How to Diagnose Glaucoma Like an Expert

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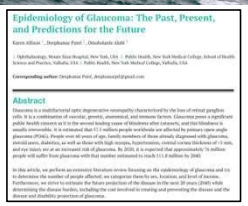
Disclosures

Michael Chaglasian, O.D.

- Bauch+Lomb - Advisory Board, Speaker Bureau
- Carl Zeiss - Consultant, Advisory Board
- Topcon- Consultant, Reaserch
- Optos- Research

Topics/Sections

1. **IOP**
   - New Thoughts and Options
   - Home Tonometry. Improving options
   - Key points
2. **Central Corneal Thickness**
   - OHTS
   - Risk Calculator
3. **Optic Disc Assessment**
   - Key things to identify
4. **Visual Fields:**
   - What is a glaucoma defect?
   - Best testing options
5. **OCT Imaging:**
   - New Methods of Analysis
   - Artifacts vs True Loss
6. **Putting it all together**


Epidemiology of Glaucoma: The Past, Present, and Predictions for the Future

Abstract

Glaucoma is Coming to Your Practice!

2x Increase by 2050


NEWS REVIEW

Glaucoma Unduly Burdens Blacks, Asians

Study projects that the disease will primarily affect these ethnic groups by 2040

https://www.reviewofoptometry.com/CMSDocuments/2011/2/FebruaryReview.pdf

Diagnosis In The Glaucoma Suspect —When To Treat?

- Glaucoma suspects can be (broadly) categorized into two groups:

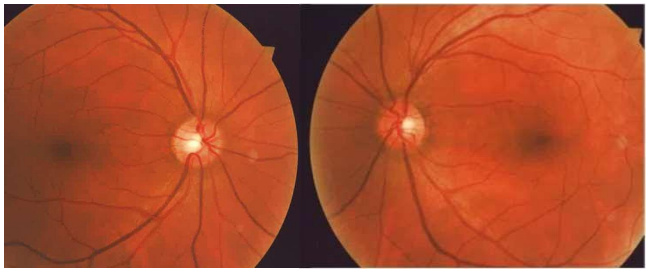
1. **Ocular hypertensive subjects with risk factors for the future development of glaucoma**
   - **These patients are addressed by OHTS data and who to treat (coming up)**
2. **Subjects with questionable glaucomatous findings that cannot definitively be distinguished from normal**
   - e.g., suspicious appearance of optic disk, OCT RNFL/GCA or VF and/or other ocular and systemic risk factors being present

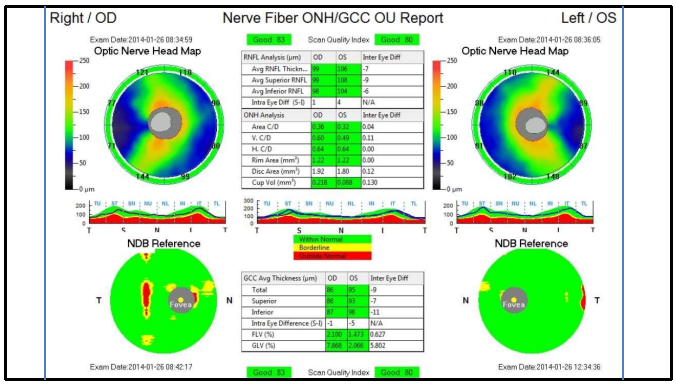
CASE

64 yo, white male, low myope
History of **ocular hypertension** w/ IOP in mid/high **20's**.
Excellent health. Question of family History of IOP.
Last seen 5-6 years ago.
Was aware of OHTN but felt everything was normal.

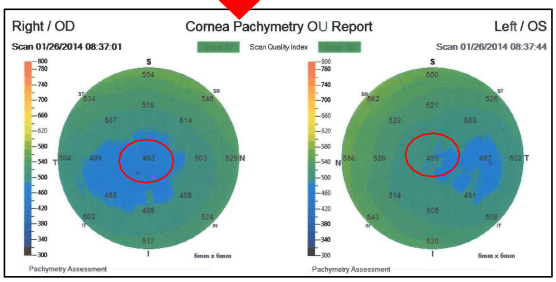
Results from earlier examination:
(other findings were normal/unremarkable)

Baseline Photos. Important for all Suspects





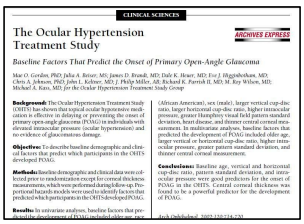
First Red Flag: IOP= 25/23 OD/OS



Ocular hypertension type of Glaucoma Suspect

PATIENT EDUCATION IS KEY,
EXPLAIN RISK OF FUTURE GLAUCOMA
THERE ARE TOOLS TO HELP WITH THIS:

How to Manage OHTN?



CLINICAL SCIENCES

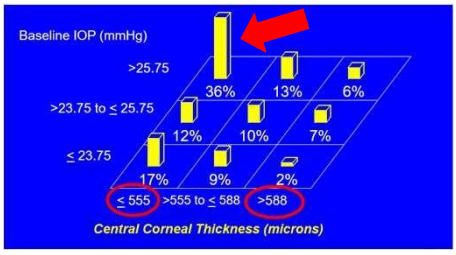
The Ocular Hypertension Treatment Study

ARCHIVES EXPRESS

Baseline Factors That Predict the Onset of Primary Open-Angle Glaucoma

Percent of subjects that Developed POAG, by Central Corneal Thickness and Baseline IOP

OHTS Data



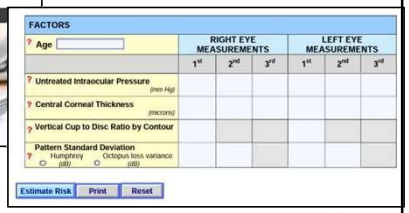
Kass MA, Heuer DK, Higginbotham EJ, Johnson CA, Keltner JL, Miller JP, Parrish RK 2nd, Wilson MR, Gordon MO. Arch Ophthalmol. 2002 Jun;120(6):701-13

Bottom Line: Ocular Hypertension, When is Therapy Indicated?

- **When there are other (multiple) significant Risk Factors:**
  - CCT under 555 microns
  - Family History
  - Disc Hemorrhage
  - Vertical CD ratio
  - Low Ocular Perfusion Pressure
- When Risk Calculation is over ~ 15%

Free Online OHTS Risk Calculator (or verified phone App)

https://ohts.wustl.edu/risk/



The predictions derived using these methods are designed to aid but not to replace clinical judgment.

What does OHTS Risk Calculator Mean?

- Expert Panel Recommendations
  - < 5% = No Treatment
  - 5-15% = Treatment optional
  - > 15% = Treatment Recommended

Expert Panel Recommendations	
<5%	No Treatment
5-15%	Treatment optional
>15%	Treatment recommended

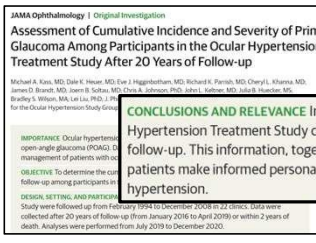
- These are suggested guidelines only, treat every case individually
  - Must consider all and other factors (family Hx, Drance Heme, age.)

Without Risk Calculator, just use Pachymetry Alone: 3 Outcomes

- Thin: <555 µ High Risk
- Average: 555-588 µ No change in Risk
- Thick: >588 µ Low Risk

The predictions derived using these methods are designed to aid, but not to replace clinical judgment.

OHTS: 20 Year Data. The difference is Risk Factors:



Reaffirms earlier results.

CONCLUSIONS AND RELEVANCE In this study, only one-fourth of participants in the Ocular Hypertension Treatment Study developed visual field loss in either eye over long-term follow-up. This information, together with a prediction model, may help clinicians and patients make informed personalized decisions about the management of ocular hypertension.

But they must be monitored.

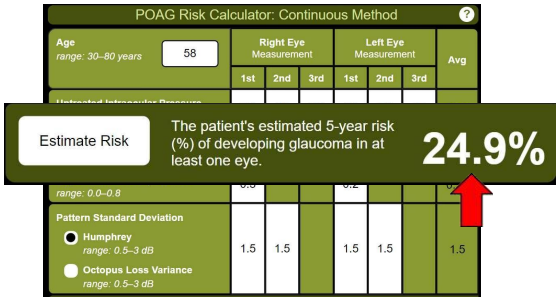
OHTS Risk Calculator (patient data entered)

- **Back to Previous Case:**
  - 58 year old
    - At time of initial suspicion
  - IOP ~ 26 mmHg
  - CD = 0.3
  - VF = normal
  - CCT = 490 microns

POAG Risk Calculator: Continuous Method

Age range: 30–80 years	58	Right Eye Measurement			Left Eye Measurement			Avg
		1st	2nd	3rd	1st	2nd	3rd	
Untreated Intraocular Pressure range: 20–32 mm Hg		26	26	26	25	25	25	25.5
Central Corneal Thickness range: 475–658 µm		483	483	483	493	493	493	488
Cup to Disc Ratio by Contour range: 0.0–0.8		0.3			0.2			0.25
Pattern Standard Deviation: Humphrey range: 0.5–3 dB / Octopus Loss Variance range: 0.5–3 dB		1.5	1.5		1.5	1.5		1.5

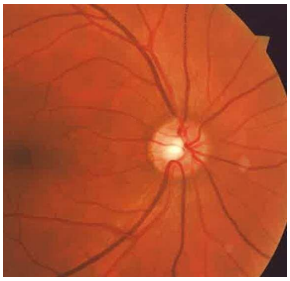
OHTS Risk Calculator

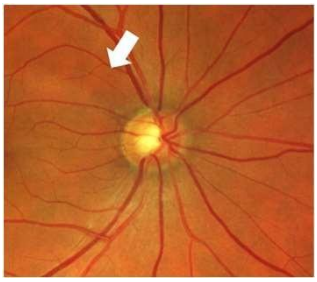


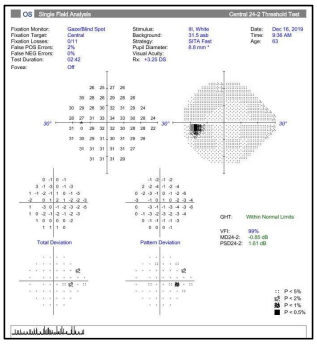
Five Years Later (now 64 ys old):

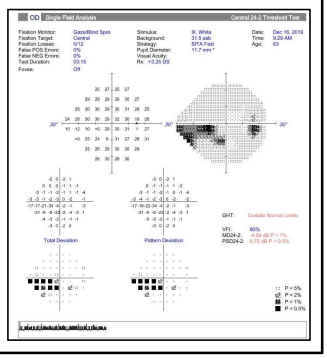
- IOP
  - **32 OD**
  - **30 OS**
- Central Corneal Thickness CCT
  - 510 microns
  - 515 microns
    - Ultrasound device vs OCT
- Family History
  - Patient re-questioned
  - 1-3 members with OHTN/POAG
- **Gonioscopy**
  - Open to Ciliary Body
  - Light Pigment

Comparison (5 years)





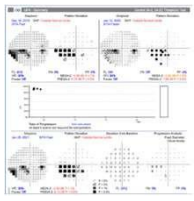




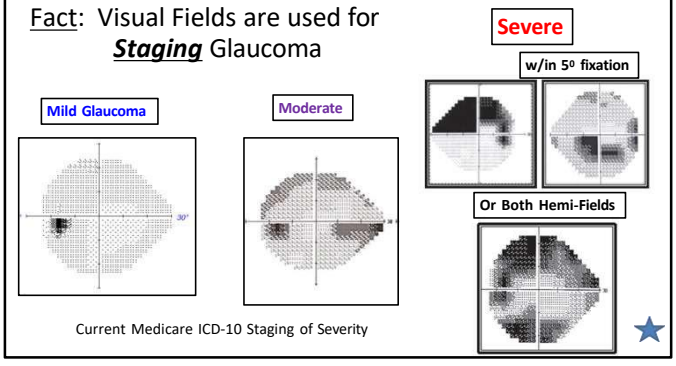
Summary

- Ocular Hypertensive patient now has moderate stage disease.
  - VF defect is noticeable to patient
- Thin CCT "predicted" glaucoma developed
- Treatment initiated OD and OS

- Treatment:
  - Start PGA OU
  - Target decrease 35%
  - Monitor Closely
  - May need second medication or SLT OD only



Fact: Visual Fields are used for ***Staging*** Glaucoma

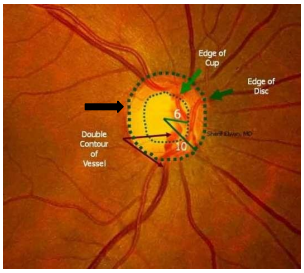


Current Medicare ICD-10 Staging of Severity

Yes, you still need to look at the optic disc.

Optic Disc Defined

Neural Retinal Rim (NRR)



Glaucomatous Disc Features

Descriptive terms to know : examples coming up

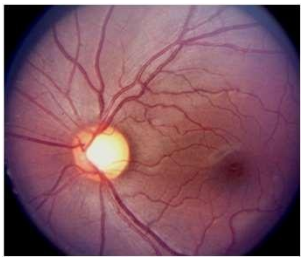
- *increased* (meaning it changed) cup-to-disc ratio or significant cup asymmetry;
- decreased or documented change in neuroretinal rim area;
- *notch* of the neuroretinal rim;
- *saucerization* of neuroretinal rim;
- flame-shaped *disc hemorrhage*;
- nerve fiber layer loss;
- peripapillary atrophy
- Laminar dot sign (non-specific to glaucoma)

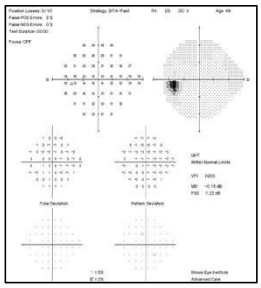
TIPS and PITFALLS

- Do not emphasize the C/D ratio
- **Concentrate on the neural retinal rim**
- Look for focal defects (notching) and and/or generalized thinning
- Evaluate symmetry between eyes
- Disc Hemes
- Peripapillary atrophy
- Baring of circumlinear vessels
  - Loss of NRR tissue

Examples of ONHs

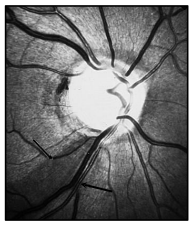
Normal: Optic Nerve, RNFL, VF

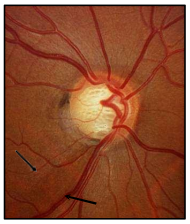




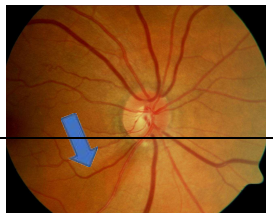
Localized RNFL defect

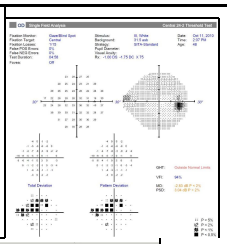
Wedge-shaped dark area

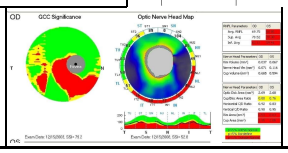




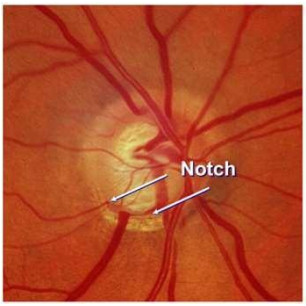
RNFL Dropout, Early Notch

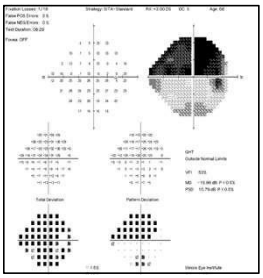






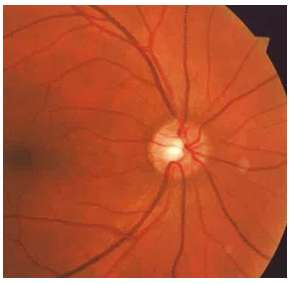
Very Advanced Notch

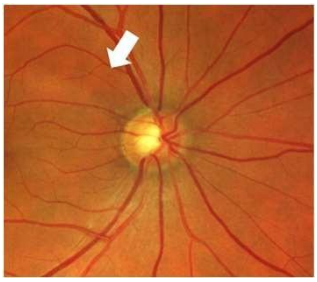


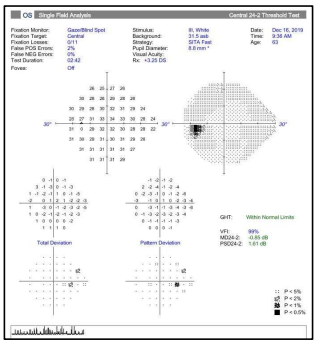


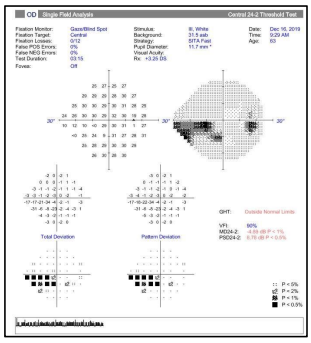
Back to Case

Comparison (5 years)





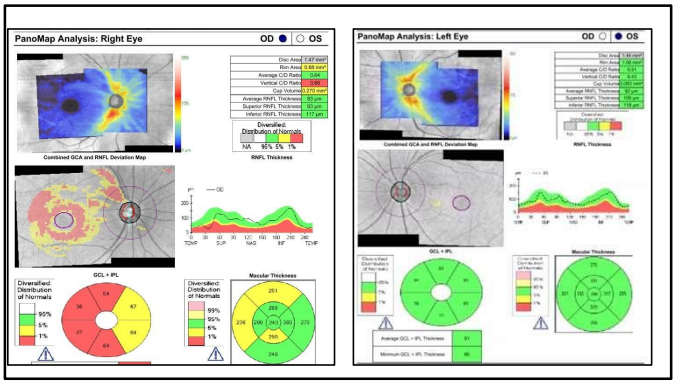




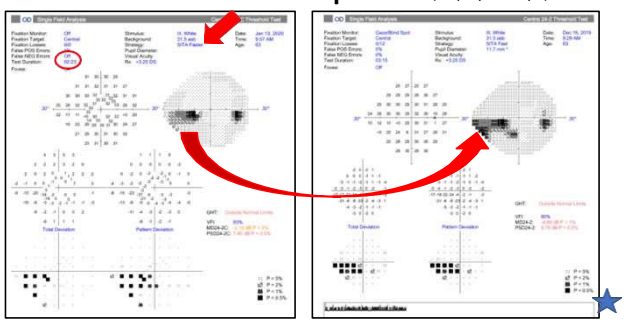
Diagnosis: Severe Stage POAG

- Steps:
  - Confirm IOP at 2nd visit
  - Discuss diagnosis and Tx options
  - Set Target IOP
    - ~35-40% decrease from baseline
  - Repeat VF and OCT testing q 6-12m in order to measure rate of progression
  - Start with PGA

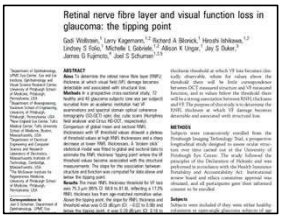
- **OCT:**

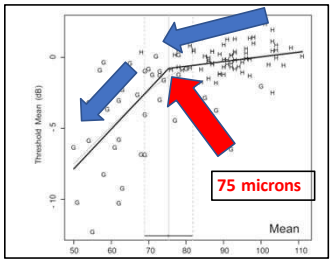


Second VF with new 24-2C pattern (Humphrey Field Analyzer)



When do we start to see VF defects in early glaucoma?

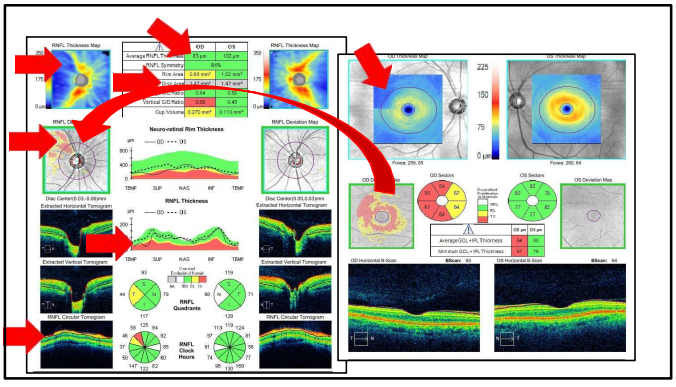


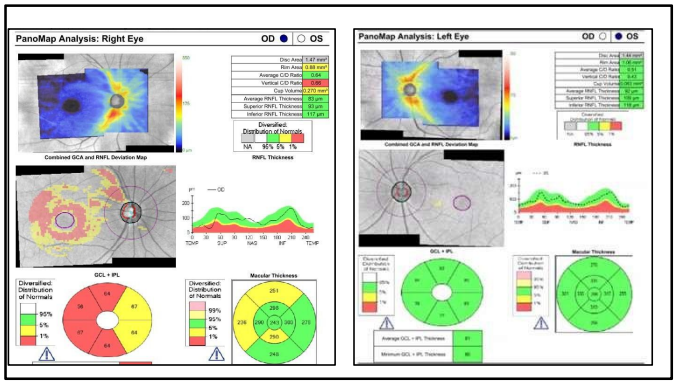


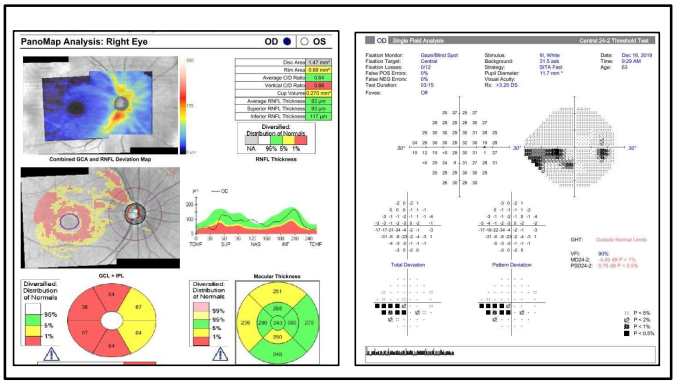
Br J Ophthalmol. 2012 Jan;96(1):47-52.

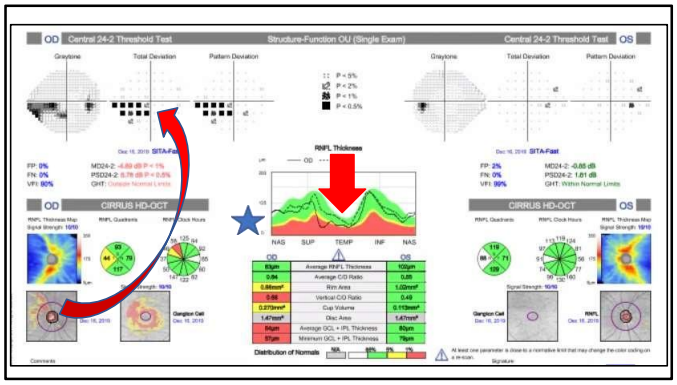
OCT Interpretation

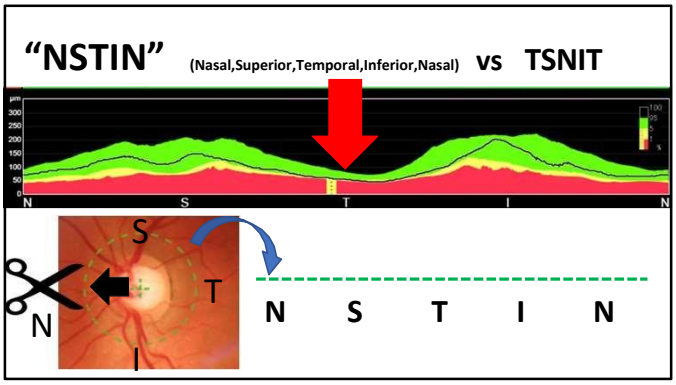
Know the details in your OCT Report. Explore the multiple layout options that may be in the system.





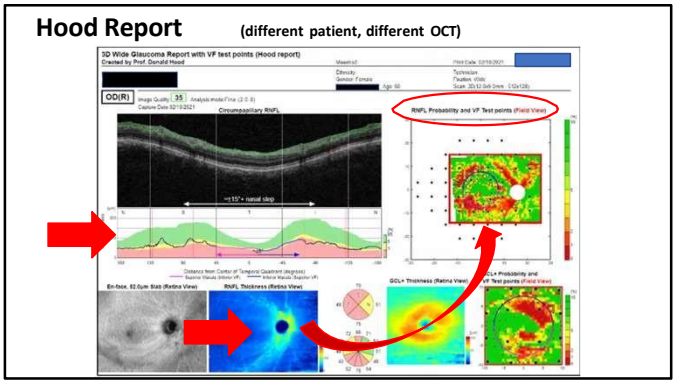




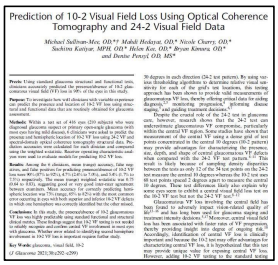


Why such detailed comparison between OCT and visual fields?

- Having good (not always perfect) correlation between structural loss (RNFL and GCC) and VF (24-2, 20-2), significantly improves diagnostic accuracy.
- Reason why you might **NOT** identify correlation:
  - Artifact from poor test quality, reliability.
  - Artifact from other disease, optic nerve, retina and other
  - Need to repeat and improve data when possible. Don't try interpret bad data.
- Early glaucoma does sometimes show damage first on OCT, less commonly on VF only.
  - This can be reduced by doing macular ganglion cell scans and 10-2 VFs.



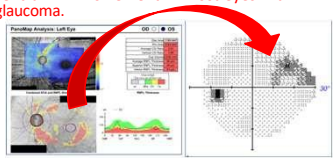
Prediction can be ***helped*** by combining OCT (RNFL+GLC) and 24-2 VF


Prediction of 10-2 Visual Field Loss Using Optical Coherence Tomography and 24-2 Visual Field Data

Michael Sullivan-Mee, OD, Mahdi Hedayat, OD,* Nicole Cherry, OD,* Sushma Kuriyan, MPH, OD,* Helen Ko, OD,* Bryan Kimura, OD,* and Bonnie Persey, OD, MS**

J Glaucoma 2021;30:e292–e299

- Conclusions:
- In this study, the presence/absence of 10-2 glaucomatous VF loss was highly predictable using standard functional and structural clinical metrics.
- These findings suggest that 10-2 VF testing is **not needed** to reliably recognize and confirm central VF involvement in most eyes with glaucoma.



The new normal for VF testing?

Advantages of Head-Mounted Perimetry

1. **Improved patient comfort.**
   - *Head-mounted perimetry devices can provide a more comfortable testing experience for patients compared with traditional perimetry machines.*
2. **Increased accessibility.**
   - *Portable head-mounted perimetry devices may offer increased accessibility, allowing for VF testing in various settings, including remote or underserved areas.*
3. **Real-time data and analytics.**
   - *Some head-mounted perimetry devices can provide real-time data and analytics, enabling healthcare professionals to monitor and analyze visual field changes more efficiently.*
4. **Customized testing.**
   - *Head-mounted perimetry devices may allow for more customized and targeted visual field testing, tailoring the assessment to specific patient needs or conditions.*
5. **Patient engagement.**
   - *The use of modern technology, such as head-mounted perimetry, may enhance patient engagement in the testing process, potentially leading to more accurate results.*

HM Perimetry (+):

Many Options, but "Early Days"

- **Perimetry**
- **Multiple testing options**

PLUS:

- **Contrast Sensitivity**
- **Color Vision**
- **Dark Adaptation**
- **Eye Tracking**
- **New Features in Development**


GET A HANDLE ON HEAD-MOUNTED PERIMETRY

AVAILABLE HEADSETS

Manufacturer	Head-Mounted Device:	Website
Elisar	AVA	elisar.com
Haag	re:View	haag.com
MEG	Smart System VR	www.rostch-eyes.com/pr-headset
MicroMedical Devices	VF2000	micromedev.com
Oculus	EasyField VR	www.oculus.de/ez/products/easyfield-vr/
Olleyes	VisuAll	olleyes.com
PadlessVR	PadlessVR	padlessvr.com
Virtual Field	VirtualField	virtualfield.ie
Virtual Vision	VirtualEye	virtualvision.health

Hoepf M, Chaglasian M. Review of Optometry Feb 2024

Why might we want to switch to clinical video perimeters?

- Reduced clinical footprint
- Lower cost
  - And costs should become more attractive over time.
- Improved reliability -- Fewer moving parts
- Binocular testing
  - A new idea, but may turn out to have advantages.
- Improved ergonomics

- **But, what are the technical limitations?**
- **Bowl device ≠ Small video device (eg your iPhone)**

Might video perimetry replace conventional clinical perimeters?

- What about commercial VR devices?
  a. Conventional over the counter "Virtual Reality" devices like the Oculus device shown here ***cannot match the stimulus and background intensity ranges required in clinical Standard Automated Perimetry (SAP).***
  b. However, if properly programmed and engineered, ordinary Virtual Reality systems may offer a cost-effective alternative for home testing.
     a. Improved technology is coming

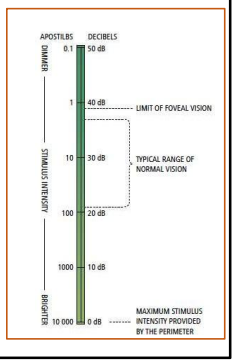
Video Gaming Device

What are some of the technical issues associated with Video Perimetry?

Switching to Video Perimetry may not be nearly as simple as you might expect.

1. Video involves many, -- perhaps TOO many – "light bulbs."
   a) Goldmann: One bulb
   b) Automated projection perimeters: 2 or 3 bulbs.
   c) Video: About 2000 X 2000 pixels = 4 million "bulbs!"

2. It probably is not trivial to calibrate – and to monitor the calibration of – 4 million "bulbs."



Slide Credit: Mike Patella, OD

VR Perimetry

Preliminary Report on a Novel Virtual Reality Perimeter Compared With Standard Automated Perimetry

Reza Razeghinejad, MD, Alberto Gonzalez-Garcia, MD,† Jonathan S. Myers, MD,* and L. Jay Katz, MD**

Visual Field:
- All common protocols e.g. 24-2, 10-2, 30-2, etc).
- Testing time is about 3 minutes for threshold and 45 seconds for screening.
- 24-2c protocol which combines 24-2 and key 10-2 locations.
- Ptosis, Esterman.

Additionally:
- Visual Acuity (near and far acuity).
- Color Vision (D-15).
- Pediatrics Visual Field.
- Contrast Sensitivity.
- LCVA (Low Contrast Visual Acuity)

J Glaucoma 2021;30:17–23

MultiFunction

VR Perimetry: Limitations

- Need to identify optimal patient type
- Limited dynamic range
  - Not yet geared for moderate and severe VF defects
- Further, wide scale validation required
- Limited progression analysis
- Many new devices are now available, shop and investigate carefully

Key Points: Summary

1. **IOP**
   - **New Thoughts and Options**
   - **Home Tonometry. Improving options**
   - **Key points**
2. **Central Corneal Thickness**
   - **OHTS**
   - **Risk Calculator**
3. **Optic Disc Assessment**
   - **Key things to identify**
4. **Visual Fields:**
   - **What is a glaucoma defect?**
   - **High frequency of testing**
   - **Best testing options?**
5. **OCT Imaging**
   - **New Methods of Analysis**
   - **Artifacts vs True Loss**
6. **Putting it all together**

Who/when do you treat?

Confirmed Glaucoma Disease

- Optic nerve damage
  - photo/exam
- OCT loss consistent w/glaucoma
  - not red disease
- Corresponding Visual Field Loss
  - helps to confirm but is not required for diagnosis or initiating therapy
- IOP can be +/- 21 mmHg

No Confirmed Disease/Damage

1. Ocular Hypertension
   - Use pachymetry, <555m, has high risk guideline
   - Use OHTS risk calculator (online)
   - Initiate Tx for those w/high risk
2. IOP can be in normal range
   - Evaluate RFs and Diagnostic data
   - Weigh risks/benefits of treatment vs close observation

Thanks!

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