Ten Steps to Better Glaucoma Care

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Ten Steps to Better Glaucoma Care

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Lecture Handout

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Disclosure Statement

Nothing to disclose

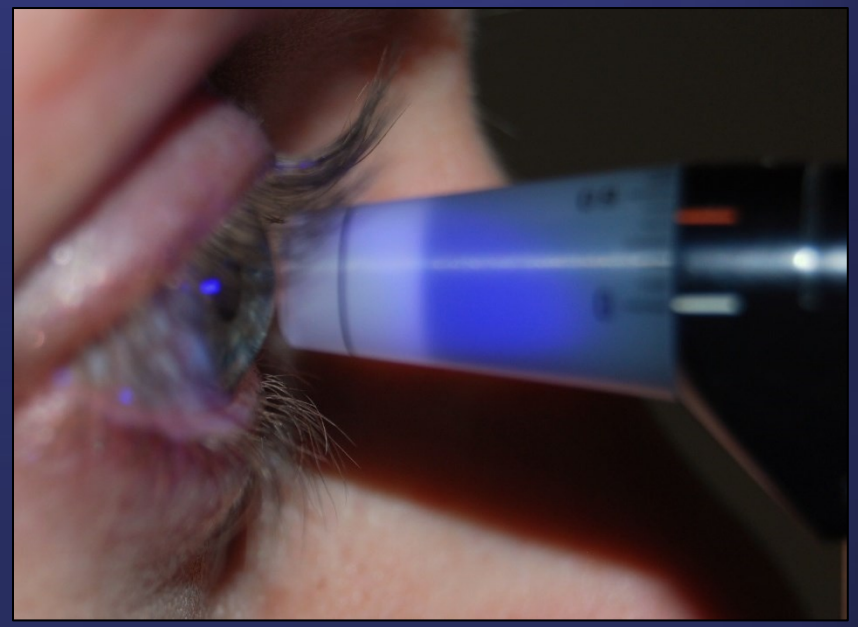
Ten Steps to Better Glaucoma Care

1. Master the Art of Tonometry

Master The Art of Tonometry

When GAT Isn't Good Enough

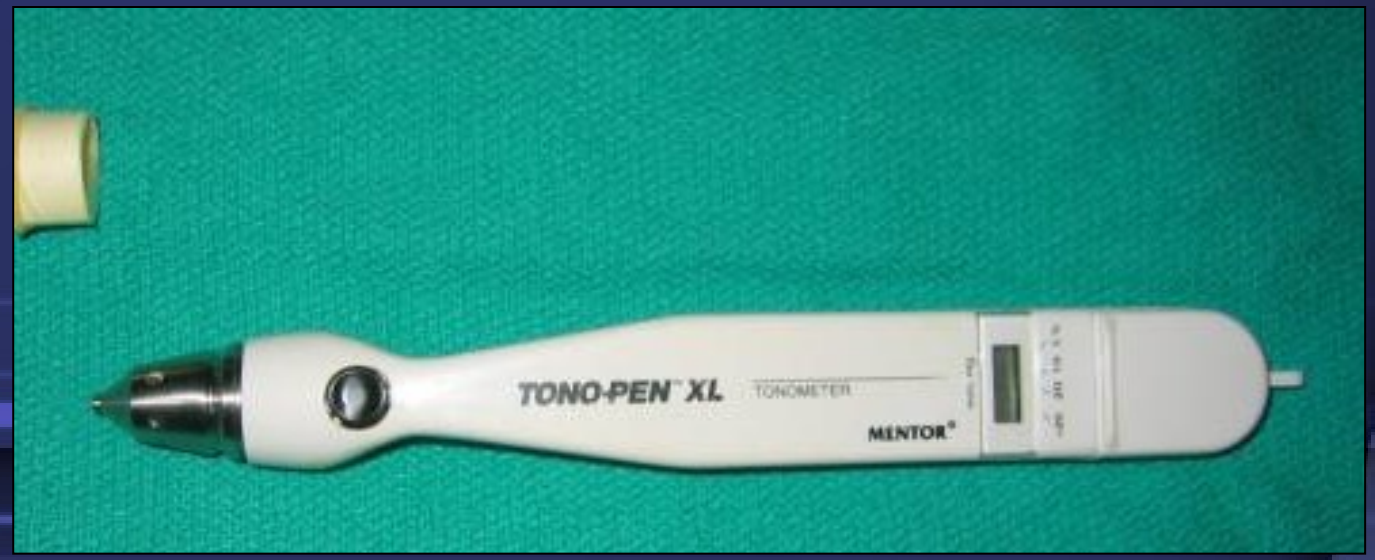
- Irregular Astigmatism
- S/P LASIK
- Blepharospasm
- Morbid Obesity
- Bedside exam
- Young children



Master The Art of Tonometry

Hand-held Tonometers

- iCare, Perkins, Tono-Pen, others
- Special populations
  - Obese, arthritic, anxious, pediatric, post-LASIK



Master The Art of Tonometry

Table 1 Mean DCT readings and mean GAT measurements according to CCT stratification

	CCT ⩽ 500 μm	501 ⩽ *CCT* ⩽ 540 μm	541 ⩽ *CCT* ⩽ 560 μm	561 ⩽ *CCT* ⩽ 600 μm	*CCT* > 600 μm
DCT (mmHg)	16.7 ± 3.5	17.5 ± 3.0	17.47 ± 3.0	18.07 ± 3.0	17.32 ± 3.0
GAT (mmHg)	11.2 ± 2.7	13.18 ± 3.2	14.10 ± 2.9	16.30 ± 3.3	19.49 ± 2.3
ΔDCT/GAT	5.47	4.30	3.37	1.77	−2.17
P	*P* < 0.001	*P* < 0.001	*P* < 0.001	*P* < 0.001	*P* < 0.001

CCT = central corneal thickness; DCT = dynamic contour tonometry; GAT = Goldmann aplanation tonometry.

THIN CORNEAS

GAT underestimates DCT by 4-5 mmHg

THICK CORNEAS

GAT within 1-2 mmHg of DCT

The problem is not that GAT reads high on patients with thick corneas but that it reads very low on patients with thin corneas

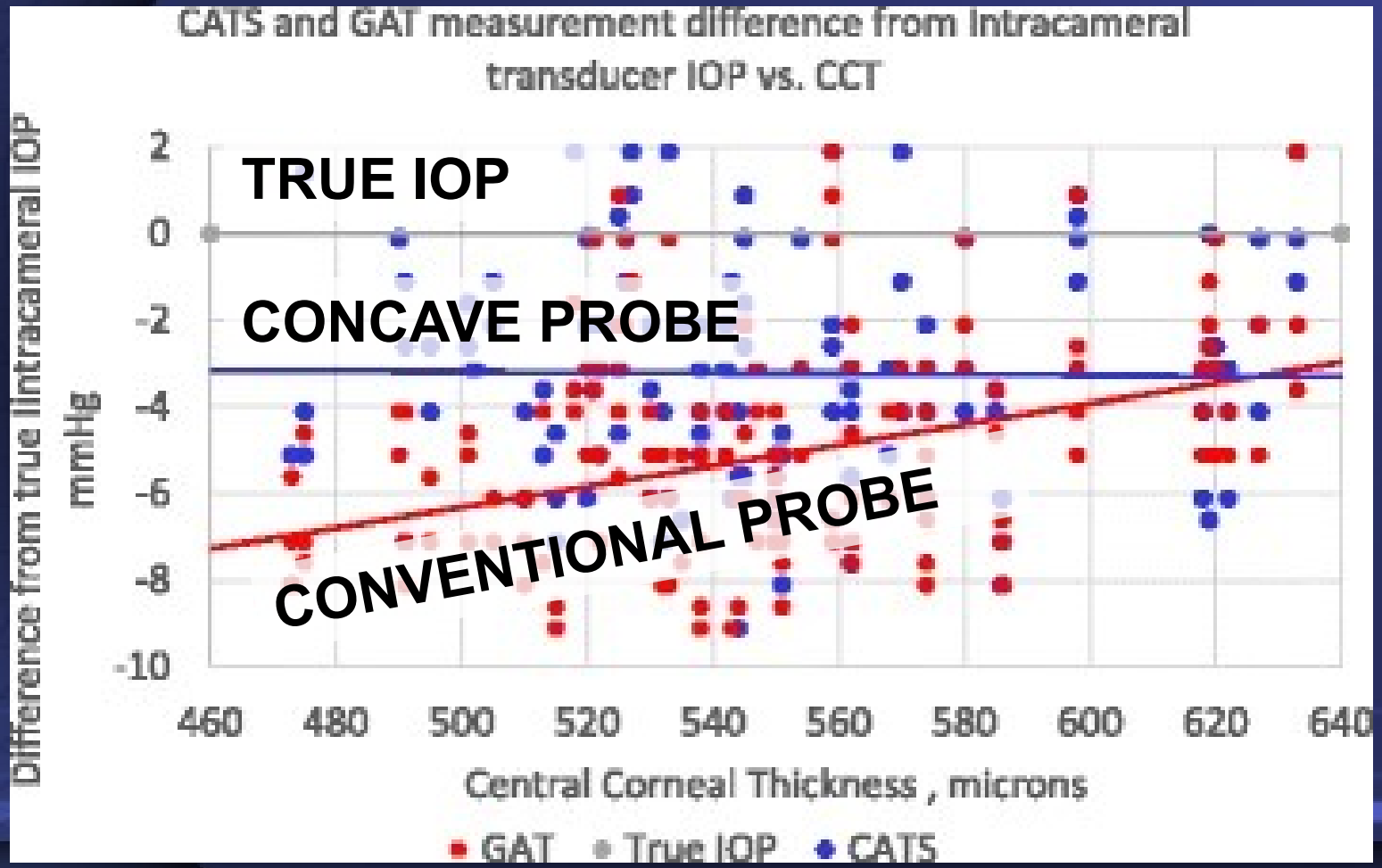
PMID: 18791544

Master The Art of Tonometry

Cornea compensated GAT probes

- Concave probe tip less influenced by cornea biomechanics
- Measurements are closer to true IOP than conventional prisms

Master The Art of Tonometry



Concave probe: underestimated true IOP by 3 mmHg at all CCT levels

Conventional probe: Underestimation was strongly influenced by CCT

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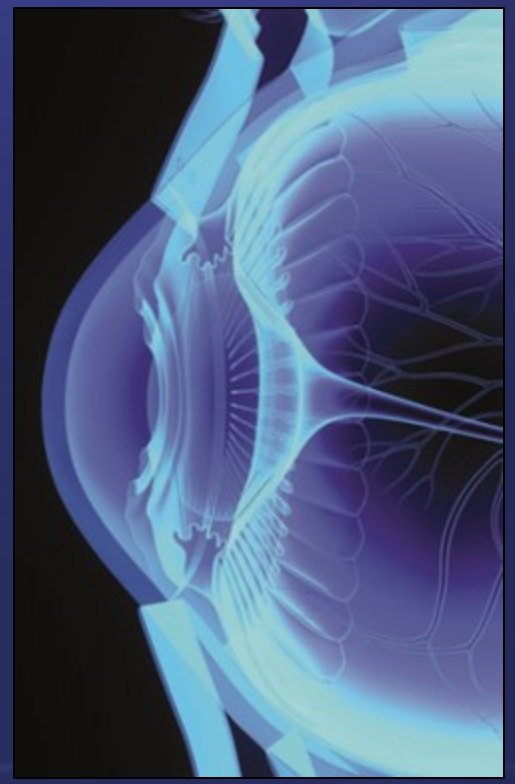
Master The Art of Tonometry

Pachymetry

- OHTS: CCT <555µm is a risk factor for POAG
- Detect depressed Goldmann readings in patients with thin corneas
- Do not attribute elevated IOP readings to thick corneas



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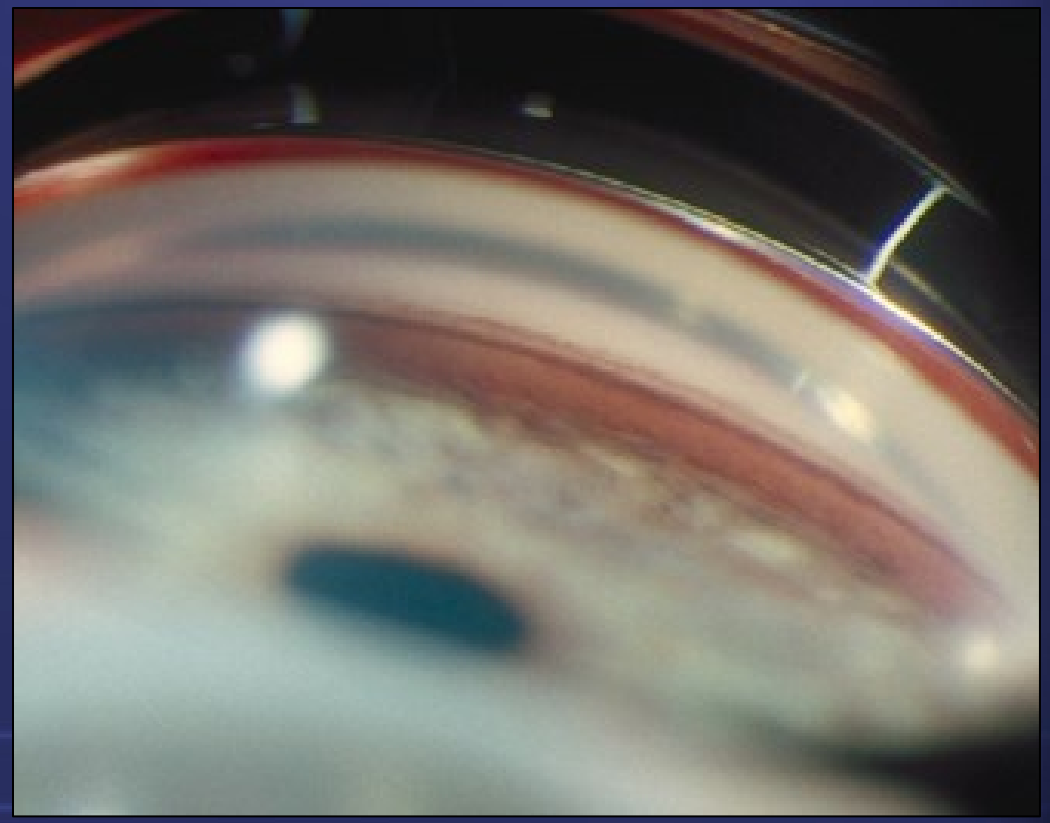
Master The Art of Tonometry

Dealing with LASIK

1. Concave probe
   - Most accurate
2. Change from baseline
   - Difference between pre-op and post-op IOP
3. Peripheral cornea
   - Tonopen or iCare tonometry outside flap

Ten Steps to Better Glaucoma Care

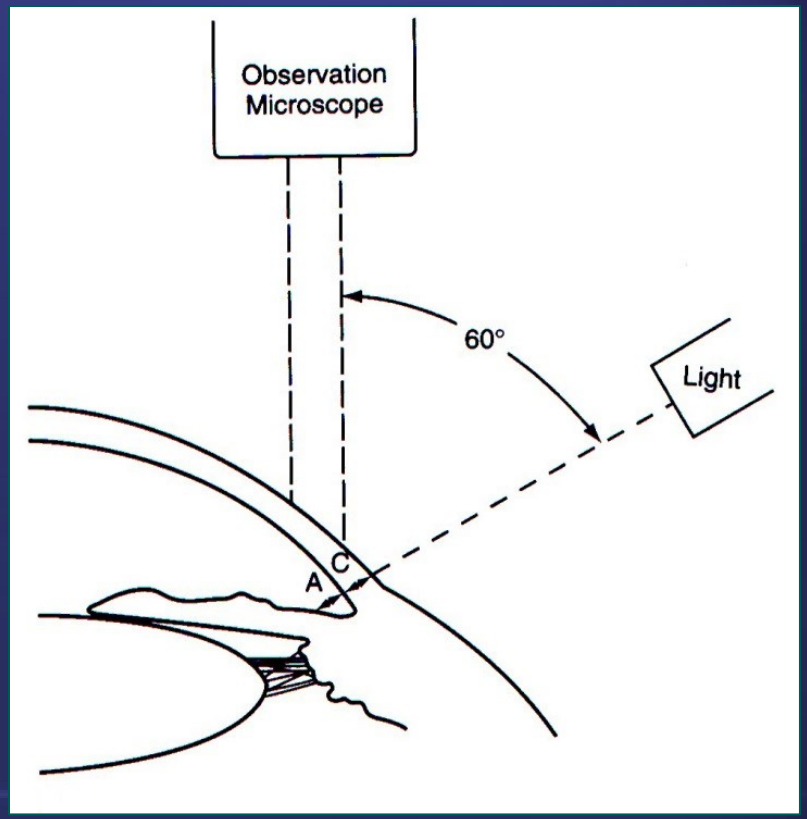
1. Master the Art of Tonometry
2. Gonioscopy is Fundamental



Gonioscopy is Fundamental

Van Herick is a mixed blessing

- GOOD NEWS
  - 99.9% of eyes that appear open are not occludable on gonio
    - Essentially no false negatives
- BAD NEWS
  - About 80% of eyes that appear occludable are not with gonioscopy (the Gold Standard)
    - Lots of false positives



Gonioscopy is Fundamental

Two Common Indications

1. Evaluate VH Grade 2 or less angles
2. Identify cause of elevated or asymmetric IOP
   - Angle closure, PAS, NVA, angle recession

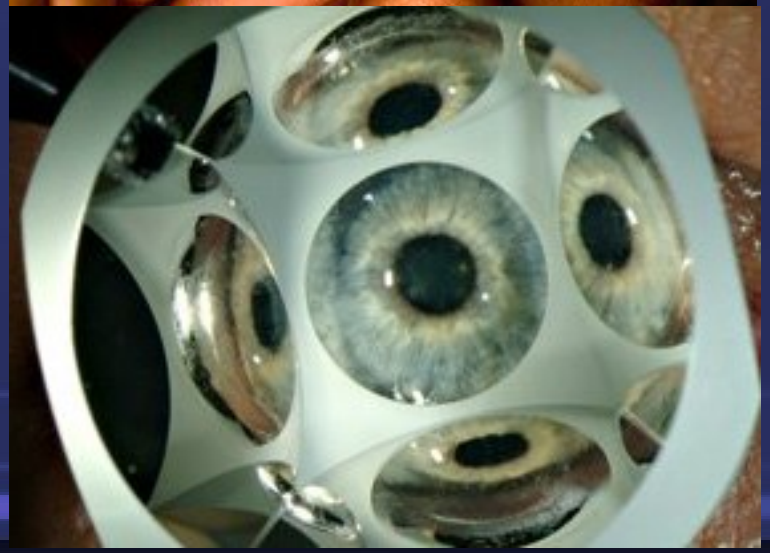
Gonioscopy is Fundamental

Goldmann 3-mirror

- – arn
- –
- – Coupling solution
- – Excellent optics

Zeiss 4-mirror

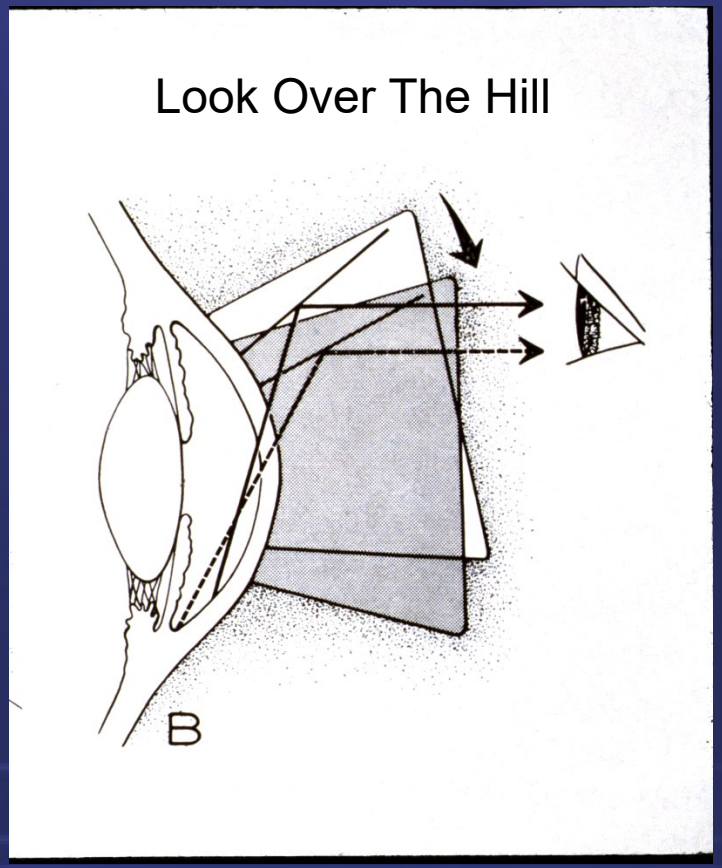
- – Relatively hard to learn
- – Unstable view
- – Indentation gonioscopy



Gonioscopy is Fundamental

Gonioscopy Tips

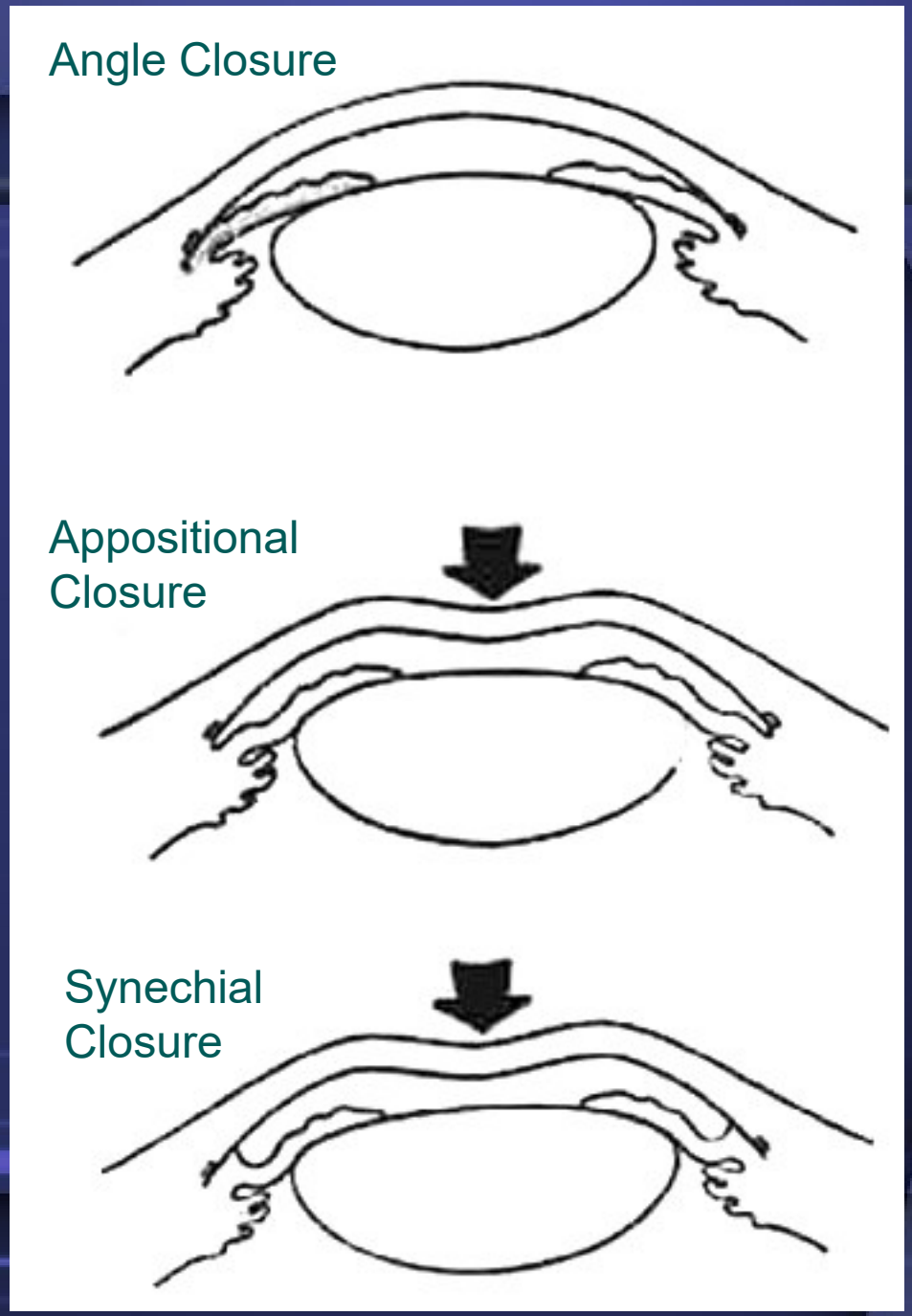
- Use an elbow rest
- Examine the inferior angle first
- Keep the light out of the pupil
- Look over the hill (Lens tilt)
- Perform indentation gonio



Gonioscopy is Fundamental

Indentation Gonioscopy

- Synechial vs appositional closure
- Pupil block vs plateau iris vs phacomorphic



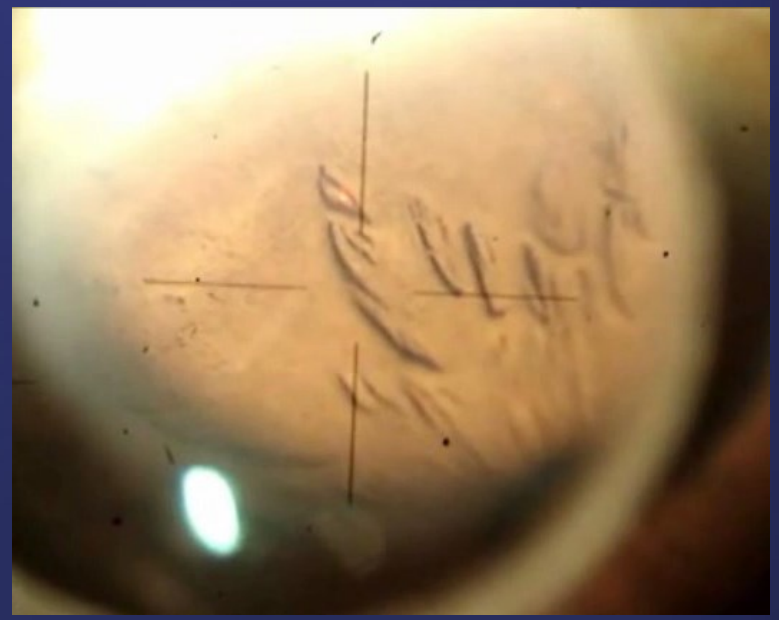
Indentation Gonioscopy

gonioscopy.org

Gonioscopy is Fundamental

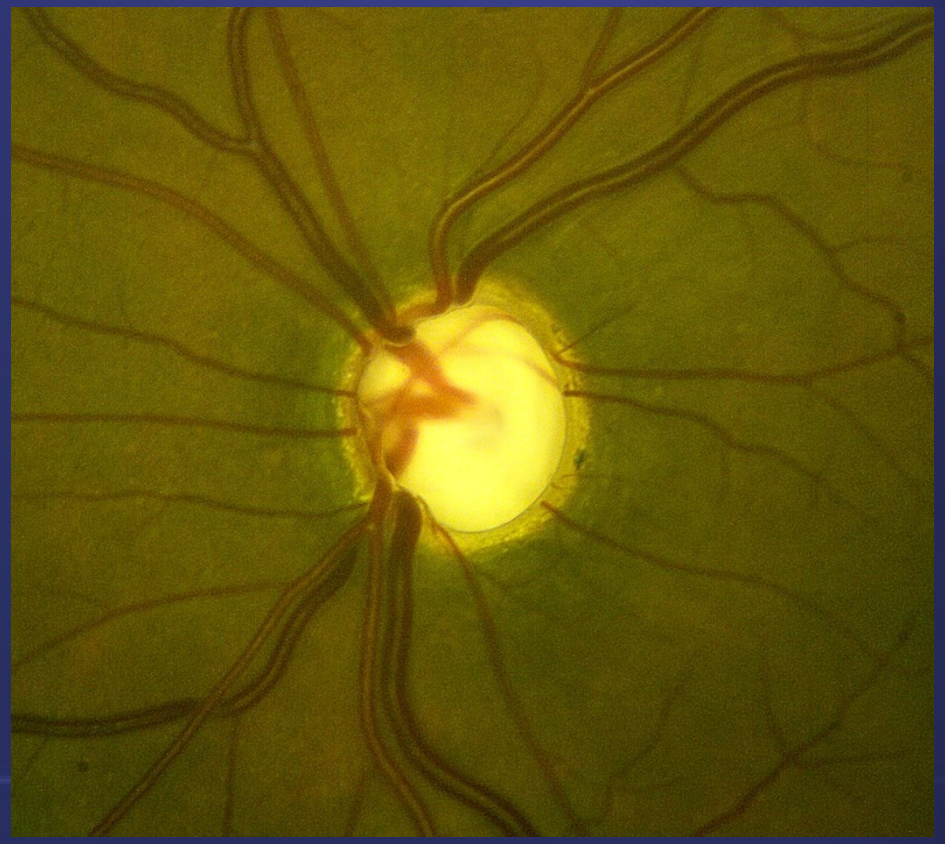
Does this patient need an iridotomy?

- Judging angle closure risk
  - No “gold standard” criteria
  - Grade 2 or less in ≥2 quads
- Corroborating evidence
  - Suggestive symptoms
  - PAS
  - VF and ONH damage
  - Elevated IOP



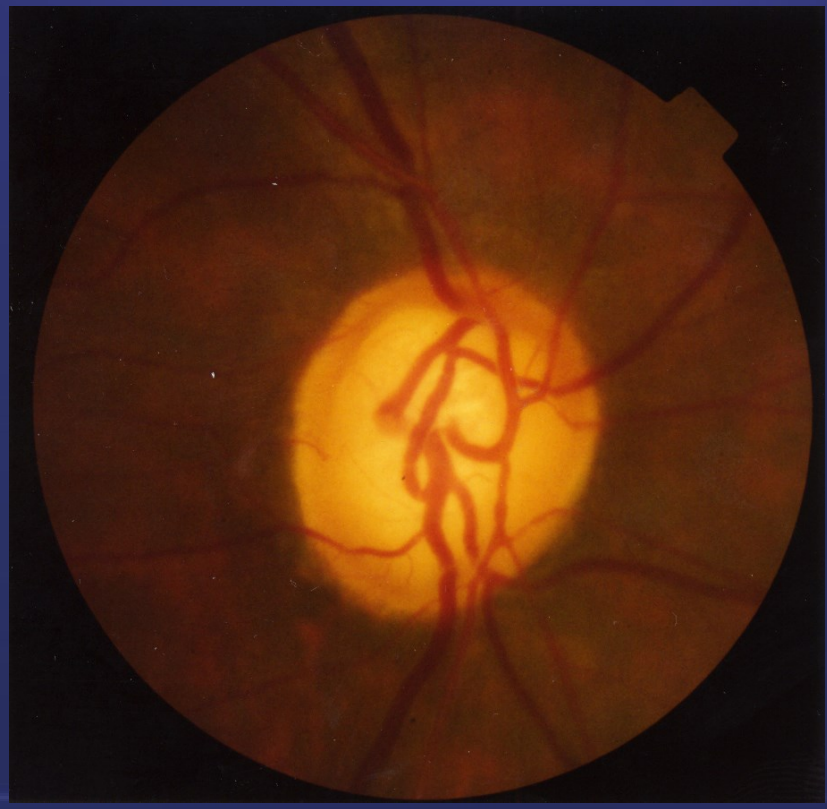
Ten Steps to Better Glaucoma Care

1. Master the Art of Tonometry
2. Gonioscopy is Fundamental
3. Examine the Rim, Not the Cup



Examine the rim, not the cup

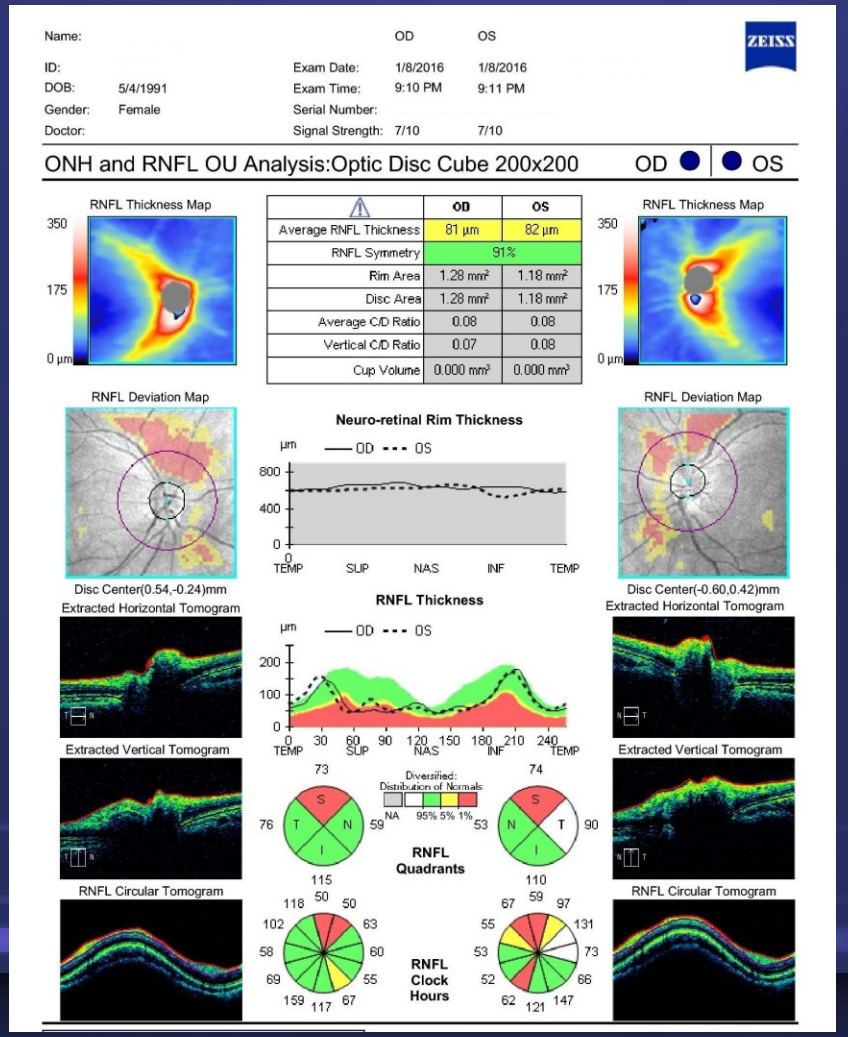
- ISNT rule
  - Decreasing order of rim thickness
- Pallor
  - Rim pallor not associated with glaucoma
- Disc Size
  - Large cups are normal in large optic discs



Examine the rim, not the cup

OCT detection of glaucoma

1. Retinal nerve fiber layer thickness
2. Optic nerve head topography
3. Ganglion cell layer thickness



Retinal nerve fiber layer

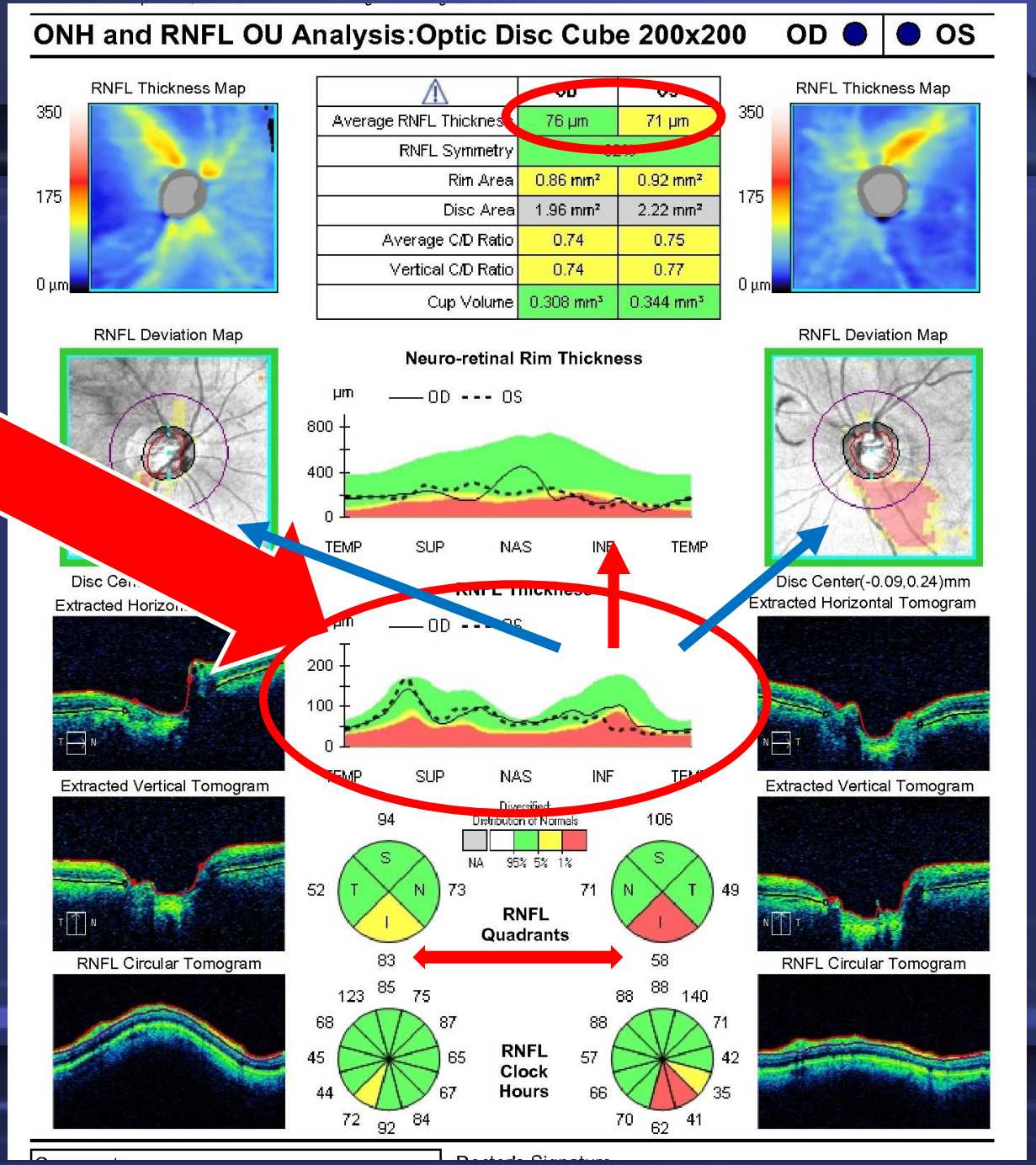
This is where most of the action is!

Is the superior (less common) or inferior (more common) hump depressed?

Is there RE/LE symmetry?

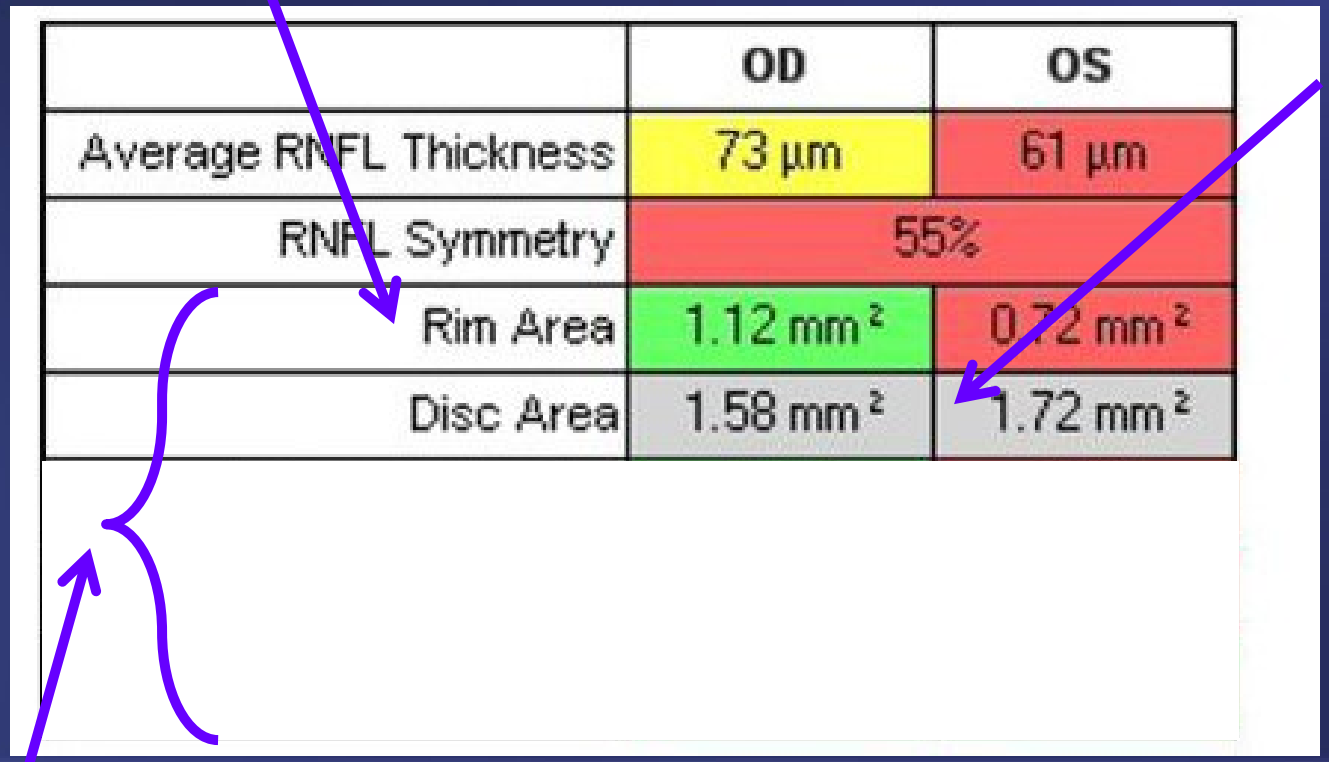
Is there evidence of rim loss corresponding to the RNFL loss?

Does the deviation map show evidence of a NFL defect?



Optic Nerve Head Morphology

Rim Area <1.0 mm^2 is *ALWAYS* suspicious



	OD	OS
Average RNFL Thickness	73 µm	61 µm
RNFL Symmetry	55%	
Rim Area	1.12 mm^2	0.72 mm^2
Disc Area	1.58 mm^2	1.72 mm^2

Always gray b/c it's not compared to normals!

<1.75 mm^2 = sm

1.75-2.75mm^2 = med

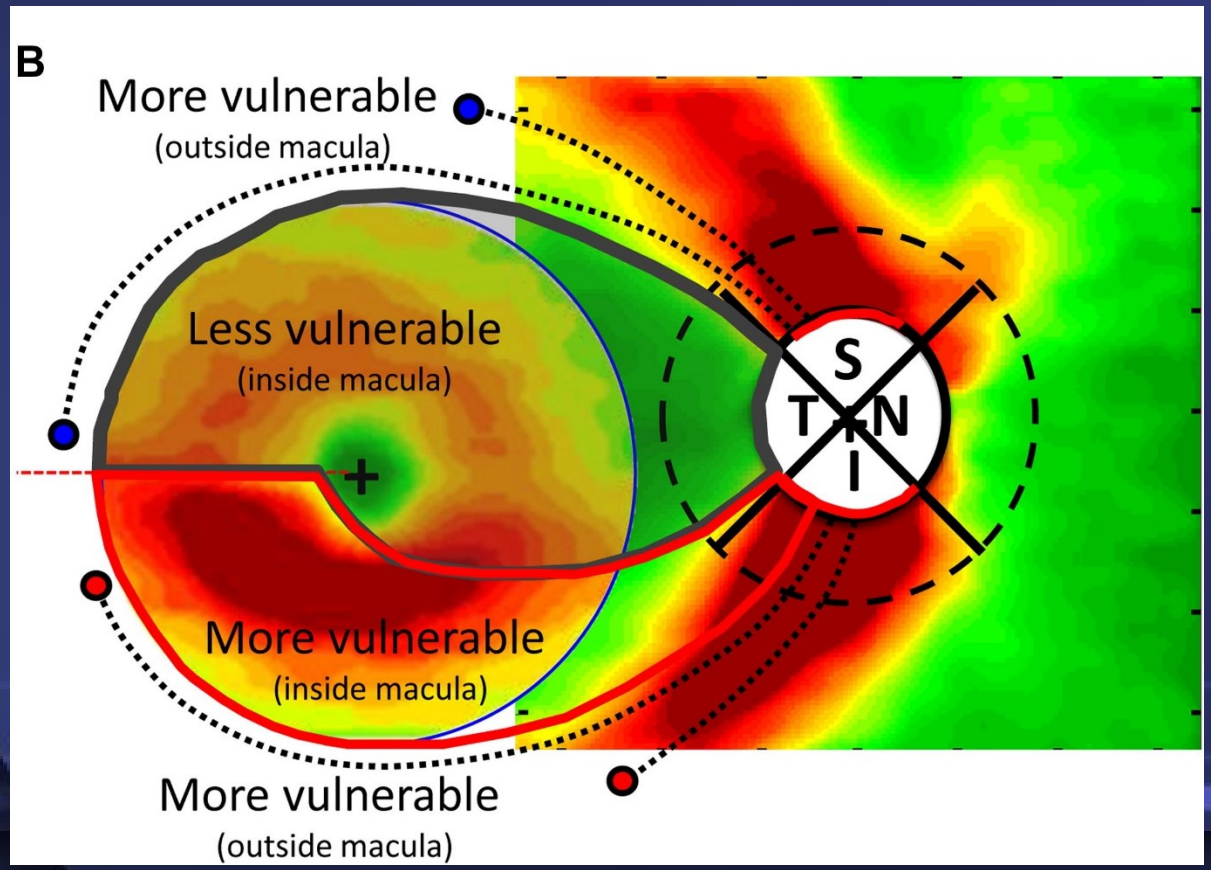
>2.75 mm^2 = lg

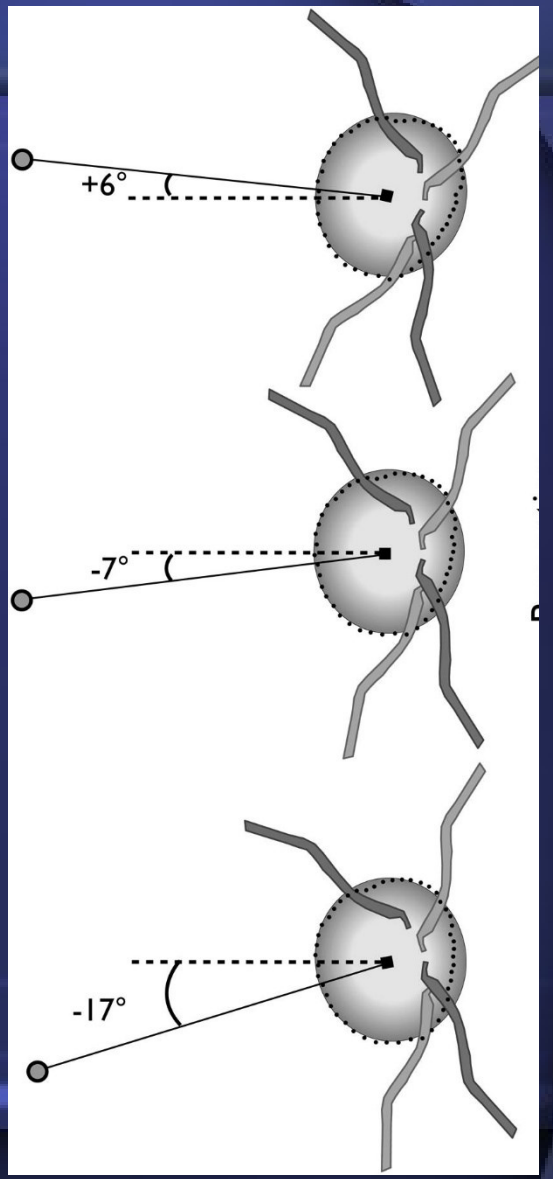
ONH morphology

NOTE: Asymmetric disc size may account for asymmetry in CDR and RNFL

Ganglion Cell Layer Thickness

Ganglion cells **inferior and temporal** to the fovea are preferentially damaged in glaucoma





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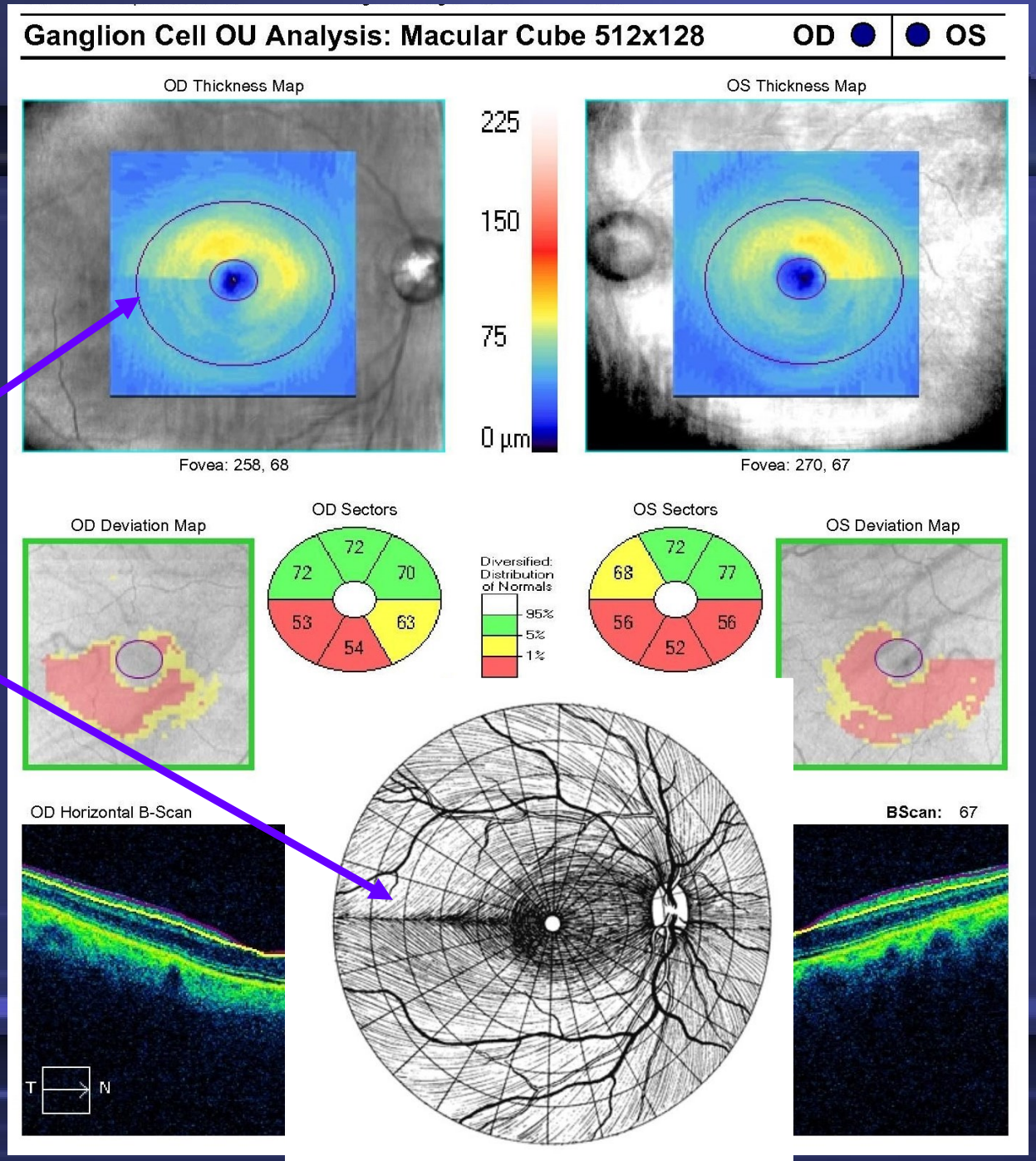
Ganglion Cell Layer Thickness

Look for temporal step defect in thickness map and sectors

Beware of eyes with binasal ganglion cell thinning!



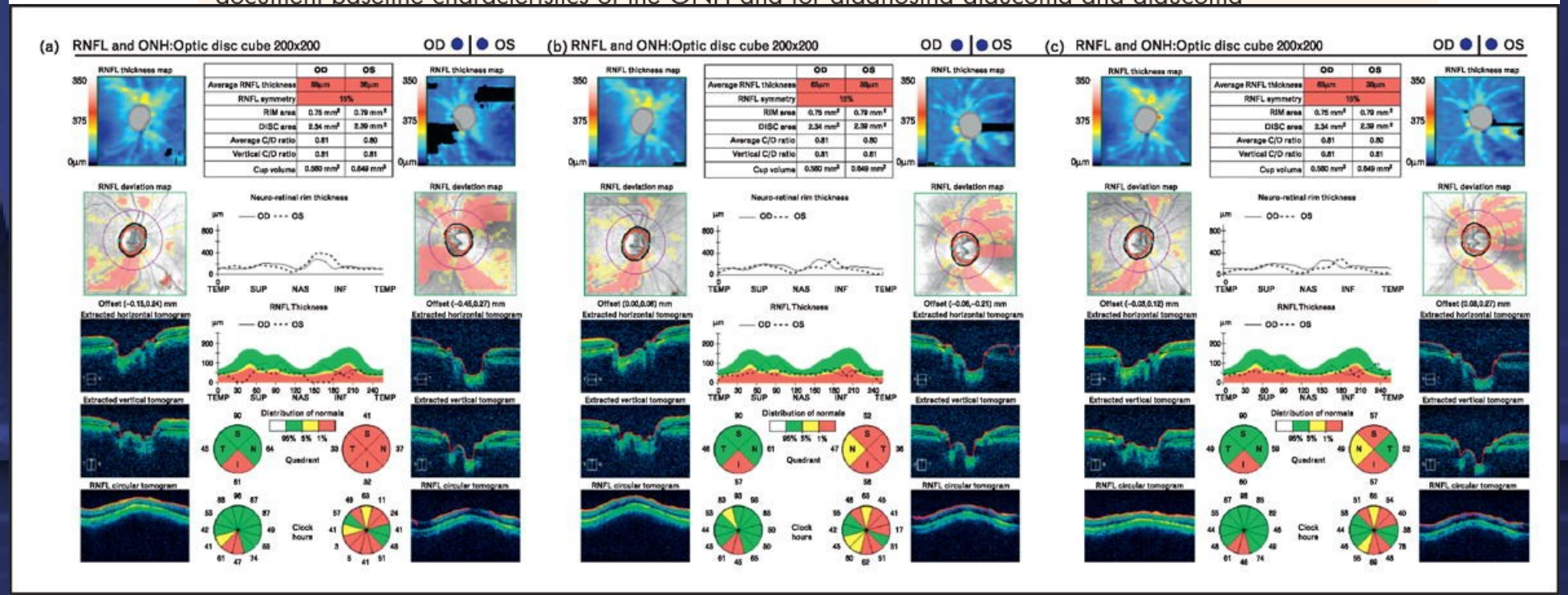
CURRENT OPINION

Glaucoma versus red disease: imaging and glaucoma diagnosis

Gabriel T. Chong and Richard K. Lee

Purpose of review

The use of ophthalmic imaging for documentation and diagnosis of ocular disease is rising dramatically. Optical coherence tomography (OCT), confocal scanning laser tomography (CSLT), scanning laser polarimetry (SLP) and photographic imaging of the optic nerve head (ONH) are currently used to document baseline characteristics of the ONH and for diagnosing glaucoma and glaucoma

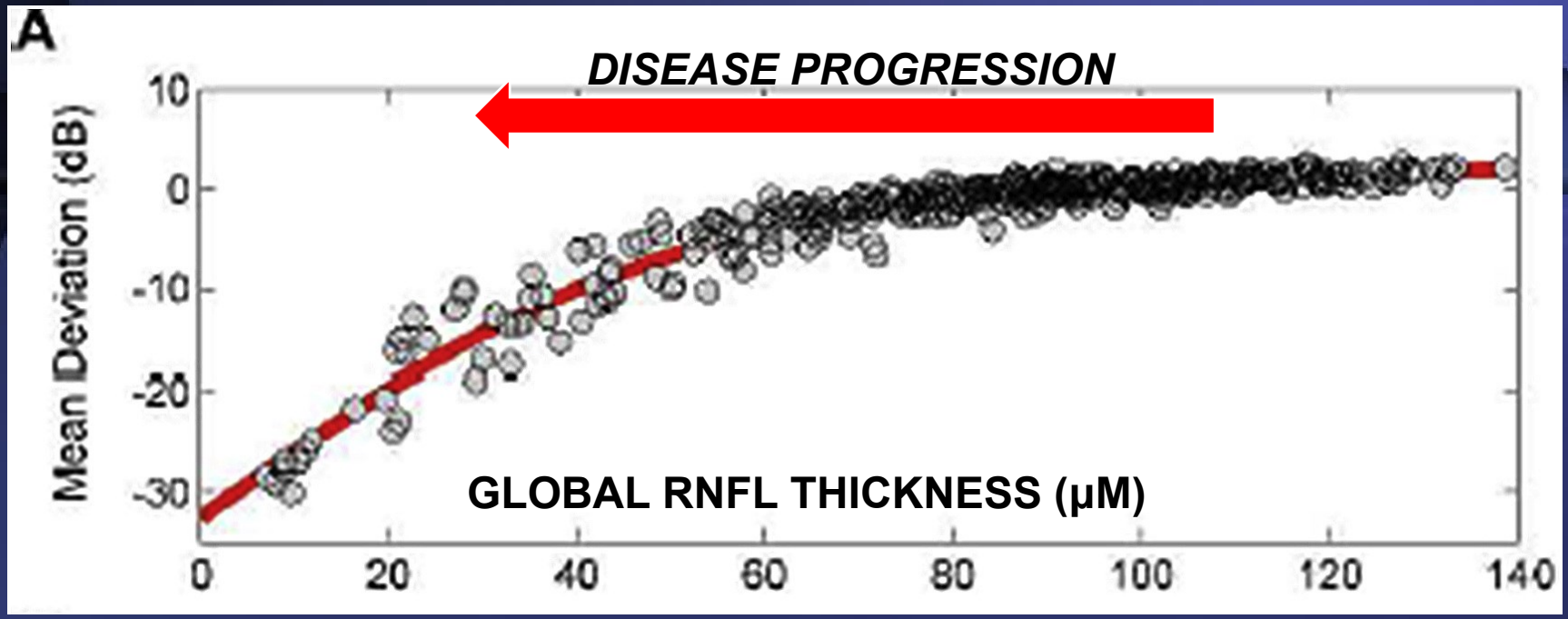


Examine the rim, not the cup

Factors affecting OCT detection of glaucoma

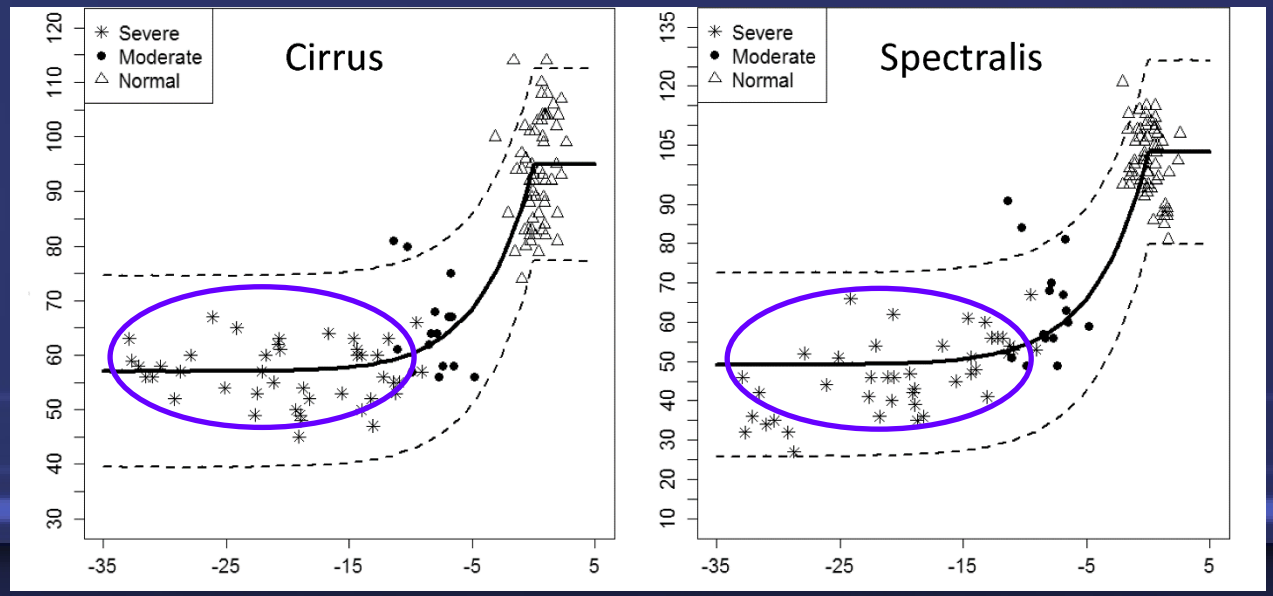
1. Disease severity
2. Optic disc size
3. Signal strength / Errors
4. Artifacts / Ocular anomalies
5. Axial length
6. Blood vessel position
7. Age
8. Race

PERIMETRY



OCT

GLOBAL RNFL THICKNESS (µM)

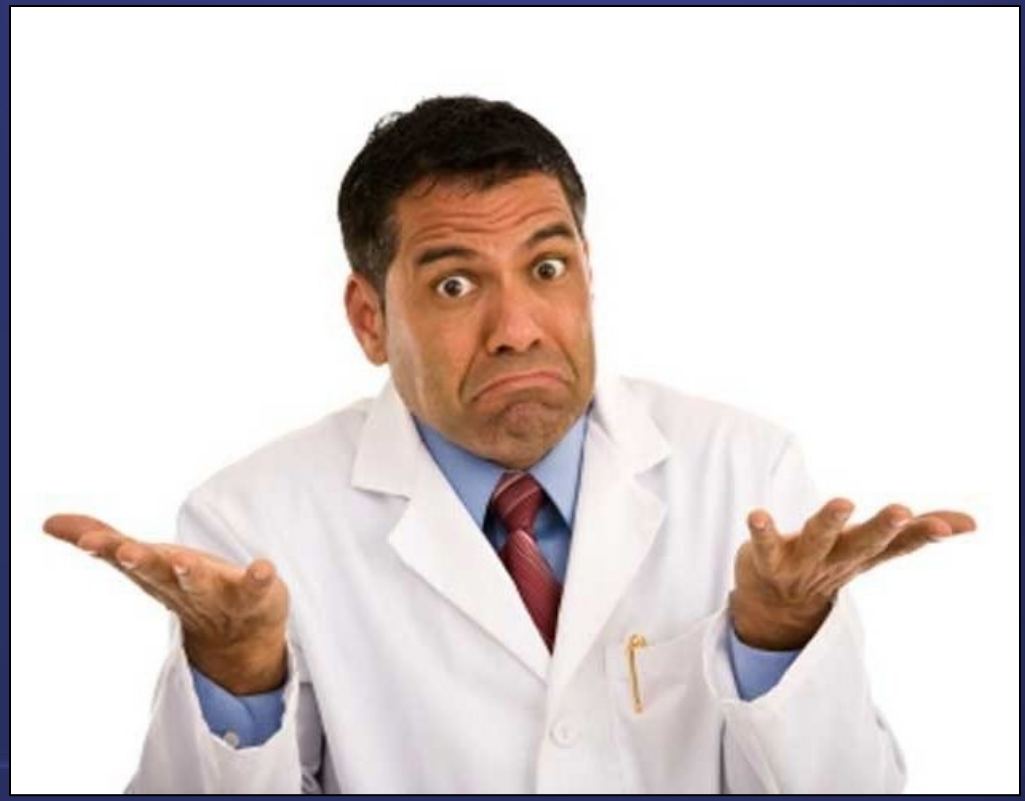


MEAN DEVIATION (dB)

FLOOR EFFECT

Ten Steps to Better Glaucoma Care

1. Master the Art of Tonometry
2. Gonioscopy is Fundamental
3. Examine the Rim, Not the Cup
4. Is this *Really* Glaucoma?



Is this *really* glaucoma?

ONH	X		X		X		X
VF	X		X	X		X	
IOP	X	X				X	X
	POAG	OHT	NTG Neurologic Diurnal IOP	Artifact? Neurologic Retinal	Anomalous ONH? Unreliable VF? Pre-perimetric	Early POAG? Small ONH	Unreliable VF? Pre-perimetric

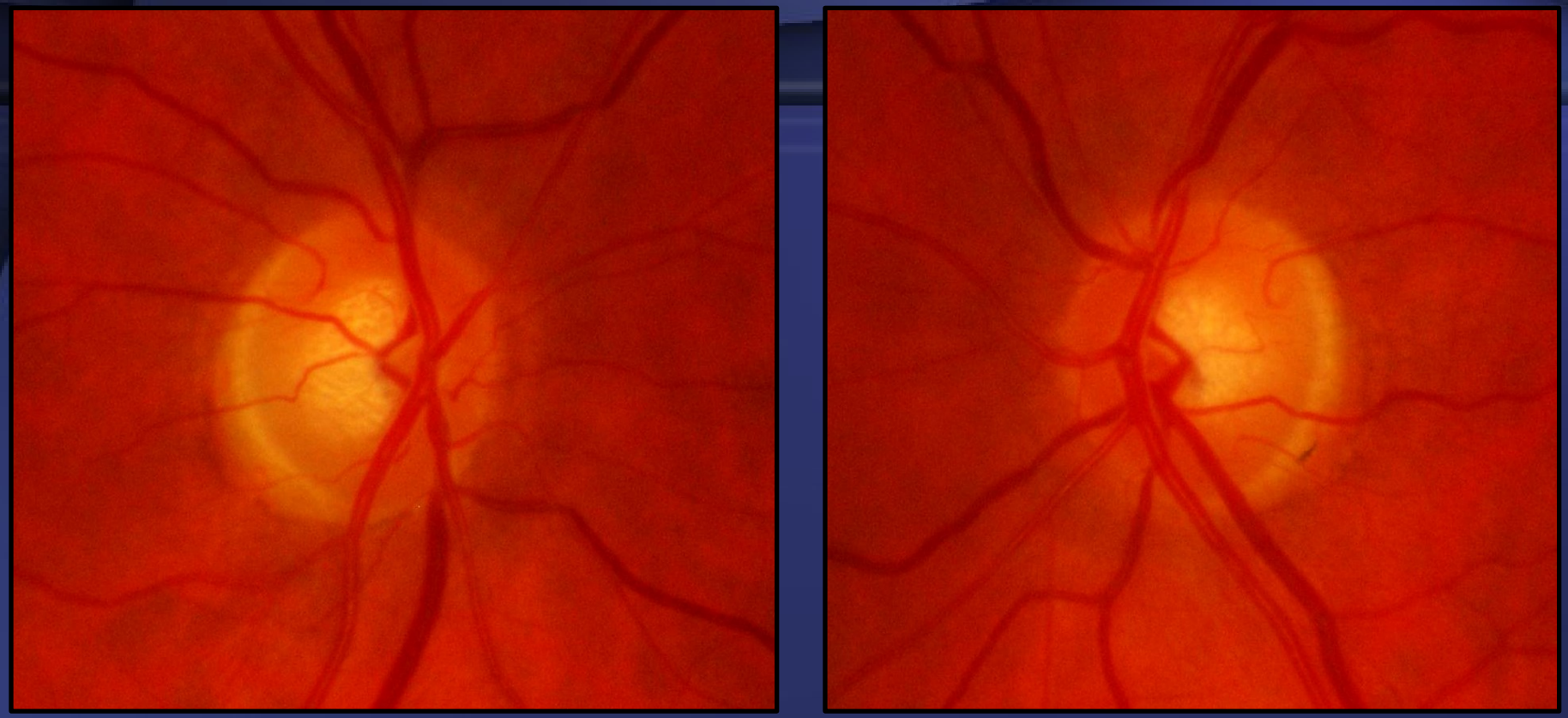
- **ONH**: Disc appearance and/or OCT findings suggestive of glaucoma
- **VF**: Defects on SAP consistent with glaucoma
- **IOP**: IOP >21mmHg on >1 occasion

Case Report

- **44yo WM** presents for routine eye exam
- LLE: 7-8yrs ago
- PMH: migraines, smoker, no meds
- FOH: No glaucoma
- Refraction:
  -4.00-0.75x060 **20/25**
  -4.75 **20/20**
- PERRL, (-)APD

- BP: 130/84
- **GAT: 20/20 3pm**
- **C/D: 0.6 OD, 0.5 OS**

- IMP: Borderline IOP w/ asym cupping
- Plan: Schedule VF



Case Report

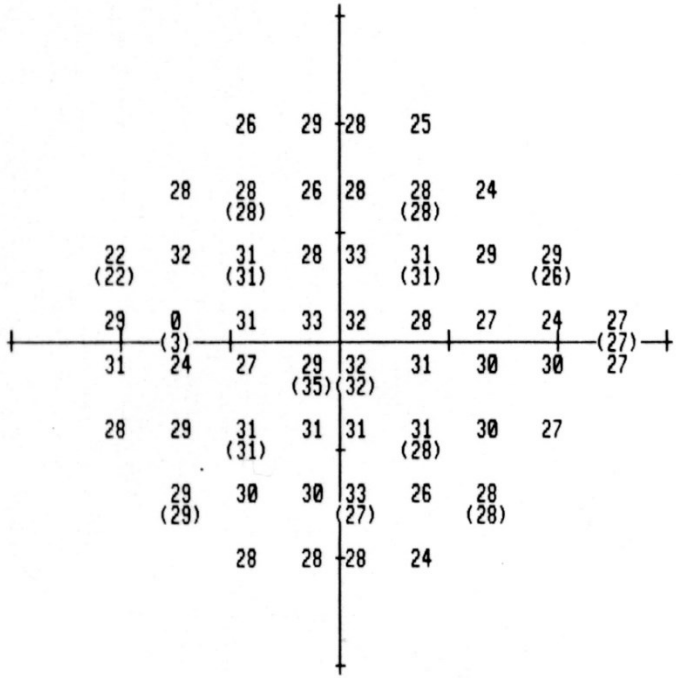
Slight asymmetry of optic cupping

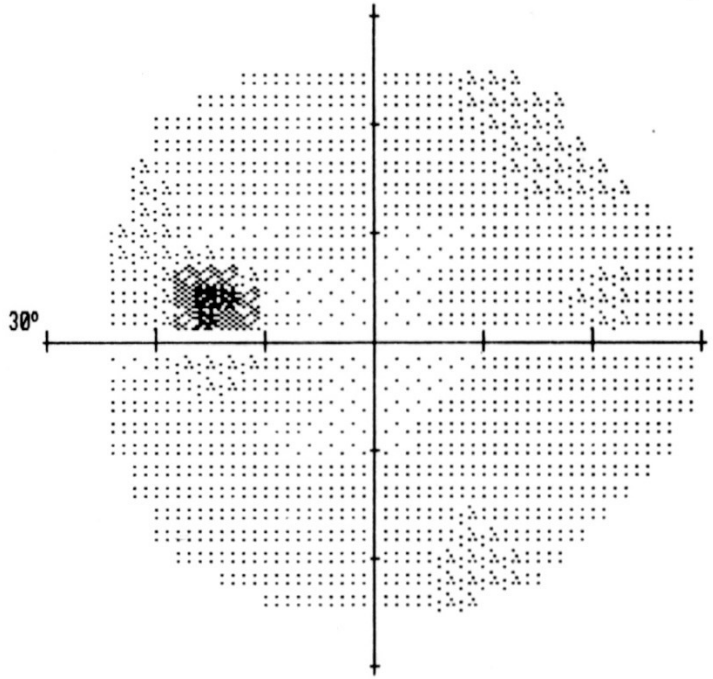
LEFT EYE

AGE 44
FIXATION LOSSES 0/12
FALSE POS ERRORS 0/9
FALSE NEG ERRORS 0/6
QUESTIONS ASKED 210
FOVEA: 37 DB
TEST TIME 05:55

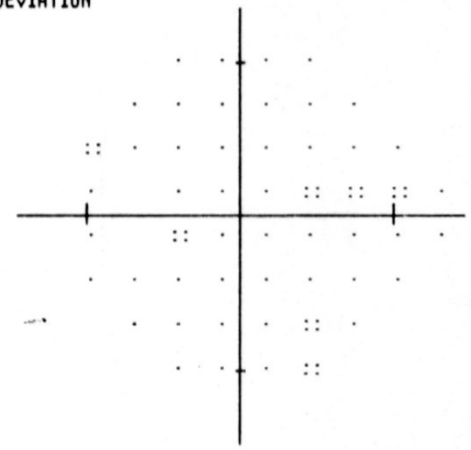
HFA S/N 607-1382

MD - 1.56 DB
PSD 1.96 DB
SF 1.60 DB
CPSD 0.96 DB

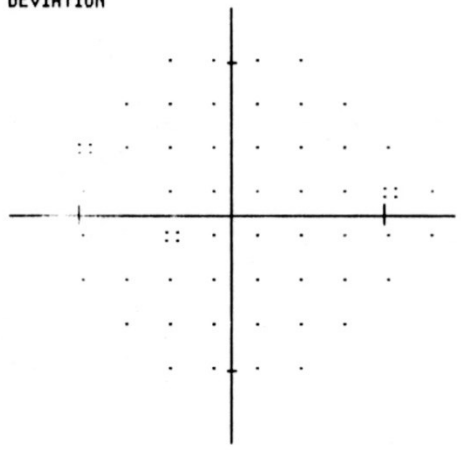




TOTAL DEVIATION



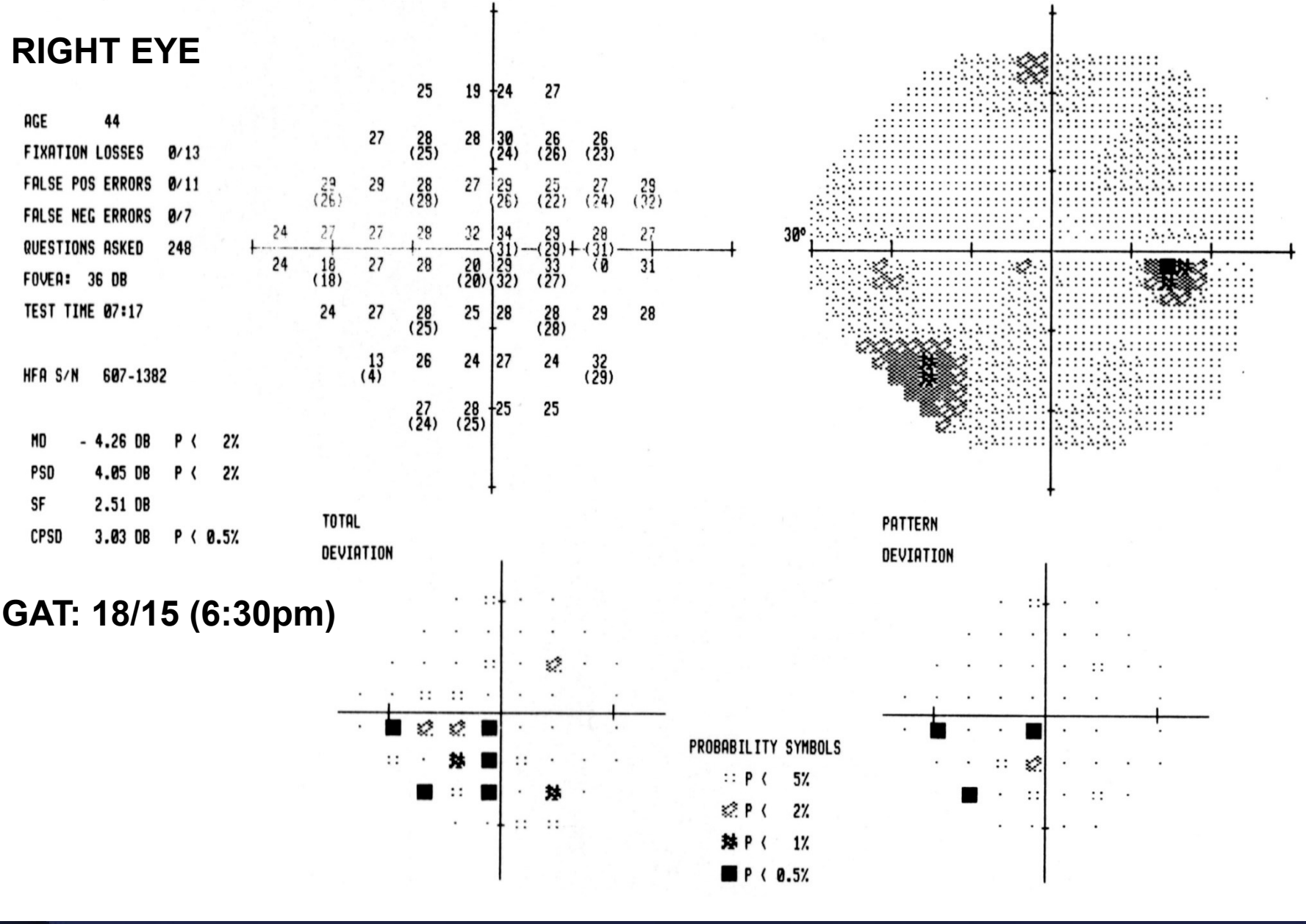
PATTERN DEVIATION



PROBABILITY SYMBOLS

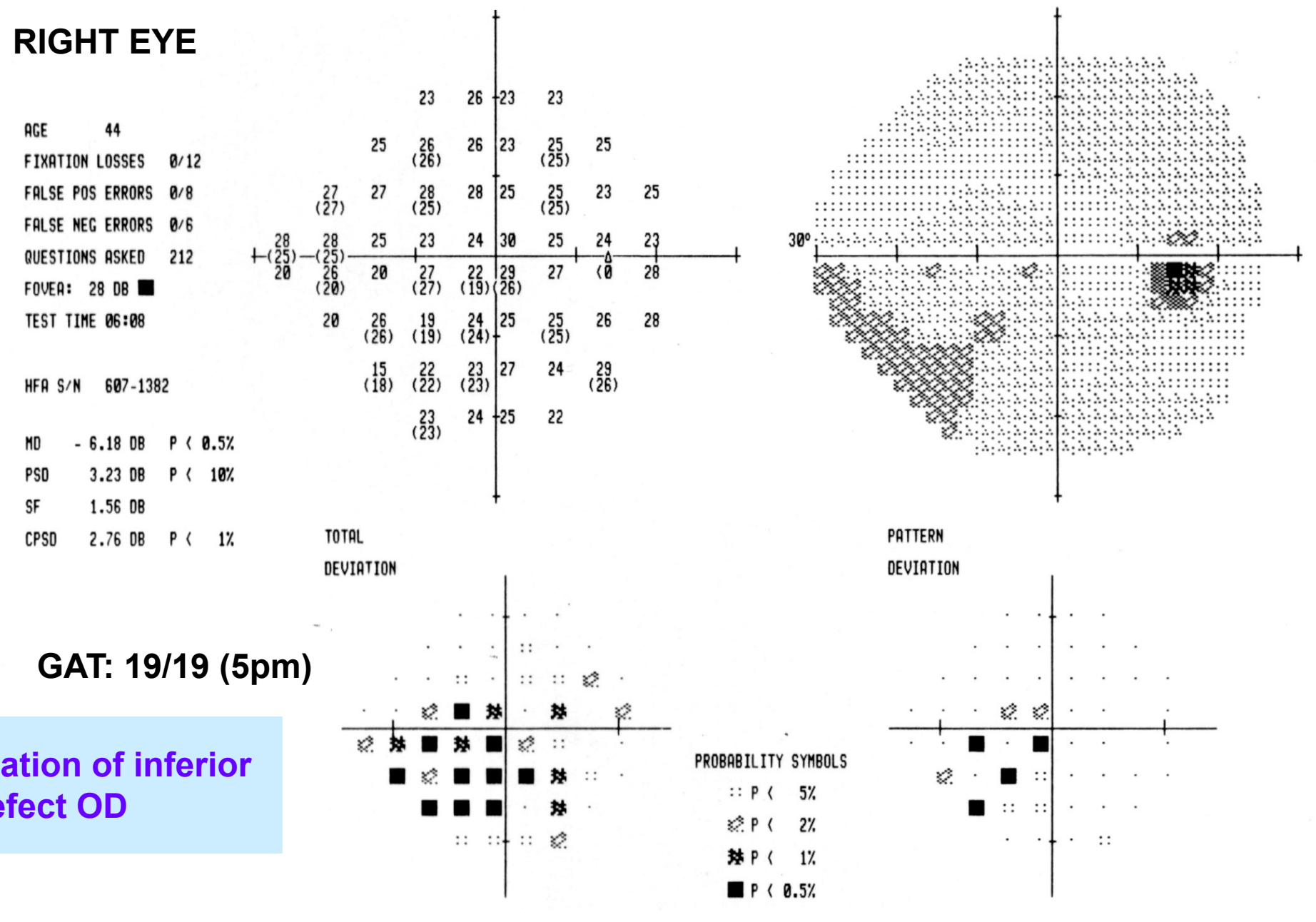
:: P < 5%
P < 2%
P < 1%
P < 0.5%

RIGHT EYE



GAT: 18/15 (6:30pm)

RIGHT EYE



GAT: 19/19 (5pm)

Confirmation of inferior nasal defect OD

What is it?

ONH	X		X		X		X
VF	X		X	X		X	
IOP	X	X				X	X
	POAG	OHT	NTG Neurologic Diurnal IOP	Artifact? Neurologic Retinal	Anomalous ONH? Unreliable VF? Pre-perimetric	Early POAG?	Unreliable VF? Pre-perimetric

What is it?

ONH	X		X		X		X
VF	X		X	X		X	
IOP	X	X				X	X
	POAG	OHT	NTG Neurologic Diurnal IOP	Artifact? Neurologic Retinal	Anomalous ONH? Unreliable VF? Pre-perimetric	Early POAG?	Unreliable VF? Pre-perimetric

- **ONH**: Asymmetric cupping. *Not frankly glaucomatous* (obeys ISNT rule). No pallor
- **VF**: Reproducible VF defect, suggestive of inferior nasal step
- **IOP**: Consistently below 21 mmHg

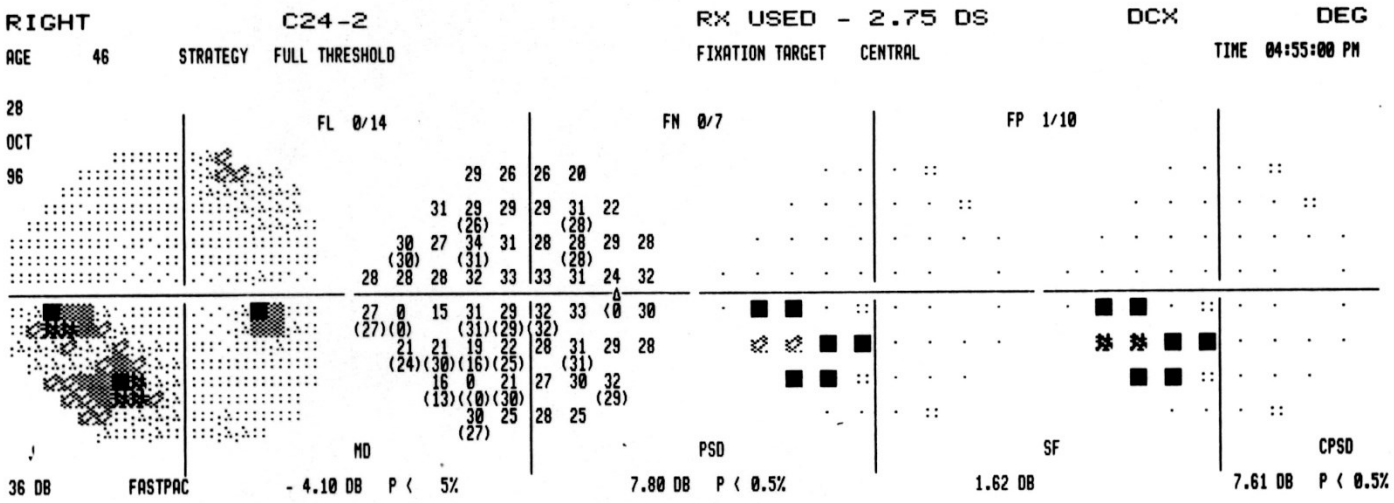
Case Report Continued

- **Lost to follow-up for 2 years**
- Returns with c/o blurry vision
- Vcc
  -4.00-0.75x060 20/40
  -4.75 20/40
- Refraction
  -5.25-1.00x075 **20/30**
  -5.25-0.50x105 **20/20**

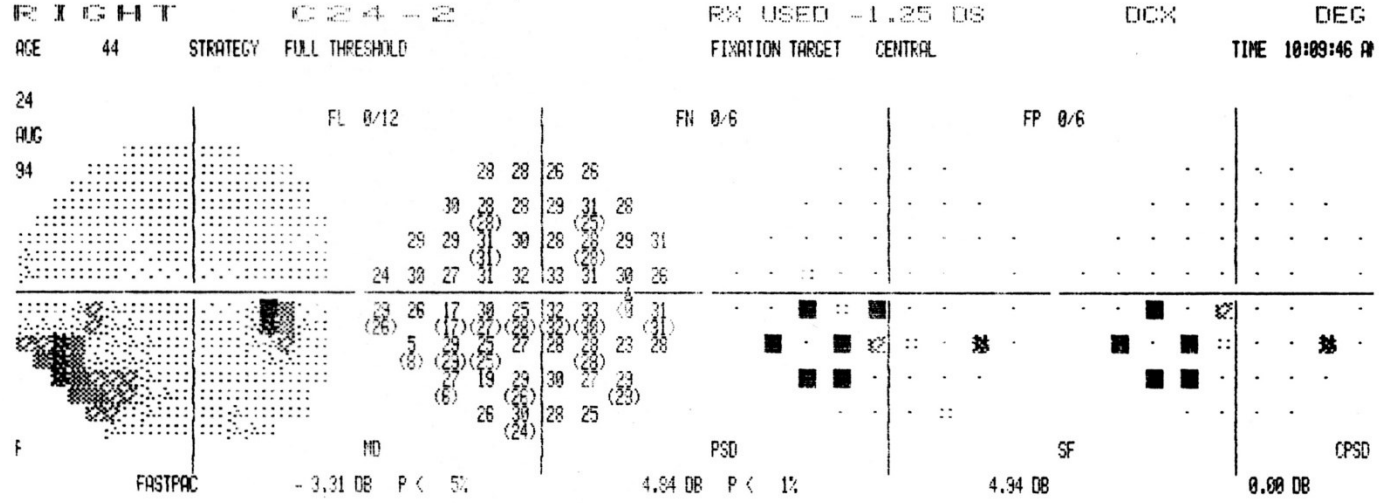
- GAT: 18/18 (3:30pm)
- PERRL, **Trace APD** OD
- C/D: 0.6/0.5

- IMP: Optic neuropathy OD
- Plan: Repeat VF, get CT scan

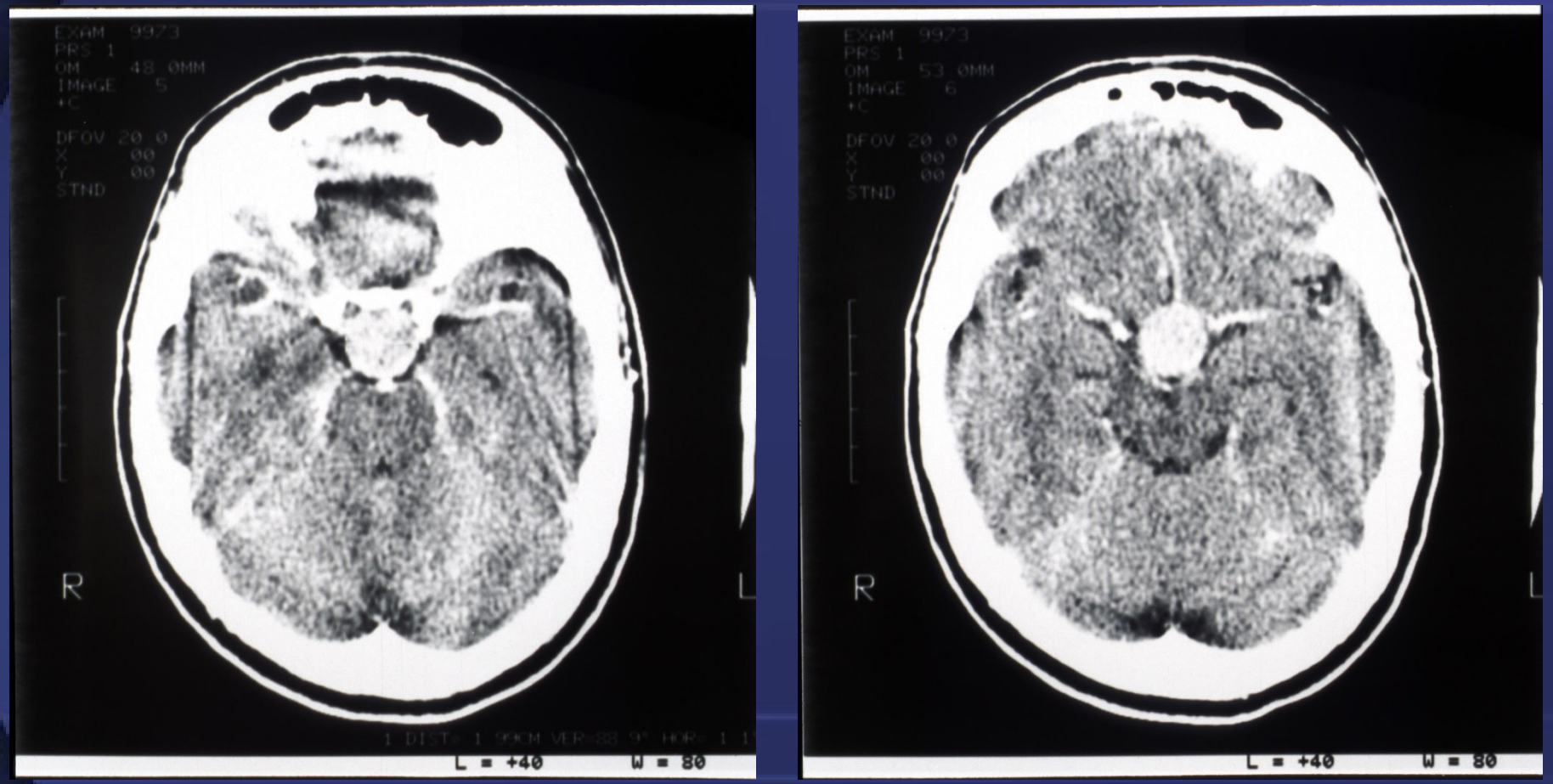
1996


RIGHT C24-2 RX USED - 2.75 DS DCX DEG
AGE 46 STRATEGY FULL THRESHOLD FIXATION TARGET CENTRAL TIME 04:55:00 PM
28 OCT 96
FL 0/14
FN 0/7
FP 1/10
MD
PSD
SF
CPSD
36 DB FASTPAC - 4.10 DB P < 5% 7.80 DB P < 0.5% 1.62 DB 7.61 DB P < 0.5%

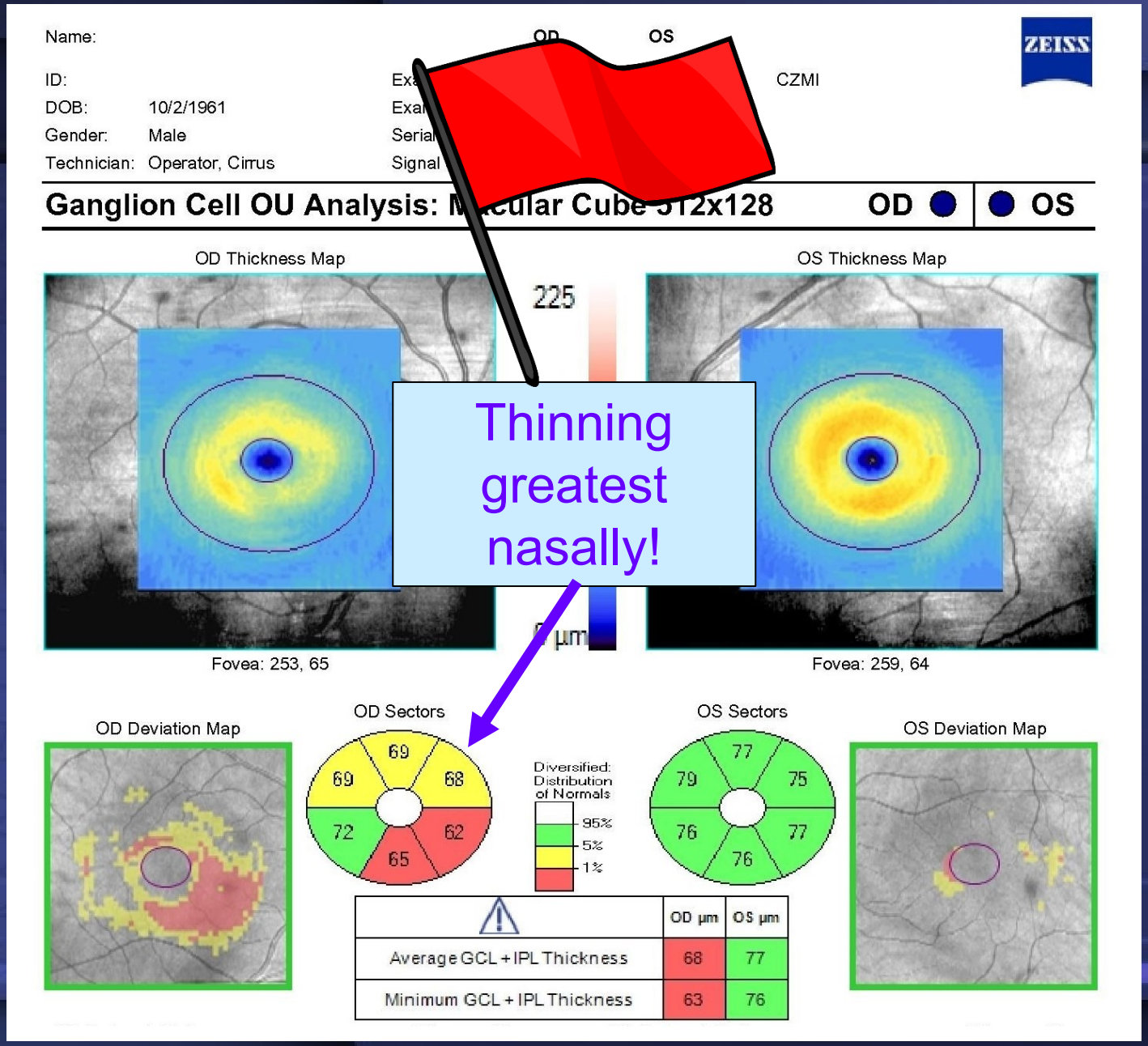
1994


RIGHT C24-2 RX USED -1.25 DS DCX DEG
AGE 44 STRATEGY FULL THRESHOLD FIXATION TARGET CENTRAL TIME 10:09:46 AM
24 AUG 94
FL 0/12
FN 0/6
FP 0/6
MD
PSD
SF
CPSD
FASTPAC - 3.31 DB P < 5% 4.94 DB P < 1% 4.94 DB 0.00 DB

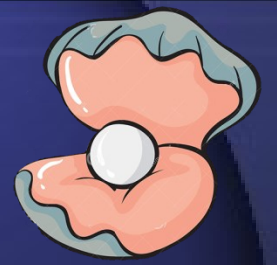
CT Scan



Pituitary adenoma



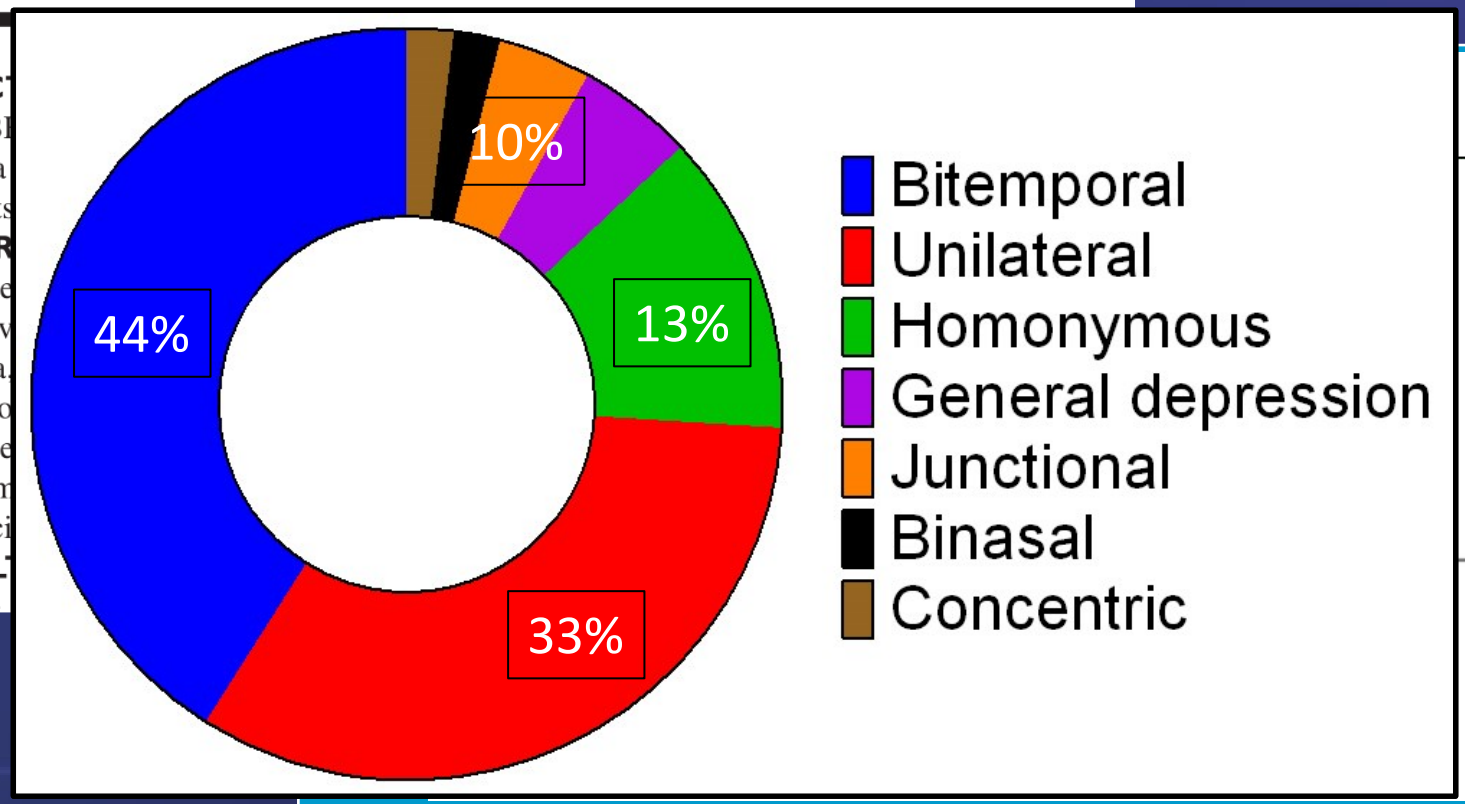
Chiasmal compression produces binasal ganglion cell loss



GCC thinning can be detected in patients with little or no VF loss

PMID: 30097827

Visual Defects in Patients With Pituitary Adenomas: The Myth of Bitemporal Hemianopsia



Bitemporal hemianopia accounts for ≈40% of VF defects caused by chiasmal compression

PMID: 26496573, 23563861

Ten Steps to Better Glaucoma Care

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2. Gonioscopy is Fundamental
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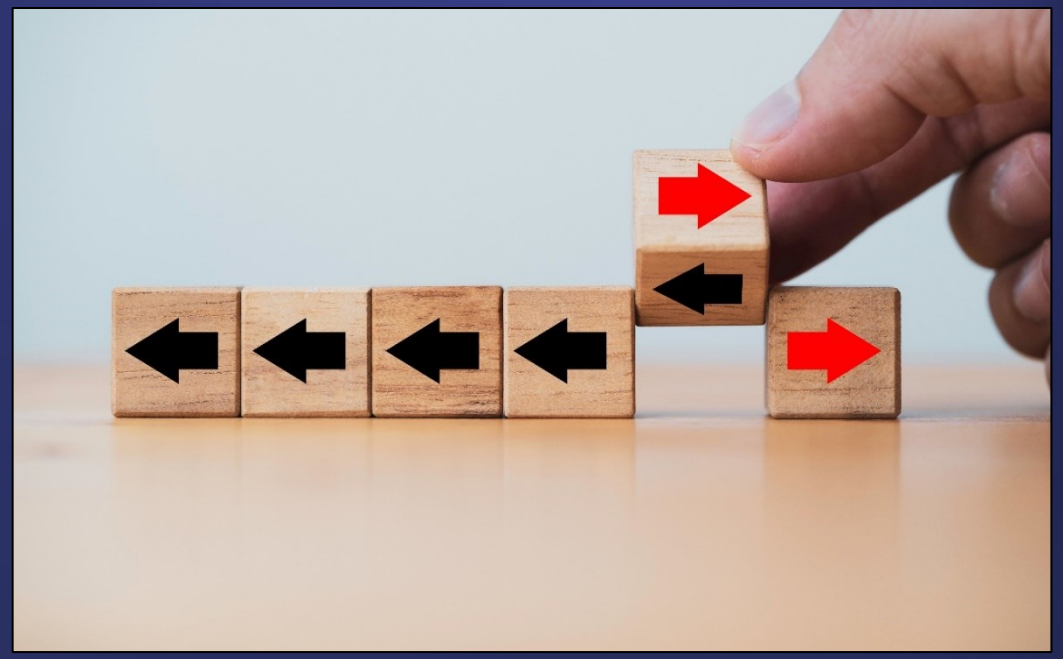
4. Is this *Really* Glaucoma?
5. Establishing the Baseline



Establishing the baseline

Why?

- Target pressure
- Detecting progression

What?

- Gonioscopy
- DFE, Photos & OCT
- At least two untreated IOP readings
  - Various times of day
- Five reliable VF exams

When?

- New onset glaucoma
- Glaucoma patients new to your practice
- Loss of IOP control
- Following period of prolonged stability
- After surgery or other significant medical events

PMID: 16157799

Establishing the baseline

How many VFs are needed to establish a baseline?

- OHTS: Chance of reverting back to normal
  - After 2 consecutive abnormal VF: 66%
  - After 3 consecutive abnormal VF: 12%
- Five exams in first 2 yrs for VF baseline

PMID: 16157799

Re-establishing baseline IOP

- PHACO / IOL
  - Long-term IOP lowering
  - Max effect at 3 mos
  - Average 2.5 mmHg decrease
  - Glaucoma pts may require fewer meds
  - IOP elevation following capsulotomy

PMID: 15811734

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Setting a target pressure

Need to Balance Two Goals

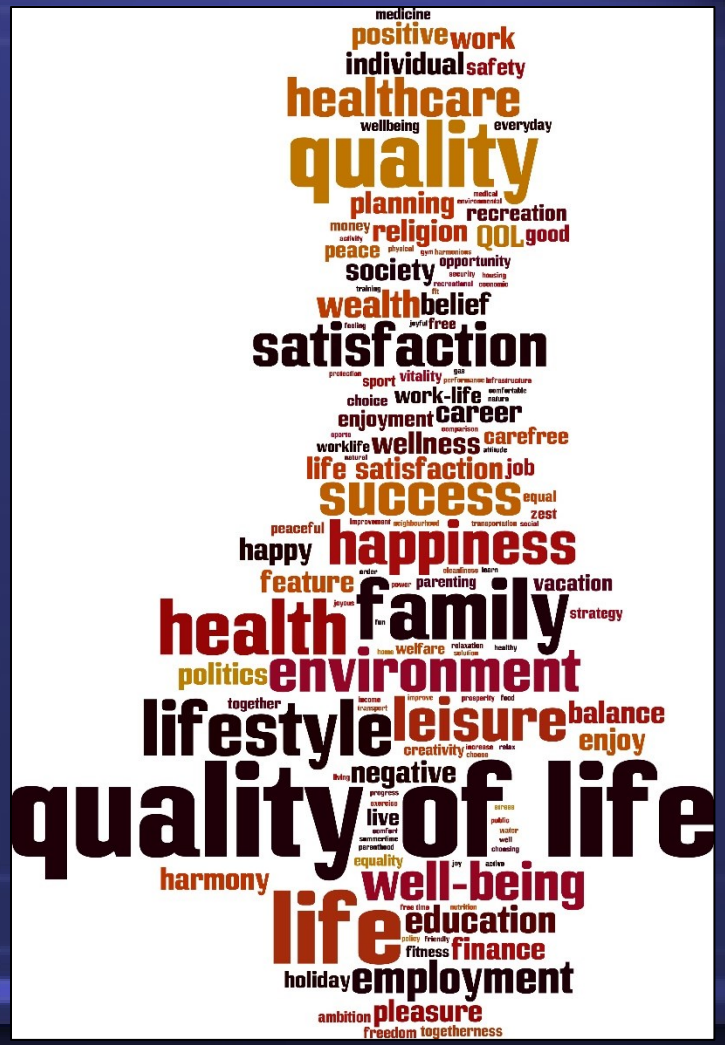
Preservation of vision

and

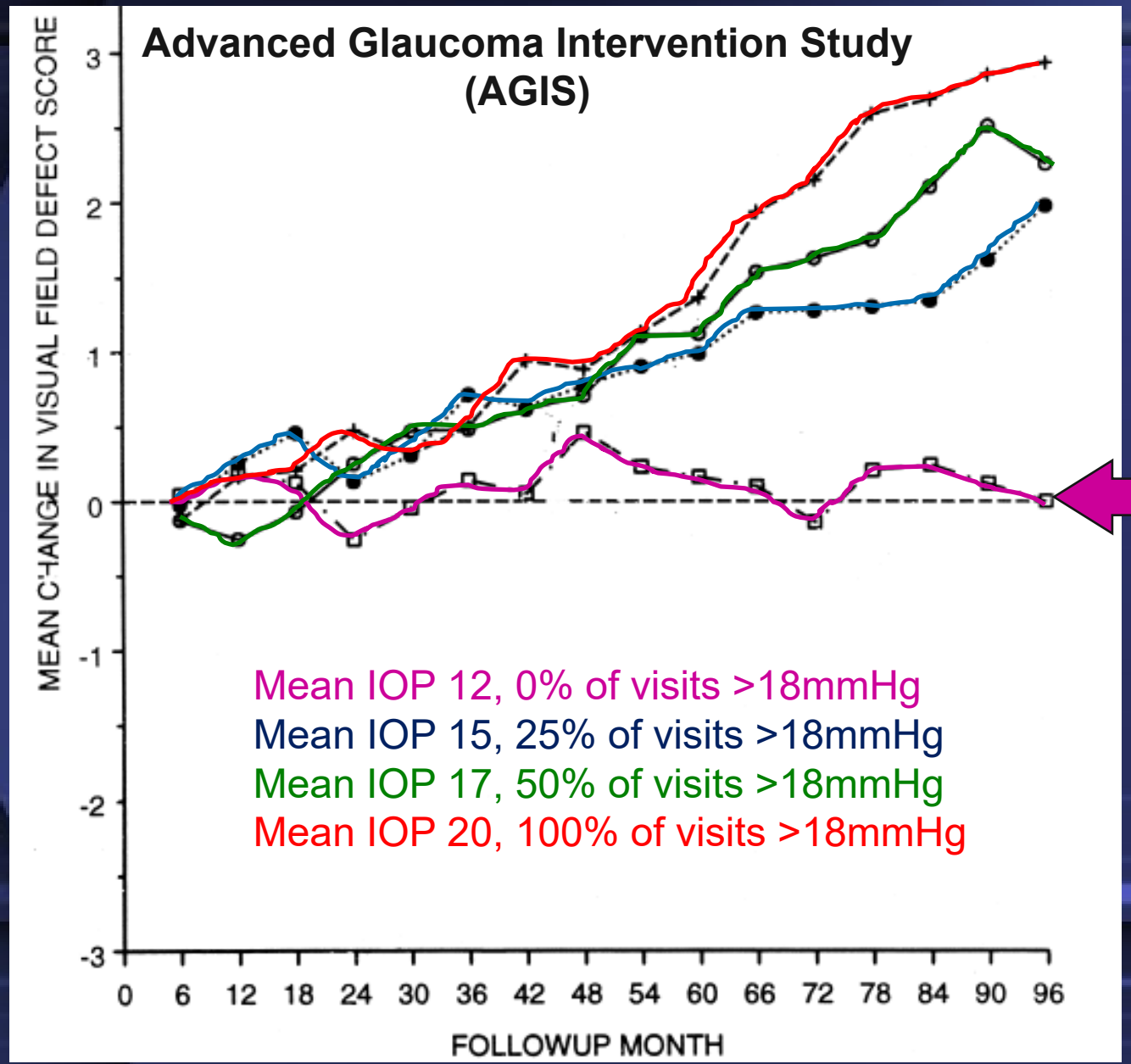
Quality of life

Some factors to consider

- Disease severity
- Baseline IOP
- Risk factors
- Life expectancy
- Status of fellow eye

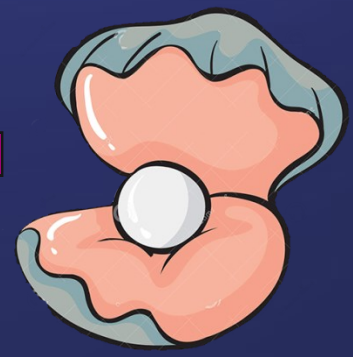


Setting a target pressure



But… How hard do you need to fight to achieve this level of control?

And… Is it always worth it?



NO PROGRESSION! If IOP <18mmHg at all visits

Journal of Current Glaucoma Practice, September-December 2009;3(3):7-11

The Ethics of Treating or Not Treating Glaucoma

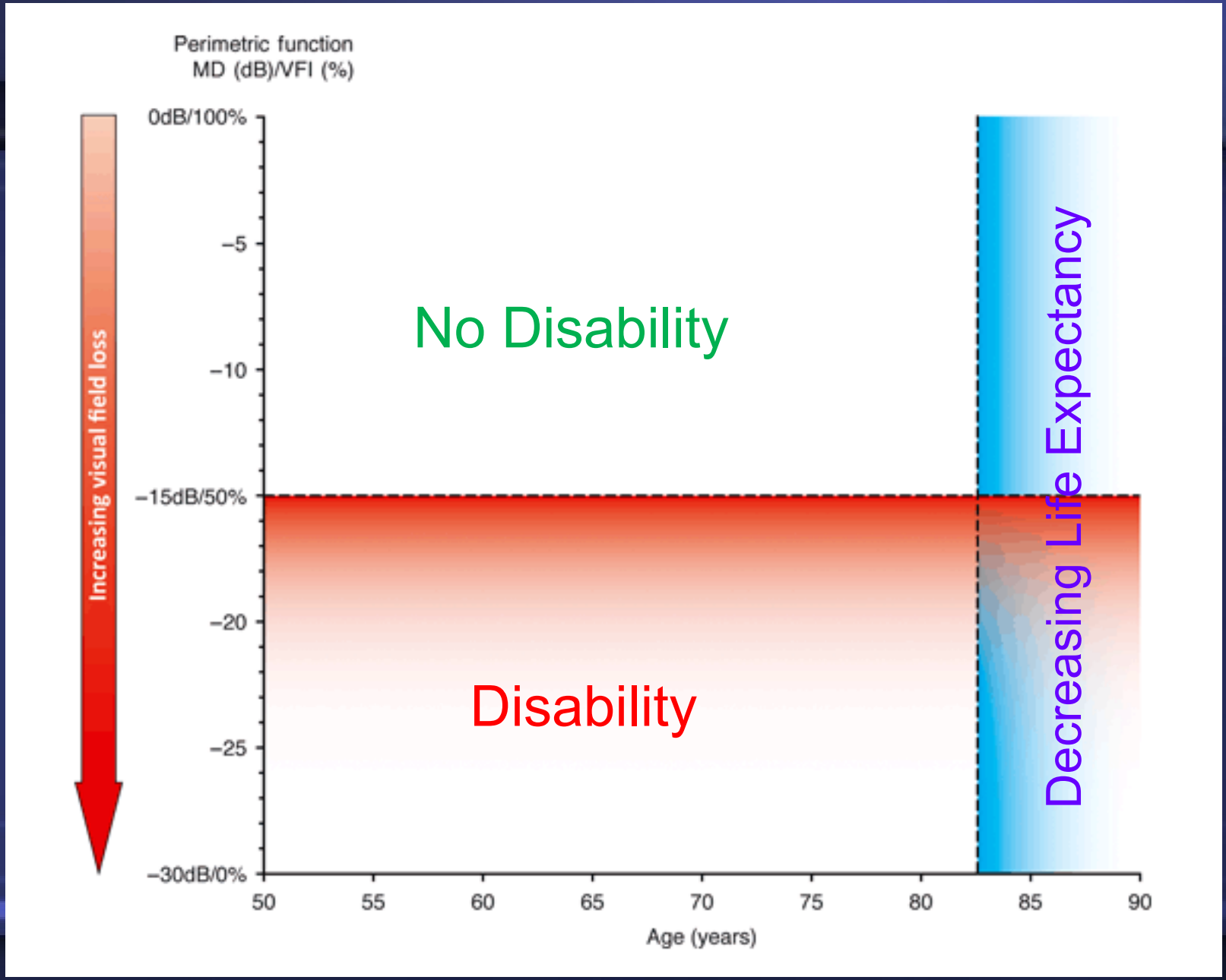
George L Spaeth, Parul Ichhpujani

Anna V Goldberg Glaucoma Service, Wills Eye Institute, 840 Walnut Street, Philadelphia, USA

"Preventing the development of asymptomatic changes, or asymptomatic damage, is not the appropriate objective of care… There is no benefit of treatment in a patient who will not develop symptoms if not treated."

The Glaucoma Graph:

Balancing Life and IOP



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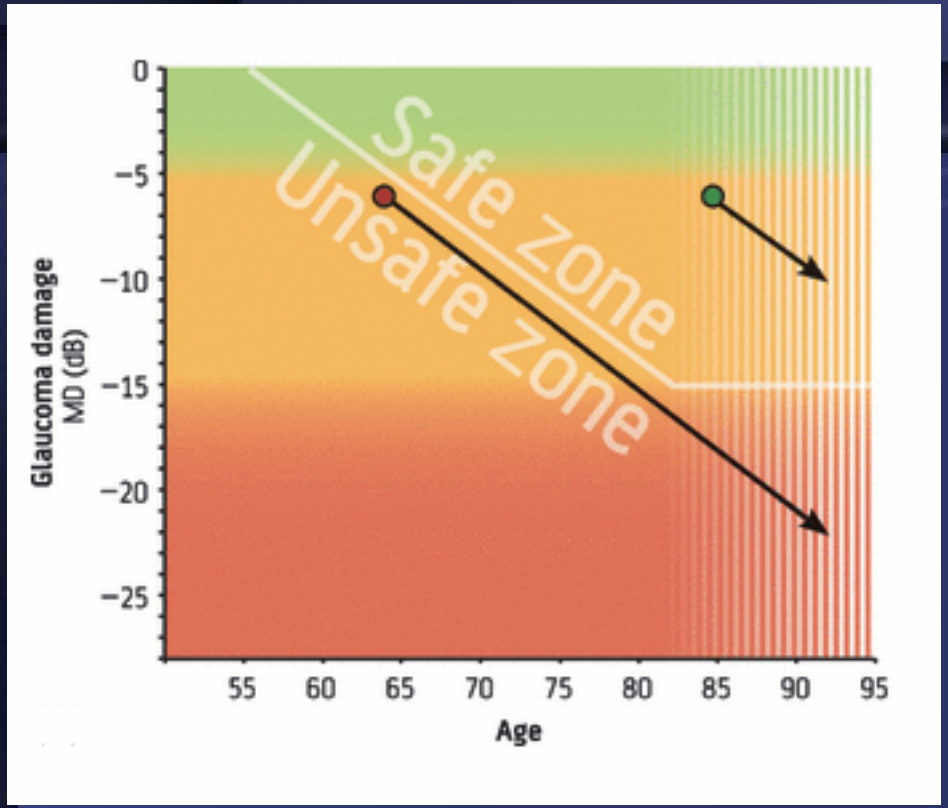
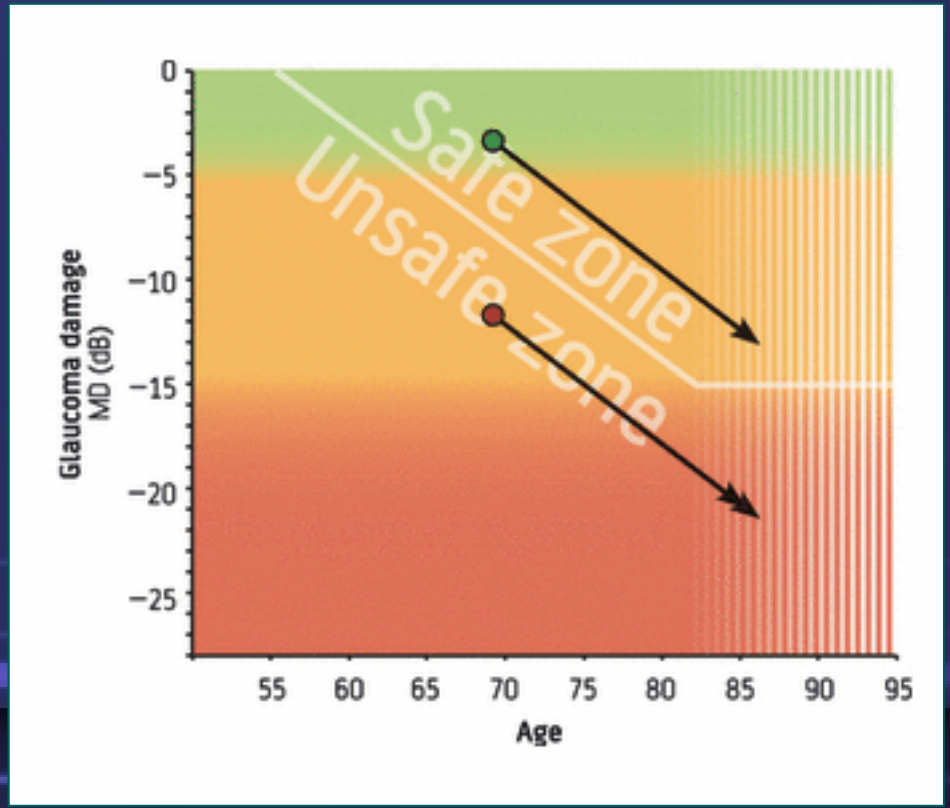


Safe Zone: Older person with mild disease

Unsafe Zone: Younger person with advanced disease



Initial target pressure can be based upon where they sit on the Glaucoma Graph, then refined once rate of progression is known

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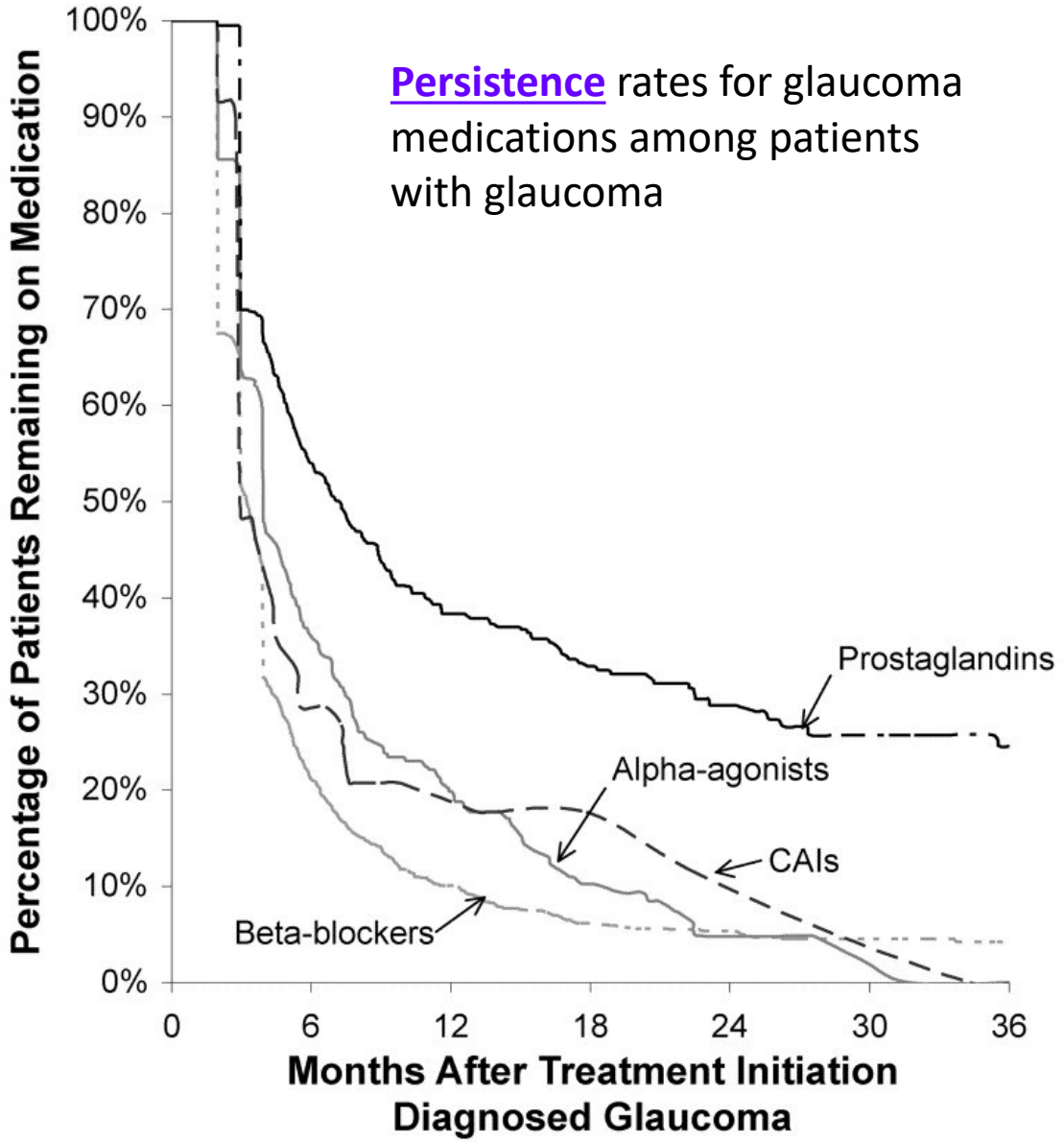
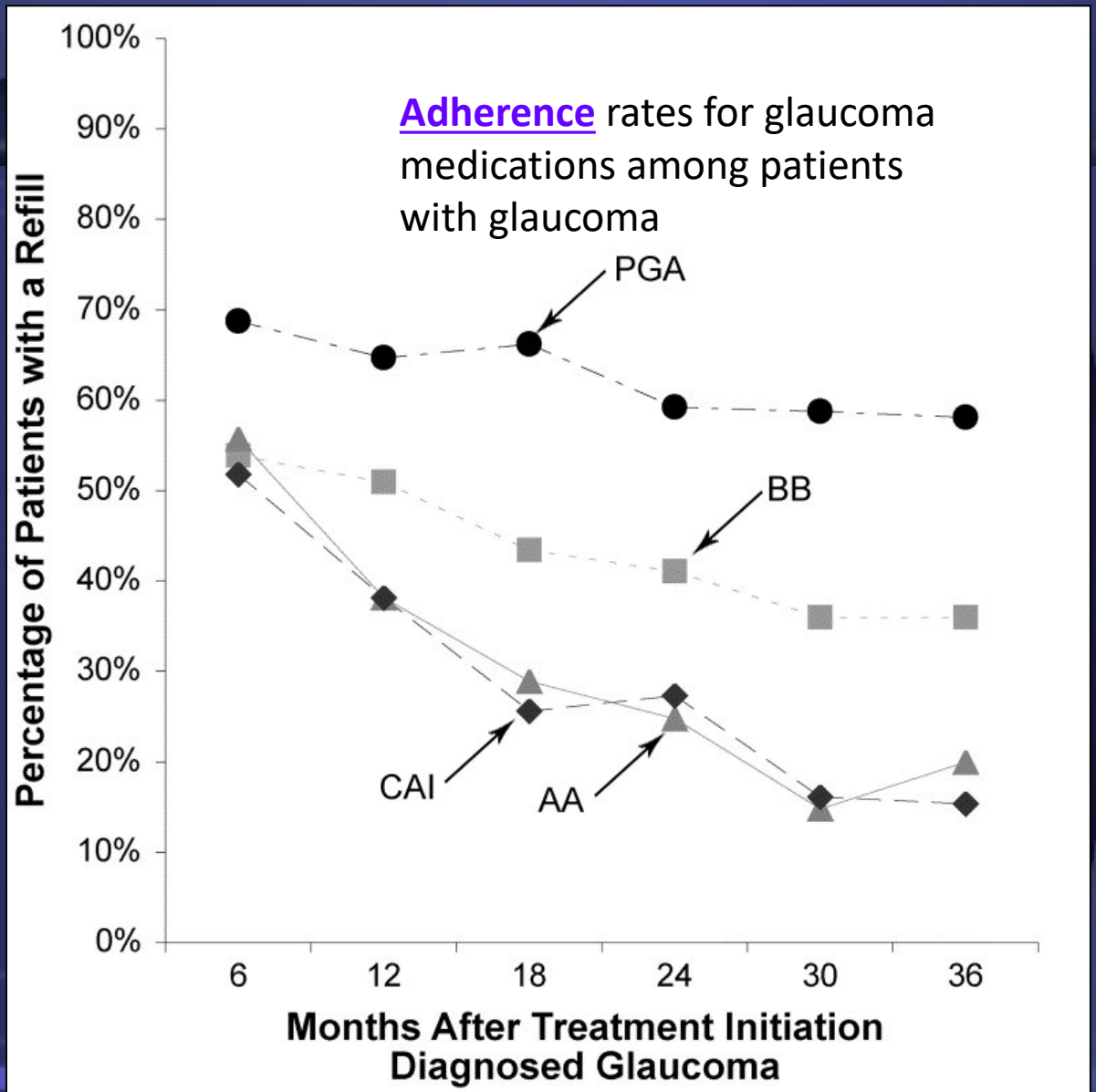
7. Maximize Patient Compliance

Persistence rates for glaucoma medications among patients with glaucoma



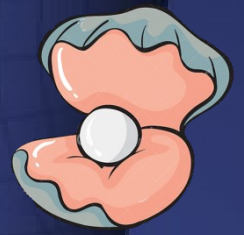
Adherence rates for glaucoma medications among patients with glaucoma



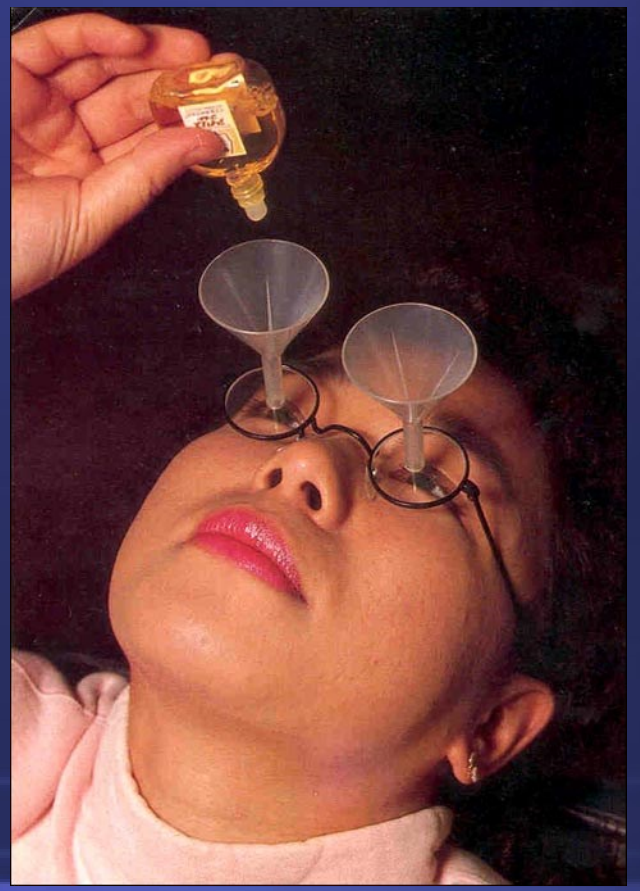
PMID: 16226511

Maximize patient compliance

Steps to improve compliance



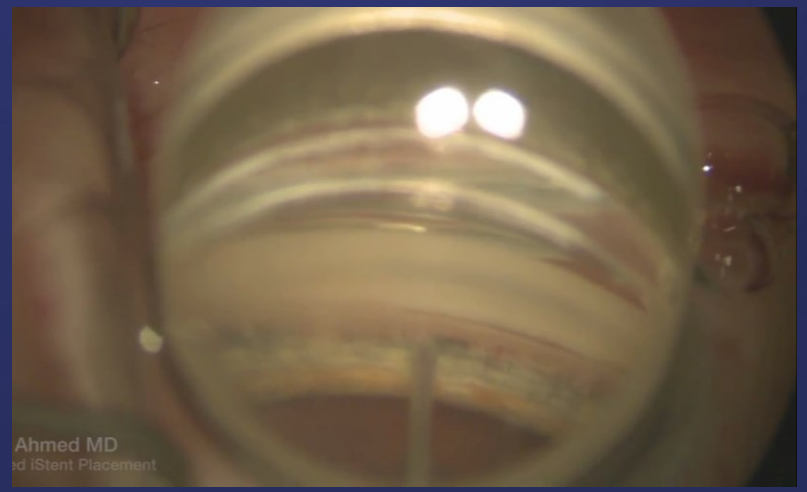
- Effective communication
- Educate patients about their disease (*The goal of treatment is to prevent blindness, not to improve vision*)
- Inquire about compliance at every visit (*"How frequently do you forget?"*)
- Simplify dosing
- Address side effects
- Give instructions in writing
- Family support



Maximize patient compliance

Alternatives to topical therapy for mild to moderate open-angle glaucoma

- Selective laser trabeculoplasty (SLT)
- Minimally Invasive Glaucoma Surgery (MIGS)



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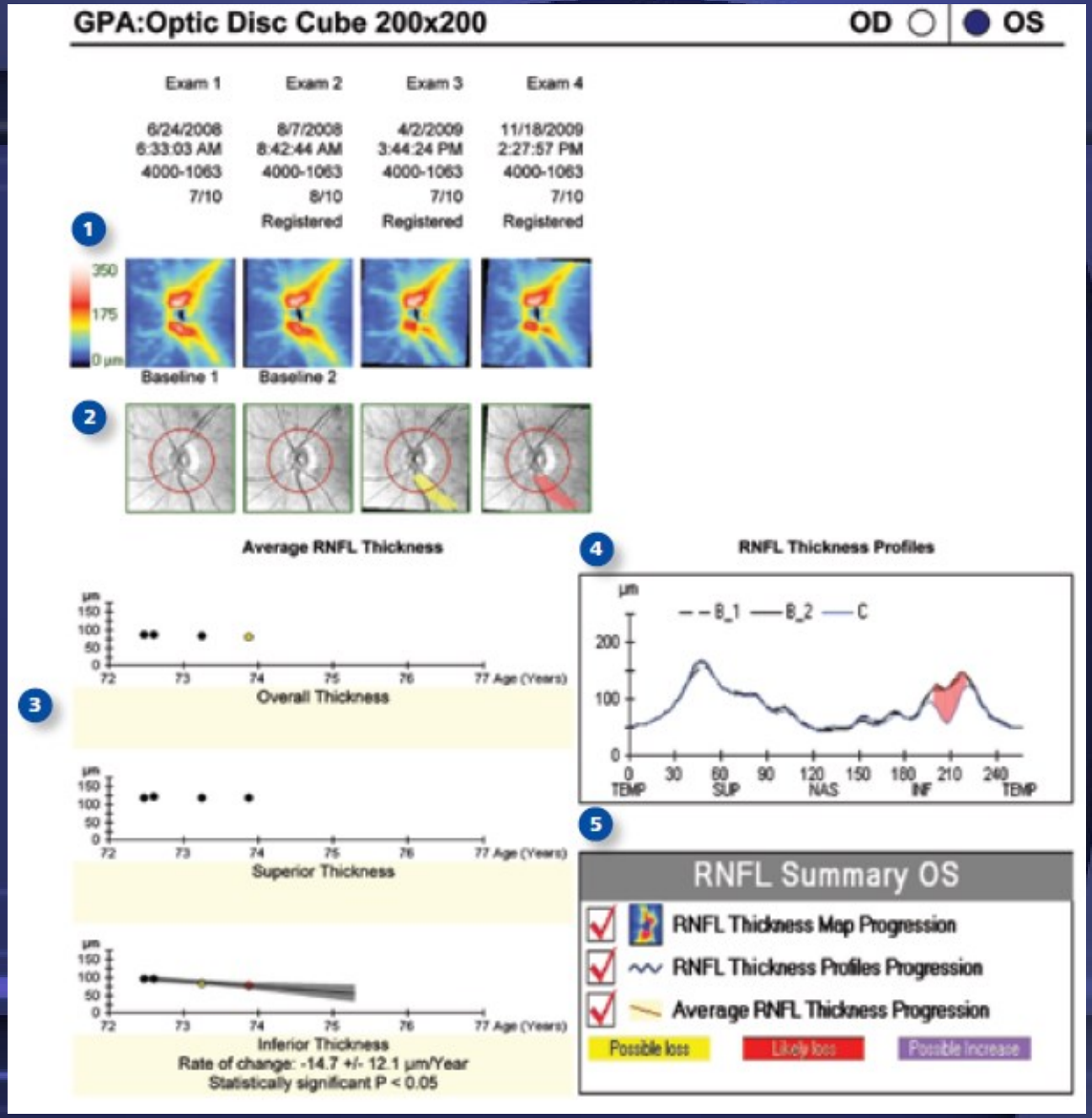
8. Confirming Progression

Confirming Progression

- Reliably detecting progression is more challenging than detecting presence of disease
- The best tool for detecting progression is adequate baseline data
  - Structural change: OCT and/or disc photos
  - Functional change: Multiple visual fields (Recommend five)
  - IOP change: Untreated baseline IOP

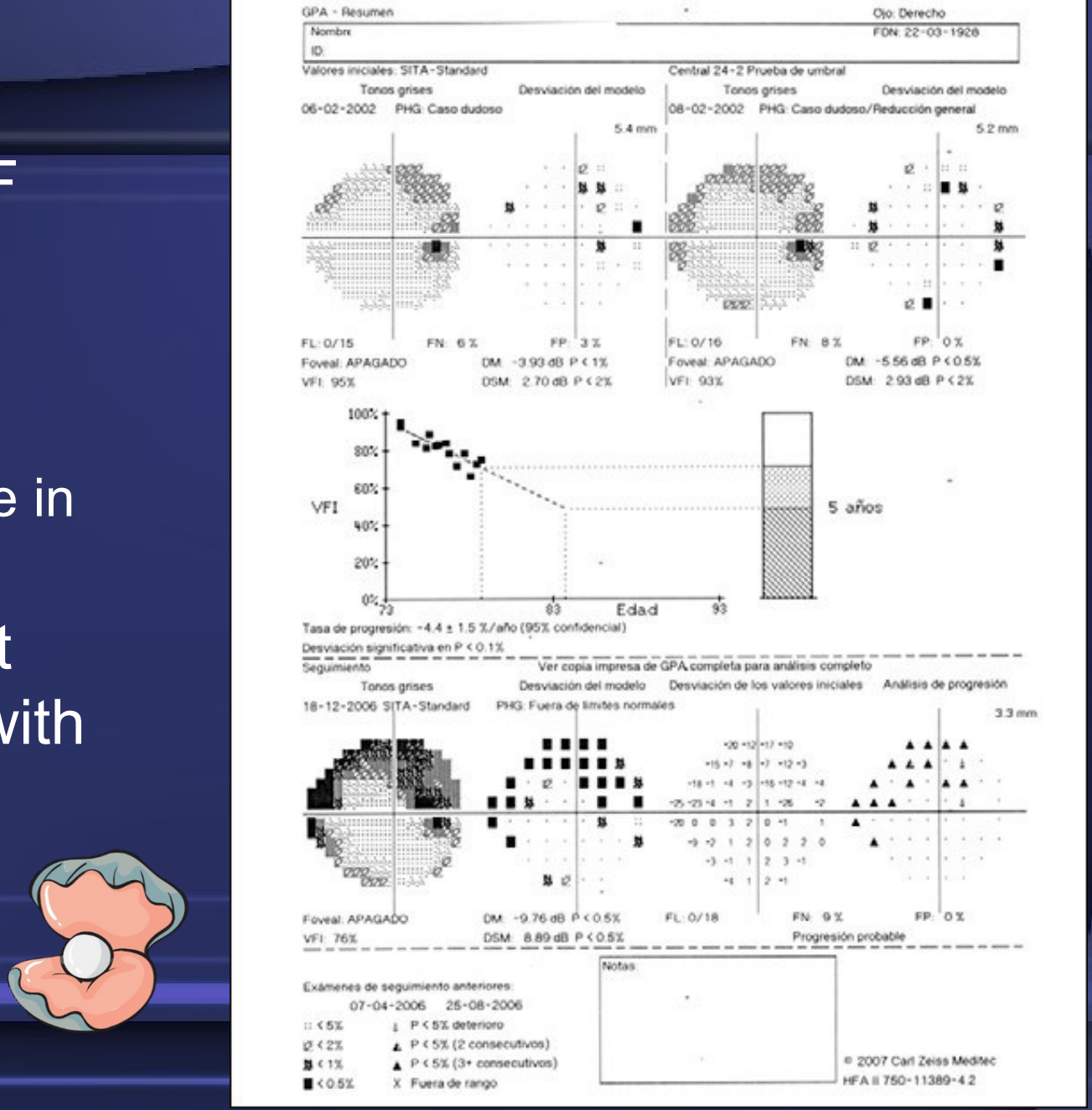
Structural Progression

- *Quantitative* OCT-based analysis
- Three structural domains
  - RNFL
  - ONH morphology
  - Macular ganglion cells
- Change less than test-retest repeatability may be noise (~5µm)
- Events (such as PVD) may masquerade as progression



Functional Progression

- *Quantitative* analysis of VF
- Two functional domains
  - Event-based: Change of specific test points
  - Trend-based: Global decline in hill of vision
- **Learning effect**: Apparent progression may resolve with repeat examination
- **Never change therapy because of a single bad visual field**



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9. Glaucoma Self-Care

Self-Care of Glaucoma

"What makes my glaucoma worse?"

- Medical non-compliance
- Chronic Valsalva
  - Weightlifting
  - Playing brass musical instruments
- Inverted body positions
  - Yoga positions
  - Inversion therapy
- Deep eye rubbing
- Corticosteroid use
  - If genetically susceptible
- Heavy caffeine consumption
  - If genetically susceptible

Self-Care of Glaucoma

"What can I do to help control my glaucoma?"

- Full medical compliance
- Regular exercise (Lowers IOP, anti-inflammatory, antioxidant)
- Yoga (lowers IOP)
- Control comorbid disease
  - CVD, sleep apnea
- Diet and supplements
  - Ginko, Palmitoylethanolamide
- Self-tonometry (iCare)
- Self-perimetry (VR)
- Medical marijuana

YALE JOURNAL OF BIOLOGY AND MEDICINE 47-353.

YALE JOURNAL OF BIOLOGY AND MEDICINE
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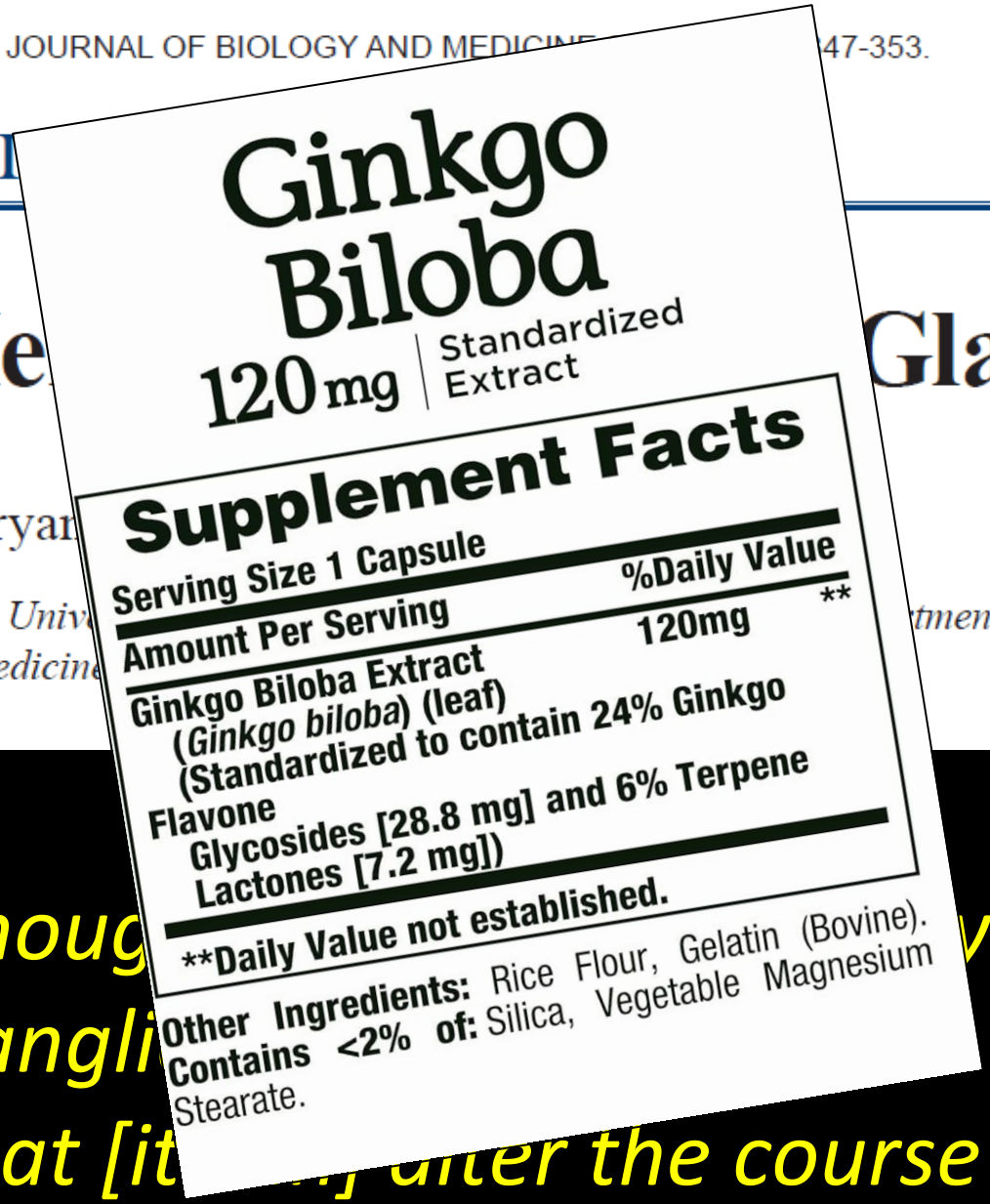

Thoug… …v preven… …wn retinal gangli… …no evidence y… …suggest that [it …] alter the course of glaucoma.

NATURAL PRODUCT RESEARCH
https://doi.org/10.1080/14786419.2024.2306916

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Palmitoyl
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ment of Clinical and Experimental Medicine

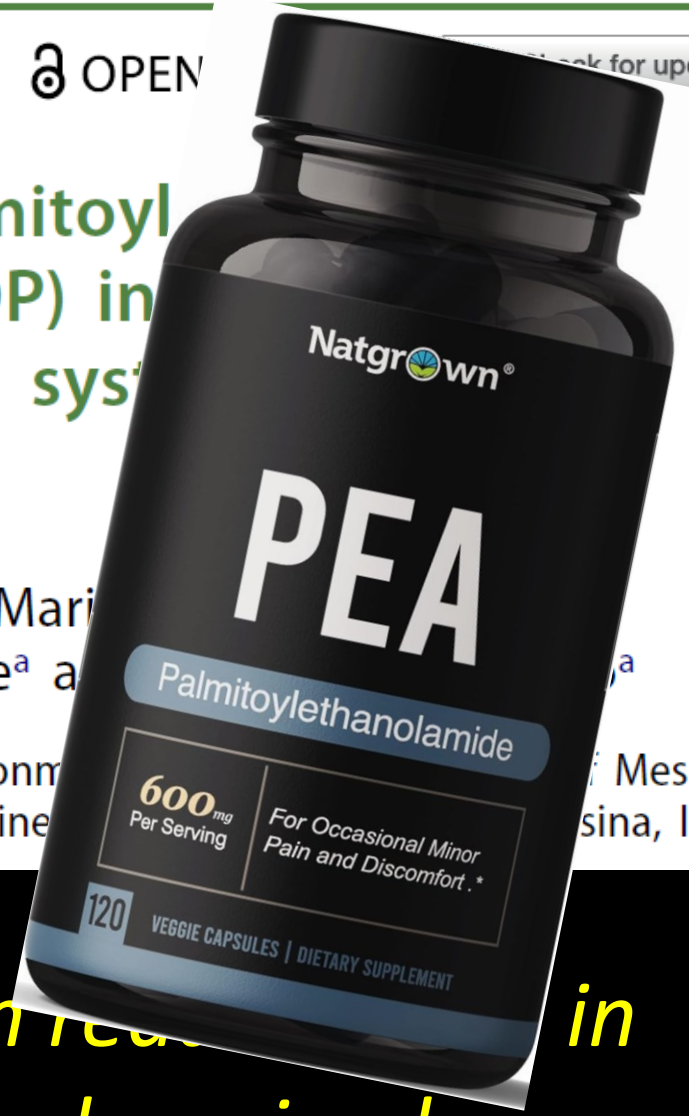
Supplement Facts

Serving Size: 2 Veggie Capsules
Servings Per Container: 60

Amount Per Serving	%DV
PEA (Palmitoylethanolamide) 600 mg	**

** Daily Value (DV) not established

Inactive Ingredients: Vegetable Cellulose (Capsules), Magnesium Stearate (Vegetable Source) Rice Flour.



PEA showed significant efficacy in [illegible] in patients, this encourages its clinical use in glaucoma.

GLAUCOMA

Elvy Musikka, one of six people receiving medical cannabis (for glaucoma) from the federal government and representative for those deprived.
Elvy is holding a month's supply of marijuana provided to her by the federal government.

" I have dedicated my life to the eradication of what I believe is our greatest enemy—ignorance!"

AMERICANS FOR MEDICAL RELIEF

EDITORIAL

American Glaucoma Society Position Statement: Marijuana and the Treatment of Glaucoma

Henry Jampel, MD, MHS

Glaucoma is a disease of the optic nerve that can result in vision loss and blindness. Although many factors, some only partially understood, contribute to the optic nerve damage in glaucoma patients, it has been definitively established that the level of intraocular pressure (IOP) is related to the presence of damage,[1] and that treatments that lower IOP reduce the risk of developing initial damage,[2] and slow the progression of preexisting damage.[3] Therefore, the mainstay of treatment for glaucoma patients is lowering the IOP.

… there is no scientific basis for use of these agents in the treatment of glaucoma.

PMID: 20160576

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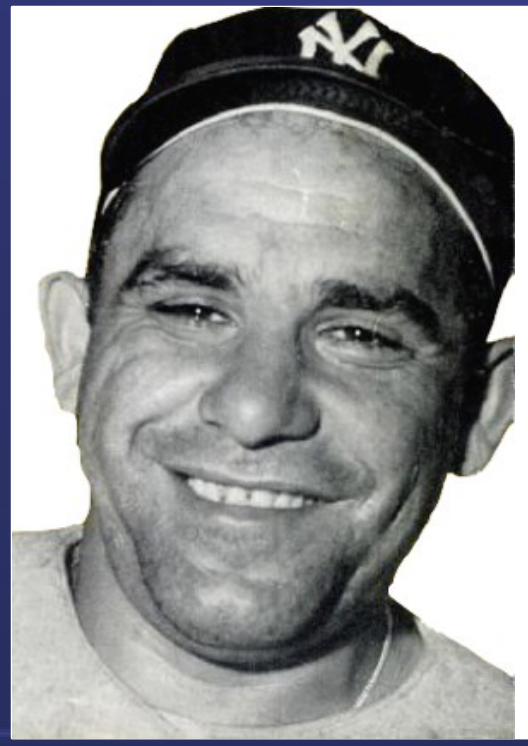
9. Glaucoma Self-Care
10. The Future of Glaucoma Care

The Future of Glaucoma Care

- Advances in laser therapy
- Sustained drug delivery devices
- New perimetry modalities
- Continuous IOP monitoring
- New MIGS procedures
- New pharmaceuticals
- Advances in imaging technology



"It's tough to make predictions, especially about the future."
Yogi Berra

Ike K Ahmed MD
theeyecomplex.com

Clinical Ophthalmology

Open Access Full Text Article

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Austeng et al. BMC Ophthalmology (2016) 16:169
DOI 10.1186/s12886-016-0348-4

BMC Ophthalmology

Eye (2021) 35:3
https://doi.org/

ARTICLE

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ADVANCED NURSING PRACTICE

Nurse-led ranibizumab intravitreal injections in wet age-related macular degeneration: a literature review

Gregg E (2017) Nurse-led ranibizumab intravitreal injections in wet age-related macular degeneration: a literature review. Nursing Standard. 31, 33, 44-52. Date of submission: 15 November 2015; date of acceptance: 7 January 2017. doi: 10.7748/ns.2017.e10344

Emma Gregg
Sister, Theatre, Moorfields Eye Hospital NHS Foundation Trust, London, England

Abstract

Aim The aim of this literature review was to explore the development of the role of specialist ophthalmic nurses in delivering ranibizumab intravitreal injections to patients with wet age-related macular degeneration (AMD), and to evaluate their contribution to reducing capacity pressures in medical retina services, while maintaining safe and effective standards of care.

Introdu
injectio

Mary-Josephin

ABSTRACT

Anti-VEGF (anti-vascular endothelial growth factor) agents are useful for a

increase in the number of IVT injections of anti-VEGF agents, clinical assessment and follow-up appointments. It became an increasing challenge to ensure treatment availability.

Hospital, Trondheim, Norway
ty of Science and Technology, Trondheim, Norway
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biosensors

PMID: 37367028

MDPI

Review

Current Innovations in Intraocular Pressure Monitoring Biosensors for Diagnosis and Treatment of Glaucoma—Novel Strategies and Future Perspectives

Rubiya Raveendran [1], Lokesh Prabakaran [1], Rethinam Senthil [2], Beryl Vedha Yesudhason [3], Sankari Dharmalingam [4], Weslen Vedakumari Sathyaraj [1,*] and Raji Atchudan [5,6,*]

[1] Faculty of Allied Health Sciences, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam 603103, Tamil Nadu, India; rubijrf23@gmail.com (R.R.);

Recent advancements in microfluidics, nanotechnology and electronics have led to the development of novel implantable and wearable biosensors for the expedient monitoring of diseases such as glaucoma.

The future of glaucoma care includes continuous 24/7 monitoring of IOP

- Numerous continuous IOP monitoring technologies are currently under investigation
- Many involve implanting a device into the AC

DOI: 10.1002/nano.202100137

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