

## Glaucoma: Making the Diagnosis

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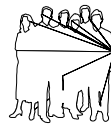
## Webster's Definition of Glaucoma

- Condition of increased pressure within the eyeball, causing gradual loss of sight

## Better way to define glaucoma

The pressure inside the eye rises to a level higher than what is healthy for the eye

## Prevalence of Glaucoma



- Ireland (1992) 1.9% ; 49% undiagnosed
- Baltimore (1990) 1.3% ; 50% undiagnosed
- Beaver Dam (1992) 2.1% ; 48% undiagnosed
- Rotterdam (1996) 1.1% ; 53% undiagnosed
- Blue Mountains (1996) 2.4% ; 51% undiagnosed
- Melbourne VIP (1997) 1.7% ; 50% undiagnosed

## IOP

- Inflow: production of aqueous by ciliary body
- Outflow: drainage of aqueous. 90% through trabecular meshwork, 10% through uveoscleral pathway

## Pathology of Glaucoma

- Increased resistance in trabecular meshwork

What's your job in diagnosing glaucoma?

- Make sure your patient does not have glaucoma at the time of visit

What's your job in diagnosing glaucoma?

- Risk assessment

What's your job in diagnosing glaucoma?

- Establish a baseline

**People at Risk**

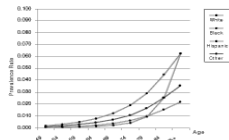
**The Easy Ones**

- People with elevated IOP
- People with increased C/D ratio
- People with pigment in trabecular meshwork and/or on corneal endothelium

**The more variable**

- Age
- Race
- Refractive error
- Systemic conditions
- Family history

## Old People



## Hispanic Population

- LALES study
- Two times greater risk for developing glaucoma than the average population

## African-American Population

- African Americans have three times higher incidence of glaucoma
- Glaucoma progresses faster
- More severe damage and loss of visual function

## Diabetes

## Hypertension

- Hypertension = elevated BP
- BP = systolic pressure/diastolic pressure

## Hypertension

- Perfusion Pressure =  
Diastolic Pressure – IOP

Normal BP = 120/80  
Normal max IOP = 20/21

## Perfusion Pressure

- Perfusion Pressure =  
Diastolic Pressure – IOP

Normal: 80 - 20 = 60

Once it gets below 40, it is a problem

## Chronic steroid use

- Eye drops
- Inhalers
- Pills
- Creams

## History of ocular/head trauma



## Myopia

|            | Cataracts | Glaucoma | Retinal Detachment | Myopic Maculopathy |
|------------|-----------|----------|--------------------|--------------------|
| -1D to -3D | 2 x       | 4 x      | 3 x                | 2 x                |
| -3D to -6D | 3 x       | 4 x      | 9 x                | 10 x               |
| > 6D       | 5 x       | 14 x     | 22 x               | 41 x               |

## Family History

- “We must be more aggressive in recommending examinations for family members of OAG patients.”
- “First-degree relatives of identified OAG patients should be evaluated with optic disc and visual field testing.”

Harry A Quigley, MD *Archives of Ophthalmology*, July 2006

## Practice Tip

- Recommend eye examinations for family members for ALL glaucoma patients

## Typical Testing

- Gonio
- IOP
- Fundus Photography
- Corneal pachymetry
- Visual Field Analysis
- Nerve Fiber Layer Analysis
- ? Tonography

## Gonioscopy: The Facts

92% of glaucomas are POAG

It is standard of care for work ups

You get paid for it!!!

## 3 most common things we see

- Potentially occludable angles (5%)
- Pigment in the trabecular meshwork (2%)
- Angle Recession (1%)

## Potentially occludable angles

- Risk factors: female, Asian descent, having hyperopia

## Potentially occludable angles

- Diagnosis:
  - Keep beam narrow as possible
  - Keep room dark as possible

## Good resource for gonioscopy

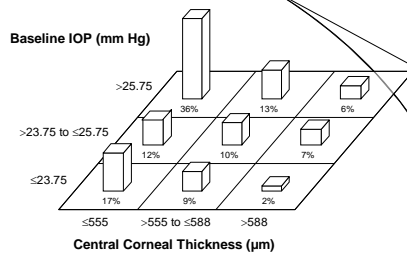
[www.gonioscopy.org](http://www.gonioscopy.org)

## Gonioscopy Billing

- CPT code: 92020
- Reimbursable once a year
- Average reimbursement: \$22

When is the cornea thin?

## Central Corneal Thickness and IOP



## Pachymetry: Billing

- CPT code: 76514
- Reimbursable once in patient's lifetime
- Average reimbursement: \$14

## What is Normal IOP?

- normal intraocular pressure is that pressure which does not lead to glaucomatous damage of the optic nerve head. It is the pressure at which the patient would not suffer from any optic atrophy at all over the course of time.

## What is normal IOP?

- How do you calculate what is normal IOP for any given patient
- You can't!!!!

## Normal IOP

- This is the least important of the risk factors for glaucoma because many patients with an IOP between 10 and 21 develop glaucoma
- However, a patient with an elevated IOP gives you reason to work him or her up

## Key Question:

**First time patient: How many patients with IOP of 21 or above are glaucoma suspects?**

**The following year: If IOP is still higher than 21 is the patient still a glaucoma suspect?**

What if cornea is 500 microns?  
What if cornea is 600 microns?

## What is normal IOP fluctuation?

- Anything greater than 5.0mm is a red flag

## How do we find this?

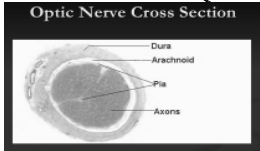
- Schedule patient appointments during different times of the day
- Serial tonometry

## Serial tonometry (CPT code: 92100)

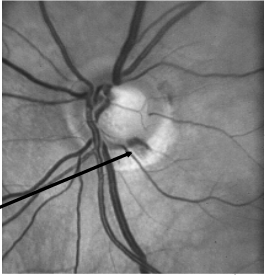
- At least 3 IOP readings during different time periods of the same day
- Can do once a year
- Average reimbursement: \$110

When is IOP the highest?

## The Optic Nerve



- 1 Observe the scleral Ring to identify the limits of the optic disc and its size
- 2 Identify the size of the Rim
- 3 Examine the Retinal nerve fiber layer
- 4 Look for Retinal and optic disc hemes



This section was developed by Robert N. Weinreb, MD, Felipe Medeiros, MD, and Remo Susanna Jr, MD.

### Optic Disc Size

Volk lens  
Measure length of slit beam

Correction factors  
Volk 60D – x 1.0  
Volk 78D – x 1.1  
Volk 90D – x 1.3

Avg vertical diameter: 1.8 mm  
Avg horizontal diameter: 1.7 mm

### Size Matters! Bigger is Better

Size discs can have small cups in glaucomatous eyes  
Large discs have large cups in healthy eyes

Small      Average      Large

Small discs: avg vertical diameter <1.5 mm  
Large discs: avg vertical diameter >2.2 mm

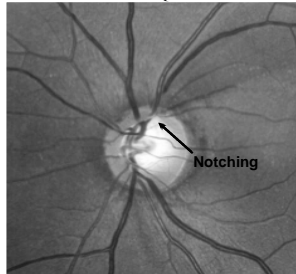
### ISNT RULE

Rim width  
Distance between border of disc and position of blood vessel bending

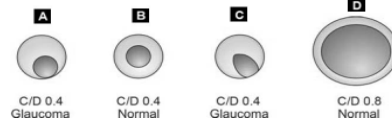
ISNT rule  
Inferior >  
Superior >  
Nasal >  
Temporal



### Localized Rim Thinning/Notching



### Notching



Where do you find these disc hemorrhages?

On your ONH photographs

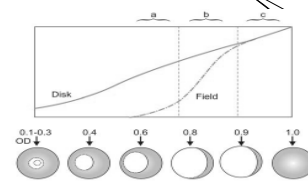
### Fundus Photos: Billing

- CPT code: 92250
- Can do once a year
- Average reimbursement: \$78

### Fundus Photos

- Establish a baseline
- Always compare to previous year's photo AND always compare to initial baseline photo

At what point do you work up?



### What is normal C/D ratio?

- .30
- 95% of the normal population falls between 0.2 to 0.4

Only 5% of the normal population has a C/D of .50 and greater

### If C/D .50 or greater

- Does this patient get a full work up?
- How often does the patient get this work up?

### What testing strategy do we use?

- Standard?
- SITA – Standard?
- SITA – Fast?

### What Stimulus Size?

- Size III is standard
- Size V used for advanced glaucoma and decreased visual acuity

### What field size do we use?

- Right field size?
  - 30-2 used to be the standard
  - 24-2 is the standard size
  - 10-2 can be used with visual field loss within the central 10° of fixation

### Reliability False Positive Rate (FP)

- Percentage of time the patient responded in the absence of a stimulus
- >25% – use caution
- >33% FP rate – unreliable
- Ideal rate is <10%

FIXATION LOSSES: 4/15  
FALSE POS ERRORS: 2 X  
FALSE NEG ERRORS: 8 X

**How do elevated FPs impact the appearance of the field**

Will cause you to miss cases of glaucoma

### Reliability False Negative Rate (FN)

- Percentage of time the patient failed to respond to a stimulus that should have been seen, based on past responses
- >25% FN rate – use caution
- >33% FN rate – unreliable

FIXATION LOSSES: 4/15  
FALSE POS ERRORS: 2 X  
FALSE NEG ERRORS: 8 X

**How does a high false negative rate impact the VF results**

Will cause you to over treat

### Reliability Fixation Losses (FL)

- Percentage of times the patient responded to a stimulus presented at the plotted blind spot
- FL increases if:
  - The patient does not maintain fixation
  - The blind spot was incorrectly located
  - The patient's head moves

FIXATION LOSSES: 4/15  
FALSE POS ERRORS: 2 X  
FALSE NEG ERRORS: 8 X

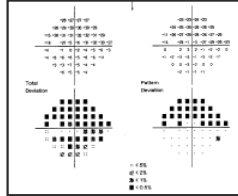
**Rule #3:  
The Probability Plots**

**Pattern Deviation & GHT**

## Review Probability Plots

### Pattern Deviation

- Most useful aspect of automated perimetry
- Comparison to normative age-matched database
- Examine depressed points
  - number of contiguous depressed points
  - location of depressed points
  - severity of depressed points



## Review Probability Plots

### Glaucoma Hemifield Test (GHT)

- Printout
  - GHT Outside Normal Limits
    - Upper and lower fields differ in <1% of normals, or differ from normal
  - GHT Borderline
    - Upper and lower fields different to extent found in <3% of normals, or both different from normal
  - Within normal limits

GHT  
OUTSIDE NORMAL LIMITS

GHT  
BORDERLINE

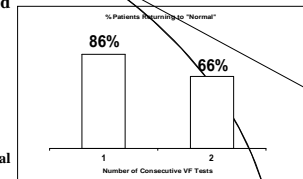
GHT  
WITHIN NORMAL LIMITS

Armen P, Heijl A. Arch Ophthalmol. 1992;110:812-819.

- Repeat test if needed
- Accuracy is more important than speed

## VF are Highly Variable

- After one abnormal visual field test:
  - 86% of patients test within normal limits on next exam
- After two consecutive abnormal test results:
  - 66% of patient test within normal limits on next exam<sup>3</sup>



Their conclusion:

You need three consecutive, reliable tests before making any decisions

## VF: Billing

- 92081: limited examination (e.g., tangent screen, or single stimulus level automated test)
- 92082: intermediate examination (e.g., at least 2 isopters on Goldmann, or automated suprathreshold)
- 92083: extended examination (e.g., automated threshold perimetry, Octopus program G-1, 32 or 42, Humphrey VF analyzer full threshold programs 30-2, 24-2, or 30/60-2).

## VF: Billing

- CPT code: 92083
- Can do once a year if stable
- Can do twice or sometimes even three times a year for progressive glaucoma
- Average reimbursement: \$59

## Scanning Laser Polarimetry

- Polarized light passing through undergoes phase shift (retardation)
- Amount of retardation is directly proportional to the thickness of the nerve fiber layer

## rNFL

- More objective than VF
- Does that mean more accurate?

## Other conditions which impact rNFL

- AION
- Optic Neuritis
- Optic Drusen

## Optic Neuritis and AION

- Differentiating feature will be optic disc pallor instead of optic nerve cupping

## Optic drusen

- Differentiating feature will be careful examination with 78 or 90 D lens
- May need Bscan, OCT, and/or CT scan

## Beware of False Positives

- 40% based on ganglion cell analysis
- 30% based on rNFL maps

Worst in eyes with long axial length and small optic disc size

## OCT and race

*"Although racial differences in disease-free populations should be considered when determining the limits of normality of the optic disc with HRT and OCT, many of these racial differences in optic disc topography may be accounted for by adjusting for disc area and reference plane height where appropriate.*

*However, race-specific normative databases may be needed to optimize the performance of devices that use RNFL or macular imaging to detect glaucoma in AD and ED groups. The role of these findings in the predilection to develop glaucoma in AD individuals warrants further investigation."*

## OCT and cataracts

## OCT and floor effect

## Normal rate of decay of rNFL

- Normal: .48 microns per year after age 40
- Glaucoma: .98 microns per year after age 40

## OCT: Billing

- CPT code: 92133
- Can do once a year on stable patients
- Can do twice a year on progressive patients
- Can't do at all on advanced glaucoma
- Average reimbursement: \$45

### Standard Glaucoma Suspect work up protocol

- Visit 1: Dilated exam, gonio, pach, photos
- Visit 2: IOP check and GDx/OCT
- Visit 3: IOP check and VF

### Truncated Glaucoma Suspect work up protocol

- Visit 1: Dilated exam, gonio, pach, photos
- Visit 2: IOP check and GDx/OCT and VF same day

### Truncated Glaucoma Suspect work up protocol

- **BENEFIT:** You save your patient one trip to your office

### Truncated Glaucoma Suspect work up protocol

- **You lose:**
  - Practice: revenue from an intermediate exam
  - Practice: 20% reimbursement for multiple procedure

### Truncated Glaucoma Suspect work up protocol

- **You lose:**
  - Clinically: another IOP measurement
  - The Intangible: The more often a patient has to come see you, it underscores the seriousness of this disease

### Average glaucoma suspect patient

- Worth over \$400 a year to your practice
- Does not count refraction, CL exam fees, eyeglasses, or contact lenses
- You can keep these patients or build someone else's practice