How Not to Miss Progression in Glaucoma: The Golden Rules

Developed in collaboration

Med-IQ DukeHealth

Learning Objective

Upon completion, participants should be able to:

- Identify a set of 5 simple rules for monitoring patients with glaucoma

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1

Test Both Structure and Function Over Time

Special Issue

IOVS 2016 Jul 1;57(9):OCT421-8.

The Relative Odds of Progressing by Structural and Functional Tests in Glaucoma

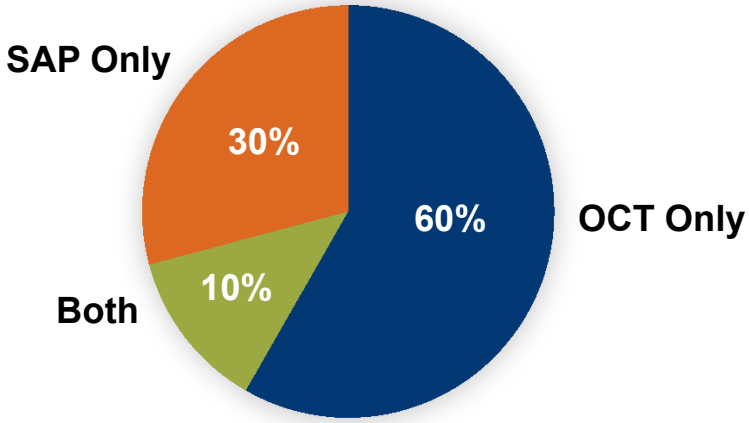
Ricardo Y. Abe, Alberto Diniz-Filho, Linda M. Zangwill, Carolina P. B. Gracitelli, Amir H. Marvasti, Robert N. Weinreb, Saif Baig, and Felipe A. Medeiros

- 462 eyes followed for 3.6 ± 0.9 years with SD-OCT and SAP 24-2 (median of 8 tests)

PROGRESSION FLAGGED ONLY IF RATE OF CHANGE WAS FASTER THAN THAT OF 95% OF HEALTHY EYES

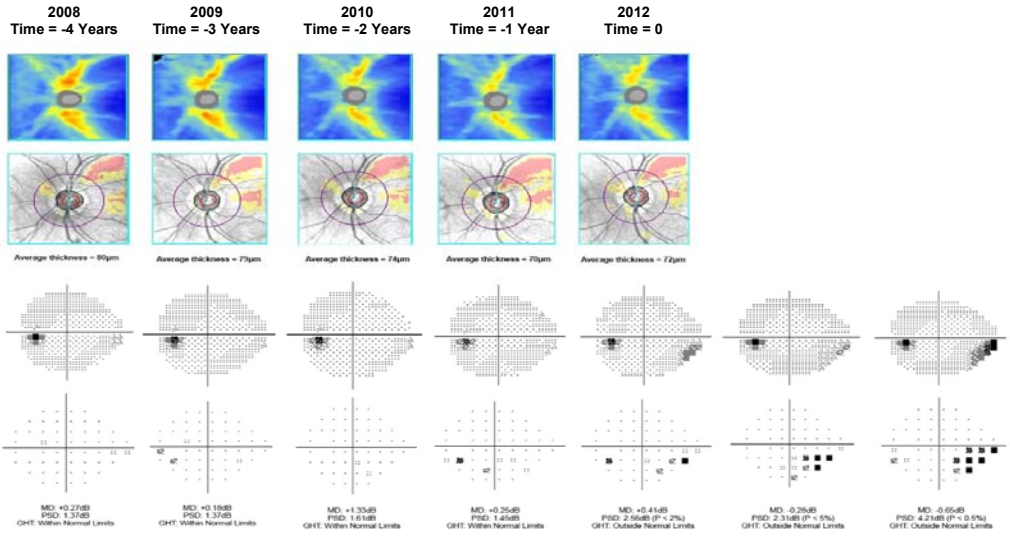
Abe RY, et al. *Invest Ophthalmol Vis Sci*. 2016;57:OCT421-8.

Glaucoma Progression: OCT Versus SAP



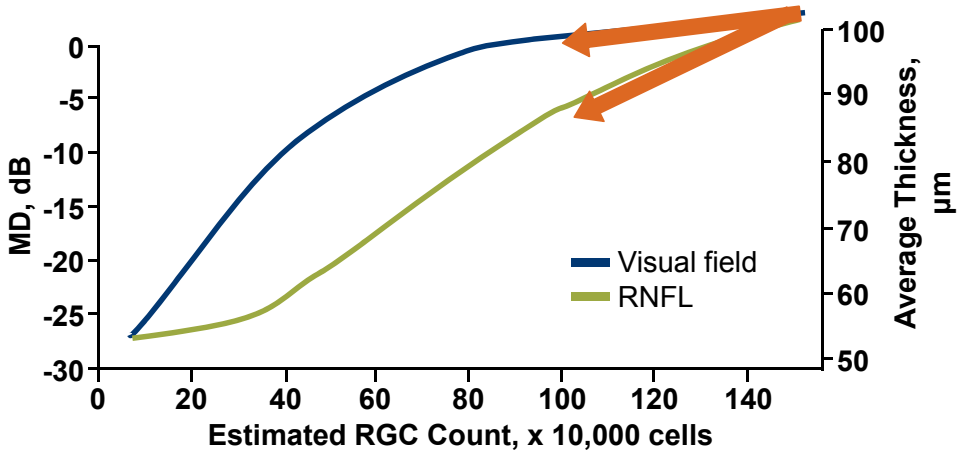
Abe RY, et al. *Invest Ophthalmol Vis Sci.* 2016;57:OCT421-8.

Progression in Early Glaucoma



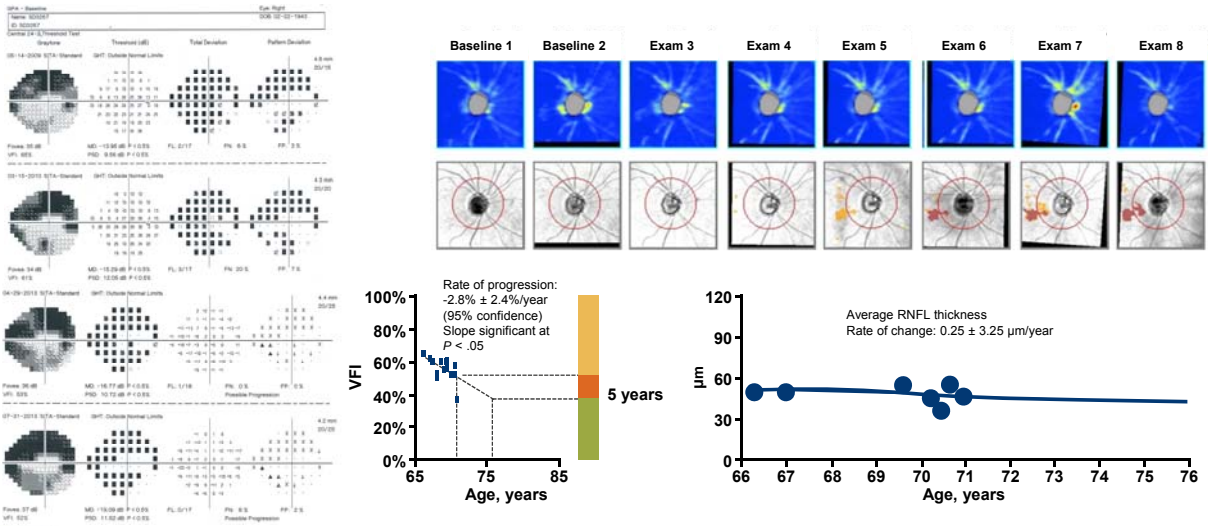
Courtesy of Dr. Medeiros (unpublished data).

Relationship Between RGC Counts, MD, and RNFL Thickness



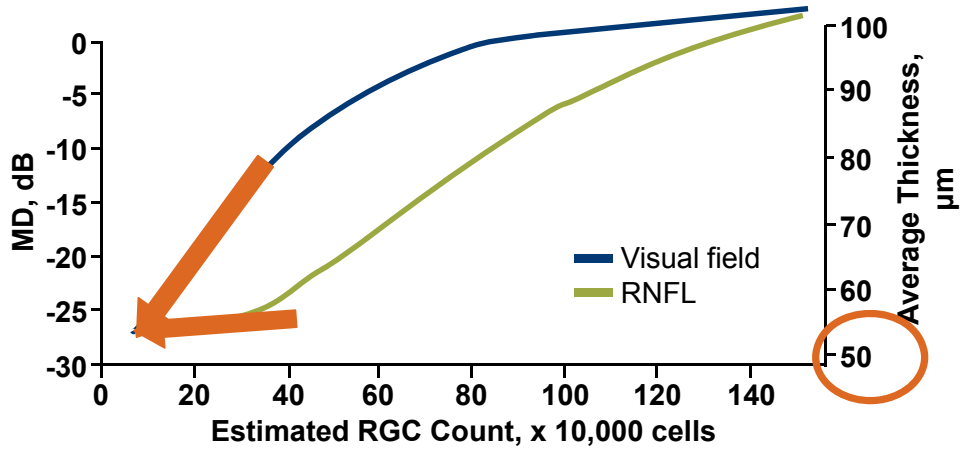
Medeiros FA, et al. *Invest Ophthalmol Vis Sci.* 2012;53:6939-46.

Progression in Advanced Glaucoma



Courtesy of Dr. Medeiros (unpublished data).

Relationship Between RGC Counts, MD, and RNFL Thickness



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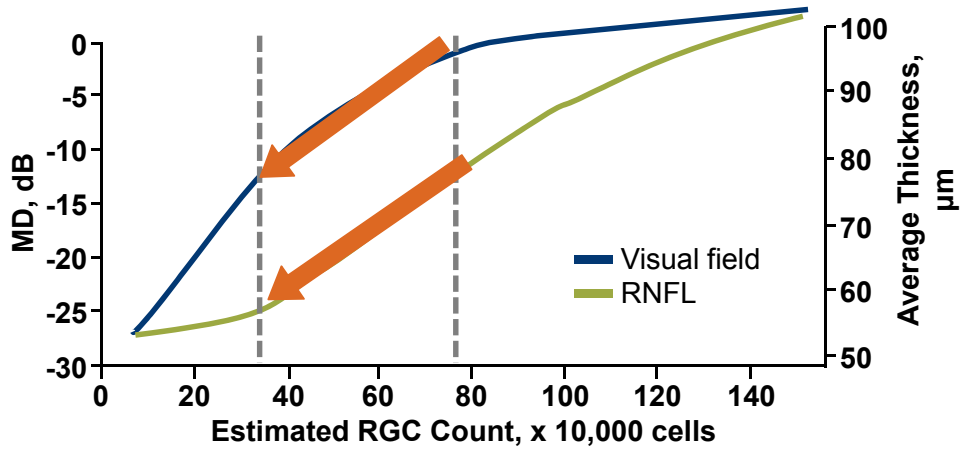


Medeiros FA, et al. *Invest Ophthalmol Vis Sci.* 2012;53:6939-46.

2

Use Trend-Based Analysis

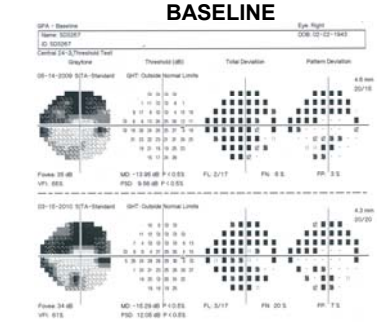
Why Use Trend-Based Analysis?

- Simple, straightforward method
- Most eyes with clinically relevant progression will be detected by trend-based analysis
- Rate of change is the most important parameter that determines treatment

Weinreb RN, et al. *JAMA*. 2014;311:1901-11.

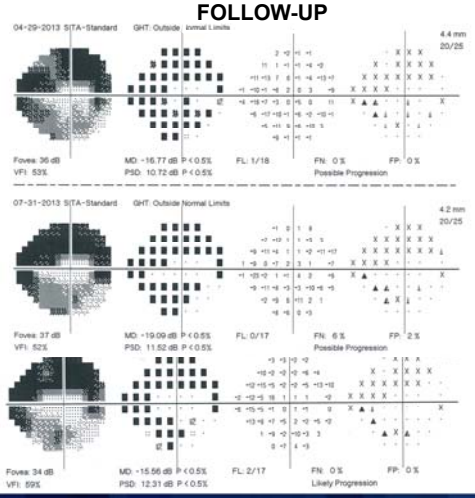
Assessing Rate of Change

BASELINE



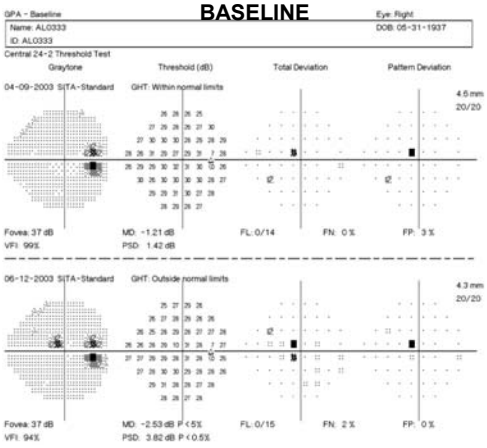
Courtesy of Dr. Medeiros (unpublished data).

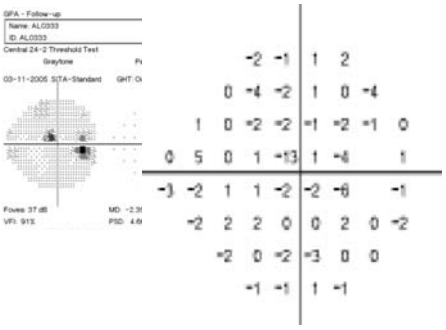
FOLLOW-UP



GPA Misses Progression in This Case

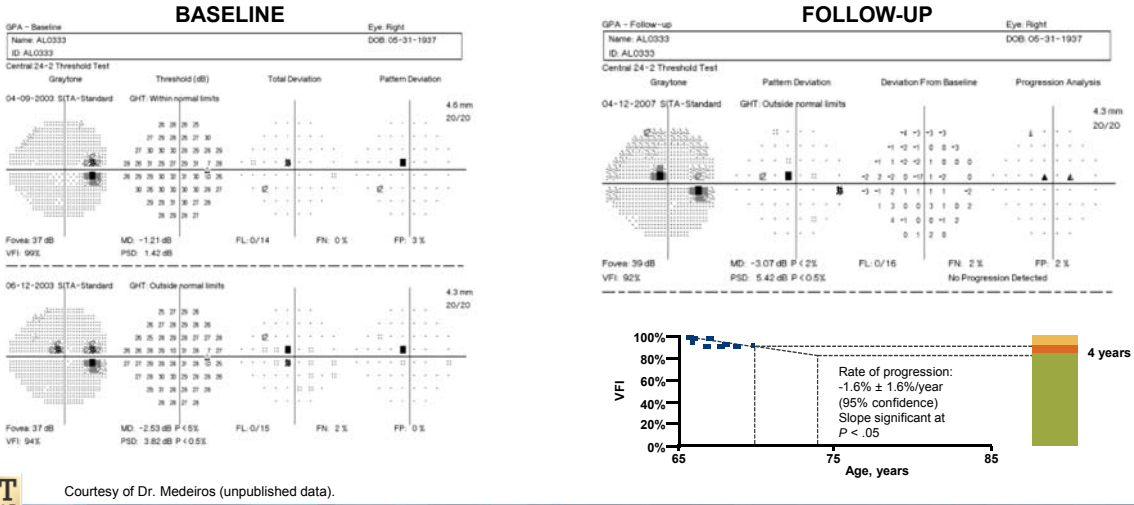
BASELINE





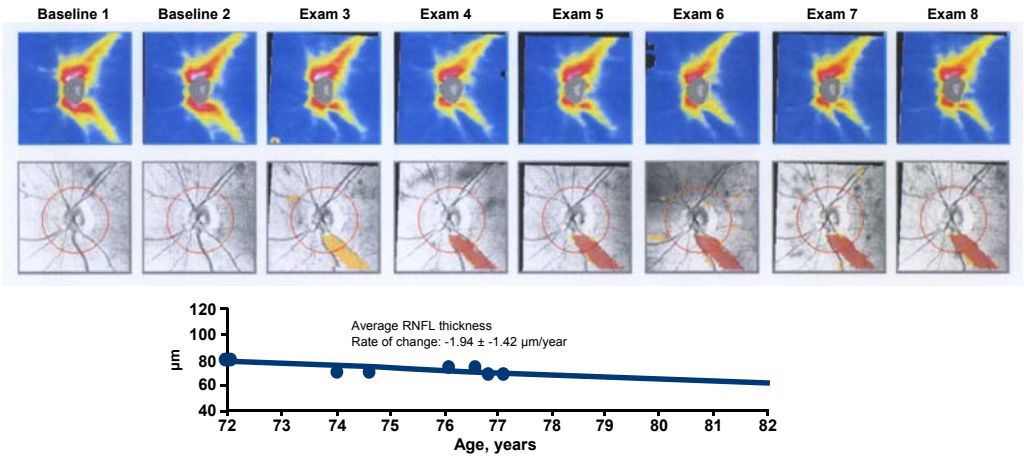
Courtesy of Dr. Medeiros (unpublished data).

GPA Misses Progression in This Case (cont.)



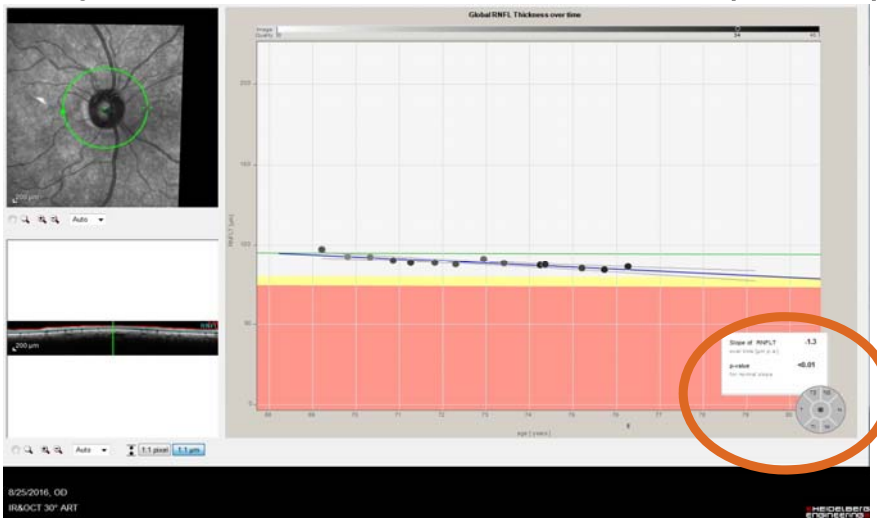
Courtesy of Dr. Medeiros (unpublished data).

Trend Analysis of RNFL Thickness



Courtesy of Dr. Medeiros (unpublished data).

Trend Analysis of RNFL Thickness (cont.)



Courtesy of Dr. Medeiros (unpublished data).

3

Take Aging Into Account

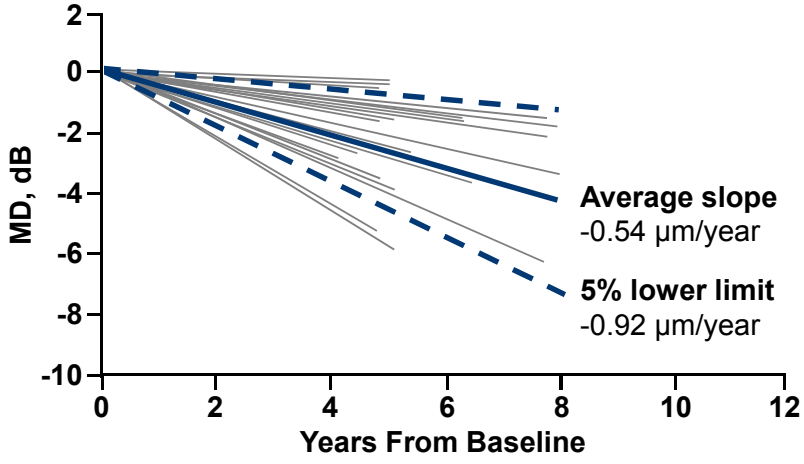
Wu Z, et al. *Am J Ophthalmol.* 2017;181:106-13.

How to Take Aging Into Account?

- Trend analysis of MD or VFI already incorporate aging
- How do we take aging into account when assessing OCT progression?

Wu Z, et al. *Am J Ophthalmol*. 2017;181:106-13.

Estimated Rates of RNFL Thickness Change for Each Eye Over Time



Wu Z, et al. *Am J Ophthalmol*. 2017;181:106-13.

How to Take Aging Into Account?

- A rate of change in average RNFL thickness faster than -1.0 µm/year is likely clinically significant
- Need enough tests to estimate the rate with confidence!

Wu Z, et al. *Am J Ophthalmol*. 2017;181:106-13.

4

Test 2 Times Per Year

Chauhan BC, et al. *Invest Ophthalmol Vis Sci*. 2014;55:4135-43.

How Frequently Should We Conduct Visual Field Tests?

Practical recommendations for measuring rates of visual field change in glaucoma

B C Chauhan,[1] D F Garway-Heath,[2] F J Goñi,[3] L Rossetti,[4] B Bengtsson,[5] A C Viswanathan,[2] A Heijl[5]

Br J Ophthalmol 2008

Chauhan BC, et al. *Br J Ophthalmol*. 2008;92:569-73.

Table 1 Time period (years) required to detect various rates of MD change with 80% power in visual fields with low, moderate and high degrees of variability with one (a), two (b) and three (c) examination per year

(a) 1 examination/year	Variability		
Progression rate (dB/year)	Low	Moderate	High
−0.5		13	
(b) 2 examinatio			
Progression rate			High
−0.5			
(c) 3 examinations/year	Variability		
Progression rate (dB/year)	Low	Moderate	High
−0.5		4.3	

FALSE!

It assumes that doubling the test frequency halves the time to detect progression

Suggested 3 tests per year

Chauhan BC, et al. *Br J Ophthalmol*. 2008;92:569-73.

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Frequency of Testing to Detect Visual Field Progression Derived Using a Longitudinal Cohort of Glaucoma Patients

Zhichao Wu, BAppSc(Optom), PhD, Luke J. Saunders, PhD, Fábio B. Daga, MD, Alberto Diniz-Filho, MD, PhD, Felipe A. Medeiros, MD, PhD

- 1,072 eyes with glaucoma followed over time
- 2 tests per year is a good compromise considering benefits/costs of testing
- Decreasing gains with increased number of tests

Wu Z, et al. *Ophthalmology*. 2017;124:786-92.

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Time Period (Years) Required to Detect Various Rates of Visual Field MD Change

	Time to Detect, Years
	Power*
One test/year	
-0.50 dB/year	7.3
Two tests/year	
-0.50 dB/year	5.7
Three tests/year	
-0.50 dB/year	5.0

*80%.

Wu Z, et al. *Ophthalmology*. 2017;124:786-92.

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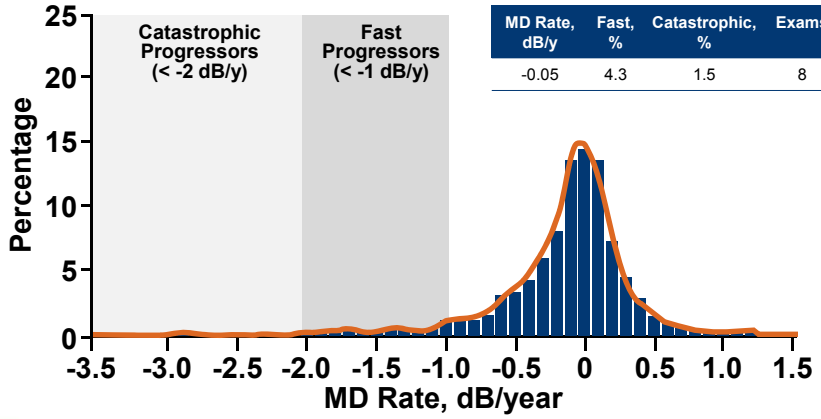
5

Look at Risk Factors

Chauhan BC, et al. *Invest Ophthalmol Vis Sci*. 2014;55:4135-43.

REMEMBER:
The Default Is No Progression



MD Rate, dB/y	Fast, %	Catastrophic, %	Exams	Follow-Up, y	Age, y	IOP, mm Hg	Baseline MD, dB
-0.05	4.3	1.5	8	7.1	65	17.1	-2.44

Chauhan BC, et al. *Invest Ophthalmol Vis Sci*. 2014;55:4135-43.

Predictors of Long-term Progression in the Early Manifest Glaucoma Trial

M. Cristina Leske, MD,MPH,[1] Anders Heijl, MD,PhD,[2] Leslie Hyman, PhD,[1] Boel Bengtsson, PhD,[2] LiMing Dong, PhD,[1] Zhongming Yang, PhD,[1] EMGT Group*

The Ocular Hypertension Treatment Study

ARCHIVES EXPRESS

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

Mae O. Gordon, PhD; Julia A. Beiser, MS; James D. Brandt, MD; Dale K. Heuer, MD; Eve J. Higginbotham, MD; Chris A. Johnson, PhD; John L. Keltner, MD; J. Philip Miller, AB; Richard K. Parrish II, MD; M. Roy Wilson, MD; Michael A. Kass, MD; for the Ocular Hypertension Treatment Study Group

Predictive Factors for Open-Angle Glaucoma among Patients with Ocular Hypertension in the European Glaucoma Prevention Study

European Glaucoma Prevention Study (EGPS) Group*

Higher IOP
Thin corneas
Pseudoexfoliation
Disc hemorrhage

Canadian Glaucoma Study

2. Risk Factors for the Progression of Open-angle Glaucoma

Balwantray C. Chauhan, PhD; Frederick S. Mikelberg, MD; A. Gordon Balaszi, MD; Raymond P. LeBlanc, CM, MD; Mark R. Lesk, MSc, MD; Graham E. Trope, MB, PhD; for the Canadian Glaucoma Study Group

Leske MC, et al. *Ophthalmology*. 2007;114:1965-72; Gordon MO, et al. *Arch Ophthalmol*. 2002;120:714-20; European Glaucoma Prevention Study Group, et al. *Ophthalmology*. 2007;114:3-9; Chauhan BC, et al. *Arch Ophthalmol*. 2008;126:1030-6.

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We Treat Individuals, Not Averages!

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How Not to Miss Progression: The Golden Rules

- Test both structure and function over time: OCT and visual fields
- Use trend-based analysis: MD/VFI and average RNFL thickness
- Take aging into account: faster than -1.0 µm/year is relevant
- Test 2 times per year
- Look at risk factors: high IOP, thin central corneal thickness (< 520 µm), pseudoexfoliation, disc hemorrhage

REMEMBER: The default is no progression

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Contact Information

Call (toll-free) 866 858 7434
E-mail info@med-iq.com

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Abbreviations and Acronyms: Progression in Glaucoma

FL = fixation loss
FN = false-negative
FP = false-positive
GHT = Glaucoma Hemifield Test
GPA = glaucoma progression analysis
IOP = intraocular pressure
MD = mean deviation
PSD = pattern standard deviation
RGC = retinal ganglion cell
RNFL = retinal nerve fiber layer
SAP = standard automated perimetry
SD-OCT = spectral-domain optical coherence tomography
SITA = Swedish Interactive Threshold Algorithm
VFI = visual field index