


1

Who am I?

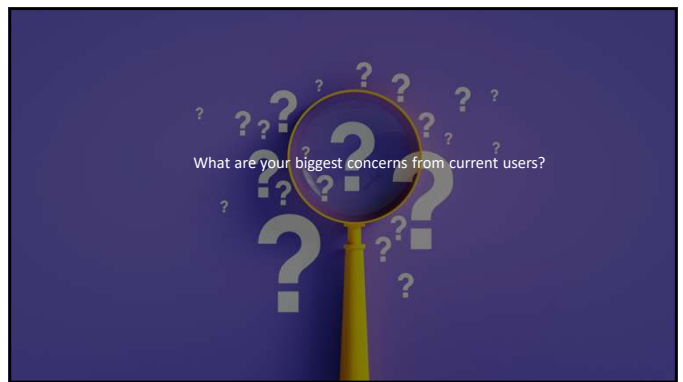
- Michael Cymbor, O.D., F.A.A.O.
- Nittany Eye Associates, State College, PA
- Medical Director of the Glaucoma Institute of State College
- Using ERG since 2019
- Wanted objective functional testing because of the many weaknesses of visual fields, using DR protocol in diabetic patients and PhNR protocol for differentiating retina/optic nerve disease
- Newsweek Top 150/PCON Top 250/AOA Young OD
- Optometric Glaucoma Society Executive Committee
- Optometric Management's new glaucoma columnist
- Husband/Father/Son/Uncle



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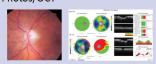
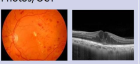


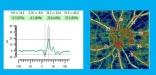
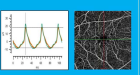


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The Relevance of ERG

	Glaucoma	Diabetic Retinopathy
Structure	Photos/OCT 	Photos/OCT 
Function	Visual Fields 	? 
Early Diagnosis	ERG/OCT-A 	ERG/OCT-A 

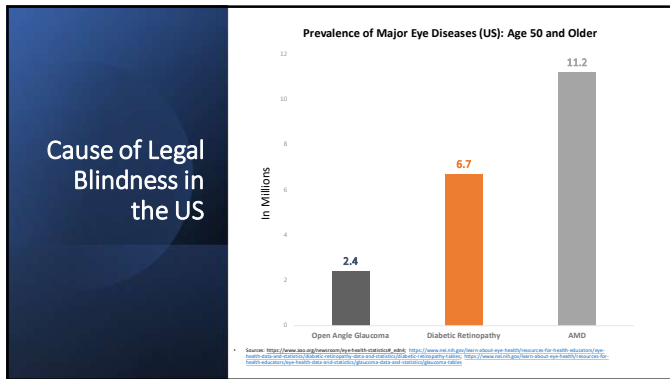
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Diabetic retinopathy

"I don't have much diabetic retinopathy in my practice"



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Follow up questions

- "I don't have much diabetic retinopathy in my practice"
- Do you see a lot of diabetics?
- If yes...
 - "Do you use widefield imaging?"
 - "Do you use OCT-A?"

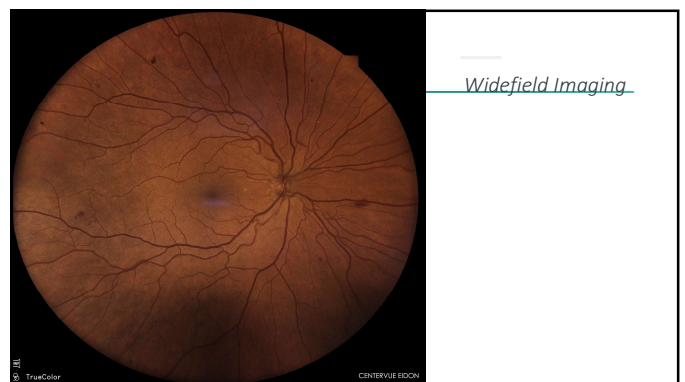
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Widefield imaging

- This technology captures up to 80.0% or nearly 200° of the retina in a single image
- Crucial for detecting and classifying DR, as manifestations often occur in the retinal periphery
- Peripheral lesions increase the risk of DR progression and PDR development

Zoom: 2.39
Enhancement: 3.0
Polarization: Multiple, Transient

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Follow up questions

- Do you use OCT-A?
- Their study unveiled early microvascular impairments, such as non-perfusion areas (NPA) and capillary tortuosity, in both central and peripheral regions of DM-NoDR eyes.

Zhao Q, Wang C, Meng L, Chang S, Gu X, Chen Y, Zhao X. Central and peripheral changes in the retina and choroid in patients with diabetes mellitus without clinical diabetic retinopathy assessed by ultra-wide-field optical coherence tomography angiography. *Frontiers in Public Health*. 2023 Jun 13;11:1194320.

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3 Complimentary Technologies in DR

- Widefield Imaging
- OCT-A
- ERG

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What is your response to this?

- "I can manage my DR patients just fine without an ERG."
- Follow up question
 - "Have you ever sent a DR patient to retina too soon or too late?"
 - Too soon?
 - Too late?



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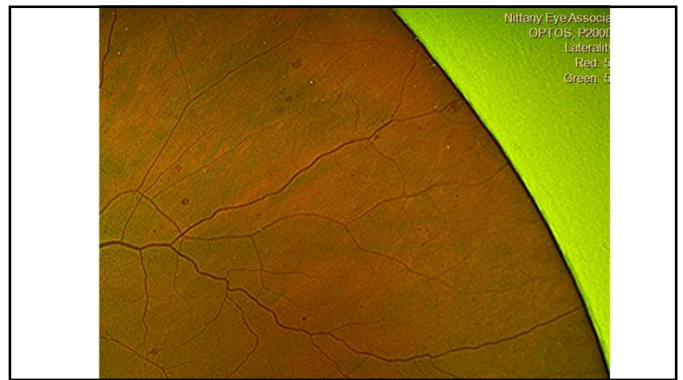
Case

- 63 Y/O W/M
- HA1C 8.1
- On Toujeo (insulin)
- Recently started taking Ozempic, Jardiance
- OChx: moderate NPDR, Hypertensive retinopathy, Chronic Angle closure glaucoma - mild, YAG PI 2020 OU, SLT 2020 OU
- IOP 21.2mmHg OD and 23.3 mmHg OS

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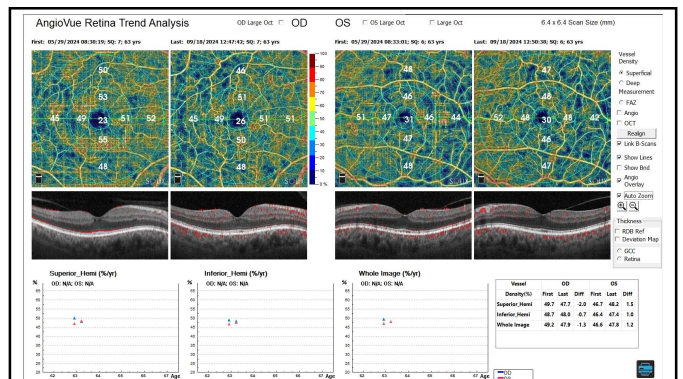
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Severe NPDR

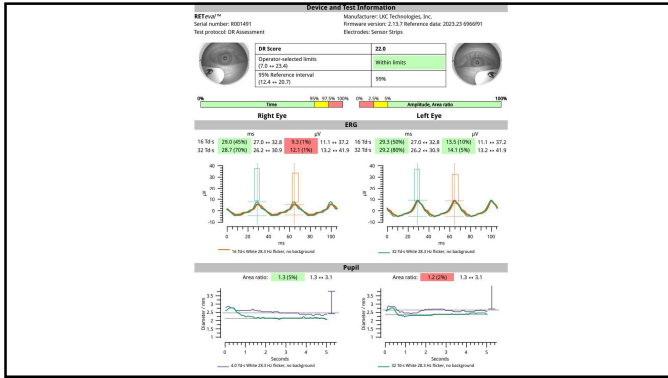
- 4-2-1 Rule - meets any of the following (what about 2?)
 - 20 intraretinal hemorrhages in 4 quadrants
 - Venous beading in 2 or more quadrants
 - IRMA in one or more quadrants
- Greater than 50% chance of converting to proliferative DR in 1 year
 - ADA Clinical Practice Guidelines
 - And...consult with an ophthalmologist



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In diabetic care, the RETeval

- Makes us better clinicians
- Brings into focus the critical moment to refer

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What about GLP-1's?

Glucagon-like peptide

- Hormone released when food is eaten to slow gastric emptying
- Increases insulin release
- Controls the feeling of satiety after eating

Options

- Trulicity
- Ozempic
- Rybelsis
- Mounjaro

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Blood sugar limbo may exacerbate retinopathy

“Our results show that these periodic low glucose levels cause an increase in certain retinal cell proteins, resulting in an overgrowth of blood vessels and worsening diabetic eye disease.”

Let's Limbo!

Akhti Sodhi, MD, PhD; Chuanyu Guo, Monika Deshpande; Yueqi Ni; Isha Kachwala; Haley Megarthy; Taylor Nuss; Saikhan Baboonor-Farrokhan; Michael Ramakia; Jason Sanchez; Neelaj Inamdar; Thomas V. Johnson; Miguel Flores-Belver; Maria Valeria Camilo-Soler; Silvia Montano; HF-1a accumulation in response to transient hypoglycemia may worsen diabetic eye disease. Cell Reports. Published January 2023. DOI: https://doi.org/10.1016/j.celrep.2022.111976

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Non-Arteritic Anterior Ischemic Optic Neuropathy (NAION)

- Recent studies have linked semaglutide, a GLP-1 RA found in medications like Ozempic and Wegovy, to an increased risk of NAION, a rare eye condition that can cause sudden vision loss.
- For instance, a study published in July 2024 reported that patients taking semaglutide for type 2 diabetes had an 8.9% rate of developing NAION, compared to 1.8% for those on non-GLP-1 diabetes medications.
- Hathaway JT, Shah MP, Hathaway DB, Zekavat SM, Krasniqi D, Gittinger JW Jr, Cestari D, Mallery R, Abbasi B, Bouffard M, Chwalisz BK, Estrella J, Rizzo JF 3rd. Risk of Nonarteritic Anterior Ischemic Optic Neuropathy in Patients Prescribed Semaglutide. JAMA Ophthalmol. 2024 Aug 1;142(8):732-739.

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But what about glaucoma?

Structure	Glaucoma Photos/OCT
Function	Visual Fields
Early Diagnosis Moderate to Advanced Response to treatment	ERG/OCT-A

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Glaucoma

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Case Report: How ERG Helped Me Initiate Treatment

- Patient Info**
- 59
- Caucasian
- Female
- Glaucoma Suspect, Mild nonproliferative diabetic retinopathy
- CcIOP 22.0 and 24.7, TMax 24.0 and 26.3
- Pach's 612 AND 613
- Relevant family ocular history: cataracts and glaucoma
- Type 2 diabetes x 11 years, hypertension x 5 years, hypercholesterolemia x 6 years
- Family history of diabetes and hypertension
- Systemic Medications:
 - Losartan, metformin, insulin, simvastatin

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Fundus Exam

- Midperipheral/peripheral dot and blot hemes OD<OS
- Venous Beading
- A/V nicking

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Fundus Exam

- Fairly symmetric optic nerves

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Visual Field

- Fields shows scattered defects OU with a reduced mean defect OD>OS.

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OCT/OCT-A

- Ganglion cell complex thinning OD>OS
- Supratemporal thinning OD on RNFL thickness and TSNIT
- Superior OCT-A vessel density reduction OD

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OCT/Visual Field/Polar Analysis

- Visual field polar analysis does not show an expected supratemporal reduction. This indicates structural/function discordance.

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OCT-A

- OCT-A showing asymmetry of the foveal avascular zone OD>OS

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Additional Clinical Testing

- OCT angle shows mildly narrow angle with lens vault

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ERG

- I ordered an ERG to explore whether a functional deficit existed and whether it could be localized to the photoreceptor layer or ganglion cell layer.
- The ERG shows a reduced a-wave amplitude OD>OS indicating photoreceptor disruption, most likely secondary to diabetic and hypertensive retinopathy. The ERG also revealed an asymmetric and reduced PhNR implicit time and amplitude OD indicating ganglion cell/optic nerve dysfunction.

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Diagnosis/Treatment

- Hypertensive retinopathy
- Moderate nonproliferative diabetic retinopathy
- Primary open angle glaucoma OD, ocular hypertension OS
- Send for bilateral SLT
- I suspected glaucoma OD but the structure/function discordance of OCT/visual field made this case a bit more challenging than if there was agreement of structure/function
- The patient is awaiting SLT

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The Value of ERG


- I probably would have **monitored this patient for 6 months to a year** before seeing OCT structural progression and/or OCT/field concordance.
- The ERG helped me make the diagnosis **earlier**.
- Early diagnosis** and early treatment leads to **better patient outcomes**.



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5 compelling studies


- All from 2020-present
- All used RETeval
- All were on glaucoma



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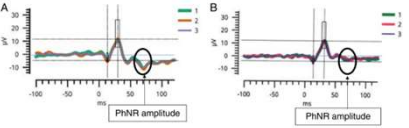
Study 1

- Kita Y, Holo G, Saito T, Momota Y, Kita R, Tsunoda K, Hirakata A. RETeval portable electroretinogram parameters in different severity stages of glaucoma. *J. Glaucoma*. 2020;29:572-580.
- Objective:** Evaluated RETeval parameters across glaucoma severity stages.
- Key Findings:**
 - RETeval parameters (e.g., W-ratio, 72msPHNR) **correlated with glaucoma severity and visual field indices**.
 - Diagnostic utility was **higher for moderate-to-advanced glaucoma**.
- Limitations:** Lower sensitivity for early glaucoma.
- Conclusion:** Supports RETeval's diagnostic utility for mid-to-late-stage glaucoma.



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Kita et al. | *J. Glaucoma* • Volume 29, Number 7, July 2020



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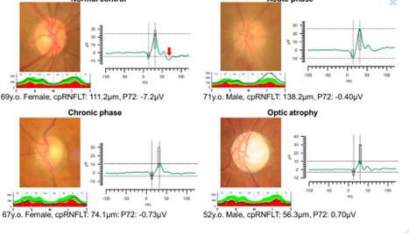
Study 2

- Yamashita T, Kato K, Kondo M, Miki A, Araki S, Goto K, Ieki Y, Kiryu J. Photopic negative response recorded with RETeval system in eyes with optic nerve disorders. *Scientific Reports*. 2022 May 31;12(1):9091.
- Objective:** Explored PhNR changes in optic nerve disorders using RETeval.
- Key Findings:**
 - PhNR was significantly reduced in optic nerve disorders, correlating with the severity of functional impairment.
 - Suggested RETeval's potential as a **non-invasive, objective marker of optic nerve health**.
- Relevance to Glaucoma:** **Validates PhNR as a marker for RGC function**, supporting its application in glaucoma diagnostics.
- Relevant quotes:**
 - We suggest that the diagnostic abilities of PhNR in optic nerve disorders are **comparable to that of cpRNFLT**.
 - PhNR is a parameter that is **easy to interpret** because it becomes uniformly lower in patients with optic nerve disorders, and we recommend the **concomitant use of OCT and PhNR to improve the accuracy of the diagnosis of optic nerve disorders**.

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Figure 1

From (Photopic negative response recorded with RETeval system in eyes with optic nerve disorders)



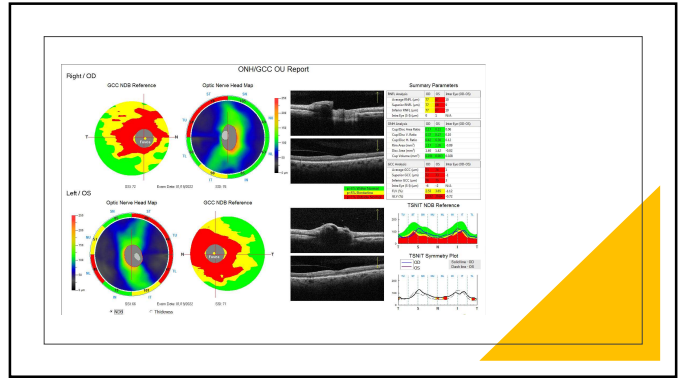
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Case

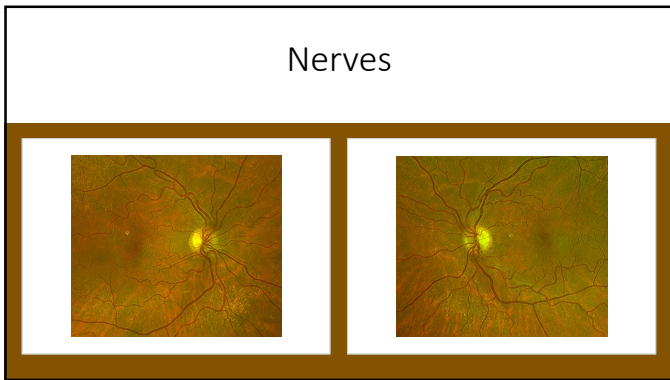


- 68 YO W/F
- Referred from local OD because of worsening mild low tension glaucoma (TMax 20mmHg OD and OS)
- Dx 4 years previous, on latanoprost qhs OU and Cosopt bid OU, 2nd dose at 10PM
- CiIOP 15.5 and 16.0, CH 10.0 and 9.4, Pachs 542 and 541

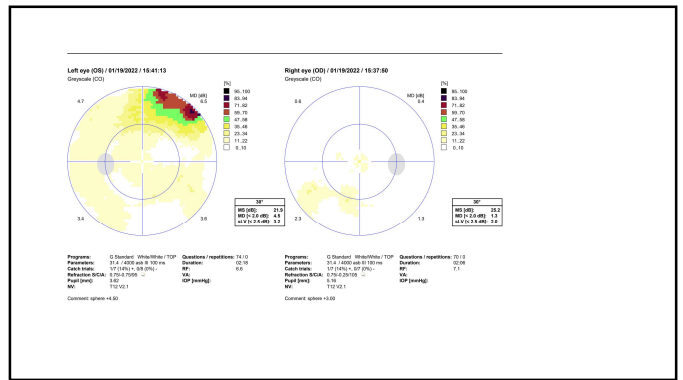
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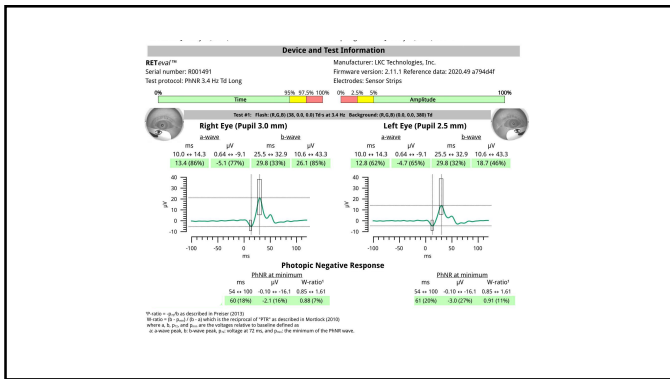
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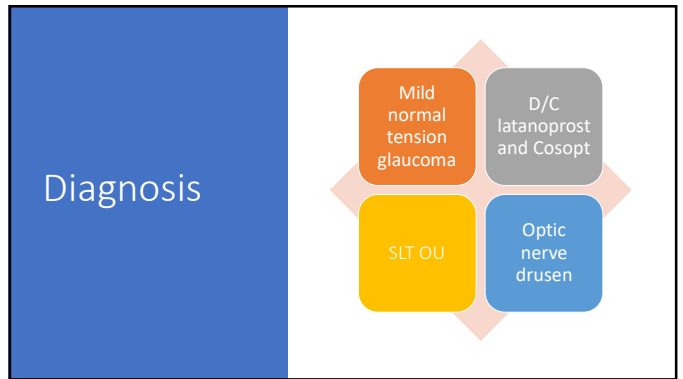
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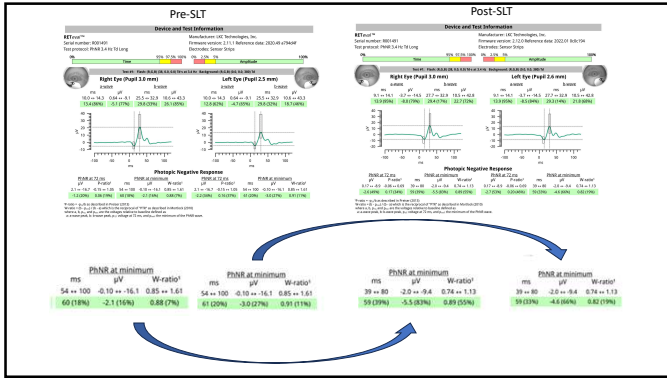
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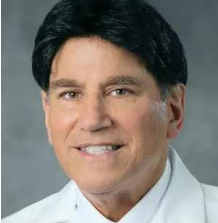
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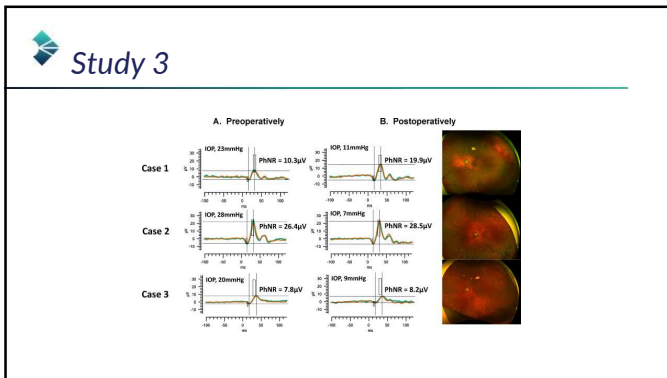
49

Study 3

- Igawa Y, Shoji T, Weisreb R, Miyake Y, Yoshikawa Y, Takano S, Shinoda K. Early changes in photopic negative response in eyes with glaucoma with and without choroidal detachment after filtration surgery. *British Journal of Ophthalmology*. 2023 Sep 1;107(9):1295-302.
- Objective:** Assessed early PhNR changes post-filtration surgery in glaucomatous eyes with/without choroidal detachment.
- Key Findings:**
 - PhNR amplitudes improved post-surgery, indicating reversibility of functional deficits with IOP reduction.
 - RETeval effectively tracked functional recovery in glaucomatous eyes post-treatment.
- Conclusion:** Highlights RETeval's role in monitoring treatment efficacy.
- Relevant Quotes:**
 - We demonstrated the rapid improvement in RGC function within several days after glaucoma filtration surgery by measuring PhNR.
 - The a-wave, b-wave and PhNR improved after glaucoma filtration surgery. This suggests the possibility that the reduction in IOP may be related to changes in blood flow in deeper layers.



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OD CODER
 254 subscribers • 8 videos
 This channel deals with all things billing and coding. It will help navigate the rough world of...more 2
 Customise channel Manage videos

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OD Coder



- ERG for Diabetic Retinopathy
- 92273 Full field electroretinogram
- 92274 Multifocal electroretinogram
- \$118.32
- Written order
- Interpretation and report
- Any diabetic retinopathy code
- Changes in retinal vascular appearance H35.011-013
- Retinal ischemia H35.82

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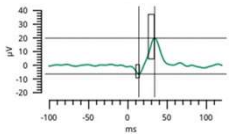
OD Coder

- 92273 Full field electroretinogram
- 92274 Multifocal electroretinogram
- \$118.32
- "To diagnose loss of retinal function OR distinguish between retinal lesions and optic nerve lesions"
- "The use of ERG for glaucoma is considered experimental and investigational"
- Written order
- Interpretation and report


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OD Coder (ERG continued)  

- Any diabetic retinopathy code
- Amaurosis fugax G45.3
- Choroidal scars H31.001-003
- Changes in retinal vascular appearance H35.011-013
- Hypertensive retinopathy H35.031-033
- AMD, drusen and macular pucker
- Lattice and pavingstone
- Retinal hemorrhage H35.61-63 or hemorrhage in optic nerve sheath H47.021-033




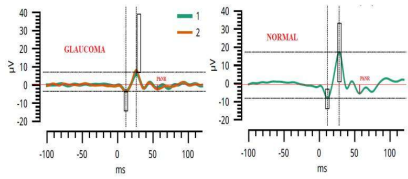
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 Study 4


- Investigating the Structural and Functional Changes in the Optic Nerve in Patients with Early Glaucoma Using the Optical Coherence Tomography (OCT) and REteval System. Bekollari M, Dettoraki M, Stavrou V, Skourliakou A, Liaparinos P. *Sensors (Basel)*. 2023 May 5;23(9):4504.
- Objective: Compared REteval and OCT in assessing structural and functional optic nerve changes in early glaucoma.
- Key Findings:
 - REteval's PhNR correlated with OCT parameters like RNFL thickness and visual field indices.
 - While both methods were complementary, OCT remained superior in early-stage detection.
- Conclusion: REteval complements OCT but is less effective for early glaucoma detection.
- Notable Quotes:
 - RNFL was found to be correlated to b-wave (ms) and W-ratio parameters
 - Until now, no previous study has compared the REteval system parameters with the OCT thickness parameter in Caucasian patients with early glaucoma and age-matched healthy controls.

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 Study 4




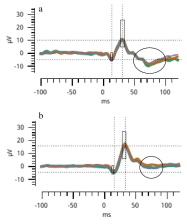
57

 Study 5


- Hidaka T, Chuman H, Ikeda Y. Evaluation of inner retinal function at different stages of primary open angle glaucoma using the photopic negative response (PhNR) measured by REteval electroretinography. *Graefes Archive for Clinical and Experimental Ophthalmology*. 2024 Jan;62(1):161-9.
- Objective: Investigated inner retinal function across primary open-angle glaucoma (POAG) stages using Photopic Negative Response (PhNR) measured with the REteval system.
- Key Findings:
 - REteval-measured PhNR parameters (e.g., base-to-trough (BT), 72msPhNR) were effective for evaluating retinal ganglion cell (RGC) function in moderate-to-advanced POAG.
 - BT demonstrated the highest diagnostic accuracy (80.7%) among PhNR parameters.
 - REteval, being non-invasive and portable, simplifies PhNR measurement compared to conventional ERG systems.
 - Limitations: Less sensitivity in early POAG detection due to difficulty detecting localized RGC damage.
- Conclusion: REteval is a valuable tool for moderate-to-advanced glaucoma but less effective for early stages.
- Relevant quotes:
 - The present results suggest that the PhNR plays a similar role to OCT as a test to supplement the floor effect of visual field test results in advanced POAG.
 - The PhNR measurement is convenient.

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 Study 5

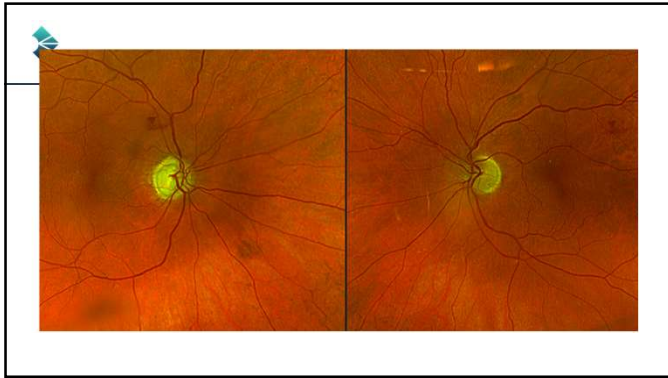


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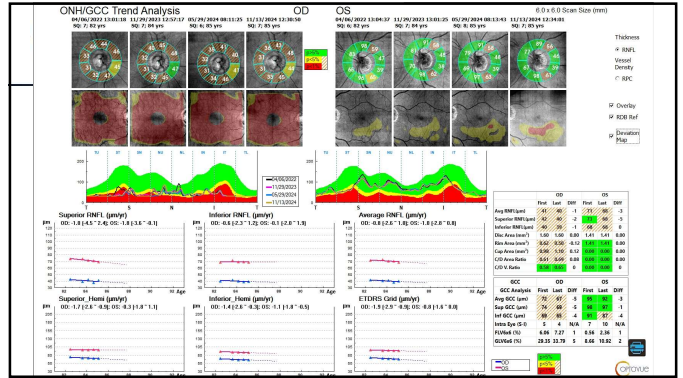
 Case

- 85 Y/O W/M
- Severe POAG OD, Moderate OS
- On Vyzulta qhs OU, Rhopressa qhs OD
- OcHx: cararact surgery + KDB OU 2017, SLT OU 2021
- SHx: Bladder CA 2021

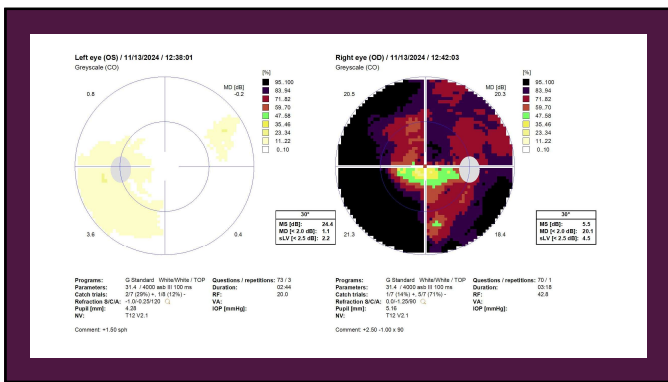
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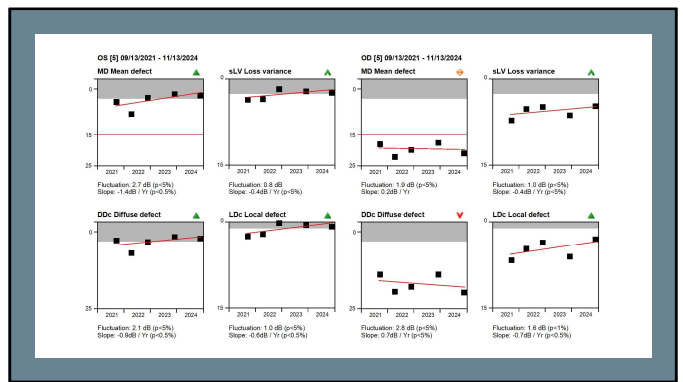
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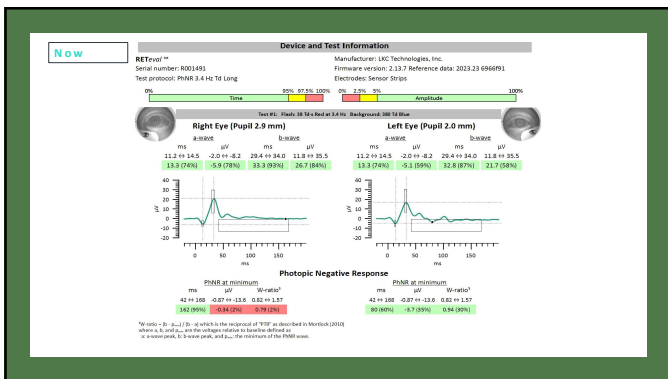
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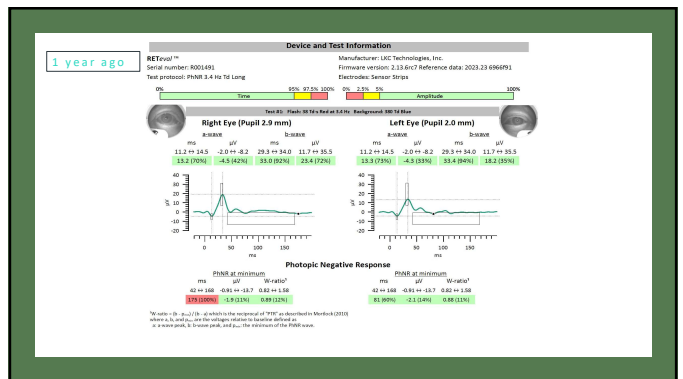
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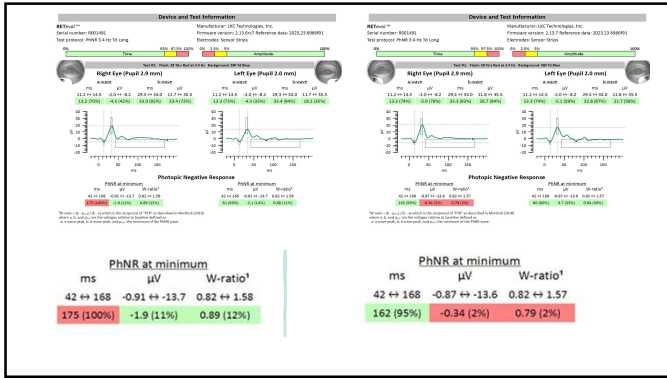
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Plan

- Repeat SLT OU
- Consider Durysta OD

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Conclusion

- The REteval system is a valuable instrument for glaucoma care, particularly for:
- **Moderate-to-Advanced Glaucoma:** Strong correlations with visual field indices and RNFL thickness make it useful for functional assessment and monitoring disease progression.
- **Post-Treatment Monitoring:** Tracks functional recovery effectively after interventions like filtration surgery.
- However, REteval has limitations in **early glaucoma detection**, as its sensitivity to localized RGC damage is lower than imaging techniques like OCT. Combining REteval with OCT may enhance comprehensive glaucoma assessment.

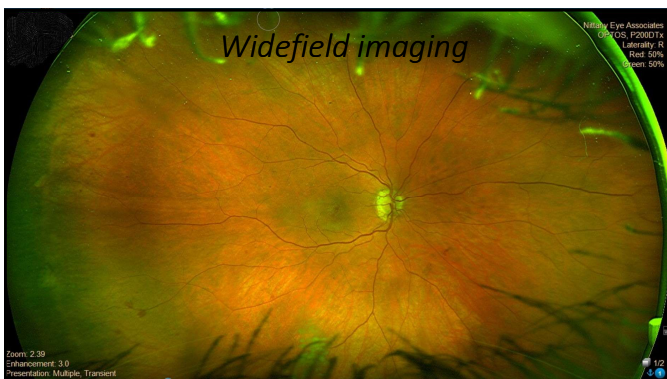
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Thank You

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