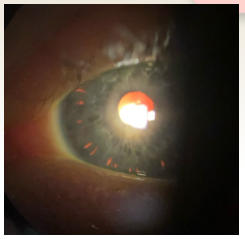

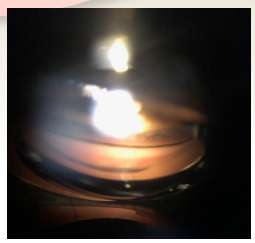

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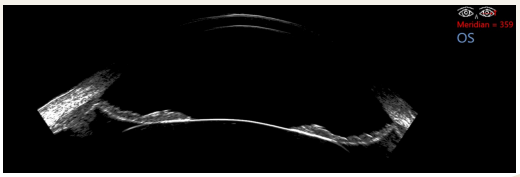
ULTRASOUND BIOMICROSCOPY (UBM)
ACD: 3.8mm OD, 3.9mm OS



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PIGMENT DISPERSION SYNDROME

Who is it?

- Mostly a disease of young people, myopes, and men
  - 20-40yo
  - Caucasians
  - SEQ -3.0D to -4.0D
  - PDS 1:1 male/female prevalence
  - Strong male prevalence for PG[1]
    - 2:1 to 5:1

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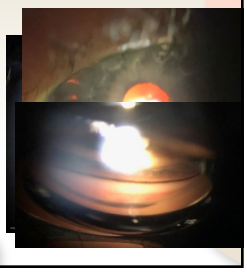
PIGMENT DISPERSION SYNDROME
Signs

- Bilateral, asymmetric
- **Clinical Triad of PDS:**
  - Krukenberg spindle
    - Melanin granules on and inside the endothelial cells
    - Not pathognomonic!
  - Mid-peripheral TIDs, spoke-like pattern
    - Corresponds to location of lens zonules
  - Trabecular meshwork pigmentation



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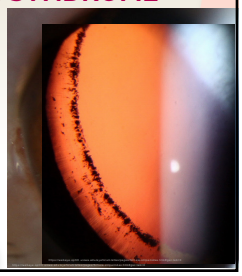
PIGMENT DISPERSION SYNDROME
Signs

- Unlikely for non-Caucasian patients to present with the **Clinical Triad for PDS**
  - TIDs only present in 11% Asian vs 14% African-American vs 86% Caucasian[1]
    - Not in a spoke-like pattern
  - KS 61% vs 57% vs 95%
- Diagnosis made via presence of:
  - TM pigmentation AND zonular pigmentation and/or peripheral lenticular pigmentation
    - Scheie stripe



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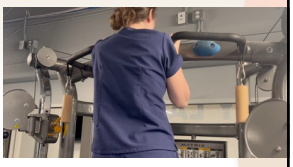
PIGMENT DISPERSION SYNDROME
Symptoms

- Majority asymptomatic
- Episodes of headaches/blurred vision after intermittent IOP elevation
  - Being in the dark or after exercise
    - Exercise-induced pigment release



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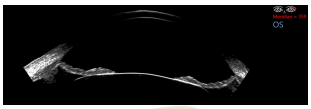
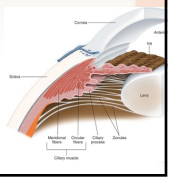
PIGMENT DISPERSION SYNDROME
How it works

- Backward bowing of the peripheral iris → friction between posterior pigmented epithelium of the iris and the lens zonules with physiologic pupillary movement
- Greater irido-lenticular contact in eyes with PDS
  - Reverse pupillary block





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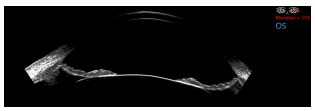
PIGMENT DISPERSION SYNDROME

How it works

- Reverse pupillary block first in 1992[1]
- Iris acts like a "flap-valve"
- Valve allows aqueous to flow forward due to pumping action of mid-peripheral iris
- Valve prevents aqueous from flowing backwards → increasing AC pressure pushing iris back into zonules



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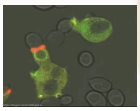
PIGMENT DISPERSION GLAUCOMA

How it works

- High-tension type of glaucoma
  - Avg IOP ~30mmHg at diagnosis
- Elevated IOP not just due to blockage of TM, but phagocytosis[1]
  - TM endothelial cells phagocytose the pigment
  - Over-stuffed cells die
  - Pigment stuffed cells cleared away by macrophages
  - TM without endothelial cells collapse
  - Increased outflow resistance



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TENDENCY FOR BURN OUT

- Less aggressive with increasing age
- Age-related increase in lens axial length and/or age related miosis
  - Lifting iris away from zonular bundles
  - Rubbed away all the pigment?
- Reduced pigment dispersion and IOP normalization over a 10-year period

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PREVALENCE

- PG represent 1-1.5% of glaucoma in the Western World[1]
- 5-10% of Caucasian pts with PDS will develop PG 5 years after diagnosis
  - 15% at 15 years
  - 35% at 35 years

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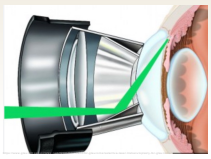
MANAGEMENT PDS/PG



- Can typically be treated like POAG
  - IOP lowering gtts
  - **SLT**
  - MIGs
  - Trabeculectomy
  - Tube shunts
  - Iridotomy?

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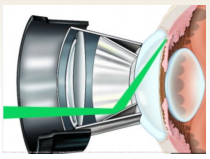
MANAGEMENT PDS/PG
SLT



- Frequency doubled q-switched Nd:YAG laser (532nm)
- Works through process called **selective photothermolysis**
- Stimulates melanin in the pigmented TM cells and facilitates improved outflow without damaging surrounding cells[4]
- IOP lowering in 4-6 weeks
- 85% of patients with PG saw a 20% ↓ in IOP at 1 year
  - Only 14% maintained IOP lowering and/or didn't need more treatment after 4 years

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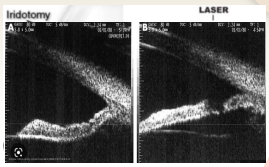
IRIDOTOMY?

- Reverses posterior bowing
- Equalize the pressure between AC and PC → decreases dispersion
  - Unlikely to help if TM already damaged
  - May be better as prophylactic for PDS before pt has OHT[1]
- Conflicting evidence in literature for long-term benefits[2]
  - Recommended for Asian PDS patients[3]



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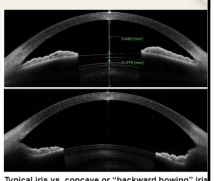
Fenestrated ICL for concave iris?

- ICL can reduce the concavity of the iris without compromising the anterior chamber angle[1]
- Eliminates the contact between anterior zonular fibers and posterior iris epithelium
- Contact between iris and ICL may prevent mechanical loss of pigment due to soft, elastic, hydrophobic surface of ICL[1]
- Few case reports of late-onset PDS secondary to ICL implantation with non-fenestrated models



Typical iris vs. concave or "backward bowing" iris

Modified from original in: Khan MA, Tan O, Sun W, Cai W, Zhao L, and Lin D. Prediction of excessively low vault after implantable collamer lens implantation using iris morphology. *Frontiers in Medicine*. 2022.

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CASE

02

65YO MALE - CATARACT EVALUATION

CC: COMPLAINS OF BLURRY, DARK VISION OD>OS

-VA: LP OD,OS

-**IOP 23/62mmHg OD,OS**

Systemic History:

- Type 2 Diabetes x 30 years
- Last A1c 6.8%
- Bilateral below-knee amputations
- H/o eye injections OS 10 years ago

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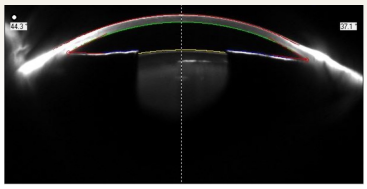

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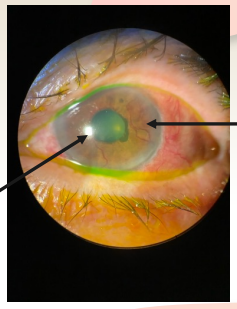

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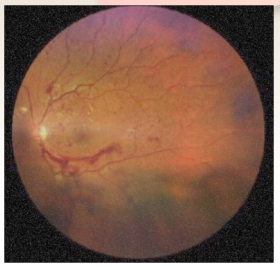

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NEOVASCULAR GLAUCOMA

- New vessels grow over the iris & into the angle causing increased IOP → ONH damage
- **Retinal ischemia** is the driving factor
  - 75% of cases caused by 3 main conditions

CRVO **PDR** **OIS**

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NEOVASCULAR GLAUCOMA
HOW DOES IT HAPPEN?

- Primary event → retinal ischemia
  - Disrupts balance between pro and anti-angiogenic factors
- Angiogenic factors released into the aqueous
  - VEGF
    - Produced by retinal and NPCE
  - TGF-Beta
    - Stimulates formation of fibrovascular membrane
- Secondary event → neovascularization obstructs the TM
  - Results in high IOP and iris hypoxia
    - Cycle continues!

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NEOVASCULAR GLAUCOMA
FOUR STAGES[1]

1. **Prerubiosis stage**: At risk of developing NVG, no visible NVI/NVA and IOP is normal
2. **Preglaucoma stage**: NVI and/or NVA present, IOP normal, patient asymptomatic
3. **Open-angle glaucoma stage**: NVA progresses, fibrovascular membrane forms obstructing aqueous outflow, elevated IOP, no synechial angle closure…yet
4. **Closed-angle glaucoma stage**: fibrovascular tissue in angle contracts, PAS develops, progressive angle closure, very elevated IOP

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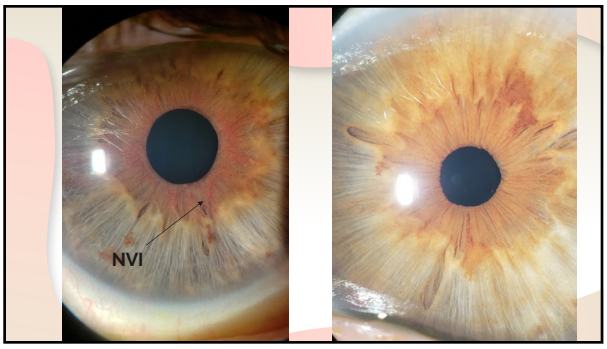

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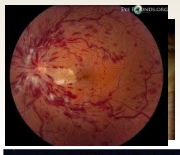
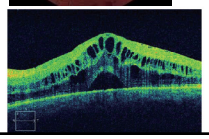
NEOVASCULAR GLAUCOMA
PROGNOSIS

- Strongly depends on
  - Prevention
  - Early Treatment
    - Treating the NVI before ONH damage vs treating after the angle has been zipped shut





CRVO with edema? Refer to retinal specialist!

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NEOVASCULAR GLAUCOMA
Signs/Symptoms

- Chronically red, painful eye
- Decreased vision
  - Acutely elevated IOP? Corneal edema!*
  - Retinal pathology
  - Glaucoma
- Headaches/nausea/halos

*If chronic or slow rises in IOP, corneal can be clear with HIGH IOP!

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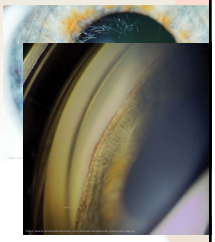
NEOVASCULAR GLAUCOMA
Signs/Symptoms

- **BEFORE DILATION….Take a close look at the iris and then DO GONIOSCOPY!**
- NVI
  - Thin, tortuous, randomly oriented near pupil margin
- NVA
  - Thin vessels crossing scleral spur and branching over the TM
  - Distinguish from normal vessels
- NVA can exist without visible NVI
  - CVOS Study: 10% of eyes with nonischemic CRVO and 6% of eyes with ischemic developed NVA without NVI[1]



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NEOVASCULAR GLAUCOMA
Goals for Treatment/Management

Reduce posterior segment ischemia
- Treat underlying systemic diseases
  - Diabetes, hypercoagulability, carotid occlusive disease
- Panretinal photocoagulation (PRP)
  - Works best once iris and angle neo develops[1]

Reduce neovascular drive
- Intravitreal Anti-VEGF to suppress NVI and NVA

Control elevated IOP
- Anti-glaucoma meds
- Glaucoma filtration surgery

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NEOVASCULAR GLAUCOMA
Goals for Treatment/Management

- IOP lowering with kitchen sink
  - 1st - Aqueous suppression via beta-blockers, topical/oral CAIs, α-agonists
  - 2nd – PGAs
  - AVOID: pilocarpine
    - Can worsen 2° angle closure due to lens shifting or aqueous misdirection → causes AC shallowing
- Referral to BOTH glaucoma and retina

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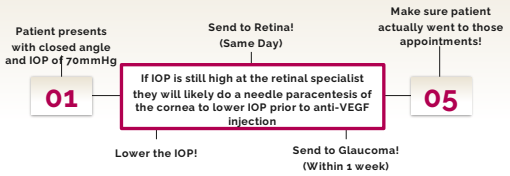
NEOVASCULAR GLAUCOMA
'IDEAL" situation



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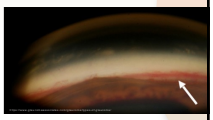
NEOVASCULAR GLAUCOMA
Tips for Diagnosis

- Look in **both eyes** to try and find the cause
  - Can use OCT-A if you have one to find NVD, NVE
- HIGH IOP often from 40-60mmHg[1]
- Look closely at the pupillary rough for NVI
- Angle may appear open on Van Herick with NVA/NVI
- Do gonioscopy
  - Will likely have PAS in the angle
  - Translucent fibrous tissue in the angle



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CASE

03

32YO MALE – GLAUCOMA EVALUATION

CC: Optometrist referred glaucoma eval

-BCVA: 20/20 OD,OS

-IOP 24/25mmHg OD,OS

-No current IOP management or past eye surgeries

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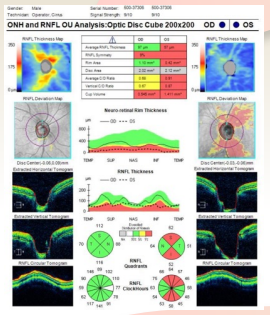
CASE 03



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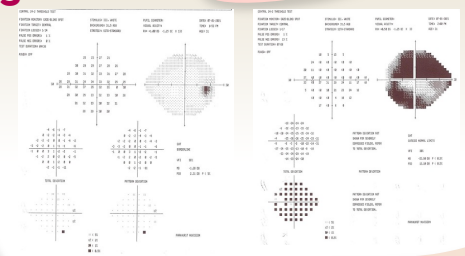
CASE 03



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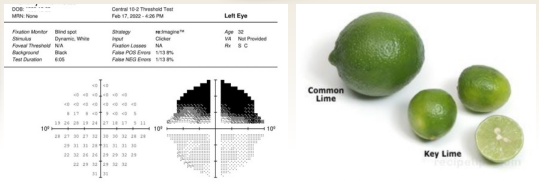
CASE 03



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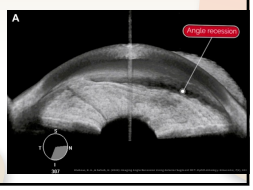
TRAUMATIC GLAUCOMA

ANGLE RECESSION GLAUCOMA

- Common after blunt injury
  - Often sports-related
- 6-7% with angle recession will eventually develop glaucoma[1]
- Glaucoma can be early-onset, but often occurs years after initial injury



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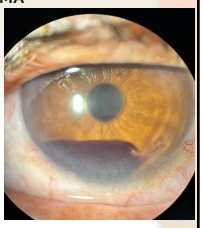
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

- Strong association between hyphema and angle recession
  - Hyphema can hide AR in up to 71-100% of eyes[1]
  - RBCs, inflammatory cells, fibrin can all decrease aqueous outflow → ↑IOP
  - Sickle cell dz or trait – watch carefully as non-pliable RBCs can't cross the TM[2]



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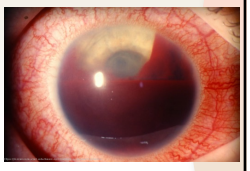
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

- Strong association between hyphema and angle recession
  - Full hyphema (8-ball)
  - Layered hyphema
  - Microhyphema
    - RBC suspension in the AC within 24 h without formation of a layered clot



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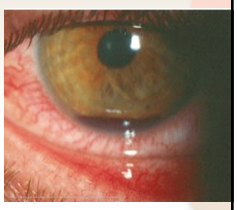
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

Hyphema Tips

- If active hyphema advise pts to:
  - Keep head elevated
  - Avoid eye rubbing
  - Avoid meds that interfere with thrombin/platelet function
  - Wear shield at night
- Treating with topical steroids + mydriatics, IOP lowering gtts and/or oral CAIs



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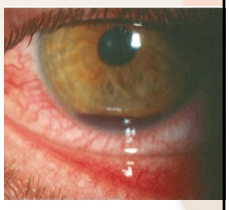
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

Hyphema Tips

- Recent trauma without gross hyphema? Suspect microhyphema!
- Not sure if WBC or RBC? Use red-free filter
- Always measure the height
- Treat IOP
- Avoid gonio on active hyphemas
- Highest chance for rebleed in 1st 2-5 days



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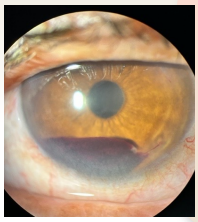
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

THE PREVALENCE OF OCULAR COMPLICATIONS AFTER BLUNT ORBITAL TRAUMA IN A REGIONAL HOSPITAL
DSC Ng, YF Choi, SY Yuen, WN Chan
Pamela Youde Nethersole Eastern Hospital, Hong Kong

- Out of 337 eyes, ER physicians were able to diagnose 100% of gross hyphemas, but failed to recognize 2/3 of cases with microhyphema



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TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

Angle-recession glaucoma: long-term clinical outcomes over a 10-year period in traumatic microhyphema
Ng, Danny Siu-chun; Ching, Ruby Hok-ying; Chan, Clement Wai-nang.
International Ophthalmology; Dordrecht Vol. 35, Iss. 1, (Feb 2015): 107-113. DOI:10.1007/s10792-014-0027-5

- 97 patients with unilateral trauma with either gross or microhyphema
- 75% of microhyphema patients also had angle recession
  - 7% of them developed glaucoma over 10 years
- Increased chance of angle recession glaucoma with >180 degrees angle recession
- **No difference between gross hyphema and microhyphema for risk of developing glaucoma**

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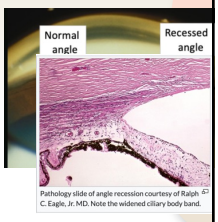
TRAUMATIC GLAUCOMA
ANGLE RECESSION GLAUCOMA

- AR defined as a tear between longitudinal and circular fibers of the ciliary muscles
- Ciliary body tear is only an indicator of trauma and **not the cause** of the glaucoma
- Scarring/fibrosis of the TM and Schlemm's canal from initial trauma may progress months to years later



Pathology slide of angle recession courtesy of Ralph C. Eagle, Jr. MD. Note the widened ciliary body band.

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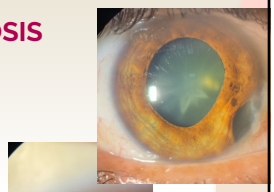
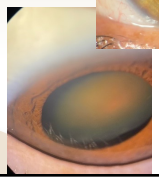
DIAGNOSIS

- H/o Trauma? Hyphema present?
- Unilateral glaucoma?
- GONIOSCOPY
  - Compare both eyes!
- Look for signs of trauma
  - Corneal scars/tears
  - Iridodialysis
  - Cataract
  - Vossius ring
  - Lens dislocation
    - Can cause pupillary block!

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TRAUMATIC GLAUCOMA

Treatment

- Topical IOP lowering gtts
  - Avoid PGAs in acute phase of trauma
    - Can worsen inflammation
  - Pilocarpine may not work as well due to disruption of ciliary muscle + scleral spur relationship
- May ultimately need surgical management depending on severity and responsiveness of glaucoma
  - SLT typically doesn't work on damaged TM
  - Trabeculectomy less effective in ARG compared to POAG (43% vs 74% success rate)[1]
  - Endoscopic Cyclophotocoagulation (ECP)

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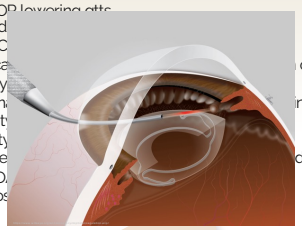
TRAUMATIC GLAUCOMA

Treatment



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CASE

04

77YO FEMALE – CATARACT EVALUATION

CC: BLURRY VISION OS>OD, POOR NIGHT VISION OU

-BCVA: 20/25+ OD, **HM OS**

-IOP 16/21mmHg OD,OS

Current eye meds:

- Lumigan qhs OU, Timolol BID OU, and Vyzulta qhs OS

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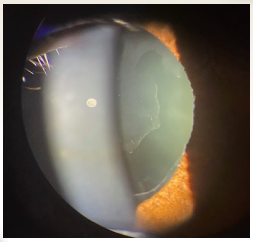

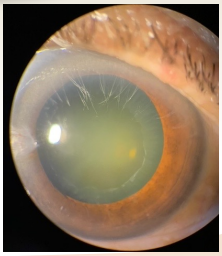

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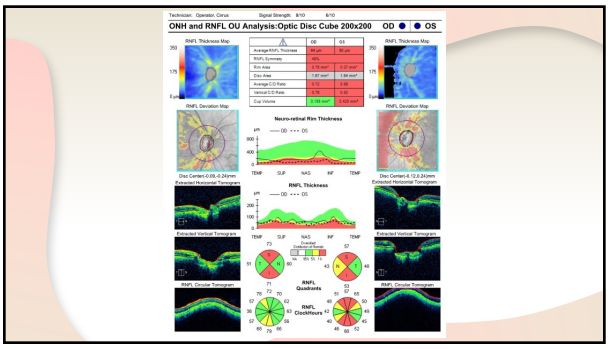

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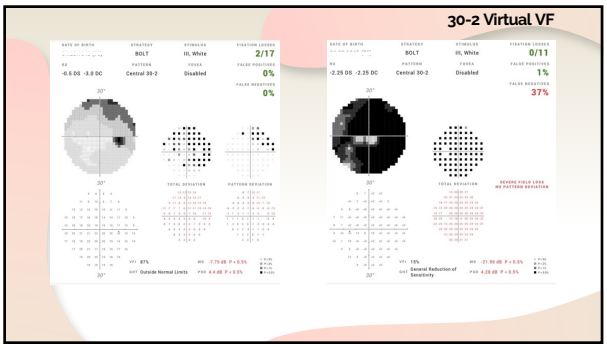

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PSEUDOEXFOLIATION

- Age-related disorder (~60+)
- Production & accumulation of fibrillar material (elastin) throughout the body
  - Build up on zonules causes disintegration
  - Blocks TM & increases outflow resistance
- Genetic component?
  - Lysyl oxidase-like 1 gene
    - Biogenesis of connective tissue

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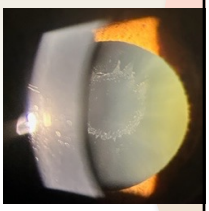
PSEUDOEXFOLIATION GLAUCOMA

- Starts unilateral → bilateral, asymmetric
- Can be very aggressive!
  - Tissues in body are lacking elastin
  - ONH less flexible/more susceptible to high IOP
- Most common 2° glaucoma in European descent
- **Most common cause of unilateral glaucoma**



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PSEUDOEXFOLIATION GLAUCOMA
SYSTEMIC IMPACT

- Associated with myocardial infarction, cerebrovascular events, systemic HTN
- PSX pts more likely to have moderate/severe hearing loss compared to aged-matched controls
  - Fibrillar materially builds up within the inner ear→ decreased sensitivity

Systematic Review | Full Access

Hearing Loss in Exfoliation Syndrome: Systematic Review a Meta-Analysis

Michael C. Shih MD, Tamar M. Gordis BA, Paul R. Lambert MD, Shaun A. Nguyen MD, Ted A. Meyer MD, PhD

First published: 10 September 2022 | https://doi-org.uiwtx.idm.oclc.org/10.1002/lary.30384

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PSEUDOEXFOLIATION GLAUCOMA
SIGNS

- White, flakey material on pupillary margin
- Anterior lens capsule changes
  - Best seen with dilation
  - 3 zones
- Iris TIDs near the pupil margin

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PSEUDOEXFOLIATION GLAUCOMA
SIGNS

- Irregular pigment deposition on the TM
  - More splotchy, less dense than PDS
- Sampaolesi's line
  - Linear pigment anterior to the Schwalbe's line
  - Not pathognomonic – also seen in PDS!

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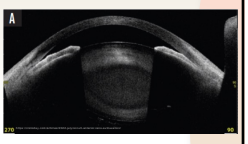
PSEUDOEXFOLIATION GLAUCOMA
SIGNS

- Poor dilation
  - Dilator muscle atrophy
- Zonular laxity
  - Lens can dislocation anteriorly and narrow the AC
  - 9-18% can have occludable angles resulting in 2° angle closure[1]



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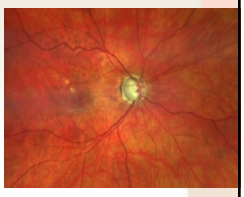
PSEUDOEXFOLIATION GLAUCOMA

IOP

- Highly unstable IOP
- Higher rates of treatment failure and faster progression of ONH damage



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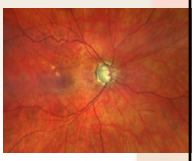
PSEUDOEXFOLIATION GLAUCOMA

IOP

Factors for Glaucoma Progression and the Effect of Treatment

The Early Manifest Glaucoma Trial

M. Cristina Leske, MD, MPH; Anders Heijl, MD, PhD; Mohamed Hussein, PhD; Bo Bengtsson, MD, PhD; Leslie Hyman, PhD; Eugene Komaroff, PhD; for the Early Manifest Glaucoma Trial Group



- 255 pts between 50-80yo previously undiagnosed/untreated OAG
- 83% of PXG progressed over 6-year follow up period >>> vs POAG vs PDG
- PXG more likely to need surgical intervention

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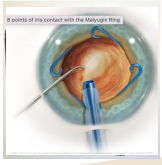
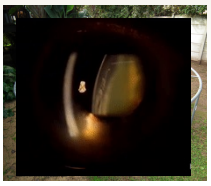
PSEUDOEXFOLIATION GLAUCOMA

CATARACT SURGERY

Poor pupil dilation



Zonular Dehiscence



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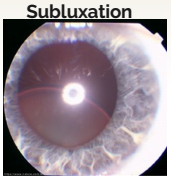
PSEUDOEXFOLIATION GLAUCOMA

CATARACT SURGERY

Lens Subluxation



- Higher incidence of lens subluxation in PSX before or after CE
- Most common reasons:
  - Pseudoexfoliation
  - H/o retinal injections
  - Trauma

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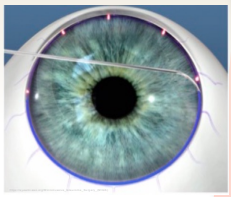
MANAGEMENT PSEUDOEXFOLIATION

- IOP lowering gtts
  - Prostaglandins > Betablockers[1]
- SLT
- MIGs
  - Trabeculotomy
- Cataract removal + MIGs
  - 5.8mmHg lowering in PXFG vs 2.7mm in POAG eyes[1]
- Tube shunts
- Trabeculectomy
  - Long-term success rate lower for PXG than POAG[2]



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SECONDARY GLAUCOMA

TAKE AWAYS

- It may not be POAG!
- Asking the right questions AND looking for specific signs can help you determine the actual cause of glaucoma.
- Each 2' glaucoma has its own preferred treatment and management. Don't be afraid to send for surgical management, if needed.

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Thank you!

Questions?

lilyarendt1@gmail.com

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