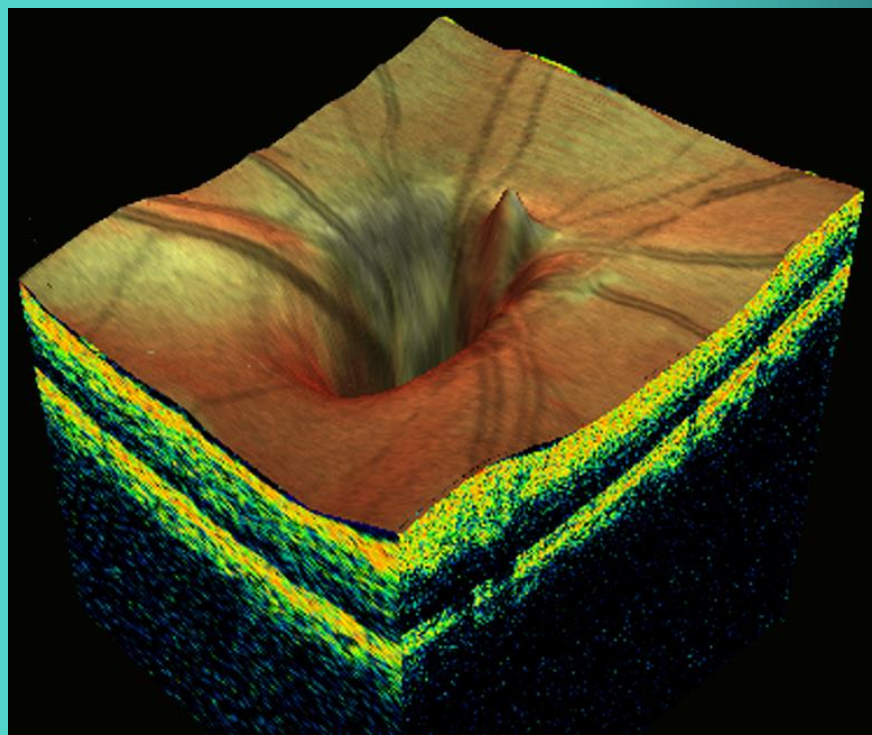
21st Century Glaucoma Care

Rick Trevino, OD, FAAO
Rosenberg School of Optometry
University of the Incarnate Word

21st Century Glaucoma Care

- Online notes
  - richardtrevino.net
- Email me
  - rctrevin@uiwtx.edu
- Disclosures
  - Research support from iCare



21st Century Glaucoma Care

Welcome to the Iowa Glaucoma Curriculum

About the Iowa Glaucoma Curriculum

This is a teaching site for residents and others interested in learning about glaucoma.

It breaks glaucoma into fifty bite-sized lectures that average 14 minutes in length (range 4 to 37 minutes). In total the curriculum is just under 12 hours long.

It is highly visual with >900 images and >90 movie clips.

Taking care of glaucoma can be very hard, but I am hoping that I have made learning about this family of diseases somewhat easier.

READ MORE

iowaglaucoma.org

21st Century Glaucoma Care

- History & Risk Factors
- Evaluation Procedures
- Management
- Patient-Centered Care

Self Assessment Quiz

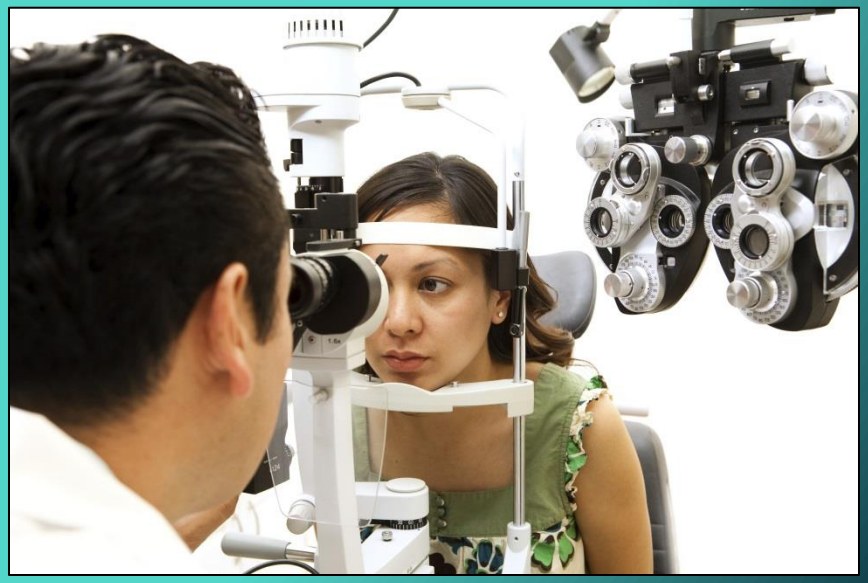
Are you attending this CE course?

- If so, award yourself 1 point
- If not, award yourself 0 points

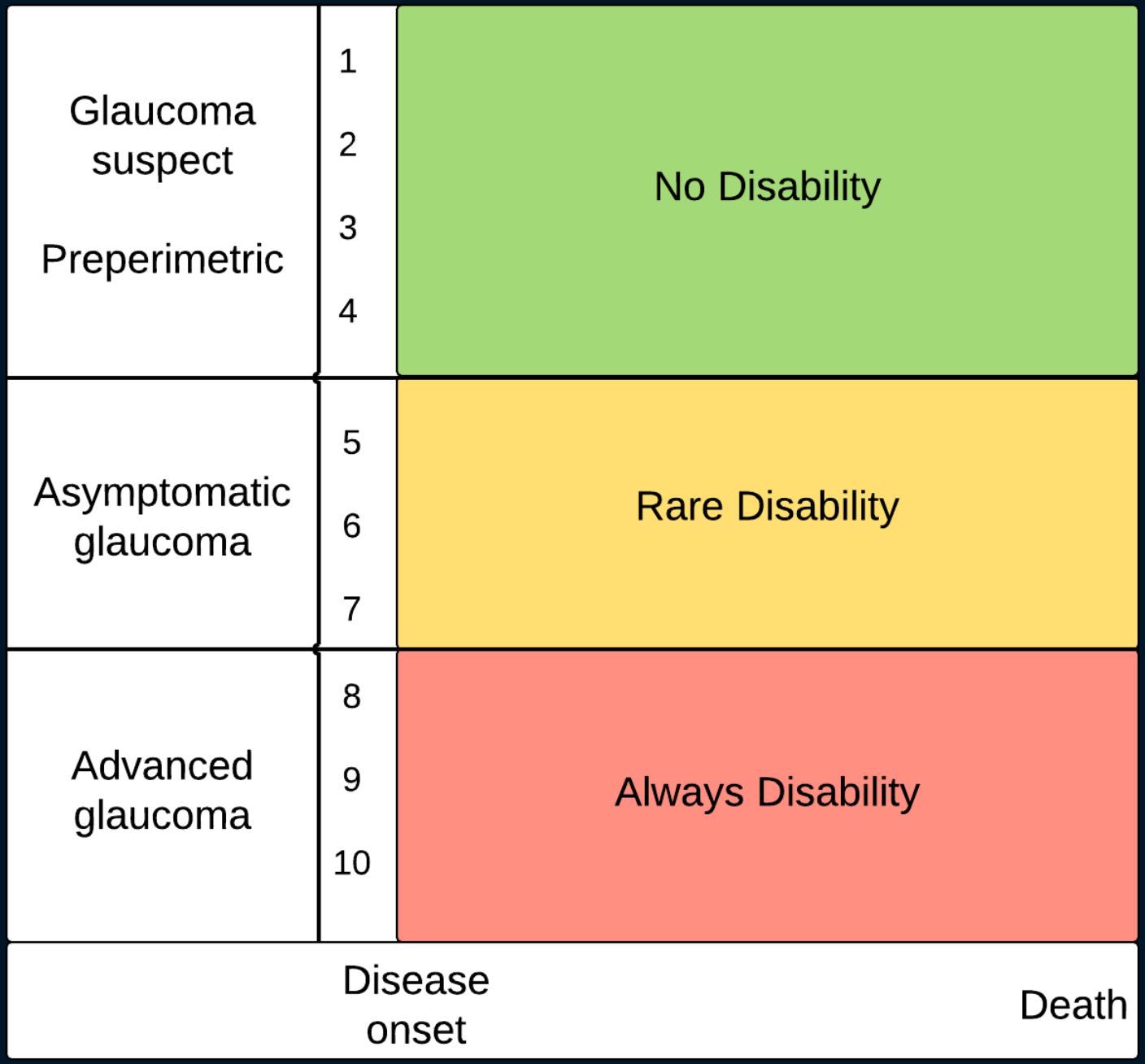
21st Century Glaucoma Care

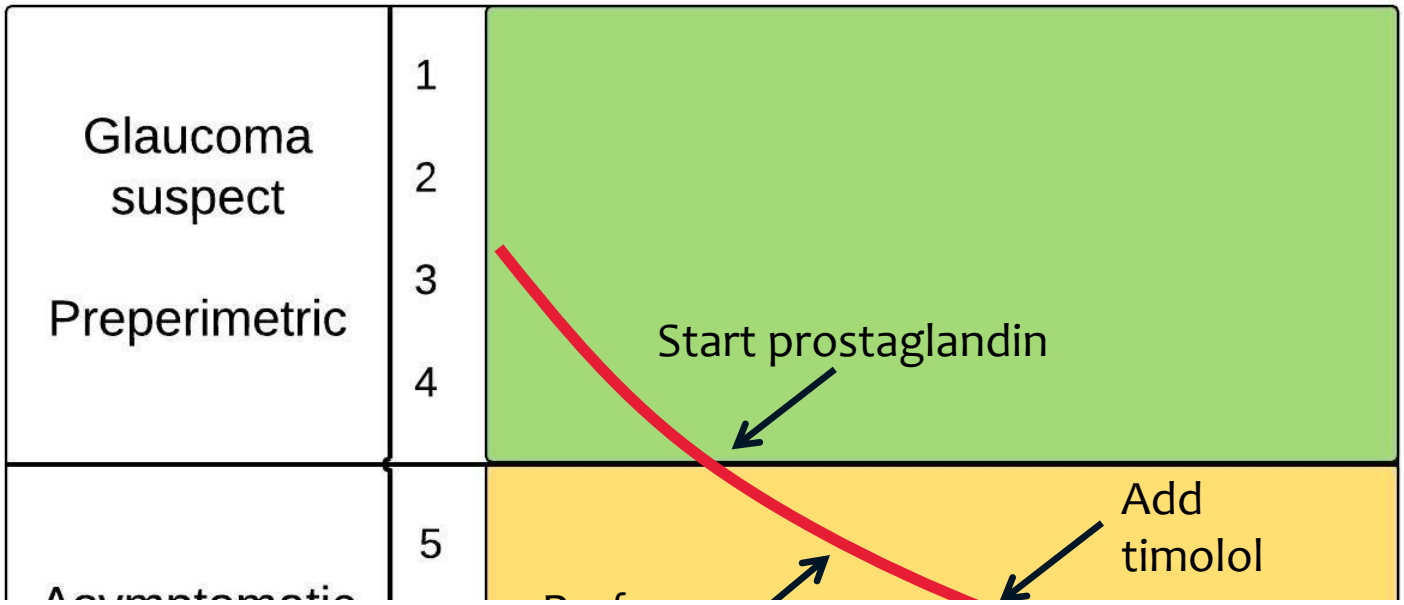
- **The Glaucoma Graph**
  - Patient-centered model for glaucoma care

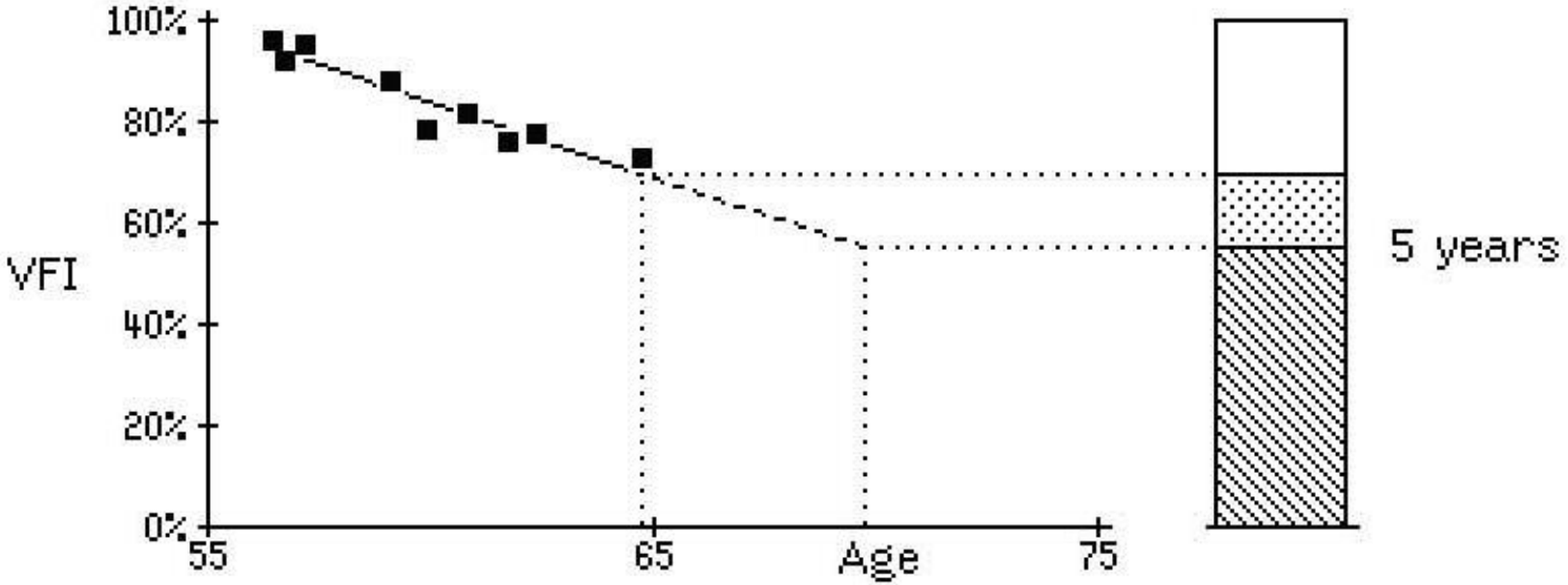
- Defining our role
  - Saving axons
  - Preserving quality of life



The Spaeth Glaucoma Graph. Glaucoma patients remain asymptomatic until the diseased is advanced. Prior to that point, from the patient's perspective the ***treatment is often worse than the disease***



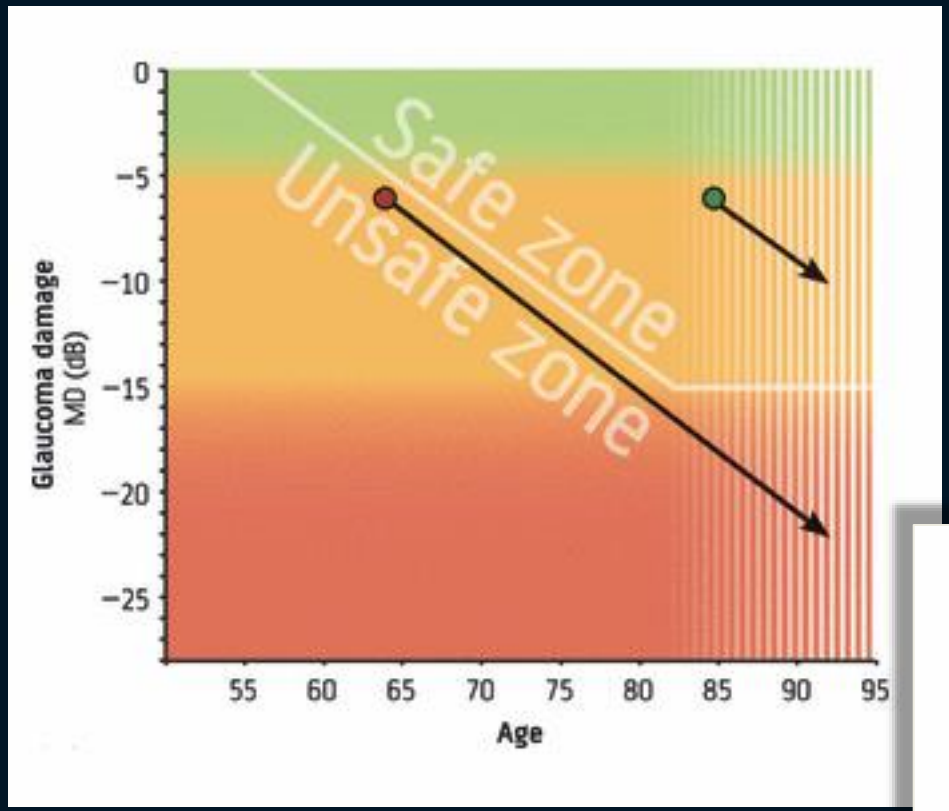


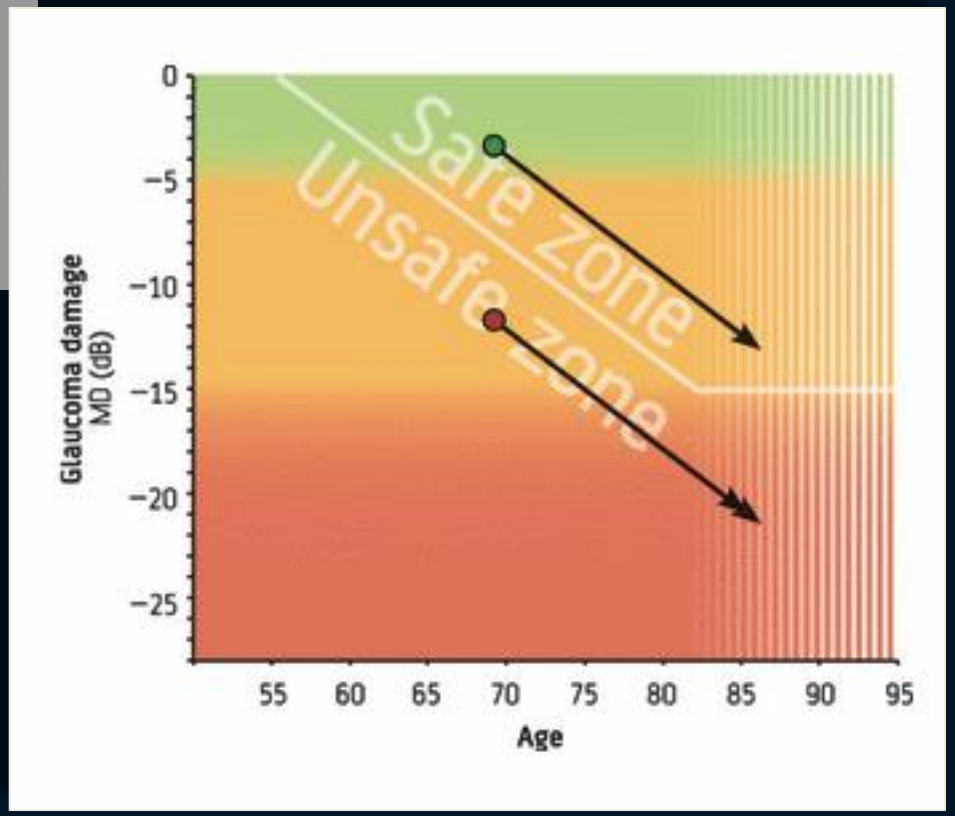


Rate of Progression: −3.0 ± 0.9 %/year (95% confidence)

Slope significant at P < 0.1%

Safe zones on the glaucoma graph





In general…

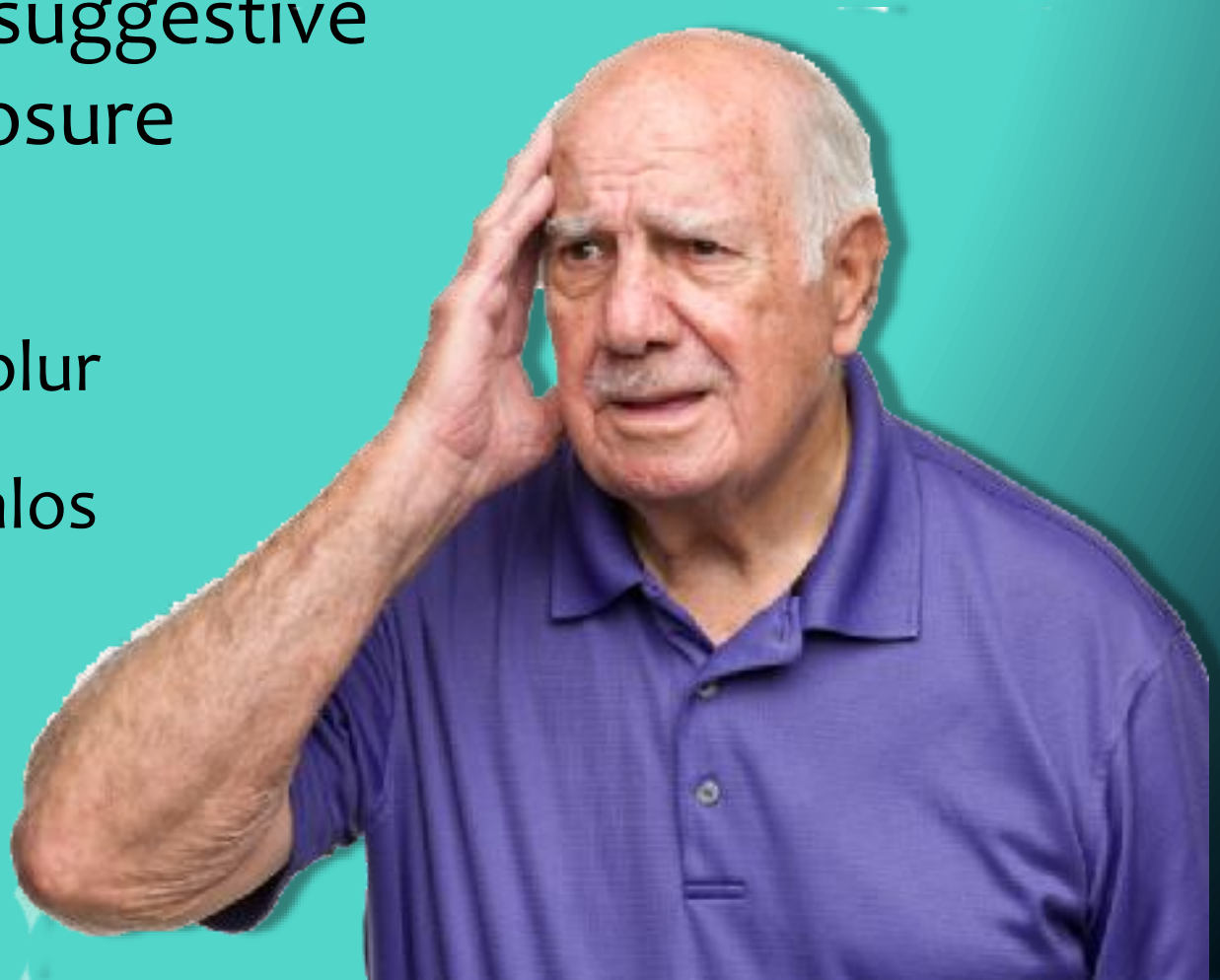
- Younger patients are treated more aggressively than older patients
- Severe disease is treated more aggressively than mild disease

21st Century Glaucoma Care

- History & Risk Factors
- Evaluation Procedures
- Management
- Patient-Centered Care

History & Risk Factors

- Symptoms suggestive of angle-closure
  - **Browache**
  - Transient blur
  - Colored halos



History & Risk Factors

Open Angle → Meds, SLT

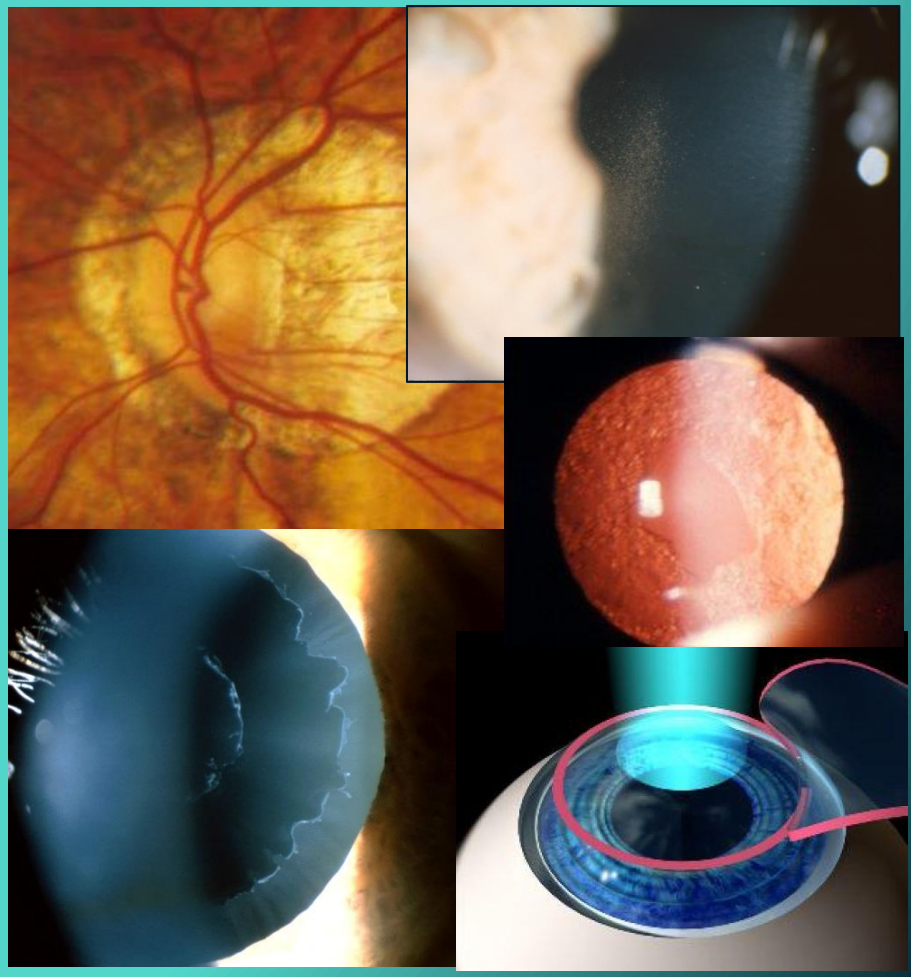
Closed Angle → LPI, CLE

Job #1 at the initial presentation…

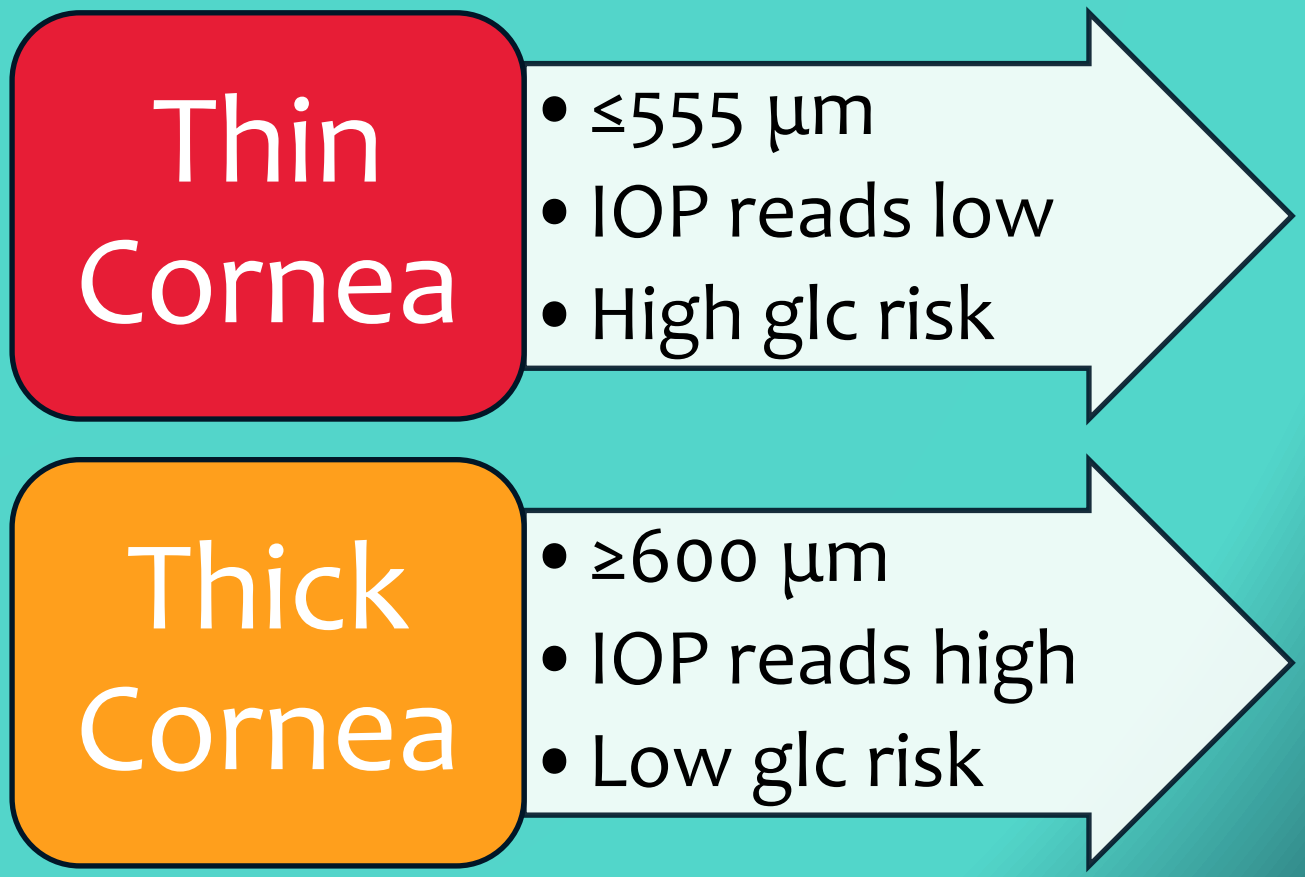
Is angle-closure contributing to the disease process?

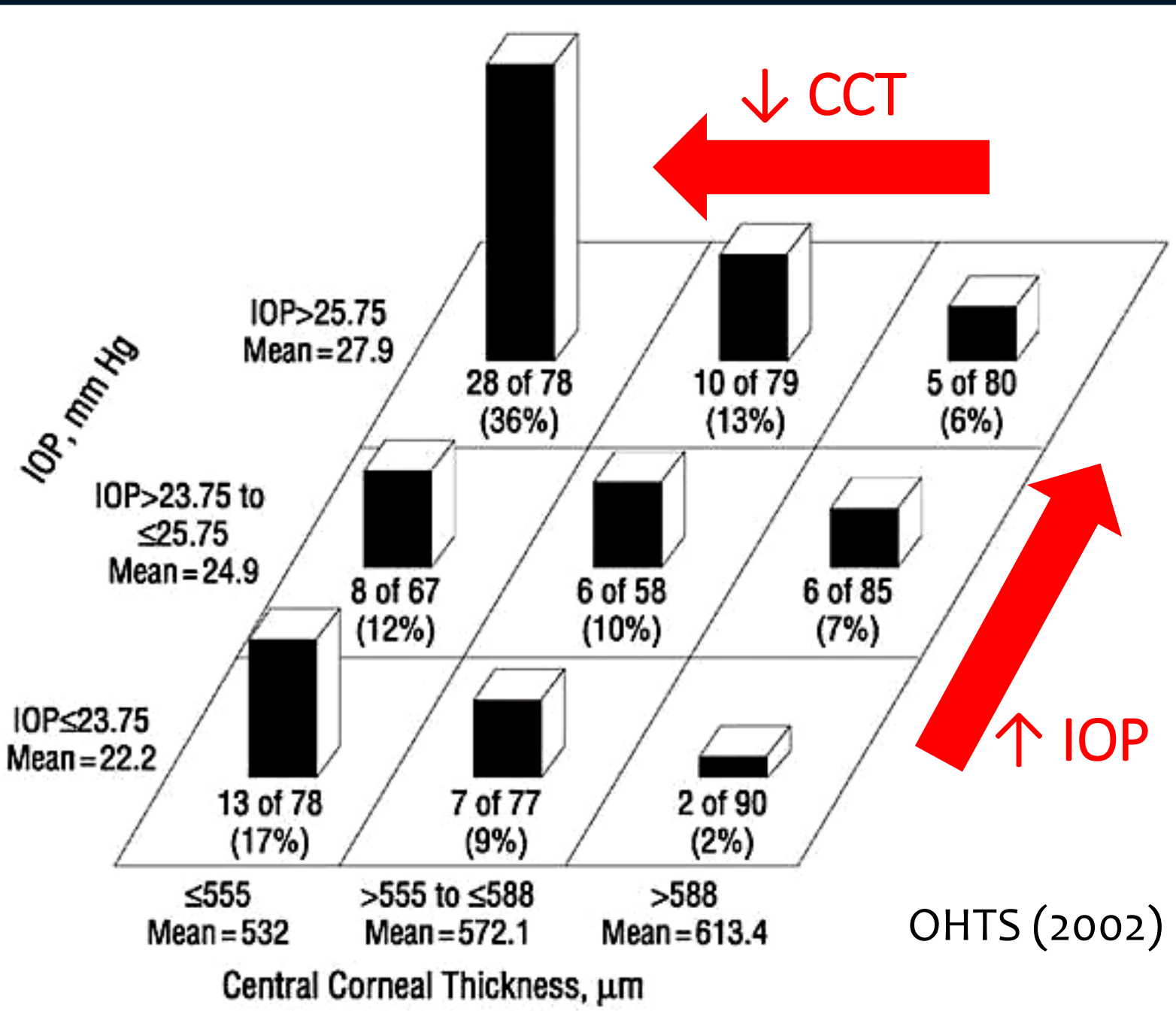
History & Risk Factors

- Ocular Factors
  - **Corneal thickness**
  - Corneal hysteresis
  - Disc Hemorrhages
  - Capsulotomy
  - LASIK



Evaluation Procedures




↓ CCT
↑ IOP
IOP, mm Hg
IOP>25.75
Mean=27.9
IOP>23.75 to
≤25.75
Mean=24.9
IOP≤23.75
Mean=22.2
28 of 78
(36%)
10 of 79
(13%)
5 of 80
(6%)
8 of 67
(12%)
6 of 58
(10%)
6 of 85
(7%)
13 of 78
(17%)
7 of 77
(9%)
2 of 90
(2%)
≤555
Mean=532
>555 to ≤588
Mean=572.1
>588
Mean=613.4
Central Corneal Thickness, µm

OHTS (2002)

History & Risk Factors

- Risk Calculators
  - **Quantitative 5yr risk** assessment using OHTS data
  - Online, cell phone app, and PDF formats
  - Google "glaucoma risk calculator"

THIN CORNEAS
GAT under-estimates by 5.5 mmHg

THICK CORNEAS
GAT over-estimates by 2.2 mmHg

DCT: 16.7 → 17.5 → 17.5 → 18.1 → 17.3

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.

GAT: 11.2 → 13.2 → 14.1 → 16.3 → 19.5

8.3 mmHg difference

Mean DCT readings and mean GAT measurements according to CCT stratification.

Jordao, 2009

History & Risk Factors

- How do you correct for CCT?
  - There is no valid correction formula
  - Expect large under-estimation with CCT <525

Large ONH → Large optic cup

Thin CCT → Under-estimate IOP

What if I don't have a pachymeter?

- CCT is very important in management of glaucoma suspects
  - Interpretation of tonometry
  - Glaucoma risk in OHT
- CCT less important in management of manifest glaucoma
  - No increased risk of progression

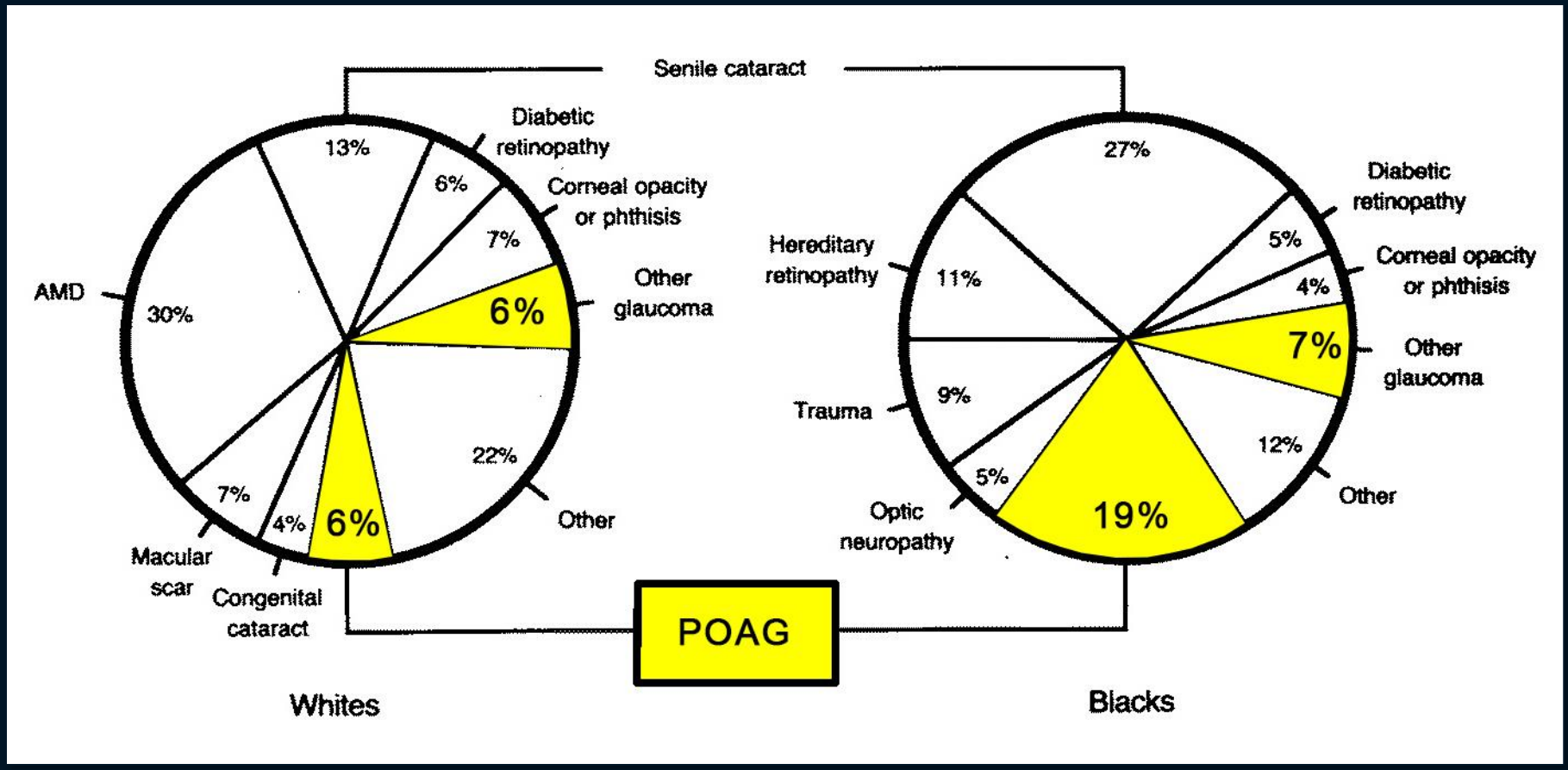
Self Assessment Quiz

Do you perform pachymetry on glaucoma suspects?

- If so, award yourself 1 point
- If not, award yourself 0 points

History & Risk Factors

- Systemic Factors - Race
  - POAG: African-Americans
    - More common and more severe
  - Angle-closure: Asians
    - China has highest prevalence worldwide
  - Exfoliation: Scandinavian
    - Rare outside northern latitudes



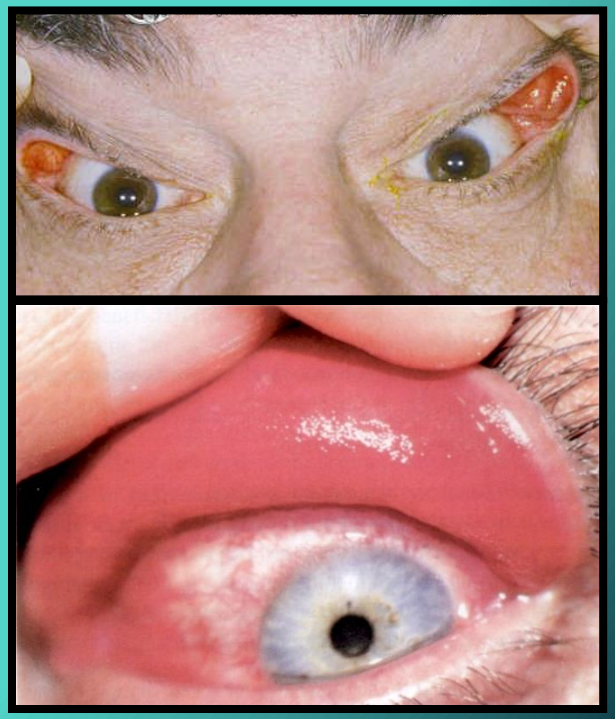
Causes of Legal Blindness in the Baltimore Eye Survey

Study population was 50% white and 50% black

POAG accounted for 6% of blindness among whites and 19% among blacks

History & Risk Factors

- Systemic Factors – Medical
  - **Sleep apnea**
    - Floppy lids signal higher glaucoma risk
  - Diabetes
    - Always look for rubeosis
  - Current or past steroid use
  - Family history
    - First degree relatives only



96% of patients with FES have sleep apnea

Patients with FES have sleep apnea until proven otherwise

Floppy Eyelid Syndrome as an Indicator of the Presence of Glaucoma in Patients With Obstructive Sleep Apnea

MaJesús Muniesa, MD,† Manuel Sánchez-de-la-Torre, PhD,†‡§‖*
Valentín Huerva, MD,† Marina Lumbierres, MD,†‡§‖ and Ferran Barbé, MD†‡§‖*

Purpose: The aim of the study was to investigate whether floppy eyelid syndr
patients with

Materials an
patients with
FES; and 25
by easy upper
the patients
to diagnose
and retinal
tomography.

Results: The
was 5.33% (4
and 3 had
glaucoma in OSA patients with FES was 23.07% (12/52). Six patients had normal-tension glaucoma, 5 had primary open-angle glaucoma and one patient had previously diagnosed glaucoma. None of the 25 patients without OSA had glaucoma. The difference

	Glaucoma
OSA + FES	23%
OSA – FES	5%
Controls	0%

most consistently reported associations of FES is with obstructive sleep apnea syndrome (OSA).[3,4] The prevalence
to 32%,[4]
cterized by
bstructions
nea is asso-
associated
isk of car-
The preva-
and 5% in
indings in
us,[8] papil-
a.[11–16] The
varies from
–16] Only 2
studies[3,7] have previously examined the association between FES and glaucoma. McNab[3] reported 1 in 8 patients (12.5%) with FES and OSA having normal-tension glau-

J Glaucoma 2014;23:e81–e85

Self Assessment Quiz

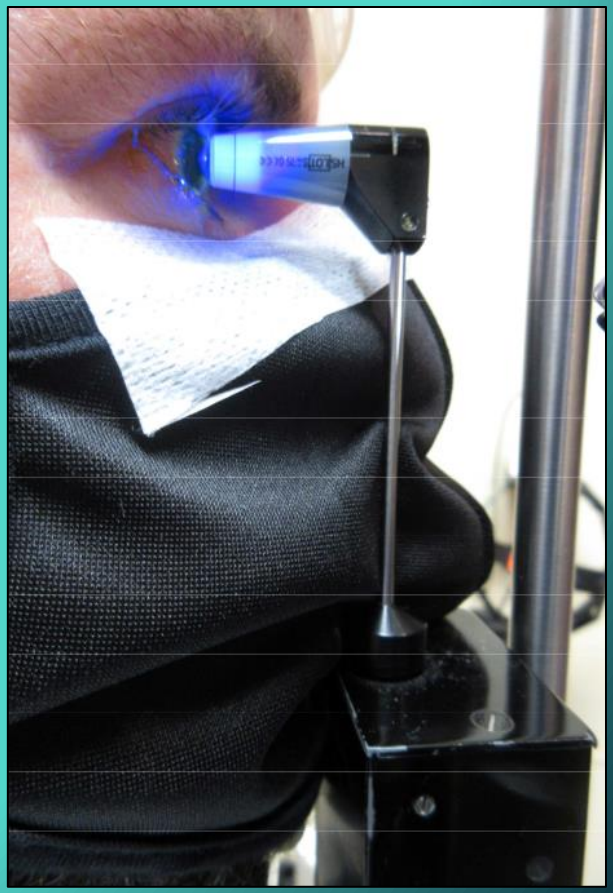
Do you screen at-risk patients for floppy eyelid syndrome?

- If so, award yourself 1 point
- If not, award yourself 0 points

NEW!

History & Risk Factors

- Systemic Factors – Medical
  - **COVID**
    - Mask-induced GAT error
    - NCT produced **tear aerosol** up to 50 cm
    - Report that survivors of severe COVID infection have elevated IOP
    - Case report of COVID-associated BAIT with IOP 32 mmHg OD, 38 mmHg OS



PMID: 34124990, 33298779, 33909233, 34040094

History & Risk Factors

- Systemic Factors – Lifestyle
  - **Exercise**
  - **Ginko biloba**
  - Diet & obesity
    - Evidence of detrimental effect of high or low BMI
    - Possible benefit of veggies, omega-3s, and tea
  - Marijuana
    - Short duration of action, lack of scientific evidence
    - CBD may elevate IOP

Cur Opin Ophthalmol 2019;30:82

AMERICAN ACADEMY OF OPHTHALMOLOGY®

Greater Physical Activity Is Associated with Slower Visual Field Loss in Glaucoma

Moon Jeong Lee, BS,[1] Jiangxia Wang, MS,[2] David S. Friedman, MD, PhD,[1] Michael V. Boland, MD, PhD,[1] Carlos G. De Moraes, MD, MPH,[3] Pradeep Y. Ramulu, MD, PhD[1]

Purpose: To determine the association between physical activity levels and the rate of visual field (VF) loss in glaucoma.

Design: Longitudinal, observational study.

Participants: Older adults with suspect or manifest glaucoma.

"Physical activity was associated with less VF progression in patients with glaucoma. Specifically, **increased steps per day, minutes of non-sedentary activity, and minutes of moderate-to- vigorous physical activity** were associated with slower rates of decline."

Ophthalmology 2019;126:958

Ginkgo Biloba

- Extract from the leaves and seeds of the ginkgo biloba tree
- Many beneficial effects
  - Increased blood flow
  - Anti-inflammatory
  - Antioxidant
  - Neuroprotection
- Found to increase survival of RGC in animal models of optic nerve injury
- **120 mg/day** reported to be safe and effective

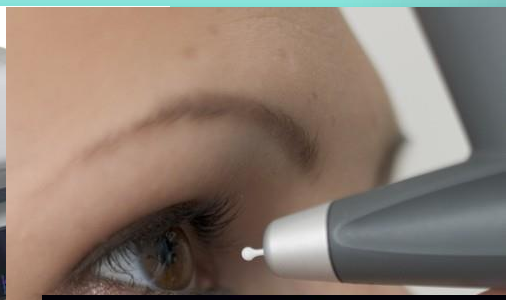
PMID 32282348

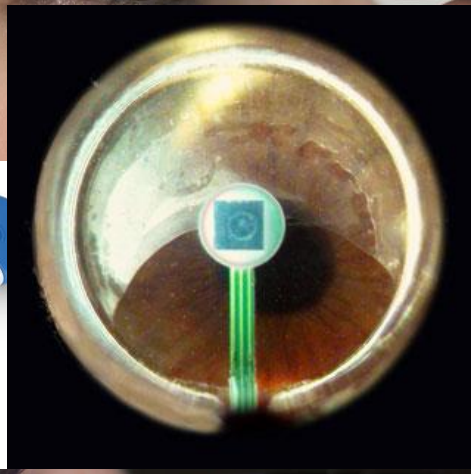
21st Century Glaucoma Care

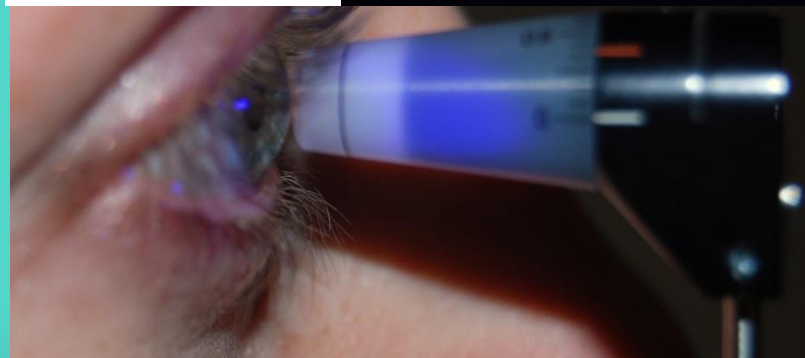
- History & Risk Factors
- Evaluation Procedures
- Management
- Patient-Centered Care

Evaluation Procedures

- Tonometry Options
  - NCT
  - **iCare**
  - Tonopen
  - GAT
  - DCT





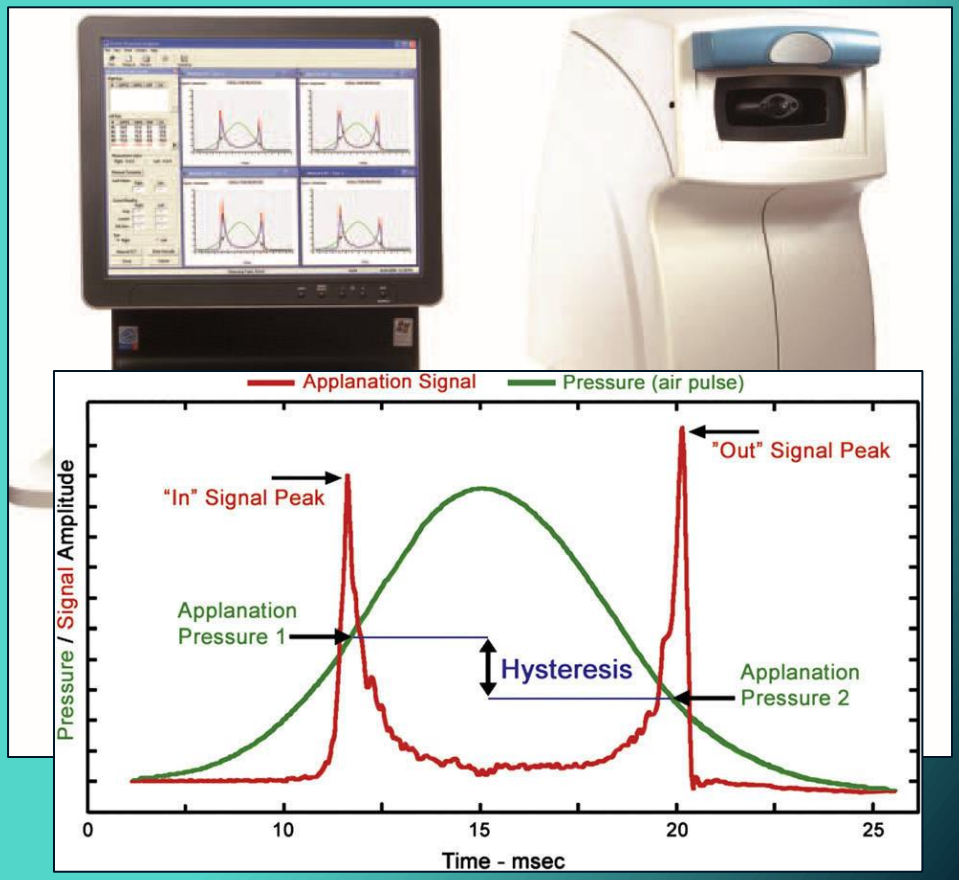


Noncontact Tonometry

Evaluation Procedures

Low **corneal hysteresis** is a glaucoma risk factor

- Increased risk of developing glaucoma
- Increased risk of glaucoma progression



PMID 25611166

Evaluation Procedures

- iCARE
  - Pros: No anesthesia, min tech training, min discomfort, handheld, irregular corneas
  - Cons: Variability (avg 6 readings), **consumable tips**
  - Clinical Value: **Excellent for kids** and bedside/wheelchair exams. Potential for **home use**

NEW!

Assessing the Reliability of Intraocular Pressure Measurements Using Rebound Tonometry

[1]Tony Realini, [1]Brian McMillan, [2]Ronald L. Gross, [3]Eva Devience, [4]Goundappa K. Balasubramani

1. Department of Ophthalmology and Visual Sciences, West Virginia University, 1 Medical Center Drive, Morgantown, WV, 26506

2. Southern Eye Group, 3290 Dauphin Street #500, Mobile, AL, 36606

3. Mid-Atlantic Permanente Medical Group, 7141 Security Boulevard, Baltimore, MD, 21244.

4. Department of Epidemiology, Graduate School of Public Health, University of Pittsburgh, 4420 Bayard Street, Suite 600, Pittsburgh, PA, 15260.

"Icare's lower measurement variability and good inter-operator and inter-device reproducibility suggest that it can characterize IOP changes over time more robustly than Goldman tonometry."

PMID 34049350

News / 03.22.2017

FDA Cleared Icare® HOME, An Innovative Device Poised To Revolutionize IOP Self-Monitoring

RALEIGH, NC, March 21, 2017—Icare USA, a subsidiary of Icare Finland, the original developer and global leader in handheld tonometry, announces that the Icare® HOME tonometer has been cleared by the FDA and is now available for use in the United States.

The Icare® HOME device, which received CE Marking in 2014, has quickly become an essential tool in Europe. Eye care professionals have come to rely on the added clinical data it provides of how their patients' IOP fluctuates throughout the day. Thanks to this recent clearance by the FDA, doctors in the United States can also now benefit from the ability to monitor patients with more regularity and confidence.

https://www.icare-usa.com

Evaluation Procedures

Clinical Ophthalmology

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Self-monitoring of intraocular pressure using Icare HOME tonometry in clinical practice

This article was published in the following Dove Press journal:
Clinical Ophthalmology

Barbara Cvenkel[1,2]
Makedonka Atanasovska Velkovska[1]

[1]Department of Ophthalmology, University Medical Centre Ljubljana,

Purpose: To determine the value of self-monitoring of diurnal intraocular pressure (IOP) by Icare Home rebound tonometer in patients with glaucoma and ocular hypertension.

Methods: Patients with open-angle glaucoma or ocular hypertension, controlled IOP at office visits, and at least 3 years of follow-up in the glaucoma clinic were included. Progression of glaucoma was based on medical records and defined by documented structural

"Icare Home self-tonometer was found to be safe, reliable, reproducible, usable by the majority of patients, and demonstrated reasonable agreement with the reference standard GAT."

Clin Ophthalmol 2019;13:841

NEW!

N OPHTHALMOLOGY
OL. 36, NO. 4, 310–314
ps://doi.org/10.1080/08820538.2021.1896759

Taylor & Francis
Taylor & Francis Group

REVIEW

Home Monitoring for Glaucoma: Current Applications and Future Directions

Inas F. Aboobakar and David S. Friedman

Department of Ophthalmology , Massachusetts Eye and Ear, Harvard Medical School, Boston, MA, USA

ABSTRACT

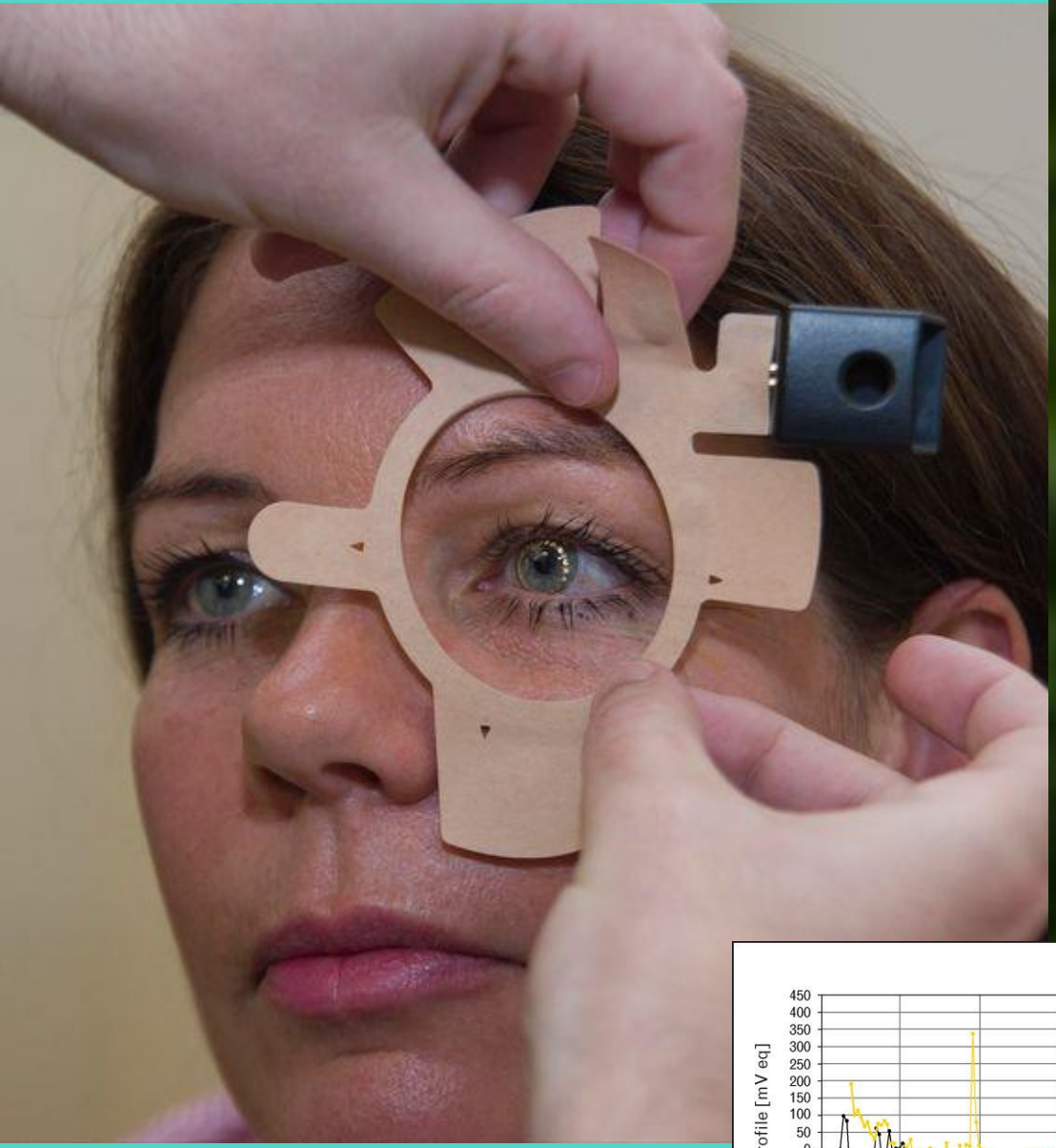
Technological advances provide a number of options for glaucoma monitoring outside the office setting, including home-based tonometry and perimetry. This has the potential to revolutionize management of this chronic disease, improve access to care, and enhance patient engagement. Here, we provide an overview of existing technologies for home-based glaucoma monitoring. We also discuss areas for future research and the potential applications of these technologies to telemedicine, which has been brought to the forefront during the ongoing COVID-19 pandemic.

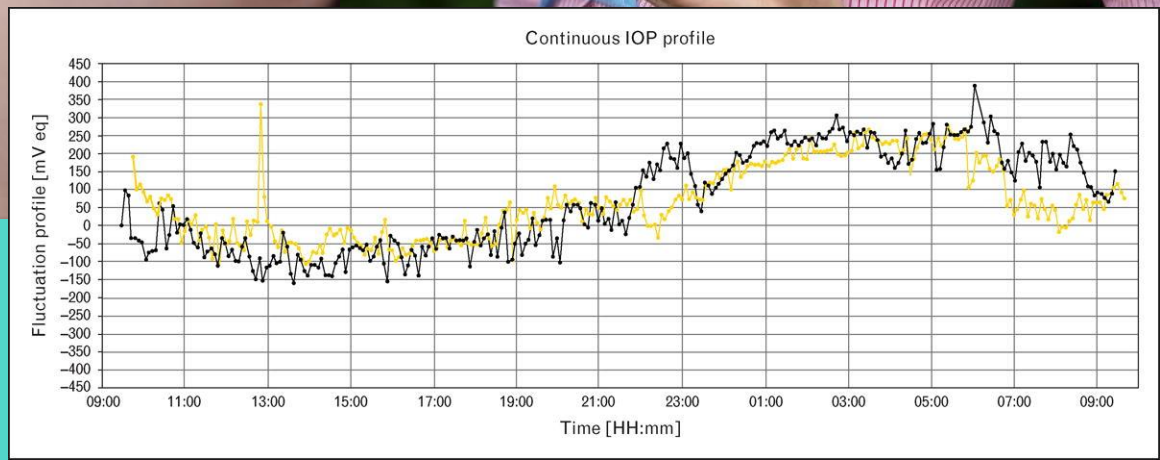
ARTICLE HISTORY
Received 19 February 2021
Accepted 19 February 2021

KEYWORDS
COVID-19; handheld OCT; home perimetry; home tonometry; telemedicine

Home tonometry may play an important role in select patient populations, including postop patients at risk for IOP spikes as well as patients who are progressing with relatively good IOP readings during daytime clinic visits.

PMID 33689562





Sensimed Triggerfish contact lens sensor

Clinical & Experimental Ophthalmology

RANZCO

Clinical and Experimental Ophthalmology 2017; 45: 625–631 doi: 10.1111/ceo.12925

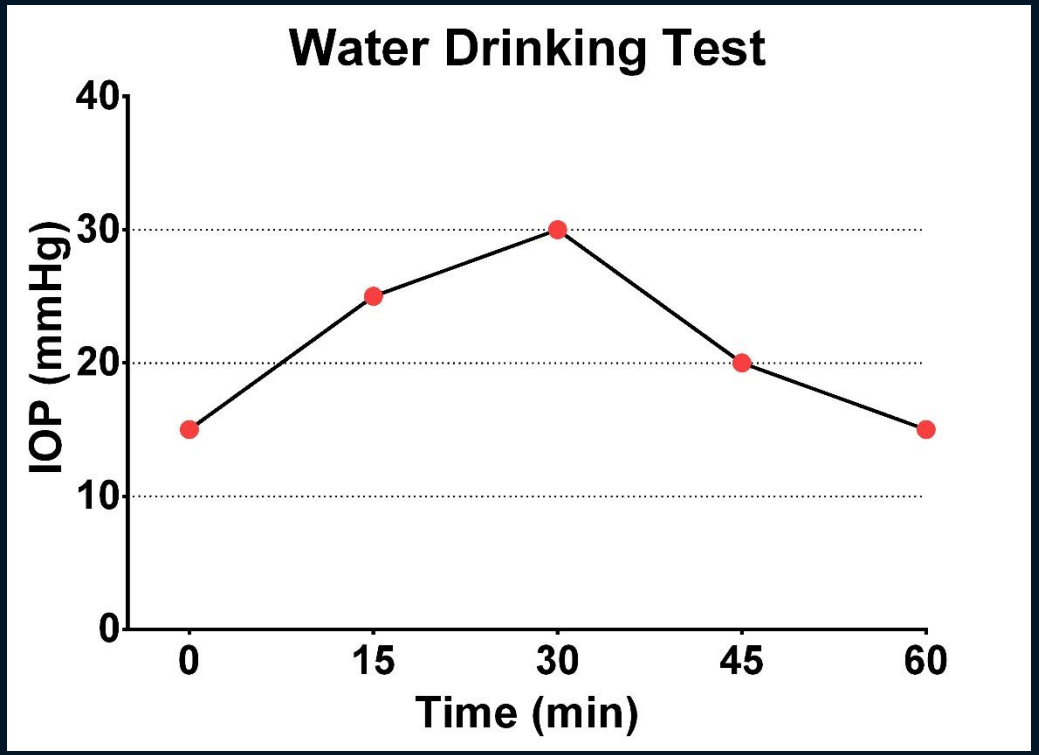
Review

Applications of the water drinking test in glaucoma management

Remo Susanna Jr, MD,[1] Colin Clement PhD FRANZCO,[2,3,4] Ivan Goldberg AM FRANZCO[2,3,4] and Marcelo Hatanaka MD[1]

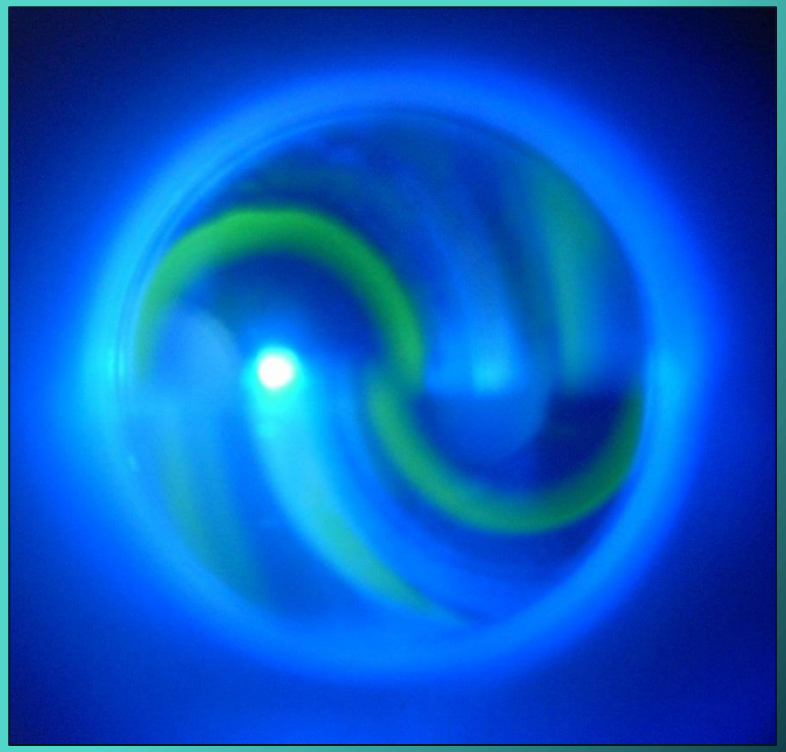
[1]University of São Paulo School of Medicine, São Paulo, Brazil; [2]Discipline of Ophthalmology, University of Sydney, [3]Glaucoma Unit, Sydney Eye Hospital, and [4]Eye Associates, Sydney, New South Wales, Australia

"The peak IOP elicited by this test strongly correlates to IOP peaks that occur during the day."



Evaluation Procedures

- Goldmann
  - Pros: The **Gold Standard**
  - Cons: Anesthesia, extensive training and skill
  - Clinical value: **Glaucoma management**

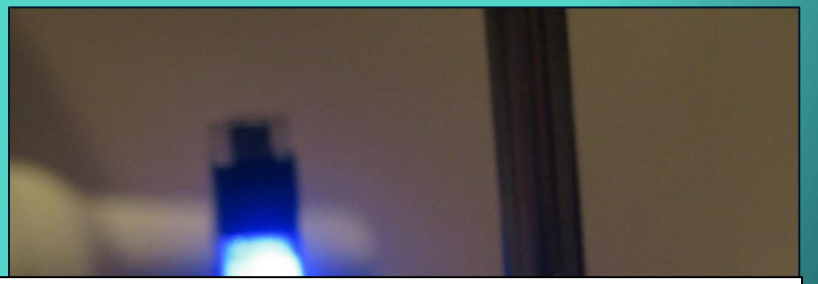


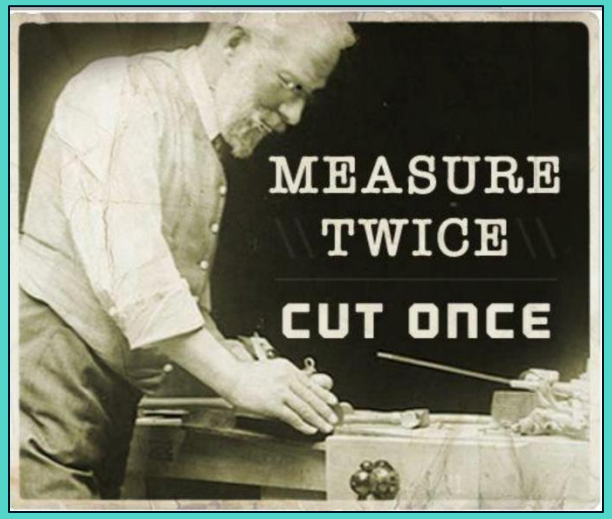
QUESTION

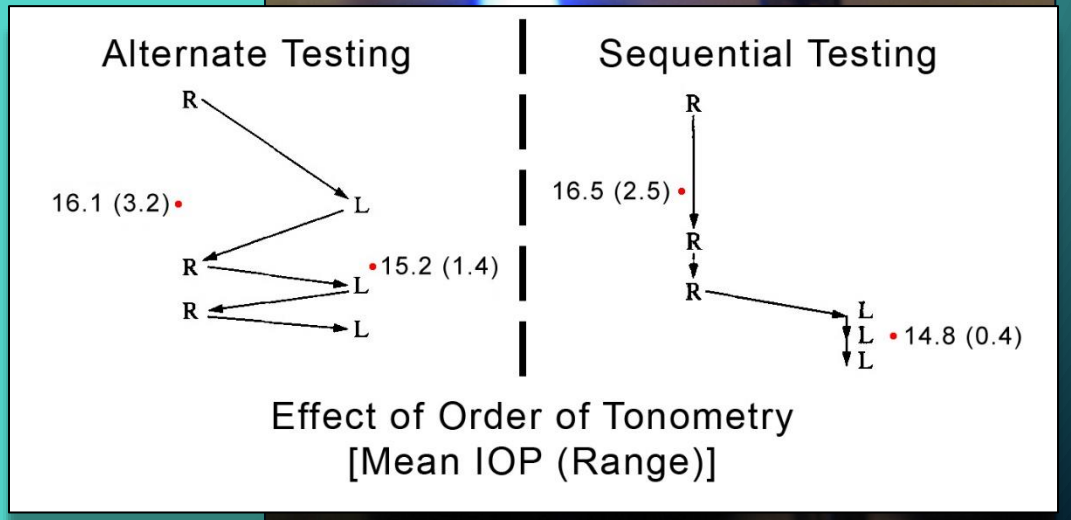
When performing GAT how do you know whether your reading is accurate?

ANSWER:

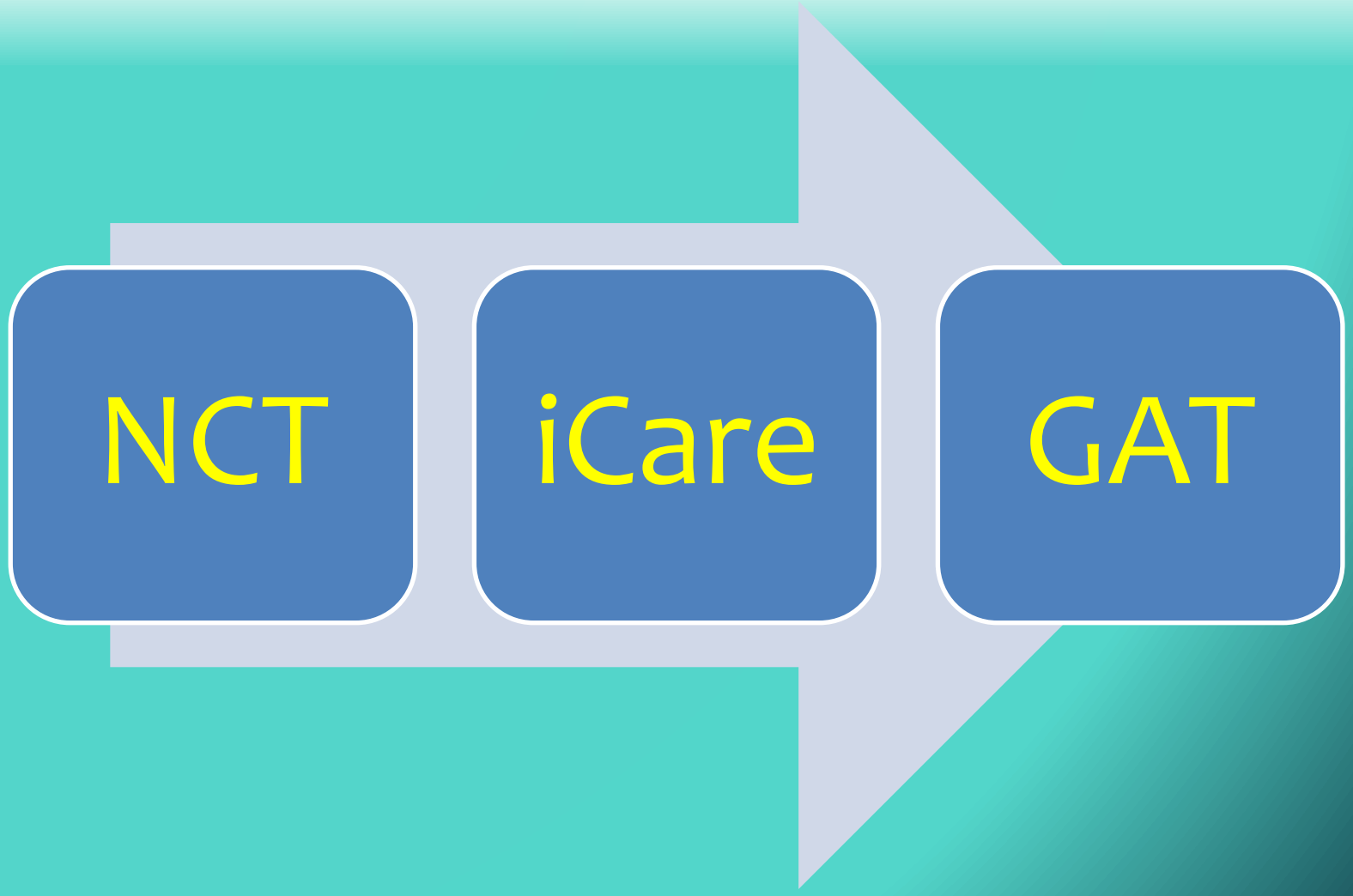
REPEAT IT! Do you get the same reading twice?







TONOMETRY ADVICE



NEW!

Clinical Ophthalmology

Dovepress
open access to scientific and medical research

Open Access Full Text Article

REVIEW

Reliability of Intraocular Pressure Measurement by Goldmann Applanation Tonometry After Refractive Surgery: A Review of Different Correction Formulas

"We think the real problem is that so far... **only a few methods have been tested in a sufficient number of patients**, while most of them are just theoretical."

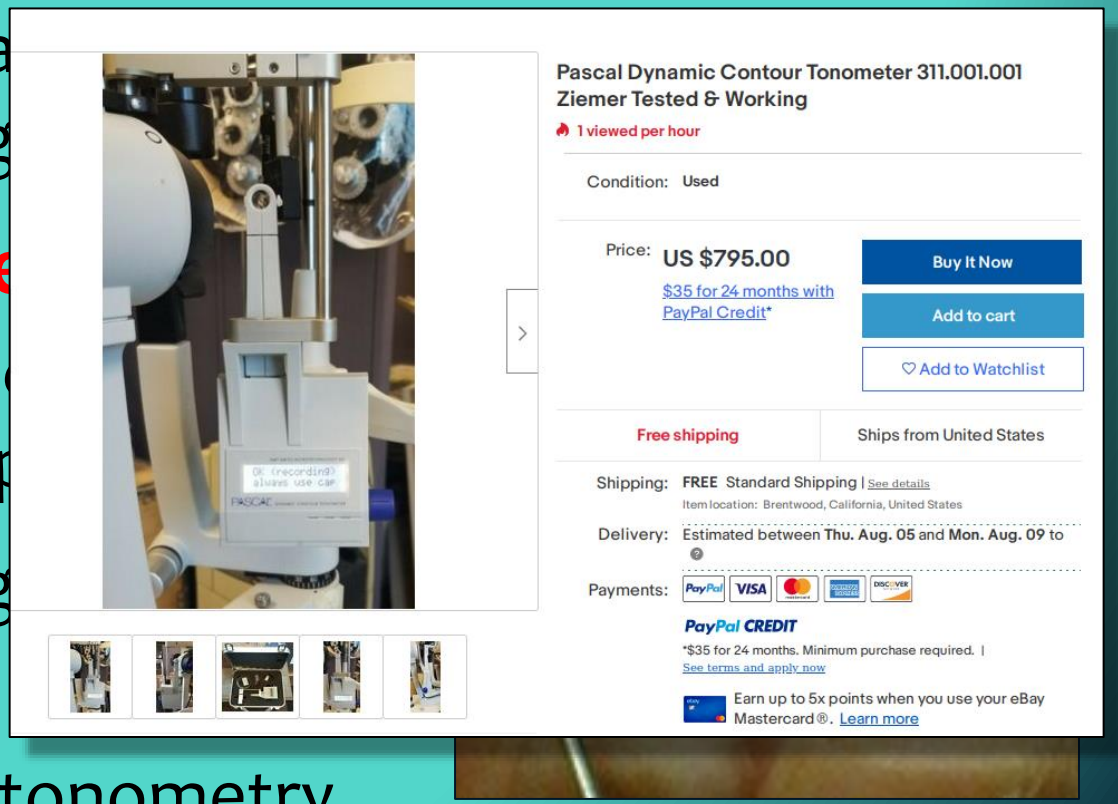
PMID 33061262

Evaluation Procedures

- Tonometry after LASIK
  - Large inaccura
    refractive surg

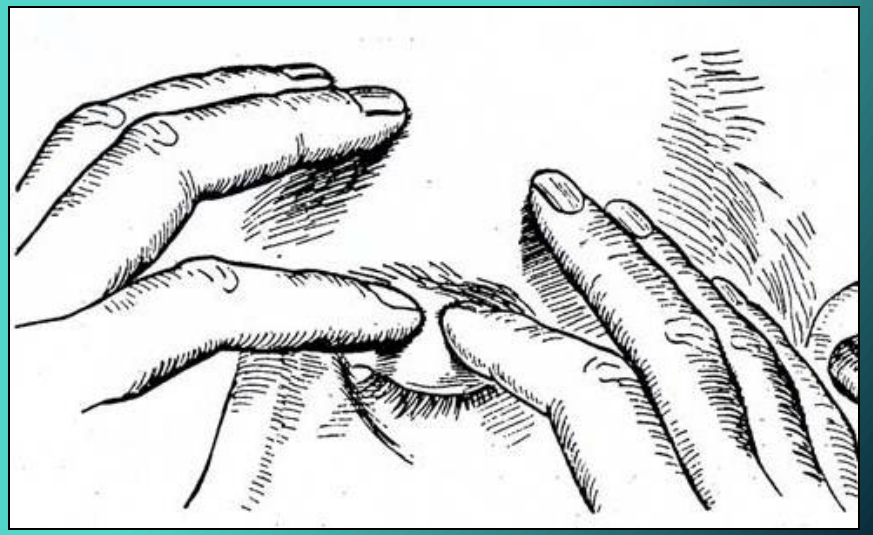
How to compe

1. Tonometry outsid
   zone (iCare, Tonop
2. Pre- and post-surg
   correction factor
3. Dynamic contour tonometry



Evaluation Procedures

- Digital palpation of the globe
  - Tonometry **method of last resort**
  - Perform when unable to assess IOP by any other means
  - Compare “hardness” and equality OU
  - Practice on normal eyes to develop feel for normal



Self Assessment Quiz

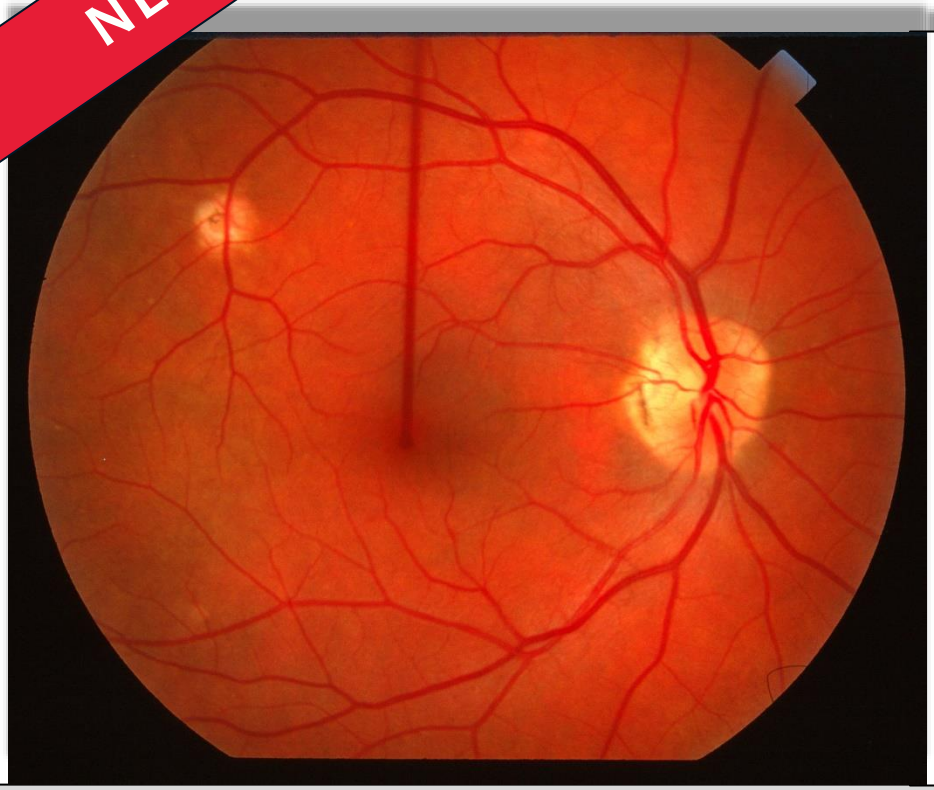
Do you have >1 tonometry method available in your office?

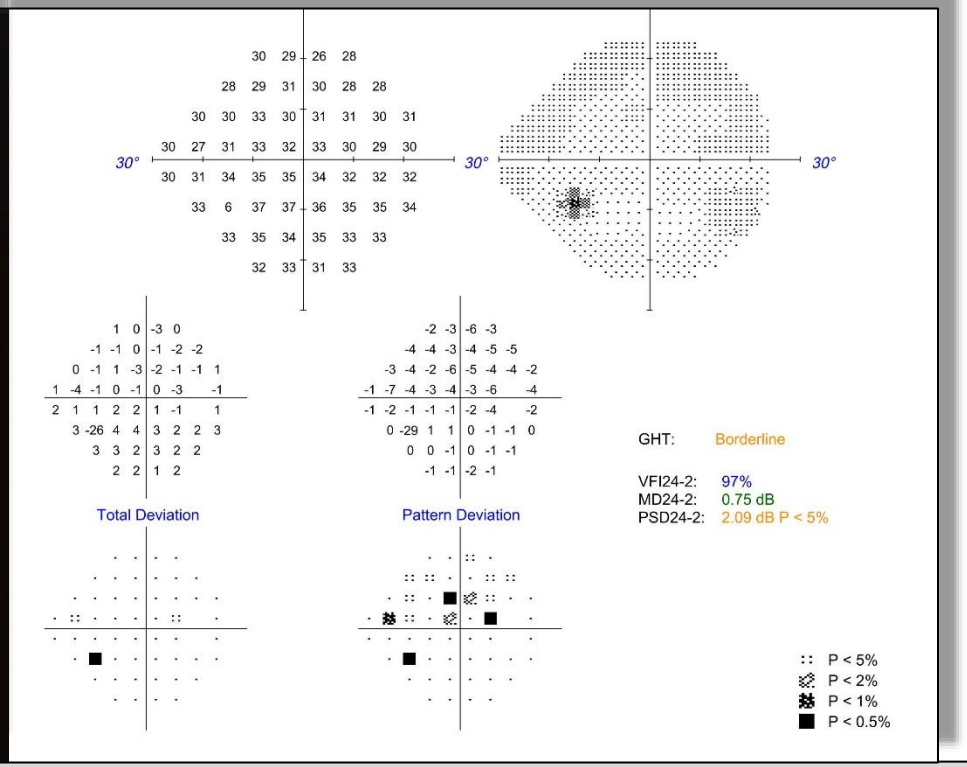
- If so, award yourself 1 point
- If not, award yourself 0 points

Evaluation Procedures

- Ophthalmoscopy
  - **ONH morphology**
  - vCDR & **rim-to-disc ratio**
  - ISNT rule
  - Disc hemorrhage
  - Peripapillary atrophy
  - RNFL

NEW!



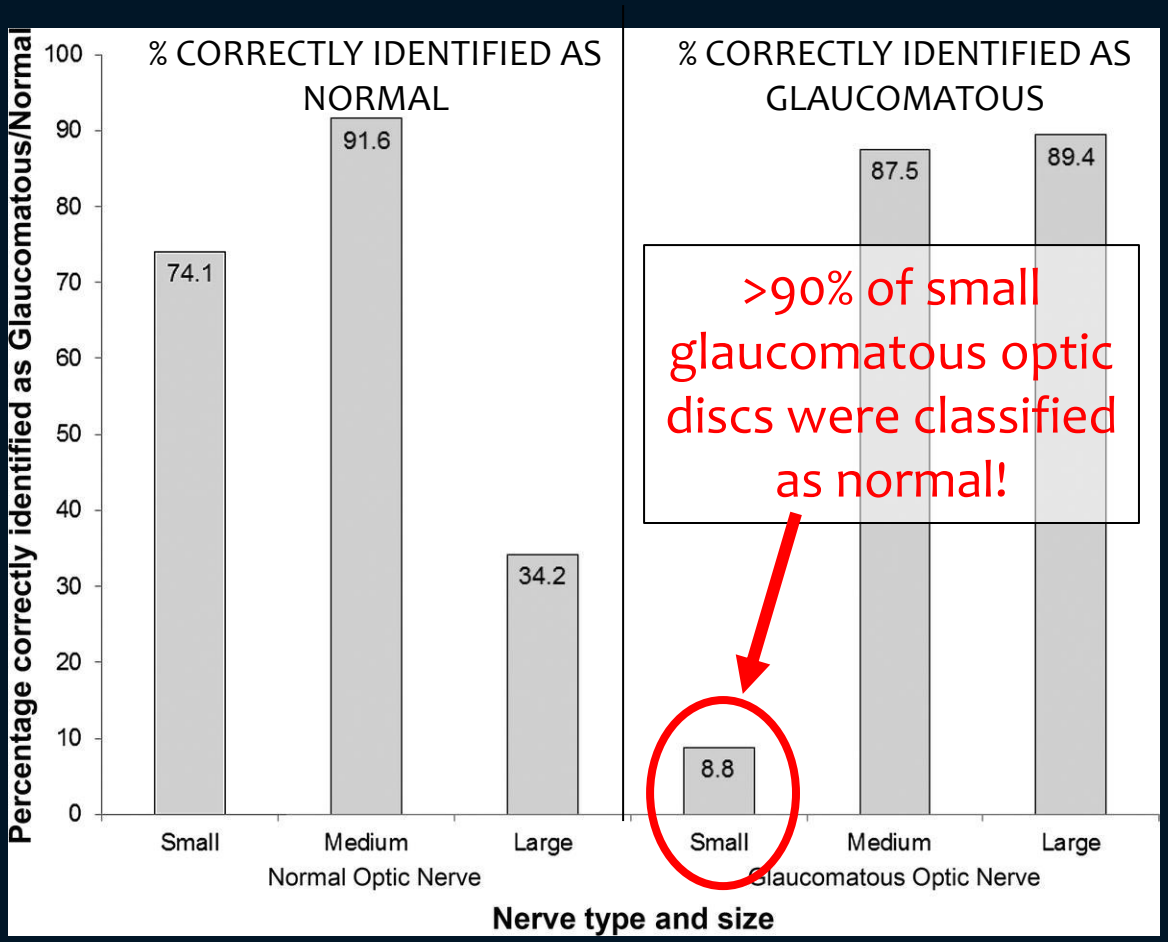


"At least for now, it is apparent that clinical examination of the ONH is very relevant… and is irreplaceable in detecting non-glaucomatous causes of ONH cupping and visual field defects similar to those in glaucoma."

PMID 33061262

Numerous studies have documented the **difficulty of correctly identifying glaucomatous damage in small optic discs**

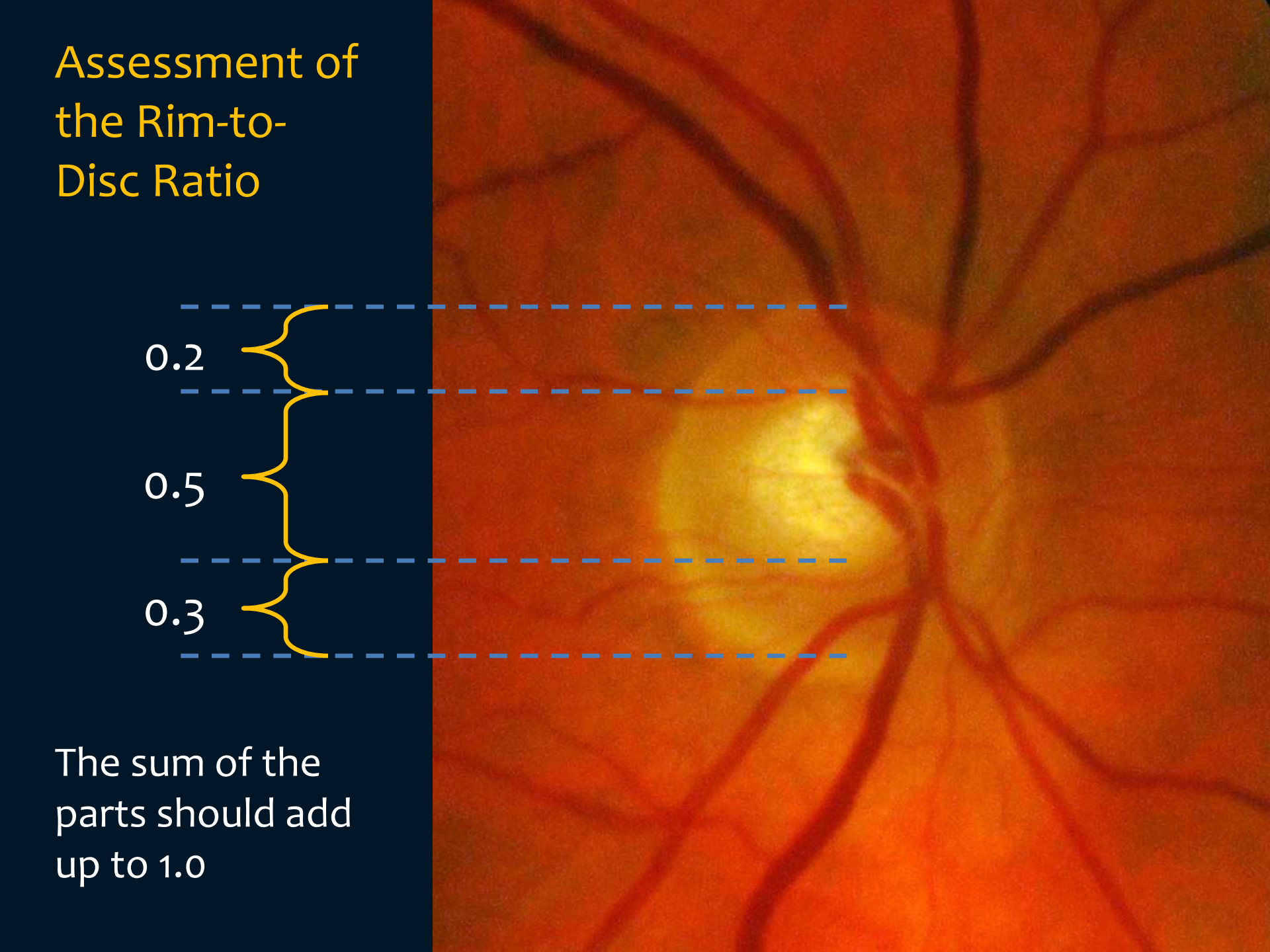
Nixon (2017): Doctors examined stereophotos of optic nerve heads and were asked to classify them as normal or glaucomatous



Percentage of images where nerve type was correctly identified, by nerve type and size. Size was assessed by OCT (<1.63 mm² = small; >1.97 mm² = large) (Nixon, 2017)

OVS 2017;94:654

Assessment of the Rim-to-Disc Ratio



The sum of the parts should add up to 1.0

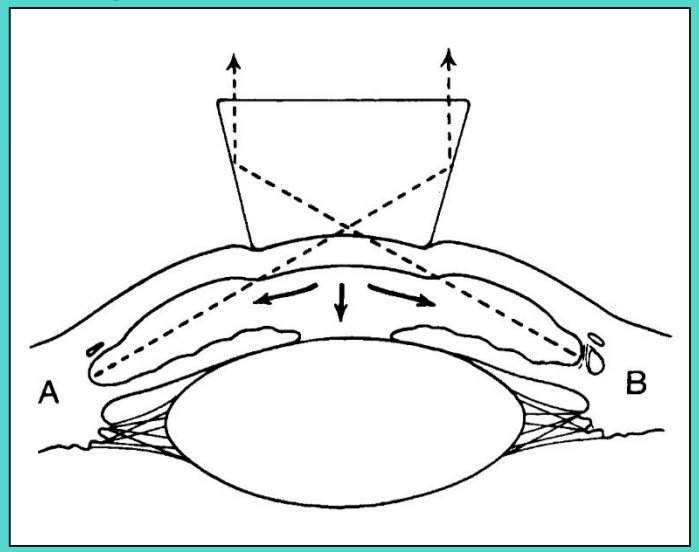
Evaluation Procedures

- Gonioscopy
  - **When to perform**

Evaluation Procedures

Indentation Gonioscopy

Requires use of a 4-mirror "Zeiss-style" gonioprism



gonioscopy.org

Self Assessment Quiz

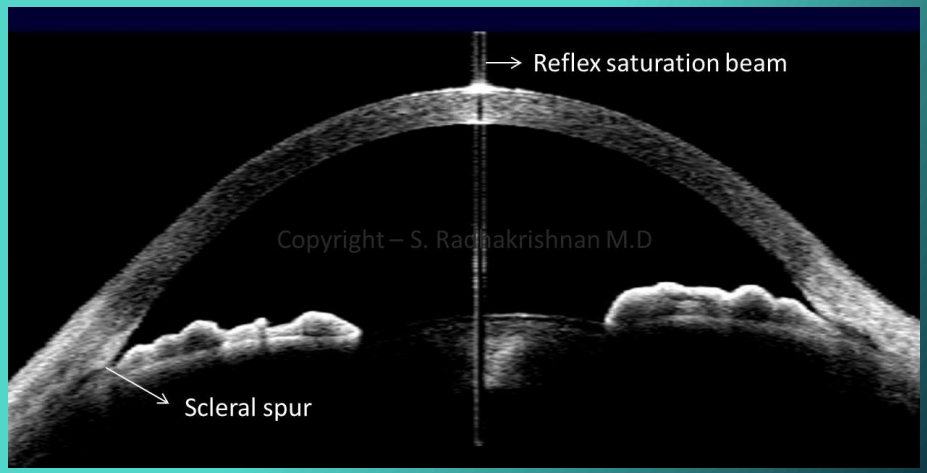
Do you perform gonioscopy as part of your glaucoma work-up?

- If so, award yourself 1 point
- If not, award yourself 0 points

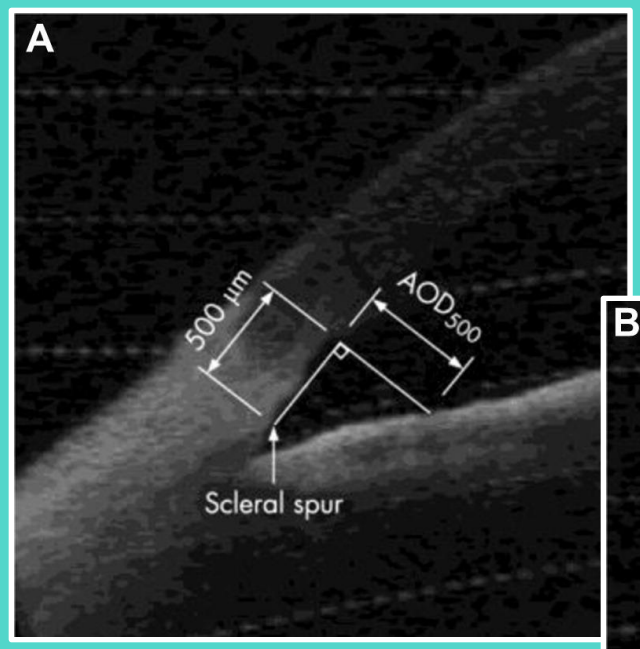
NEW!

Evaluation Procedures

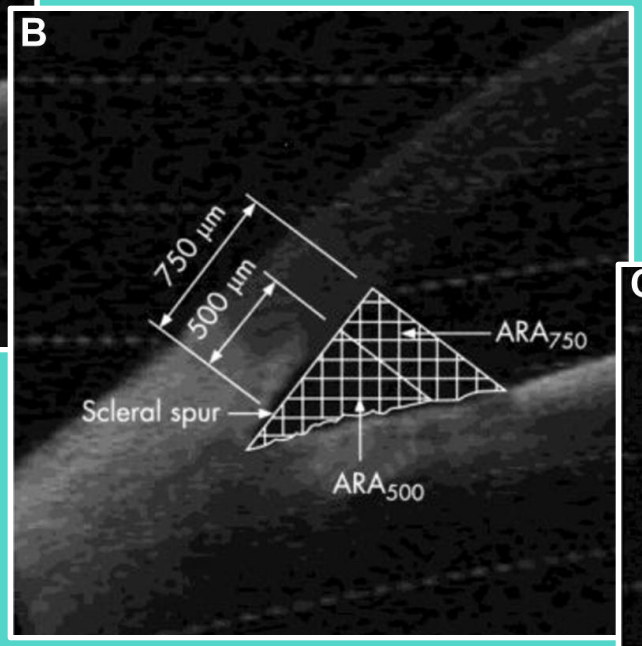
- Anterior segment OCT
  - **Quantitative assessment of angle anatomy**
  - Gonioscopy: Qualitative assessment
    - The current "***gold standard***" for diagnosis of ACG
  - AS-OCT supplements but does not replace gonioscopy



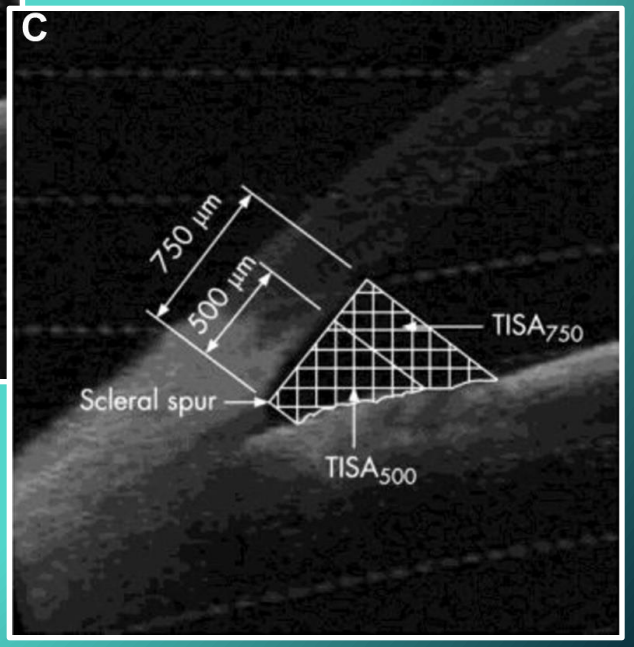
Angle Opening Distance (AOD)



Angle Recess Area (ARA)



Trabecular-Iris Space Area (TISA)



NEW!

Archive for Clinical and Experimental Ophthalmology
https://doi.org/10.1007/s00417-021-05271-4

REVIEW ARTICLE

Diagnostic accuracy of AS-OCT vs gonioscopy for detecting angle closure: a systematic review and meta-analysis

Thomas Desmond[1,2] · Vincent Tran[2] · Monish Maharaj[3,4] · Nicole Carnt[1,2,5,6] · Andrew White[1,2,5]

Received: 12 January 2021 / Revised: 13 May 2021 / Accepted: 3 June 2021

It is currently unclear how AS-OCT fits into clinical practice. It has high sensitivity for detecting angle closure, but has a high false positive rate compared to gonioscopy. AS-OCT may be a good screening tool for angle closure but is not yet able to replace gonioscopy.

PMID 34223989

What if I don't have a gonioscopy lens?

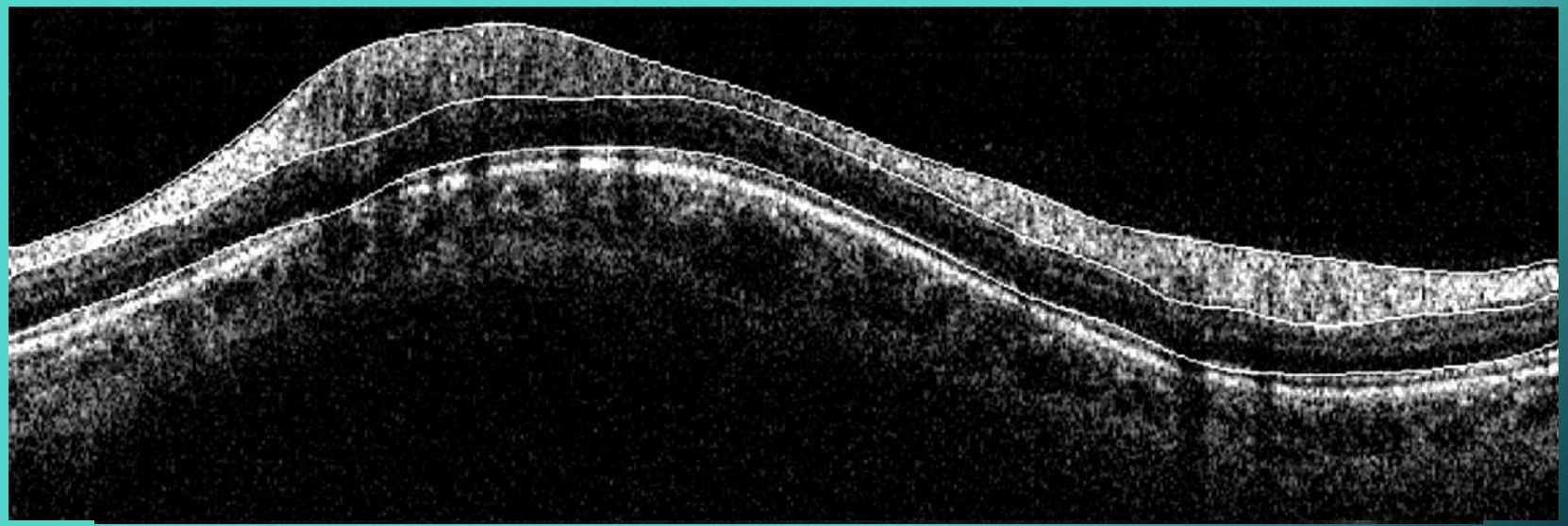
- Glaucoma management requires gonioscopy
- There is no alternative
  - Pentacam and AS-OCT do not replace gonioscopy
- Learn how to perform gonioscopy if you wish to manage glaucoma

Evaluation Procedures

Evaluation Procedures

Optical Coherence Tomography (OCT)

- Retinal Nerve Fiber Layer
- Optic Nerve Head Topography
- Ganglion Cell Complex Thickness



Evaluation Procedures

Method #1: Retinal Nerve Fiber Layer Thickness

- 3.4mm diameter measurement circle
- Segmentation of RNFL from other layers
  - Accuracy dependent upon **signal strength**
- Compare to norms and ***fellow eye***
  - Within 10µm between eyes, compare TSNIT's
- **Floor effect** in advanced glaucoma

4 Questions

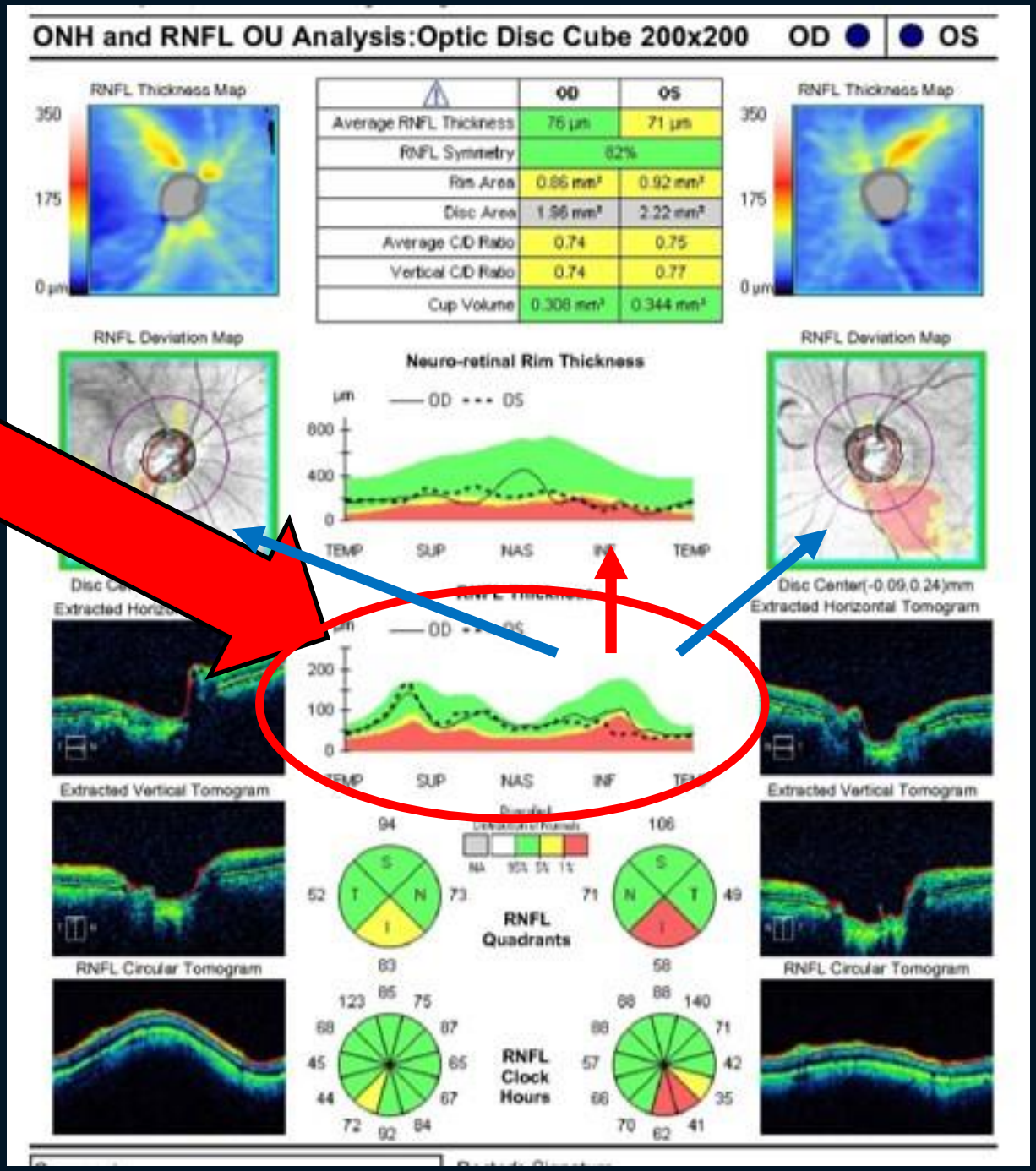
This is where most of the action is!

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

2. Is there RE/LE symmetry?

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

4. Does the deviation map show evidence of a NFL defect?



Evaluation Procedures

Method #2: Optic Disc Morphology

	OD	OS
Average RNFL Thickness	73 µm	61 µm
RNFL Symmetry	55%	
Rim Area	1.12 mm²	0.72 mm²
Disc Area	1.58 mm²	1.72 mm²
Average C/D Ratio	0.53	0.75
Vertical C/D Ratio	0.49	0.77
Cup Volume	0.036 mm³	0.220 mm³

Rim Area

<1.0mm² is always suspicious

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

<1.75mm² = sm

>2.75mm² = lg

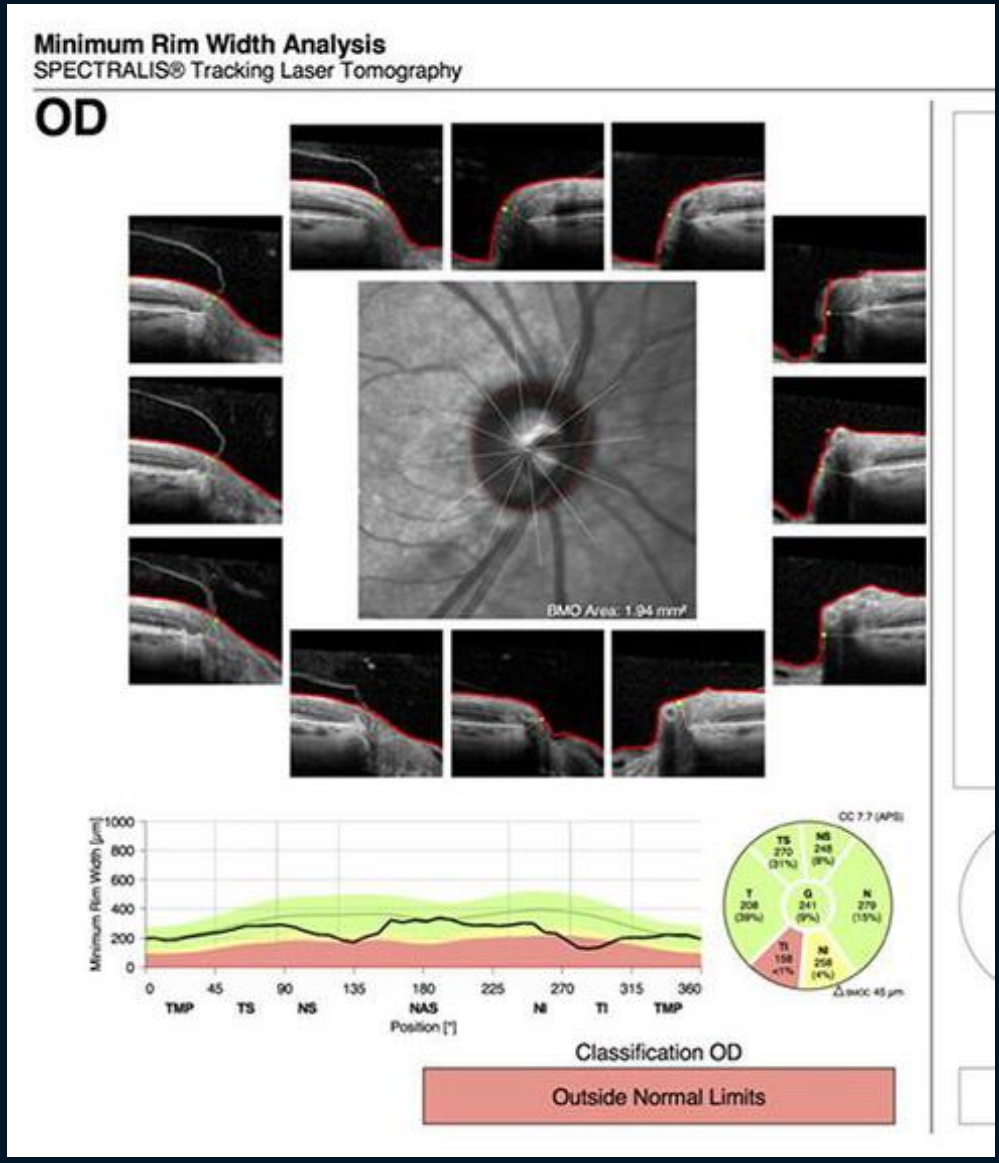
ONH morphology

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

Minimum Rim Width

Neuroretinal rim thickness at 12 locations around ONH

Expect rim loss to occur in same location as RNFL thinning



Evaluation Procedures

Method #3: Ganglion Cell Complex Thickness

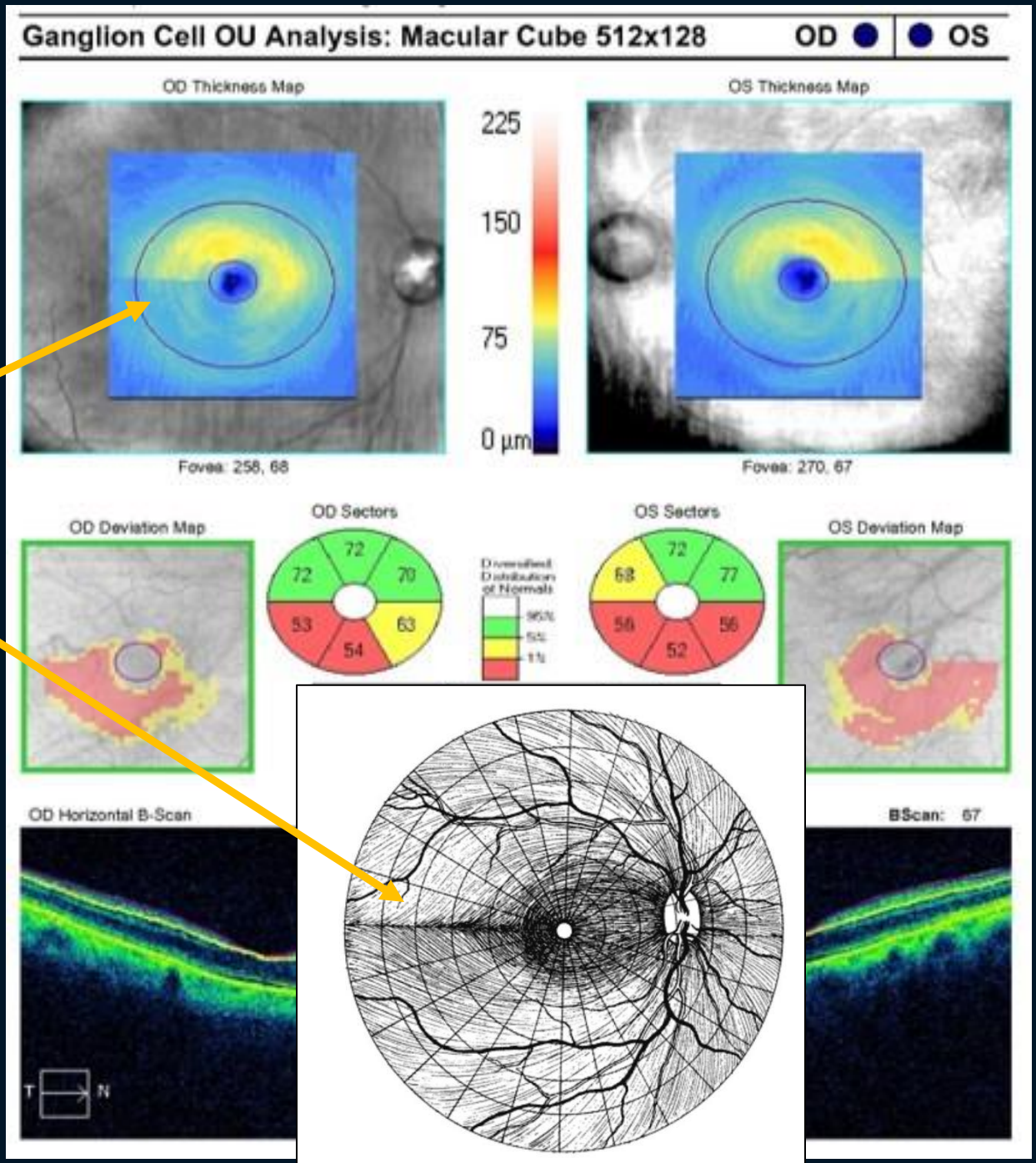
- Death of ganglion cells leads to macular thinning
- **Ganglion Cell Complex** (GCC)
  - GCC = RNFL + Ganglion cells + Inner plexiform
  - Cirrus does not include RNFL in its analysis, so cannot compare across instruments

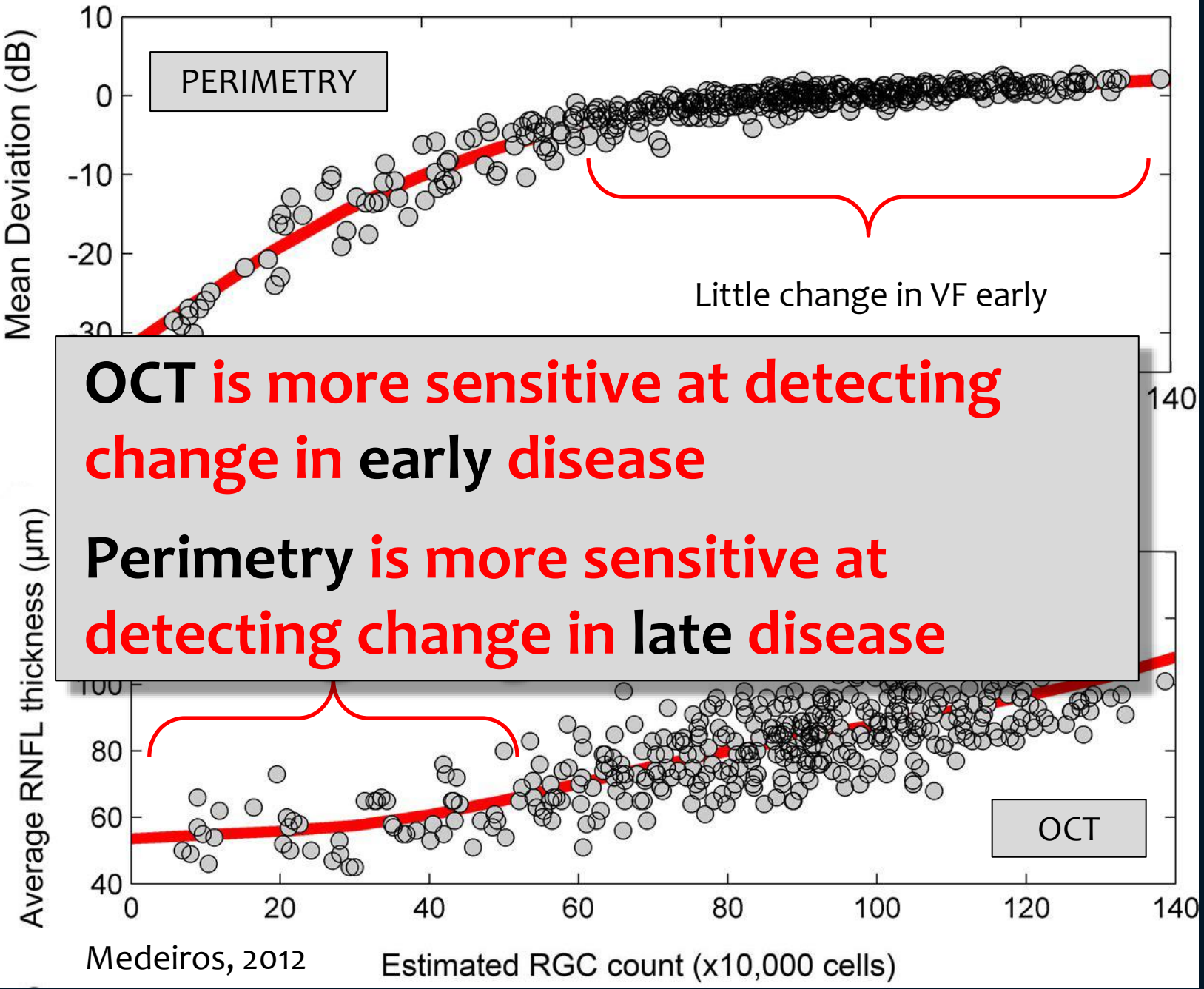
GCC Thickness

Look for temporal step defect in thickness map and sectors

"Windshield wiper defect"

Are the GCC findings consistent with the RNFL findings?



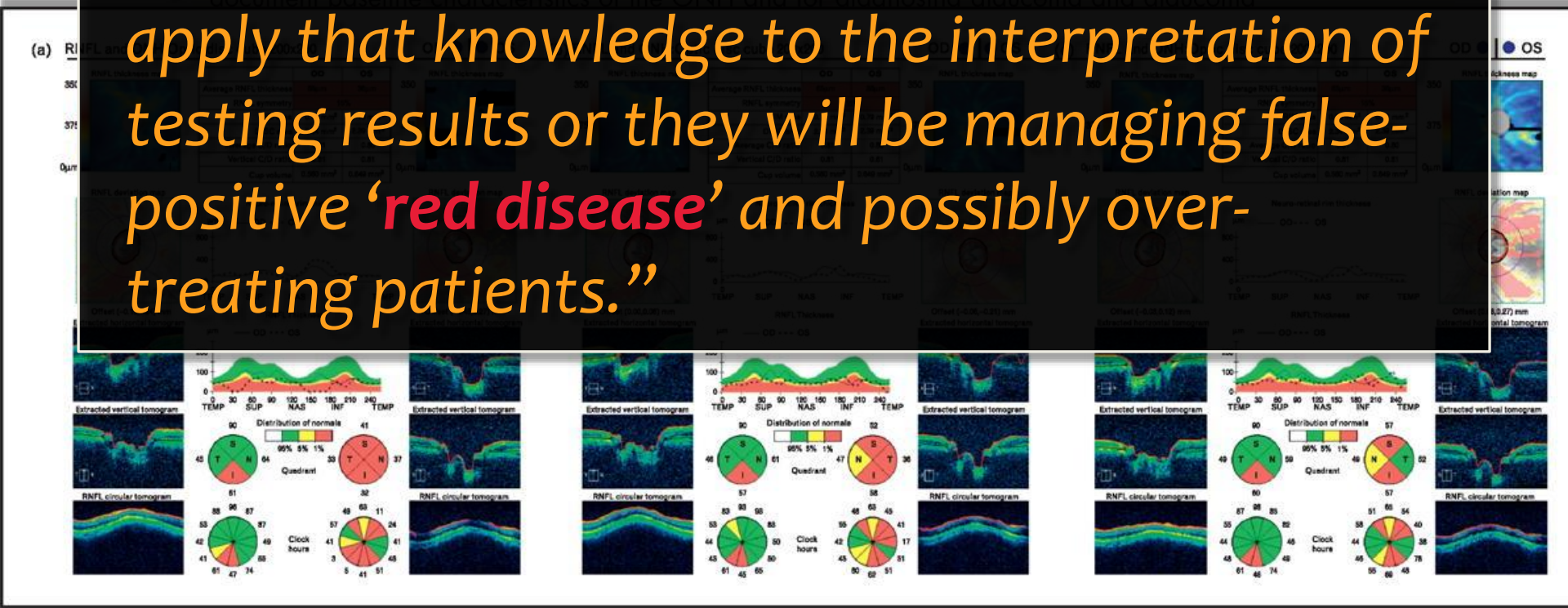

PERIMETRY
Mean Deviation (dB)
10
0
-10
-20
Little change in VF early
140
OCT is more sensitive at detecting change in early disease
Perimetry is more sensitive at detecting change in late disease
Average RNFL thickness (µm)
100
80
60
40
0
20
40
60
80
100
120
140
OCT
Medeiros, 2012
Estimated RGC count (x10,000 cells)

CURRENT OPINION

Glaucoma versus red disease: imaging and glaucoma diagnosis

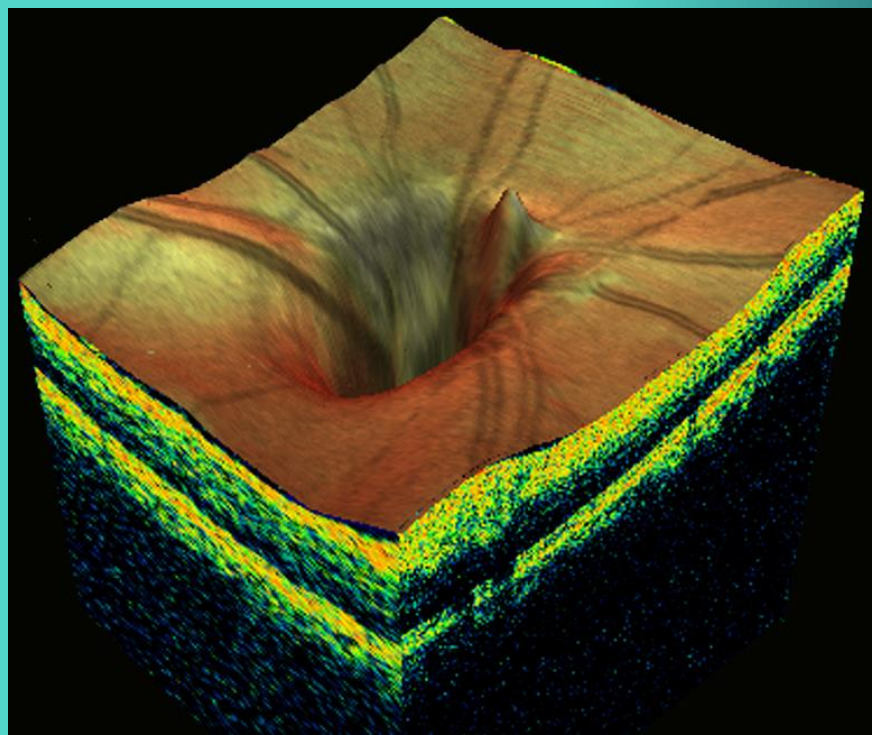
Gabriel T. Chong and Richard K. Lee

*"Clinicians need to understand the limitations of the imaging technologies they use and to apply that knowledge to the interpretation of testing results or they will be managing false-positive '**red disease**' and possibly over-treating patients."*

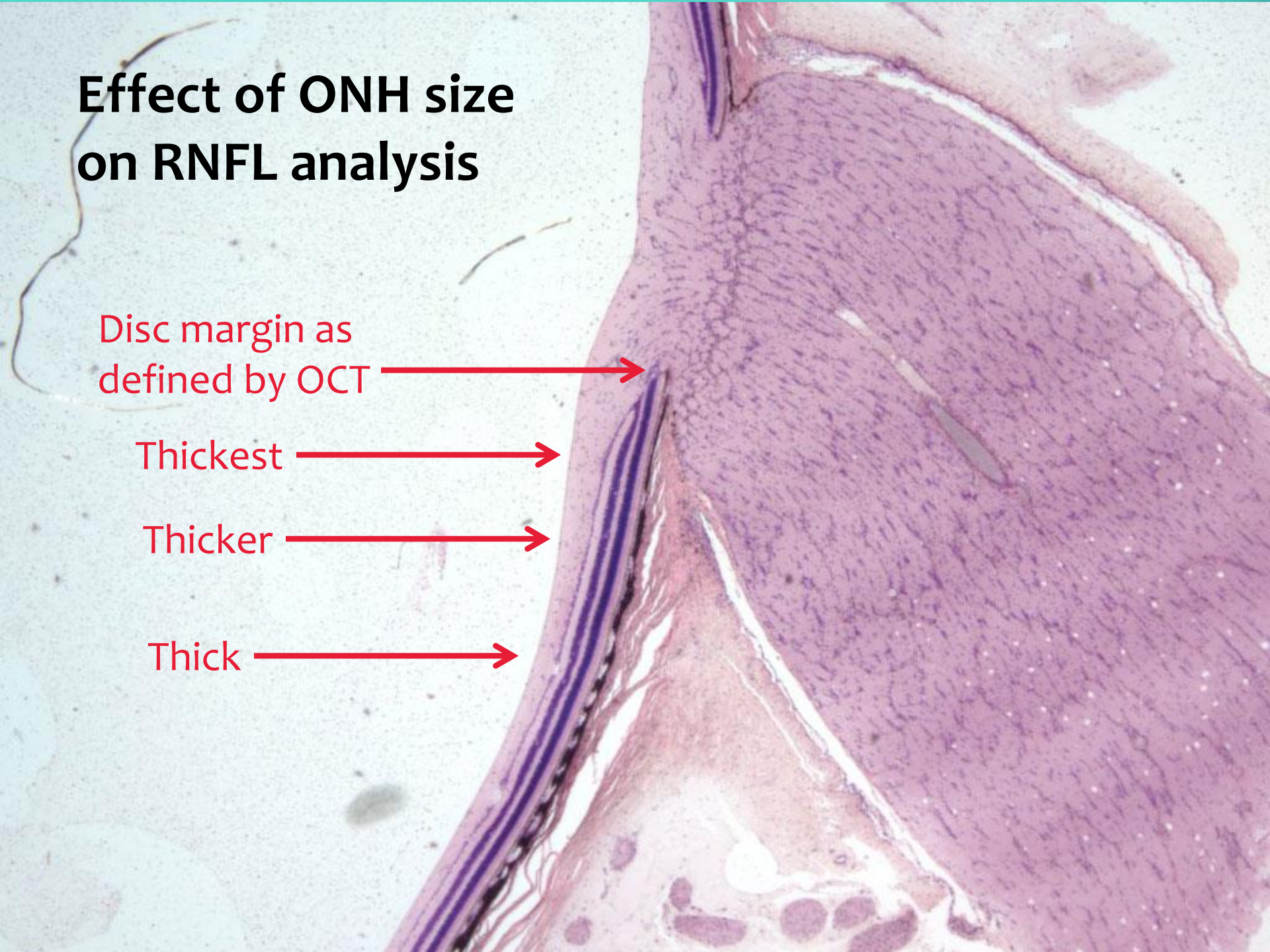


Evaluation Procedures

- Factors affecting OCT detection of glaucoma
  - **Optic disc size**
  - Signal strength / Errors / Artifacts
  - **Axial length**
  - Blood vessel position

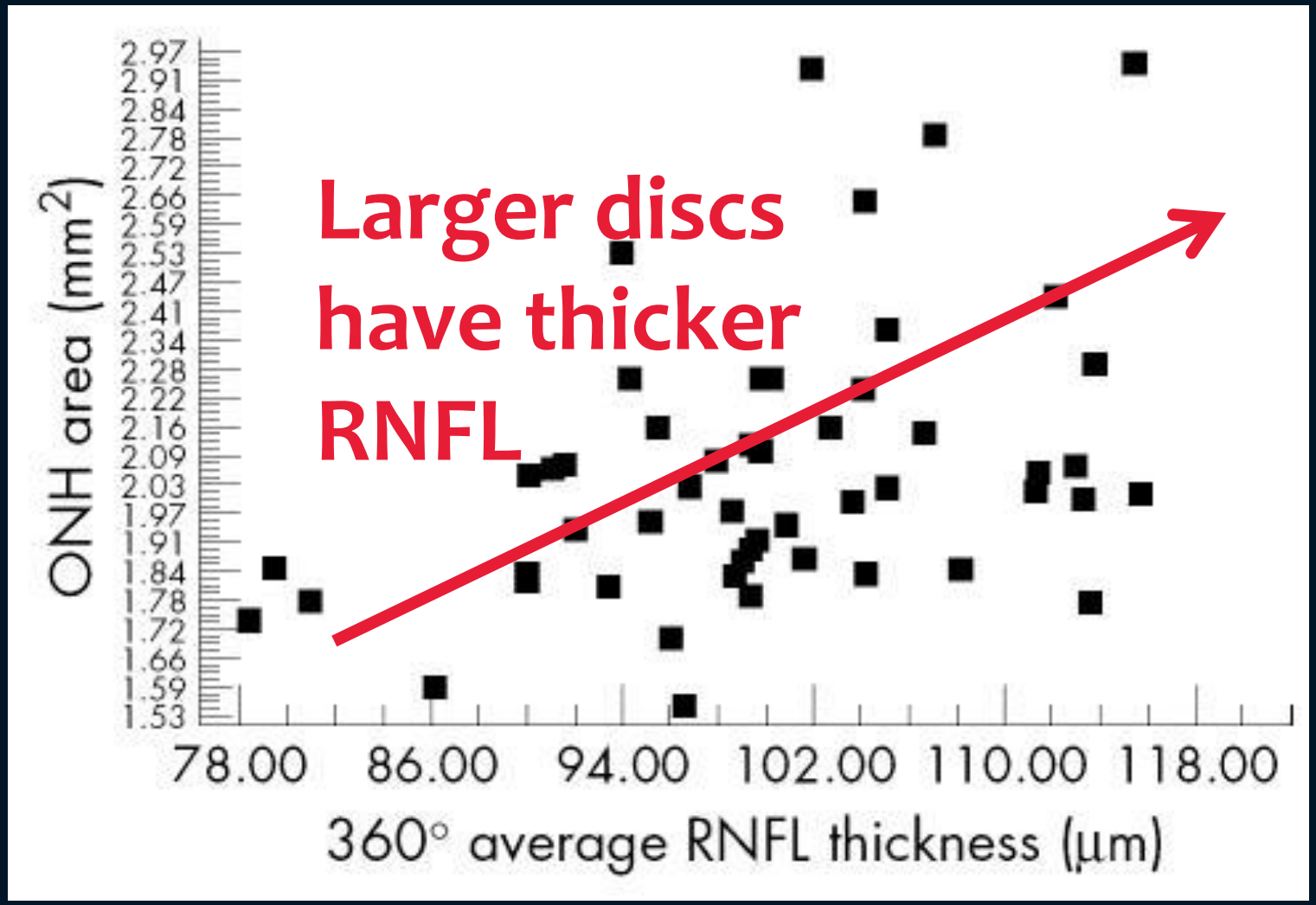


Effect of ONH size on RNFL analysis

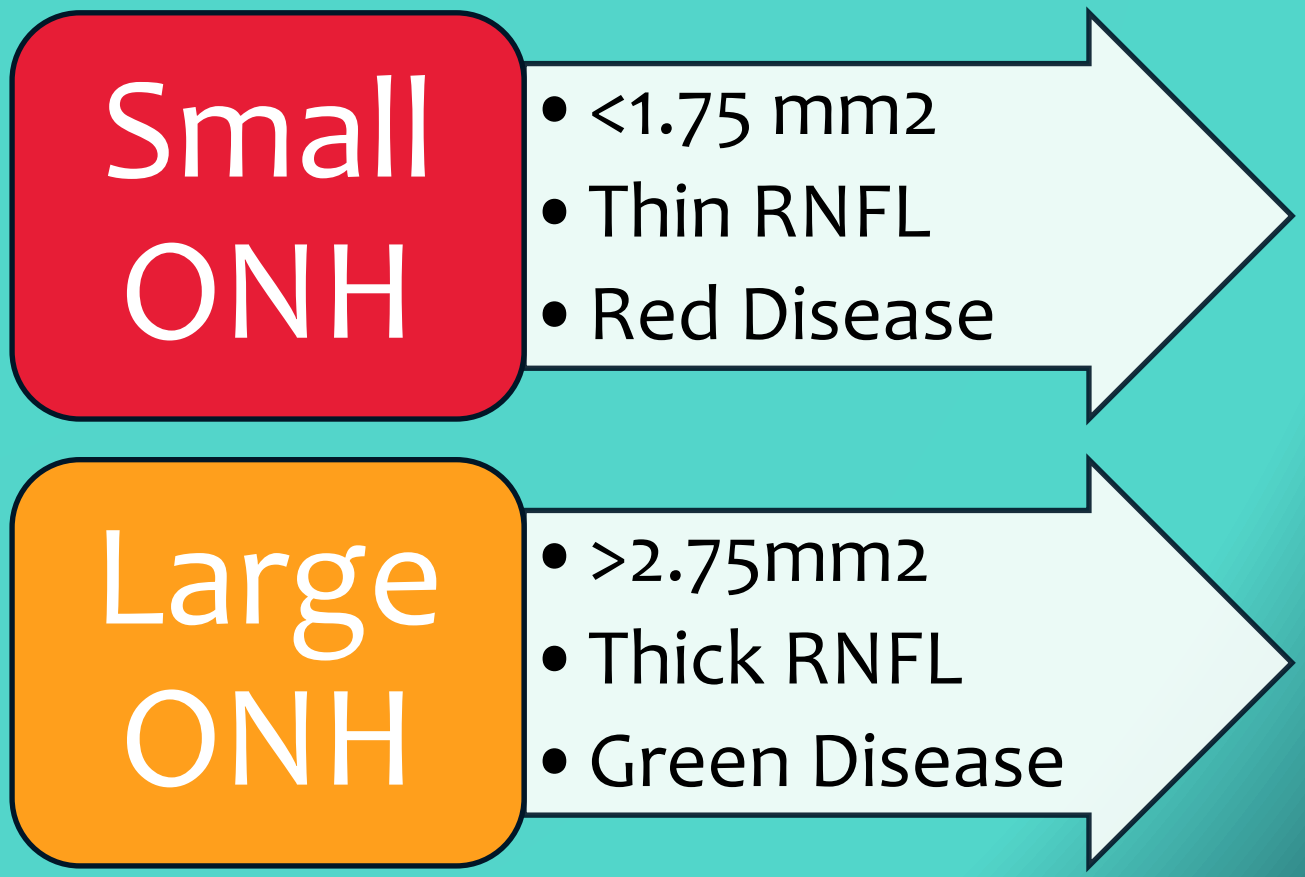


Relationship between ONH size and RNFL thickness

Savini, BJO. 2005;89:489



Evaluation Procedures



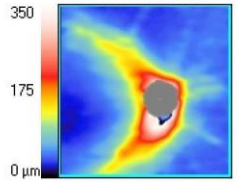
Ophthalmology. 2011;118:1774

Normal small ONH

			OD	OS
Name:				
ID:		Exam Date:	1/8/2016	1/8/2016
DOB:	5/4/1991	Exam Time:	9:10 PM	9:11 PM
Gender:	Female	Serial Number:		
Doctor:		Signal Strength:	7/10	7/10

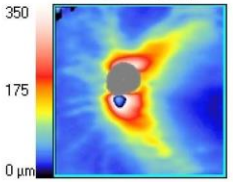
ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● | ● OS

RNFL Thickness Map

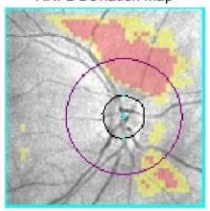


	OD	OS
Average RNFL Thickness	81 µm	82 µm
RNFL Symmetry	91%	
Rim Area	1.28 mm²	1.18 mm²
Disc Area	1.28 mm²	1.18 mm²
Average C/D Ratio	0.08	0.08
Vertical C/D Ratio	0.07	0.08
Cup Volume	0.000 mm³	0.000 mm³

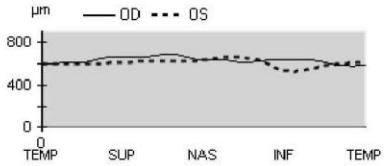
RNFL Thickness Map



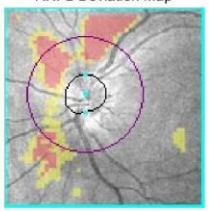
RNFL Deviation Map



Neuro-retinal Rim Thickness

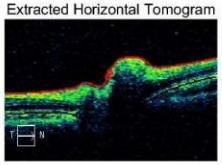


RNFL Deviation Map

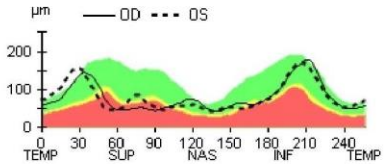


Disc Center(0.54,-0.24)mm

Extracted Horizontal Tomogram

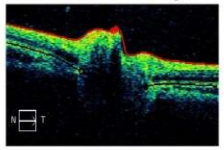


RNFL Thickness

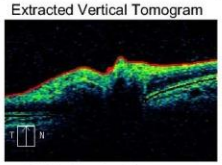


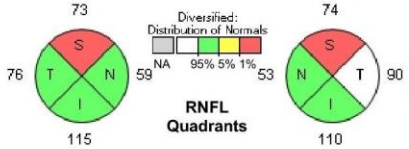
Disc Center(-0.60,0.42)mm

Extracted Horizontal Tomogram

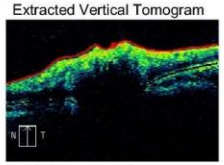


Extracted Vertical Tomogram

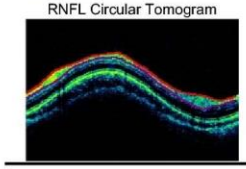


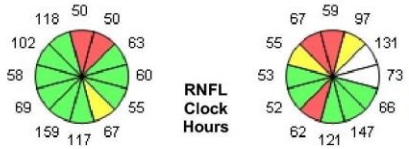


Extracted Vertical Tomogram

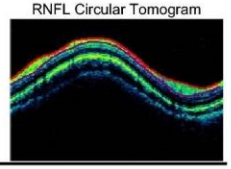


RNFL Circular Tomogram





RNFL Circular Tomogram

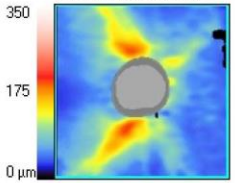


Normal large ONH

			OD	OS
Name:				
ID:		Exam Date:	6/19/2017	6/19/2017
DOB:	3/22/1956	Exam Time:	2:04 PM	2:05 PM
Gender:	Female	Serial Number:		
Technician:	Operator, Cirrus	Signal Strength:	9/10	9/10

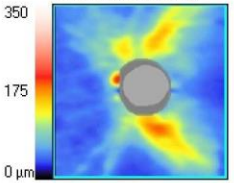
ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● | ● OS

RNFL Thickness Map

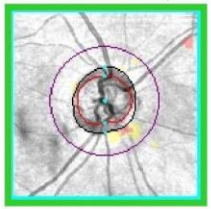


	OD	OS
Average RNFL Thickness	93 µm	91 µm
RNFL Symmetry	91%	
Rim Area	1.17 mm²	1.12 mm²
Disc Area	3.39 mm²	2.93 mm²
Average C/D Ratio	0.80	0.78
Vertical C/D Ratio	0.72	0.71
Cup Volume	0.879 mm³	0.636 mm³

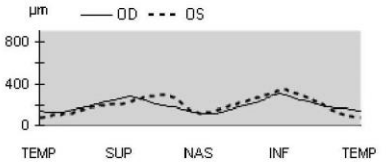
RNFL Thickness Map



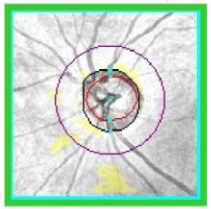
RNFL Deviation Map



Neuro-retinal Rim Thickness

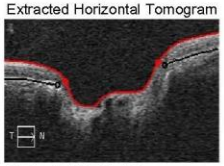


RNFL Deviation Map

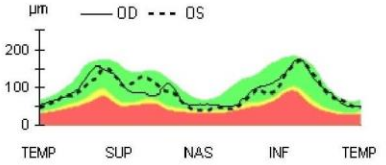


Disc Center(-0.06,0.15)mm

Extracted Horizontal Tomogram

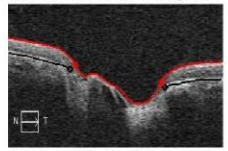


RNFL Thickness

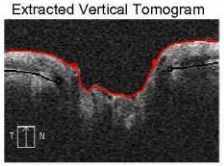


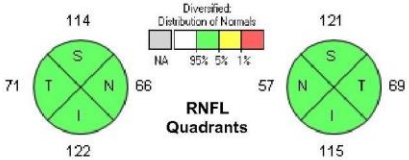
Disc Center(0.12,0.18)mm

Extracted Horizontal Tomogram

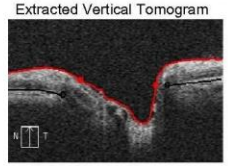


Extracted Vertical Tomogram

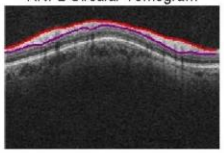


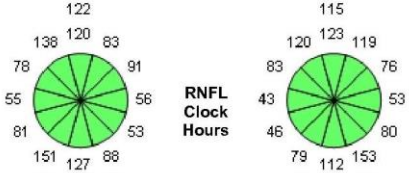


Extracted Vertical Tomogram

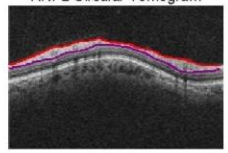


RNFL Circular Tomogram





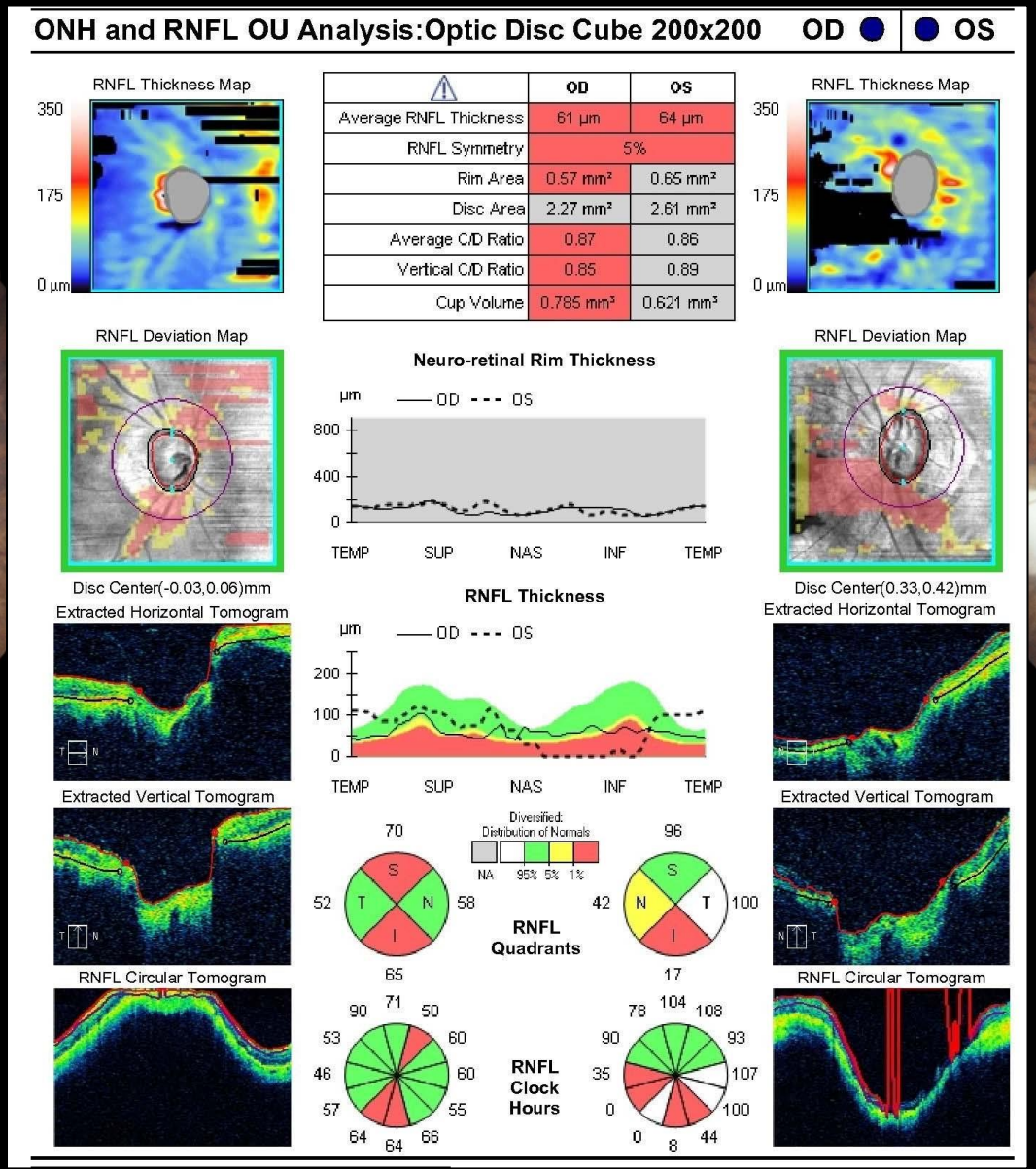
RNFL Circular Tomogram



Evaluation Procedures

- Axial Length (Myopia)
  - 1mm ↑axial length → 2.2µm ↓RNFL thickness
  - Risk of OCT **false positive**
  - **Lateral shifts** in the RNFL arcuate bundles

Pathologic Myopia



Self Assessment Quiz

Do you have an OCT in your office?

- If so, award yourself 1 point
- If not, award yourself 0 points

<u>BONUS</u>: Does your OCT interpretation consist solely of looking at the colors?

- If so, award yourself -1 point
- If not, award yourself 1 point

What if I don't have an OCT?

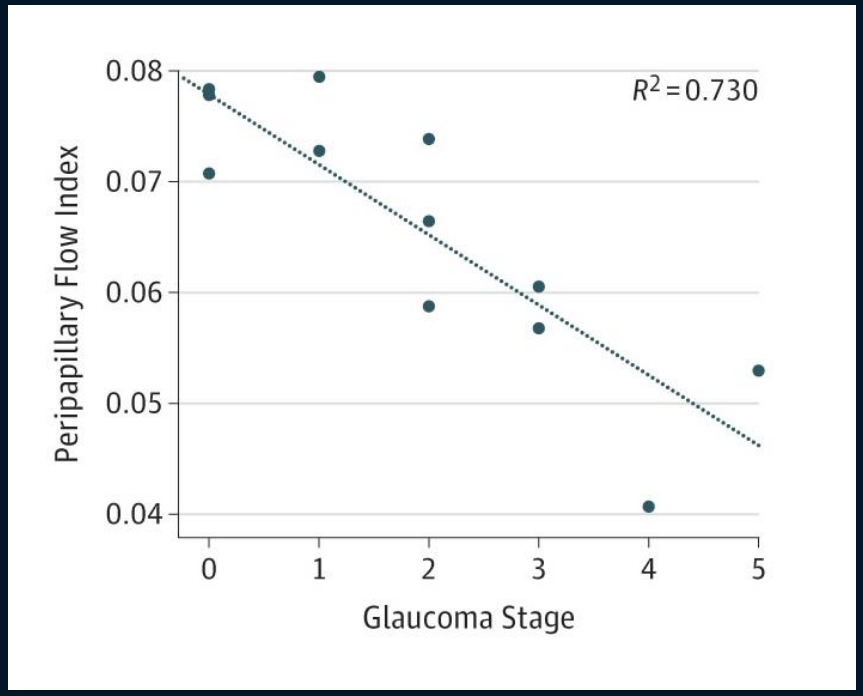
- Glaucoma management requires careful ONH inspection, but OCT is not required
- Stereo disc examination (eg. 78D or 90D) is required
- ONH photography is highly recommended
- Consider co-managing with colleague that has OCT

NEW!

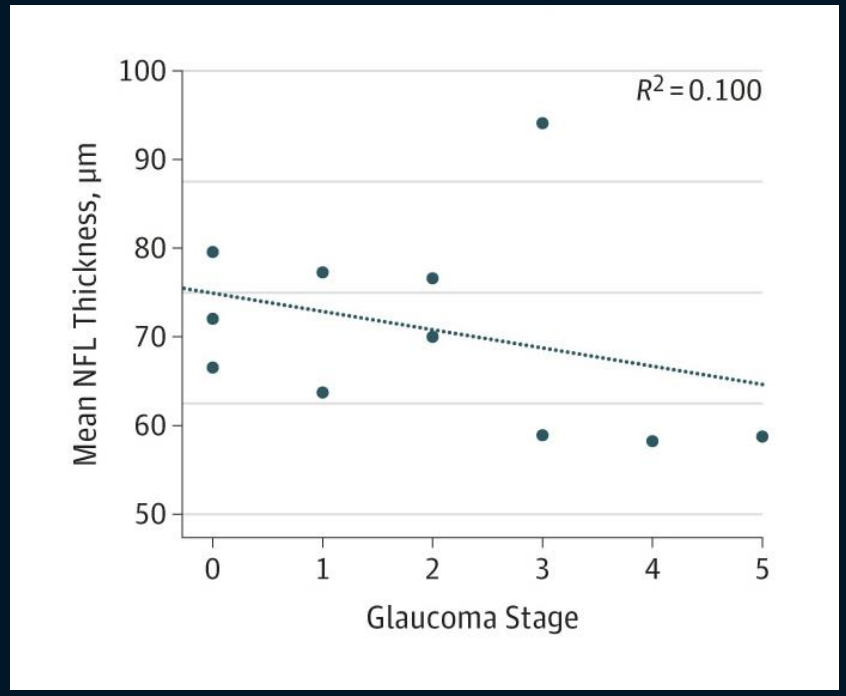
Evaluation Procedures

- OCT Angiography
  - **OCTA detects decreased ONH blood flow and vascularization in glaucoma**
  - OCTA changes in glaucoma have been correlated with both structural (RNFL) and functional (VF) alterations
  - May have value as an objective means of detecting and monitoring glaucoma

OCTA vs Glaucoma Severity



RNFL vs Glaucoma Severity



"These data suggest that blood peripapillary flow indexes measured by OCT may be more meaningful indicators of glaucoma severity than structural measures."

JAMA Ophthalmol. 2015;4197: 1045–1052.

Seminars in Ophthalmology, 2019; 34(4): 279–286

ISSN: 0882-0538 print / 1744-5205 online
DOI: https://doi.org/10.1080/08820538.2019.1620807

A Review of OCT Angiography in Glaucoma

Astrid C. Werner and Lucy Q. Shen

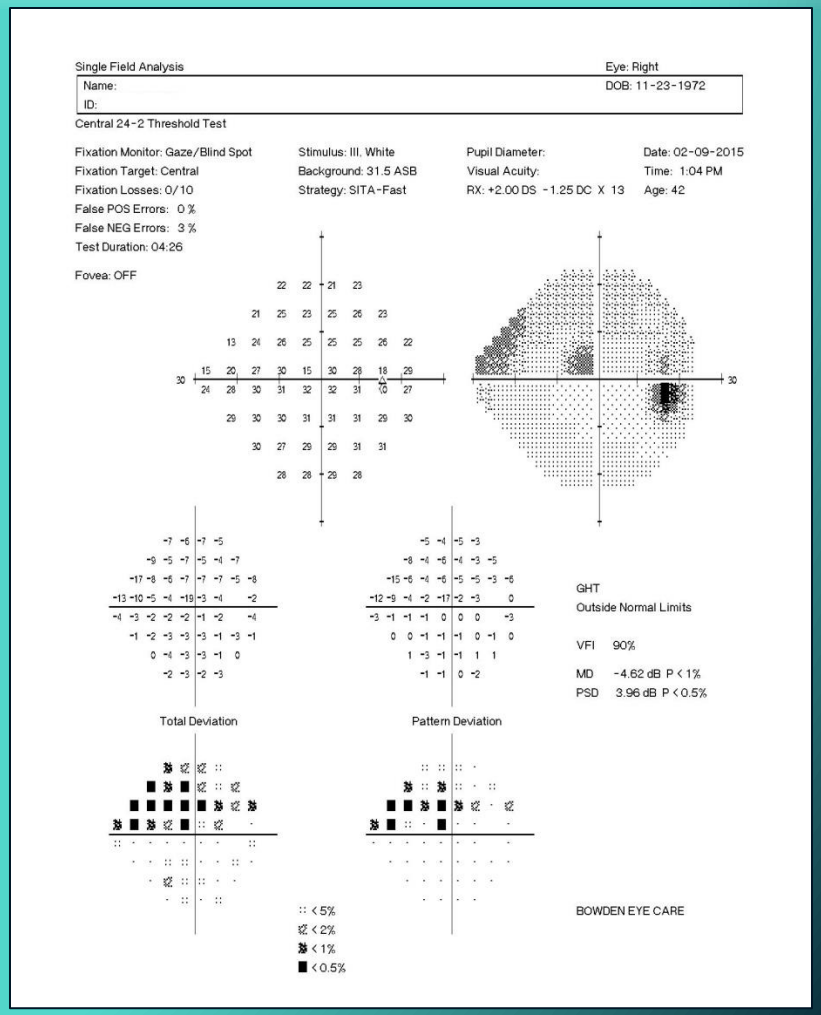
Department of Ophthalmology, Massachusetts Eye and Ear Infirmary, Boston, USA

*There is early evidence that OCTA may be of particular use in **very early or very late stage disease** where our current functional or structural diagnostic modalities fall short, however, its superiority to existing technology has not been confirmed.*

Semin Ophthalmol. 2019;34:279

Evaluation Procedures

- Perimetry
  - **Improving reliability**
  - Recognizing glaucomatous loss
  - Staging visual field loss



Evaluation Procedures

- Reliability
  - Beware **false positive errors!**
  - False Negatives: Associated with VF damage and fatigue
  - Fixation Losses: May be caused by blind spot mislocation or poor cooperation

NEW!

False Positive Responses in Standard Automated Perimetry

Heijl, Anders[1]; Patella, Vincent Michael[2]; Flanagan, John G.[3]; Iwase, Aiko[4]; Leung, Christopher K.[5]; Tuulonen, Anja[6]; Lee, Gary C.[7]; Callan, Thomas[7]; Bengtsson, Boel[1]

The relationship of higher FP rates to signs of trigger-happy fields is weak to poor... Therefore, it seems likely that test results should never be discarded solely on the basis of FP response rates.

PMID 34283973

Evaluation Procedures

- How to improve reliability
  - Dark, quiet room without distractions
  - Proper patient instruction
  - **Perimetrist monitoring & encouragement**
  - Realignment, Rest breaks & Reinstruction
  - **Decrease test duration**
  - Address specific problems
    - Lid taping for dermatochalasis, pillows for back support, fixation target for low vision, etc…

A New SITA Perimetric Threshold Testing Algorithm: Construction and a Multicenter Clinical Study

ANDERS HEIJL, VINCENT MICHAEL PATELLA, LUKE X. CHONG, AIKO IWASE, CHRISTOPHER K. LEUNG, ANJA TUULONEN, GARY C. LEE, THOMAS CALLAN, AND BOEL BENGTSSON

• PURPOSE: To describe a new time-saving threshold visual field–testing strategy—Swedish Interactive Thresholding Algorithm (SITA) Faster, which is intended to replace SITA Fast—and to report on a clinical evaluation of this new strategy.

• DESIGN: Description and validity analysis for modifications applied to SITA Fast.

Ophthalmol 2019;198:154–165.

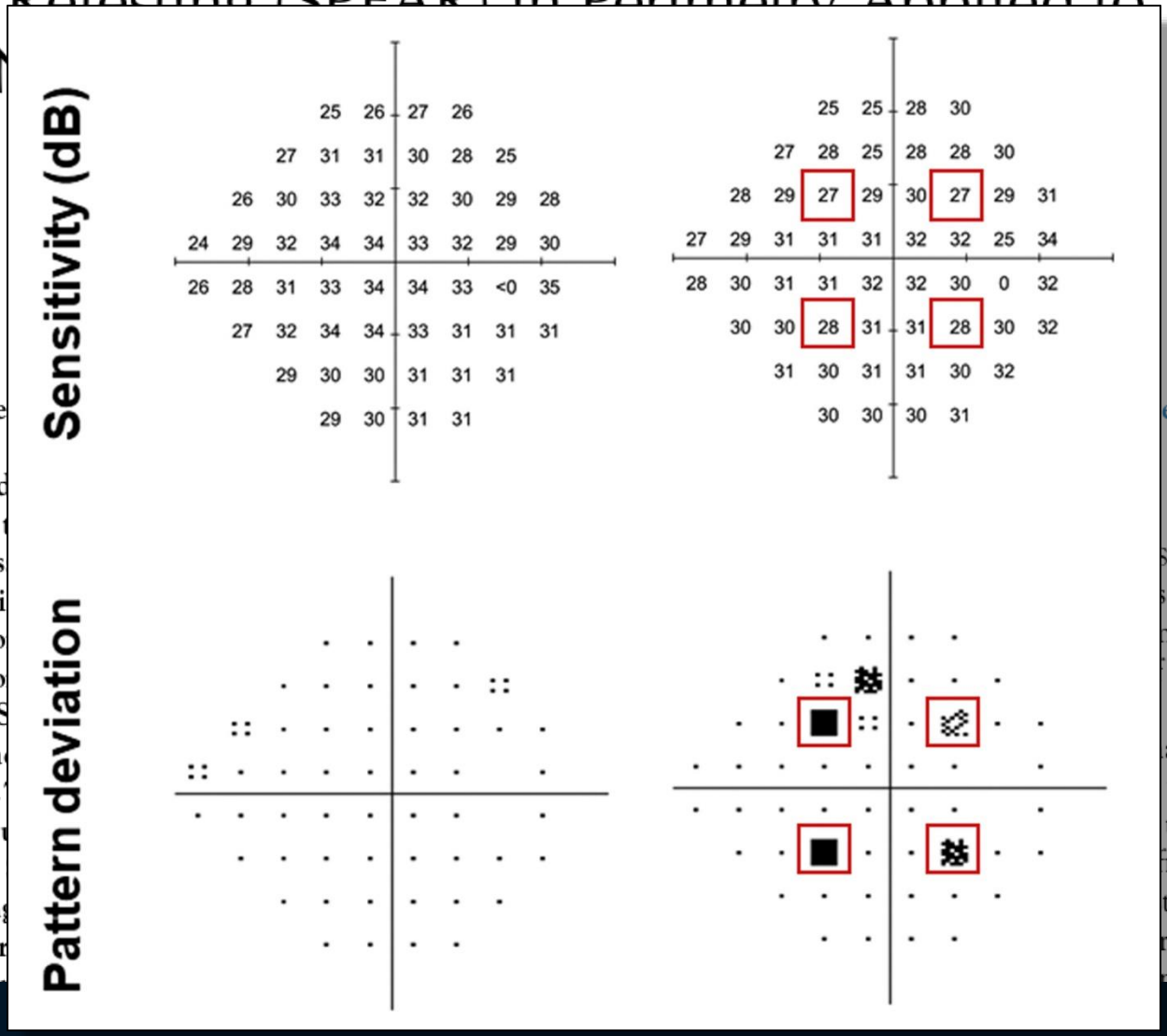
COMPUTERIZED PERIMETRY STARTED IN THE EARLY

SITA Faster saved considerable test time. SITA Faster and SITA Fast gave **almost identical results**.

Am J Ophthalmol. 2019;198:154

NEW!

A Strategy for Seeding Point Error Assessment for Retesting (SPEAR) in Perimetry Applied to



• PURPOSE: We
ing point errors
in perimetry and
ror early in the t
• DESIGN: Cros
• METHODS: Vi
patients (77 no
and 109 glauco
for identifying S
Swedish intera
Faster and 32
Standard) were u
for identifying
compared among
sion models wer
SPEs from pre

ecommons.org/

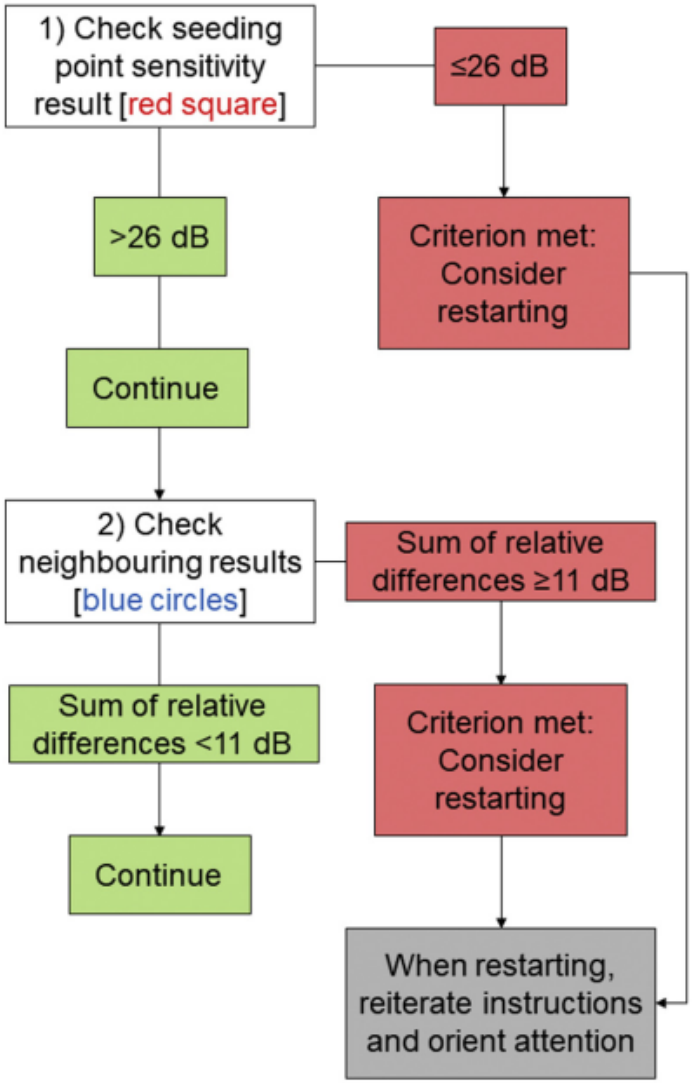
SING PERIMETRY
s of the visual
nated perimetry
glaucoma and

ated perimetry
test protocols,
test grid and
fficiency,[11,12] to
t representative
rithm efficiency
ng test time but

PMID 32777379

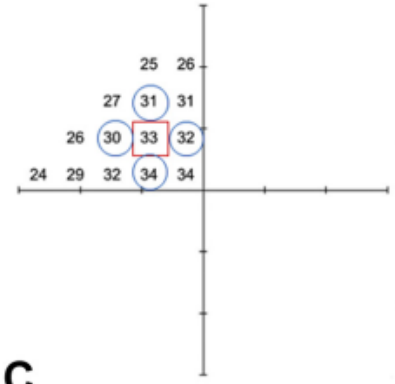
A

Simplified framework



B

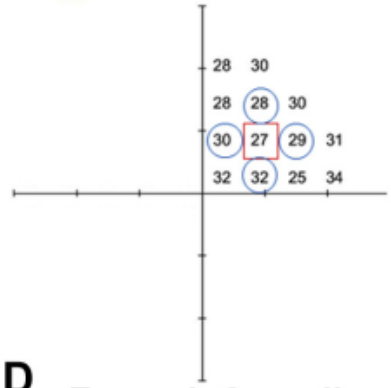
Reliable field



Criterion	Value	Criterion met?
1) Seeding sensitivity	33 dB	No
2) Neighbouring sensitivity (sum of differences)	5 dB	No

C

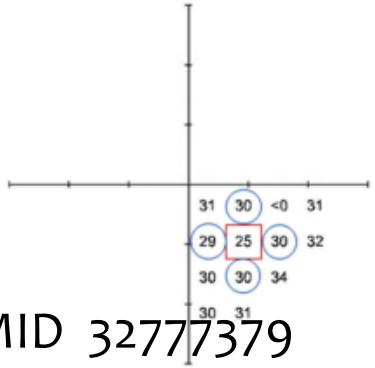
Example 1 seeding point error



Criterion	Value	Criterion met?
1) Seeding sensitivity	27 dB	No
2) Neighbouring sensitivity (sum of differences)	11 dB	Yes

D

Example 2 seeding point error



Criterion	Value	Criterion met?
1) Seeding sensitivity	25 dB	Yes
2) Neighbouring sensitivity (sum of differences)	19 dB	Yes

PMID 32777379

Self Assessment Quiz

You perform automated perimetry in your office.

- If so, award yourself 1 point
- If not, award yourself 0 points

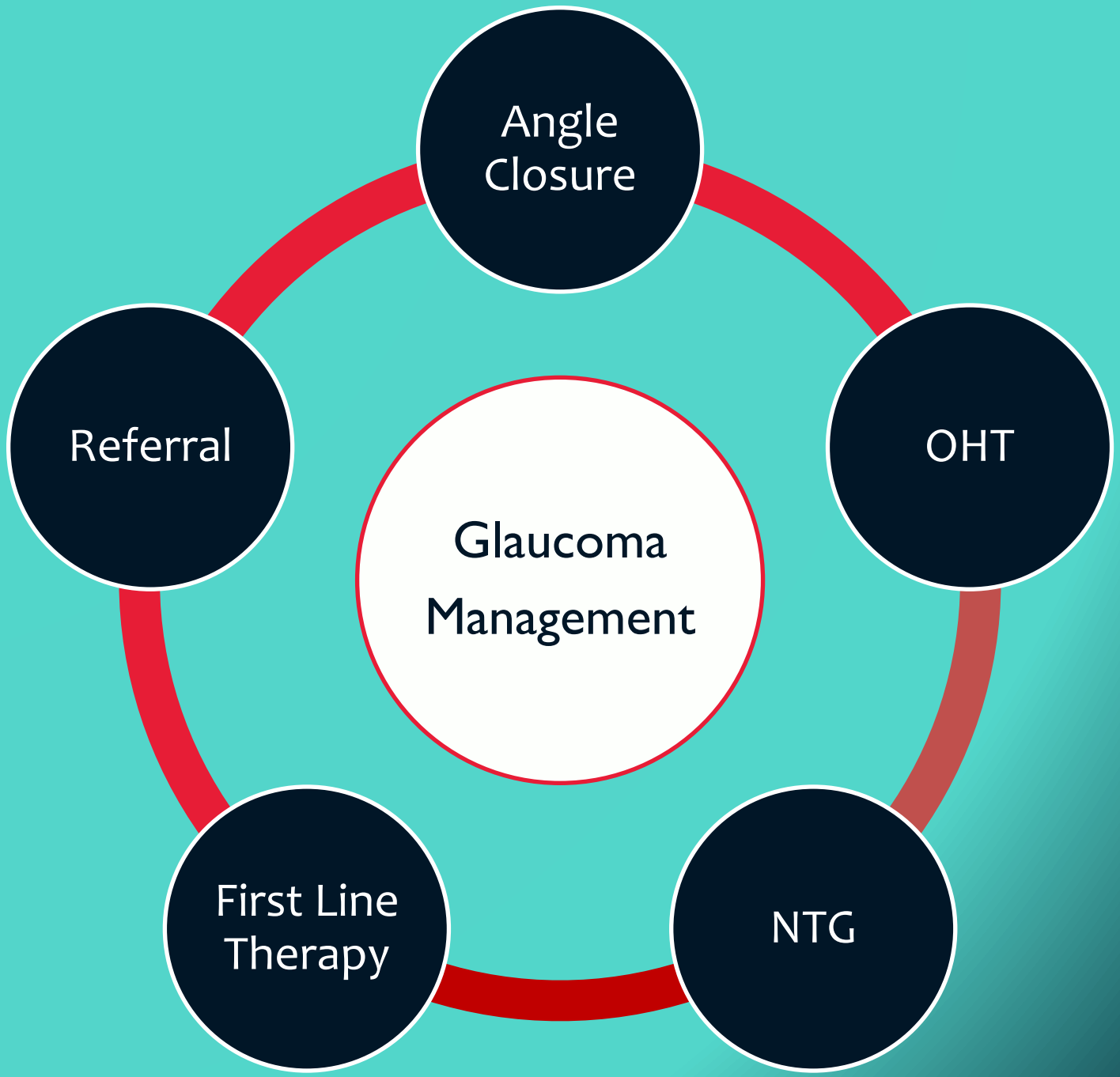
What if I don't have a perimeter?

- Currently, there is no satisfactory alternative to full threshold standard automated perimetry for glaucoma management
- Screening devices (eg. FDT) are useful for detecting glaucoma, but are not ideal for management

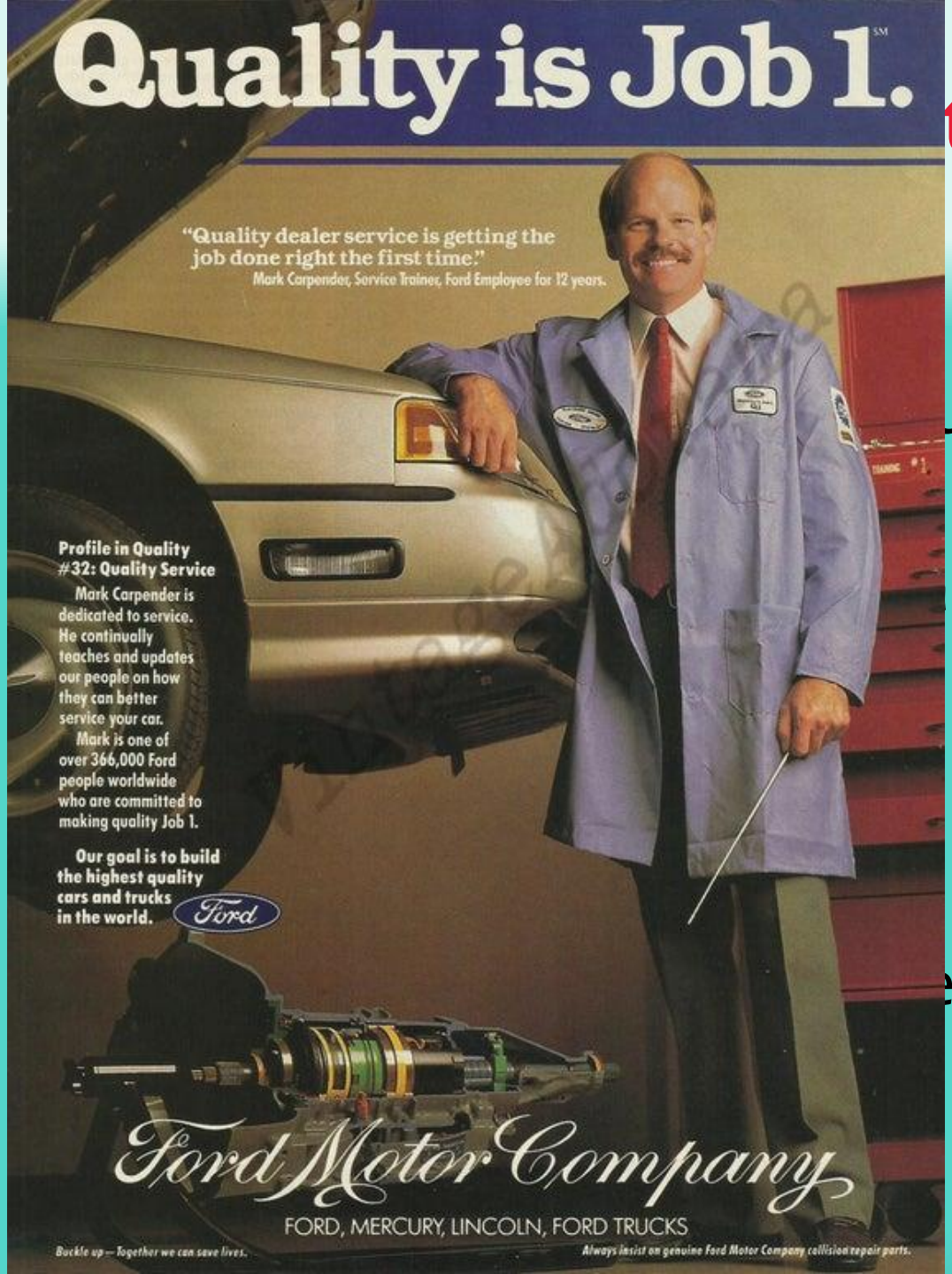
Glaucoma Management

21st Century Glaucoma Care

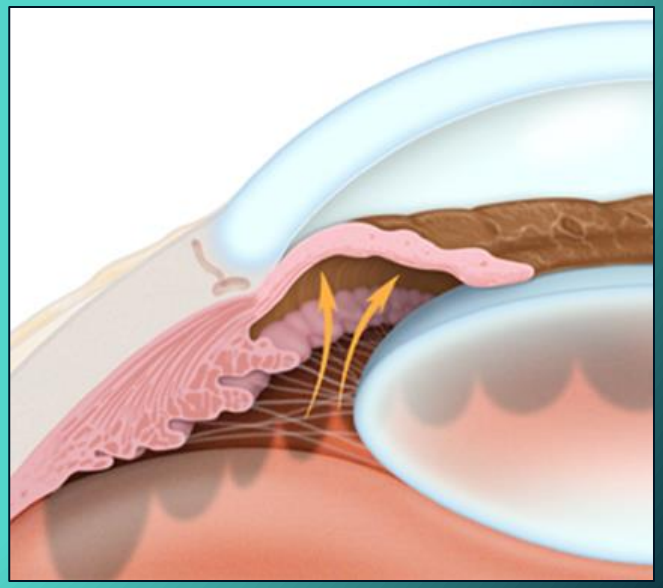
- History & Risk Factors
- Evaluation Procedures
- Management
- Patient-Centered Care


Angle Closure
OHT
NTG
First Line Therapy
Referral
Glaucoma Management

t: ACG

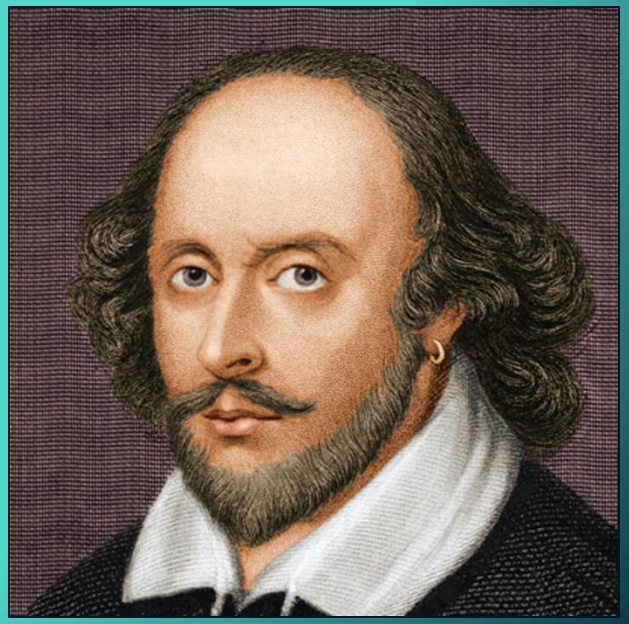


Gonio is Job 1.



Management: OHT

- To Treat, or Not To Treat. That is the Question
  - About 10% of all persons with OHT will convert
  - Use risk calculators: **Treat if ≥20% conversion risk**
  - **Treat if IOP ≥30mmHg**
  - Other factors to weigh
    - Monocular status
    - Extremes of age
    - Patient anxiety
    - VF reliability
    - Ocular comorbidity



Management: NTG

- NTG Suspect
  - Suspicious ONH &/or VF (with normal IOP)
  - Differential diagnosis
    - Active glaucoma
    - Inactive glaucoma
    - **Treatable non-glaucomatous conditions!**
    - Untreatable non-glaucomatous conditions
    - Normal variations
    - Testing artifact

The Cupped Disc

Who Needs Neuroimaging?

David S. Greenfield, MD,[1] R. Michael Siatkowski, MD,[1] Joel S. Glaser, MD,[1,2] Norman J. Schatz, MD,[1,2] Richard K. Parrish II, MD[1]

Objective: To determine the incidence of positive neuroradiologic studies in consecutive patients with glaucoma associated with normal intraocular pressure and to compare the psychophysical and clinical characteristics of these eyes with eyes with disc cupping associated with intracranial masses.

Compare the characteristics of NTG patients with a control population of patients with **nonglaucomatous cupping associated with intracranial masses.**

(1) Younger age, (2) lower levels of visual acuity, (3) vertically aligned visual field defects, and (4) neuroretinal rim pallor may increase the likelihood of identifying an intracranial mass lesion.

Ophthalmology 1998;105:1866

Optical coherence tomography retinal ganglion cell complex analysis for the detection of early chiasmal compression

Richard J. Blanch[1,2,3] · Jonathan A. Micieli[1] · Nelson M. Oyesiku[4] · Nancy J. Newman[1,4,5] · Valérie Biousse[1,5]

Abstract

Purpose To report patients with sellar tumors and chiasmal compression with normal visual fields, who demonstrate damage to the retinal nerve fiber layer (RNFL) and ganglion cell complex (GCC) on optical coherence tomography (OCT).

Methods Seven patients with sellar tumors causing mass effect on the optic chiasm without definite visual field defect, but abnormal GCC are described. GCC/RNFL analyses using Cirrus-OCT were classified into centiles based on the manufacturer's reference range.

Results In seven patients with radiologic compression of the chiasm by a sellar tumor, OCT-GCC thickness detected compressive chiasmopathy before visual defects became apparent on standard automated visual field testing. Without OCT, our patients would have been labelled as having normal visual function and no evidence of compressive chiasmopathy. With only OCT-RNFL analysis, 3/7 patients would still have been labelled as having no compression of the anterior visual pathways.

Conclusions These patients show that OCT-GCC analysis is more sensitive than visual field testing with standard automated perimetry in the detection of compressive chiasmopathy or optic neuropathy. These cases and previous studies suggest that OCT-GCC analysis may be used in addition to visual field testing to evaluate patients with lesions compressing the chiasm.

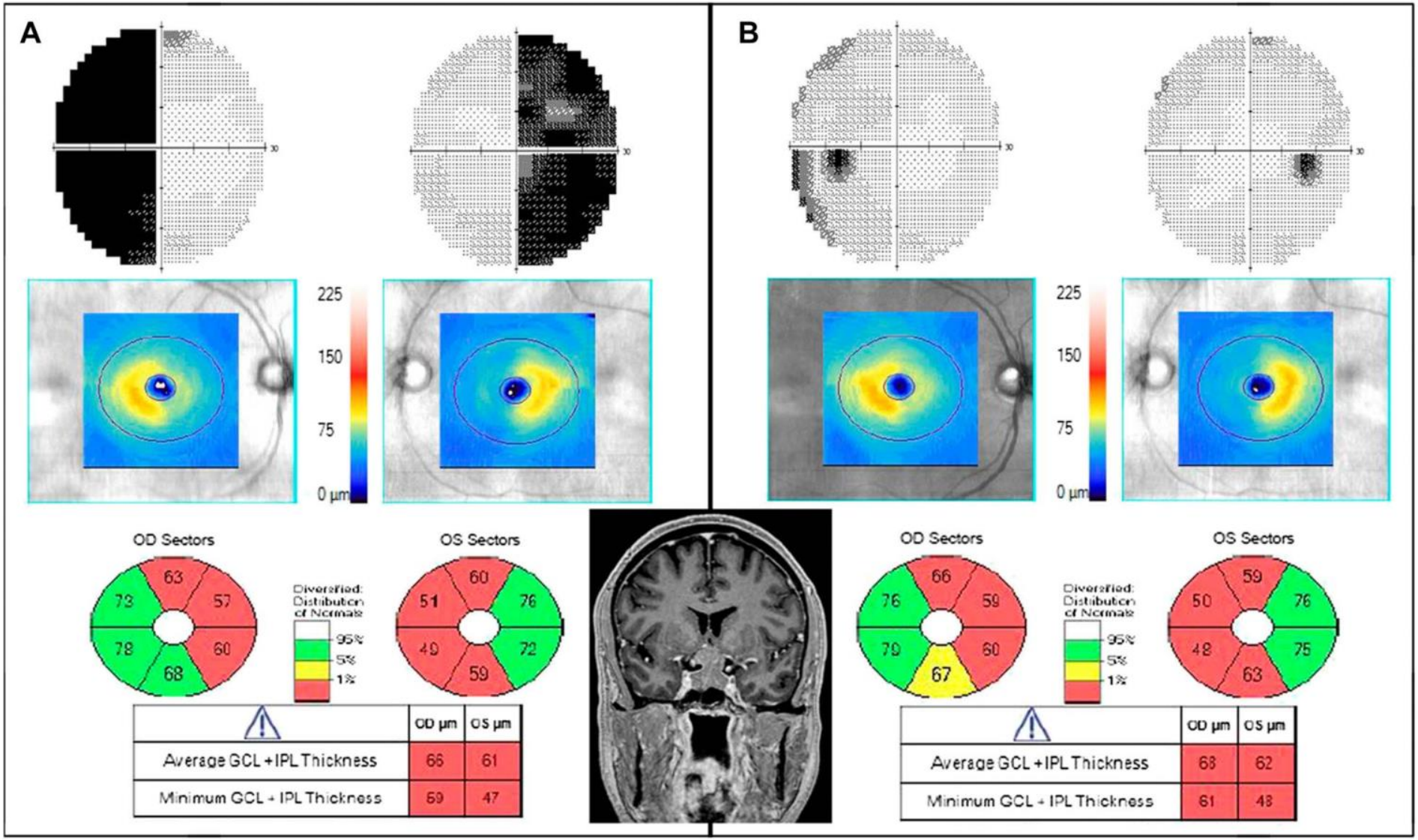
OCT can detect chiasmal compression

before VF loss occurs

Pituitary 2018;21:515

Pre-Op

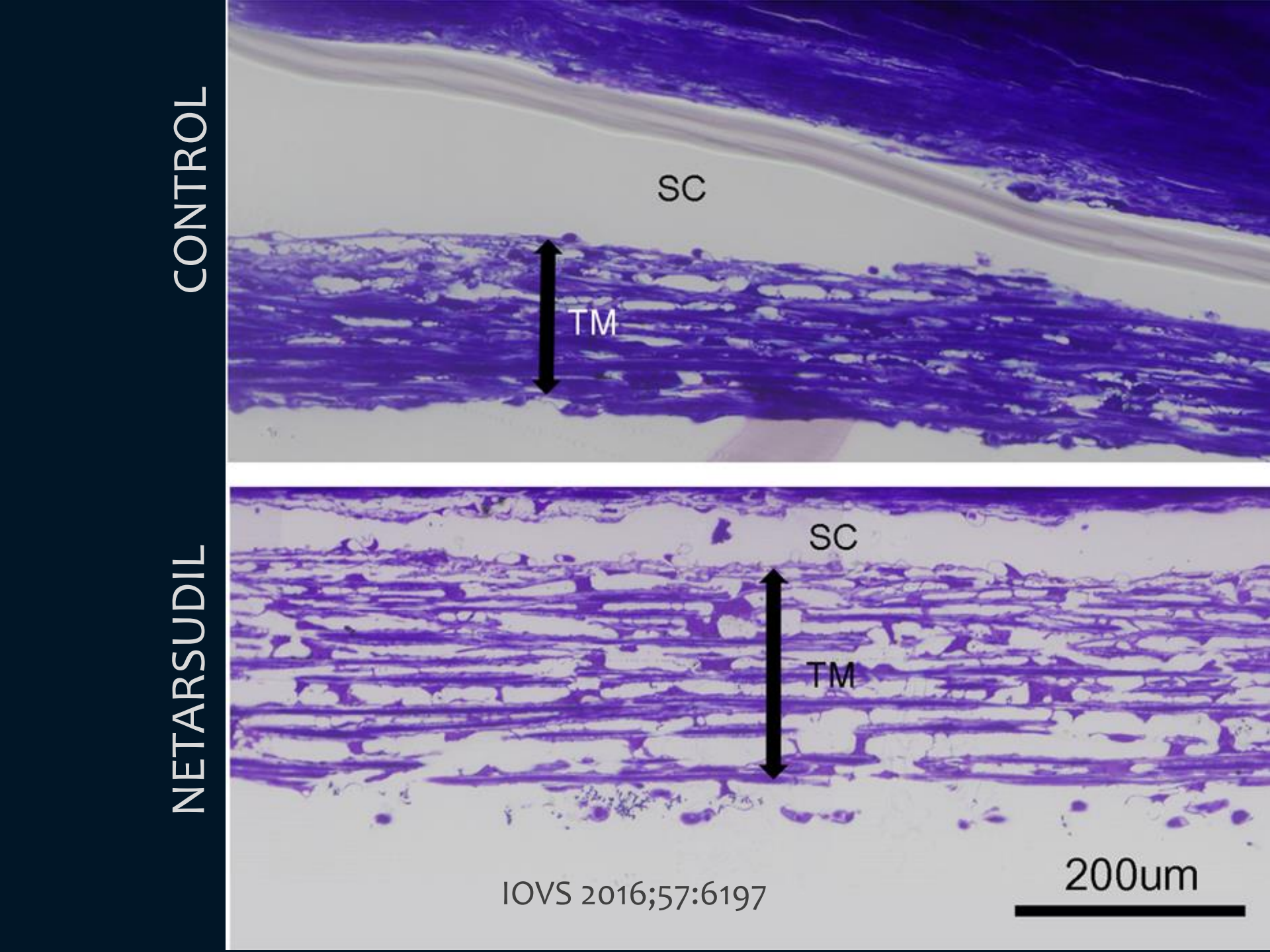
Post-Op



Pituitary 2018;21:515

Management: Meds

- Rho-kinase Inhibitors
  - First new glaucoma drug class in >20 years
  - **Netarsudil (Rhopressa®) FDA approved 2017**
  - Lowers IOP primarily by improving outflow through the TM
  - QHS dosing lowers IOP 20-25% (similar to timolol)
  - Ocular adverse effects: **hyperemia**, corneal verticillata and conjunctival hemorrhage

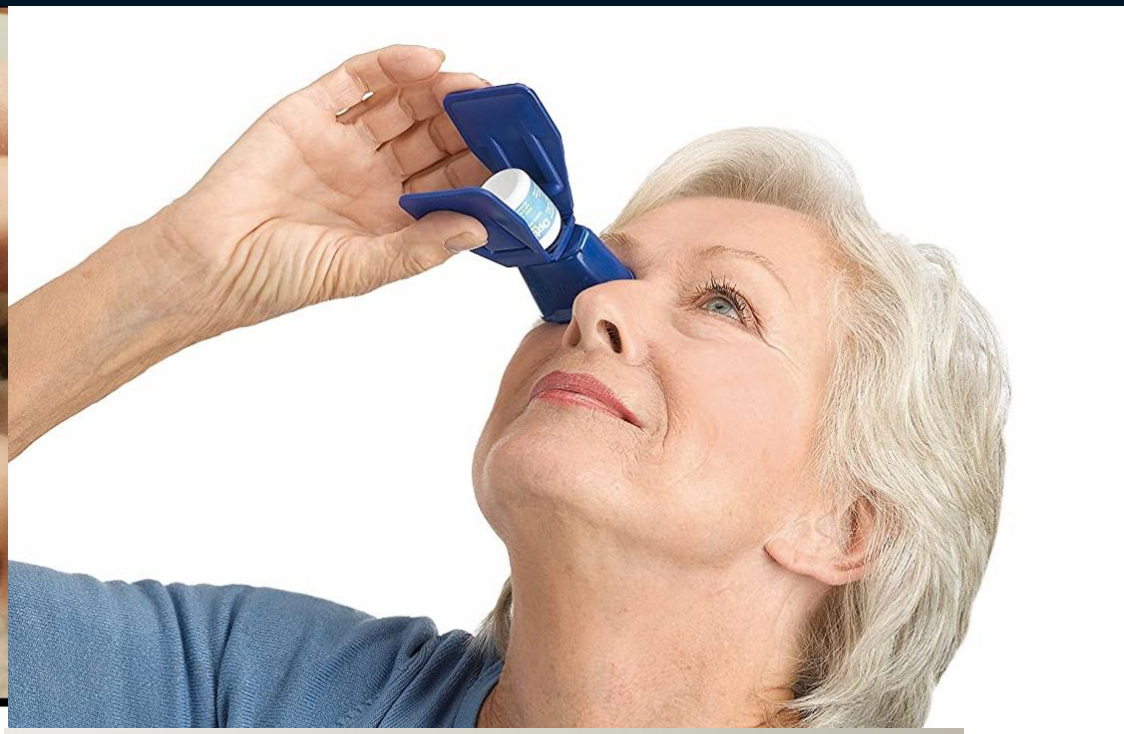


IOVS 2016;57:6197

Management: Meds

- Latanoprostene bunod (Vyzulta®)
  - Unique **dual-action drug**: PGA + nitric oxide
  - Drug molecule dissociates into latanoprost and nitric oxide after instillation
  - **Nitric oxide**: Increases trabecular outflow
  - Achieves an additional 1-2 mmHg of IOP reduction over latanoprost alone
  - Same dosing and safety profile as PGA
  - **Most effective ocular hypotensive agent!**

Eyedrop instillation aids



Management: First Line

- First Line Therapy: Surgery or Drops?
  - **SLT is an appropriate first-line therapy** for mild-moderate POAG
  - SLT lowers IOP by ≈20% in most people
  - **Advantages**: Cost (over time), Compliance, Risk (avoid side effects), Repeatable (PRN)
  - **Disadvantages**: Failure to sufficiently lower IOP, Patients lost to follow-up care

Selective laser trabeculoplasty versus eye drops for first-line treatment of ocular hypertension and glaucoma (LiGHT): a multicentre randomised controlled trial

*Gus Gazzard, Evgenia Konstantakopoulou, David Garway-Heath, Anurag Garg, Victoria Vickerstaff, Rachael Hunter, Gareth Ambler, Catey Bunce, Richard Wormald, Neil Nathwani, Keith Barton, Gary Rubin, Marta Buszewicz, on behalf of the LiGHT Trial Study Group**

Lancet 2019; 393: 1505–16
Published Online
March 9, 2019
http://dx.doi.org/10.1016/
S0140-6736(18)32213-X

Summary

Background Primary open angle glaucoma and ocular hypertension are habitually treated with eye drops that lower intraocular pressure. Selective laser trabeculoplasty is a safe alternative but is rarely used as first-line treatment. We compared the two.

Laser-first gave **drop-free disease control** at stringent target IOPs, lower trabeculectomy rates, **less glaucoma progression**, and lower cost in ¾ of patients at 3 years

Lancet 2019;393:1505

NEW!

PERSPECTIVE

Low-energy Selective Laser Trabeculoplasty Repeated Annually: Rationale for the COAST Trial

Tony Realini, MD, MPH, Gus Gazzard, MD,†‡ Mark Latina, MD,§ and Michael Kass, MD§‖*

A recent data set suggested that lower energy SLT, applied as primary therapy and repeated annually irrespective of IOP – rather than PRN when its effect wanes and irrespective of IOP rises – yields **longer medication-free survival** than standard energy SLT repeated PRN.

PMID 33428350

NEW!

REVIEW ARTICLE

OPEN

Minimally Invasive Glaucoma Surgery: Where Is the Evidence?

Kevin Gillmann, MBBS, FEBOphth, MArch and Kaweh Mansouri, MD, MPH*†*

Purpose: The last decade has witnessed an unprecedented growth in glaucoma treatment options through the introduction of minimally invasive glaucoma surgeries (MIGS). The aim of the present review is to provide an understanding of the currently available MIGS and to examine what data are currently available to guide treatment

Glaucoma is a progressive optic neuropathy and a leading cause of blindness worldwide. Indeed, with a forecasted rise in excess of 45% from 2020, it has been estimated that >110 million people would suffer from glaucoma by 2040.[1] To face the increasing burden of glaucoma, the landscape of glaucoma man-

Only few studies compare different MIGS techniques and even fewer assess MIGS against criterion standard treatments

PMID 32501895

NEW!

Ophthalmol Ther (2021) 10:349–358
https://doi.org/10.1007/s40123-021-00343-4

ORIGINAL RESEARCH

Short-term Evaluation of Negative Pressure Applied by the Multi-Pressure Dial System to Lower Nocturnal IOP: A Prospective, Controlled, Intra-subject Study

Jeffrey L. Goldberg · Jesus Jiminez-Roman · Alejandra Hernandez-Oteyza · Hugo Quiroz-Mercado

Received: January 11, 2021 / Accepted: March 26, 2021 / Published online: April 19, 2021

The MPD holds promise as a potential new, non-invasive treatment option for the control of nocturnal IOP.

PMID 33871812

Management

- When to Hold and When to Fold

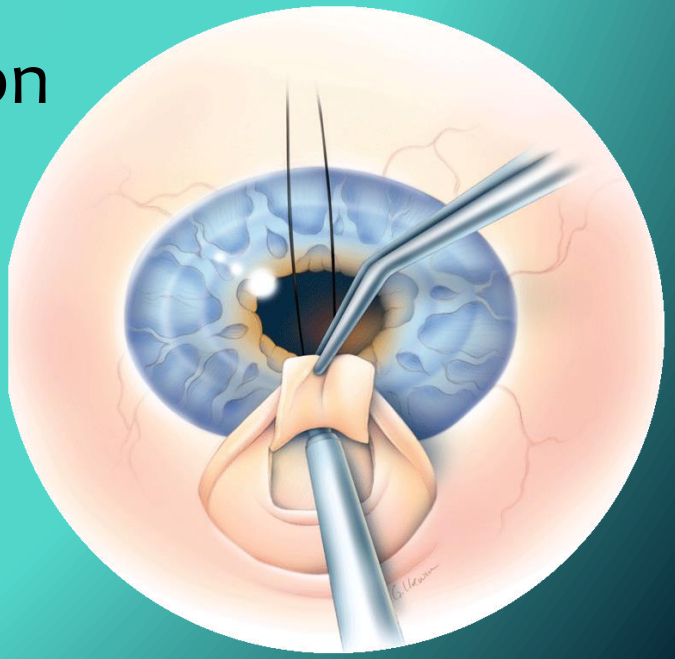
  Indications for glaucoma specialist referral

  – Failure to achieve target pressure

  – Failure to control progression

  – Inability to accurately assess VF, ONH, or IOP

  – Surgical intervention indicated (eg. fixation threatened)



Self Assessment Quiz

Glaucoma referrals only occur if you are unable to manage the condition yourself.

- If so, award yourself 1 point
- If you refer all glaucoma suspects, award yourself -1 points

21st Century Glaucoma Care

- History & Risk Factors
- Evaluation Procedures
- Management
- Patient-Centered Care

Why Do Some People Go Blind from Glaucoma?

W. MORTON GRANT, MD, JOSEPH F. BURKE, JR., MD

Abstract: Retrospective analysis of patients blinded by glaucoma has revealed a need to educate patients to the significance of premonitory symptoms, to investigate a higher incidence of blindness from open-

Three main reasons why people go blind from glaucoma:

33% were undiagnosed prior to blindness	33% had not been treated properly	33% noncompliant with therapy

Ophthalmology 1982;89:991

tvst

DOI: 10.1167/tvst.4.2.1

Perspective

Why Do People (Still) Go Blind from Glaucoma?

Remo Susanna Jr.[1], **Carlos Gustavo De Moraes**[2], **George A. Cioffi**[2], **and Robert Ritch**[3]

[1] Department of Ophthalmology, University of Sao Paulo School of Medicine, Sao Paulo, SP, Brazil
[2] Department of Ophthalmology, Columbia University Medical Center, New York, NY, USA
[3] Einhorn Clinical Research Center, New York Eye & Ear Infirmary of Mount Sinai, New York, NY, USA

Correspondence: C. Gustavo De Moraes, Edward S. Harkness Eye Institute, Columbia University Medical Center, New York, NY, USA; e-mail: demoraesmd@gmail.com

Received: 13 August 2014
Accepted: 18 January 2015
Published: 9 March 2015

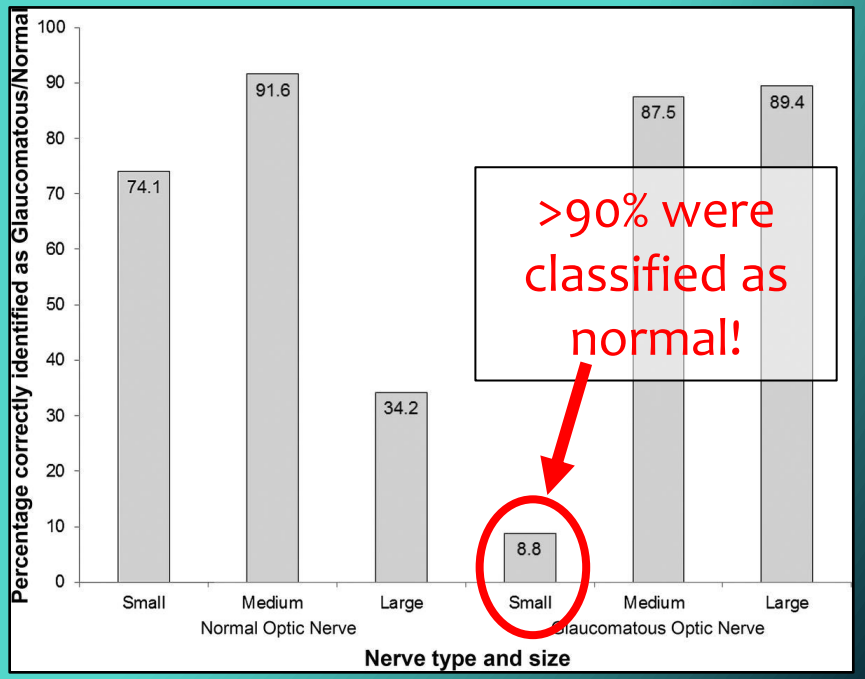
Keywords: glaucoma; blindness; intraocular pressure; visual fields; adherence

further functional loss or blindness. Forchheimer et al.[4] investigated the relationship between baseline visual field damage, IOP, and rate of progression and found that among eyes with more severe functional damage (mean deviation [MD] worse than −12 dB), those with mean follow-up IOP < 14 mmHg progressed more slowly than those with higher pressures. Kotecha et al.[5] found that following

"Thirty years later, despite meaningful improvements in technology, therapeutic tools, and knowledge of the disease, patients continue to go blind from glaucoma."

Patient-Centered Care

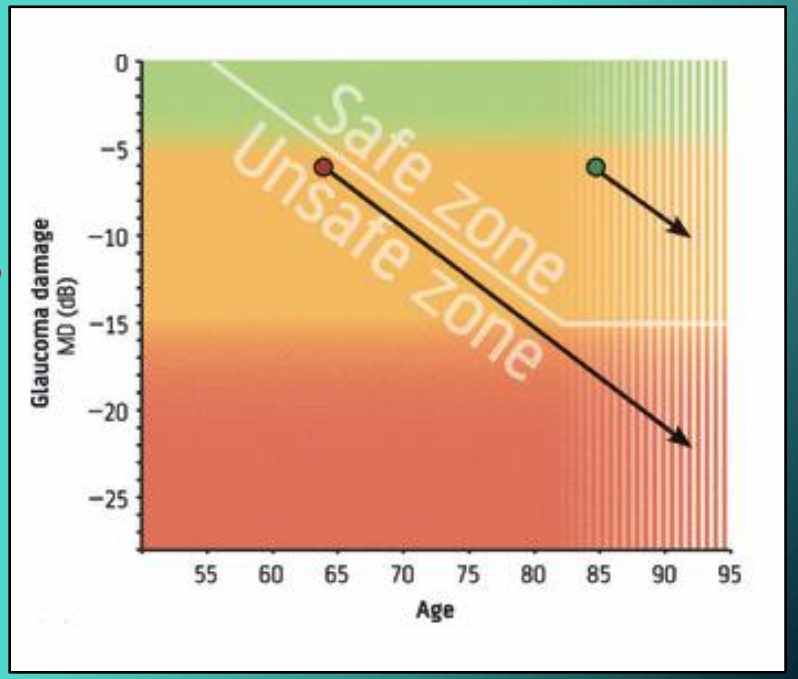
- Undiagnosed glaucoma
  - Over half of all glaucoma cases in the US remain undiagnosed
  - Access to care issues
  - **Inability to recognize glaucomatous optic disc damage**



Patient-Centered Care

- Improper Treatment of Glaucoma
  - Failure to adhere to practice guidelines
  - Insufficient IOP reduction
  - Inadequate assessment of progression

Aggressive treatment of patients in "Unsafe Zone" to prevent symptomatic vision loss



Patient-Centered Care

- Poor Compliance
  - **Poor adherence is associated with inadequate patient education** about glaucoma, especially the potential for permanent vision loss.
  - Ways to improve compliance
    - Simplify treatment regimens
    - Reduce side effects
    - Reduce medication costs
    - Educate about potential for blindness

Self Assessment Quiz

Have you paid attention to what I was saying for the past 10 min?

- +1 point if you know what I was talking about
- -10 points if you were sleeping for the past 10 minutes

Self Assessment Quiz

SCORE

0-2	1980's
3-5	1990's
6-8	Early 2000's
>8	I need a new OD, are you accepting new patients?

21st Century Glaucoma Care

THANK YOU