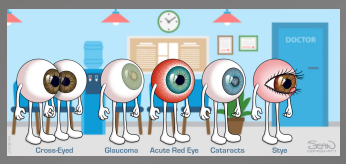
Glaucoma



Nathan Law, MD
Ophthalmology Resident
Casey Eye Institute
Oregon Health and Science University

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Learning Objectives

- Understand how to classify different types of glaucoma.
- Understand the tools used to assess for glaucoma and progression.
- Understand some of the different treatments.

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Overview

- Demographics
- What is glaucoma?
- Types of Glaucoma
- Monitoring for progression
- Treatment

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Demographics

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How big of a problem is Glaucoma?

US Patients > 40 years old with Primary Open-Angle Glaucoma

2011: 2.71 million Patients | **2050: 7.32 million Patients**

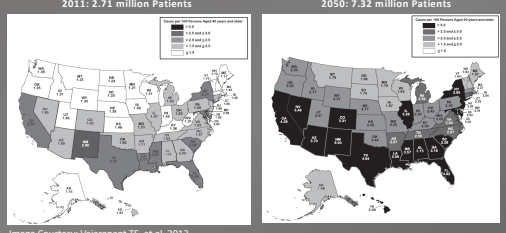

Image Courtesy: Vajaranant TS, et al. 2012.

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2nd leading cause of blindness worldwide after cataracts

Who is getting Glaucoma?

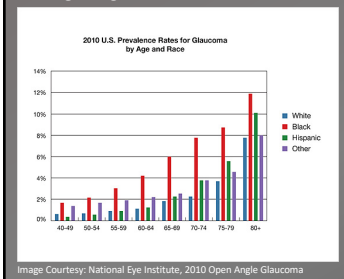

Image Courtesy: National Eye Institute, 2010 Open Angle Glaucoma Statistics

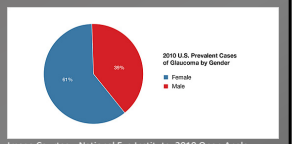

Image Courtesy: National Eye Institute, 2010 Open Angle Glaucoma Statistics

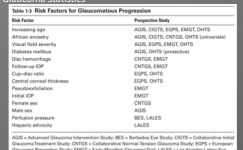

Image Courtesy: BCSC 2018-2019.

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What is Glaucoma?

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What is Glaucoma?

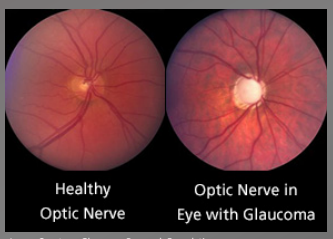

Image Courtesy: Glaucoma Research Foundation

the most common optic neuropathy worldwide ≠ high eye pressure

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Fundus Histology

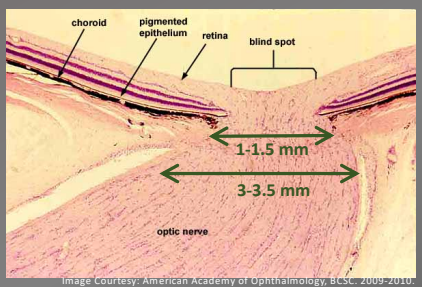

Image Courtesy: American Academy of Ophthalmology, BCSC. 2009-2010.

~1,000,000 fibers from the Retinal Nerve Fiber Layer pass through the optic disc

Glaucoma Symptoms Appear at approx. 50% nerve fiber loss

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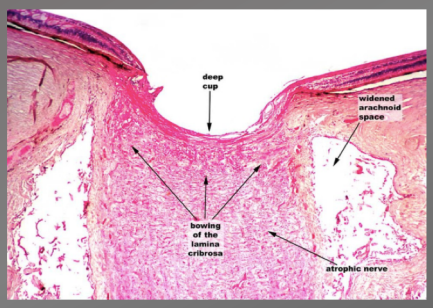

Courtesy of Weng Sehu

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What is the cup and disc?

Image Courtesy: Burgoyne, C. 2015.

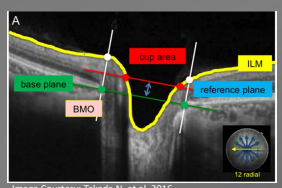

Image Courtesy: Takada N, et al. 2016.

"Normal" Cup-To-Disc Ratio:

0.1-0.4

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Types of Glaucoma

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Aqueous Humor Dynamics

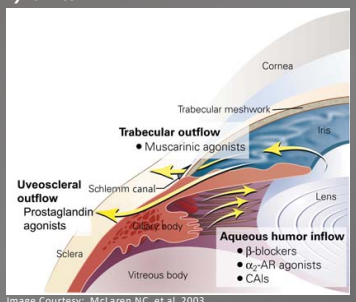

Image Courtesy: McLaren NC, et al. 2003.

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Assessing the Angle

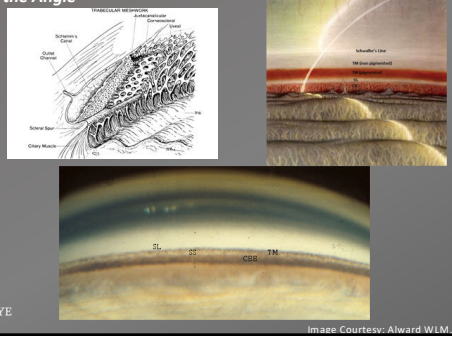

Image Courtesy: Alward WLM, Lonemuir RA. 2017

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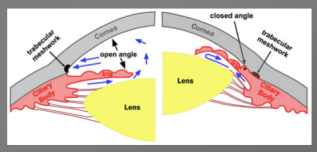
Types of Glaucoma

- Closed Angle
  - Primary Angle Closure
    - Acute
    - Chronic
  - Secondary Angle Closure
- Open Angle
  - Primary Open Angle Glaucoma
  - Normal Tension Glaucoma
  - Secondary Open Angle



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Secondary Angle Closure	Secondary Open Angle Glaucomas
• Plateau Iris Sydrome • Neovascular Glaucoma • Iridocorneal Endothelial Syndrome • Tumors • Inflammation • Malignant Glaucoma • Epithelial and Fibrous Ingrowth • Trauma • Nanophthalmos • Persistent Fetal Vasculature • Drug Induced	• Pseudoexfoliation Syndrome • Pigment Dispersion Syndrome • Lens Induced Glaucoma • Intraocular Tumors • Uveitic Glaucoma • Elevated Episcleral Venous Pressure • Trauma and Surgery • Schwartz Syndrome • Medication Induced Glaucoma

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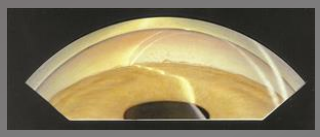
What if the angle looked like this….?



If this happened acutely 360-degrees around, the patient is likely presenting as:

Acute Angle Closure Glaucoma

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Image Courtesy: Alward WLM, Longmuir RA. 2017

Monitoring for Progression

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Monitoring for Progression

- Optic nerve exam
- Intraocular pressure
- Visual Fields
- OCT RNFL

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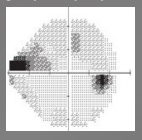
Consequences of Cupping

Inferior Nerve Damage

Loss of inferior temporal nerve fiber layer

24-2 Right Eye Humphrey Visual Field



SUPERIOR NASAL STEP VISUAL FIELD DEFECT

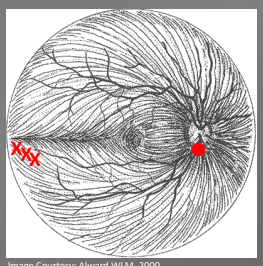


Image Courtesy: Alward WLM. 2000.

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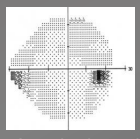
Consequences of Cupping

Superior Nerve Damage

Loss of superior temporal nerve fiber layer

24-2 Right Eye Humphrey Visual Field



INFERIOR NASAL STEP VISUAL FIELD DEFECT

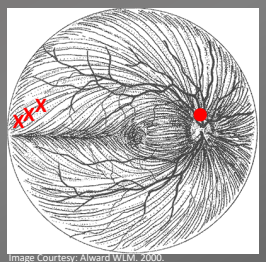


Image Courtesy: Alward WLM. 2000.

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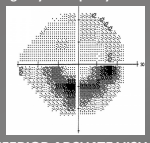
Consequences of Cupping

Arcuate Nerve Damage

Loss of Superior Arcuate nerve fiber layer

24-2 Right Eye Humphrey Visual Field



INFERIOR ARCUATE VISUAL FIELD DEFECT

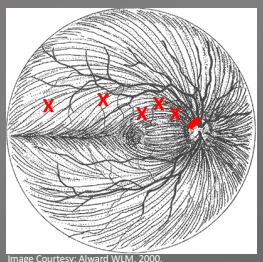


Image Courtesy: Alward WLM. 2000.

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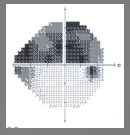
Consequences of Cupping

Hemi-Nerve Damage

Loss of Inferior Hemi-field Nerve Fiber Layer

24-2 Right Eye Humphrey Visual Field



SUPERIOR ALTITUDINAL VISUAL FIELD DEFECT

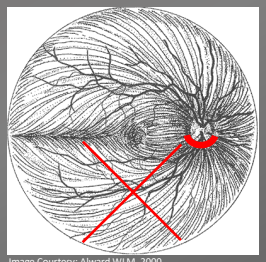


Image Courtesy: Alward WLM. 2000.

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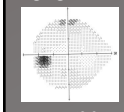
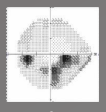
Staging Disease



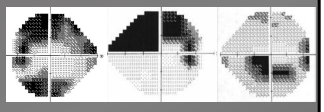
Mild

1. Glaucomatous Nerve
2. No visual field changes OR
3. Changes on SWAP or Frequency-Doubling Visual Field Only



Moderate

1. Glaucomatous Nerve
2. VF change 1 Hemi-field only
3. VF change not within 5-deg of fixation



Severe

1. Glaucomatous Nerve
2. VF change Both Hemi-fields and/or
3. VF change within 5-deg of fixation

PROGRESSION (TREATMENT REFRACTORY, MUST ESCALATE)
REFER BACK TO OPTHALMOLOGIST

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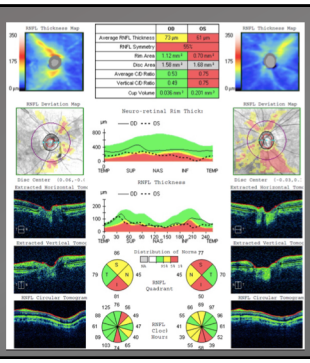
Image Courtesy: Mattox C, AAO 2014.

OCT RNFL



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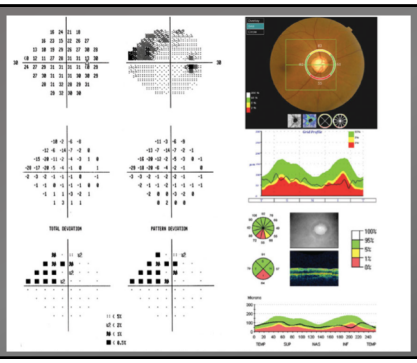

Reis et al.

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Staging Disease – What if IOP, Cup-to-disc, and VF stable, but nerve now appears:

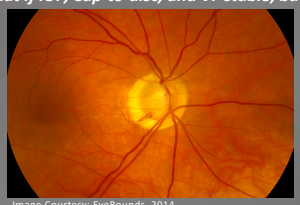

Image Courtesy: EyeRounds, 2014

DISEASE IS STILL PROGRESSING. MUST ESCALATE TREATMENT.

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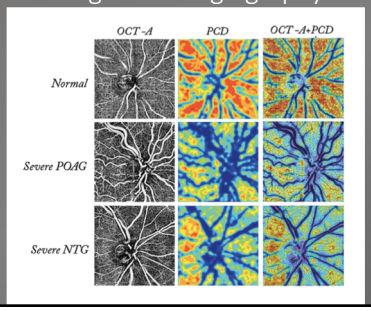
Up and Coming - OCT Angiography



Scripsema et al

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Treatment

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Treatment

- Medical
- Lasers
- Surgical

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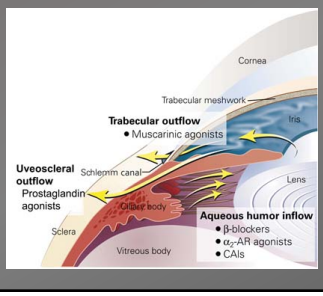
Medical Management



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Up and Coming

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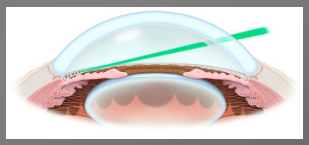
Lasers

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When to Refer for Iridotomy

Acute Angle Closure Glaucoma – If there is adequate corneal view, consider iridotomy placement

Narrow Angles/Chronic Angle Closure – Prophylactic iridotomy if:

- **Angle occludable (< 180-deg trabecular meshwork on Gonioscopy)**

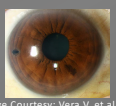

Image Courtesy: Vera V, et al. 2014.

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Surgery - When Medicine is Not Enough

Trabecular Meshwork/Schlemm's Canal Remodeling:
- **Goniotomy**
- **Trabeculotomy**
- **Laser Trabeculoplasty**
- **Canaloplasty**

Filtration Surgery
- **Trabeculectomy**

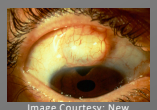

Image Courtesy: New Glaucoma Treatments, San Marino Eye, 2018.

Tube Shunt
- **Baerveldt Shunt**
- **Ahmed Valve**

Image Courtesy: New World Medical, Rancho Cucomonga, CA.

Cyclophotocoagulation

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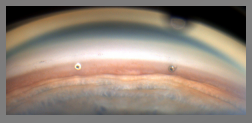
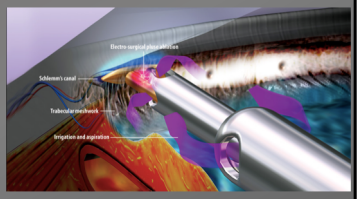
Up and Coming - MIGS

MIGS.org

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Parting Thoughts…

- Glaucoma is usually a slow, but progressive disease
- An important modifiable risk factor is IOP
- Serial exams, visual fields, and nerve fiber analysis are critical to monitoring progression
- Any progression requires medical or surgical treatment

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Overview

- Extent of Primary Open Angle Glaucoma
- Understanding Cup-to-Disc Assessment
- Types of Visual Field Defects Common to Glaucomatous Injury
- Risk Factors for Progression and Pressure Management
- Aqueous Humour and the Anterior Chamber Angle
- Angle Closure

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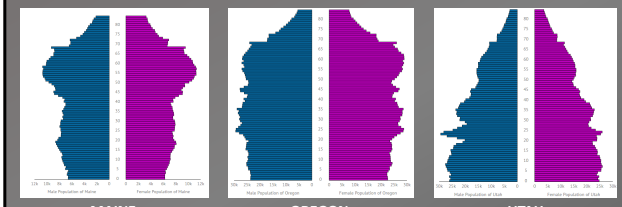
What about Oregon?



MAINE ("Oldest" State in Union)

OREGON 48% Population > 40 1,795,217 individuals

UTAH ("Youngest" State in Union)

>24,000 patients with Open Angle Glaucoma
Only 19,216 Ophthalmologists in the USA

Image Courtesy: US Census Estimates, 2015

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Normal Tension Glaucoma

Patients with:

1. Glaucomatous Appearing Nerves
2. Visual Field Defects
3. Intraocular Pressure < 21

Comparison of Glaucomatous Progression Between Untreated Patients With Normal-Tension Glaucoma and Patients With Therapeutically Reduced Intraocular Pressures

COLLABORATIVE NORMAL-TENSION GLAUCOMA STUDY GROUP*

1. IOP IS A FACTOR IN THE PATHOGENESIS OF NORMAL TENSION GLAUCOMA
2. LOWERING IOP BY 30% IS BENEFICAL
3. RATE OF PROGRESSION ACCELERATES WITH FEMALE GENDER, H/O MIGRAINES, and DISC HEMORRHAGES

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Risk Factors for Nerve Damage from Primary Open Angle Glaucoma

CLINICAL SCIENCES

The Ocular Hypertension Treatment Study

A Randomized Trial Determines That Topical Ocular Hypotensive Medication Delays or Prevents the Onset of Primary Open-Angle Glaucoma

Michael A. Kass, MD; Dale K. Heuer, MD; Eve J. Higginbotham, MD; Chris A. Johnson, PhD; John L. Keltner, MD; J. Philip Miller, AB; Richard K. Parrish II, MD; M. Roy Wilson, MD; Mae O. Gordon, PhD; for the Ocular Hypertension Treatment Study Group

- Baseline Intraocular Pressure - Modifiable
- Age
- Cup-to-disc ratio
- Central Corneal Thickness (CCT, < 555 microns)

Other Risk Factors from Other Studies

- Race
- Family History
- *Diabetes*
- *Hypertension*
- *Myopia*
- *Migraines*

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A Little More on Intraocular Pressure (IOP)

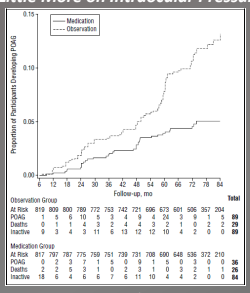

Image Courtesy: Kass MA, et al. 2002.

20% reduction in baseline IOP →

Risk of Visual Field Loss without Medication 9.5%

Risk of Visual Field Loss with Medication 4.4%

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Factors Favoring Angle Closure

Lens-Induced or Phacomorphic Glaucoma

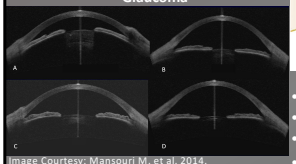

Image Courtesy: Mansouri M, et al. 2014.

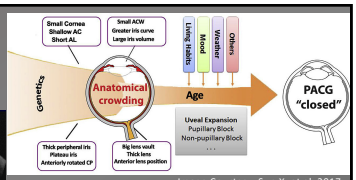

Image Courtesy: Sun X, et al. 2017.

- Narrow Angle
- Shallow Anterior Chamber Depth
- Small Corneal Diameter
- Increased Lens Thickness
- Physiologic Mydriasis (natural large pupils)
- Pharmacologic Mydriasis (medical dilation)
- Multiple Systemic Medications

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