

Medical management of glaucoma

What happens prior to the OR?



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February 2, 2024

Overview

1. What is glaucoma?
2. Relevant anatomy
3. Classification of glaucoma
4. Clinical workup
5. Medical management



What is glaucoma?

- Epidemiology
 - worldwide prevalence ~ 3.5% in those > 40 yrs old
- What is it?
 - group of disorders: **progressive** injury to optic nerve (optic neuropathy): resulting in particular patterns of vision loss



<https://www.aao.org/education/images/elevated-iop-in-pediatric-patient>

Intraocular Pressure

- What is IOP?
 - describes amount of aqueous humor (production vs outflow)
 - produced 2-3 μ L/min via ciliary processes $\rightarrow$ leaves via trabecular meshwork
- What is normal IOP?
 - range ~ 10-21
 - fluctuates: diurnal fluctuation 2-6 mmHg
 - glaucomatous eyes >10 mmHg variation
 - differences in IOP are usually painless (unless significantly elevated)
- IOP: target of intervention via medical or surgical intervention
 - Goal: maintain/ slow progression, primarily via visual field



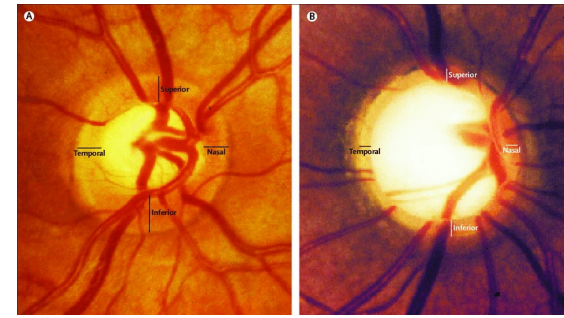
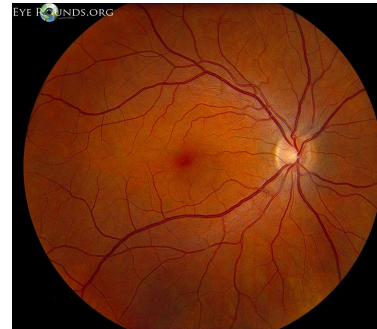
Chandler and Grant's Glaucoma, edited by Mark Krieger, and Joel Schuman, SLACK Incorporated, 2012.
ProQuest Ebook Central, <http://ebookcentral.proquest.com/lib/nyu/ehome/detailaction?docID=3560776> Created from nyu library systems on 2018-02-02 17:38:17. Figure 6-1 and 6-4.

Clinical Workup

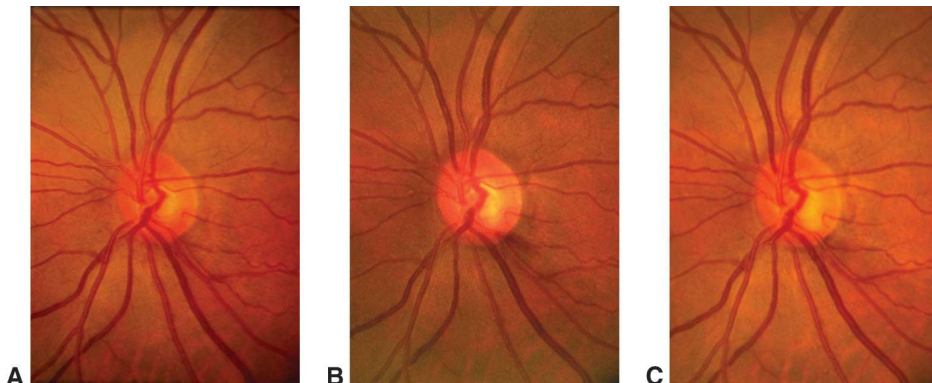
- Clinical exam: tonometry, gonioscopy/ anterior segment exam & fundusoscopic exam
- Corneal studies e.g. pachymetry
- Imaging
 - OCT: retinal nerve fiber layer (RNFL) & macula, angiography
 - anterior segment: OCT, UBM
- Visual fields

Optic Nerve

- Optic nerve: 1.2-1.5 million axons

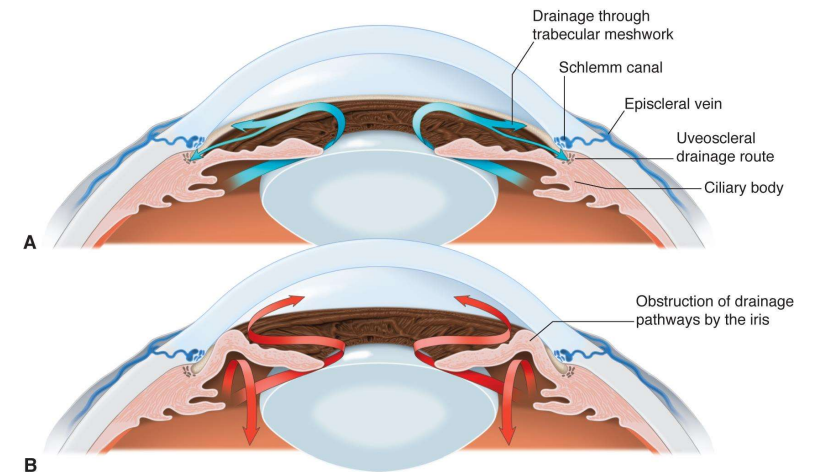


Jonas, José & Aung, Tin & Brisse, Rupert & Bion, Alain & Ritch, Robert & Paulus-Jonas, Sangeetha. (2017). Glaucoma. The Lancet. 390, 10.1016/S0140-6736(17)31499-1. Figure 1



Courtesy of Angelo P. Tanna, MD. <https://www.aao.org/education/image/localized-loss-of-acar-retinal-dm>

Normal Angle Anatomy



<https://www.aao.org/education/image/aqueous-drainage-flow>

Fig. 18.20 Retinal nerve fibre layer defects. (a) Superotemporal wedge-shaped defect associated with a disc margin haemorrhage; (b) red-free photograph of the same eye.

(Courtesy of P. Gull)

Figure 1: Comparison of RNFL thickness measurements.

The figure displays a comparison of RNFL thickness measurements between a normal eye (left) and a glaucomatous eye (right). The central table summarizes key metrics for both eyes.

	OD	OS
Average RNFL Thickness	121 μm	123 μm
RNFL Symmetry	97%	97%
Rim Area	1.52 mm^2	1.54 mm^2
Disc Area	2.00 mm^2	1.88 mm^2
Average C/D Ratio	0.45	0.42
Vertical C/D Ratio	0.44	0.51
Cup Volume	0.077 mm^3	0.081 mm^3

Left Column (Normal Eye):

- RNFL Thickness Map:** Color-coded map showing normal RNFL thickness distribution.
- RNFL Deviation Map:** Map showing normal RNFL thickness deviation.
- Topographic Map:** Map showing normal topographic features.
- Disc Center:** 0.21 $\pm$ 0.12 mm.
- Extraction Results:** Horizontal and vertical tomograms show normal RNFL thickness profiles.
- RNFL Circular Tomogram:** Circular map showing normal RNFL thickness distribution.

Right Column (Glaucomatous Eye):

- RNFL Thickness Map:** Color-coded map showing glaucomatous RNFL thickness distribution.
- RNFL Deviation Map:** Map showing glaucomatous RNFL thickness deviation.
- Topographic Map:** Map showing glaucomatous topographic features.
- Disc Center:** -0.33 $\pm$ 0.06 mm.
- Extraction Results:** Horizontal and vertical tomograms show glaucomatous RNFL thickness profiles.
- RNFL Circular Tomogram:** Circular map showing glaucomatous RNFL thickness distribution.

Central Table:

The table compares OD and OS measurements for various parameters. The left column shows measurements for a normal eye, and the right column shows measurements for a glaucomatous eye.

Parameters:

- Average RNFL Thickness
- RNFL Symmetry
- Rim Area
- Disc Area
- Average C/D Ratio
- Vertical C/D Ratio
- Cup Volume

Legend:

- OD: Open circles
- OS: Filled circles
- Age: 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100
- Gender: M (Male), F (Female)

Bottom Section:

The bottom section displays RNFL thickness maps for various quadrants (125, 136, 85, 86, 130, 119, 164, 114, 76, 102, 122, 142, 145, 104) and a color-coded legend for age and gender.

RNFL Thickness Map

	OD	OS
Average RNFL Thickness	98 μm	92 μm
Average RNFL Symmetry	0.7%	0.2%
Rim Area	1.35 mm ²	1.24 mm ²
Disc Area	1.35 mm ²	1.42 mm ²
Average C/D Ratio	0.78	0.80
Vertical C/D Ratio	0.80	0.82
Disk Volume	305 mm ³	335 mm ³

RNFL Thickness Map

RNFL Deviation Map

Neuroretinal Rim Thickness

μm — OD *** OS

Disc Center (0.08 ~ 0.33) mm
Extracted Horizontal Tomogram

RNFL Thickness

μm — OD *** OS

Disc Center (-0.45 ~ -0.42) mm
Extracted Horizontal Tomogram

Extracted Vertical Tomogram

Extracted Vertical Tomogram

RNFL Circular Tomogram

RNFL Clock-Hours

Figure 1: RNFL thickness maps and profiles

Top Section: Average RNFL Thickness and RNFL Thickness Profiles

- Top Left:** Four heatmaps showing Average RNFL Thickness at Baseline 1, Baseline 2, and two follow-up visits. A color scale on the left ranges from 0 to 200 μm .
- Top Middle:** Five circular maps showing the progression of RNFL thickness over time, with red and yellow areas indicating thinning.
- Top Right:** Line graph of RNFL Thickness Profiles (μm) vs. Temporal Position (TSAP). Profiles are shown for Baseline 1 (B_1), Baseline 2 (B_2), and a follow-up visit (C). The profiles show characteristic peaks at the superior, nasal, and inferior positions.
- Bottom Left:** Scatter plot of Average RNFL Thickness (μm) vs. Age (Years). Data points are shown for Baseline 1, Baseline 2, and follow-up visits. A regression line shows a slight decrease in thickness with age. The overall thickness rate of change is $-4.4 \pm 2.0 \mu\text{m}/\text{Year}$ (Statistically significant $P < 0.01$).
- Bottom Middle:** Scatter plot of Superior Thickness (μm) vs. Age (Years). Data points are shown for Baseline 1, Baseline 2, and follow-up visits. A regression line shows a slight decrease in thickness with age.
- Bottom Right:** Scatter plot of Inferior Thickness (μm) vs. Age (Years). Data points are shown for Baseline 1, Baseline 2, and follow-up visits. A regression line shows a slight decrease in thickness with age. The rate of change is $-15.6 \pm 6.6 \mu\text{m}/\text{Year}$ (Statistically significant $P < 0.01$).

Bottom Section: RNFL Summary OD

- Legend:**
 - ☒ RNFL Thickness Map Progression
 - ☒ RNFL Thickness Profiles Progression
 - ☒ Average RNFL Thickness Progression
- Progression Status:**
 - Possible loss:** Indicated by a blue square icon.
 - Little or no loss:** Indicated by a yellow square icon.
 - For stable disease:** Indicated by a red square icon.

Chandler and Grant's Glaucoma, edited by Mufik Kalkook, and Joel Schuman, SLACK Incorporated, 2012, ProQuest Ebook Central <http://ebookcentral.proquest.com/libtry-silibrary/ebooks/view.action?docID=3401779>. Created from nyulibrary-ebooks on 2018-02-05 17:39:47, figure 11-11.

Classification of Glaucoma

- Primary open angle
- Low tension glaucoma
 - JOAG- juvenile open angle glaucoma
- Secondary open angle glaucoma e.g.:
- Pigmentary glaucoma
 - Pseudoexfoliation
 - Pigment dispersion
 - Elevated episcleral venous pressure
 - Steroid induced
- Primary angle closure
- Acute angle closure
 - Chronic angle closure
- Secondary angle closure
- e.g. uveitic glaucoma (PAS)

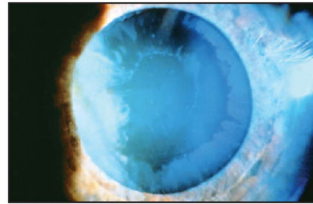


Figure 5-10. Marked exfoliation on anterior lens surface. Exfoliation is often subtle and easily overlooked, especially if the patient is not re-examined at the slit-lamp after dilation.

Primary Open Angle Glaucoma

- Prevalence: 1.86% (95% CI 1.75- 1.96%) US population > 40 = 2.2 million
- Risk factors
 - age
 - family history
 - high myopia (~ defined as > -6D): delayed diagnosis
 - ethnicity: AA
 - thin corneas (CCT, pachymetry): falsely low, +/- structural differences in lamina cribrosa
 - sex (?)

Medical Management

	gtt dosing	mechanism	side effects	top color
Prostaglandin analogues latanoprost, bimatoprost, travoprost, tafluprost, latanoprostene budnod	qHS	increase uveoscleral outflow	- hyperemia - loss of peri orbital fat - darkening of iris/ skin - eyelash growth - considerations for inflammatory states	teal
Beta blockers timolol, betaxolol, cartelol	qAM or BID	decrease production of aqueous humor	- bradycardia/hypotension - CNS depression/fatigue - masking of hypoglycemia - bronchospasm	yellow
Carbonic anhydrase inhibitors dorzolamide, brinzolamide oral: acetazolamide, methazolamide	BID-TID	decrease production of aqueous humor	- renal dysfunction, metabolic acidosis, hypokalemia - GI discomfort, sickle cell crises - sulfa allergy - oral: large fluid shifts	orange



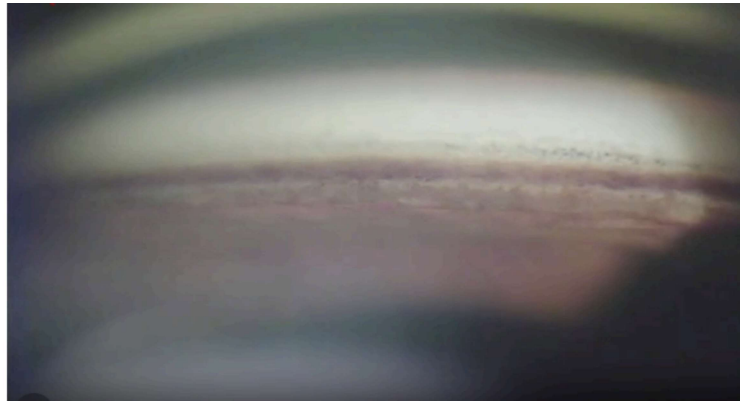
Considerations:

- cost
- side effects: systemic and local toxicity
- adherence

Medical Management

	gtt dosing	mechanism	side effects	top color
Alpha adrenergic agonists brimonidine, apraclonidine	BID-TID	decrease production of aqueous humor, Incr. uveoscleral outflow	- local allergy: follicular conjunctivitis - vasoconstriction (desirable- Lumify) - NOT to be used in young children (risk central apnea) - dry mouth	purple
Rho Kinase inhibitors rhopressa	qHS	improve uveoscleral outflow	injection	white
Miotics pilocarpine, echothiophate	BID-QID	increases outflow via TM	myopia (desirable- Vuity)	green
Hyperosmotics mannitol, oral glycerol			large fluid shifts, risk of CHF, careful in diabetics	

Laser Trabeculoplasty



<http://gonioscopy.org/cases/normal-angle/normal-pigmented-angle.htm>

Primary Angle Closure

- risk factors for angle closure:
 - age
 - sex: f
 - hyperopes
 - Inuit/ Asian descent
- narrow angles → primary angle closure (acute angle closure attack) → primary angle closure glaucoma

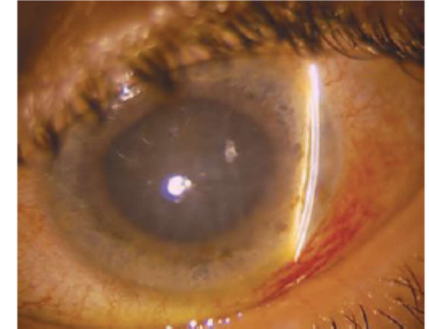
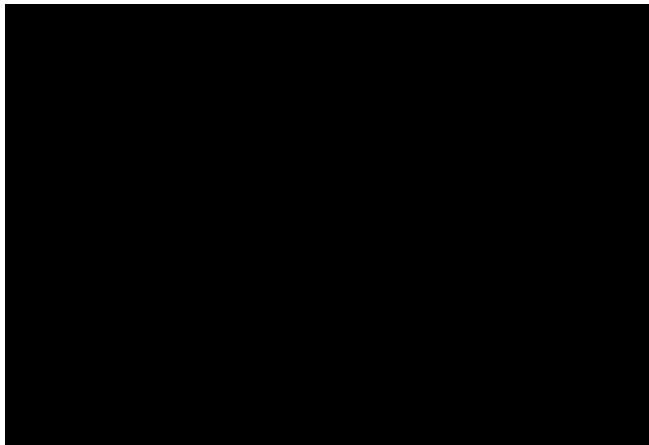


FIGURE 9.4.1. Acute angle-closure glaucoma with mid-dilated pupil and shallow anterior chamber.

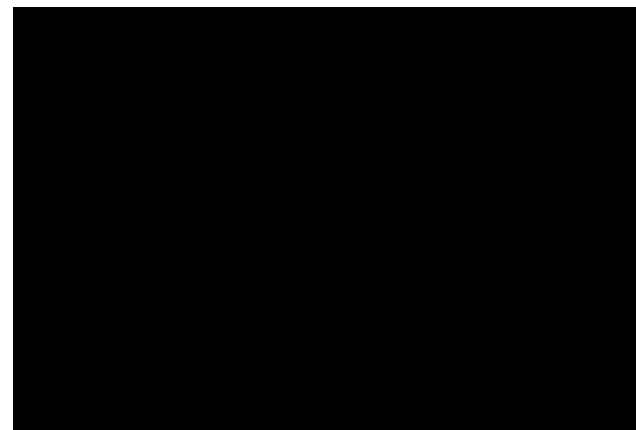
Gertsenoff, Adam T., Rabenstein, Michael R. May 27, 2012. Wills Eye Manual : Office and Emergency Room Diagnosis and Treatment of Eye Disease, Wolters Kluwer Health | Philadelphia, ISBN: 9781451186024, Figure 9.4.1, Figure 9.4.1

Slit lamp view: narrow angle



<http://gonioscopy.org/cases/pupillary-block/narrow-angle-slit-lamp-only.htm>

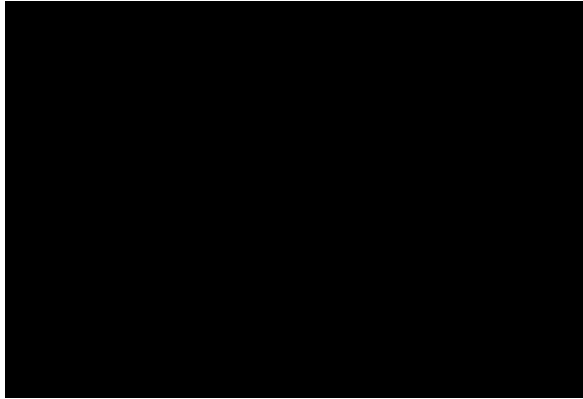
Gonioscopic view: narrow angle



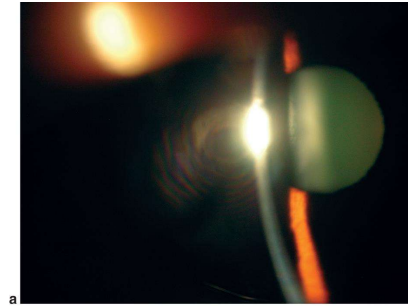
<http://gonioscopy.org/cases/pupillary-block/narrow-angle-pupillary-block.htm>

Acute Angle Closure

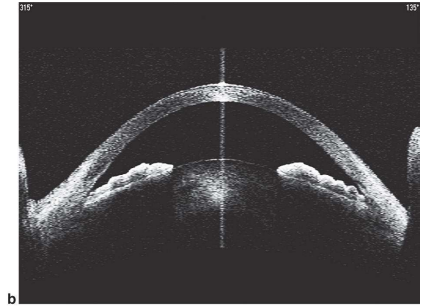
- Angle closure symptoms: photophobia, pain, nausea, decreased vision
 - signs: mid dilated pupil, injection , K edema , shallow AC, iris bombe
- RX: topical gtts, oral/ IV agents, LPI if able, trabeculoplasty, early cataract extraction



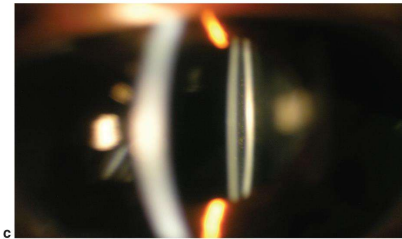
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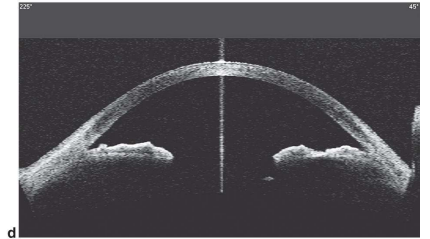
a



b



c



d

<https://www.aao.org/education/image/before-and-after-lens-extraction>

Thank you