


On behalf of Vision Expo, we sincerely thank you for being with us this year.


Vision Expo Has Gone Green!

We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Education Planning Committee considers content and speakers for future meetings to provide you with the best education possible.



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Corneal Hysteresis A Vital Piece to The Glaucoma Puzzle



Justin Schweitzer, OD, FAAO
Nathan M. Radcliffe, MD

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Financial Disclosure – Justin Schweitzer, OD, FAAO

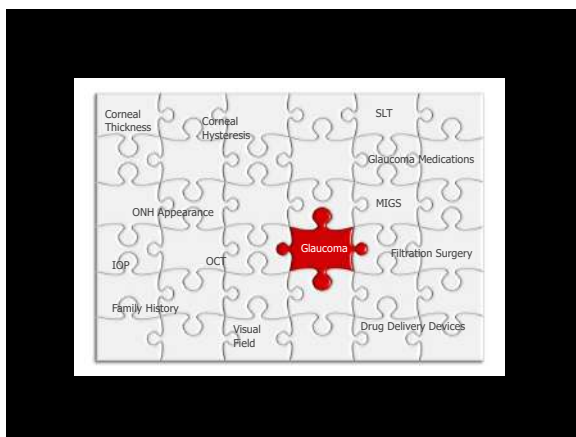
<ul style="list-style-type: none">• Aerie – C/L• Alcon – C/L• Allergan – C/L• Bausch + Lomb – C/L• Ocular Therapeutix - C• EyePoint – C• Sight Sciences – C/L• Dompé – C• Zeiss – C/L• Vistus - C• Science Based Health – C• Kala – C• RVL - C	<ul style="list-style-type: none">• Sun – C/L• Equinox - I• Reichert – C• JBU – C/L• Glaukos – C/L• Heitman – C• Quidel – C• MedPrint – C• IXC – C/L• Avellino – C• Novartis – C• Iveric bio – C• Occuphire - C
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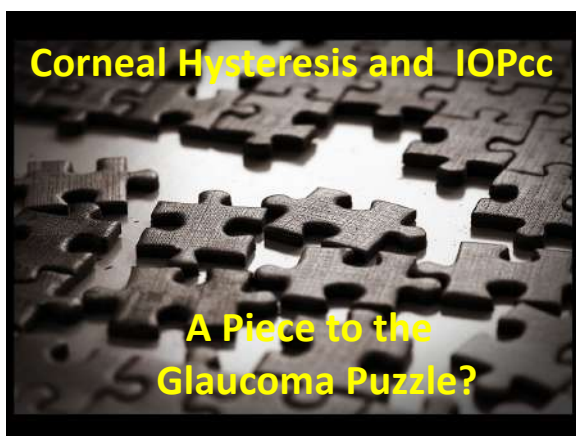
Financial Disclosures: Nathan Radcliffe

Aerie Pharmaceuticals, Inc.	CL
Alcon Laboratories, Inc.	CL
Alkermes Therapeutics, Inc.	C
Almac Sciences, Inc.	CL
Allergan, Inc.	CLIS
Astellera Labs	C
Bausch + Lomb	CL
Beaver-Visitec International, Inc.	C
BEHRM Laser Ltd	C
Carl Zeiss Meditec	C
Dorpare	C
Essi-Vision	CSD
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EyePoint Pharmaceuticals	CL
Galvus Corporation	CL
ImpinaPhx	C
IREX	C
Invision	C
Ivoric Bio	C
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Novartis Pharma AG	CL
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Omnios Corporation	C
Oxus Pharmaceuticals	C
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Rayner	CL
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Santara, Inc.	C
Shire	CSD
Spectra Pharma	CSD
Talus Pharmaceuticals	C
Tecolcar	CSD
TIBA	C
Valuse Inc.	CSD

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Influences on IOP Measurement

CCT
Post-Refractive
Time of Day
Medications

Physical Activity and Posture

10

CCT-based IOP Adjustment is not Advisable

"Correction nomograms that adjust GAT IOP based solely on CCT are neither valid nor useful in individual patients"

- Dr. IR. Robert N. Weinreb, James D. Brandt, David Garway-Heath and Felipe Medeiros
World Glaucoma Association on Intraocular Pressure; Consensus Series 4; May 5, 2007

Adjusting Intraocular Pressure for Central Corneal Thickness Does Not Improve Prediction Models for Primary Open-Angle Glaucoma

From OHTS

James D. Brandt, M.D.,¹ Hae D. Gerton, PhD^{2,3}, Peng Gao, PhD², Julia A. Serran, M.S., J. Philip Miller, A.B.,⁴ and Michael A. Kass, M.D.¹ for the Glaucoma Hypertension Treatment Study Group

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When gold standards change: time to move on from Goldmann tonometry?

Gus Gazzard,^{1,2} Hari Jayaram ,^{2,3} Ana M Roldan ,⁴ David S Friedman⁵

Br J Ophthalmol: 10.1136/bjophthalmol-2020-317112 24 September 2020

"Why are we persisting in using GAT clinically? The test itself is relatively time consuming, physicians often repeat the measurement because they cannot fully trust a technician, it slows down the clinic requiring technical staff to have slit lamps and place drops in patient's eyes and worse, it may be giving us a false sense of security."

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Reducing the Corneal effect on Measured IOP

ORA's Patented IOPcc

ORA derived Corneal biomechanical information, which gives us Corneal Hysteresis, is also used to quantify (and reduce) the impact of these properties on the IOP measurement.

IOPcc: a pressure measurement that is less affected by corneal properties than other methods of tonometry, such as Goldmann (GAT).

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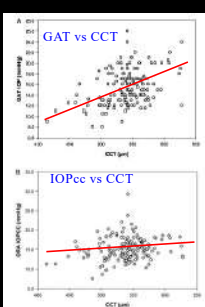
Clinical Study

Evaluation of the Influence of Corneal Biomechanical Properties on Intraocular Pressure Measurements Using the Ocular Response Analyzer

Edgar A. Medeiros, MD and Robert N. Weinreb, MD

J Glaucoma 2006;15:364-370

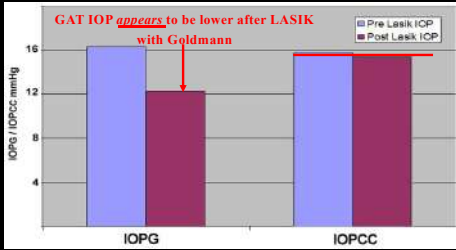
Parameter	Mean ± Standard Deviation	Range
CCT (µm)	538 ± 35	414-627
Corneal curvature (mm)	7.74 ± 0.53	7.05-9.04
Axial length (mm)	23.82 ± 1.06	20.92-26.70
GAT IOP (mm Hg)	15.3 ± 3.5	8.0-24.0
ORA IOPcc (mm Hg)	15.2 ± 3.0	7.4-29.1
CRF (mm Hg)	9.47 ± 1.75	4.68-14.4



Evaluation of the Influence of Corneal Biomechanical Properties on Intraocular Pressure Measurements Using the Ocular Response Analyzer. Edgar A. Medeiros, MD and Robert N. Weinreb, MD. *J Glaucoma* 2006;15:364-370.

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IOPcc Little influence from refractive surgery



29 eyes pre and post LASIK. Data courtesy Dr. David Castelfano, MD / Dr. Jay Pepose, MD

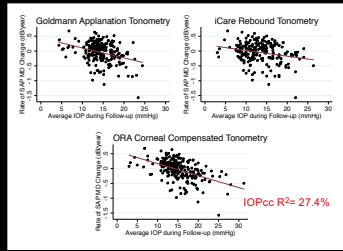
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Association between Rates of Visual Field Progression and Intraocular Pressure Measurements Obtained by Different Tonometers

Bianca N. Susanna, Nara G. Ogata, MD, Fábio B. Daga, MD, Caroline N. Susanna, Alberto Diniz Filho, MD, PhD, Felipe A. Medeiros, MD, PhD

GAT R²= 12.8%



iCare R²= 6.5%

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The Correcting Applanation Tonometer Surface (CATS)



British Journal of Ophthalmology

Modified Goldmann prism intraocular pressure measurement accuracy and correlation to corneal biomechanical metrics: multicentre randomised clinical trial

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The Correcting Applanation Tonometer Surface (CATS)

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Corneal Hysteresis (CH)

Corneal Hysteresis reflects the ability of the corneal tissue to dissipate energy¹
 Function of viscoelastic damping²

Provides insight into ocular properties that were not previously understood or conceived of

1. Luce DA. J Cataract Refract Surg. 2005;31:156-162.
 2. Dupps WJ 3rd. J Cataract Refract Surg. 2007;33:1499-1501.
 3. Glass DH et al. Invest Ophthalmol Vis Sci. 2008;49:3919-3926.

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Intro to Corneal Hysteresis

Viscoelastic tissue with complex, interconnected microstructure

Geometrical attributes are not a surrogate for biomechanical properties

The eye appears to be a mechanical structural continuum

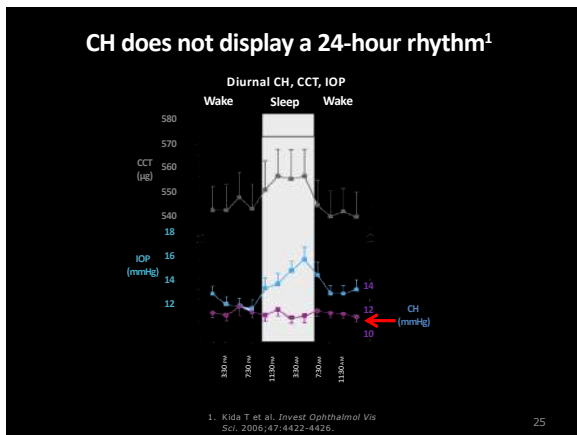
More than 13,000 + papers published on hysteresis

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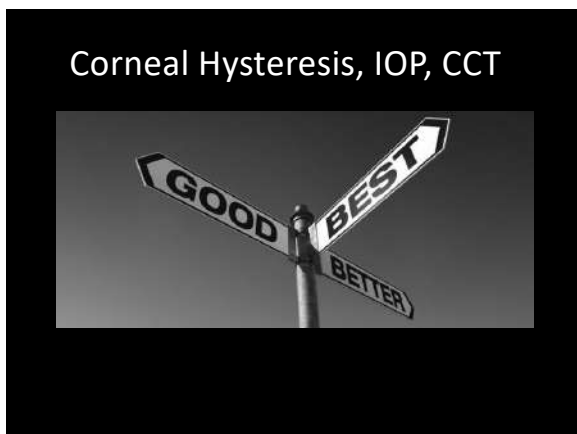
Average CH in Normal Subjects

	N	CH
Brazil	105	10.1 +/- 1.8
UK	272	10.2 +/- 1.2
China	125	10.9 +/- 1.5
Japan	204	10.2 +/- 1.3
Spain	88	10.8 +/- 1.5
USA	44	10.5 +/- 1.2

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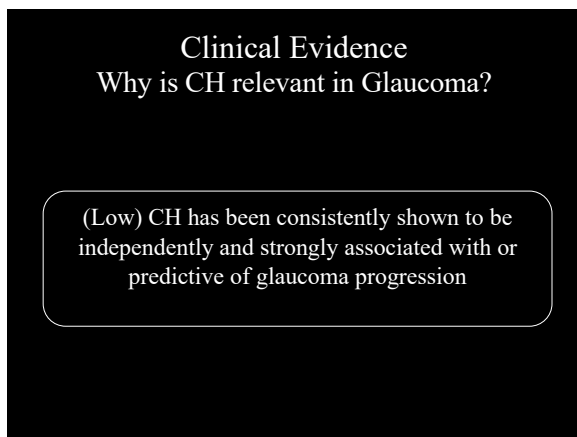
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Corneal Hysteresis in Glaucoma
Association with Progression in a Retrospective Study

	OR	LCL	UCL	P-value
Age per year <65	1.12	1.01	1.24	.03
Age per year >65	1.08	1.01	1.15	.02
GAT IOP per mmHg	1.22	0.95	1.58	.12
Treatment	1847.6	3.16	10 ⁶	.02
IOP by treatment interaction	0.79	0.61	1.03	.08
CCT per 100 microns	1.65	0.66	0.58	.30
Years with glaucoma	1.00	0.96	1.04	.98
Baseline IOP	0.99	0.93	1.06	.79
CH per mmHg	0.81	0.66	0.98	.03

- 230 POAG or suspected POAG patients were included in the study
- 3 years or more FU
- Minimum 5 VF exams

Conclusions: Corneal Hysteresis was the parameter most associated with progressive field worsening

Geigley NG et al. Am J Ophthalmol. 2006;141:868-875.

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Ophthalmology, 2013 Aug;120(8):1533-40. doi: 10.1016/j.ophtha.2013.07.032. Epub 2013 May 1.

Corneal hysteresis as a risk factor for glaucoma progression: a prospective longitudinal study.

Medeiros FA¹, Meiri-Finkel D, Libassi R, Kuang TM, Zanotti LM, Weinstock RS.

① **Author Information**

Abstract

PURPOSE: To evaluate the role of corneal hysteresis (CH) as a risk factor for the rate of visual field progression in a cohort of patients with glaucoma followed prospectively over time.

DESIGN: Prospective observational cohort study.

PARTICIPANTS: The study group included 114 eyes of 68 patients with glaucoma followed for an average of 4.0 ± 1.1 years. Visual fields were obtained with standard automated perimetry. Included eyes had a median number of 7 (range, 5-12) tests during follow-up.

METHODS: The CH measurements were acquired at baseline using the Ocular Response Analyzer (Reichert Instruments, Depew, NY). Evaluation of rates of visual field change during follow-up was performed using the visual field index (VFI). Linear mixed models were used to investigate the relationship between rates of visual field loss and baseline CH, baseline intraocular pressure (IOP), and central corneal thickness (CCT), while adjusting for potentially confounding factors. An interaction term between IOP and CH was included in the model to investigate whether the effect of IOP on rates of progression depended on the level of CH.

MAIN OUTCOME MEASURES: Effects of CH, IOP, and CCT on rates of VFI loss over time.

RESULTS: The CH had a significant effect on rates of visual field progression over time. In the univariable model including only CH as a predictive factor along with time and their interaction, each 1 mmHg lower CH was associated with a 0.25%/year faster rate of VFI decline over time (P=0.001). The multivariable model showed that the effect of IOP on rates of progression depended on CH. Eyes with high IOP and low CH were at increased risk for having fast rates of disease progression. The CH explained a larger proportion of the variation in slopes of VFI change than CCT (17.4% vs. 5.2%, respectively).

CONCLUSIONS: The CH measurements were significantly associated with risk of glaucoma progression. Eyes with lower CH had faster rates of visual field loss than those with higher CH. The prospective longitudinal design of this study supports the role of CH as an important factor to be considered in the assessment of the risk of progression in patients with glaucoma.

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CH as a Predictor of Progression

114 POAG eyes followed at 6 month intervals for 4 years.

CH was 2x more predictive of VF progression than GAT and 3X more predictive than CCT

Note - NO rapid progressors in CH ≥10 mmHg group!

The prospective longitudinal design of this study supports the role of CH as an important factor to be considered in the assessment of risk for glaucoma progression

Medeiros FA, et al. *Ophthalmology*. 2013;120:1533-1540.

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CH as a Predictor of Progression

Medeiros FA, et al. *Ophthalmology*. 2013;120:1533-1540.

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AMERICAN ACADEMY OF OPHTHALMOLOGY

Corneal Biomechanics and Visual Field Progression in Eyes with Seemingly Well-Controlled Intraocular Pressure

Rama N. Srinivasan, MD,^{1,2,3} Nima G. Oghes, MD,⁴ Alejandro A. Javal, MD,¹ Carolina N. Sosa, MD,^{1,2,3}
Samuel I. Barkan, PhD,^{1,2} Felipe A. Molino, MD, PhD¹

460 eyes of 334 glaucoma patients
Follow-up – 4.3 years
Well controlled if IOP < 18 mm HG

CH (8.6 vs 9.4)
CCT (515 vs 531)

179 eyes well controlled
42 (23.5%) of those eyes had VF progression

68% higher risk of progression

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Ocular Response Analyzer Corneal Hysteresis

92145

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Clinical Cases

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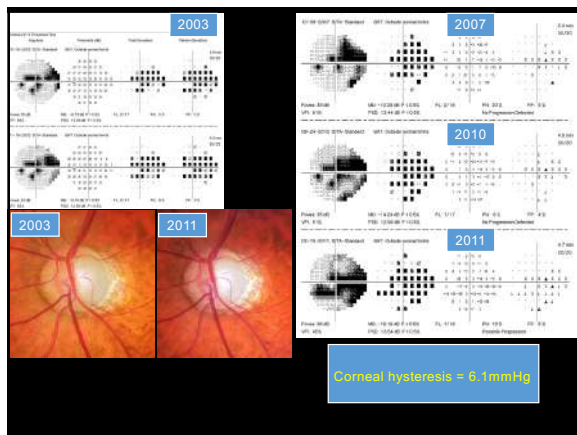
Clinical Case 1
Slow Progression Despite IOP control

62 yr old, male, with diagnosis of POAG

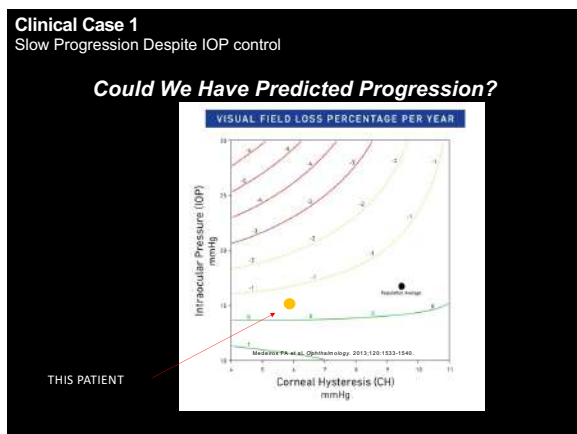
Currently on maximum tolerated medical therapy and having undergone 2 sessions of laser trabeculoplasty

- BCVA: 20/20 OU
- Biomicroscopy: normal
- GAT IOP: 13mmHg to 15mmHg on maximum tolerated medical therapy
- Corneal thickness: 545µm OD
541µm OS

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Clinical Case 2
High IOP "non-responder" with High CH

73 y/o Caucasian Female diagnosed with OHTN 3 years prior by outside provider

Sister also being followed for glaucoma but not being treated

Meds: Bystolic, Pravastatin, MVI

Ocular Meds: Latanaprost qhs

Tmax: 26 mmHg OU

Medicated IOP: 21 mmHg ou on multiple visits

CCT: 558 OD 562 OS

CH: 11.6 OD 12.3 OS

Healthy RNFL, C/D 0.65 OD 0.6 OS, no disc heme or beta zone atrophy

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Clinical Case 2
High IOP "non-responder" with High CH

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Clinical Case 2
High IOP "non-responder" with High CH

What is your diagnosis?

- POAG?
- OHTN?

Does she need to be treated?

- CH is high
- Healthy RNFL

THIS PATIENT

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What did we do?

- Stopped latanoprost - IOP stable at 25-26 mmHg ou meds
- VF stable last year+
- ONH stable
- OCT Stable

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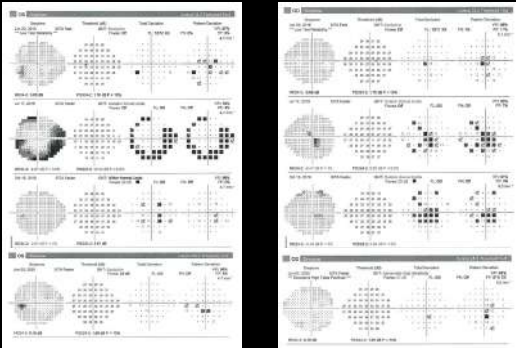
Case 3: Patient CT (65 YO Caucasian male)

CC: Glaucoma Followup
PmHx: Hyperlipidemia
FeHx: Unremarkable
Medications: Lipitor
Topical Medications: latanoprost 0.005% qhs OU

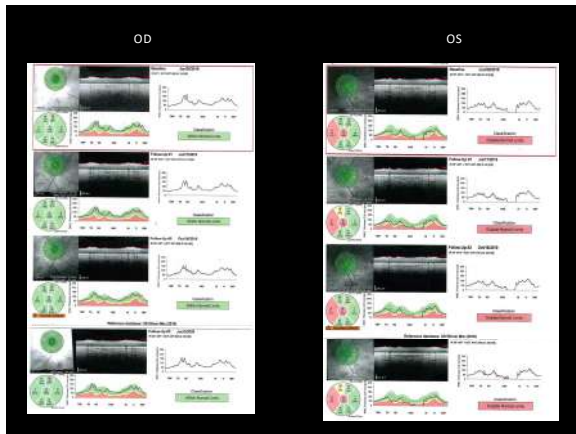
Tmax IOP: 28 mmHg OU
Current IOP: 22 mm HG OD, 23 mm HG OS
Corneal Hysteresis: 10.1 OD, 11.3 OS
Pach: 545 OU
Gonioscopy: Open to CB, no pigment present in TM
SLE: Unremarkable, except for well centered IOL's

ONH: C/D OD: 0.70/0.70 C/D OS: 0.75/0.75

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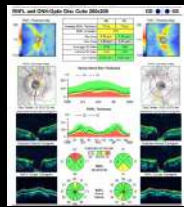


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Would you treat SK?

Case Data:

- Age: 70 year old man presents
- IOPs (GAT): 28 mmHg OU
- CCT: 545 microns
- VF: Full (PSD 1.4)
- OCT: borderline, some thinning
- VCDR: 0.7
- Corneal Hysteresis: not available

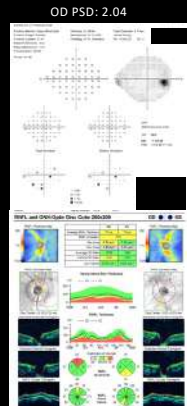


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SK progress: 5 years later...

- Been on 3 topical agents (PGA, b-blocker and CAI)
- IOP (GAT): still 24 mmHg!
- VF: No progression in 5 years

- Old Plan: Consider Surgery
- However... (see next slide)



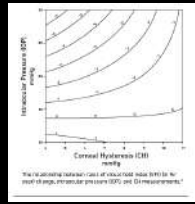
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SK progress: 5 years later...

CH = 13 mmHg

New Treatment Plan:

Continue medical therapy with ongoing monitoring of HVF and OCT



Source: Corneal Hysteresis as a Risk Factor for Glaucoma Progression: A Prospective Longitudinal Study. Ophthalmology, Aug. 2013; Moore, Hiroe

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Summary & Considerations of SK Case

SUMMARY

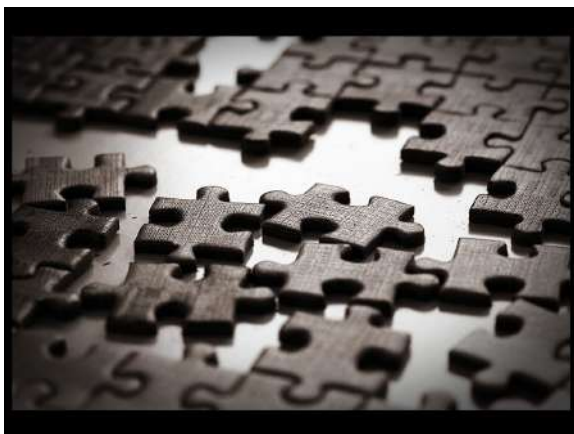
- High risk OHTN, IOP: 28 mmHg
- CCT average: 545 microns
- Patient's IOP not much lower with treatment
- No progression in 5 years
- High Corneal Hysteresis may have predicted this

CONSIDERATIONS

What might have been done differently if Corneal Hysteresis was known 5 years ago?

How might knowing Corneal Hysteresis today change management going forward?

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Thank You!

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