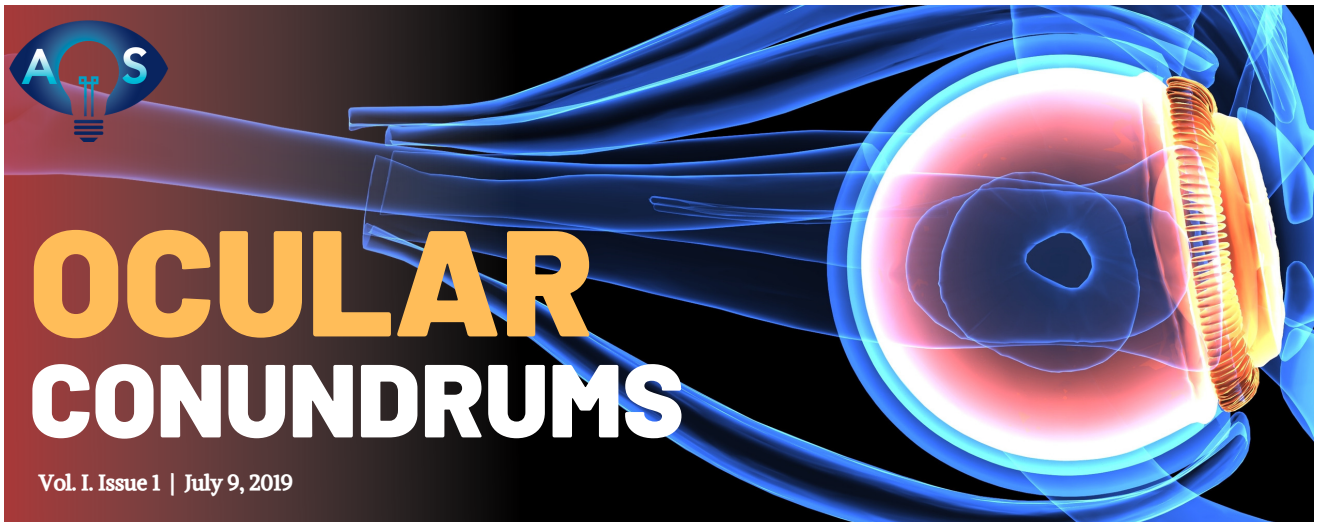

GLAUCOMA: CASE 1 | OCULAR HYPERTENSION

The Value of a Normal OCT in a Patient with Ocular Hypertension in the Setting of an Otherwise Normal Exam

With comments from:

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PATIENT PROFILE

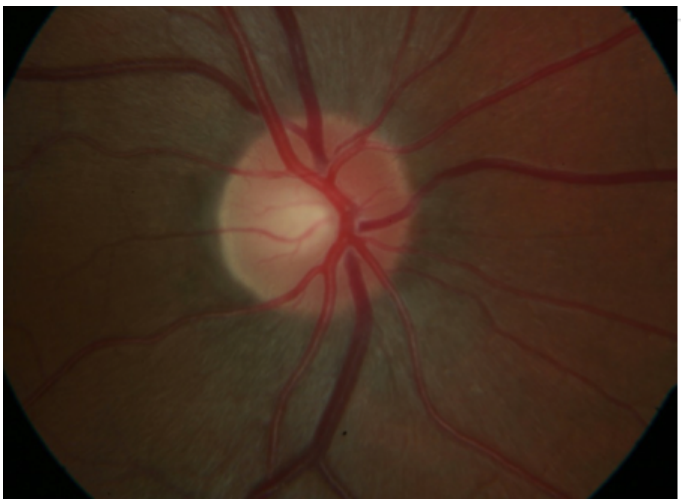
36 Year-old White Male

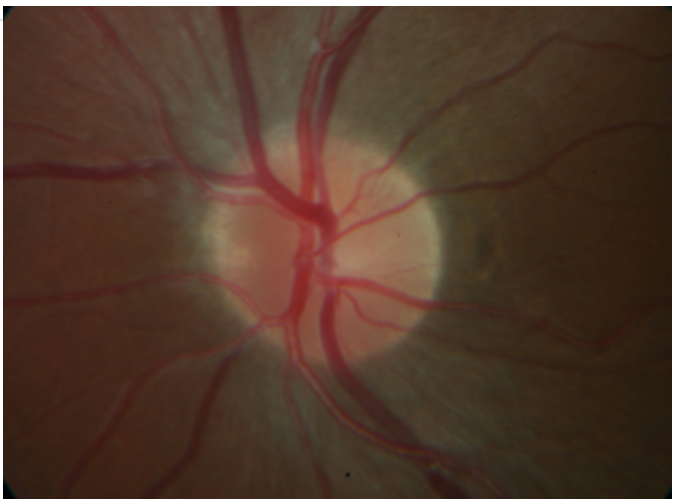
Pertinent ocular/medical hx:	No known history of steroid use or ocular trauma
Family history:	Unsure if mother has glaucoma or is suspect
Best Corrected VA:	20/20 OU
Manifest Refraction:	OD: -4.00sph, OS: -3.25-0.25X128
Anterior segment:	Unremarkable, (-) pseudo-exfoliation (PXE), krukenberg spindle (KS), iris transillumination defects (TIDs) OU with a deep and quiet anterior chamber (AC) OU
Pupils:	PERRL-APD
Lens:	Clear without pseudo-exfoliative material (PXE) OU
IOP:	26/26 @ 8:23am with Goldmann Applanation Tonometry (GAT) (reported TMAX: 28/27)
CCT:	534/553
Gonioscopy:	Gr 4, flat, CB 360 OU, gr 1 uniform pigment OU
Optic nerve head:	See photos
Retina:	Flat 360 OU
VF 24-2 and OCT:	See Below

5 RULES (R'S) OF THE DISC:

1. Identify the scleral **Ring** to determine the size of the optic disc
2. Observe the size and quality of the **Rim**
3. Examine the **Retinal** Nerve Fiber Layer (RNFL)
4. Examine the **Region** of parapapillary atrophy (PPA)
5. Look for **Retinal** and optic disc hemorrhages (DH)

Fingeret M, Medeiros FA, Susanna R Jr, Weinreb RN. Five rules to evaluate the optic disc and retinal nerve fiber layer for glaucoma. Optometry 2005. 76(11):661–8.





	COMMENTS OD:	COMMENTS OS:
DISC AREA	Smaller than average disc sharp borders	Smaller than average disc sharp borders
RIM	Pink and healthy rims; follows ISNT rule*	Pink and healthy rims; follows ISNT rule*
RNFL	RNFL appears intact with mild cup-to-disc (CD) asymmetry OD>OS, no visible RNFL defect	RNFL appears intact with mild cup-to-disc (CD) asymmetry OD>OS, no visible RNFL defect
REGION	No alpha or beta zone PPA	No alpha or beta zone PPA
RETINAL HEM.	No disc or retinal hemorrhage evident	No disc or retinal hemorrhage evident
SUMMARY	Appearance of normal discs in the presence of mild CD asymmetry OD>OS	

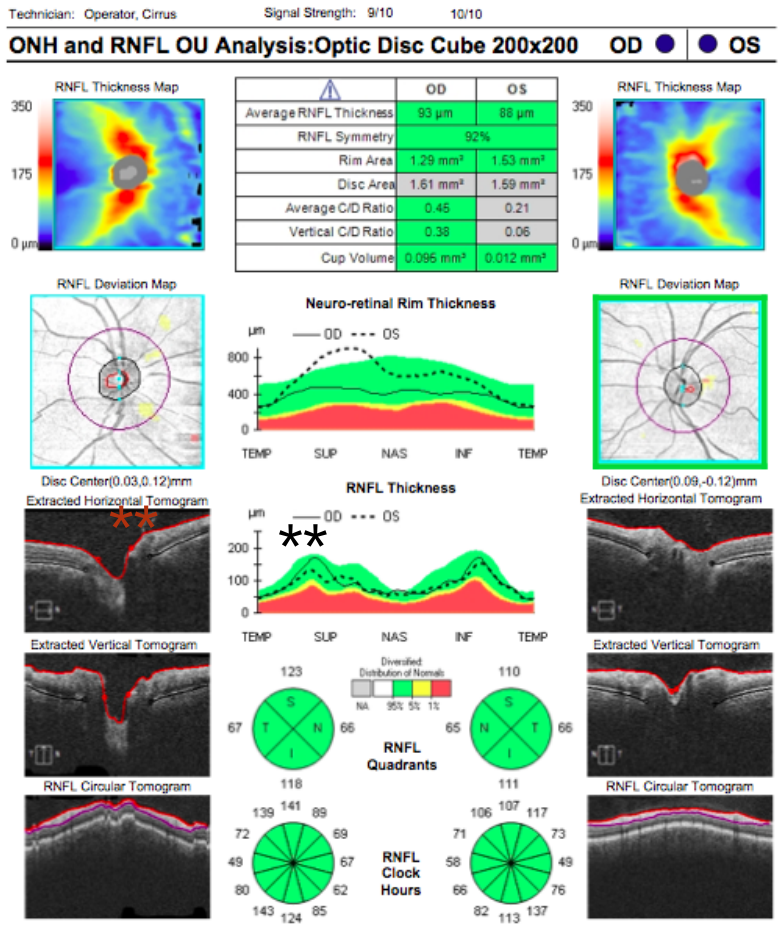
SUBTLE TEACHING POINTS:

- *ISNT Rule (that normal eyes show a characteristic configuration for disc rim thickness of inferior ⩾ superior ⩾ nasal ⩾ temporal), is useful in differentiating normal from glaucomatous optic nerves and is unaffected by race.

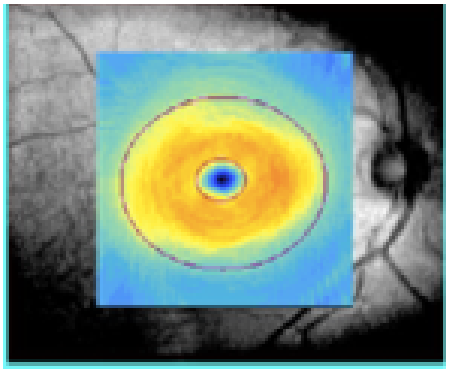
Harizman N, Oliveira C, Chiang A, Tello C, Marmor M, Ritch R, Liebmann JM. The ISNT Rule and Differentiation of Normal from Glaucomatous Eyes. Arch Ophthalmol. 2006; 124(11):1579–1583.

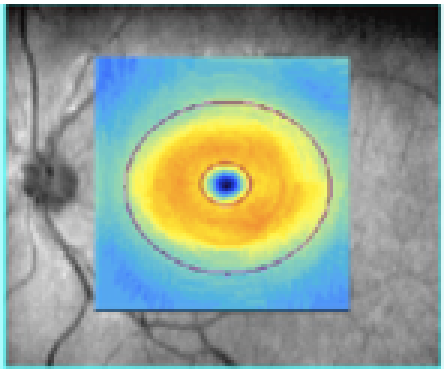
CONVENTIONAL REPORT

1. Observe the quality of the scan (signal strength, artifact, etc.)
2. Look closely at the RNFL at the thickness and deviation maps as well as TSNIT plot
3. Evaluate the ganglion cell layer in the macula cube scan



	OD	OS
Average RNFL Thickness	93 µm	88 µm
RNFL Symmetry	92%	
Rim Area	1.29 mm²	1.53 mm²
Disc Area	1.61 mm²	1.59 mm²
Average C/D Ratio	0.45	0.21
Vertical C/D Ratio	0.38	0.06
Cup Volume	0.095 mm³	0.012 mm³





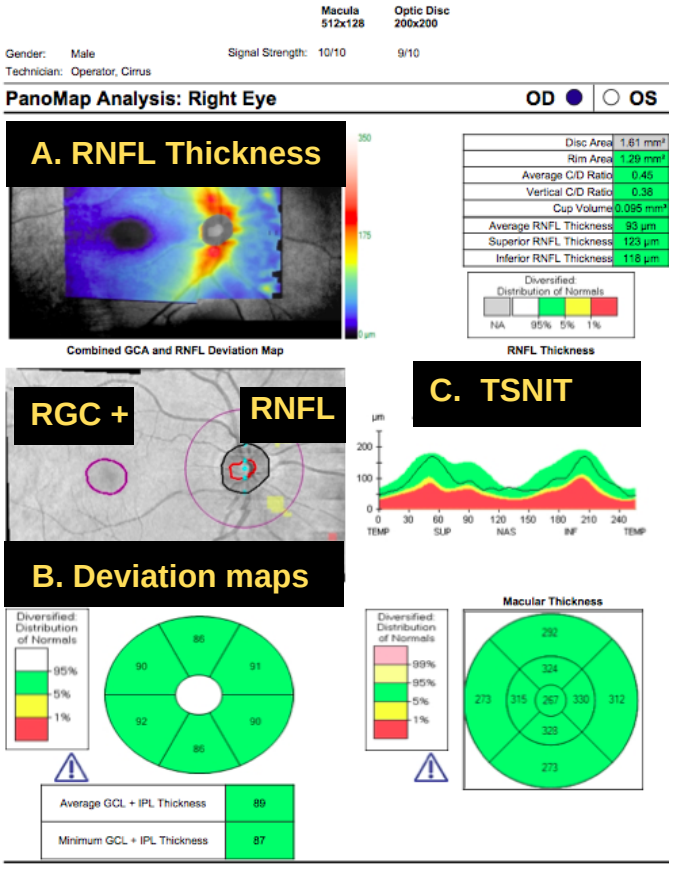
	COMMENTS OD:	COMMENTS OS:
Quality	No artifact, good signal strength (SS)	No artifact evident, good SS
RNFL	Normal	Normal
GCC	Normal	Normal
Other	**Slightly decreased thickness superiorly OS noted on the TSNIT compared to OD.	

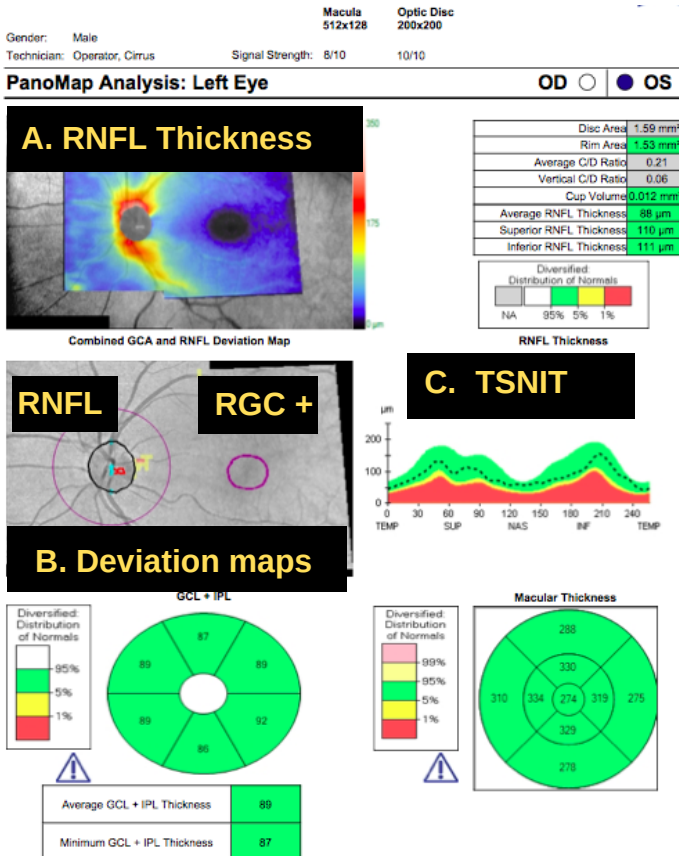
SUBTLE TEACHING POINTS:

- On the Cirrus machine you can double-click the cpRNFL image (red star) to enlarge it if you want to do an even more careful analysis.
- In addition to adequate signal strength (7/10 or better is generally preferred), assessment for any artifact and proper alignment is important in determining reliability of the image.

PANOMAP ASSESSMENT

1. Observe the quality of the scan (signal strength, artifact, etc.)
2. Look closely at the RNFL thickness maps and the RGC+ and RNFL deviation maps





	COMMENTS OD:	COMMENTS OS:
Quality	No artifact evident	No artifact evident
A. RNFL	Normal	Normal
B. GCL	Normal	Normal
C. TSNIT	Normal	Normal, although superior region is slightly thinner than in OD.

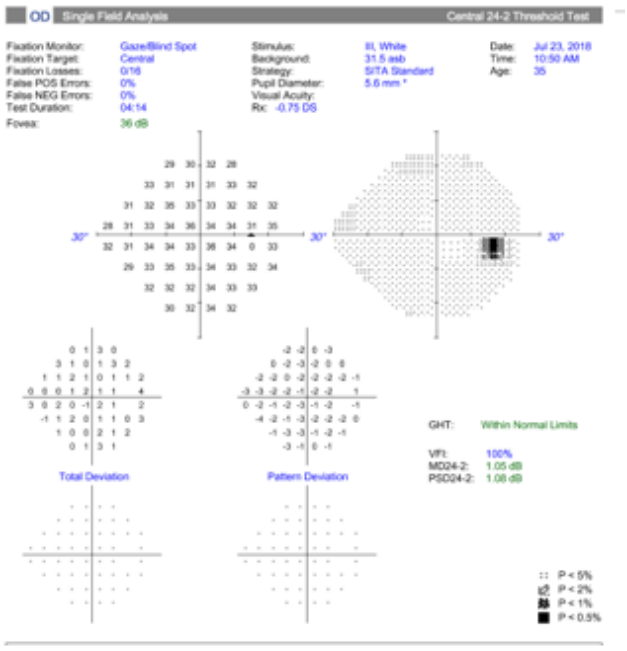
SUBTLE TEACHING POINTS:

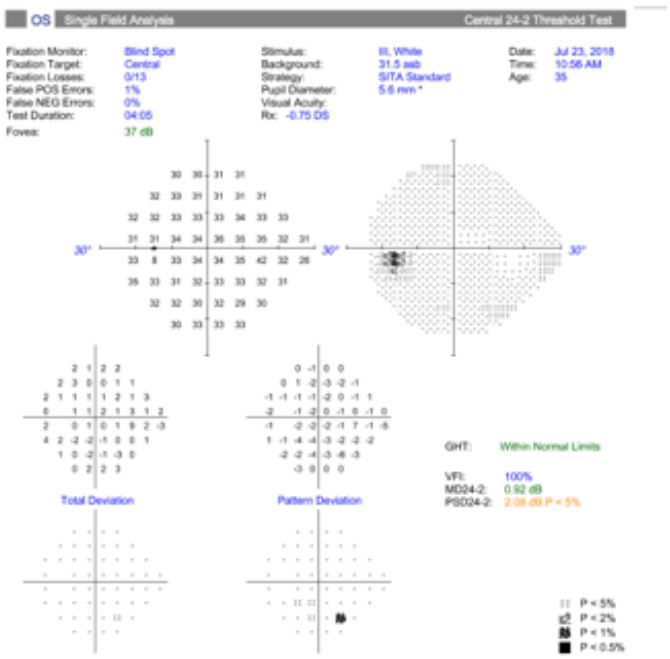
- It is helpful to look at the cpRNFL image (as described on page 4) which is only available on the Conventional Report.

5 RULES FOR INTERPRETATION

1. Is it the right test (eg: 10-2, 24-2, proper Rx, etc.)
2. Is it reliable (eg: FL, FP, etc.)
3. Review probability plots
4. Does the defect follow the RNFL pattern (eg: decide if glaucomatous or non-glaucomatous defect
5. Re-affirm the diagnosis (eg: structure/function correlation)

Adapted from FORGE II.





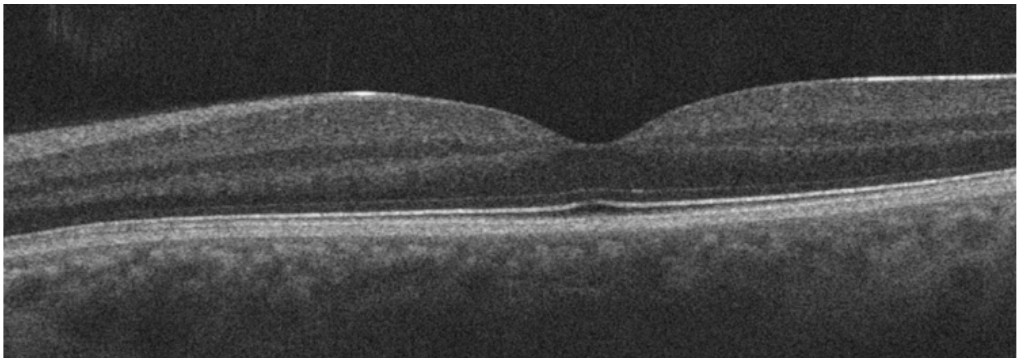
	COMMENTS OD:	COMMENTS OS:
Test	24-2, Sita Standard, Stimulus Size III	24-2, Sita Standard, Stimulus Size III
Reliability	Fixation loss: 0/16, FP: 0%; Good quality	Fixation loss: 0/13, FP: 1%; Good quality
Probability Plots	MD, PSD, GHT all within normal limits	MD and GHT within normal limits **PSD abnormal**
Pattern	No glaucomatous defect pattern evident in pattern deviation plot	No glaucomatous defect pattern evident in pattern deviation plot
Diagnosis	OCT consistent with normal visual field	OCT consistent with normal visual field

SUBTLE TEACHING POINTS:

- False negatives no longer are viewed as having meaningful information and are excluded from the latest algorithm of visual fields.
- Elevated false positives(FP) artifactually improve the appearance of the field, be wary of FP>15%.
- Although the PSD is abnormal OS, there is no structural correlate on the OCT. The VF needs to be repeated.

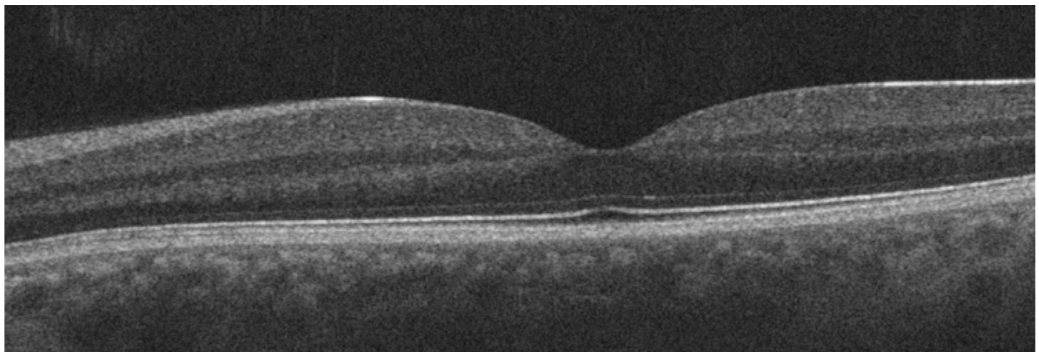
5 LINE ROSTER SCAN

1. Is macula anatomy normal
2. Is there a macula structural defect that might impact the OCT Panomap and VF (eg: macula edema, AMD, ERM, etc.)



COMMENTS OD:

- Normal
- A, B, and C from the panomap all agree with the appearance of the macula



COMMENTS OS:

- Normal
- A, B, and C from the panomap all agree with the appearance of the macula

SUBTLE TEACHING POINTS:

- In this case, the maculae are normal.

OHTS RISK CALCULATOR

CONTINUOUS METHOD FOR ESTIMATING 5-YEAR RISK OF DEVELOPING POAG

The estimated risk displayed below is a projection of the patient's likelihood of developing early glaucoma in at least one eye within 5 years, based on the information entered, and using the model developed by the OHTS-EGPS Collaboration and published in Ophthalmology: (in press). [OHTS-EGPS GLAUCOMA PREDICTOR, version 2006.1. Copyright 2006, Washington University]

FACTORS

? Age 36	RIGHT EYE MEASUREMENTS			LEFT EYE MEASUREMENTS		
	1st	2nd	3rd	1st	2nd	3rd
? Untreated Intraocular Pressure *(mm Hg)*	26	26	28	26	26	27
? Central Corneal Thickness *(microns)*	534			553		
? Vertical Cup to Disc Ratio by Contour	0.40			0.20		
? Pattern Standard Deviation ◉ Humphrey *(dB)* ○ Octopus loss variance *(dB)*	2.1			1.1		

Print Reset 7.8% The patient's estimated 5-year risk (%) of developing glaucoma in at least one eye.

SUBTLE TEACHING POINTS:

- Risk calculator available at: https://ohts.wustl.edu/risk/ (select "use continuous method").
- This calculator works for a single visit as in this case but is more correctly used with a series of 3 visits and 2 VF's.

CLINICAL ASSESSMENT

by Dr. Liebmann

1. How do we define ocular hypertension (OHT)?
OHT is defined as statistically elevated IOP in the presence of a normal optic nerve and visual field.

2. Does this patient have OHT?
Repeating IOP measurements is always a good idea, This establishes an improved understanding of the range of IOP before treatment is initiated, enhances understanding of the patient risk profile, and allows determination of the effectiveness of any prescribed treatment.

3. Is there a secondary cause of OHT found on the examination?
There is no discernable secondary cause of elevated IOP, such as PXE or pigmentary dispersion, and the angle is open.

4. Does this patient fit the OHTS criteria?
The optic nerve is asymmetric, but both neuroretinal rims appear intact clinically and the visual field is normal, which meets the criteria used in OHTS for OHT.

5. Is the OHTS risk calculator helpful in this case?
The OHTS risk calculator suggest a moderate risk of conversion (7.8%) to glaucoma in 5 years.

6. How does the OCT help in the diagnosis of this case?
OCT is an excellent tool for OHT to detect early injury. If the OCT is normal (as it is in this case), the patient could be monitored without treatment, but if the OCT reveals evidence of RNFL or GCIPL injury, the diagnosis would actually be POAG, and the patient should be treated.

7. What else should be considered as part of this patient's risk profile?
Other risk features that increase his risk of developing glaucoma are his family history and young age, which increases the duration of his lifelong exposure to high IOP and increases his risk over the long term.

8. What do you suggest as the treatment and management of this patient?
For these reasons, I suggest serial monitoring of IOP, OCT and VF, and treatment for further IOP elevation, increased risk, or any change in the OCT or VF. Given his young age, it would not be wrong to treat this patient with a prostaglandin analogue at this time, and the options should be discussed with the patient.

TO LEARN MORE ABOUT OCULAR HYPERTENSION SEE REFERENCES BELOW:

Risk assessment in the management of patients with ocular hypertension.
Weinreb RN, Friedman DS, Fechtner RD, Cioffi GA, Coleman AL, Girkin CA, Liebmann JM, Singh K, Wilson MR, Wilson R, Kannel WB.
Am J Ophthalmol. 2004 Sep;138(3):458-67. Review.

An evidence-based assessment of risk factors for the progression of ocular hypertension and glaucoma.
Friedman DS, Wilson MR, Liebmann JM, Fechtner RD, Weinreb RN.
Am J Ophthalmol. 2004 Sep;138(3 Suppl):S19-31. Review.

IMAGING PEARLS

by Dr. Hood

1. Is the OCT normal?
Despite some asymmetry, optic neuropathy is not evident.

2. Is the visual field normal? Is there consistency with the OCT?
Although the visual fields are normal, when I see any defect on a visual field, I look back at the OCT for correlation. In this case, the single inferior defect OS is correlative with a slightly depressed hump of the superior region on the TSNIT curve OS as compared to OD. Although I do not believe this is necessarily abnormal, I would pay closer attention to this area at follow-up examinations.

3. What is the likelihood that this patient has glaucoma?
The images suggest that this patient has a very low risk of having optic neuropathy at this time. I cannot comment on future risk without longitudinal data. As noted, I would follow this patient with a 24-2 OS.

4. What is your recommendation for monitoring this patient?
Repeat visual field 24-2 and get an OCT at the same visit to confirm or deny whether there is a true visual field defect

TO LEARN MORE ABOUT OCT INTERPRETATION:

- Follow this link to Dr. Hood's recorded lectures: http://hoodvisualscience.psych.columbia.edu/lectures/

CONSULTANTS & EDITORS

Donald C. Hood, the James F. Bender Professor of Psychology and Professor of Ophthalmic Science (in Ophthalmology), has been a member of the Columbia faculty since 1969. He holds M.Sc. and Ph.D. (1970) degrees from Brown University and honorary degrees from Smith College (2000) and Brown University (2017). He is an elected Fellow of the American Academy of Arts and Sciences and a recipient of an Alcon Research Institute Award (2014). He currently serves as Editor-in-Chief of IOVS and is on the editorial boards of IOVS (since 1992), Documenta Ophthalmologica (since 2004), and J. of Glaucoma (since 2016); and he previously served on the boards of Translational Vision Science & Technology (2011-2017), Progress in Retinal and Eye Reseach (2016-2018), and J. of Vision (2004-2012). While some of his over 300 publications deal with issues of the basic neuroscience of vision, most of his work over the last 25 years has concerned research on diseases of the retina and optic nerve. He has had continuous grant support from NIH/NEI for over 45 years.

Dr. Jeffrey M. Liebmann graduated from Boston University School of Medicine, completed his ophthalmology residency at the State University of New York/Downstate Medical Center, and his glaucoma fellowship at the New York Eye and Ear Infirmary. Dr. Liebmann serves as Shirlee and Bernard Brown Professor, Vice-Chair, and Director of the Glaucoma Division of the Department Ophthalmology at Columbia University Medical Center. He is a fellow of the American Academy of Ophthalmology, Association for Research in Vision and Ophthalmology and American College of Surgeons. Dr. Liebmann is currently Editor-in-Chief of Journal of Glaucoma, a member of the Board of Governors of the World Glaucoma Association and Board of Directors of The Glaucoma Foundation and Secretary-Treasurer of the New York Glaucoma Society. Dr. Liebmann is a past-President of the World Glaucoma Association, American Glaucoma Society, and the New York Society for Clinical Ophthalmology and was co-founder of the New York Glaucoma Research Institute, the American Glaucoma Society Foundation and ASCRS Glaucoma Day.

In addition to maintaining a busy tertiary-care referral practice in New York City, Dr. Liebmann is Principal Investigator for the NIH African Descent and Glaucoma Evaluation Study (ADAGES) and Ocular Hypertension Treatment Study (OHTS III) at Columbia University and is the author and/or co-author of more than 1000 medical and scientific papers, book chapters, and abstracts. He has lectured widely in the United States and abroad on glaucoma diagnosis and management. His current main areas of research interest include the causes of glaucoma, glaucoma progression, glaucoma surgery, ocular imaging, and neuroprotection.

C. Gustavo De Moraes, MD, MPH is an Associate Professor and the Medical Director of Clinical Trials at the Department of Ophthalmology at Columbia University Medical Center, New York, NY. He obtained his MD degree at University of Sao Paulo, Brazil, and completed Ophthalmology Residency and Glaucoma Fellowship at the same institution. He later completed his Glaucoma Fellowship at the New York Eye and Ear Infirmary under the supervision of Robert Ritch, MD and Jeffrey Liebmann, MD. Dr. De Moraes later pursued a Masters of Public Health degree at the Mailman School of Public Health at Columbia University, with an emphasis on Biostatistics. He has been a collaborator at the Hood Vision Lab with Donald Hood, PhD for the past 10 years. He is a glaucoma attending at the Edward S. Harkness Eye Institute at Columbia University Medical Center, New York.

His primary research interests are risk factors for glaucoma progression and novel techniques for glaucoma diagnosis, monitoring, and treatment. He was Principal Investigator on an NEI/NIH funded project investigating progression of glaucomatous damage to the macula from 2015 to 2018. He is a member of Columbia University's Institutional Review Board (IRB). Dr. De Moraes recently co-chaired two sections of the World Glaucoma Association's Consensus Meetings on Glaucoma Diagnosis and Progression.

Y. Shira Kresch OD, MS, FAAO is a primary care optometrist who specializes in the non-surgical treatment and management of glaucoma as well as myopia control. After obtaining her BS in Nutrition and Food Science from Wayne State University Honors College with a co-major in University Honors, she received her OD/MS degrees from the State University of New York and completed her residency in primary care and ocular disease at the NY VA Harbor Healthcare System under the supervision of Dr. Murray Fingeret and Dr. Evan Canellos. Following residency, Dr. Kresch underwent further training with Dr. Jeffrey Liebmann and Dr. Jack Cioffi in the glaucoma service at Columbia University Medical Center where she is currently an Instructor of Optometric Sciences in Ophthalmology and the clinic lead of the myopia control clinic. In addition to her clinical work, Dr. Kresch pursues research in the areas of early detection of glaucoma and technological advances in patient education.

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