

Glaucoma Management Glaucoma Advances and Updates



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Disclosure

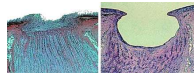
- Sanofi Speaker
- Innova System Consultant
- EyePromise Employee

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"All relevant financial relationships have been mitigated"

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Glaucoma an epidemic/ endemic

- ▶ Glaucoma in USA about **3 million**;
- ▶ Ocular hypertensive 4.5% of population >40 age
 - ▶ **Reaches 8% in people aged ≥ 80 yr**
- ▶ Glaucoma suspects 4 times more than glaucoma
- ▶ worldwide 76 million 2020 ; 111.8 by 2040
- ▶ African Americans have a four times greater risk than Caucasians.



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Diagnosis

- ▶ 50% undiagnosed
- ▶ Over diagnosed in clinics
- ▶ How can it be both?

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Intraocular pressure



Diagnosis- not helpful



Treatment- only proven method



Progression- very closely associated with IOP



Risk factor- without a doubt most important risk factor



In fact, the only alterable risk factor!

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Ocular Response Analyzer

- ▶ IOPG - Goldmann Correlated IOP
- ▶ IOPCC - Corneal Compensated IOP
- ▶ CH - Corneal Hysteresis



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A Comparative Study of the Hand-held IC200 and Slit Lamp-mounted ST500 rebound tonometers with Goldmann Applanation Tonometry

Ryo Tomita MD¹, Glen P. Sharpe MSc¹, Devin Betsch MD¹, Rodolfo Bonatti MD¹, Belwanray C. Chauhan PhD^{1,2,3,4}

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<https://doi.org/10.1016/j.ajgl.2024.10.008>

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Excellent intraclass correlations

- 156 participants
- Age 45-72 years
- Average CCT 553 microns
- IOP range GAT 8.5-53 mmHg
- Median IOP 17.1

Conclusions: The ST500 shows **good agreement** with GAT over a large range of IOP and significantly higher repeatability compared to the IC200 and GAT, suggesting it may be advantageous in clinical settings where topical anesthesia or skilled staff are unavailable.

Ophthalmol Glaucoma. 2024 Nov 30;5(2):41962406219-1. doi: 10.1016/j.ajgl.2024.11.008. Online ahead of print.

Agreement between the iCare HOME tonometer and the Goldmann Applanation Tonometry in the assessment of the Peak Intraocular Pressure in the Water-Drinking Test

Carolina N. Susanna¹, Fernanda N. Susanna², Laura Goldfarb Cyrino³, Renato Antunes Schiavo Germano⁴, Bruno Susanna Jr.⁵, Pradheep Y. Ramulu⁶, Marcelo Hatanaka²

Affiliations + expand

PMID: 39620413 | DOI: 10.1016/j.ajgl.2024.11.008

Results: The agreement between iCare and Goldmann Applanation Tonometer was high during the WDT: the intraclass correlation coefficient (i) between the two methods from basal to 45 min: 0.94 (p < 0.001), at basal: 0.91 (p < 0.001), at 15 min: 0.94 (p < 0.001), at 30 min: 0.94 (p < 0.001), at 45 min: 0.95 (p < 0.001) and for peak IOP: 0.94 (p < 0.001). There was no significant difference between peak IOP with GAT and iCare 18.3 ± 4.6 (I0-33) and 18.5 ± 5.0 (I0-33) (p = 0.533), nor between the delta of fluctuation between basal and peak IOP with GAT and iCare 3.96 ± 3.22 and 4.54 ± 3.52 (p = 0.054).

Conclusion: Our study demonstrated a **high agreement** between iCare HOME and Goldmann Applanation Tonometer during the WDT in a clinical environment with supervision.

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Rebound tonometer

- ▶ When to use? - Screenings
- ▶ Why?
- ▶ When not to use? Glaucoma patients except for childhood glaucoma
- ▶ Concerns ?
 - ▶ Can't be used when wearing contact lenses

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Disposable tips- Goldmann tonometer

- ▶ 10% Bleach soak 5-minutes and wash with water and let dry...effective against most microbes
- ▶ No disinfectant technique works against prions.



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Disposable CATS tonometer probe FDA approved

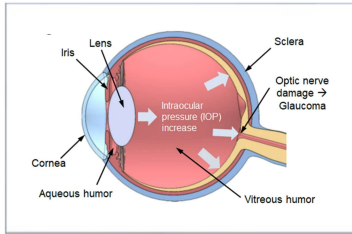


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Intraocular Pressure (IOP) Target Ranges Staging of disease

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Intraocular pressure



Overview^[a,b]

- Imbalance between production and drainage of aqueous humor
- IOP > 21 mm Hg is considered elevated
 - Most important known risk factor for OH and POAG
- All current treatments target IOP levels
- Patients with POAG should be offered lifelong control of IOP
 - Require monitoring of optic nerve appearance and visual function

a. Tappin L, et al. Patient Prefer Adher. 2021;15:1477-1489; b. Pereira ICJ, et al. Eye. 2021;35:3202-3221. Image by Kim Y, et al. Scientific Reports. 2019;9:3235.

Most Caucasians have 0.3 CDs, so a CD of 0.5 can be considered at risk, especially if a 0.2 asymmetry is seen between eyes.

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Most common agent?

- Prostaglandin analogs are the most common agents.
- Once daily
- At evening

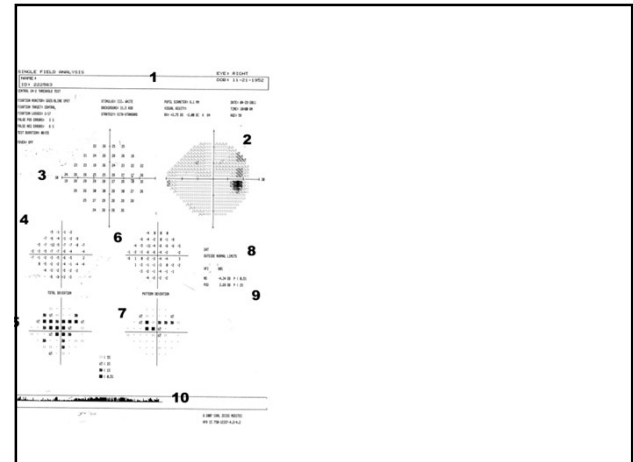
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Criteria for glaucomatous damage

- 1) GHT outside normal limits
- 2) PSD < 5% of normal individuals
- 3) A cluster of three or more **non-edge** points (pattern deviation plot) all of which are depressed at a $p < 5\%$ and one of which is depressed at a $p < 1\%$ on two occasions (respecting horizontal meridian)
 - This criterion was written for 30-2, if 24-2 field is analyzed edge points are included.
 - Criteria should be met on 2/3 issues mentioned above
 - Confirmed on two occasions!

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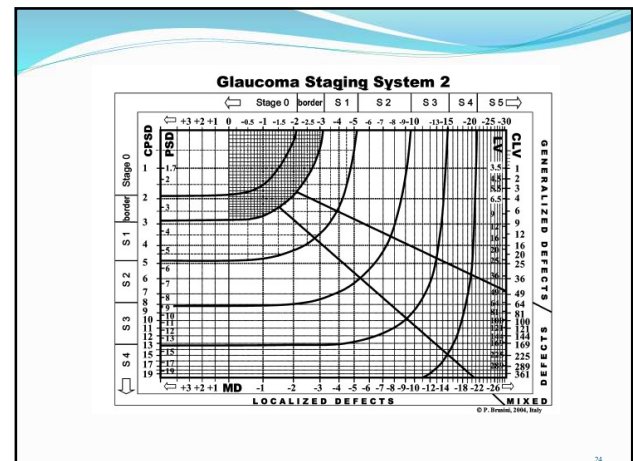
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Staging based on MD

- Better than -6 db- Mild
- Worse than -6.0 dB but better than -12 dB – Moderate
- Worse than -12.0 dB severe

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Staging POAG

Stage/Severity	Symptoms/Signs
1 – Suspected	✓ IOP ≥ 22 mm Hg ✓ Asymmetry of vertical C/D ratio (> 0.2 between the 2 eyes) ✓ Suspect appearance of the optic disc ✓ Suspected central-field defect
2 – Mild (early)	✓ Slight glaucomatous changes in the cup (C/D ratio ≤ 0.65 for an optic nerve of average diameter) ✓ Slight visual-field defect outside the central 10°
3 – Moderate	✓ Moderate glaucomatous changes in the cup (C/D ratio 0.7-0.85) ✓ Moderate visual-field defect outside the central 10°
4 – Advanced	✓ Significant glaucomatous changes in the cup (C/D ratio ≥ 0.9) ✓ Visual-field defect within the central 10°

C/D, cup/disc; Fontaine M, et al. [Semantic Scholar](#). Published 2013. Accessed June 6, 2023.

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IOP Target Ranges

	Glaucoma Severity		
	Mild	Moderate	Advanced
Target range	High teens	Mid teens	Low teens
Acceptable fluctuation	< 5 mm Hg	< 4 mm Hg	< 3 mm Hg*

*Least fluctuation tolerance

Asrani S. [Eye Ophthalmol](#). Published 2016. Accessed May 15, 2023.

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Treatment of glaucoma

- Repeatable visual field defect that fits pattern of glaucoma.
- Progressive loss of VF or ONH, or OCT
- Management depends on stage as described previously.

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Management of OHT and OAG

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The Scoring Tool for Assessing Risk (S.T.A.R. II) calculator FOR Ocular Hypertensive



Probability of conversion in 5- years
<5% observe and monitor
5 to 15% consider treatment
>15% treat

- ▶ OHTs and EGPS data
- ▶ Intended for use only in untreated OHT patients
- ▶ Age (30-80)
- ▶ IOP 20-32 mmHg
- ▶ CCT 475 to 650 microns
- ▶ PSD 0.50 to 3.00 dB
- ▶ C/D ratio vertical 0.00 to 0.8

<https://ohts.wustl.edu/risk/>



Increased risk with thin cornea

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- Early medical treatment should be considered for individuals with ocular hypertension (OHT) who are at moderate or high risk of developing primary open-angle glaucoma (POAG).^{10,11,29} (Evidence Grade: A, Strong Recommendation)

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Visual fields and early glaucoma

- ▶ True variability
- ▶ Lower Repeatability on testing
- ▶ Learning curve

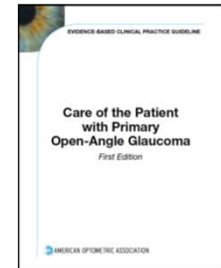
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Open-angle glaucoma and ocular hypertension

- Primary open-angle glaucoma
- Normal tension glaucoma'



rtension



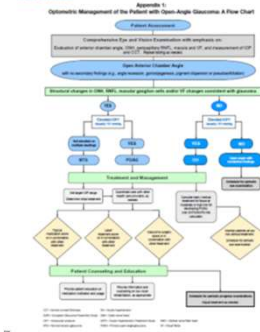
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Evaluation and Examination

- The examination of a person suspected of having primary open-angle glaucoma (POAG) should include all aspects of a comprehensive eye and vision examination, with emphasis on the evaluation of the anterior chamber angle, optic nerve head (ONH), peripapillary retinal nerve fiber layer (RNFL), macula and visual fields (VF), and measurement of intraocular pressure (IOP) and central corneal thickness (CCT).^{415-418,424,425,431,432,451-453} (Evidence Grade: B, Recommendation)
- Eye doctors should be persistent in providing education and training to patients with primary open-angle glaucoma (POAG) to improve adherence/compliance with recommended therapy.^{415-418,424,425,431,432,451-453} (Evidence Grade: B, Recommendation)

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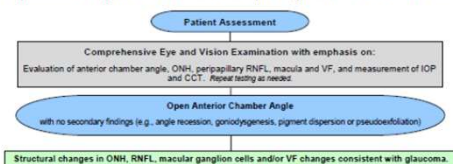
VI. APPENDICES



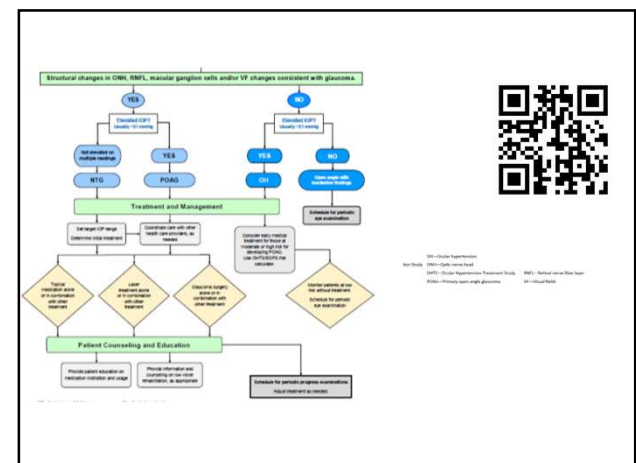
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VI. APPENDICES

Appendix 1: Optometric Management of the Patient with Open-Angle Glaucoma: A Flow Chart



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Sequence of management

- Not a constant depends on stage of disease
- Optometrists prefer
 - 1) Topical
 - 2) Laser
 - 3) Conventional surgeries
- Prophylactic treatment of glaucoma is based on global risk assessment.
- Glaucoma is a slow progressive disease and takes years to progress or worsen
- 10% failure rate of topical glaucoma medications

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Disc hemorrhages

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Disc hemorrhage

- ▶ Location- Infero temporal followed by superior temporal regions
- ▶ Does not mean glaucoma always
- ▶ Is not the only location of damage
- ▶ More likely to progress to POAG
- ▶ POAG progression is greater in eyes with DH



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Disc hemorrhages

- ▶ RNFL changes – Wedge shaped defects
- ▶ Associated notching of rim
- ▶ Vertical elongation of cupping after an episode

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Disc Hemorrhages Are Associated With Localized Three-Dimensional Neuroretinal Rim Thickness Progression in Open-Angle Glaucoma

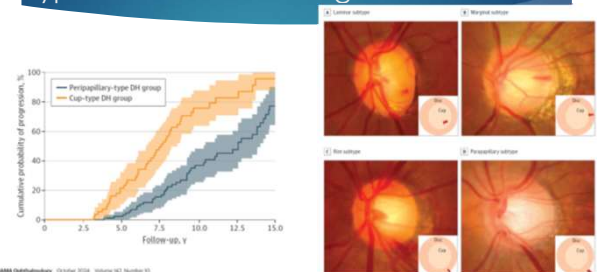
MILICA A. MARGETA, KITIYA RATANA WONGPHAIBUL, EDEM TSIKATA, MICHELE ZEMPLENY, COURTNEY L. ONDRICK, JANICE KIM, ANNE L. COLEMAN, FEI YU, JOHANNES F. DE BOER, AND TERESA C. CHEN

124 OAG patients
5 year follow-up
19 showed hemorrhage (15.3%)

• CONCLUSIONS: Glaucoma progression detected by high-density 3D SD-OCT neuroretinal rim measurements preceded DH occurrence in the majority of patients. These findings support the hypothesis that DHs are indicators of ongoing glaucoma progression rather than discrete events that cause subsequent progression. (Am J Ophthalmol 2022;234: 188–198, © 2021 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>))

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Types of disc hemorrhages



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Cornea , Disc and Visual fields in Normal tension glaucoma

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Can IOP be underestimated in NTG?

- ▶ Yes, absolutely
- ▶ CCT is lower in NTG patients compared to POAG or OHT
- ▶ POAG vs NTG – 21 cut off
- ▶ An NTG patient can have lower than 21 pressure, borderline pressure and IOP > 21 with
 - ▶ ORA, DCT, 7CR, CORVIS ST (CCT independent measures)

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Corneal Stiffness and Modulus of Normal-Tension Glaucoma in Chinese

YUNZHI XU, YIMING YE, ZIDONG CHEN, JIANGANG XU, YANGFAN YANG, YANMEI FAN, PINGPING LIU, JOK TONG CHONG, KEMING YU, DAVID C. C. LAM, AND MINBIN YU

• CONCLUSIONS: The corneas of NTG patients were softer than those of HTG patients and controls, as assessed by CID, which were associated with thinner CCT. These might suggest different ocular biomechanical properties in NTG and HTG. (NOTE: Publication of this article is sponsored by the American Ophthalmological Society; Am J Ophthalmol 2022;242:131–138. © 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>))

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VF loss in NTG

- ▶ Progression of NTG tends to be slow
- ▶ Some people reported differences in location of defects of visual field.
- ▶ VF defects focal, deeper and central (closer to fixation)

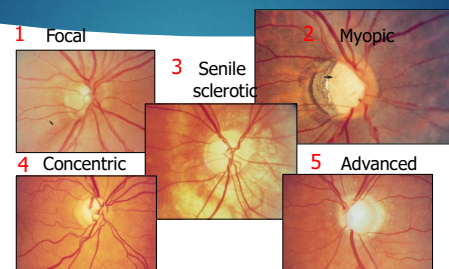
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VF loss in NTG -2

- ▶ A dense paracentral scotoma encroaching on fixation is not an unusual finding as the initial defect
- ▶ The findings of visual field differences is supported by some researchers where as others failed to confirm them

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Glaucomatous Disc Classifications



Braddaway D.C, Nicolela M. T, Drance S.M., Survey of Ophthalmology. 1999

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Optic disc and NTG

- ▶ NTG patients have a thinner rim inferiorly and inferotemporally when compared to other glaucoma with similar total VF loss

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Optic disc appearance-NTG

- ▶ Senile sclerotic group
 - ▶ Shallow sloping of NRR
- ▶ Focal ischemic
 - ▶ Deep focal polar notching in the neuroretinal rim
 - ▶ Shallow saucerized cupping
- ▶ Senile sclerotic nerve
 - ▶ Commonly found hemorrhage-locations
 - ▶ Proximal constriction of retinal arteriole
 - ▶ Importance of large peripapillary atrophy and its blood flow associations
 - ▶ Loss of superficial capillaries and delayed filling of the nerve head

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Differential diagnosis

- ▶ Diurnal IOP is a useful in determining the peak IOP
- ▶ Also useful in establishing target IOP
- ▶ CCT and IOP issue

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Microvasculature Dropout and Development of Normal Tension Glaucoma in Glaucoma Suspects: The Normal Tension Glaucoma Suspect Cohort Study

YOUNGHA JUNG, HAE-YOUNG LOPELY PARK, HEBONG SHIN, SI EUN OH, SEONG AH KIM, B-YOUNG LEE, DA YOUNG SHIN, SOO H JEON, YONG-CHAN KIM, JYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK

- **CONCLUSIONS:** NTG suspects with baseline MvD or a lower laminar deep VD on OCT-A had a higher risk of conversion. (Am J Ophthalmol 2022;243: 135–148. © 2022 Elsevier Inc. All rights reserved.)

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Vascular parameters and endothelin-1 measurements in glaucoma patients with low- and high-tension optic disc hemorrhages

Isabella M. F. Almeida¹, Elise Taniguchi², Cecilia Victoria Agapito Tito³, Diego Torres Dias^{1,4}, Michele Uchida⁵, Sybil Dorairaj⁶, Robert Ritch⁶, Sérgio H. Teixeira³, Augusto Paranhos Jr¹, Carolina P. B. Gracitelli⁴, Cristiane Kayser⁷ & Tiago Santos Prata^{1,4,8,9,10}

Patients developing DH and had low IOP (<16) have higher endothelin-1 and more peripheral vascular dysfunction

Compared to DH in higher IOP

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Myopia-Glaucoma-OCT

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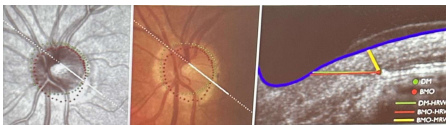
Stats and why should it be concerning

- ▶ 2050 – 5 billion people will have myopia (half the worlds population)
- ▶ About 1/3 will have high myopia $\geq -6D$

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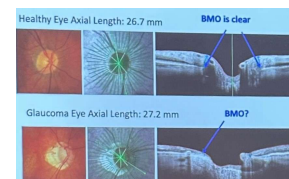
Issues with myopia and OCT

Clinical Disc versus disc margin identified by Bruchs membrane opening



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BMO is not clear in all patients



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A AL ≤ 24 mm



B 24 mm < AL ≤ 26 mm



Macula structural and vascular differences in glaucoma eyes with and without high axial myopia

Jassem Razaee,^{1,2} Christopher Brown,¹ Jade Durrleman,¹ Akram Belghith,¹ James A. Poulsen,¹ Mark Christopherson,¹ Leslie Heyman,¹ Joel B. Jonas,^{1,2} Rafaela C. Pereira,¹ Susan Moorthy,¹ Huayuan Hou,¹ Naveen V. El-Nami,¹ Eleonora Micheli,¹ Massimo A. Fazio,¹ Robert N. Weinreb,¹ Linda M. Zangwill,¹

C AL > 26 mm



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Can OCT values be trusted in myopia?

- ▶ Axial length is not adjusted? Magnification is off so away from true value
- ▶ The disc analysis is off given the tilted appearance and myopic type stretched disc
- ▶ Bruch's membrane opening is displaced
 - ▶ Thus clinically what is considered as an edge of disc is not the same
- ▶ Nerve fiber layer may be utilized
- ▶ Macula may be more sensitive to changes
- ▶ But macula can also be pathological!
- ▶ Visual field defects also seen in myopic eyes!
- ▶ Management of glaucoma in high myopes is a tough situation.

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Blood pressure and Glaucoma

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Independent risk factors

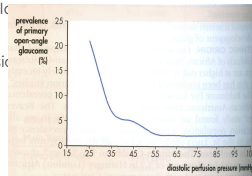
- ▶ Low Diastolic blood pressure
- ▶ Low Mean Ocular Perfusion Pressure
- ▶ Low Diastolic Perfusion Pressure
- ▶ Measure Blood pressure after 5 minutes being seated
- ▶ Measure BP twice, 5 minutes apart
- ▶ If SBP was 10 mmHg or DBP was 5mmHg different measure 3rd time
- ▶ Average two measurements that are the closest.

Zheng et al. IOVS 2010

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Systemic hypertension and glaucoma

- ▶ Blood pressure and pathogenesis of glaucoma
 - ▶ Hospital based study
 - ▶ Baltimore Eye Survey examined perfusion pressure
- ▶ Diastolic perfusion pressure= DBP-IOP



Tielsch et al Hypertension perfusion pressure and primary open angle glaucoma Arch ophthalmol 1995

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Mean Ocular perfusion pressure-

- ▶ $MOPP = \frac{2}{3} [DBP + \frac{1}{3}(SBP - DBP)] - IOP$.

IOP	Blood pressure					
	120/80	120/70	120/60	110/70	110/60	100/60
22	40.2	35.7	31.3	33.5	29.1	26.8
24	38.2	33.7	29.3	31.5	27.1	24.8
26	36.2	31.7	27.3	29.5	25.1	22.8
28	34.2	29.7	25.3	27.5	23.1	20.8

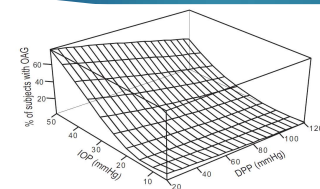
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Mean Ocular perfusion pressure-

- ▶ $MOPP = \frac{2}{3} [DBP + \frac{1}{3}(SBP - DBP)] - IOP$.

IOP	Blood pressure					
	120/80	120/70	120/60	110/70	110/60	100/60
18	44.2	39.7	35.3	37.3	33.3	30.8
16	46.2	41.7	37.3	39.3	35.3	32.8
14	48.2	43.7	39.3	41.3	37.3	34.8
12	50.2	45.7	41.3	43.3	39.3	36.8

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Perfusion pressure and IOP

Zheng et al. IOVS 2010

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Summary perfusion pressure

Greater the IOP
lower the blood
flow

Elevated IOP
with Lower blood
pressure – Bad
combination

In terms of
Perfusion
pressure

Low IOP (12
mmHg) but with
lower BP (100/60)

=

Elevated IOP(26
mmHg) at
"normal BP"
120/80

Clinical tip: Measure BP and Pulse rate on all glaucoma patients
Particularly in suspects that IOP is not high, but nerves appear suspicious

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Systemic Hypertension as a Risk Factor for Open-Angle Glaucoma: A Meta-Analysis of Population-Based Studies

Hyungwon Bae¹, Naeyun Lee^{1,2}, Hye Sun Lee³, Samin Hong³, Gong Je Seong³, Chan Yun Kim^{1,4}

¹ Department of Ophthalmology, Severance Hospital, Institute of Vision Research, Yonsei University College of Medicine, Seoul, Korea, ² Department of Research Affairs, Biomedical Collaboration Unit, Yonsei University College of Medicine, Seoul, Korea, ³ Department of Ophthalmology, Pohang Hospital, Pohang, Korea, ⁴ Yonsei University College of Medicine, Seoul, Korea

Conclusions: Systemic hypertension increases the risk for developing OAG, especially in those with HTG.

Model	Study name	Statistics for each study	Odds ratio and 95% CI		
		Odds ratio	Lower limit	Upper limit	
A	Tekken, 1995	0.98	0.72	1.37	
	Blaum, 2000	1.45	0.50	2.15	
	Quigley, 2001	0.97	0.63	1.49	
	Ramakrishnan, 2003	1.90	0.50	2.00	
	Mitchell, 2004	1.56	1.01	2.41	
	Vitaya, 2005	1.02	0.60	1.74	
	Sunahara, 2006	1.67	1.14	2.44	
	Hallmark, 2007	1.29	0.62	1.81	
	Lankes, 2008	1.38	0.97	1.91	
	Witkop, 2008	1.10	0.71	1.71	
Wong, 2009	1.35	0.86	2.13		
Tan, 2009	0.72	0.45	1.16		
Chaturvedi, 2010(1)	0.97	0.45	2.08		
Chaturvedi, 2010(2)	1.20	0.66	2.21		
Uthman, 2011	1.07	0.41	2.79		
Uthman, 2011	1.43	0.70	2.52		
Sun, 2012	2.45	1.17	5.15		
Fixed	1.22	1.09	1.36		
Random	1.22	1.08	1.37		

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Hypertension/hypotension

Systemic hypertension increases the risk for developing POAG.⁸⁰ Low nocturnal blood pressure (BP), especially more than 10 mmHg below daytime mean arterial pressure, is predictive of progression of VF defects in NTG.⁸³ (Evidence Grade: B)

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Advances in perimetry

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Opportunities for Improvement in Central 10 Degrees

Glaucomatous damage of the macula
Donald C. Hood^{1,2,3}, Ali S. Raza^{4,5}, Carlos Gustavo V. de Moraes^{6,7}, Jeffrey M. Liebmann^{4,6} and Robert Ritch^{4,1}

¹Progr Retin Eye Res, 2013 Jan; 32C: 1-21

- glaucomatous damage of the macula is common and can occur early in the disease
- can be missed and/or underestimated with standard 24-2 VF tests that use a 6° grid

The Prevalence and Nature of Early Glaucomatous Defects in the Central 10° of the Visual Field
John J. Francis, B.S.^{1,2}, Carlos G. de Moraes, M.D.^{1,2}, Ali S. Raza, B.A.³, Jeffrey M. Liebmann, M.D.^{1,2}, Robert Ritch, M.D.^{1,2} and Donald C. Hood, Ph.D.^{1,2}

24-2 and 10-2 VF Examples

Blue cross region on the 24-2 VF = central 10-2 VF.

(A) Both are abnormal.

(B) 24-2 VF normal; 10-2 VF abnormal

(C) 24-2 VF abnormal; 10-2 VF normal

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Highest Importance Locations Chosen from 10-2 Pattern

Selecting additional test locations to enhance the 24-2 pattern using a scoring system

Matthew M. Mott¹, Gary L. Y. Allen², John D. Chang³

¹Topcon Co. Inc., Paramus, NY, USA; ²Topcon Co. Inc., Paramus, NY, USA; ³Topcon Co. Inc., Paramus, NY, USA

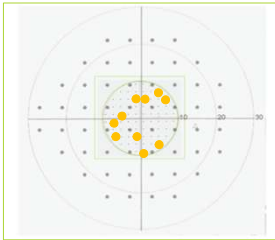
- Expert group selected specific 10-2 test point locations
- Prevalence and depth of glaucomatous macular defects were systematically evaluated to select optimum test points
- Pattern covers areas known to be susceptible to glaucomatous defects both from structural and functional studies

Selected test locations are shown in red boxes

The expert group: Donald C. Hood, Stuart K. Gardiner, Allison M. McKendrick and William H. Swanson.

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Resulting SITA Faster 24-2C Pattern on HFA3



The 24-2C test pattern combines all 24-2 points + ten selected 10-2 points (shown in OD orientation)

Large Gray	24-2 pattern
Large Orange	Ten additional 24-2C points
Small Gray	10-2 pattern

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Minimize Time and Maximize Information in VF Testing with HFA3

SITA Faster 24-2

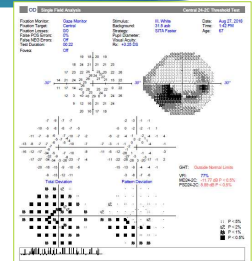
- test in 2 minutes or less
- ~50% faster than SITA Standard; ~30% faster than SITA Fast

SITA Faster 24-2C

- more information in central field
- ~20% faster than SITA Fast 24-2

Add new tests to patient progression

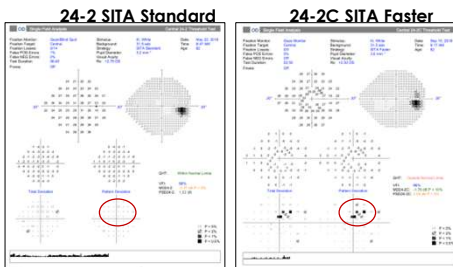
- Mixed SITA GPA
- Includes SITA Faster, Fast, Standard, 24-2, 30-2, and 24-2C in progression analysis



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24-2C SITA Faster

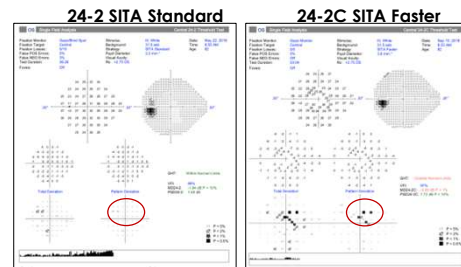
Flagged points detected centrally in OD



75

24-2C SITA Faster

Flagged points detected centrally in OS



76

Thresholding requires time

- ▶ 62 points in 3 minutes or so.
- ▶ Is SITA Faster too fast?
- ▶ Can it threshold reliably ?

77

New 24-2C SITA Faster protocol

- ▶ Free upgrade if you have HFA III
- ▶ Gives more macula points.
- ▶ Results comparable to 24-2 SITA FAST
- ▶ Thresholds are ± 3 dB
- ▶ Gives you some macula information
- ▶ You need 10-2 if damage is noticed in macula region

78

Virtual reality
perimetry- Are
you ready for
prime time?

79

Poll

Do you believe the virtual reality perimeter is the wave of the future?

- a) Yes, that will be ideal, given the flexibility.
- b) No, that is just a fad.
- c) Definitely, if it can do more than just fields.
- d) Depends on if I can sell my current device

80

How do I
correlate
structure and
function ?

81

ARVO JOURNALS

From: The Structure and Function Relationship in Glaucoma: Implications for Detection of Progression and Measurement of Rates of Change
Invest. Ophthalmol. Vis. Sci. 2012;53(11):6938-6948. doi:10.1167/iovs.12.10345

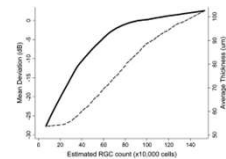


Figure Legend:

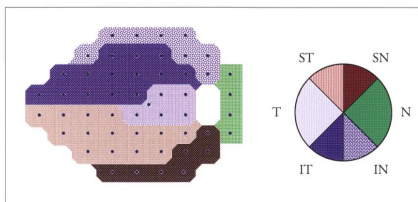
Relationship between MD, average RNFL thickness measurements, and estimated RGC counts. At early stages of damage (high RGC counts), changes in estimated RGC counts correspond to relatively smaller changes in MD (continuous line) and relatively larger changes in average RNFL thickness (dashed line). At advanced stages of damage (low RGC counts), changes in estimated RGC counts correspond to relatively large changes in MD, but only small changes in average RNFL thickness.

Date of download: 6/15/2018

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Structure function correlation



Perimetry Update 1998/1999, pp. 351-359

83

Narrow
angle/acute
attack/angle
closure glaucoma

84

Risk factors Angle closure

- ▶ Race- Chinese Asians more common, Inuit population, higher prevalence compared to Caucasians
- ▶ Women- 70% cases; shallow chamber, smaller axial length compared to men
- ▶ Age-older individuals
- ▶ Hyperopia
- ▶ Smaller axial length
- ▶ Fellow eyes of an individual at risk
- ▶ First degree relatives of an angle closure patient

85

Precipitating factors

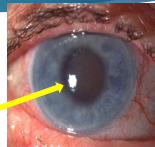
- ▶ Factors that produce dilation
 - ▶ Dim illumination
 - ▶ Emotional stress
 - ▶ Drugs
- ▶ Factors that produce miosis (rare)

86

Pupillary block

- ▶ Most common form of Primary angle closure
- ▶ Initiating event- increased resistance of to flow of aqueous humor at pupil and anterior surface of lens
- ▶ Forward bending of iris
- ▶ Closure of angle

Location
of
resistance



87

Classification on clinical presentation

- ▶ Acute angle-closure/glaucoma
- ▶ Subacute angle-closure/glaucoma
- ▶ Chronic angle-closure/glaucoma
- ▶ Combined mechanism/glaucoma

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Acute angle-closure

Symptoms

- ▶ Ocular pain
- ▶ Nausea and vomiting
- ▶ Blurred vision,
- ▶ Colored halos around lights
- ▶ Loss of vision

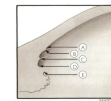
Signs

- ▶ Conjunctival and ciliary congestion,
- ▶ Corneal edema
- ▶ Shallow peripheral anterior chamber with cells and flare
- ▶ Intraocular pressure usually exceeds 40 mmHg

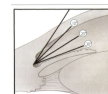
89

Gonioscopy- CPT 92020

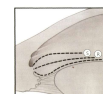
A = Above Schwalbe line, totally occluded angle.
B = Behind the Schwalbe line, peripheral iris is in contact with TM.
C = Scleral spur Iris root at the level of scleral spur
D = Deep anterior ciliary body seen.
E = extremely deep



Iris insertion



Angle approach



Curvature of
peripheral iris

90

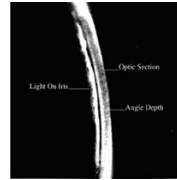
Angle Measurement with Quantification



Clinical tip: Angle 20 degree or less
needs further evaluation

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Van Herrick angle estimation

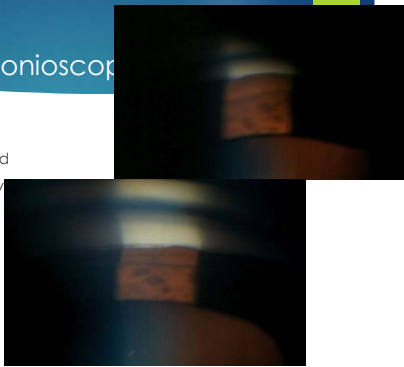


- ▶ 1:1 – Open angle, VH grade 4
- ▶ 1:1/2 – Open angle, VH grade 3
- ▶ 1:1/4 – Narrow angle, VH grade 2 (Angle Closure Possible)
- ▶ 1: <1/4 – Angle closure likely, VH grade 1

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Indentation gonioscopy

- ▶ Angle narrow
- ▶ Angle appears closed
- ▶ Angle structures not visible in a quadrant
- ▶ Ruling out synechiae



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Lowering IOP in office

94

Medical treatment- Goals

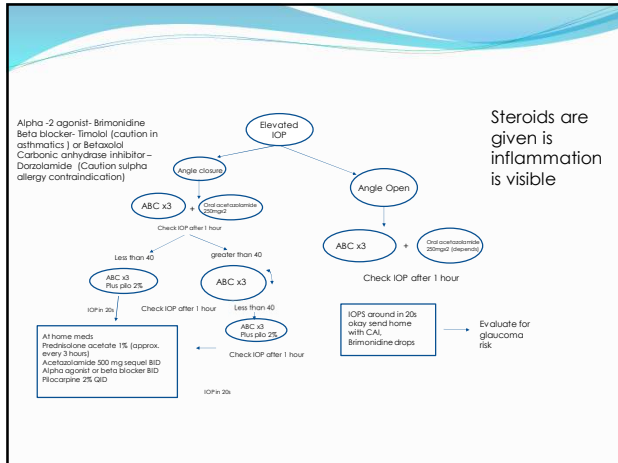
- Lower intraocular pressure
- Alleviate pain
- Clear cornea
- Prevent synechiae

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Intravenous medications

- Acetazolamide 500mg intravenous
- Intravenous Mannitol
- Best therapy however is not always available in clinics

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Take home medication

- Prednisolone acetate 1% q1-6 hours (approx every 3 hours)
- Acetazolamide 500 mg sequel BID
- Alpha agonist or beta blocker BID
- Pilocarpine 2% QID

98

Anti-VEGF and IOP

- Anti-vascular endothelial growth factor (VEGF) agents has dramatically changed the management of ocular diseases
- associated with macular edema, providing improved visual outcomes and a favorable safety profile
- ranibizumab, bevacizumab, pegaptanib and aflibercept and are commonly used in the treatment of diabetic macular edema, neovascular age-related macular degeneration and other pathologies characterized by retinal or choroidal neovascularization
- Less known fact there is a spike in IOP post injection typically returning to baseline in 1 hour
- Very rarely long-term spike in pressure 6-14.8%

99

Why is there an IOP spike with anti-VEGF?

- Volume of drug injected
- Associated factors repeated injections
- Prolonged treatments
- Mechanisms
 - Direct toxic effect of anti-VEGF on TM
 - Injury of TM from large volume
 - Inflammation secondary to anti-VEGF
 - Mechanical blockage of TM

100

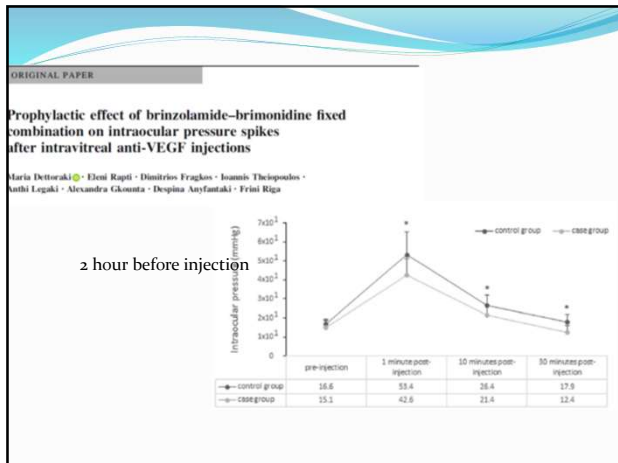
Do we pretreat patient?

101

Why should we?

- RNFL defects after long term treatment and no glaucoma have been reported
- IOP does increase significantly after an injection

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103

Can other medications be utilized?

- Apraclonidine 1%
- Brimonidine timolol fixed combination
- Dorzolamide timolol fixed combination

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Current consensus

- None
- prophylactic use of hypotensive medications only in patients with glaucoma
- Some recommended their routine use in both glaucomatous and non-glaucomatous eyes
- Whereas others have proposed IOP checking in all patients and treating accordingly.
- Topical prophylactic treatment cannot prevent the immediate IOP rise

105

Does LPI prevent angle closure? ZAP trial

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ZAP-trial

Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial

Wongwing Ho, Yuetling Liang, Shengming Huang, Yidong Zhang, Baozhen Wu, Xiaohong, Pei Li, Yuxian Li, David S. Friedman*

Zhongshan Angle Closure Prevention (ZAP) Trial

- ▶ 11,991 screened
- ▶ 889 enrolled
- ▶ 889 eyes treated; fellow eye 889 not treated
- ▶ Primary outcome Angle closure by 72 months
- ▶ Incidence of angle closure
 - ▶ 4.19 per 1000 treated
 - ▶ 7.97 per 1000 untreated
- ▶ Small but significant protective effect of treatment
- ▶ Widespread prophylactic laser for angle closure suspects not recommended

www.thelancet.com Vol 393 April 20, 2019

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EAGLE trial

Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): a randomised controlled trial

Wongwing Ho, Yuetling Liang, Shengming Huang, Yidong Zhang, Baozhen Wu, Xiaohong, Pei Li, Yuxian Li, David S. Friedman*

www.thelancet.com Vol 388 October 1, 2016

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EAGLE trial

Hypothesis tested –

- ▶ clear lens extraction after primary angle closure glaucoma
- ▶ leads to **better quality of life, lowering of IOP and less need for glaucoma surgery** than standard care

▶ Standard care – Laser iridotomy and medications.

Interpretation Clear-lens extraction showed greater efficacy and was more cost-effective than laser peripheral iridotomy, and should be considered as an option for first-line treatment.

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Selective laser trabeculoplasty

110

SLT and glaucoma

- ▶ Great first or second line option.
- ▶ Non-compliant individuals
- ▶ Individuals that fluctuation of IOP is a concern
- ▶ In theory can be repeated to lower IOP.
- ▶ Is the IOP lowering the same second attempt?

111

Primary Selective Laser Trabeculoplasty for Open-Angle Glaucoma and Ocular Hypertension

Clinical Outcomes, Predictors of Success, and Safety from the Laser in Glaucoma and Ocular Hypertension Trial

- ▶ A total of 611 eyes (195 OHT and 416 OAG) of 355 patients received SLT, and 622 eyes (185 OHT and 437 OAG) of 362 patients received topical medication at baseline.
- ▶ At 36 months, 536 eyes (87.7% of 611 eyes) of 314 patients (88.5% of 355 patients) were available for analysis.
- ▶ Some **74.6% of eyes (400 eyes) treated with primary SLT achieved drop-free disease-control at 36 months; 58.2% (312 eyes) after single SLT.**
- ▶ Six eyes of 6 patients experienced immediate post-laser IOP spike (>5 mmHg from pretreatment IOP) with 1 eye requiring treatment.

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Primary Selective Laser Trabeculoplasty for Open-Angle Glaucoma and Ocular Hypertension

Clinical Outcomes, Predictors of Success, and Safety from the Laser in Glaucoma and Ocular Hypertension Trial

- ▶ Conclusions: Primary SLT achieved comparable early absolute IOP-lowering in OHT and OAG eyes compared to medications.
- ▶ Drop-free disease-control was achieved in approximately 75% eyes at 36 months after 1 or 2 SLTs, the majority of these after single SLT.
- ▶ These analyses are exploratory but support primary SLT to be effective and safe in treatment-naïve OAG and OHT eyes.

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Automated Direct Selective Laser Trabeculoplasty: First Prospective Clinical Trial

Mordechai Goldenfeld¹, Michael Belkin², Masha Dobkin-Belkman³, Zachary Sacks¹, Sharon Blum Meirovitch¹, Noa Geffen^{1,4}, Ari Leshno^{1,4}, and Alon Skaa^{1,4}

Clinical science

OPEN ACCESS

Direct selective laser trabeculoplasty in open angle glaucoma study design: a multicentre, randomised, controlled, investigator-masked trial (GLAURIous)

120 shots over 2 seconds at the limbus
1.4-1.8 mJ
400 micron 3ns



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- 909-469-8473