Optometric Management Symposium

Diagnosing and Treating Glaucoma
- Pearls for Each Stage-

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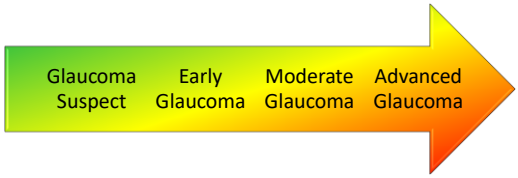
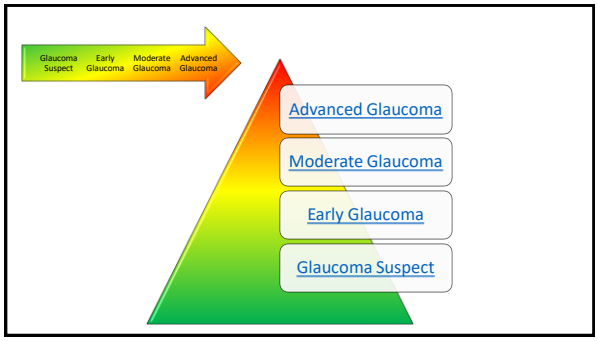
Disclosures – Dr. Lifferth

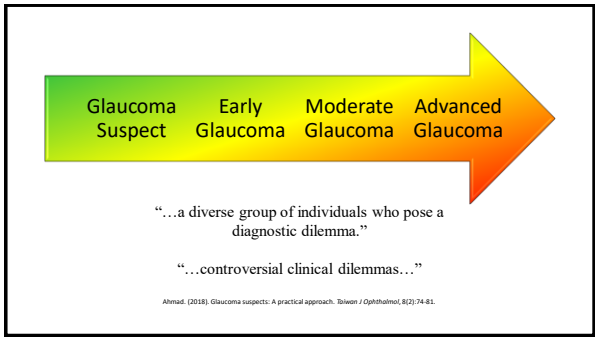
- None

Disclosures – Dr. Fechtner

- Aerie – speakers bureau
- Alcon – consultant
- Nicox - consultant
- Santen – consultant







Case Presentation I
Ocular Hypertension

- 65 year-old male returns for *continued* Ocular Hypertension evaluation and testing
  - LASIK OU 2001
  - Review of Systems: unremarkable and noncontributory.
    - No medications
      - Multivitamin
    - Non-smoker
    - Social drinker
    - Healthy, active
  - Negative FOHx
  - Profession: "Doctor"

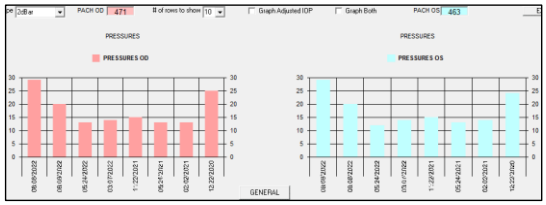
Case Presentation

UNCORRECTED VISUAL ACUITY
OD: = 20/20-1
OS: = 20/25-2

PUPILS
OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS
OD: Full to FC
OS: Full to FC

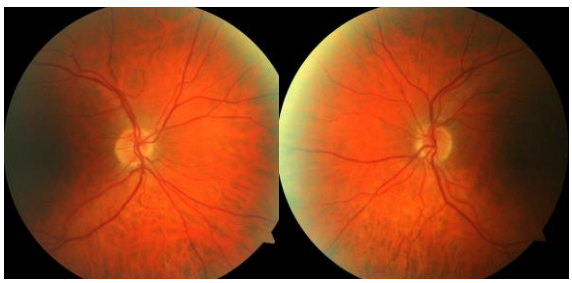
Case Presentation

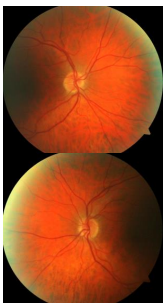


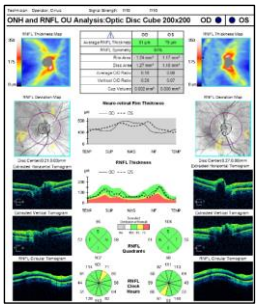
Case Presentation

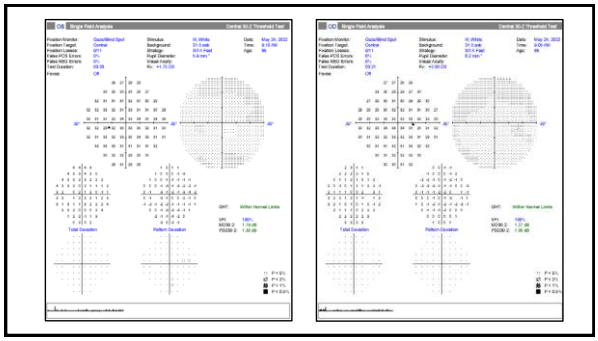
SLIT LAMP EXAM OU

- Lids/Adnexa: 1+ MGD
- Conjunctivae: palpebral/bulbar clear
- Sclera: white
- Cornea: clear/normal; (-)pigment OU; faint LASIK scar OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: trace NS OU; NO PXE OU





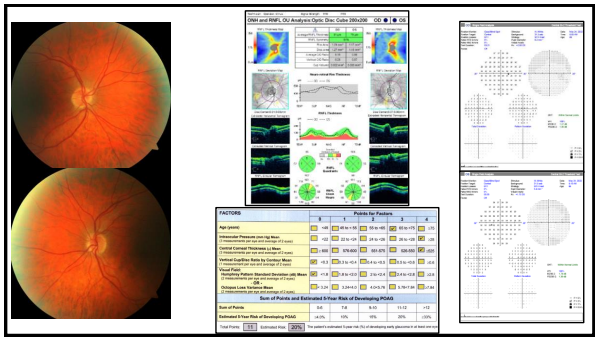




FACTORS	Points for Factors				
	0	1	2	3	4
Age (years)	☐ <45	☐ 45 to < 55	☐ 55 to <65	☑ 65 to <75	☐ ≥75
Intraocular Pressure (mm Hg) Mean (3 measurements per eye and average of 2 eyes)	☐ <22	☐ 22 to <24	☐ 24 to <26	☐ 26 to <28	☑ ≥28
Central Corneal Thickness (μ) Mean (3 measurements per eye and average of 2 eyes)	☐ ≥ 600	☐ 576-600	☐ 551-575	☐ 526-550	☑ ≤525
Vertical Cup/Disc Ratio by Contour Mean (1 measurement per eye and average of 2 eyes)	☑ <0.3	☐ 0.3 to <0.4	☐ 0.4 to <0.5	☐ 0.5 to <0.6	☐ ≥0.6
Visual Field: Humphrey Pattern Standard Deviation (dB) Mean (2 measurements per eye and average of 2 eyes) - OR - Octopus Loss Variance Mean (2 measurements per eye and average of 2 eyes)	☑ <1.8	☐ 1.8 to <2.0	☐ 2 to <2.4	☐ 2.4 to <2.8	☐ ≥2.8
	☐ < 3.24	☐ 3.24<4.0	☐ 4.0<5.76	☐ 5.78<7.84	☐ ≥7.84
Sum of Points and Estimated 5-Year Risk of Developing POAG					
Sum of Points	0-6	7-8	9-10	11-12	>12
Estimated 5-Year Risk of Developing POAG	≤4.0%	10%	15%	20%	≥33%

Total Points: 11 Estimated Risk: 20% The patient's estimated 5-year risk (%) of developing early glaucoma in at least one eye.

Risk Calculator | Ocular Hypertension Treatment Study (OHTS) (wustl.edu)



Case Presentation II
Ocular Hypertension

- 41 year-old male returns for *continued* Ocular Hypertension/Glaucoma Suspect evaluation and testing
  - No relevant ocular history
  - Review of Systems: unremarkable and noncontributory.
    - No medications
    - Non-smoker
    - Social drinker
    - Healthy, active
  - Negative FOHx

Case Presentation

UNCORRECTED VISUAL ACUITY

OD: = 20/20

OS: = 20/20

PUPILS

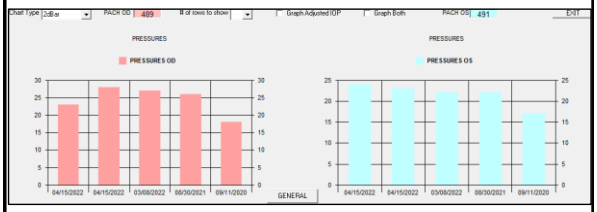
OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS

OD: Full to FC

OS: Full to FC

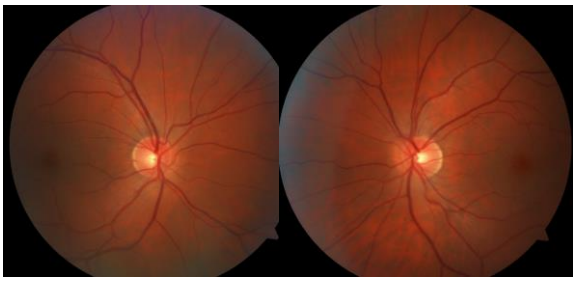
Case Presentation

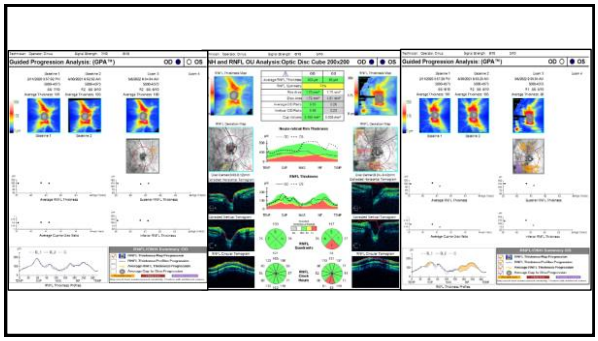


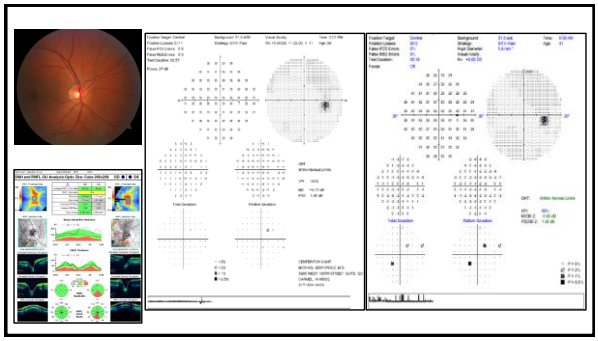
Case Presentation

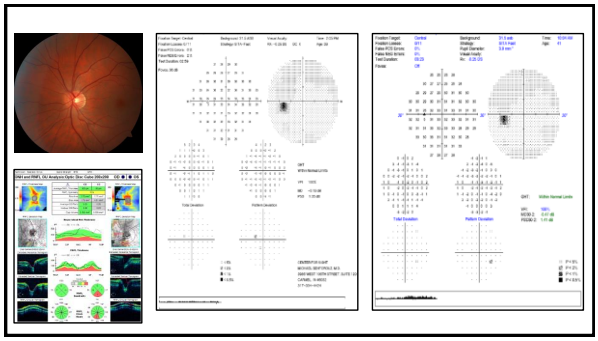
SLIT LAMP EXAM OU

- Lids/Adnexa: clear OU
- Conjunctivae: palpebral/bulbar clear
- Sclera: white
- Cornea: clear/normal; (-)pigment OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: clear OU; NO PXE OU





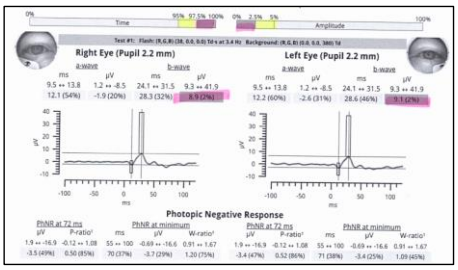


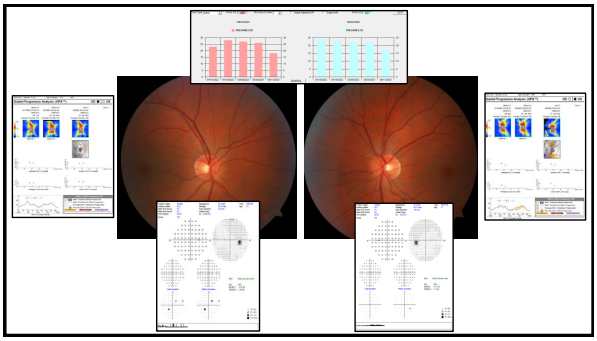


FACTORS	Points for Factors				
	0	1	2	3	4
Age (years)	☑ <45	☐ 45 to < 55	☐ 55 to <65	☐ 65 to <75	☐ ≥75
Intraocular Pressure (mm Hg) Mean (3 measurements per eye and average of 2 eyes)	☐ <22	☐ 22 to <24	☐ 24 to <26	☑ 26 to <28	☐ ≥28
Central Corneal Thickness (μ) Mean (3 measurements per eye and average of 2 eyes)	☐ ≥ 600	☐ 576-600	☐ 551-575	☐ 526-550	☑ ≤525
Vertical Cup/Disc Ratio by Contour Mean (1 measurement per eye and average of 2 eyes)	☐ <0.3	☑ 0.3 to <0.4	☐ 0.4 to <0.5	☐ 0.5 to <0.6	☐ ≥0.6
Visual Field: Humphrey Pattern Standard Deviation (dB) Mean (2 measurements per eye and average of 2 eyes) - OR - Octopus Loss Variance Mean (2 measurements per eye and average of 2 eyes)	☑ <1.8	☐ 1.8 to <2.0	☐ 2 to <2.4	☐ 2.4 to <2.8	☐ ≥2.8
	☐ < 3.24	☐ 3.24<4.0	☐ 4.0<5.76	☐ 5.78<7.84	☐ >7.84
Sum of Points and Estimated 5-Year Risk of Developing POAG					
Sum of Points	0-6	7-8	9-10	11-12	>12
Estimated 5-Year Risk of Developing POAG	≤4.0%	10%	15%	20%	≥33%

Total Points: 8 Estimated Risk: 10% The patient's estimated 5-year risk (%) of developing early glaucoma in at least one eye

Risk Calculator | Ocular Hypertension Treatment Study (OHTS) (wustl.edu)





Case Presentation – Glaucoma Suspect

- 50 year-old male returns for *follow-up* glaucoma suspect evaluation and testing
  - LASIK OU 2004
  - Review of Systems: unremarkable and noncontributory.
    - No medications
    - Non-smoker
    - Social drinker
    - Healthy, active
  - Negative FOHx

Case Presentation

UNCORRECTED VISUAL ACUITY

OD: = 20/30

OS: = 20/40

PUPILS

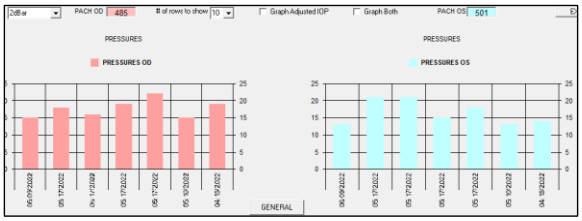
OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS

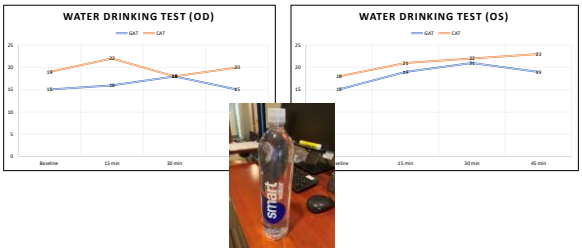
OD: Full to FC

OS: Full to FC

Case Presentation



Case Presentation



Case Presentation

SLIT LAMP EXAM OU

- Lids/Adnexa: clear OU
- Conjunctivae: palpebral/bulbar clear
- Sclera: white
- Cornea: clear/normal; (-)pigment OU
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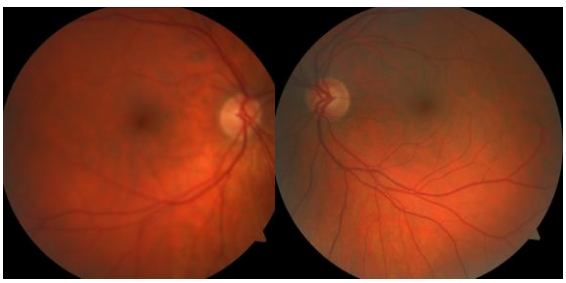
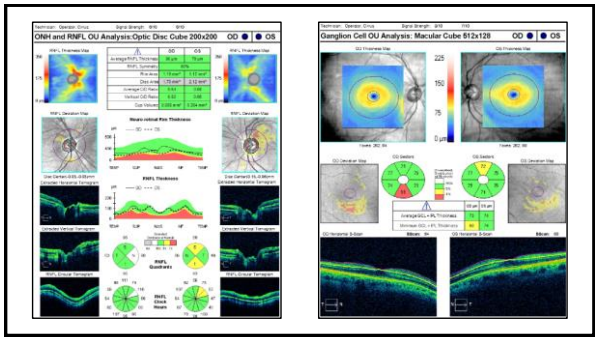
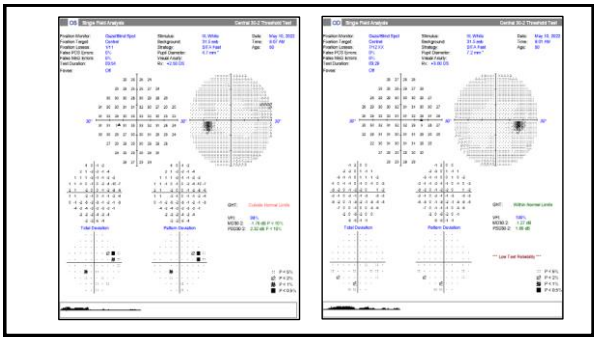
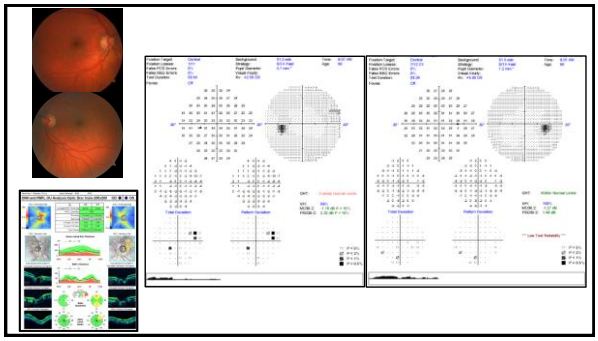
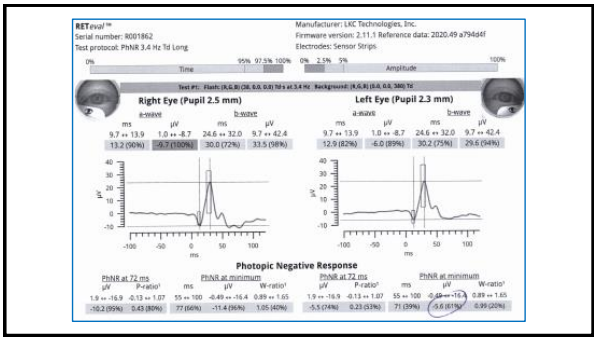



ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD OS
Ganglion Cell OU Analysis: Macular Cube 512x128 OD OS






RETeval™
Right Eye (Pupil 2.5 mm)
Left Eye (Pupil 2.3 mm)
Photopic Negative Response

"Are there any studies regarding my condition?"

FACTORS	Points for Factors				
	0	1	2	3	4
Age (years)	☐ <45	☑ 45 to < 55	☐ 55 to <65	☐ 65 to <75	☐ ≥75
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Estimated 5-Year Risk of Developing POAG	≤4.0%	10%	15%	20%	≥33%

Total Points: 11 Estimated Risk: 20% The patient's estimated 5-year risk (%) of developing early glaucoma in at least one eye.

Print Reset

Risk Calculator | Ocular Hypertension Treatment Study (OHTS) (wustl.edu)

"How high does *my eye* pressure need to be to start treatment?"

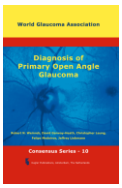
- http://oil.wilmer.jhu.edu/threshold
- Threshold to Treat Calculator
- Does not take into account IOP fluctuation or peak IOP
- Based on populations with strict inclusion criteria
- Not for patients with treated glaucoma

Age	50	years (40-90)
Pattern Standard Deviation	2.32	dB (0.50-4.00)
Central Corneal Thickness	485	microns (450-700)
Vertical Cup to Disc	0.55	0 to 0.9
Threshold for 5-year risk of progression	50	Percent
Calculate Threshold to Treat / Clear Values		
Estimated threshold to initiate treatment	25	mmHg

Jampel H, Boland M. Calculating the "Threshold to Treat" in Ocular Hypertension. *Journal Of Glaucoma*. October 2014;23(8):485

Risk Calculators and WGA

"Predictive models (risk calculators) may provide objective assessment of individual risk and their use should be considered in patients suspected of having glaucoma."



"Current validated risk calculators apply only to OHT patients. Moreover, they do not include all known risk factors."

"What would other doctors do?"

Appropriate to initiate treatment for glaucoma if	IOP≤19 mm Hg	IOP=20-23 mm Hg	IOP=24-26 mm Hg	IOP=27-29 mm Hg	IOP≥30-34 mm Hg
1) Age <55					
A) Cup/Disc 0.5 to <0.7					
I) CCT <520 μm	Age=50, IOP=19, C/D=0.6, CCT=500 predicted 5-year risk=22.4%	Age=50, IOP=22, C/D=0.6, CCT=500 predicted 5-year risk=28.3%	Age=50, IOP=25, C/D=0.6, CCT=500 predicted 5-year risk=35.3%	Age=50, IOP=28, C/D=0.6, CCT=500 predicted 5-year risk=43.5%	Age=50, IOP=30, C/D=0.6, CCT=500 predicted 5-year risk=49.5%
a) Small Disc Size					
With no family history					
With family history					
b) Medium Disc Size					
With no family history					
With family history					
c) Large Disc size					
With no family history					
With family history					

Original article: For Which Glaucoma Suspects Is It Appropriate to Initiate Treatment?. *Ophthalmology*. January 1, 2009;116:710-716.e82

Questions/Comments

Case Presentation

- 54 year-old female returns for *early* glaucoma evaluation and testing.
  - No pertinent ocular history
  - Review of Systems: HTN, Arthritis
    - Medications
      - Multivitamin, Lisinopril
    - Non-smoker
    - Social drinker
    - Healthy, active
  - FOHx: Father, Paternal Grandfather
  - Profession: Chief Privacy Officer

Case Presentation

UNCORRECTED VISUAL ACUITY

OD: = 20/20

OS: = 20/25+1

PUPILS

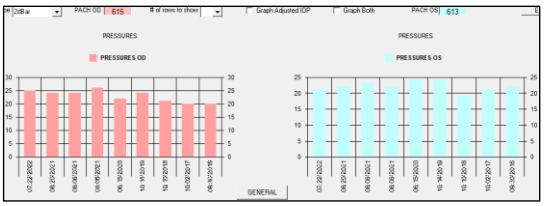
OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS

OD: Full to FC

OS: Full to FC

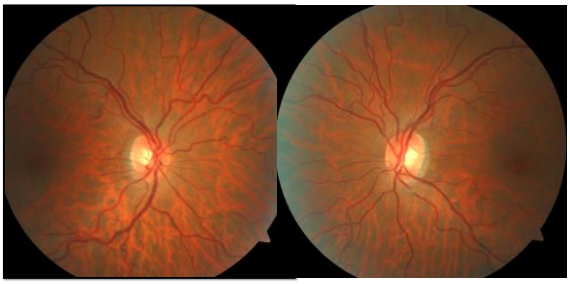
Case Presentation

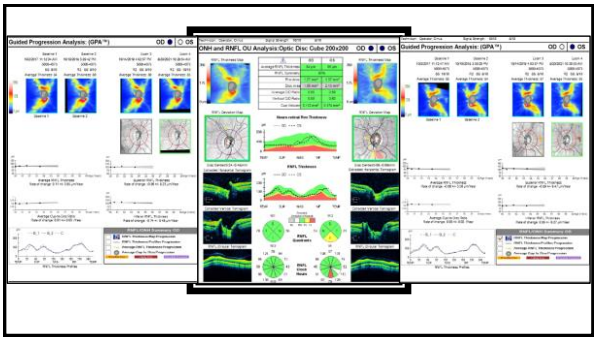


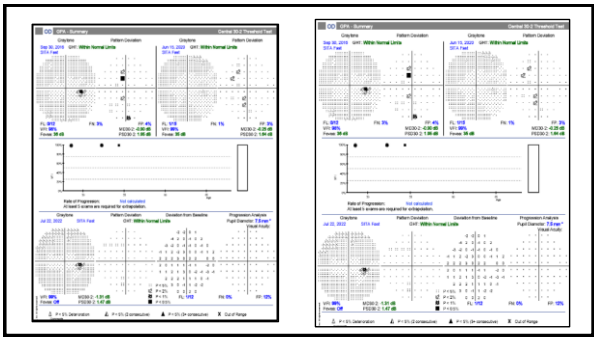
Case Presentation

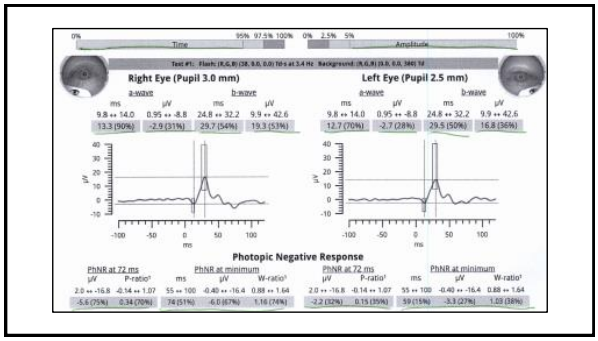
SLIT LAMP EXAM OU

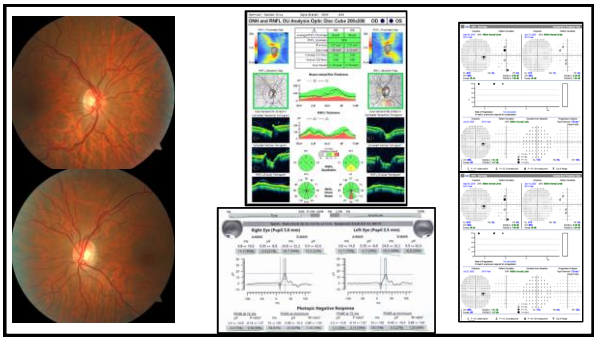
- Lids/Adnexa: clear
- Conjunctivae: palpebral/bulbar clear
- Sclera: white
- Cornea: trace SPK OU; (-)pigment OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: trace NS OU; NO PXE OU

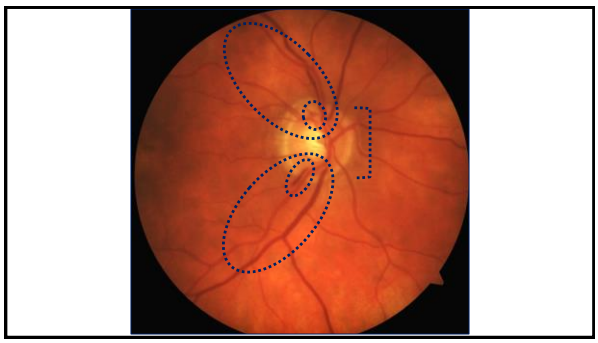


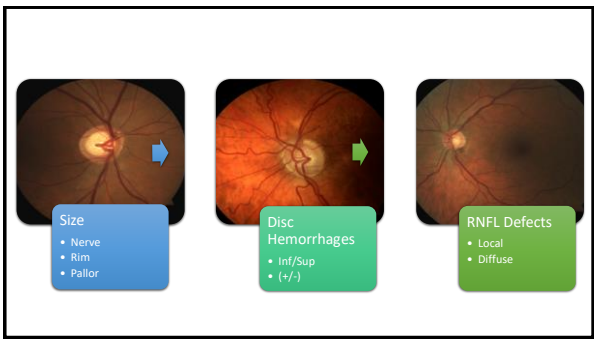





Right Eye (Pupil 3.0 mm)
Left Eye (Pupil 2.5 mm)
Photopic Negative Response

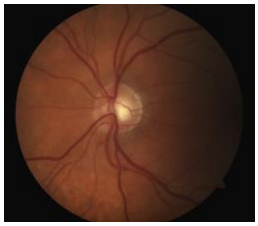





Size
• Nerve
• Rim
• Pallor
Disc Hemorrhages
• Inf/Sup
• (+/-)
RNFL Defects
• Local
• Diffuse

Neuroretinal Rim Size

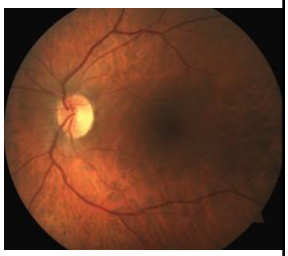
- Due to oval shape of the optic disc and the horizontal oval shape of the optic cup, usually follows ISNT rule
  - Inferior>Superior>Nasal> Temporal
  - Understanding characteristic shape is helpful to diagnose early glaucoma suspect in OHTN eyes *prior* to VF defects



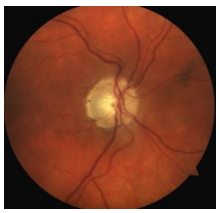
Jonas J, Gusek G, Naumann G. Optic disc, cup and neuroretinal rim size, configuration and correlations in normal eyes. *Investigative Ophthalmology & Visual Science*. July 1988;29(7):1151-1158.
Harizman N, Oliveira C, Liebmann J, et al. The ISNT rule and differentiation of normal from glaucomatous eyes. *Archives Of Ophthalmology (Chicago, Ill.: 1960)*. November 2006;124(11):1579-1583.

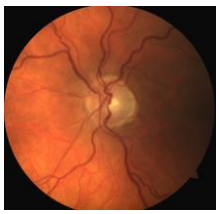
Neuroretinal Rim Pallor

- A sign of optic nerve damage
- More noticeable in eyes with *non*glaucomatous optic neuropathy
- Nonglaucomatous optic nerve damage is usually not associated with neuroretinal rim loss, just pallor
  - Pallor extends beyond the cupping



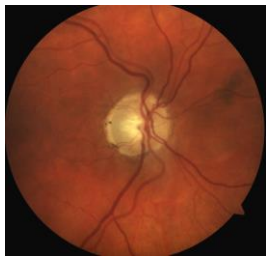
Neuroretinal Rim Pallor





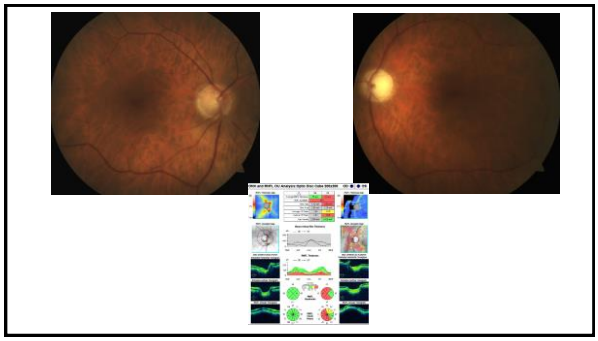
1. Choudhari N, Neog A, Fudnawala V, George R. Cupped disc with normal intraocular pressure: the long road to avoid misdiagnosis. Indian Journal Of Ophthalmology. November 2011;59(6):491-497.
2. Greenfield D, Siatkowski R, Glaser J, Schatz N, Parrish R. The cupped disc. Who needs neuroimaging? Ophthalmology . October 1998;105(10):1866-1874.
3. Greenfield D. Glaucomatous versus nonglaucomatous optic disc cupping: clinical differentiation. Seminars In Ophthalmology June 1999;14(2):95-108.

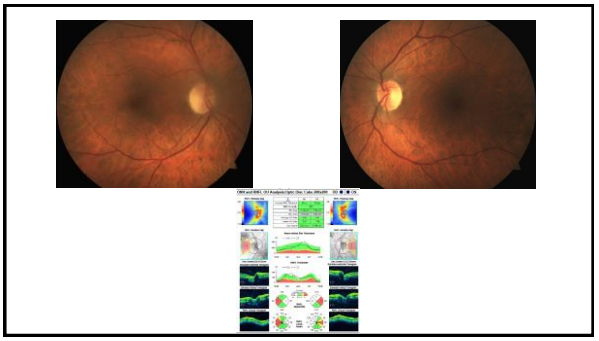
Neuroretinal Rim Pallor

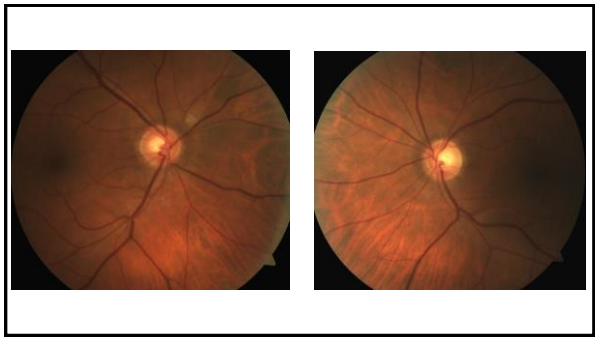


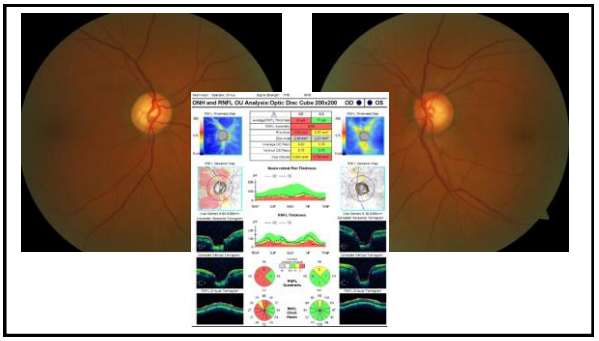
- Younger than 50 years of age
- BCVA worse than 20/40
  - Out of proportion to media clarity
- Visual field defects that respect the vertical meridian
- Neuroretinal rim pallor
- Neurological symptoms and/or non-migraine headaches

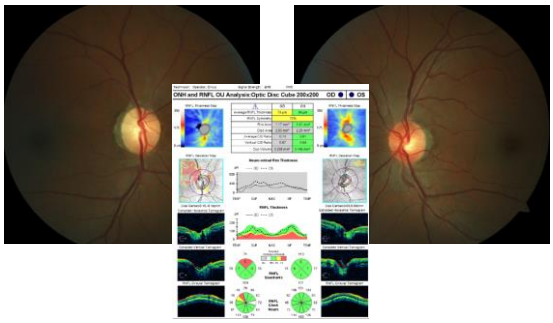
1. Greenfield D, Siatkowski R, Glaser J, Schatz N, Parrish R. The cupped disc. Who needs neuroimaging? Ophthalmology . October 1998;105(10):1866-1874.

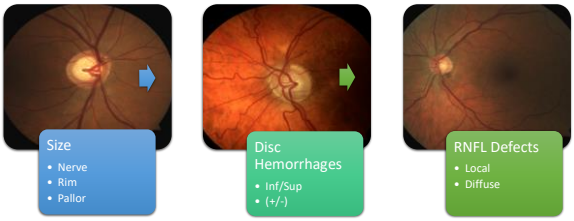






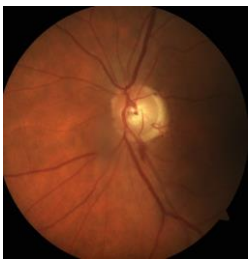






Glaucomatous Disc Hemorrhages

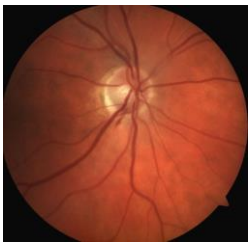
"…its presence should be an unfavorable prognostic event."[1]



1. Drance S, Fairclough M, Butler D, Kottler M. The importance of disc hemorrhage in the prognosis of chronic open angle glaucom a. *Archives Of Ophthalmology (Chicago, Ill.: 1960)*. February 1977;95(2):226-228.

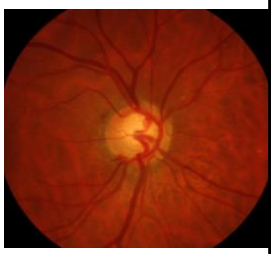
Patients with OCHTN *with* a disc hemorrhage "more frequently developed" glaucomatous visual field defects than those patients with OCHTN *without* a disc hemorrhage.

Patients with COAG and *with* a disc hemorrhage have a "substantially greater incidence" of visual field progression compared to patients with COAG *without* a disc hemorrhage.



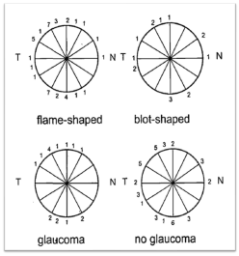
1. Drance S, Fairclough M, Butler D, Kottler M. The importance of dischemorrhage in the prognosis of chronic open angle glaucom a. *Archives Of Ophthalmology (Chicago, Ill.: 1960)*. February 1977;95(2):226-228.

- Usually located more in the I.T. and S.T. areas of the optic disc.
  - 66.7% I.T.
  - 29 % S.T.
    - *Same* areas associated with early glaucomatous damage.



Kim Y, Park K. Lamina cribrosa defects in eyes with glaucomatous disc haemorrhage. *Acta Ophthalmologica*. September 2016;94(6):e468-e473.

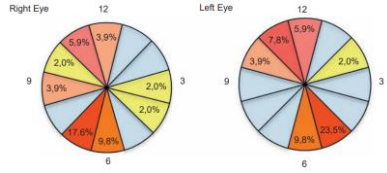
- Flame-shaped:71%
  - More common on temporal side of ONH
    - In *this* study, greatest proportion superior-temporal quadrant
- Blot-shaped:29%
  - Even distribution
- Glaucoma:
  - Superior and inferior regions
- No Glaucoma:
  - Random distribution



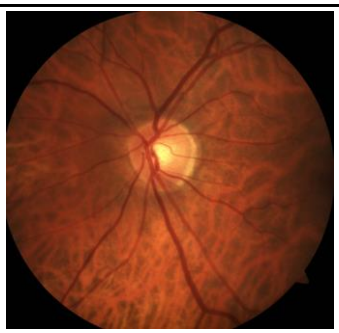
1. Healey P, Mitchell P, Smith W, Wang J. Optic disc hemorrhages in a population with and without signs of glaucoma. *Ophthalmology*. February 1998;105(2):216-223

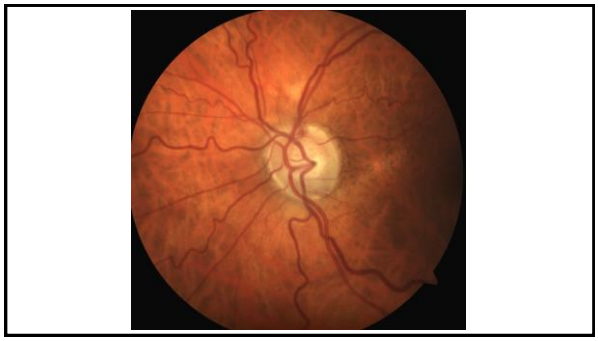
Table 4—Morphologic characteristics of optic disc hemorrhages in relation to the notches

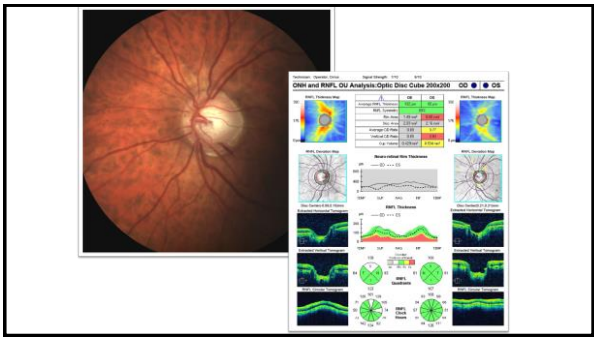
Variable	Disc Hemorrhages (n = 29)
Location	
Inferior	60% (17)
Superior	40% (12)
Nasal	—
Temporal	—
Shape	
Splinter or flame	75.8% (22)
Dot or blot	17.2% (5)
Diffuse	6.8% (2)
Depth	
Superficial to or within the nerve fibre layer	79.3% (23)
Prelaminar region	20% (6)
Laminar region	—



Osturker ZK, Munro K, Gupta N. Optic disc hemorrhages in glaucoma and common clinical features. Can J Ophthalmol. 2017 Dec;52(6):583-591



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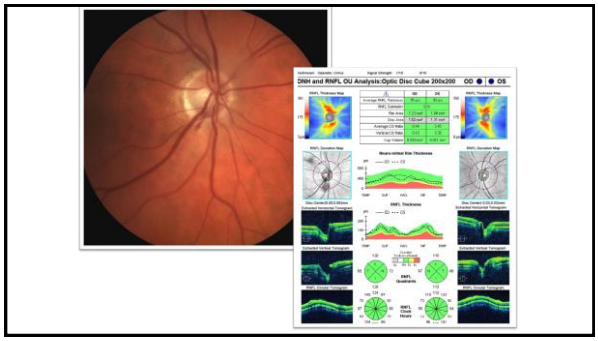
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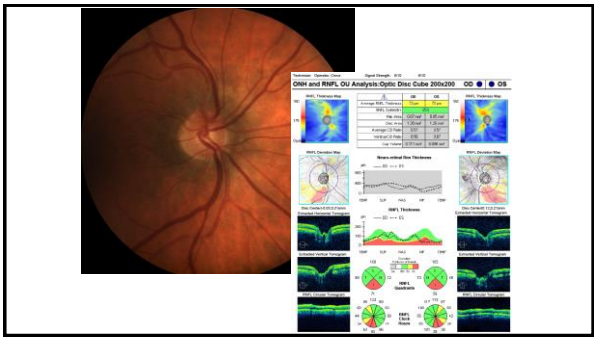
ONH and RNFL OU Analysis:Optic Disc Cube 200x200
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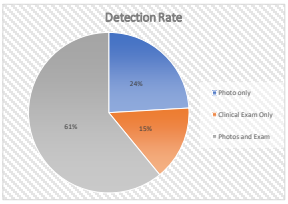
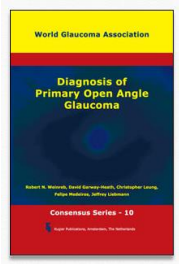
- How to *Improve* Detection Rate?
  - Examine carefully all sectors of optic nerve with *special* attention to inferior temporal and superior temporal sectors.
  - Document as 'pertinent negative'.
  - Photo documentation, then review, then re-examine looking for why/how the disc hemorrhage was missed.
  - Few extra seconds.

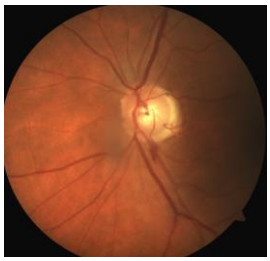


Suh M, Park K. Period prevalence and incidence of optic disc haemorrhage in normal tension glaucoma and primary open-angle glaucoma. *Clinical & Experimental Ophthalmology*. August 2011;39(6):513-518.

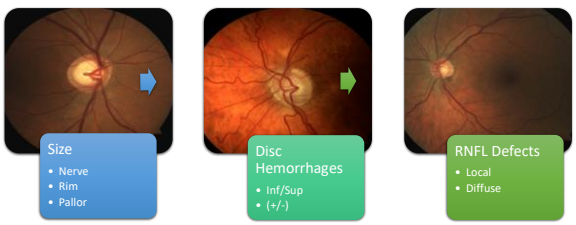
"Disc hemorrhage is associated with *increased risk* of developing glaucoma and it is *a marker* for glaucomatous progression. *Consideration* of treatment escalation or closer follow-up should be given for patients presenting with optic disc hemorrhages."



"But given what we already know, not *looking* for a disc hemorrhage *at every* glaucoma follow-up visit [and *every* exam] would be akin to not measuring IOP. The more we look, certainly the more we shall find."



Healey P. Optic disc haemorrhage: the more we look the more we find. *Clinical & Experimental Ophthalmology*. August 2011;39(6):485-486.



Glaucoma

Gaze Behavior among Experts and Trainees during Optic Disc Examination: Does How We Look Affect What We See?

Evelyn C. O'Neill, Yu Xiang George Kong, Paul P. Connell, Dai Ni Ong, Sharon A. Haymes, Michael A. Conte, and Jonathan G. Crowston

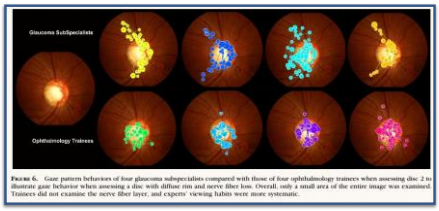
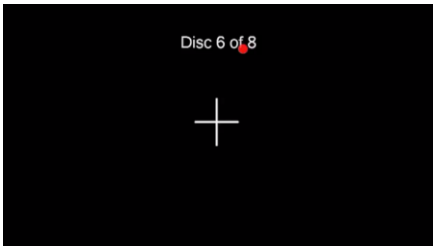
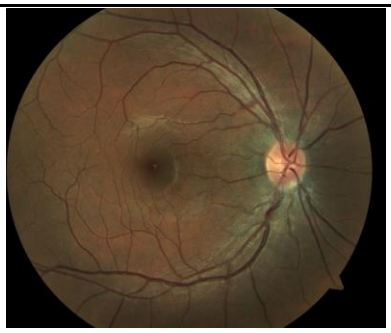
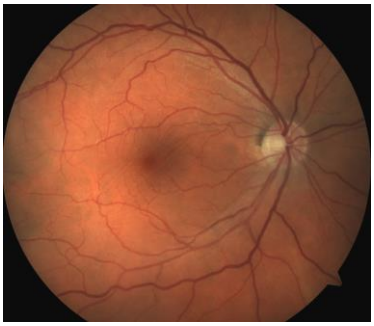


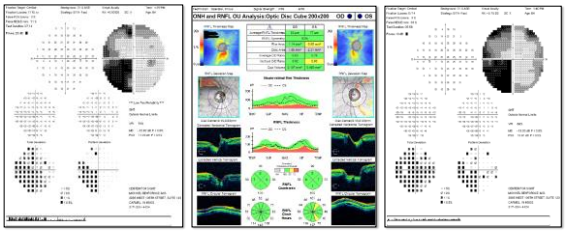
Figure 6. Gaze pattern behaviors of four glaucoma subspecialists compared with those of four ophthalmology trainees when assessing disc 2 to illustrate gaze behavior when assessing a disc with diffuse rim and nerve fiber loss. Overall, only a small area of the entire image was examined. Trainees did not examine the nerve fiber layer, and experts' viewing habits were more systematic.

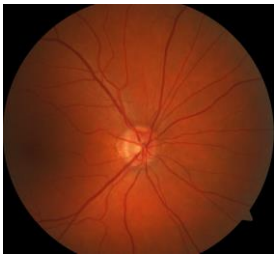


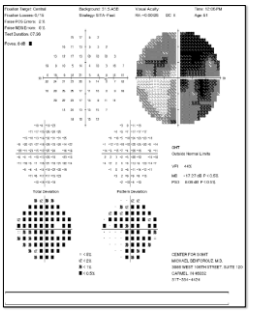




- Localized RNFL Loss
  - NOT present in normal eyes
- Examine RNFL *carefully every time*
  - Important application for OCHTN or glaucoma suspect patients who may have "normal" visual field testing
  - Helpful for patients who may have pseudo normal but glaucomatous mini-cups
    - Less helpful for advanced disease (use perimetry)

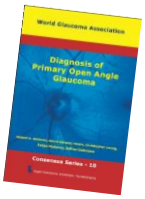






WGA Consensus Statements

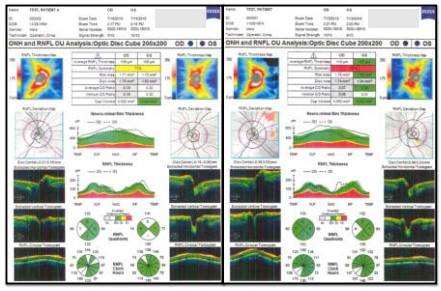
- "Clinical evaluation and documentation of the optic nerve head is essential for the diagnosis and the monitoring of glaucoma."
- "The diagnosis of glaucoma does not always require the detection of visual field defects with perimetry."
- "Photography is effective to document glaucomatous optic disc appearance and nerve fiber layer damage."
- "OCT may be the best currently available digital imaging instrument for detecting and tracking optic nerve structural damage in glaucoma."
  - "*Pitfalls* of OCT such as artifacts and false segmentation should be considered when using OCT."

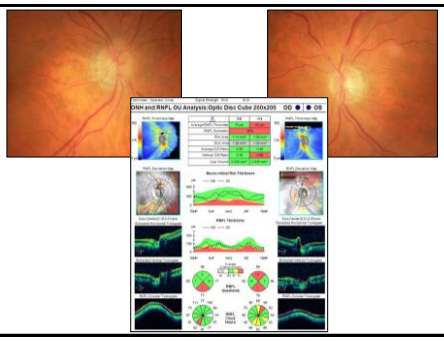


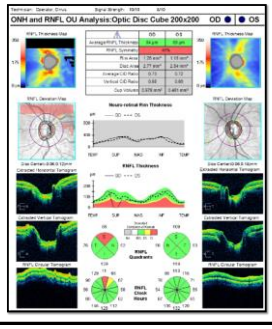
OCT Overview

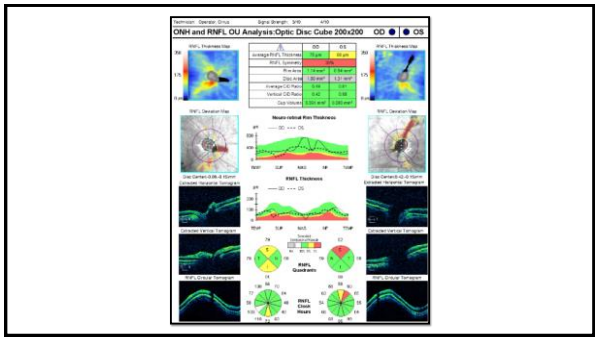
- False positive rate of 26.2% in 149 eyes of 77 healthy adults[1].
- Image-related artifacts in 15.2%–36.1% of scans[2].
- "...misinterpretation of artifacts on OCT can lead to *errors in clinical judgment*, where both false reassurance and false concern can be created. Using *a systematic approach* to OCT analysis allows one to identify and interpret these artifacts[3]"

1. Kim NR, Lim H, Kim JH, Rho SS, Seong GJ, Kim CY. Factors associated with false positives in retinal nerve fiber layer color codes from spectral-domain optical coherence tomography. Ophthalmology. 2011 Sep;118(9):1774-81.
2. Asrani S, Essaid L, Alder BD, Santiago-Turla C. Artifacts in spectral-domain optical coherence tomography measurements in glaucoma. JAMA Ophthalmol. 2014 Apr 1;132(4):396-402.
3. Chen JJ, Kardon RH. Avoiding Clinical Misinterpretation and Artifacts of Optical Coherence Tomography Analysis of the Optic Nerve, Retinal Nerve Fiber Layer, and Ganglion Cell Layer. J Neuroophthalmol. 2016;36(4):417-438.





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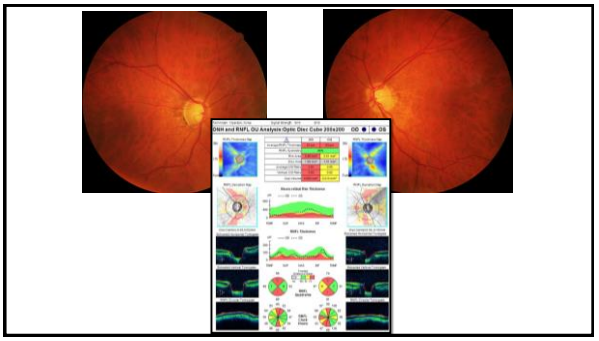

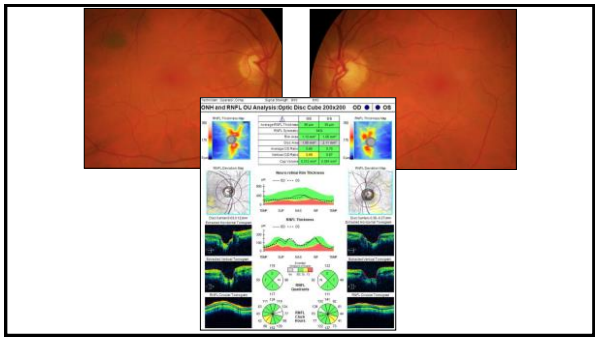

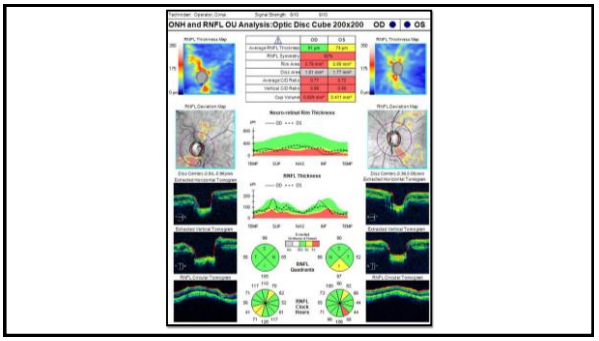
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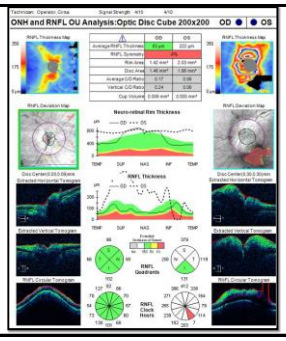
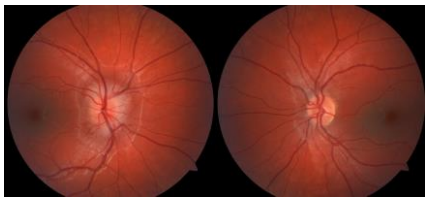
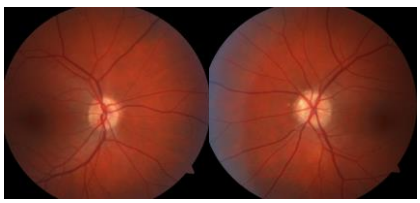
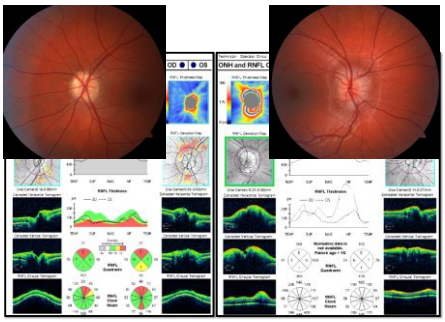


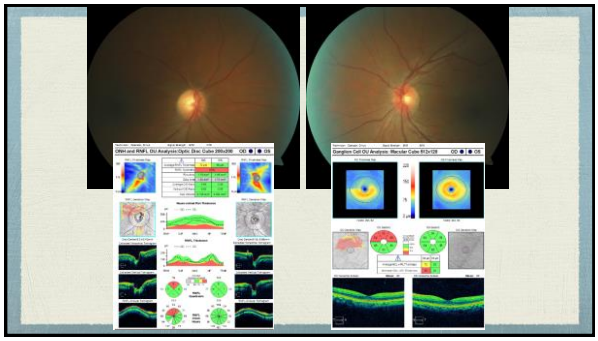
ONH Drusen vs Edema

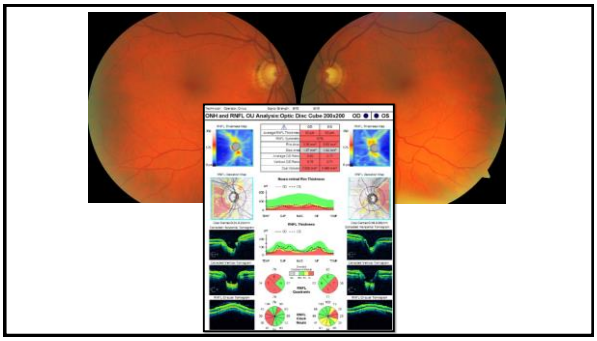


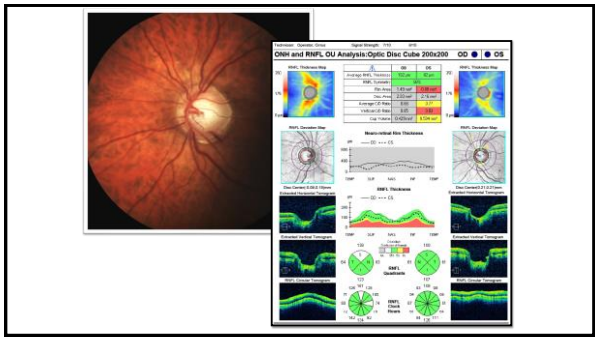
ONH Drusen vs Edema

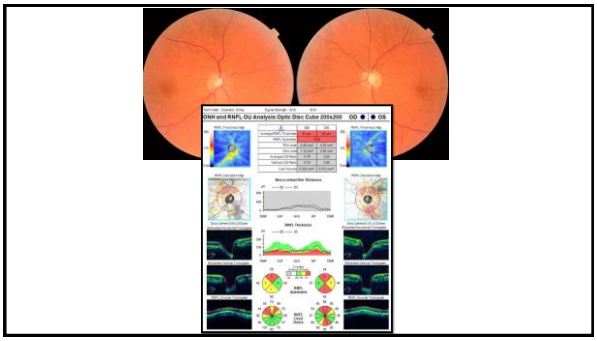


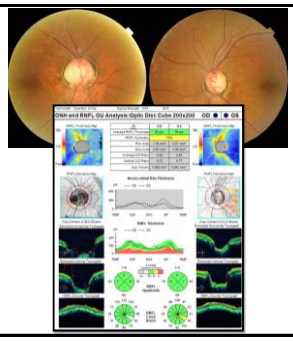


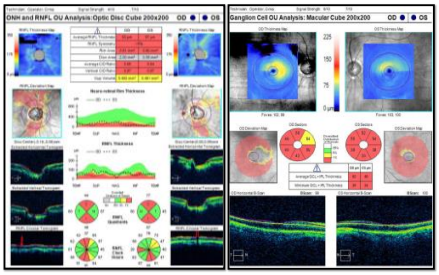


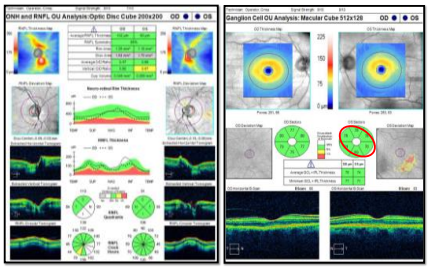


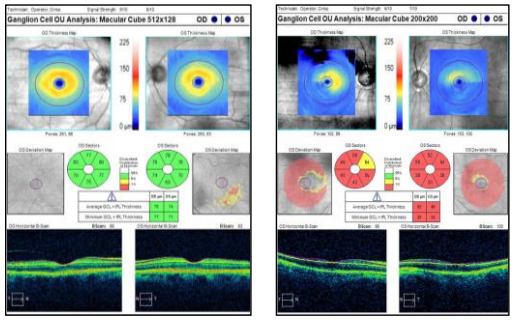


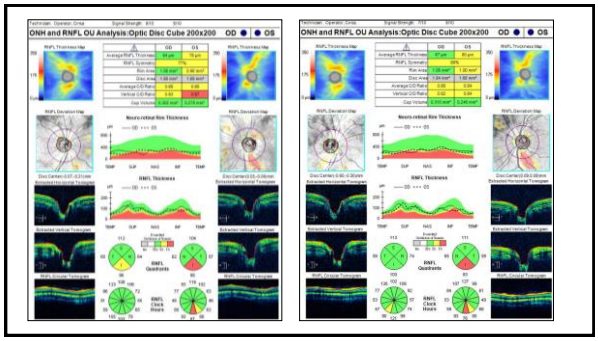



ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD OS

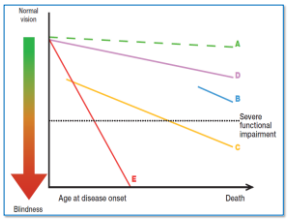

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD OS
Ganglion Cell OU Analysis: Macular Cube 200x200 OD OS


ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD OS
Ganglion Cell OU Analysis: Macular Cube 512x128 OD OS


Ganglion Cell OU Analysis: Macular Cube 512x128 OD OS
Ganglion Cell OU Analysis: Macular Cube 200x200 OD OS



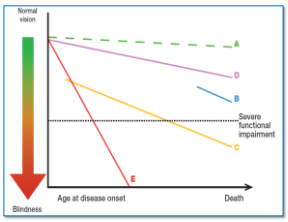
Determine the Risks



- "A good baseline of reliable visual fields is essential to be able to monitor for progression."
- "In clinical scenarios, where the lifetime risk of visual disability is high…three baseline visual fields may be necessary."
- "The frequency of follow-up visual fields should be based on the risk of clinically significant progression (based on extent of damage and life expectancy)."

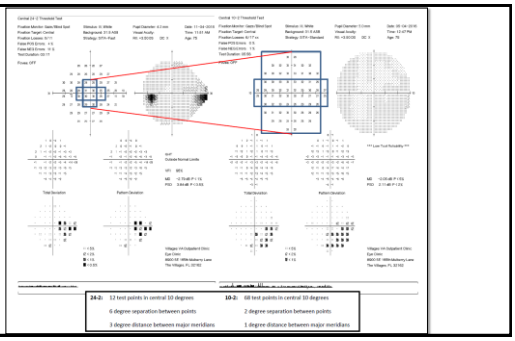
1. Weinreb R, World Glaucoma A. *Progression of Glaucoma: The 8Th Consensus Report of The World Glaucoma Association*. Amsterdam: Kugler Publications; 2011.

Determine the Risks



- "Perform sufficient [visual field testing] to detect change."
- "Decisions on progression should not be made by comparing only the most recent field with the one before."
- "Suspected progression should be confirmed by repeating the field."

1. Weinreb R, World Glaucoma A. *Progression of Glaucoma: The 8Th Consensus Report of The World Glaucoma Association*. Amsterdam: Kugler Publications; 2011.



- Eleven eyes with *normal* 24-2 visual fields outside the central 10 degrees showed arcuate defects within the central 10 degrees with 10-2 testing[1].
- Nine percent of *normal* 30-2 threshold visual fields in glaucoma suspect or early glaucoma patients were actually classified as abnormal with 10-2 testing. Additionally, 30-2 testing *underestimated* the level of glaucomatous damage in 13 % of the hemifields[2].
- Macular damage, with correlating functional damage on 10-2 testing, appears to occur almost as frequently as peripheral defects in patients with early glaucoma. Approximately 16% of these patients may have undetected functional central defects when using 24-2 testing alone[3].
- Paracentral scotomas that may be missed on 24-2 perimetry may be detected by 10-2 perimetry. Furthermore, previously missed defects detected *only* by 10-2 perimetry were deep and involved only a small area of the visual field at or near fixation[4].

1. Hood DC, Raza AS, de Moraes CG, et al. *Initial Arcuate Defects within the Central 10 Degrees in Glaucoma.* Invest Ophthalmol Vis Sci. 2011;52(2):940-946.
2. Langerhorst CT, Carenini LL, Bakker D, De Bie-Raakman MAC. *Measurements for Description of Very Early Glaucomatous Field Defects.* Perimetry Update 1996/1997. New York, NY: Kugler Publications;1997:67-73.
3. Traynis I, de Moraes CG, Raza AS, Liebmann JM, Ritch R, Hood DC. *Prevalence and Nature of Early Glaucomatous Defects in the Central 10 degrees of the Visual Field.* JAMA Ophthalmol. 2014;132(3):291-297.
4. Hangai M, Ikeda H, Akagi T, Yoshimura N. *Paracentral Scotoma in Glaucoma Detected by 10-2 but not by 24-2 Perimetry.* Japanese Journal Of Ophthalmology [epub ahead]. March 2014;58(2):168-185.

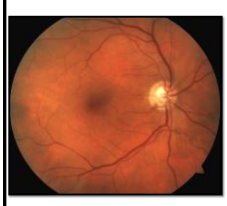
Table 1. One Hundred Sixty-Eight Eyes of 152 Ocular Hypertensive Participants with Primary Open-Angle Glaucoma (POAG) End Points

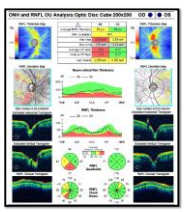
POAG Study End Point	No. of Eyes	% of Eyes
Optic disc, no visual field	87	52
Visual field, no optic disc	40	24
Both visual field and optic disc at same time	12	7
Visual field initially, then optic disc	17	10
Optic disc initially, then visual field	12	7
Total	168	100

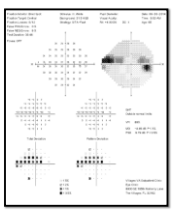
Keltner JL, Johnson CA, Anderson DR, et al. The association between glaucomatous visual fields and optic nerve head features in the Ocular Hypertension Treatment Study. Ophthalmology. 2006;113:1603–1612.

"Both the visual field and the optic disc must be monitored *with equal diligence*, because either may show the first evidence of glaucomatous damage."

Preferential Loss
- Structural and Functional Correlation -

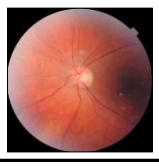


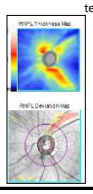


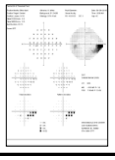


Visual Field Progression
- WHERE do we see it? -

- Regional preferential rim loss depending on stage of disease:
  - Early: Look carefully in I.T. and S.T. disc regions
  - Moderate: Temporal horizontal disc region
  - Advanced: Inferior nasal, then superior nasal rim loss
- The sequence of disc sector rim loss *correlates* with the progression of the VF defects:
  - Early VF loss: Nasal upper or lower quadrant
  - Moderate VF loss: Connecting arcuate
  - Advanced: Island of sensitivity in the inferior-temporal VF



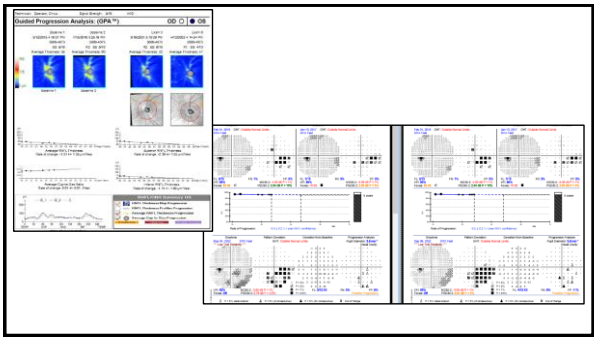


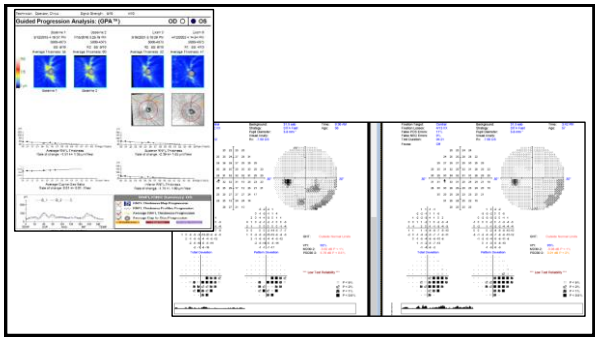


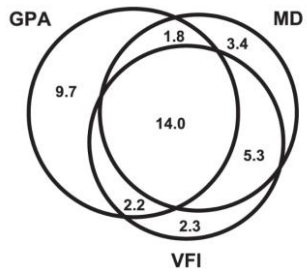
Visual Field Progression
- HOW can we detect it? -

- LOOK for:
  - Deepening of current defects (PSD)
  - Enlargement of current defects (MD)
  - NEW defects
- "Visual field progression may be analyzed by either 'event-' or 'trend-'based methods"
  - "In general, event-based methods are used early in the follow-up, when few VFs are available for serial analysis.
  - "In general, rate-based analyses are used later in the follow-up, when a greater number of VFs is available over a sufficient period of time to measure the rate of progression."

R.N. Weinreb, D. G.-H. (2011). *Progression of Glaucoma – World Glaucoma Association 8th Consensus Meeting.* Paris: Kugler Publications.



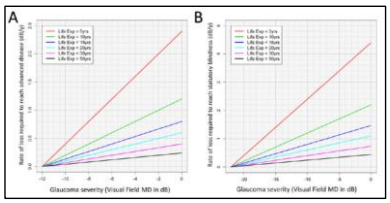




"…when matched by specificity, the performance of point-wise event-based analysis of progression with the GPA was similar to those obtained by global trend–based analyses of MD and VFI. However, there was only a moderate level of agreement in the eyes detected as progressing by these methods…both methods may provide complementary information which should be considered collectively in clinical practice."

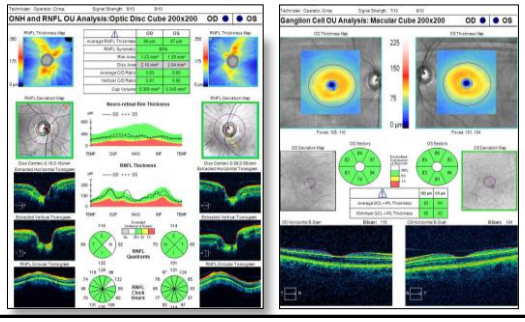
"…information from both methods could be exploited to improve the overall detection of visual field progression in clinical practice…"

Wu Z, Medeiros FA. Comparison of Visual Field Point-Wise Event-Based and Global Trend-Based Analysis for Detecting Glaucomatous Progression. Transl Vis Sci Technol. 2018 Aug 27;7(4):20



"These examples clearly show that it is not only important to determine whether a glaucoma patient is progressing, but it is also critical to estimate the rate of progression to determine how aggressively to treat the patient. To do this, regular monitoring of patients is essential in glaucoma management."

Saunders LJ, Medeiros FA, Weinreb RN, Zangwill LM. What rates of glaucoma progression are clinically significant? Expert Rev Ophthalmol. 2016;11(3):227-234.



Questions/Comments

Case Presentation I
Moderate Glaucoma

- 69 year-old male returns for *continued* glaucoma evaluation and testing.
- Patient reports "vision is stable without glasses."
  - Cataract Surgery OU with iStent OU 2021
  - Review of Systems: unremarkable and noncontributory.
    - No medications
      - Adderall 20 mg XR
      - Multivitamin
    - Non-smoker
    - Social drinker
    - Profession: "Laborer"
  - FOHx: glaucoma, mother

Case Presentation

UNCORRECTED VISUAL ACUITY

OD: = 20/20-1

OS: = 20/20-1

PUPILS

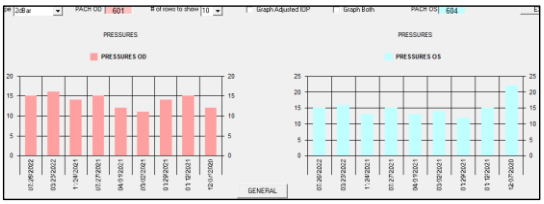
OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS

OD: Full to FC

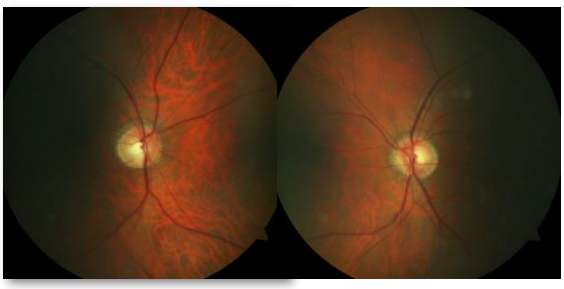
OS: Full to FC

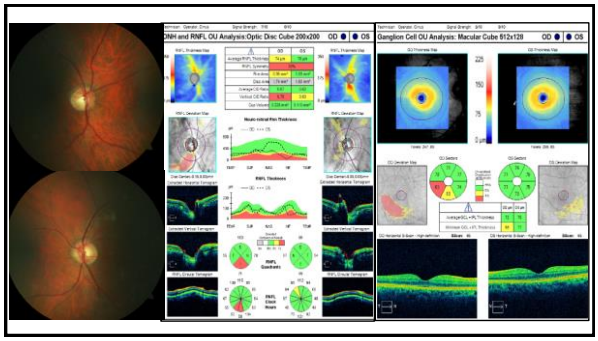
Case Presentation

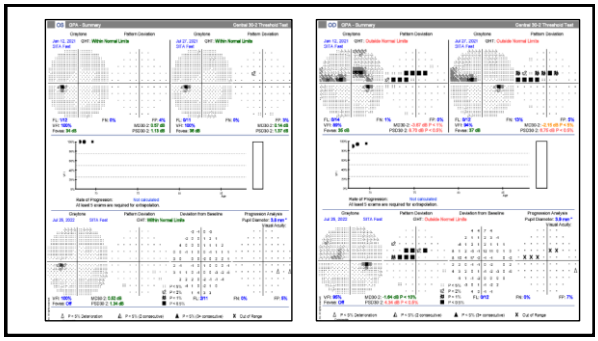


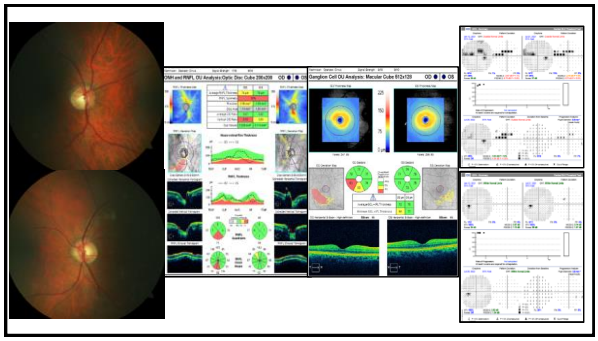
SLIT LAMP EXAM OU

- Lids/Adnexa: clear
- Conjunctivae: palpebral/bulbar clear
- Sclera: white
- Cornea: clear/normal; 1+pigment OU;
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: PCIOL OU, tr PCO OU; NO PXE OU









Case Presentation II
Moderate Glaucoma

- 78 year-old male returns for *continued* glaucoma evaluation and testing.
- Patient reports "near blur for last 6 months, gradually worsening."
  - No pertinent ocular history
  - Review of Systems: unremarkable and noncontributory.
    - No medications
      - Multivitamin, Aspirin, Ginkgo Biloba, Glucosamine
    - Non-smoker
    - Social drinker
    - BMI = 30
  - Negative FOHx

Case Presentation

BEST CORRECTED VISUAL ACUITY

OD: = 20/40-1

OS: = 20/30-2

PUPILS

OU: round, reactive; (-) rAPD OD, OS

CONFRONTATION VISUAL FIELDS

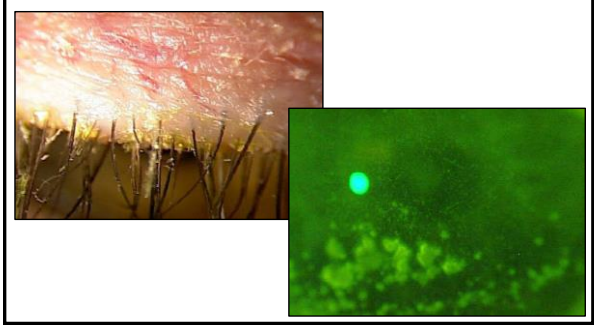
OD: Full to FC

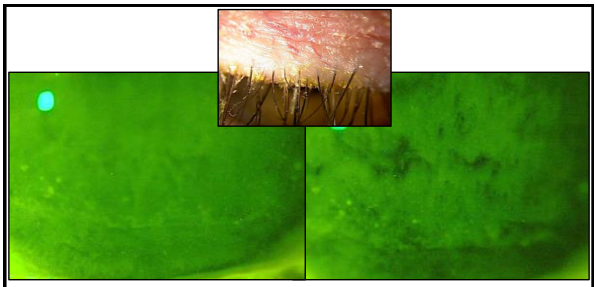
OS: Full to FC

Case Presentation

SLIT LAMP EXAM OU

- Lids/Adnexa: see next slide…
- Conjunctivae: 1+ injection
- Sclera: white
- Cornea: see next slide….(-)pigment OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: 1+ NS OU; NO PXE OU

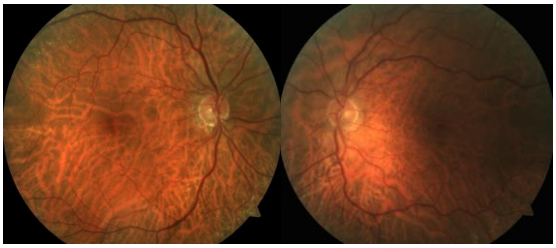


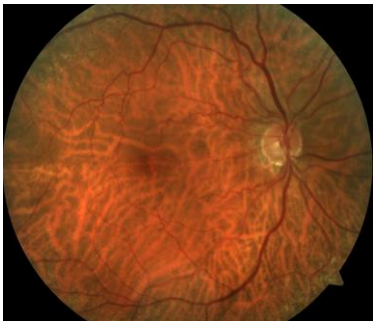


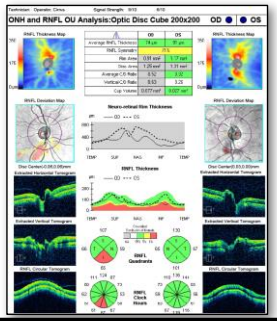
Case Presentation

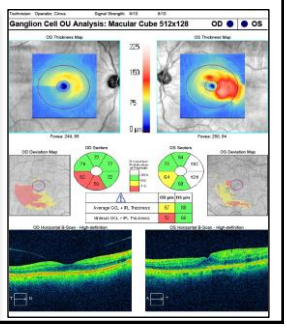
INTRAOCULAR PRESSURES @13:44
OD: = 18 mmHg
OS: = 19 mmHg

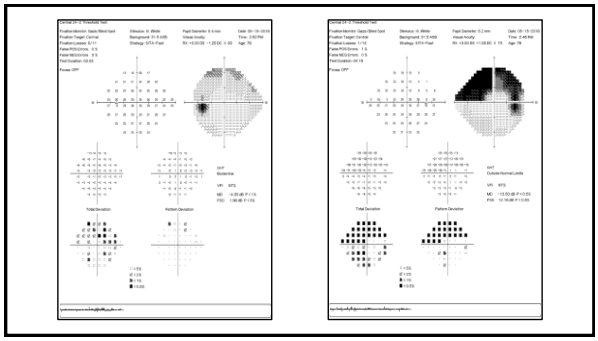
PACHYMETRY
OD: = 548
OS: = 536

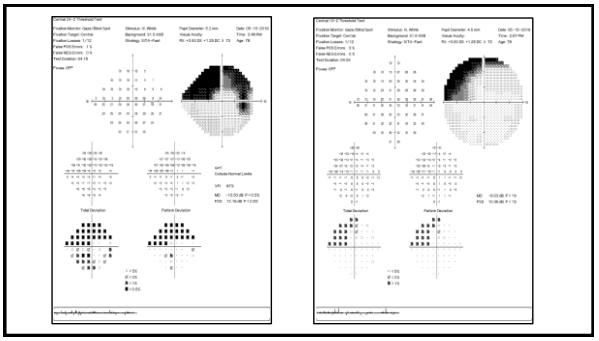


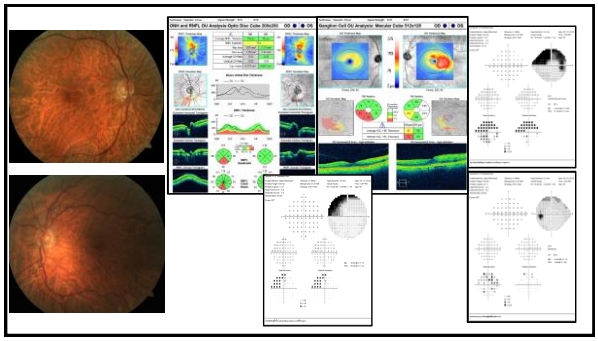


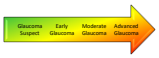












Questions/Comments

Case Presentation I
Advanced Glaucoma

- 71 year-old female returns for glaucoma evaluation
- Patient reports "…right eye vision went bad 3+ years ago" and used to take drops prior to the pandemic but no treatment or evaluation since early 2020.
  - No Ocular History
  - Review of Systems: Diabetes, Hypertension, High Cholesterol
  - Medications
    - atorvastatin 80 mg tablet
    - glipizide 2.5 mg tablet extended release 24hr
    - hydrochlorothiazide 12.5 mg capsule
    - irbesartan 300 mg tablet
    - metformin 500 mg tablet extended release 24 hr - Non-smoker
  - Social drinker
  - Profession: Retired teacher
  - FOHx: none

Case Presentation

BEST CORRECTED VISUAL ACUITY

OD: = CF @3 ft

OS: = 20/70-2

PUPILS

OU: round, reactive; (-) rAPD OD, OS; sluggish

CONFRONTATION VISUAL FIELDS

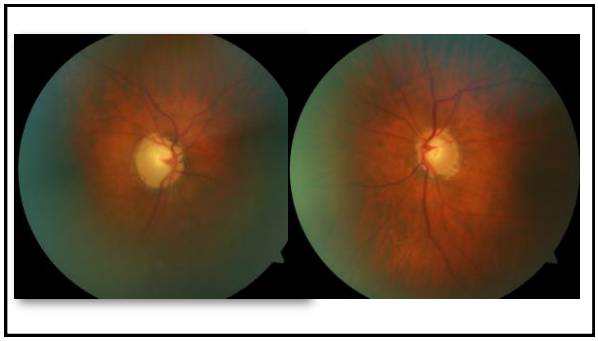
OD: see HVF

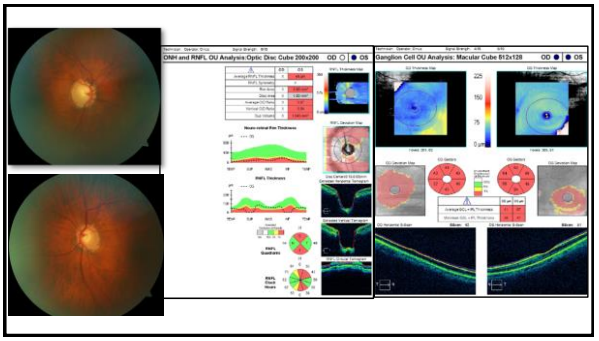
OS: see HVF

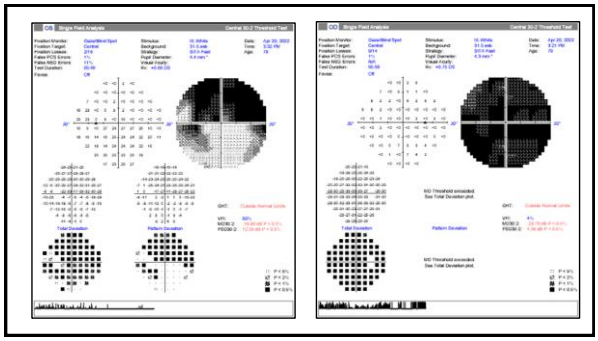
Case Presentation

SLIT LAMP EXAM OU

- Lids/Adnexa: clear
- Conjunctivae: clear
- Sclera: white
- Cornea: clear (-)pigment OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: 2+ NS, Cortical OU; NO PXE OU







Case Presentation II
Advanced Glaucoma

- 38 year-old African American male reports to clinic for glaucoma evaluation.
- Patient reports that he "…wants to establish care [and that he] last used drops over 6 months and stopped because they made his vision blurry."
- Ocular History: Glaucoma
- Family History: Glaucoma, father
- Profession: Financial advisor
- Review of Systems: Diabetes, Hypertension
- Medications
  - amlodipine 10 mg tablet - 1 pill DAILY by mouth
  - escitalopram oxalate 10 mg tablet - 1 pill DAILY by mouth
  - metformin 500 mg tablet - 1 pill BID by mouth

Case Presentation

BEST CORRECTED VISUAL ACUITY

OD: = HM

OS: = 20/30-2

PUPILS

OU: round, reactive; (-) rAPD OD, OS; sluggish

CONFRONTATION VISUAL FIELDS

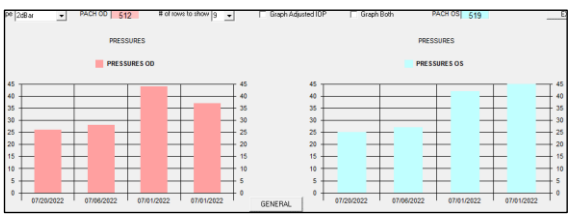
OD: see HVF

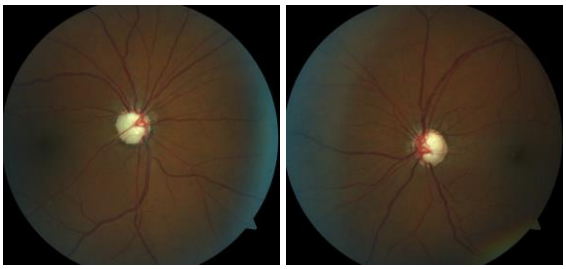
OS: see HVF

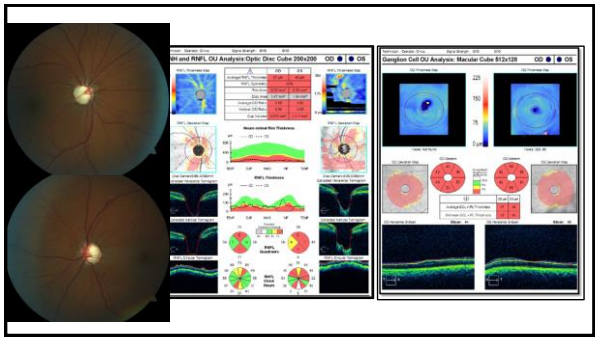
Case Presentation

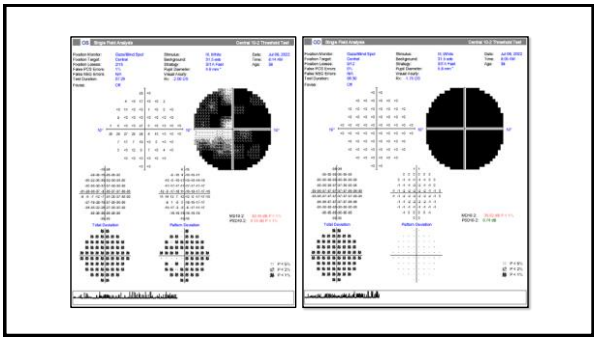
SLIT LAMP EXAM OU

- Lids/Adnexa: clear
- Conjunctivae: clear
- Sclera: white
- Cornea: clear (-)pigment OU
- Anterior Chamber: deep and quiet OD,OS; NO cell
- Iris: clear/normal; NO NVI, synechiae
- Lens: tr Cortical OU; NO PXE OU









Summary - Conclusion