MODULE 1:
Diagnostic workup

EAGLE ALLIANCE

Acknowledgement

Our sincere thanks to the **EAGLE Faculty** for developing the modules, and to the **APGS Review Experts** for their contributions throughout the review and approval process. Their guidance and dedication have been essential in ensuring the accuracy, clarity, and relevance of these educational resources.

Eagle Alliance Faculty – Module 1

- **Chair:** Prof. Tina Wong (Singapore)
- Prof. Jin Wook Jeoung (South Korea)
- Assoc Prof. Yanin Suwan (Thailand)
- Assoc Prof. Yu-Chieh Ko (Taiwan)

APGS Expert Review – Module 1

- Prof. Ching-Yu Cheng (Singapore)
- Prof. Ki Ho Park (South Korea)

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Introduction to the **EAGLE Alliance Initiative**

Welcome to the EAGLE Alliance initiative:

The EAGLE Alliance has been developed to strengthen clinical capacity in glaucoma management among general ophthalmologists across Asia. Through expert-led modules aligned with the APGG (4th edition), we aim to provide practical, guideline-based learning that supports everyday clinical practice.

How to use each module:

Each module follows the flow of one section of the APGG, concluding with a summary to reinforce key learning points

Look out for:

Expert tips and tricks – practical insights from the faculty

Tips and tricks from the experts

FAQs from the APGG – answers to common clinical questions

FAQs from the APGG

APGG: Asia-Pacific Glaucoma Guidelines; FAQ: frequently asked question.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

Introduction to **Module 1: Diagnostic workup**

Module 1 focuses on the diagnostic workup for glaucoma. It provides clear, structured guidance on the essential assessments needed to identify and monitor glaucoma, including:

- IOP measurement
- Anterior chamber angle assessment
- Optic disc, RNFL, and GCIPL evaluation
- VF testing
- Risk factors for glaucoma

Meet the expert faculty:

The diagnostic workup module was developed with guidance and insights from the following faculty members from the EAGLE Alliance, whose expertise helped shape the content for use in daily practice:

Prof. Jin Wook Jeoung | **Assoc. Prof. Yu-Chieh Ko** | **Assoc. Prof. Yanin Suwan**

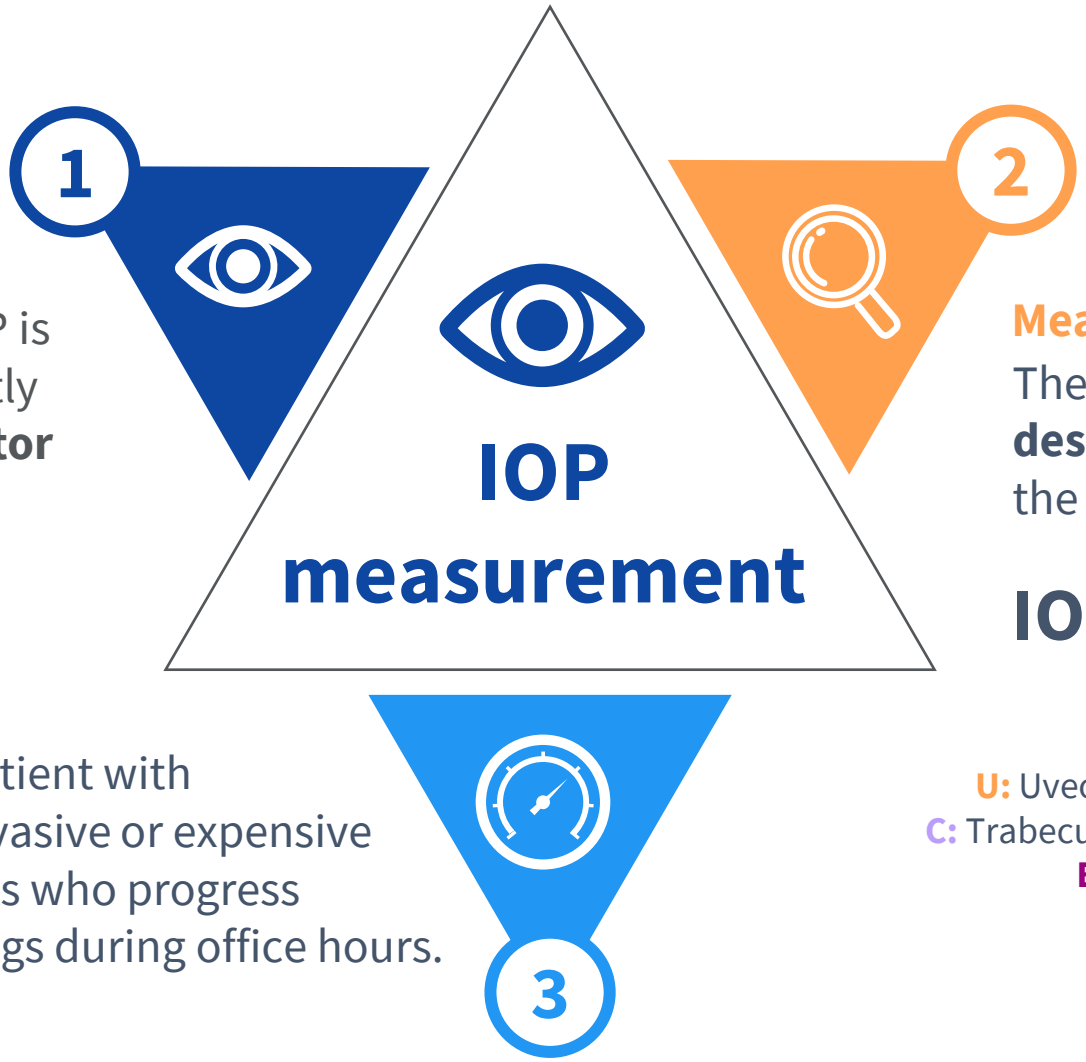
GCIPL: ganglion cell–inner plexiform layer; IOP: intraocular pressure; RNFL: retinal nerve fiber layer; VF: visual field.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

IOP plays a critical role in the management of glaucoma

Assoc. Prof. Suwan

"Both the peak and trough IOP should be identified and documented, if possible."



Importance of IOP:

Identifying and managing IOP is essential because it is currently **the only modifiable risk factor for glaucoma**.

Measuring IOP:

The **modified Goldmann equation describes steady-state IOP** using the following key determinants:

$$IOP = [(Q–U)/C] + EVP$$

Q: Aqueous inflow rate
U: Uveoscleral outflow (pressure-insensitive)
C: Trabecular outflow facility (inverse of resistance)
EVP: Episcleral venous pressure

24-hour IOP monitoring:

Helpful before subjecting a patient with normotensive glaucoma to invasive or expensive investigations, and for patients who progress despite acceptable IOP readings during office hours.

IOP: intraocular pressure.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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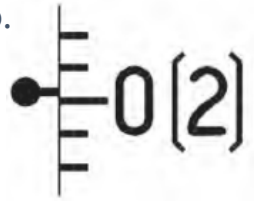
The GAT calibration process involves the following steps (1/2)

1

1. Set the tonometer in position on the slit-lamp stand, with the Perspex biprism head in place and the tension on the circular dial on the right side (from the examiner's side of the slit lamp) set at 5 mmHg. The head should lean slightly forward (away from the examiner).

2

2. Slowly twirl the circular dial counter-clockwise until the head rocks back towards you. The tension should read 0 to 2 mmHg below zero.



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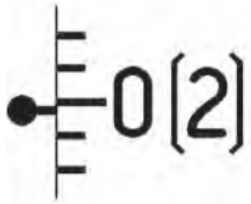
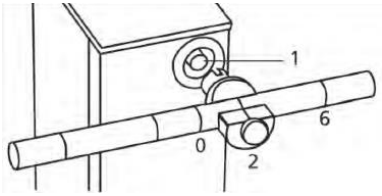


3. Slowly twirl the dial clockwise until the head rocks forward again. The tension should read 0 to 2 mmHg.

4

4. Remove the calibration rod from its box. Firmly screw into position the holding bracket that slides along the rod so that the closest mark in front of the center one (on the other side of the center from you) is aligned as exactly as you can.



5

5. Slip the rod and its holder into the receptacle on the right side of the tonometer. The head will rock backwards towards you.

GAT: Goldmann applanation tonometry.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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The GAT calibration process involves the following steps (2/2)

Assoc. Prof. Suwan and Assoc. Prof. Ko

"GAT should generally be performed before other slit lamp examinations that may exert pressure on the globe, but certain assessments – such as evaluation of the corneal surface or tear film – should precede GAT."

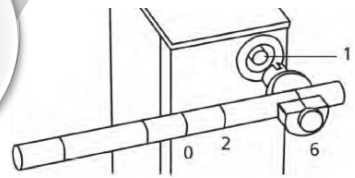
6

6. Slowly twirl the circular dial clockwise until the head rocks forward. Note the tension reading on the dial: it should be 20 to 23 mmHg.

7

7. Slowly twirl the circular dial counter-clockwise until the head rocks backward. The tension on the dial should read 17 to 20 mmHg.

8



8. Remove the rod and holding bracket from the tonometer and reposition the bracket so that it is aligned exactly with the most forward mark on the rod furthest away from you.

9

9. Replace the rod in its bracket in the tonometer receptacle. The tonometer head should rock backwards towards you. Slowly twirl the dial clockwise until the head rocks forward. The tension should read 60 to 64 mmHg.

10

10. Slowly twirl the dial counter-clockwise until the head rocks backwards – the tension should read 56 to 60 mmHg.

GAT: Goldmann applanation tonometry.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

Alternative IOP measurement devices are available

Portable devices

- **Tono-Pen:** Applanation/indentation; Useful in irregular, scarred, edematous, or post-transplant corneas; disposable tip; good for limited mobility
- **iCare:** Rebound tonometry, no anesthesia; home/supine use; multiple versions
- **Pneumatonometer:** Gas system + silicone membrane; continuous IOP waveform; 5–10 seconds of corneal flattening
- **Pulsair Mark 1:** Portable air-puff; non-contact; good for patients with mobility issues

Tono-pen

iCare (rebound tonometer)

Photos courtesy of Prof. Jin Wook Jeoung.
CCT: central corneal thickness; IOP: intraocular pressure; ORA: ocular response analyzer.
Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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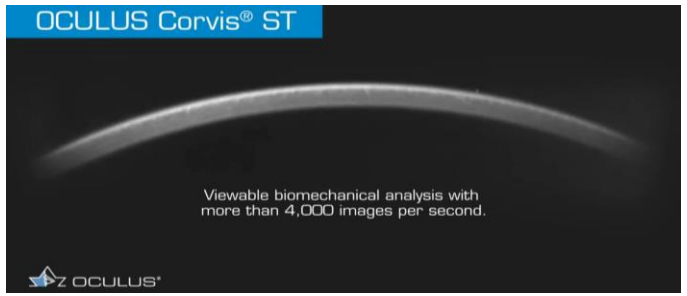
Non-contact tonometry

- **Air-puff tonometers:** No contact/anesthesia; table-mounted; require calibration
- **ORA:** Air pulse + electro-optical system; measures corneal hysteresis and resistance factor
- **Corvis ST:** Air pulse + high-speed camera; assesses corneal biomechanics; provides indices



Corvis ST tonometer

CCT: central corneal thickness; IOP: intraocular pressure; ORA: ocular response analyzer; ST: Scheimpflug-Technology.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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Dynamic contour tonometry

- Slit-lamp mounted; uses a concave sensor
- Measures IOP independently of CCT or curvature
- Also records ocular pulse amplitude

CCT: central corneal thickness; IOP: intraocular pressure; ORA: ocular response analyzer; ST: Scheimpflug-Technology.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

Methods of anterior chamber angle assessment

Assoc. Prof. Suwan

"When utilizing AS-OCT, it is important to note that segmentation error is common in narrow angle eyes."*

Feature	Van Herick method[1,2]	Gonioscopy[2]	AS-OCT[2]
Type	Slit-lamp estimation	Direct clinical examination	Non-contact imaging (optical)
Contact with eye	Non-contact	Direct contact	Non-contact
View of anterior chamber	**Indirect (estimates peripheral depth)**	**360° assessment**	**Cross-sectional view**
Detection ability	Uses corneal thickness as a unit of measure. Good screening tool.	**Can detect secondary causes of elevated IOP**, including pigment dispersion syndrome (pigmentation of the TM) and neovascularization of the angle. **Dynamic gonioscopic assessment enables differentiation between appositional and PAS closure and facilitates detection of plateau iris configuration.**	**Objective measurement of angle dimensions in the dark.**
Limitations	Estimation only; not diagnostic	Subjectivity and potential overestimation of the angle width by inadvertent corneal indentation and slit-lamp illumination	Potential obscuring of the superior and inferior angles by the eyelid. Cannot detect pigmentation or neovascularization of the angle

*In clinical practice, outputs can vary depending on the device used.

AS-OCT: anterior segment optical coherence tomography; IOP: intraocular pressure; ITC: iris trabecular contact; PAS: peripheral anterior synechiae; TM: trabecular meshwork.

1. Van Herick W, et al. *Am J Ophthalmol* 1969;68:626–9; **2.** Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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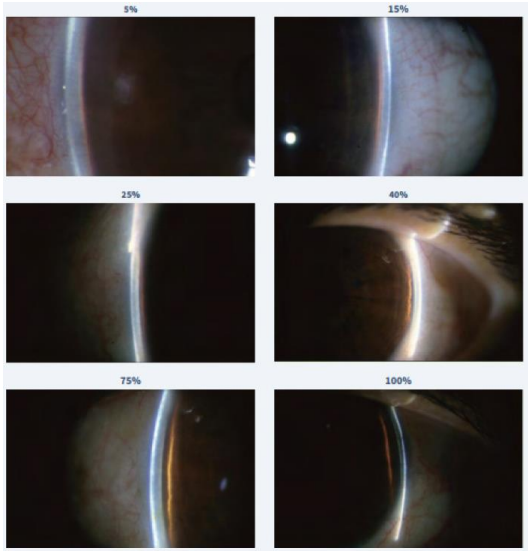
Visual comparison of assessment methods

Van Henrik Method: If the test result is at least one-quarter corneal thickness and the torchlight test is negative, it is almost 98% certain that the angle is not closed

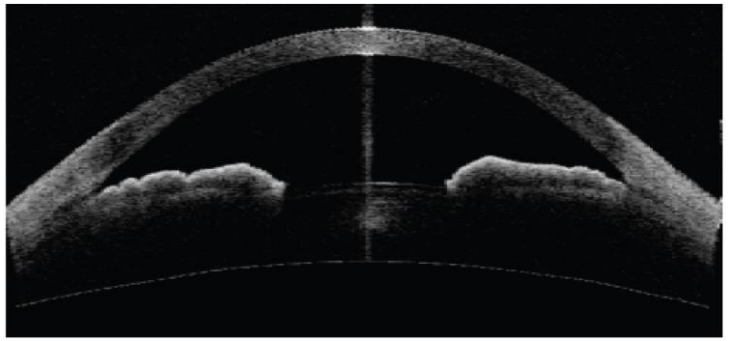


Gonioscopy: Involves biomicroscopic examination of the anterior chamber angle, and is essential for glaucoma diagnosis, treatment, and prognosis

Gonioscopy narrow angle without indentation

Gonioscopy narrow angle without indentation showing PAS

AS-OCT: The use of AS-OCT for the evaluation of the anterior chamber angle has significantly advanced with the introduction of high-speed swept-source AS-OCT technology



AS-OCT: anterior segment optical coherence tomography; PAS: peripheral anterior synechiae.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

Practical guidance for gonioscopy

Assoc. Prof. Ko

"Gonioscopy provides comprehensive, dynamic clinical information for angle assessment without the need for additional instrumentation or technical assistance, while AS-OCT offers objective quantitative data valuable for research and detailed structural analysis"

Direct gonioscopy

- Place Koeppe goniolens on anesthetized cornea (patient supine)
- Fill lens–cornea space with saline or methylcellulose
- View angle with handheld biomicroscope and illuminator

Indirect gonioscopy

At slit lamp, place mirrored lens on anesthetized cornea:

- **Goldmann-style 1- (or -2) mirror lens:** Use viscous filler
- **4-mirror Zeiss-type lens:** No space filler is needed
- **4-mirror goniolens:** View entire angle without rotation; dynamic gonioscopy via corneal indentation

Indentation (pressure/ dynamic) gonioscopy

- With the 4-mirror indirect gonioscopy, press on the cornea to displace fluid into the angle to visualize the anatomic landmarks and to differentiate appositional from PAS closure
- Facilitate visualization into narrow angles by:
  - Static primary position gonioscopy
  - Dynamic gonioscopy

AS-OCT: anterior segment optical coherence tomography; PAS: peripheral anterior synechiae

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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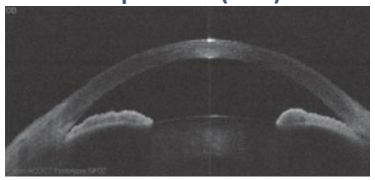
Evaluation of PACD

PACD is a condition that encompasses three stages:

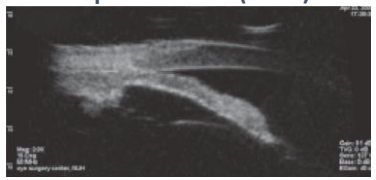
1. PACS
2. PAC
3. PACG

Diagnostic evaluation of angle closure:

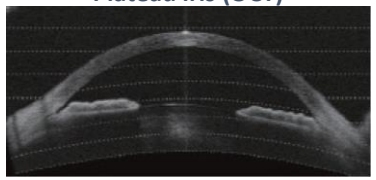
Pupil block (OCT)



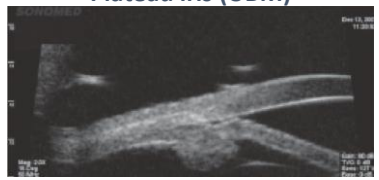
Pupil block RLE (UBM)



Plateau iris (OCT)

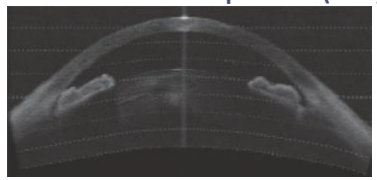


Plateau iris (UBM)

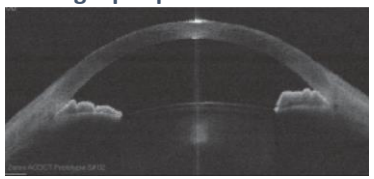


Pseudoplateau iris (OCT)

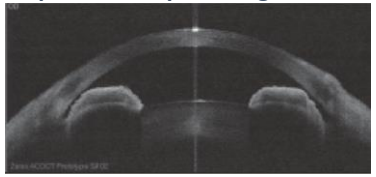
Lens – thick forward position (OCT)



Angle crowding – peripheral iris roll in dark (OCT)



Very steep nasal temporal angle in dark (OCT)



Creeping very steep inferior angle in dark (OCT)

OCT: optical coherence tomography; PAC: primary angle closure; PACD: primary angle-closure disease; PACG: primary angle-closure glaucoma; PACS: primary angle-closure suspect; UBM: ultrasound biomicroscopy.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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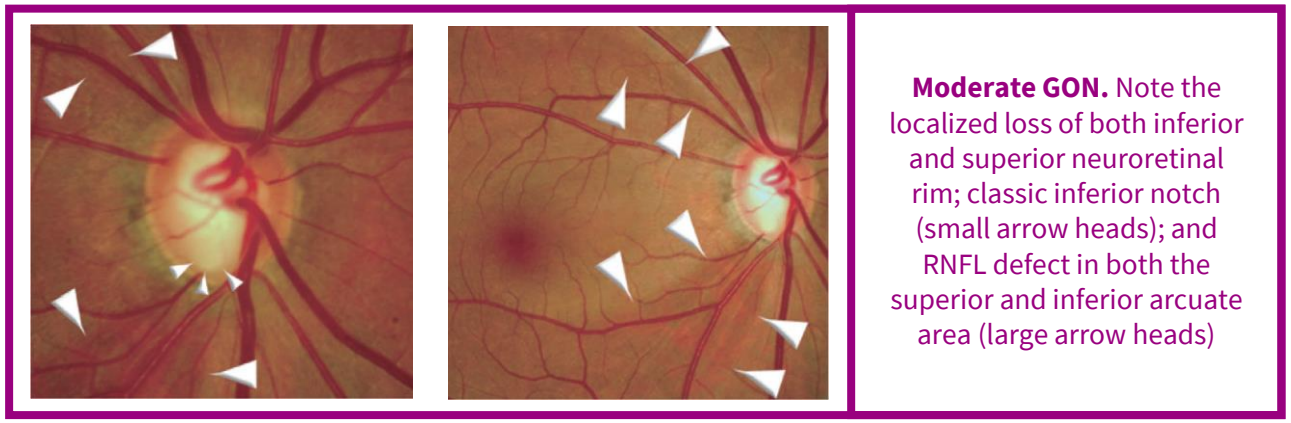
Clinical examination of the optic disc

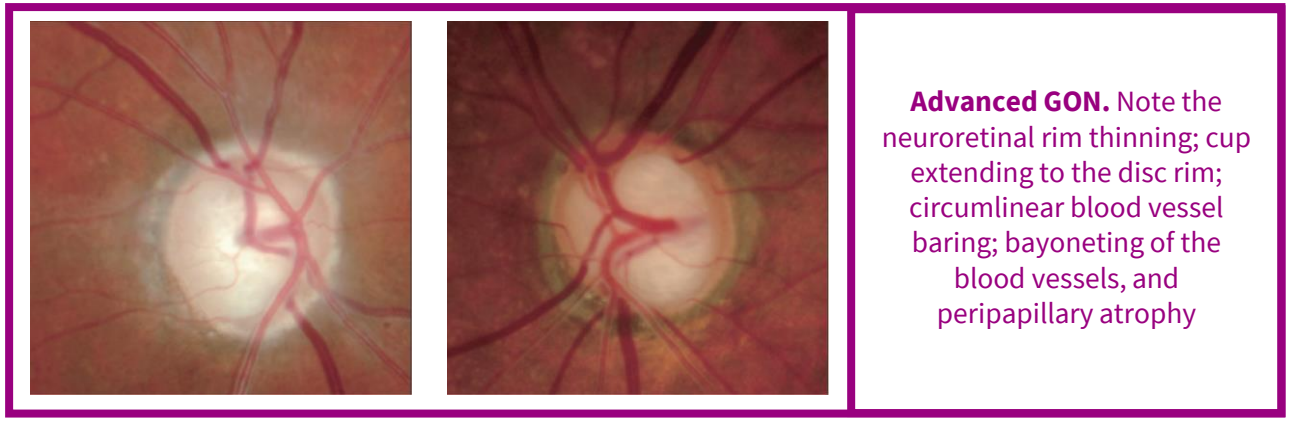
A hallmark of GON during neuroretinal rim assessment is the depletion of tissue from the rim's inner edge



Moderate GON. Note the localized loss of both inferior and superior neuroretinal rim; classic inferior notch (small arrow heads); and RNFL defect in both the superior and inferior arcuate area (large arrow heads)

Disc hemorrhage increases progression risk:[1–3]

- 4-fold increase by multivariate
- Recurrent hemorrhages raise risk of optic nerve damage 3–4 times vs single hemorrhage



Advanced GON. Note the neuroretinal rim thinning; cup extending to the disc rim; circumlinear blood vessel baring; bayoneting of the blood vessels, and peripapillary atrophy

GON: glaucomatous optic neuropathy; RNFL: retinal nerve fiber layer.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Siegner S, et al. *Ophthalmology* 1996;103:1014–24; **3.** Kim SH, Park KH. *Ophthalmology* 2006;113:598–602.

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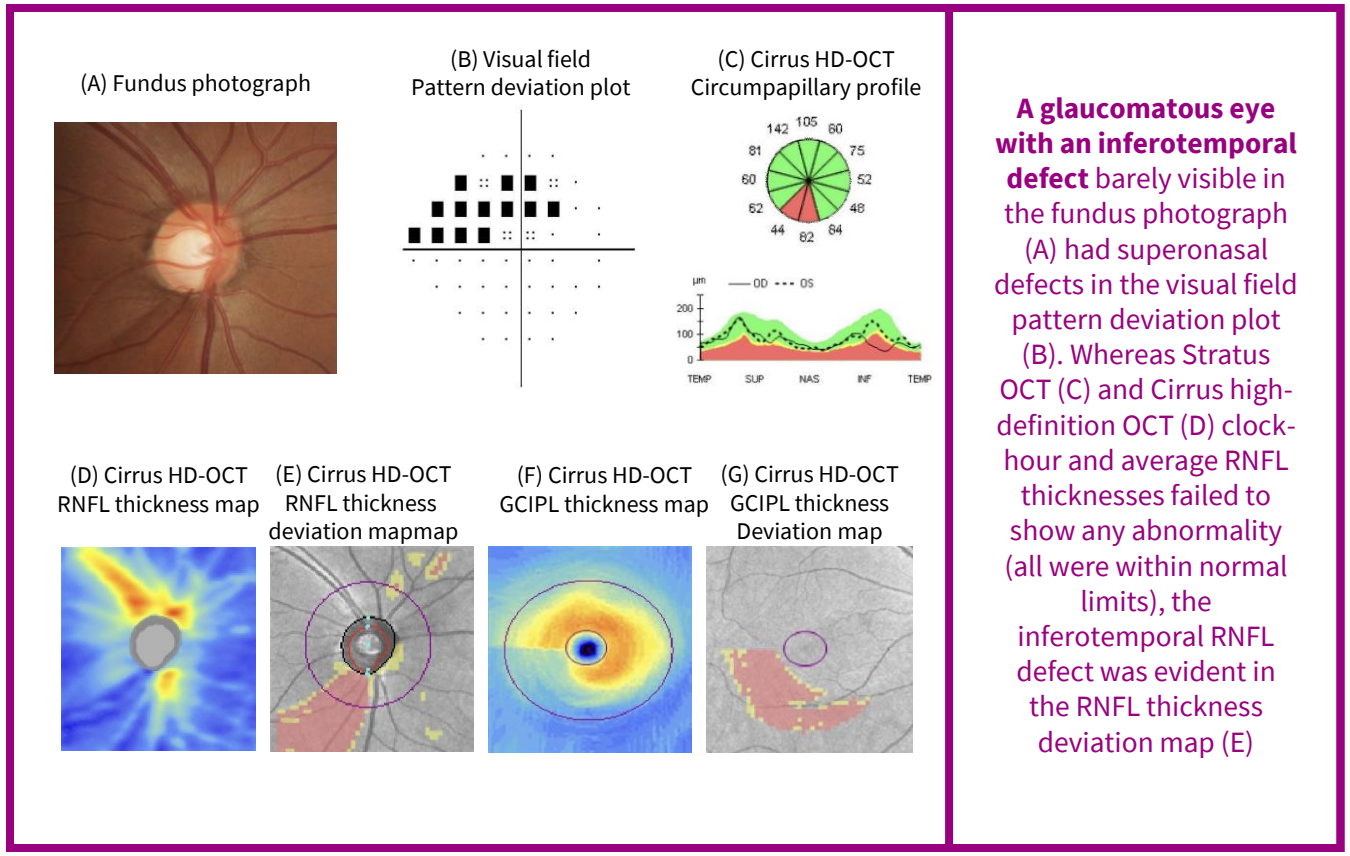
OCT-based assessment of RNFL and GCIPL

Thinning of the RNFL and GCIPL is a key diagnostic feature of glaucoma in OCT[1–5]

Standard OCT uses normative reference databases to report RNFL/GCIPL thickness outside the normal limits (below the 1st or 5th percentiles)[6,7]

RNFL optical texture analysis (ROTA):
A novel algorithm that integrates RNFL thickness and reflectance data without relying on the normative reference databases[8–10]



A glaucomatous eye with an inferotemporal defect barely visible in the fundus photograph (A) had superonasal defects in the visual field pattern deviation plot (B). Whereas Stratus OCT (C) and Cirrus high-definition OCT (D) clock-hour and average RNFL thicknesses failed to show any abnormality (all were within normal limits), the inferotemporal RNFL defect was evident in the RNFL thickness deviation map (E)

GCIPL: ganglion cell–inner plexiform layer; OCT: optical coherence tomography; RNFL: retinal nerve fiber layer; ROTA: RNFL optical texture analysis.

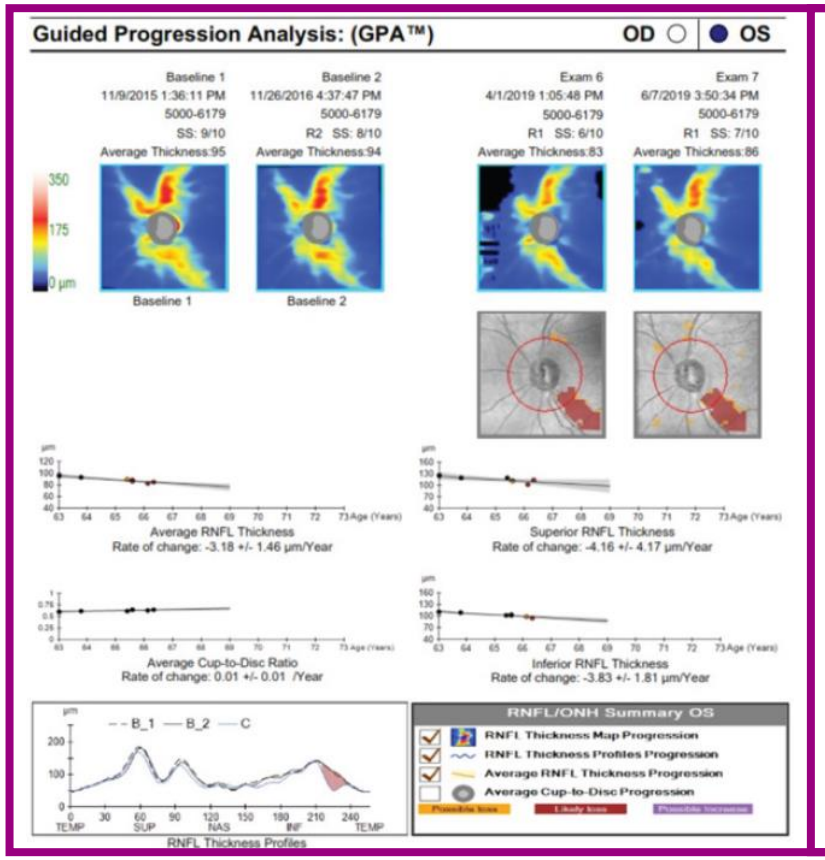
1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Quigley H. *Lancet* 2011;377:1367–77; **3.** Weinreb R, et al. *Nat Rev Dis Primers* 2016;2:16067; **4.** Kim YK, et al. *Ophthalmology* 2015;122:2252-60; **5.** Ha A, et al. *Am J Ophthalmol* 2020;219:205-14; **6.** Leung C, et al. *Ophthalmology* 2009;116:1257–63; **7.** Mwanza J, et al. *Invest Ophthalmol Vis Sci* 2011;52:8323–9; **8.** Leung C, et al. *Nat Biomed Eng* 2022;6:593–604; **9.** Leung C, et al. *Ophthalmology* 2022;129:1043–55; **10.** Su C, et al. *Ophthalmology* 2023;130:1080–9.

Assessment of progressive RNFL and GCIPL thinning

Both RNFL and GCIPL thinning are predictive of VF progression; including both is relevant to facilitate early detection of progression[1–3]

OCT progression analysis reports should be interpreted in the context of the entire clinical picture

OCT is a complementary tool rather than a replacement for a comprehensive clinical evaluation.



GPA of Cirrus high-definition OCT, showing structural progression on both event- and trend-based methods

GCIPL: ganglion cell–inner plexiform layer; GPA: Guided Progression Analysis; IOP: intraocular pressure; OCT: optical coherence tomography; RNFL: retinal nerve fiber layer; VF: visual field.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Lee WJ, et al. JAMA Ophthalmol 2018;136(10):1121-7; **3**. Hou H, et al. *Ophthalmology* 2018;125:822–31; **4.** Wu K, et al. *Ophthalmology* 2020;127:1322–30; **5.** Lin C, et al. *JAMA Ophthalmol* 2017;135:189–95; **6.** Leung C, et al. *Invest Ophthalmol Vis Sci* 2010;51:217–22; **7.** Lee WJ, et al. *Am J Ophthalmol* 2018;196:65–71.

Evaluation of glaucoma with OCTA

Peripapillary vessel density may better monitor advanced glaucoma progression, as OCTA vessel density reaches a lower measurement floor than RNFL thickness

Assoc. Prof. Suwan

OCTA may be useful for evaluating myopic glaucoma, as it is less affected by the low reflectance of the RNFL in myopia

OCTA is a non-invasive, dye-less technology capable of imaging large vessels as well as the microvasculature of the ONH and retina[1]

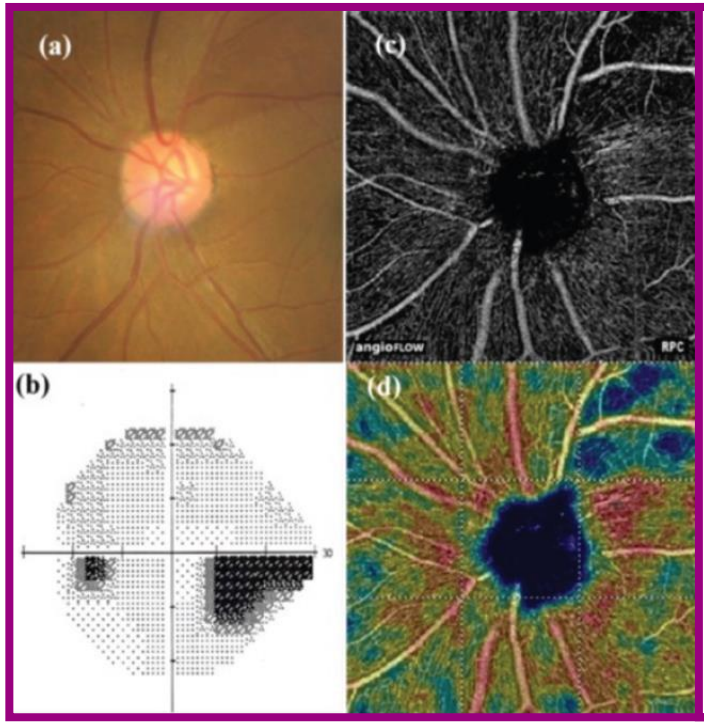
Check for reduced vessel density inside the ONH, peripapillary region, and macula of eyes with glaucoma[2–5]

Presence and enlargement of CMvD is associated with a **faster rate of RNFL thinning and VF progression**[6–10]

Limitations of OCTA:[1]

- Motion artifacts are more common
- Image quality can be affected by media opacities
- May not provide a comprehensive evaluation of the deeper retinal and choroidal vasculature due to projection artifacts

Superotemporal RNFL defect in can be seen in (a)



A glaucomatous left eye showing superior neuroretinal rim thinning with superotemporal RNFL defect (a) with correlating inferior nasal defect on VF (b). Optical coherence tomography angiography shows vessel density reduction in the corresponding topographic location (c), better appreciated on the heat map (d)

CMvD: choroidal microvasculature dropout; OCT: optical coherence tomography; OCTA: OCT angiography; ONH: optic nerve head; RNFL: retinal nerve fiber layer; VF: visual field.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Jia Y, et al. *Biomed Opt Express* 2012;3:3127–37; **3.** Jia Y, et al. *Ophthalmology* 2014; 121:1322–32; **4.** Liu L, et al. *JAMA Ophthalmol* 2015;133:1045–52; **5.** Yarmohammadi A, et al. *Invest Ophthalmol Vis Sci* 2016;57:OCT451–9; **6.** Park H, et al. *Ophthalmology* 2018;125:1003–13; **7.** Lin S, et al. *Invest Ophthalmol Vis Sci* 2019;60:838–42; **8.** Kim J, et al. *JAMA Ophthalmol* 2019;137:810–6; **9.** Kwon J, et al. *Am J Ophthalmol* 2019;200:65–75; **10.** Jo Y, et al. *Sci Rep* 2019;9:8525.

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VF testing in glaucoma

VF testing is essential for diagnosis, monitoring progression, and adjusting treatment strategies

The test strategy should be kept consistent for reliable comparison

In addition to standard 24° or 30° test, additional 10° test is beneficial for certain patients.

Assoc. Prof. Ko

Central VF testing: "Presence of central VF defect carries a high risk of future progression and visual acuity loss. Central VF test, including 10-2, or 24-2C, should be arranged in cases with glaucomatous structural damage on macular scans, when a detailed assessment of central vision loss is required, and for patients at higher risk of central visual field progression."

Interpreting VF test results

1. Test data elements:

- Numerical Threshold Map
- Grey Scale
- Total Deviation
- Pattern Deviation
- Probability Map

2. Reliability indices:

- Check false positives, fixation losses, gaze tracker
- Repeat test if results are unreliable

3. Summary indices:

- Mean Deviation (MD) – overall loss
- Visual Field Index (VFI) – central weighting
- Pattern Standard Deviation (PSD) – localized loss

OCT: optical coherence tomography; SAP: standard automated perimetry; SITA: Swedish Interactive Thresholding Algorithm; VA: visual acuity; VF: visual field.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Wu JH, et al. *J Glaucoma* 2023;32:549–55; **3.** Sullivan-Mee M, et al. *J Glaucoma* 2023;32:1–8; **4.** David RCC, et al. *Am J Ophthalmol* 2021;231:109–19; **5.** Park HY, et al. *Invest Ophthalmol Vis Sci* 2014;55:2557–63; **6.** Park HY, et al. *Am J Ophthalmol* 2012;154:466–75.e1; **7.** Leung CKS, et al. *Ophthalmology* 2022;129:1043–55.

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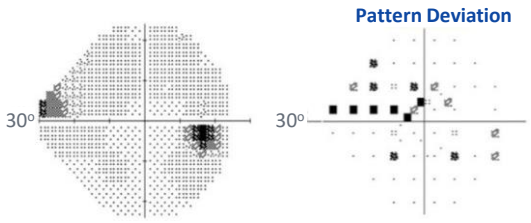
Recognizing glaucomatous VF defects

The criteria for identifying glaucomatous VF defects encompass:

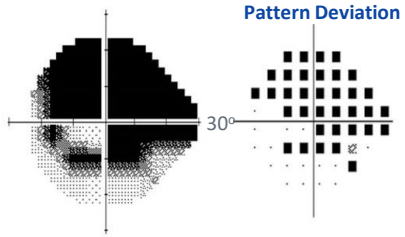
1. **A Glaucoma Hemifield Test 'outside normal limits',** or
2. **A cluster of three points with a probability <5%, including at least one point with a probability <1%,** or
3. **A PSD with a probability <5%**

The Hodapp's classification for staging the VF defects is structured as follows:

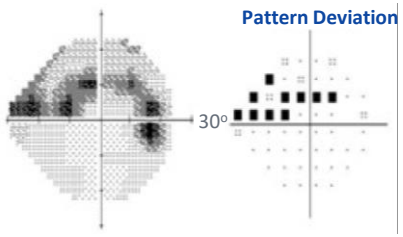
- **Early stage:** MD value greater than or equal to –6 dB
- **Moderate stage:** MD value between –12 and –6 dB
- **Severe stage:** MD value less than –12 dB



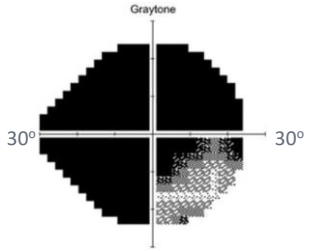
Nasal step visual field defect



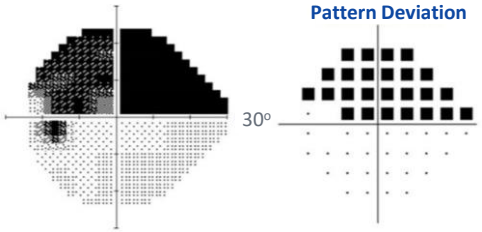
Double arcuate scotoma



Arcuate scotoma



Temporal and nasal defects



Hemifield visual field defect

MD: mean deviation; PSD: pattern standard deviation; SITA: Swedish Interactive Thresholding Algorithm; VF: visual field.

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Monitoring progression through VF analysis

Assoc. Prof. Ko

Initial frequent testing is essential to establish a baseline, after which the frequency should be tailored to the patient's initial findings, risk profile, and progression status. High-risk patients may require testing every 4–6 months, whereas low-risk patients may be tested annually[2–5]

Testing strategy should take the following factors into account:[1]

1. **Disease stage**
2. **Patient age**
3. **Current progression status**

The assessment of functional changes is primarily conducted through VF analysis[1]

VF progression includes

- Widening or deepening of pre-existing defects
- Emergence of new defects

Generalized depression across the VF suggests

- Cataracts
- Miosis
- Issues with test reliability
- Acute IOP elevation
- Uncorrected refractive error
- Ageing

GPA: Guided Progression Analysis; VF: visual field.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Melchior B, et al. *J Glaucoma* 2023;32:721–4; **3.** Wu Z, et al. *Ophthalmology* 2017;124:786–92; **4.** European Glaucoma Society Terminology and Guidelines for Glaucoma, 5th Edition. *Br J Ophthalmol* 2021;105(Suppl 1):1–169; **5.** Chauhan B, et al. *Br J Ophthalmol* 2008;92:569–73.

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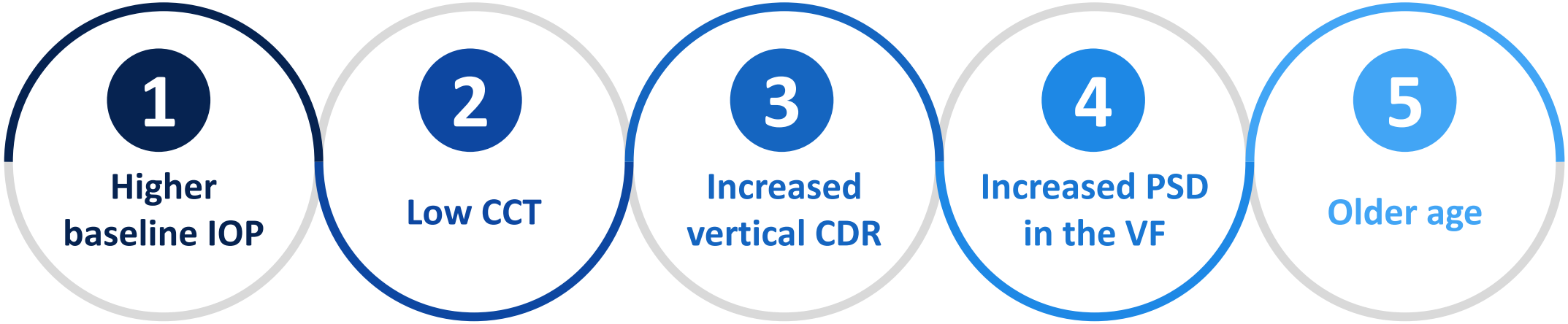
Risk factors for POAG development

Risk factors associated with the development of glaucoma from OHT:[1–3]



Other risk factors that play a significant role in POAG development:[3–15]

- Ethnic background
- Family history of glaucoma
- Rate of RNFL loss
- Low CSF pressure
- Myopia
- Low OPP
- Low SBP

CCT: central corneal thickness; CDR: cup-to-disc ratio; CSF: cerebrospinal fluid; IOP: intraocular pressure; OHT: ocular hypertension; OPP: ocular perfusion pressure; POAG: primary open-angle glaucoma; PSD: pattern standard deviation; RNFL: retinal nerve fibre layer; SBP: systolic blood pressure; VF: visual field.

1. Gordon MO, et al. *Arch Ophthalmol* 2002;120:714–20; **2.** Miglior S, et al. *Ophthalmology* 2007;114:3–9; **3.** Asia-Pacific Glaucoma Society (APGS). Asia-Pacific Glaucoma Guidelines. 4th ed. May 2024; **4.** Zhang N, et al. *Sci Rep* 2021;11:13762; **5.** Wolfs R, et al. *Arch Ophthalmol* 1998;116:1640–5; **6.** Miki A, et al. *Ophthalmology* 2014;121:1350–8; **7.** Marcus M, et al. *Ophthalmology* 2011;118:1989–94.e2; **8.** Topouzis F, et al. *Am J Ophthalmol* 2008;145:327–35; **9.** Zhang X, et al. *JAMA Ophthalmol* 2013;131:1198–206; **10.** Ren R, et al. *Ophthalmology* 2010;117:259–66; **11.** Tielsch J, et al. *Arch Ophthalmol* 1995;113:216–21; **12.** Zheng Y, et al. *Invest Ophthalmol Vis Sci* 2010;51:3399–404; **13.** Hayreh S, et al. *Am J Ophthalmol* 1994;117:603–24; **14.** Charlson M, et al. *Ophthalmology* 2014;121:2004–12; **15.** Flammer J, et al. *Prog Retin Eye Res* 2001;20:319–49.

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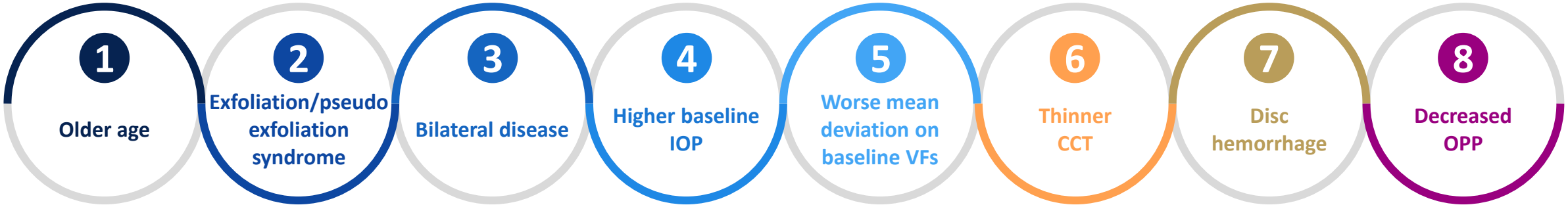
Risk factors for progression of OAG

Risk factors associated with glaucomatous progression[1–4]



Other risk factors that play a significant role in OAG progression:[3]*

- Rate of RNFL loss
- Myopia
- IOP fluctuations (only for low mean IOP)
- Longer follow-up
- Increased number of glaucoma interventions

*Some variables, such as longer follow-up duration and increased number of glaucoma interventions, can show statistical associations with glaucoma progression but may not always be independent risk factors. These associations may reflect detection bias or consequences of disease progression and should therefore be interpreted with caution.
CCT: central corneal thickness; IOP: intraocular pressure; OAG: open-angle glaucoma; OPP: ocular perfusion pressure; RNFL: retinal nerve fiber layer; VF: visual field.

1. The Advanced Glaucoma Intervention Study (AGIS). *Ophthalmology* 1998;105:1137–45; **2.** Heijl A, et al. *Arch Ophthalmol* 2002;120:1268–79; **3.** Garway-Heath DF, et al. *Ophthalmology* 2013;120:68–76; **4.** Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.

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Risk factors for PACD

Demographic[1–3]

- Older age
- East Asian ancestry
- Female
- Axial hyperopia

Anatomical[1,4]

- Small cornea
- Shallow central ACD
- Smaller anterior chamber volume
- Smaller anterior chamber area
- Thick lens
- Anterior lens position
- Thicker irises
- Greater iris curvature
- Greater lens vault
- Shorter axial length
- Narrower baseline mean angle width

Risk factors for progression from PACS to PAC/PACG[5–8]

- Older age
- Bilateral PACS
- Small anterior chamber angle width
- Flatter horizontal iris curvature
- Shallow limbal and central ACD

ACD: anterior chamber depth; PACD: primary angle-closure disease; PACS: primary angle-closure suspect.

1. Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024; **2.** Tham Y, et al. *Ophthalmology* 2014;121:2081–90; **3.** Cho H, Kee C. *Surv Ophthalmol* 2014;59:434–47; **4.** Zhang Y, et al. *Acta Ophthalmol* 2022;100:e253–61; **5.** Xu B, et al. *Ophthalmology* 2022;129:267–75; **6.** Thomas R, et al. *Acta Ophthalmol Scand* 2003;81:480–5; **7.** Thomas R, et al. *Br J Ophthalmol* 2003;87:450–4; **8.** Alsbirk P. *Int Ophthalmol* 1992;16:265–72.

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Diagnostic workup: Summary

1. GAT remains the gold standard for IOP measurement
2. Examination of the anterior chamber angle with gonioscopy is mandatory in diagnostic workup
3. Clinical examination of the optic disc is essential to discriminate GON from non-GON
4. VF testing is essential for diagnosis, monitoring progression, and adjusting treatment strategies
5. Major risk factors for the development of POAG include elevated IOP, thinner CCT, and increased age, CDR, and VF PSD pattern standard deviation

CCT: central corneal thickness; CDR: cup-to-disc ratio; GAT: Goldmann applanation tonometry; GON: glaucomatous optic neuropathy; IOP: intraocular pressure; POAG: primary open-angle glaucoma; VF: visual field.

Asia–Pacific Glaucoma Society (APGS). Asia–Pacific Glaucoma Guidelines. 4th ed. May 2024.