

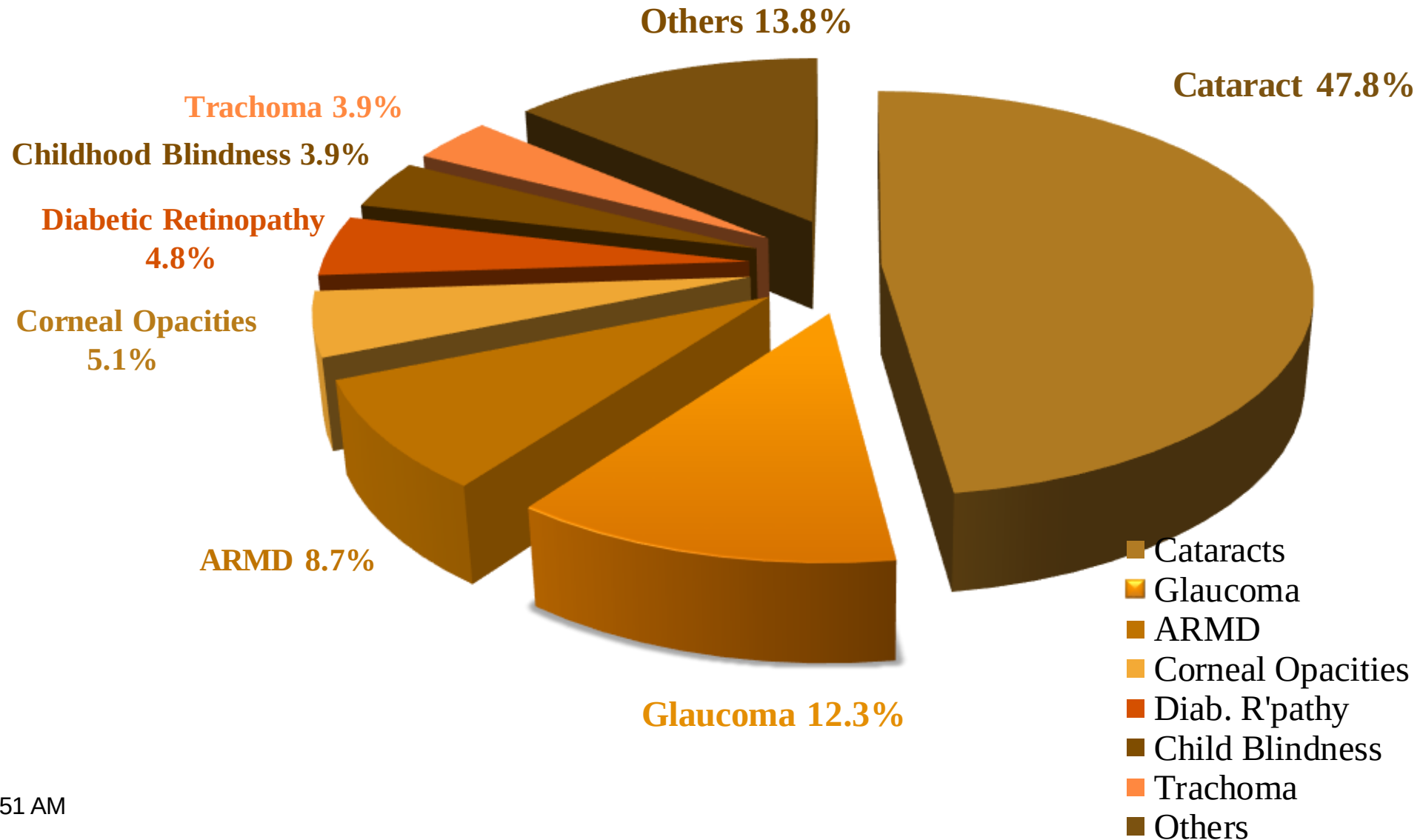


Glaucoma

Dr. N. Abidi

23.4.2020

Magnitude





Magnitude

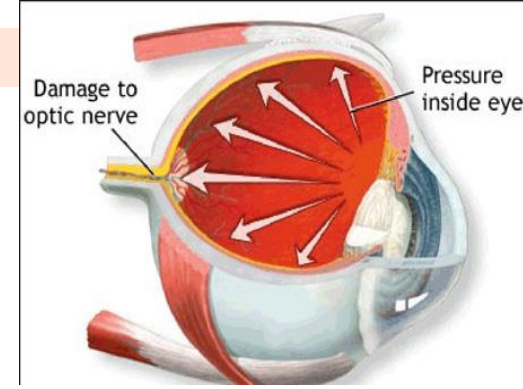
- Second major cause of blindness
- Often asymptomatic in early stage.
- Damage is irreversible.
- Effective treatment is available

Glaucoma

- Second major cause of blindness in the world.
- Which can be prevented by early diagnosis and treatment



Definition



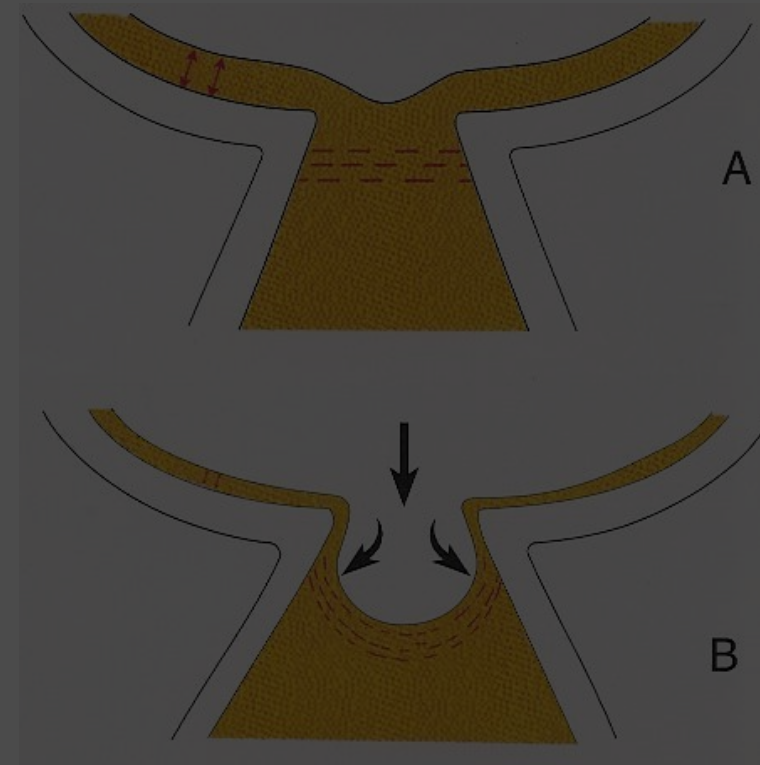
- A chronic, disease of progressive optic neuropathy with loss of retinal neurons and the nerve fibre layer, resulting in **blindness** if left untreated.

Normal IOP is between 10 – 20 mmHg $\pm$ 2.5 mmHg

Normally the IOP is highest in the morning and lowest in the evening

Glaucoma

- Glaucoma is characterized by three factors:
 - **Elevated Intra Ocular Pressure (IOP)**
 - **Optic nerve damage (cupping of the disc)**
 - **Progressive loss of visual field**



Risk Factors for POAG

- High Intraocular (Eye) Pressure
- Over the age of 40
- Family history of glaucoma
- African or Caribbean descent
- Thin cornea
- High myopia (Nearsightedness)
- Diabetes
- High blood pressure

Steroid responsiveness

- Steroids lead to increase in myocilin production by trabecular meshwork.
- According to response it can be classified as
 - **High – IOP > 30**
 - **Moderate- IOP : 22 -30**
 - **Non responders-no change**
- Therefore steroids should be cautiously used.....

Classification

- Primary glaucoma:
 1. **Primary open angle Glaucoma**
 2. **Low Tension Glaucoma**
 3. **Primary closed angle**
- Congenital Glaucoma: **Buphthalmos**
- Secondary glaucoma (causes):
 1. **Trauma**
 2. **Ocular surgery**
 3. **Associated with other ocular diseases (uveitis)**
 4. **Raised episcleral venous pressure**
 5. **Steroid induced**



GLAUCOMA CLASSIFICATION

PRIMARY

- No detectable ocular or systemic abnormality.
- Often bilateral.
- Often familial

SECONDARY

- Predisposing ocular or systemic abnormality.
- Often unilateral.
- Often sporadic

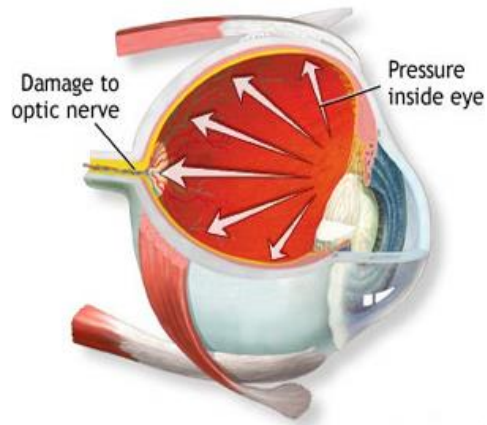
STEPWISE DIAGNOSIS

- IOP with Applanation tonometry with Corneal Pachymetry (to measure corneal thickness)
- Good S/L exam (look for AC depth and other Ant. Seg. findings)
- Stereoscopic Dilated Ophthalmoscopic examination
- Gonioscopy
- Formal visual-field testing
- Imaging

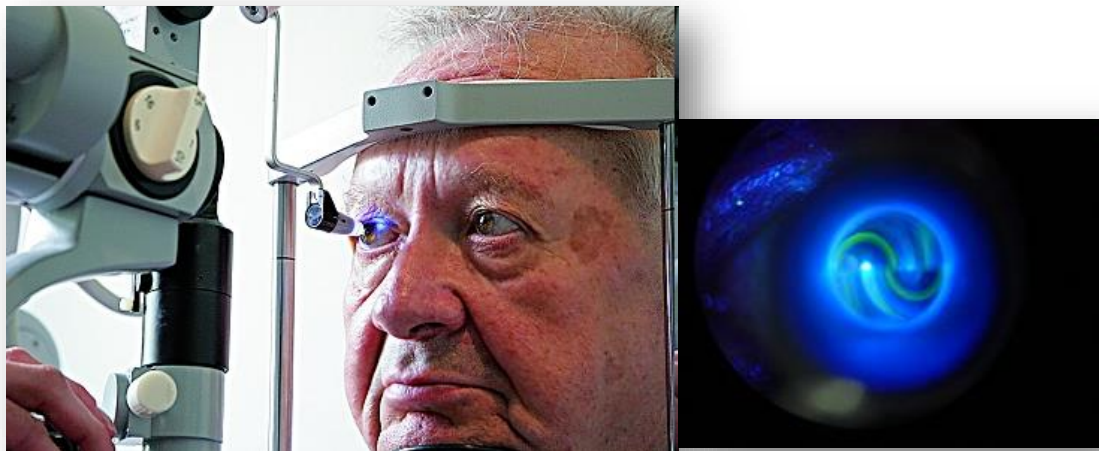


Normal Optic disc

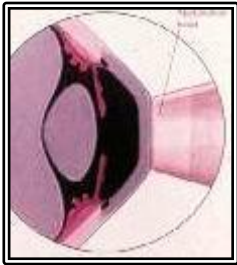
Different Tonometers



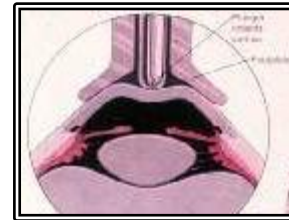
The tonometry eye test measures the inner pressure of the eye also known as Intraocular Pressure or IOP.



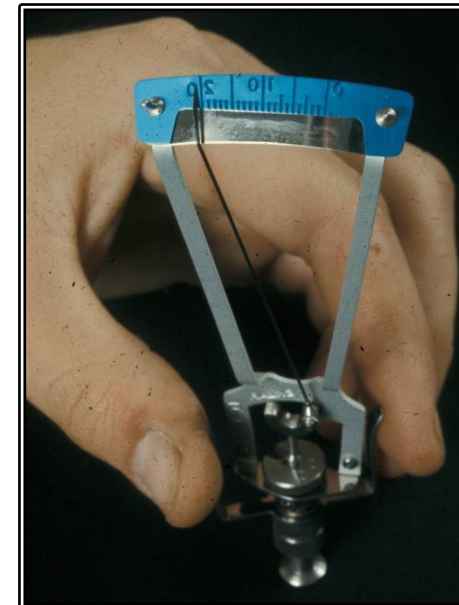
Tonometry



Applanation

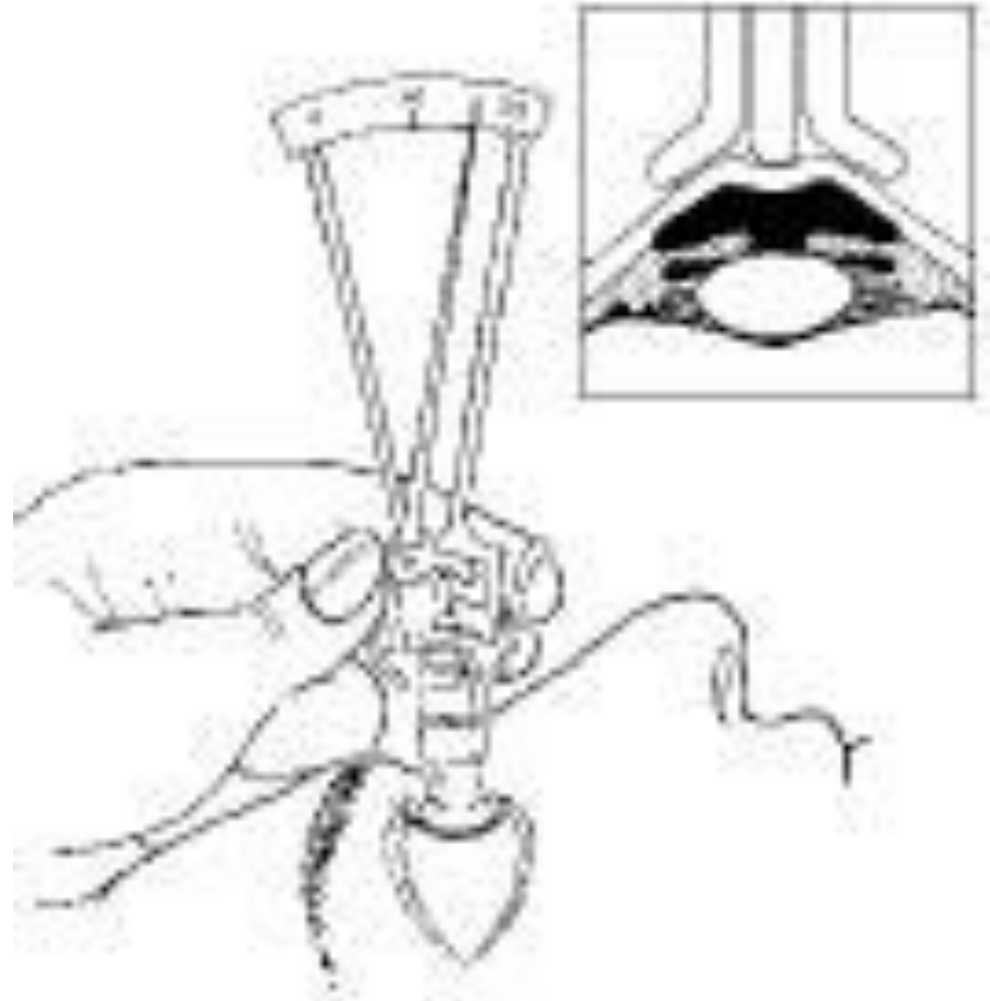


Schiotz



Indentation (Schiotz) tonometry

- Not used much anymore
- Third world countries
- Rests on cornea & indents it
 - **More indentation = softer cornea = lower IOP**



Gonioscopy

- Can differentiate between open-angle and narrow-angle glc
- Types
 - **Goniolens**
 - **Two to four-mirror lenses**



What we see through a gonio lens

- *Ciliary body band*
 - **Pale brown/greyish**
- *Scleral spur*
 - **Thin white line above the CB**
- *Trabecular meshwork*
 - **Pigmented**
- *Schwalbe's line*
 - **Seen as glistening white line**

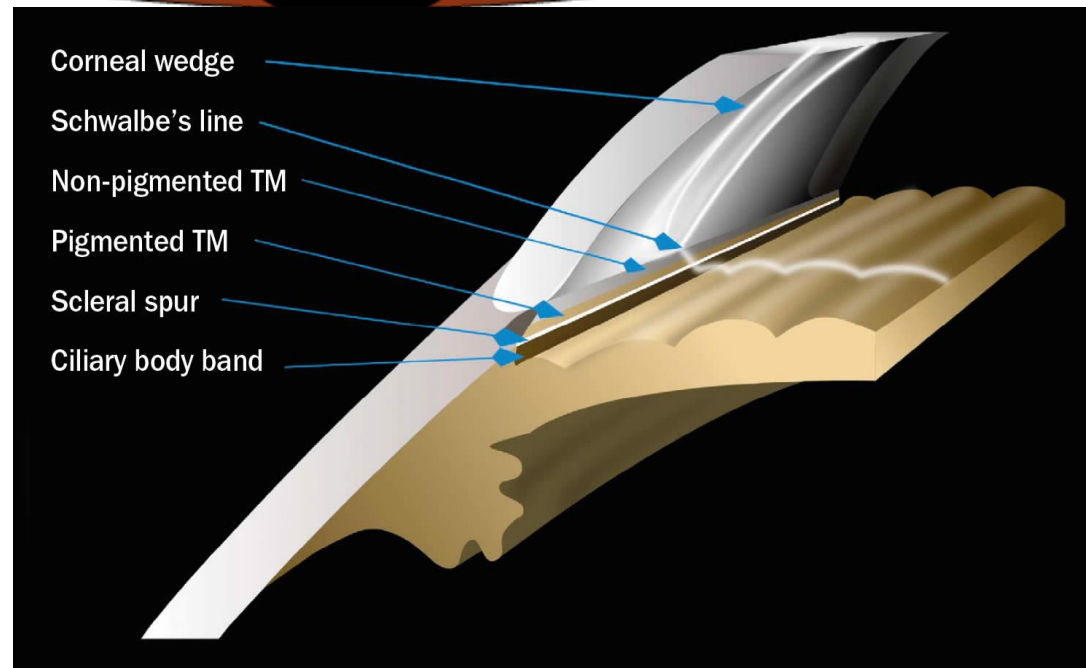
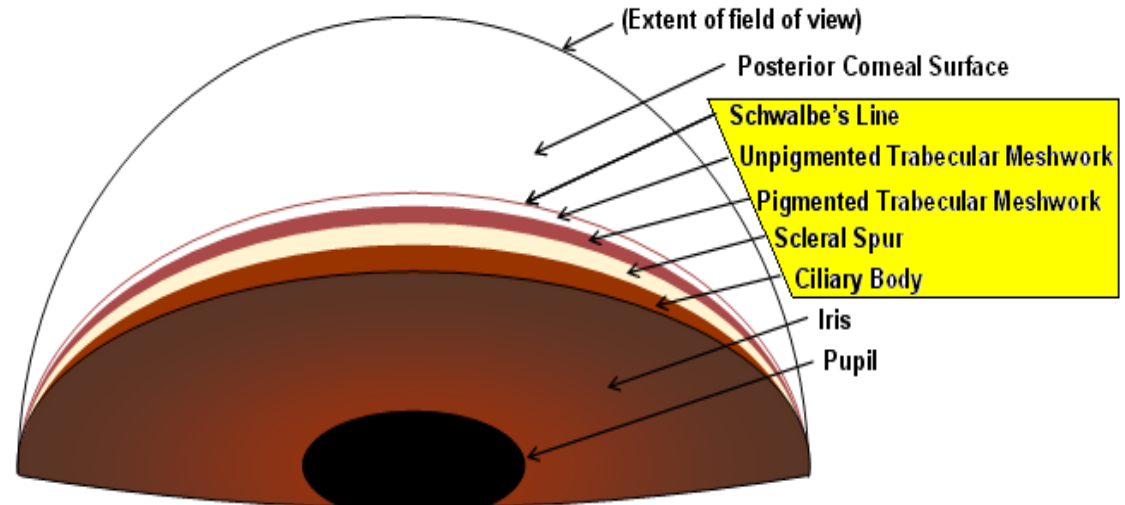
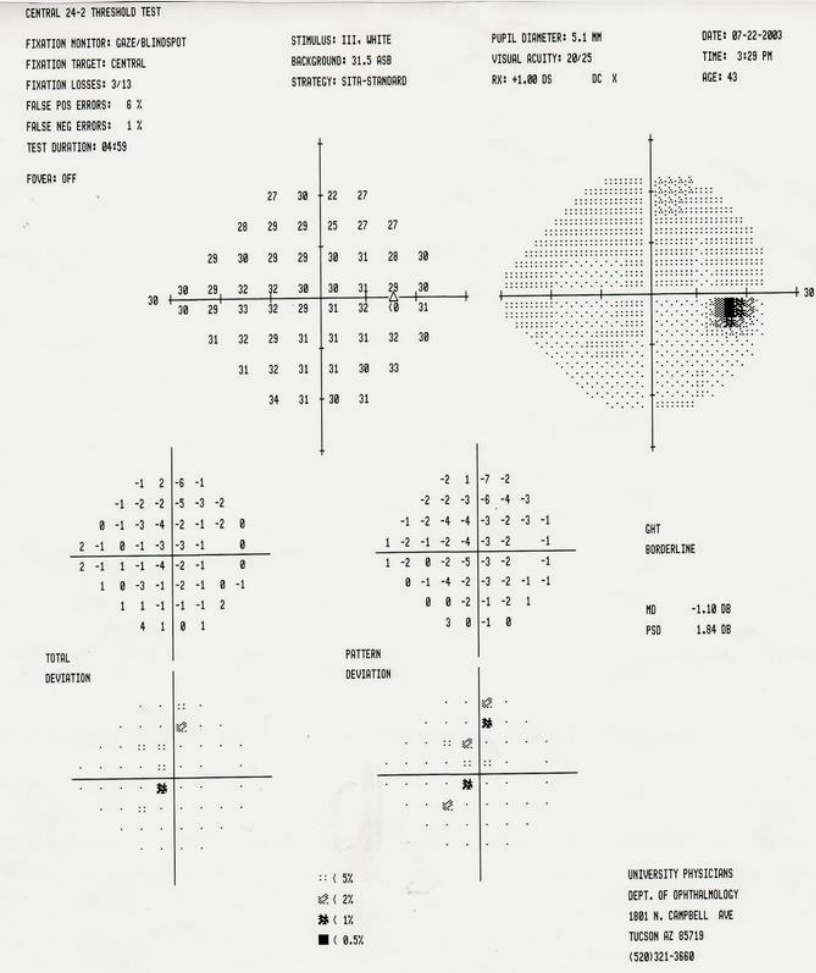
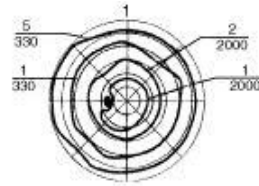


Figure 1 consists of two diagrams, A and B, illustrating the range of motion of the head. Diagram A is a lateral view of a human head in profile, facing right. A shaded sector indicates the range of motion from 60° to 75°. Diagram B is a superior view of a human head, showing the top of the head. A shaded sector indicates the range of motion from 100° to 60°. Below the diagrams is a double-headed arrow pointing left and right, labeled 'Temporal' on the left and 'Nasal' on the right.



Visual Field Defects



Baring of the blind spot. The earliest nerve fiber bundle defect.



Incipient double nerve fiber bundle defect (Bjerrum scotoma).



Bjerrum scotoma isolated from blind spot.



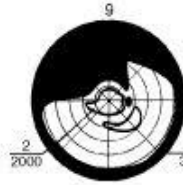
End stages in glaucoma field loss. Remnant of central field still shows nasal step.



The basic visual field loss in glaucoma is the nerve fiber bundle defect with nasal step and peripheral nasal depression. It is here shown superimposed upon the nerve fiber layer of the retina and the retinal vascular tree. All perimetric changes in glaucoma are variations of these fundamental defects.



Fully developed nerve fiber bundle defect with nasal step (arcuate scotoma).



Peripheral depression with double nerve fiber bundle defect. Isolation of central field.



Double arcuate scotoma with peripheral breakthrough and nasal step.



Nasal depression connected with arcuate scotoma. Nasal step of Rönne.



Peripheral breakthrough of large nerve fiber bundle defect with well-developed nasal step.

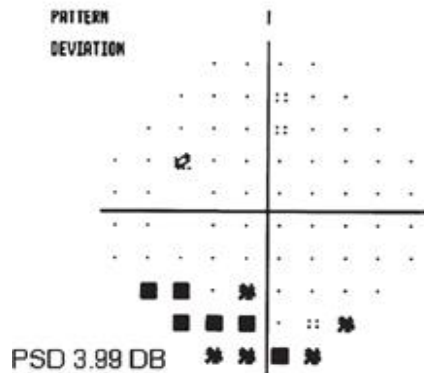
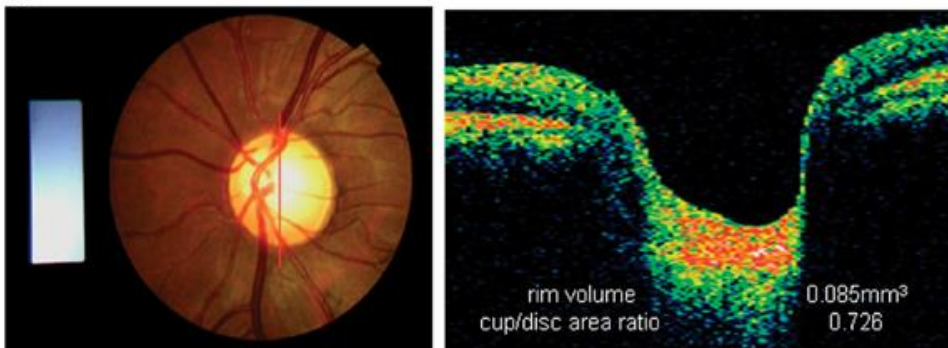


Seidel scotoma. Islands of greater visual loss within a nerve fiber bundle defect.

Diagnosis

- Recently, there have been many new machines to help
 - **Image the optic nerve e.g. HRT ®**
 - **Image the surrounding nerve fibre layer e.g. GDX ®, OCT**
 - **Image the angle with OCT**

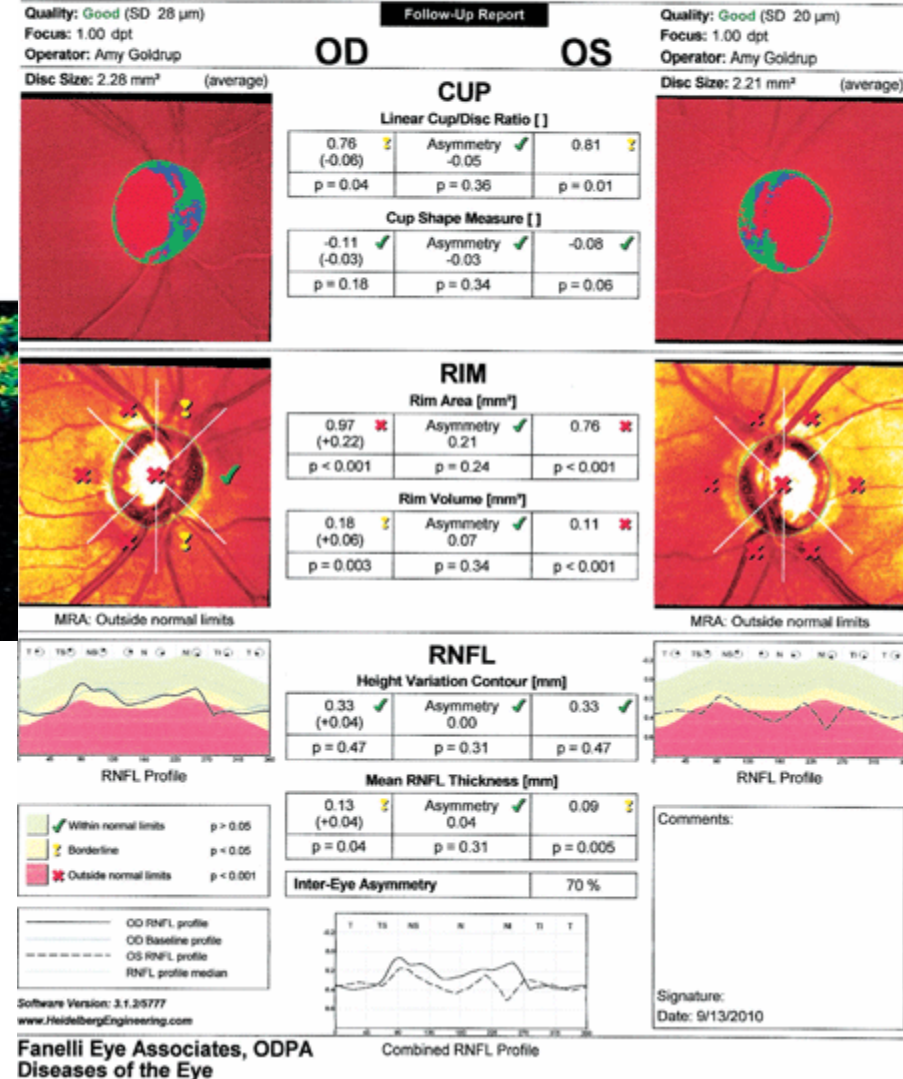
Fundus photographs, OCT optic nerve head scans (vertical cut) and Humphrey visual field pattern deviation plots of the left eye



Fanelli Eye Associates, ODPA
5311 S. College Rd
Wilmington, NC 28412
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HEIDELBERG
ENGINEERING

DOB: Nov/10/1950 Examination: Sep/13/2010
Gender: male Ethnicity: Caucasian

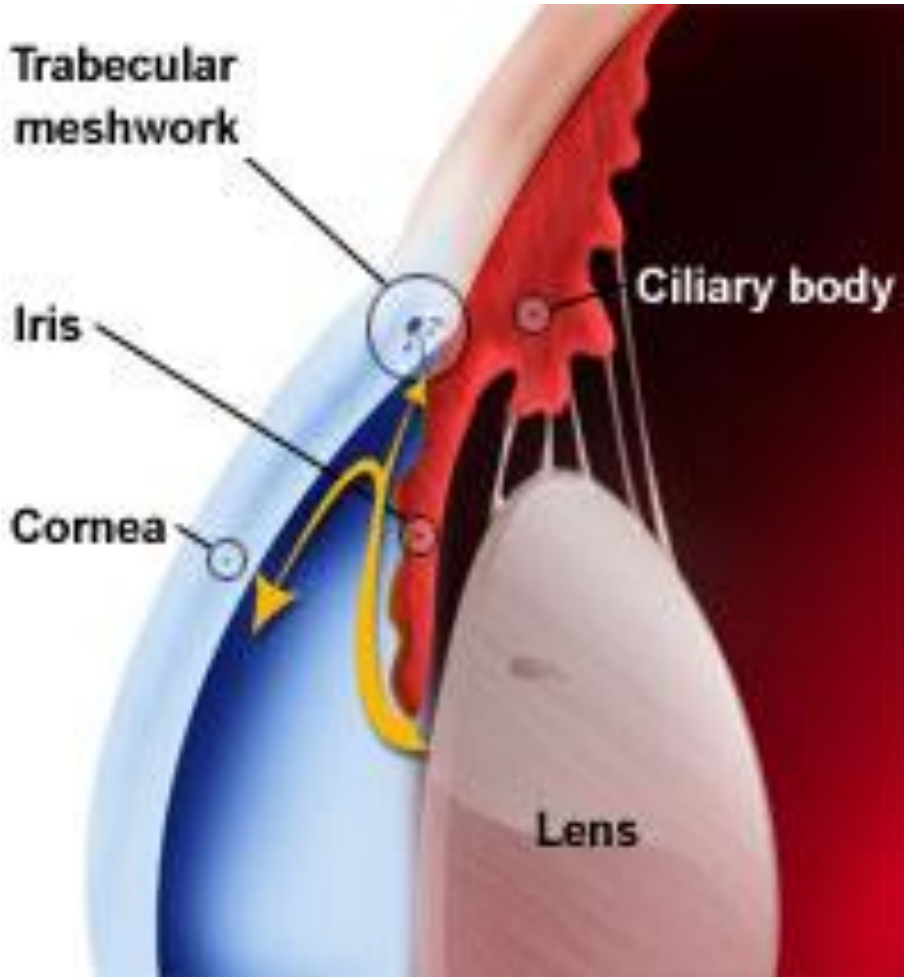


Case 1

Mr. S presents to you with diminished peripheral vision

He complains that he feels like the world is closing in on him. He also notes that he has trouble looking at lights as they all appear to be surrounded by halos. You perform fundoscopic and gonioscopic exam with tonometry and diagnose glaucoma.

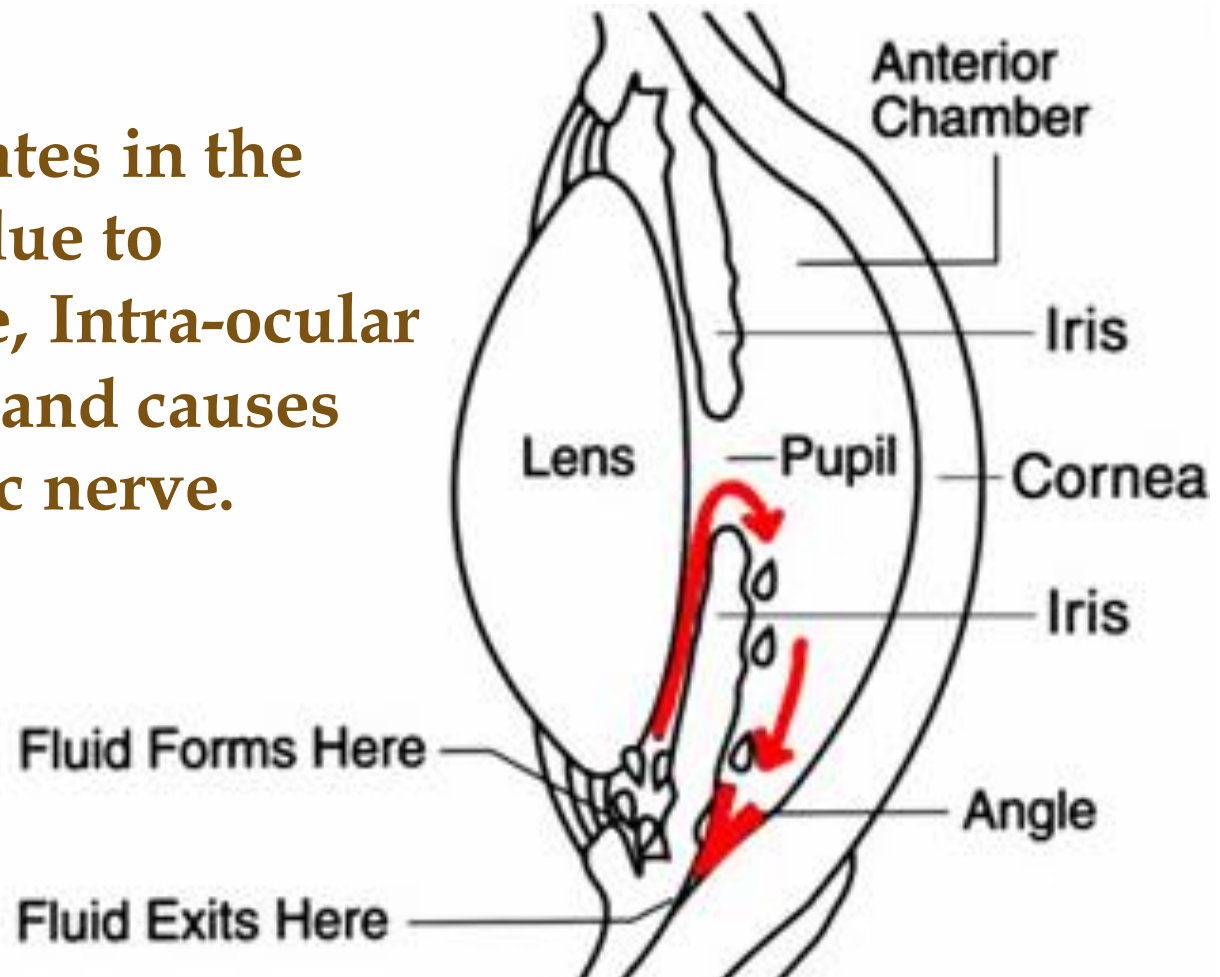
Open Angle Glaucoma



- Obstruction at the level of the trabecular meshwork
- Progressive loss of visual field over time from periphery to center
- Presence of hollowed out optic disc ('cupping') due to retinal ganglion cell death
- Open anterior chamber angle
- Majority of patients have IOP > 21 mmHg, asymptomatic

Pathogenesis

As fluids accumulates in the anterior chamber due to decreased drainage, Intra-ocular pressure increases and causes damage to the optic nerve.



Symptoms of Primary Open Angle Glaucoma

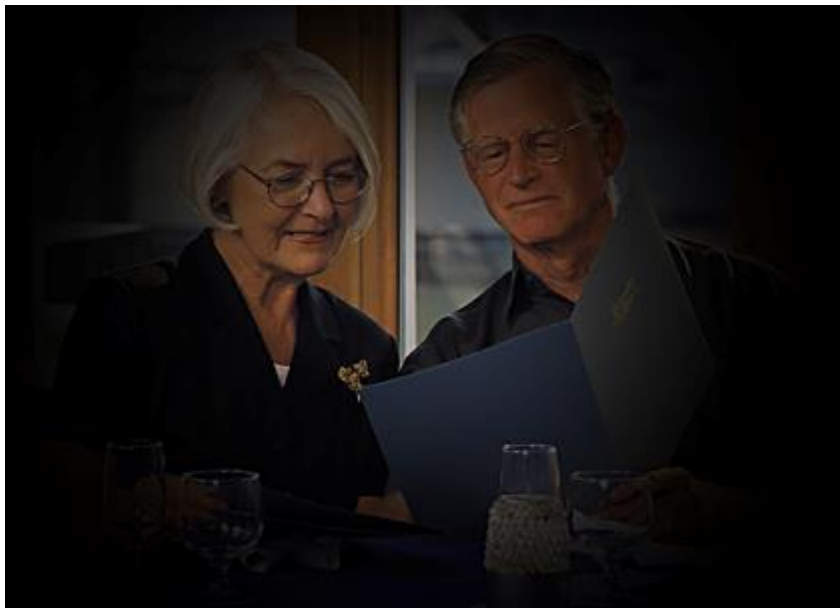
- POAG develops gradually and painlessly and has no initial symptoms
- History of mild headaches, frequent changes of near correction



*Vision is normal
in the early
stages*

Symptoms of Primary Open Angle Glaucoma

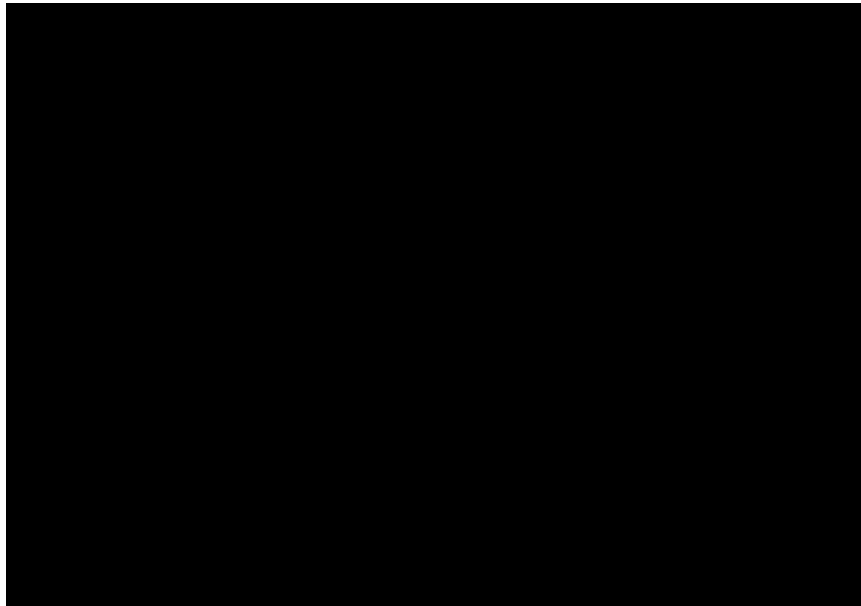
- At times asymptomatic (as moderately elevated IOP usually causes no symptoms but the IOP is still high enough to cause glaucomatous optic neuropathy)
- If untreated, peripheral or side vision is slowly lost



Tunnel vision

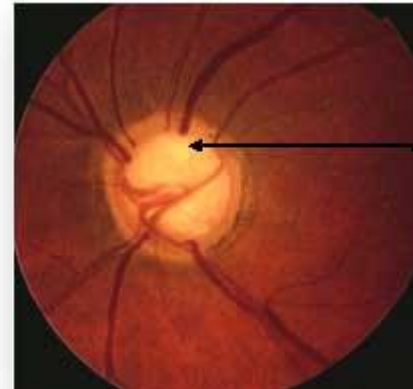
Symptoms of Primary Open Angle Glaucoma

- Eventually, all vision may be lost



Signs

- Open angle
- Elevated Intraocular Pressure (normal range 10 – 20mm of Hg +/- 2.5)
- Glaucomatous optic nerve cupping (c/d ratio of > 0.5, an asymmetry betn. the two cups of > than 0.2, narrowing, pallor or notching NRR, disc H'ages)
- May have visual field loss (glaucomatous)



Note the loss of neuro-retinal rim allowing the blood vessels to disappear

Ocular Hypertension

- Some people can have high eye pressure but the optic nerve does not get damaged.
- This condition is called ocular hypertension.
- These patients must be closely followed because of the risk of developing glaucoma.

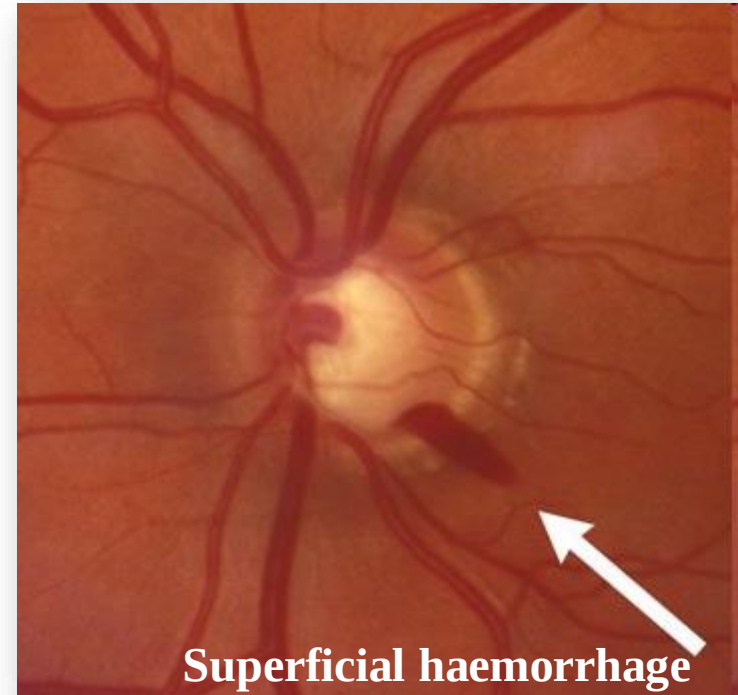
Normal Tension Glaucoma

- Normal Tension (or Low Tension) Glaucoma is not as common.
- In these cases, the eye pressure is in the normal range but the optic nerve still gets damaged.
- The exact mechanism of damage is still unknown.

Normal tension glaucoma

- **Risk factors:**
 - **Family history of glaucoma.**
 - **Cardiovascular diseases.**

- **Treatment:**
 - **Even though the IOP is normal but medication to decrease IOP as much as possible are used.**



Secondary Glaucoma

- Glaucoma can develop as a complication from other conditions including:
 - **Eye injuries**
 - **Uveitis (internal eye inflammation)**
 - **Pigment dispersion**
 - **Diabetes (Neovascular glaucoma)**
 - **Steroid use**

Provocative tests

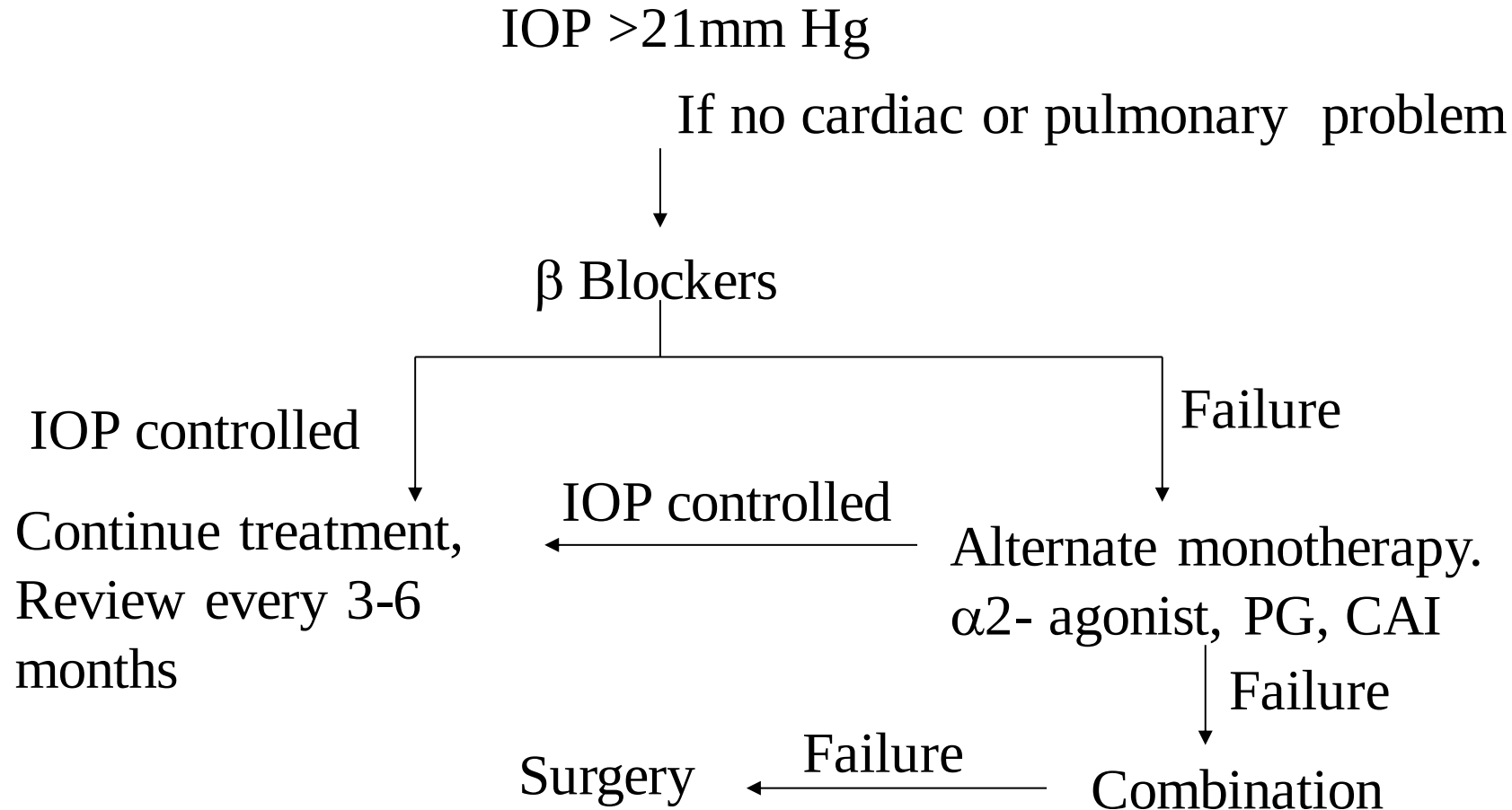
- Mydriatic Provocative test: Topical Tropicamide 1%; a rise of IOP of 8 mm of Hg or more is considered positive test.
- Dark Room Provocative test: Exposure to dark for 60 – 90 min – rise of 8 mm of Hg or more is considered positive test.
- Prone Provocative test : Prone position for 60 min, rise of 8 mm of Hg or more is considered positive test

Treatment Rationale

- The key to effective glaucoma therapy is early diagnosis and treatment
- LOWER IOP BY:
 - (1) Decreasing Production of Aqueous Humor
 - (2) Increasing Outflow of Aqueous Humor

Focus on **Pharmacologic Rx**: First-line

TREATMENT ALGORITHM for POAG



WHEN ADDING AGENTS

- Think mechanism of action
- Best chance of additivity by combining medications with different mechanisms
- PGAs lower IOP by increasing aqueous outflow (uveoscleral/trabecular)
- Complement a PGA by adding a drug that inhibits aqueous production
 - **Brimonidine (also acts on uveoscleral outflow)**
 - **CAI**
 - **Beta-blocker**

DRUGS THAT DECREASE AQUEOUS PRODUCTION

I. **Beta-Blockers** [levobunolol, timolol, carteolol, betaxolol]

- Mechanism: Act on ciliary body to ↓ production of aqueous humor
- Administration: Topical drops to avoid systemic effects
- Side Effects: Cardiovascular (bradycardia, asystole, syncope), bronchoconstriction (avoid with β_1 -selective betaxolol), depression

II. **Alpha-2 Adrenergic Agonists** [apraclonidine, brimonidine]

- Mechanism: ↓ production of aqueous humor
- Administration: Topical drops
- Side Effects: Lethargy, fatigue, dry mouth [apraclonidine is a derivative of clonidine (antihypertensive) which cannot cross BBB to cause systemic hypotension]

III. **Carbonic Anhydrase Inhibitors** [acetazolamide, dorzolamide]

- Mechanism: Blocks CAII enzyme production of bicarbonate ions (transported to posterior chamber, carrying osmotic water flow), thus ↓ production of aqueous humor
- Administration: Oral, topical
- Side Effects: malaise, kidney stones, possible (rare) aplastic anemia

DRUGS THAT INCREASE AQUEOUS OUTFLOW

I. Nonspecific Adrenergic Agonists [epinephrine, dipivefrin]

- Mechanism: ↑ uveoscleral outflow of aqueous humor
- Administration: Topical drops
- Side Effects: Can precipitate acute attack in patients with narrow iris-corneal angle, headaches, cardiovascular arrhythmia, tachycardia

II. Parasympathomimetics [pilocarpine, carbachol, echothiophate]

- Mechanism: ↑ contractile force of ciliary body muscle, ↑ outflow via TM
- Administration: Topical drops or gel, (slow-release plastic insert)
- Side Effects: Headache, induced myopia. Few systemic SE for direct-acting agonists vs. AchE inhibitors (diarrhea, cramps, prolonged paralysis in setting of succinylcholine).

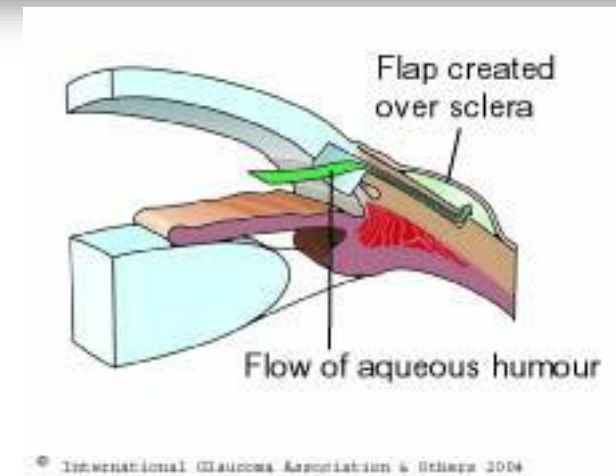
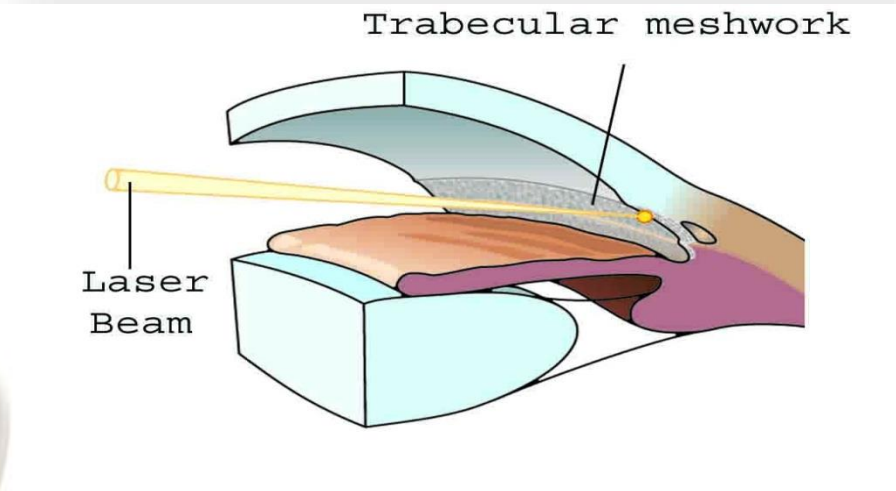
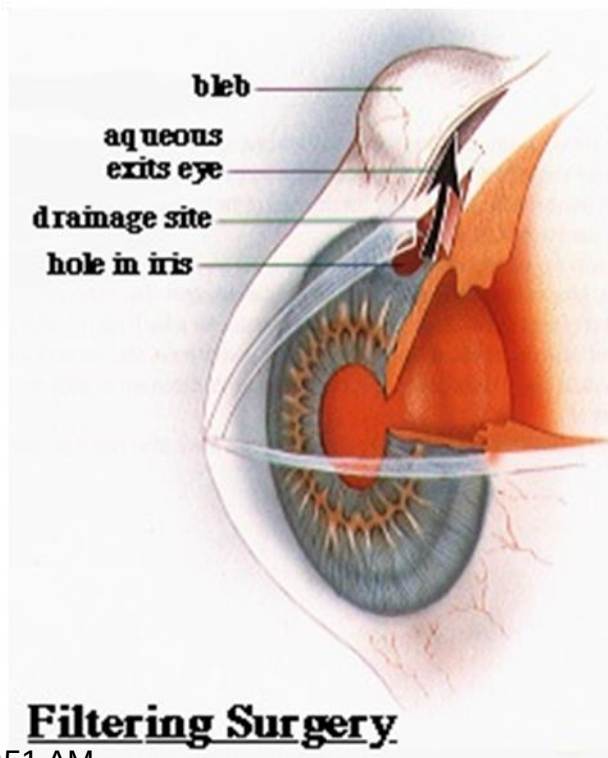
III. Prostaglandins [latanoprost]

- Mechanism: May ↑ uveoscleral outflow by relaxing ciliary body muscle
- Administration: Topical drops
- Side Effects: Iris color change

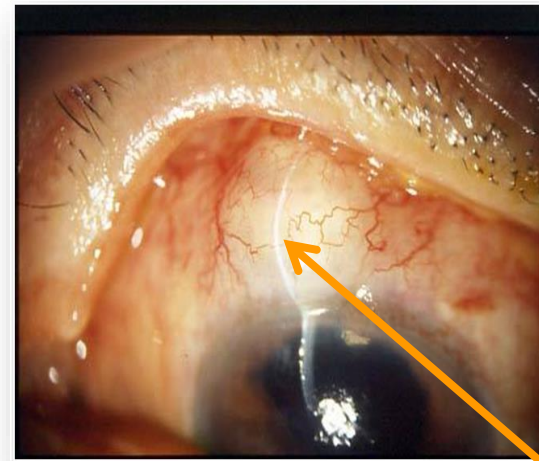
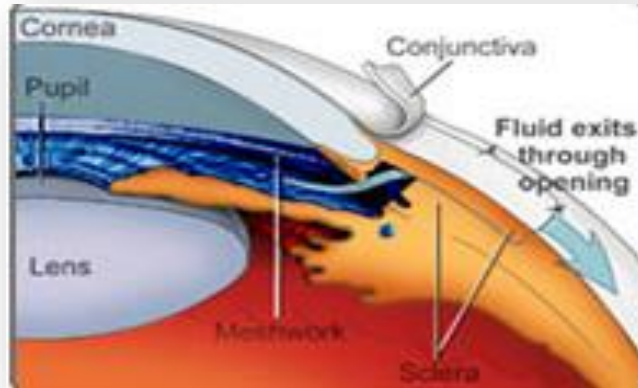
Rx GLAUCOMA: ADDITIONAL CONSIDERATIONS

1. No single medication can be used in all patients
2. Compliance
 - Critical: Rx often requires several agents, multiple times a day, everyday
 - Role of slow-release drug delivery devices (Langer)
3. Non-pharmacologic ways to lower IOP:
 - Laser (argon laser trabeculoplasty)
 - ↑ aqueous outflow, loses effectiveness over time
 - Surgical (trabeculectomy)
 - Creates alternative path for aqueous outflow
 - Only definitive therapy for closed angle
4. Effectiveness of Rx measured by ability to lower IOP, but other factors may be (more) important:
 - Neuroprotection/increased blood flow to optic nerve

Laser and Surgical Treatment of POAG

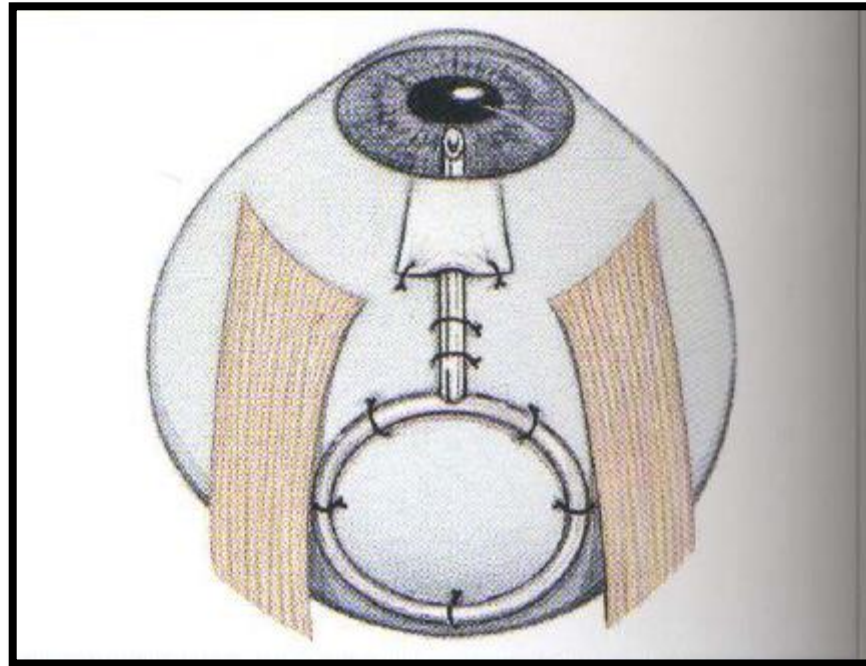


Surgical Treatment of POAG



Filtering Bleb

Drainage devices



Molteno implant

GLAUCOMA: Key Points

- Glaucoma: -Visual loss from optic neuropathy
 - Open angle chronic, Closed angle acute
 - Final common pathway: $\uparrow$ IOP (usually)
- Drug Rx: -All directed towards $\downarrow$ IOP either via:
 - $\downarrow$ aqueous production: Beta blockers
Alpha-2 agonists
Carbonic anhydrase inhibitors
 - $\uparrow$ aqueous outflow: (Adrenergic agonists,
nonspecific)
Parasympathomimetics
Prostaglandins
- Treatment slows progression

Early Detection & Treatment

Regular eye health examinations are important to detect glaucoma early so that treatment can be started and vision loss can be prevented.

