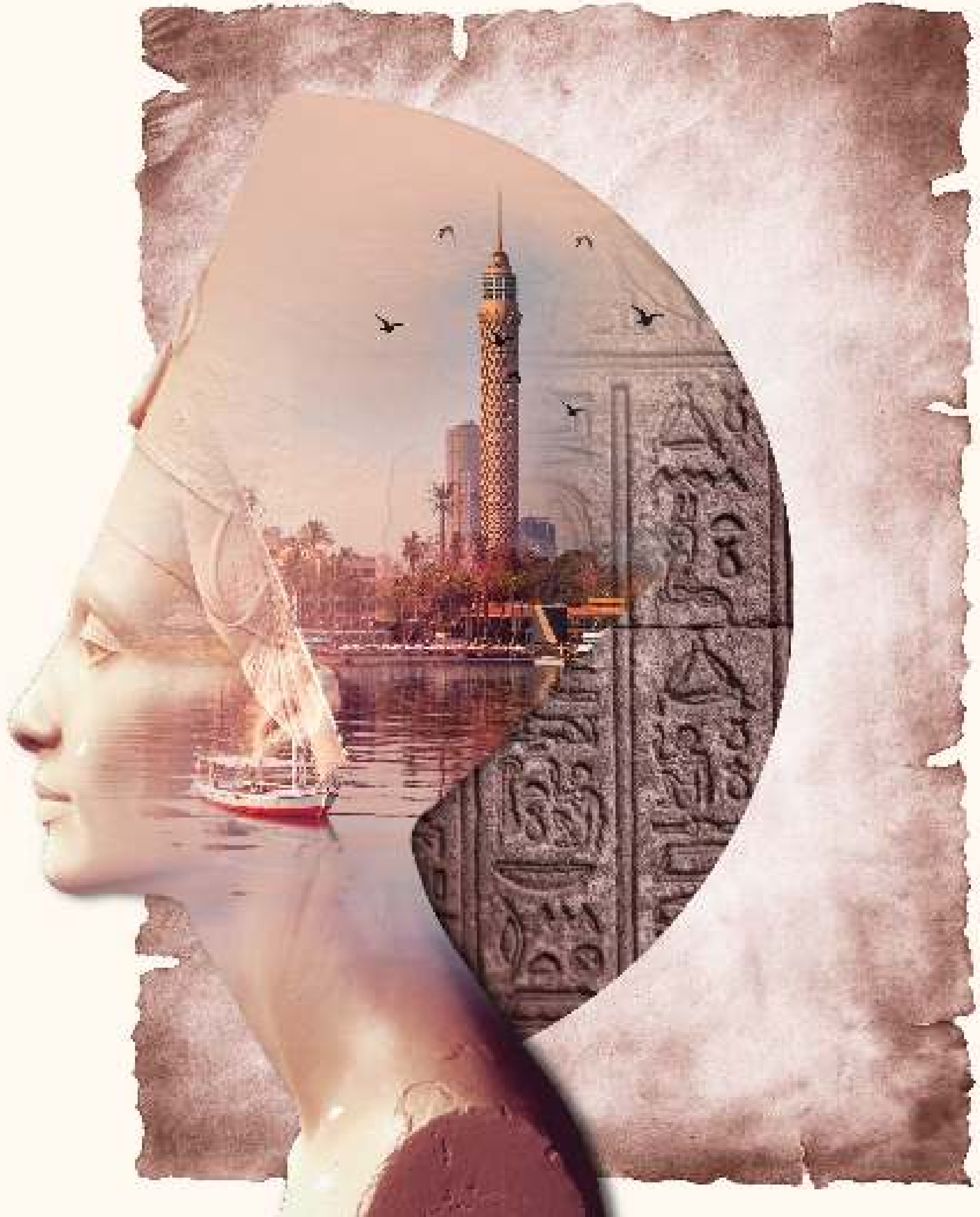
INTERNATIONAL CONGRESS OF THE EGYPTIAN OPHTHALMOLOGICAL SOCIETY

EOS 1902

In collaboration with: MEACO

Trends in Visual field



Prepared by

Muhammad Ali Abouhamid

Lecturer of Ophthalmology, Tanta University

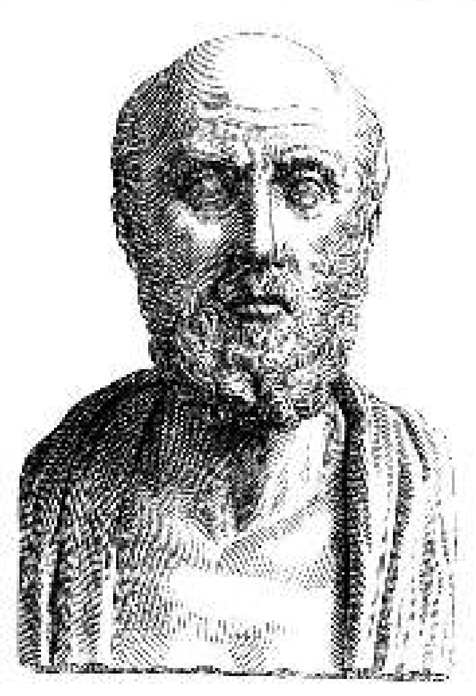
No financial interests to disclose


The
past

The past

Hippocrates was the first to describe a VF defect;

Contralateral hemianopia in brain lesions



450 BC

The past

Ptolemy described VF to be *circular*

150 BC

The past

Leonardo da Vinci recognized that *temporal VF is beyond 90 degrees*

“The eye sees those objects behind it that are placed in lateral areas.“

(Manuscript D. folio 8 verso)

1510

The past

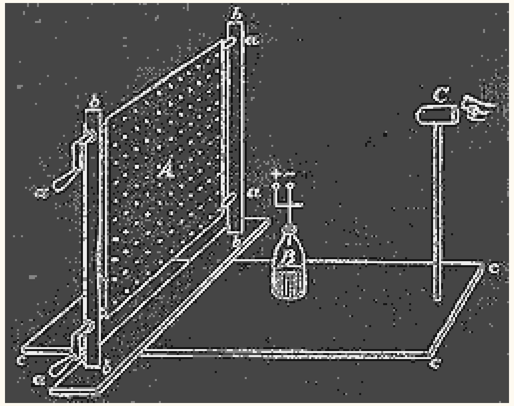
Thomas Young made the first *accurate VF measurements*

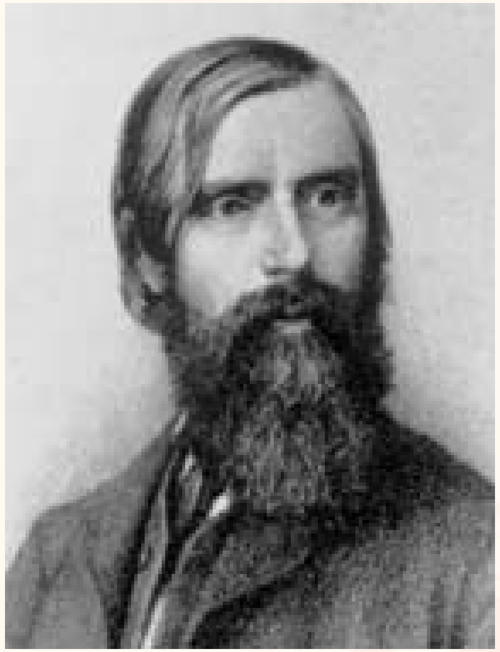
"The visual axis being fixed in any direction, I can at the same time see a luminous object placed laterally at a considerable distance from it, but in various directions the angle is very different. Upwards it extends to 50 degrees, inwards to 60 degrees, downwards to 70 degrees and outwards to 90 degrees."

1801

Von Graefe made the first perimetry;

a blackboard as a tangent screen



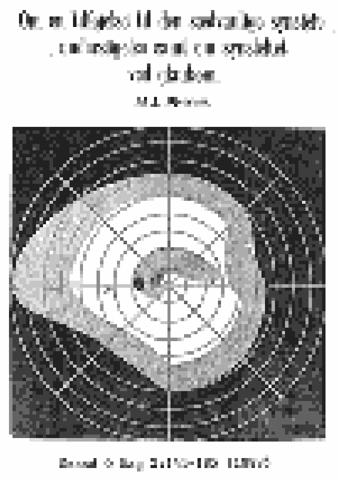


1855

The past

Bjerrum reintroduced central VF testing

Campimetry

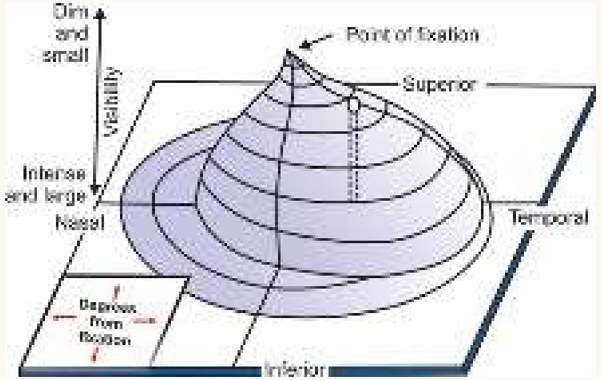


1889

The past

Traquair described

the hill of vision



1914

The past

Hans Goldmann devised the first standardized perimeter;

The Goldman kinetic perimeter

1945

The past

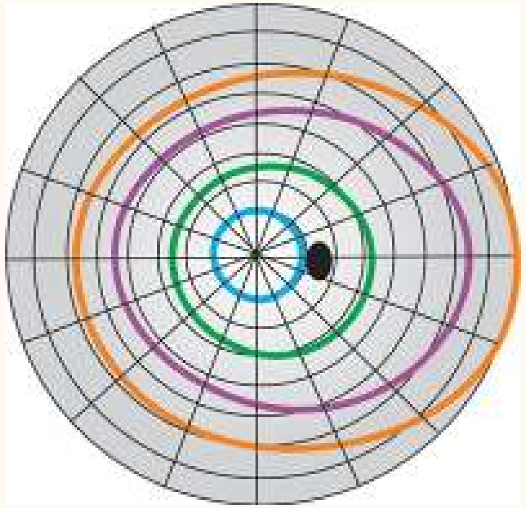
Anders Heijl developed a static perimetry

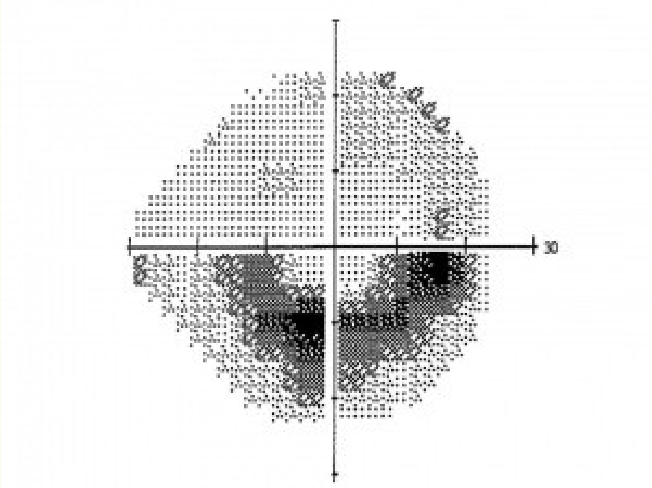
the Humphrey Field Analyzer

(HFA)

1970s

Kinetic perimetry	Static perimetry
Drawing isopters (from outside)	Drawing a map (from inside)
Moving from non-seeing to seeing	Differential light sensitivity





The present

=The age of automation

Humphery/Octopus →

static automated perimetry (SAP)

The gold standard

1980s

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The present

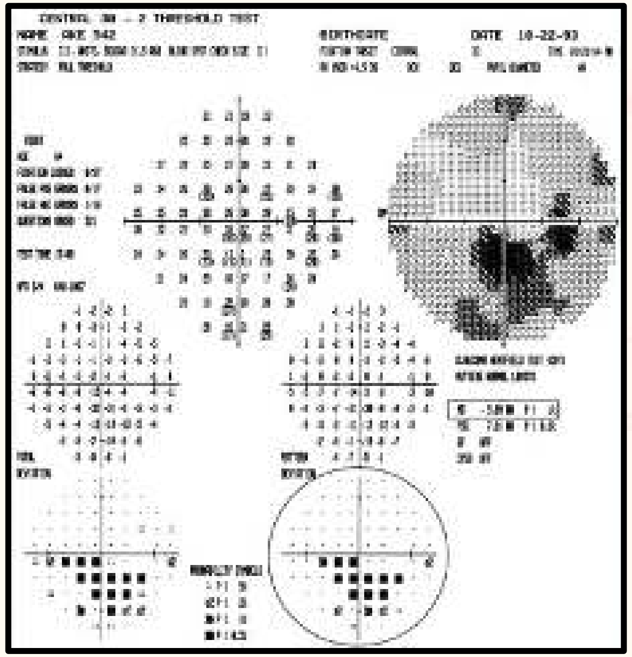
SAP

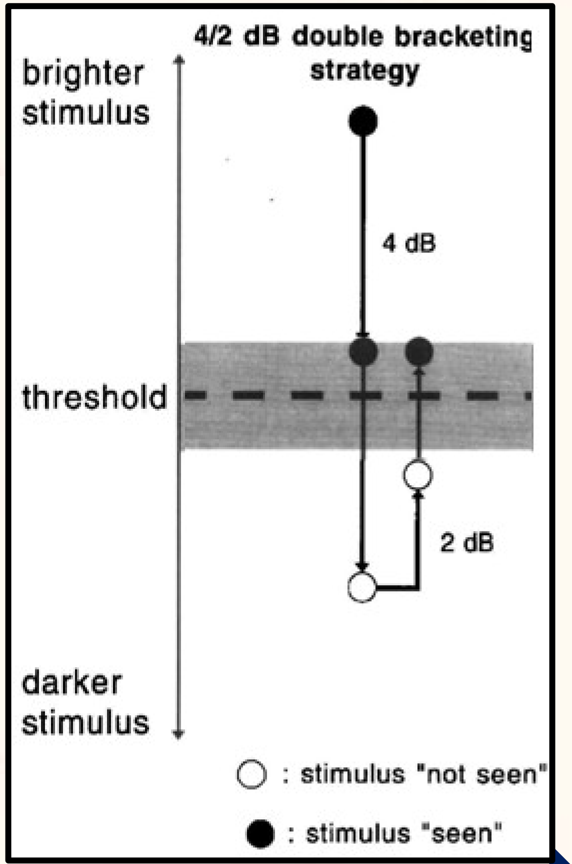
Full threshold test

All points tested similarly,

Small steps (as small as 2 dBs),

Double crossing/bracketing





10-15 minutes per eye

1980s

Heijl A, Patella VM, Bengtsson B. Excellent Perimetry; the Field Analyzer Primer. 5th ed., Carl Zeiss Meditec, Inc.; 2021.

The present

SAP

FASTPAC test

Start with 4 Cardinal points =full threshold,

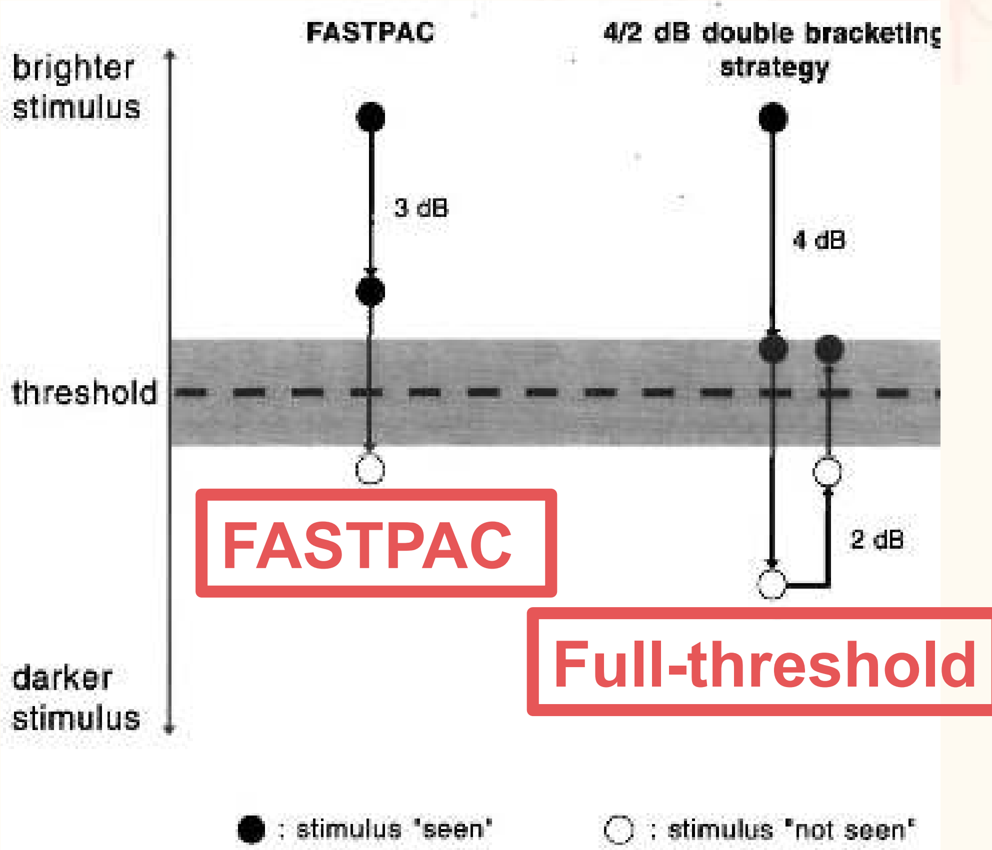
Then →

small fixed steps,

single crossing

8-10 minutes per eye (35% shorter)

Higher fluctuation (25%)



1980s

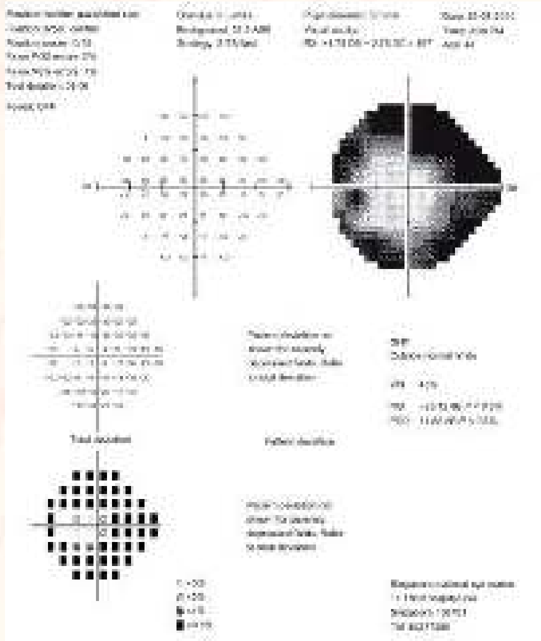
Schaumberger M, Schäfer B, Lachenmayr BJ. Glaucomatous visual fields. FASTPAC versus full threshold strategy of the Humphrey Field Analyzer. Invest Ophthalmol Vis Sci. 1995 Jun;36(7):1390-7. PMID: 7775117.

The present

SAP

SITA

(Swedish Interactive Threshold Algorithm)



Statistically sophisticated algorithms to calculate expected thresholds → testing starts at closer points

Once an "information index" reaches a pre-determined confidence limit, it moves to another point.

SITA-Standard: 4-2 dB steps ≈ Full-threshold (7 minutes)*

SITA-Fast: 4 dB steps ≈ FASTPAC (4 minutes)*

1990s

Wild JM, Pacey IE, O'Neill EC, Cunliffe IA. The SITA perimetric threshold algorithms in glaucoma. Invest Ophthalmol Vis Sci. 1999 Aug;40(9):1998-2009. PMID: 10440254.

The present

SAP

SITA

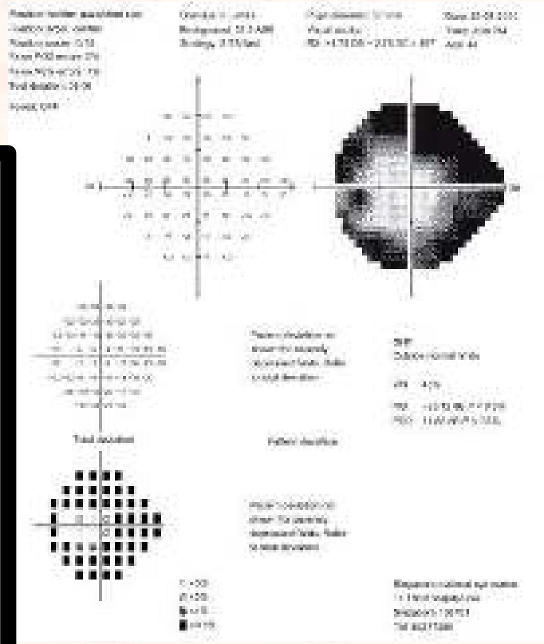
(Swedish Interactive Threshold Algorithm)

Statistically sophis

expected threshol

Once an "information index" reaches

Good time/reliability trade-off



SITA-Standard: 4-

SITA-Fast: 4 dB st

1990s

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Wild JM, Pacey IE, O'Neill EC, Cunliffe IA. The SITA perimetric threshold algorithms in glaucoma. Invest Ophthalmol Vis Sci. 1999 Aug;40(9):1998-2009. PMID: 10440254.

The present

SWAP

(Short-wavelength automated perimetry)

-Addressing the issue of RGC redundancy

(responsible for the early structure-function discrepancy)

-Selective testing of the Koniocellular pathway

(blue stimulus on a yellow background)

-Improved sensitivity and earlier glaucoma detection but with

several limitations ⚠

2000s

Demirel S, Johnson CA. Incidence and prevalence of short wavelength automated perimetry deficits in ocular hypertensive patients. Am J Ophthalmol. 2001 Jun;131(6):709-15. doi: 10.1016/s0002-9394(00)00946-6. PMID: 11384565.

The present

FDT

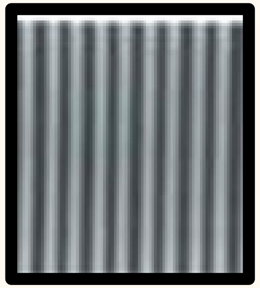
(Frequency doubling perimetry)

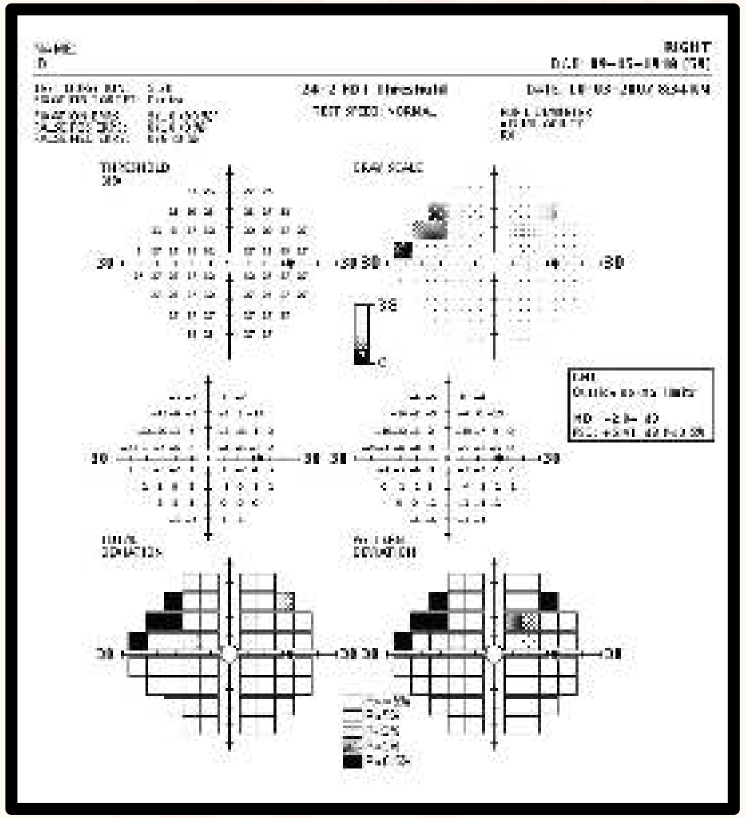
-Selective testing of the Magnocellular pathway

(stimuli of low spatial frequency and high temporal frequency)

-Improved sensitivity, portability

- Shorter duration, less affection by optical blurring





-Uses larger steps that may miss minor changes , not inter-changable with SAP

2000s

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Doozandeh A, Irandoost F, Mirzajani A, Yazdani S, Pakravan M, Esfandiari H. Comparison of Matrix Frequency-Doubling Technology (FDT) Perimetry with the SWEDISH Interactive Thresholding Algorithm (SITA) Standard Automated Perimetry (SAP) in Mild Glaucoma. Med Hypothesis Discov Innov Ophthalmol. 2017 Fall;6(3):98-104. PMID: 29392149; PMCID: PMC5787029.

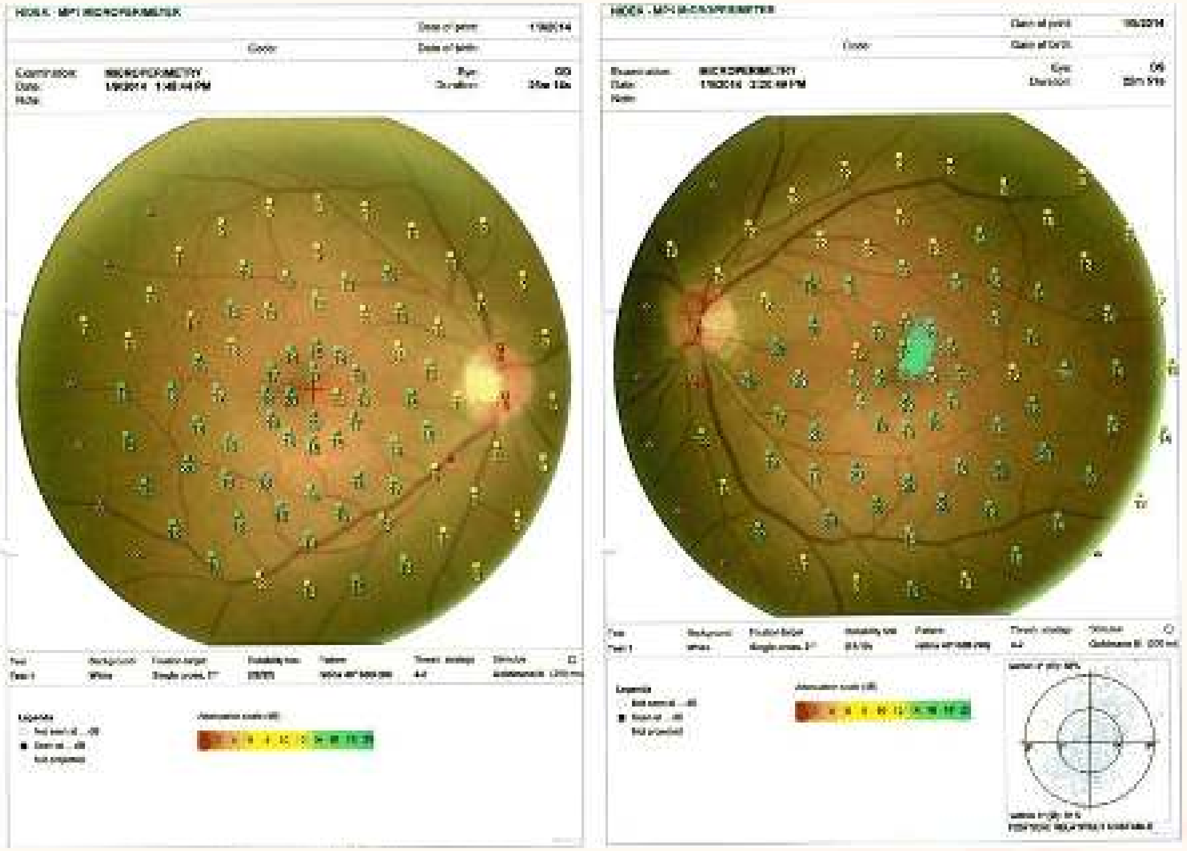
The present

Microperimetry

(Fundus perimetry)

-Combine the anatomical (non-myriatic fundu
camera) and functional assessment (SAP) o
the **retina** in one device

-Enables gaze tracking



2005

Molina-Martín A, Pérez-Cambrodí RJ, Piñero DP. Current Clinical Application of Microperimetry: A Review. Semin Ophthalmol. 2018;33(5):620-628. doi: 10.1080/08820538.2017.1375125. Epub 2017 Oct 9. PMID: 28991503.

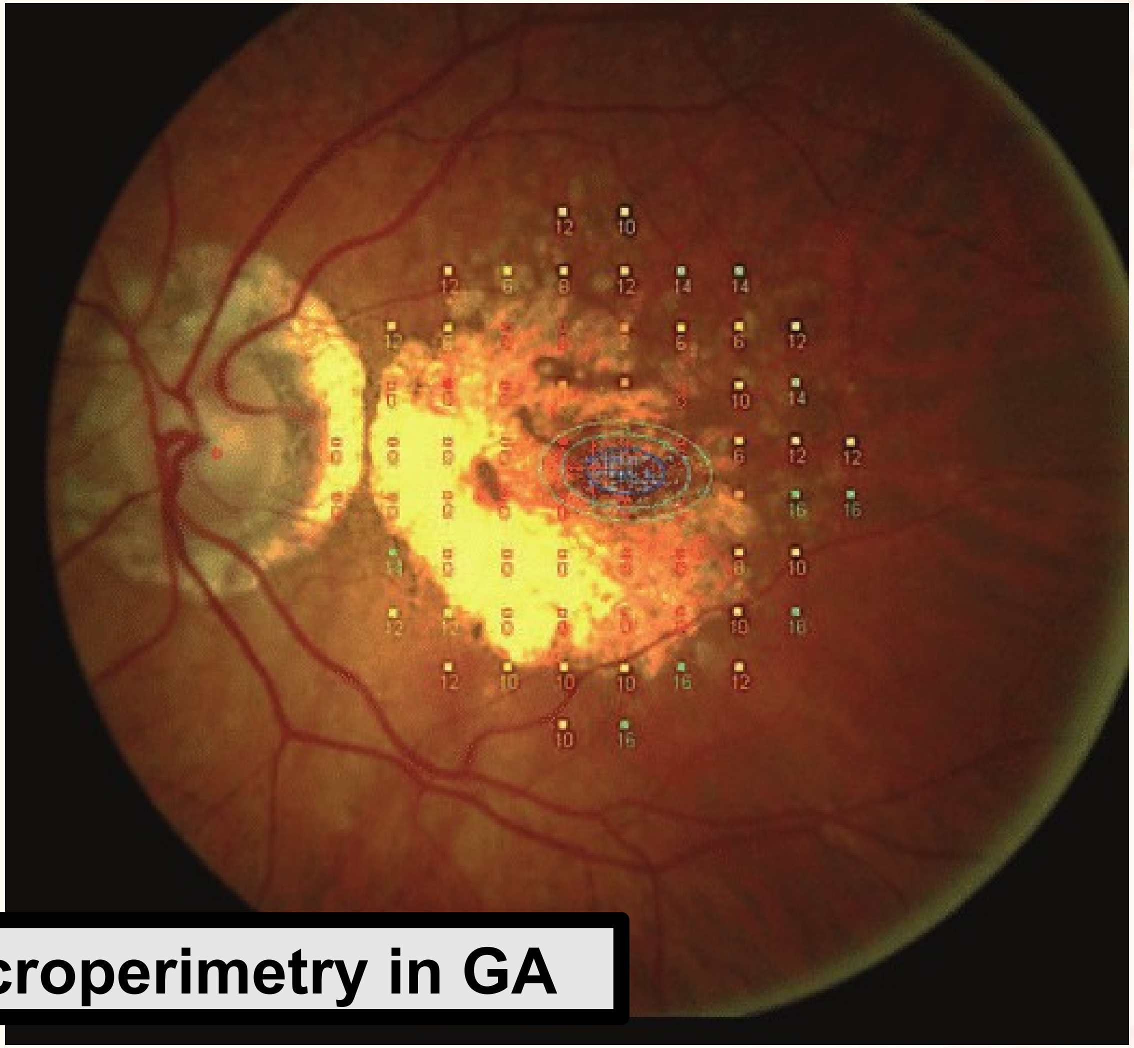
The present

Microperimetry

(Fundus perimetry)

-Limited field (the macula) →

Main use in macular pathologies



Microperimetry in GA

2005

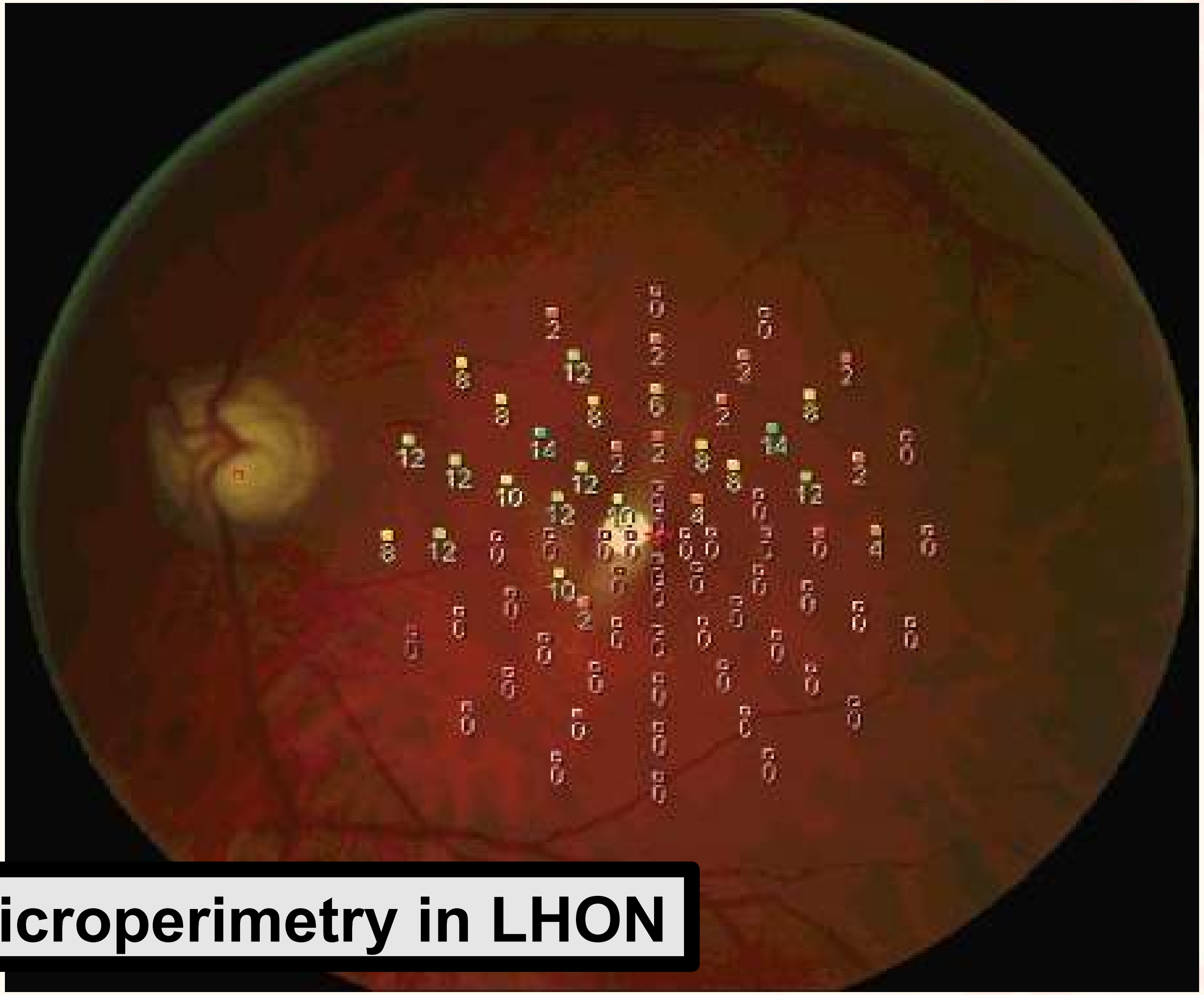
Molina-Martín A, Pérez-Cambrodí RJ, Piñero DP. Current Clinical Application of Microperimetry: A Review. Semin Ophthalmol. 2018;33(5):620-628. doi: 10.1080/08820538.2017.1375125. Epub 2017 Oct 9. PMID: 28991503.

The present

Microperimetry

(Fundus perimetry)

In optic neuropathies with
fixation instability
e.g. Hereditary optic neuropathies



Microperimetry in LHON

2005

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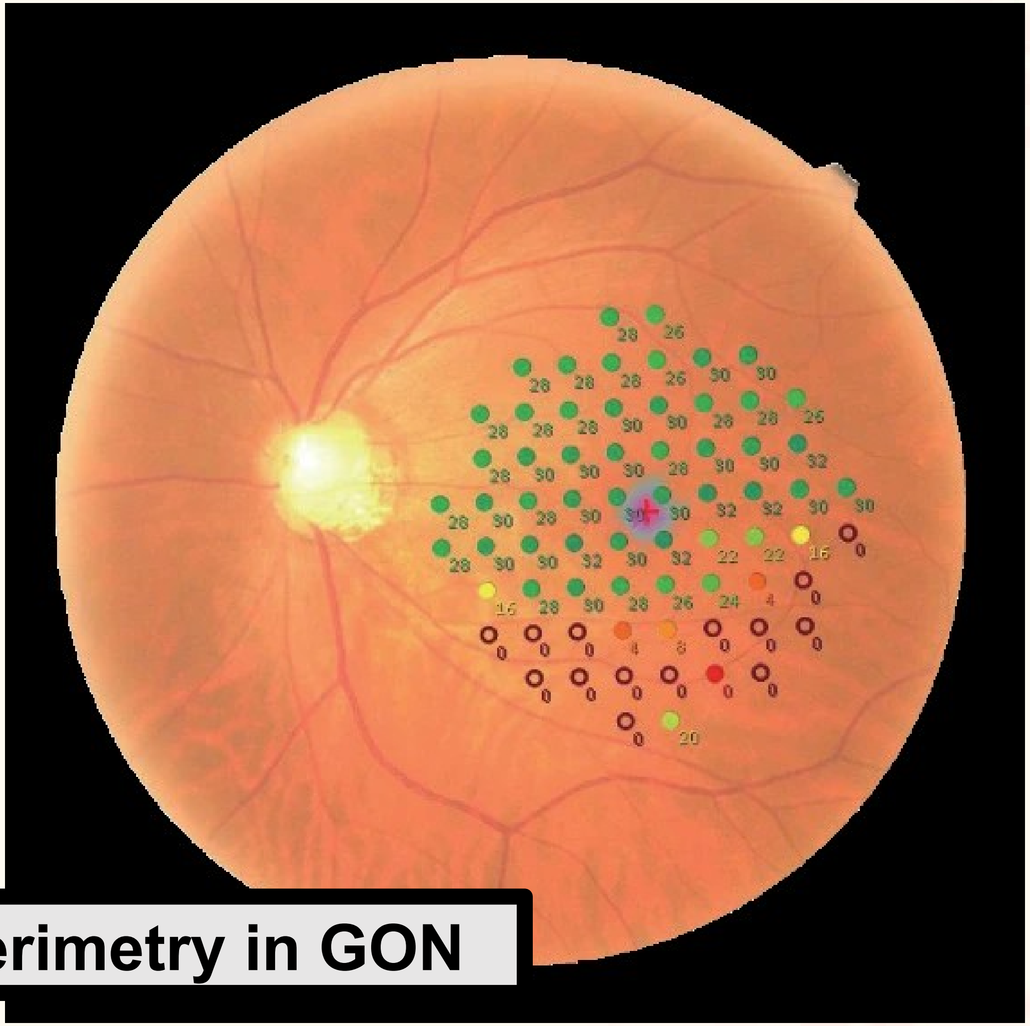
Molina-Martín A, Pérez-Cambrodí RJ, Piñero DP. Current Clinical Application of Microperimetry: A Review. Semin Ophthalmol. 2018;33(5):620-628. doi: 10.1080/08820538.2017.1375125. Epub 2017 Oct 9. PMID: 28991503.

The present

Microperimetry

(Fundus perimetry)

In optic neuropathies with
fixation instability
e.g. Glaucoma (early/late)



Microperimetry in GON

2005

Molina-Martín A, Pérez-Cambrodí RJ, Piñero DP. Current Clinical Application of Microperimetry: A Review. Semin Ophthalmol. 2018;33(5):620-628. doi: 10.1080/08820538.2017.1375125. Epub 2017 Oct 9. PMID: 28991503.

The present

SAP

SITA-Faster

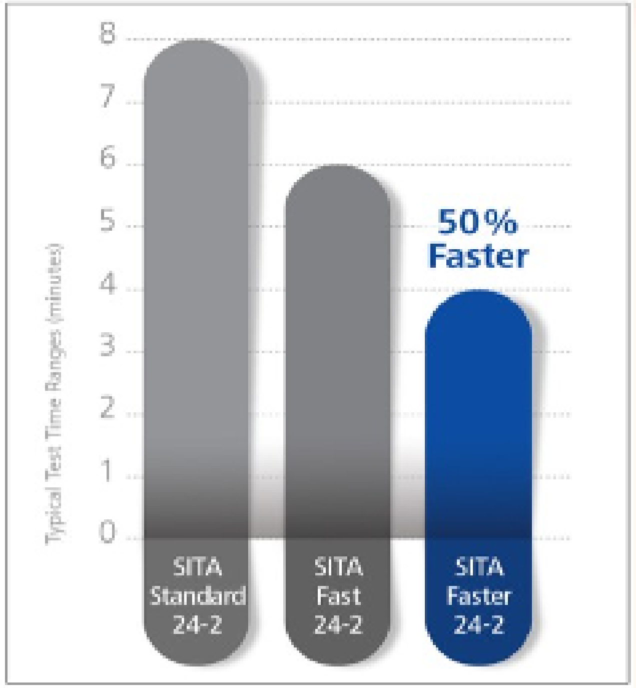
FAST → FASTER

Cardinal points and blind spot tested only once

No false negative testing

Gaze tracking only, no blind spot monitoring

Removing delay after unseen stimuli



2 minutes per eye

50% < SITA-Standard – 30%< of SITA-Fast

2010

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Heijl A, Patella VM, Chong LX, Iwase A, Leung CK, Tuulonen A, Lee GC, Callan T, Bengtsson B. A New SITA Perimetric Threshold Testing Algorithm: Construction and a Multicenter Clinical Study. Am J Ophthalmol. 2019 Feb;198:154-165. d 10.1016/j.ajo.2018.10.010. Epub 2018 Oct 16. PMID: 30336129.

The present

SITA **Faster** vs. SITA-standard:

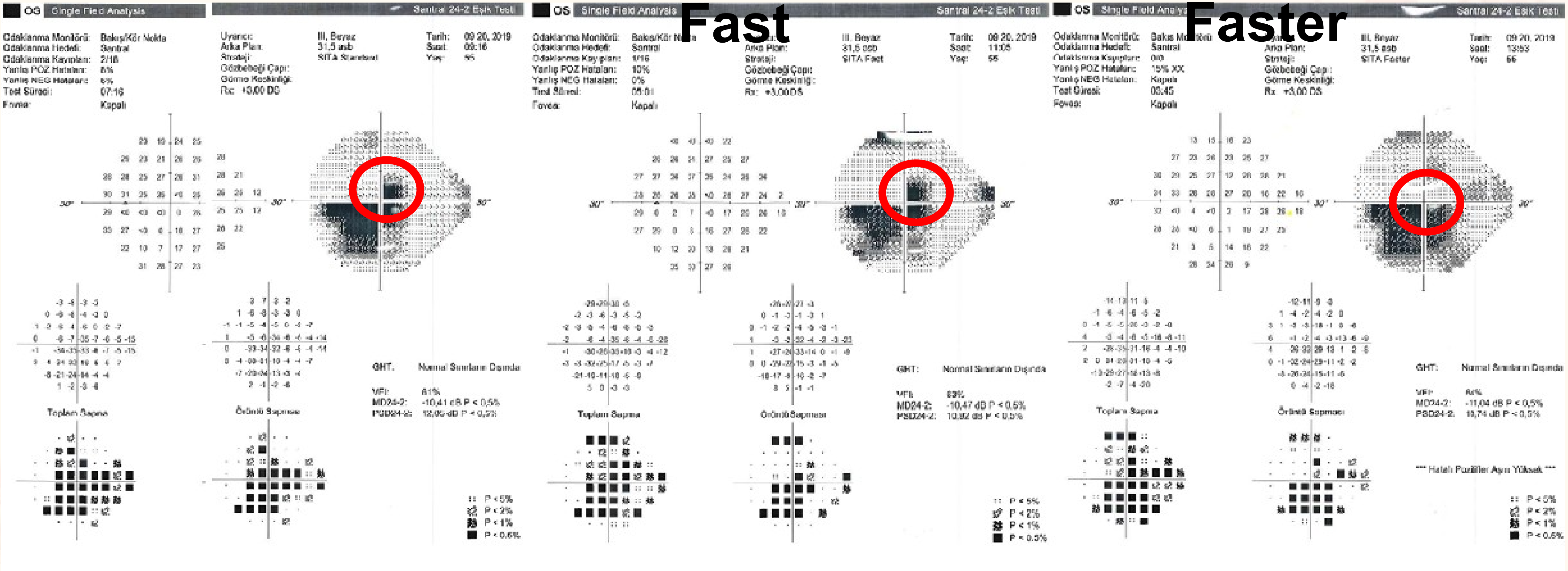
Significant differences in MD, foveal threshold, and number of points (P<0.5%) on PSD → VF defects appear **smaller**

SITA **Fast** vs. SITA-standard

Comparable results

Patyel S Thulasidas M. Comparison of 24-2 faster, fast, and standard programs of Swedish interactivethreshold algorithm of Humphrey field analyzer for perimetry in patients with manifest and suspect glaucoma. J Glaucoma. September 3, 2020. [Epub ahead of print].

SITA-Standard | SITA-Fast | SITA-Faster



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Köksaldı S, Arıkan G, Dadaş ÖF, Günenç Ü. Comparison of Humphrey 24-2 SITA Standard, SITA Fast, and SITA Faster Test Strategies in Patients with Glaucoma. Turk J Ophthalmol. 2025 Apr 24;55(2):67-73. doi: 10.4274/tjo.galenos.2025.85666. PMID: 40272077; PMCID: PMC12035064.

The present

Applying SITA Standard MD cutoffs to newer protocols can lead to misdiagnosis

Glaucoma Staging by HPA Criteria with Proposed Modifications

	Early	Moderate	Severe
SITA Standard (HPA)	below -6 dB	between -6 and -12 dB	above -12 dB
SITA Fast (proposed)	below -5.3 dB	between -5.3 and -10.8 dB	above -10.8 dB
SITA Faster (proposed)	below -5.2 dB	between -5.2 and -10 dB	above -10 dB

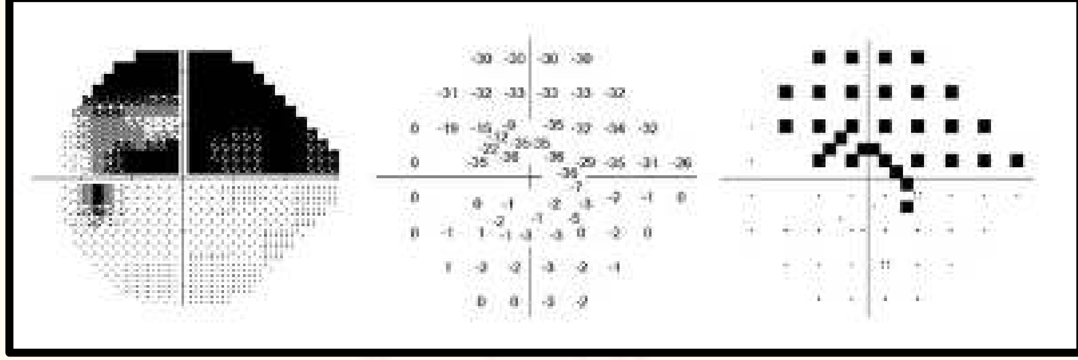
Bradley C, Almidani L, Herbert P, Yohannan J. Estimating percent misdiagnosis when applying SITA-Standard criteria to SITA-Fast and SITA-Faster. ARVO 2024 annual meeting.

The present

SAP

24-2C

-Merged 10 additional points from the 10-2 test into the 24-2 grid.



*-**Why?** Because in mild glaucoma, central field defects may appear only on 10-2 but not 24-4.*

10-2 testing act as a functional vulnerability zone.

-With fast(ER) → Shorter time than each of 24-2 and 10-2 tests.

	Testing Time	P Value
24-2 SITA Standard (s)	308 (302-315)	
10-2 SITA Standard	343 (334-353)	
24-2C SITA Faster	165 (161-170)	<.001,[a] <.001[b]

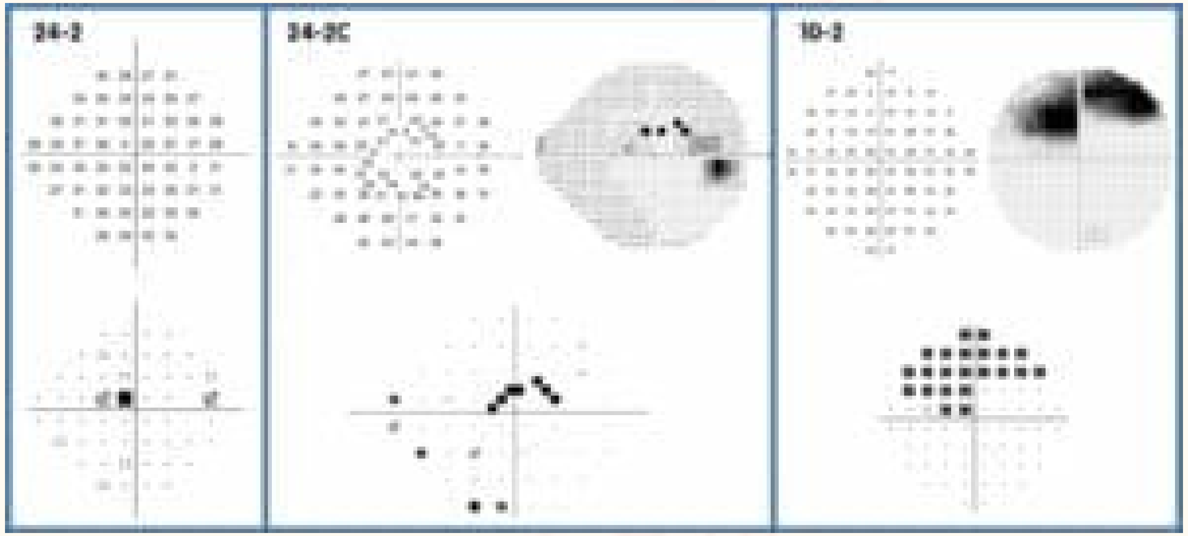
2019

Nishijima E, Fukai K, Sano K, Noro T, Ogawa S, Okude S, Tatemichi M, Lee GC, Iwase A, Nakano T. Comparative Analysis of 24-2C, 24-2, and 10-2 Visual Field Tests for Detecting Mild-Stage Glaucoma With Central Visual field Defects. Am J Ophthalmol. 2024 Dec;268:275-284. doi: 10.1016/j.ajo.2024.07.024. Epub 2024 Aug 2. PMID: 39094994.

The present

SAP

24-2C



Vs. 24-2:

Identifies more central VF defects

Achieves higher structure-function concordance.

Vs. 10-2:

*24-2C is useful in **flagging** the presence of a clustered central VF defect, but 10-2 should be used to more comprehensively characterize it.*

2019

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Nishijima E, Fukai K, Sano K, Noro T, Ogawa S, Okude S, Tatemichi M, Lee GC, Iwase A, Nakano T. Comparative Analysis of 24-2C, 24-2, and 10-2 Visual Field Tests for Detecting Mild-Stage Glaucoma With Central Visual field Defects. Am J Ophthalmol. 2024 Dec;268:275-284. doi: 10.1016/j.ajo.2024.07.024. Epub 2024 Aug 2. PMID: 39094994.

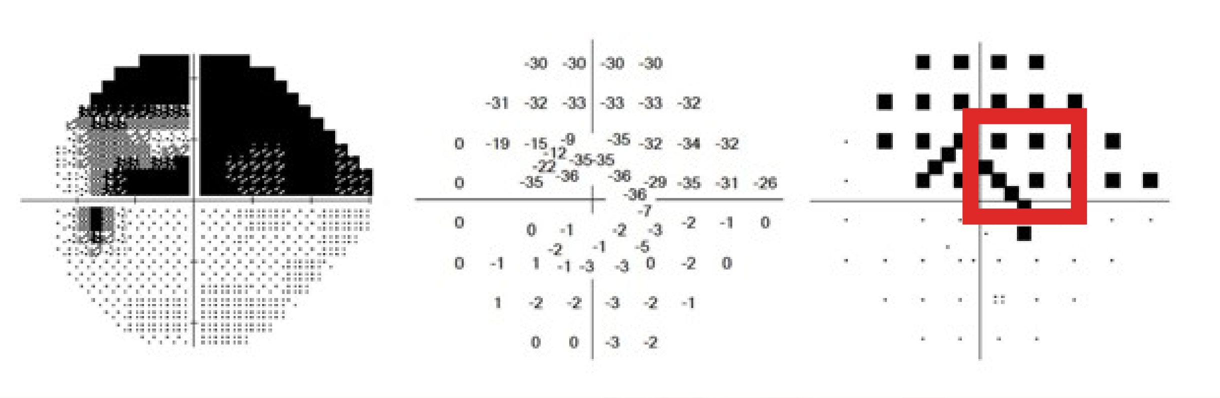
The present

SAP

24-2C

- *Available as SITA-standard, SITA-fast and SITA-faster 24-2C.*

- *The asymmetrical distribution of points (the* ***slope****) is an concern.*



2019

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More

Objectivity

Patient engagement

Feasibility/portability

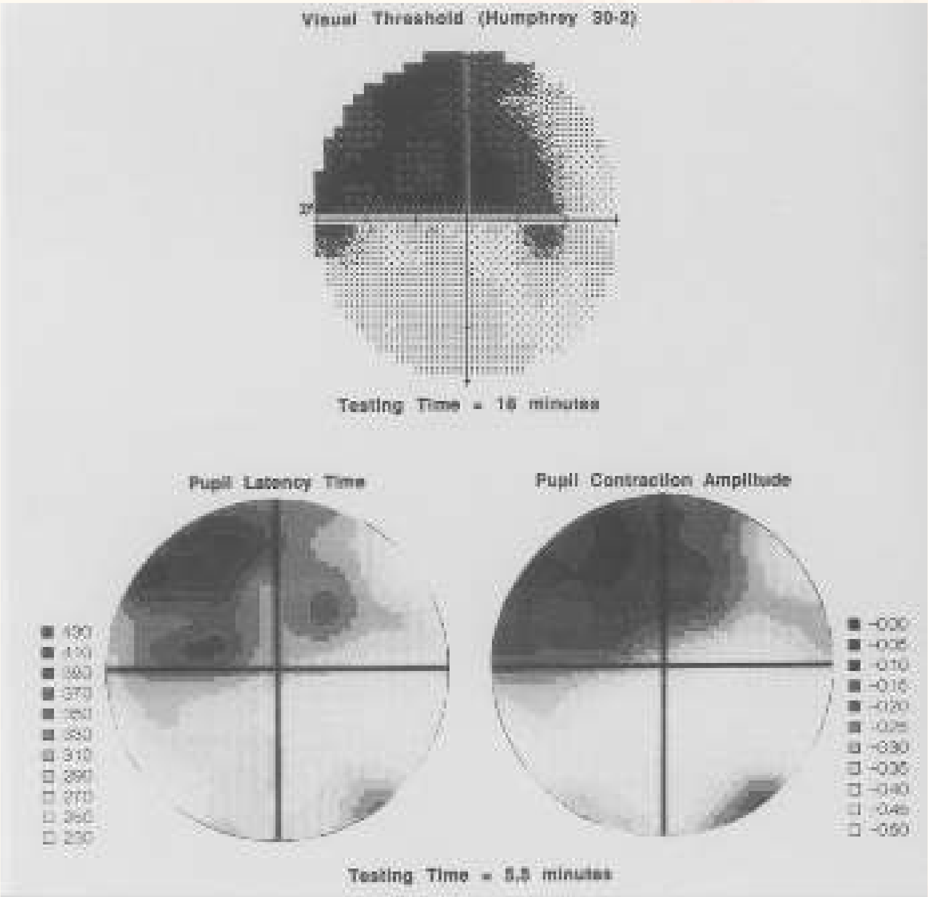
is needed


Welcome To
The Future

Pupil perimetry

-Instead of relying on patient's response, ***Infrared tracing*** of pupillary size to measure latency and amplitude

- Linked to a HFA



1991

First pupil perimetry

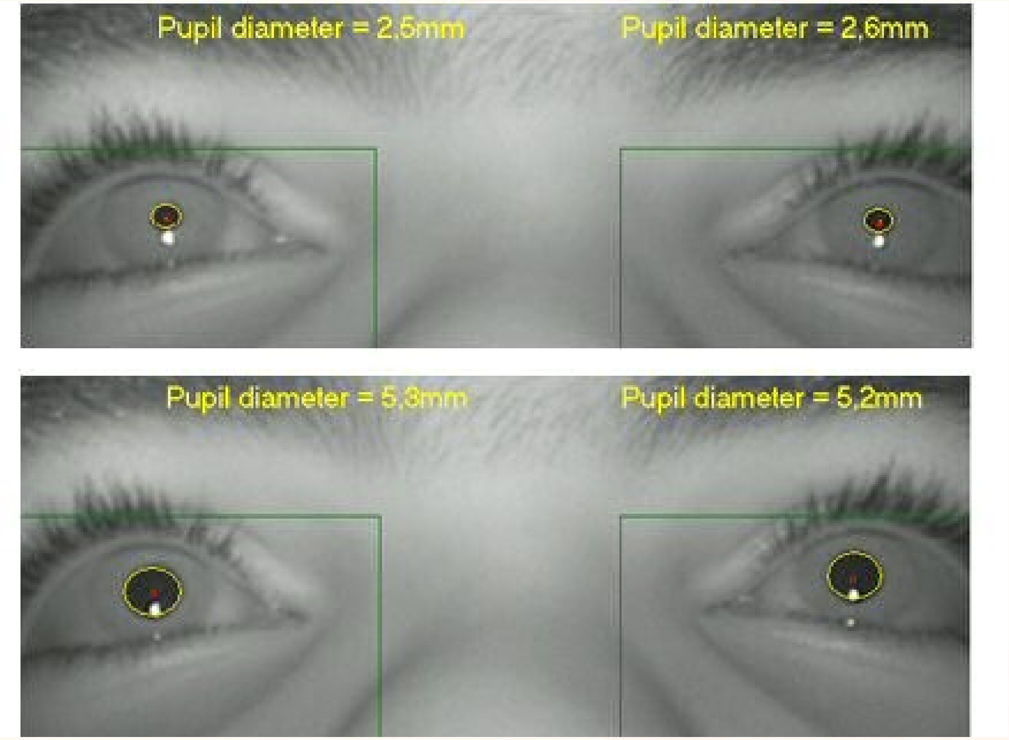
Kardon RH, Kirkali PA, Thompson HS. Automated pupil perimetry. Pupil field mapping in patients and normal subjects. Ophthalmology. 1991 Apr;98(4):485-95; discussion 495-6. doi: 10.1016/s0161-6420(91)32267-x. PMID: 2052302.

Pupil perimetry

-Testing of koniocellular and parvocellular pathways using **rapid colored stimuli,** avoiding the slow mid-brain pathway

-Despite the inter-subject variability, the intra-subject agreement is **very high**

-Only **one** functional pupil is needed



Rai BB, Sabeti F, Carle CF, Maddess T. Visual Field Tests: A Narrative Review of Different Perimetric Methods. J Clin Med. 2024 Apr 23;13(9):2458. doi: 10.3390/jcm13092458. PMID: 38730989; PMCID: PMC11084906.

The future

Pupil perimetry

objectiveFIELD Analyzer (OFA), *by Konan*

FDA cleared

Multifocal pupillographic objective perimetry

2019

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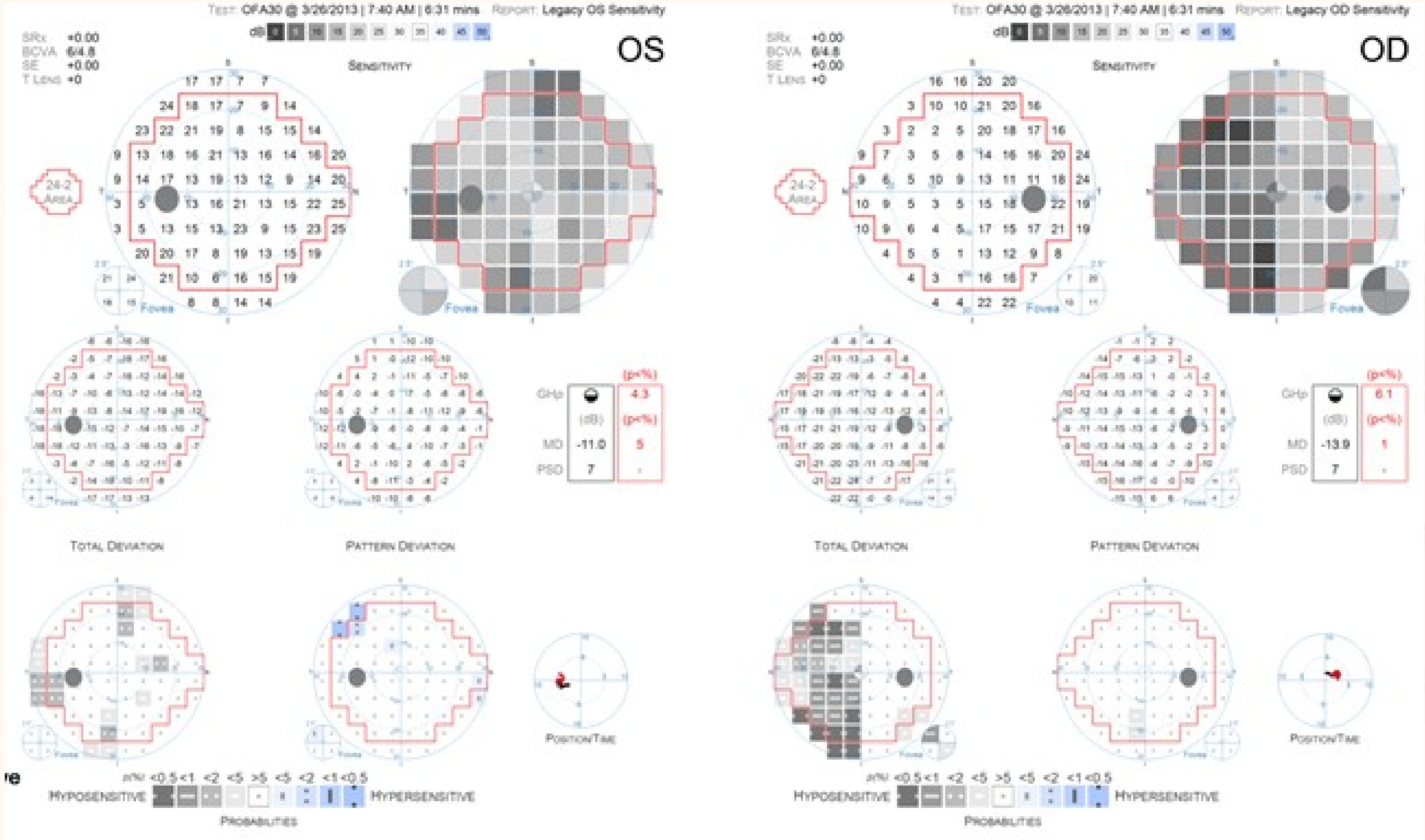
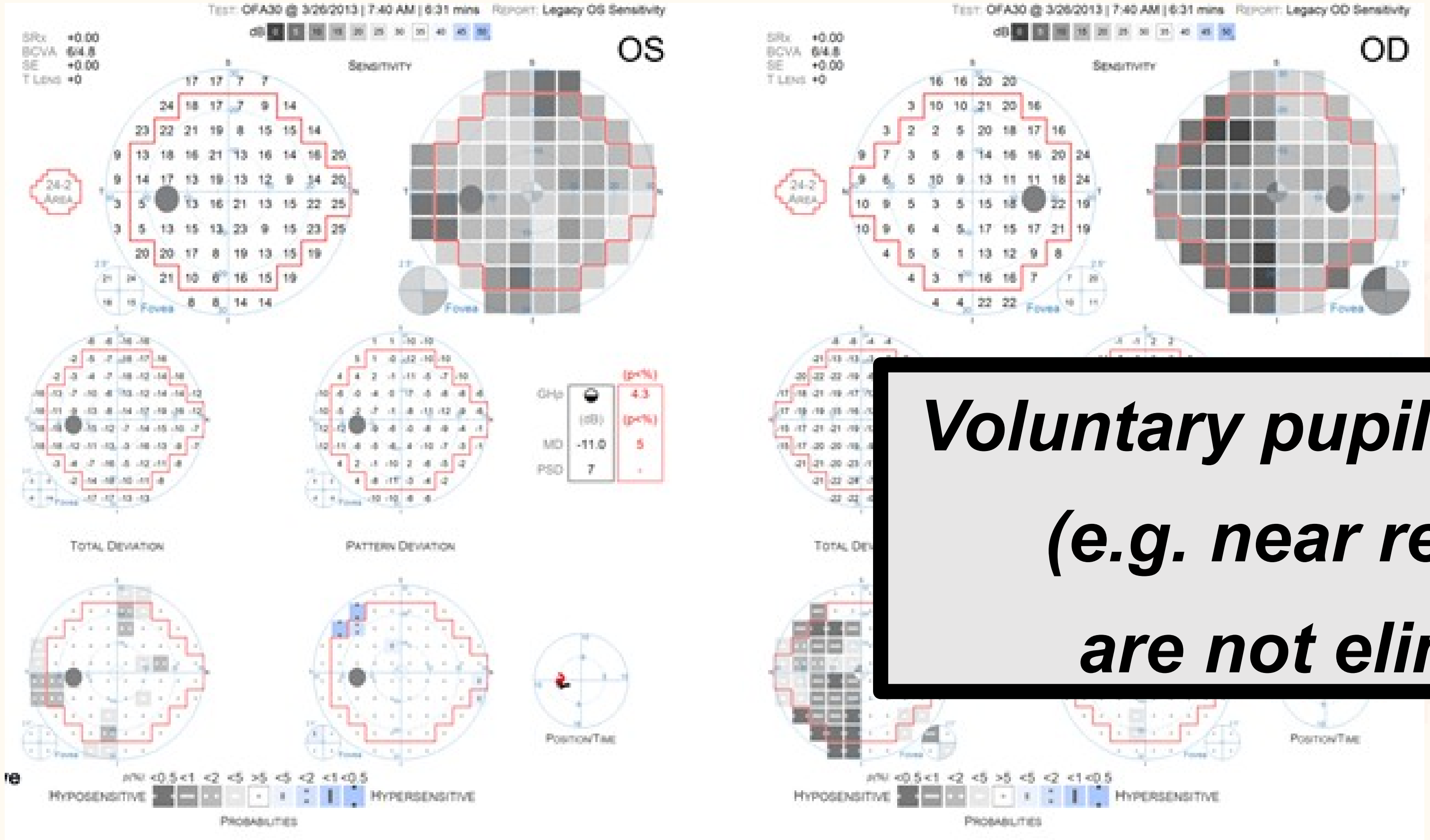
Rai BB, Sabeti F, Carle CF, Maddess T. Visual Field Tests: A Narrative Review of Different Perimetric Methods. J Clin Med. 2024 Apr 23;13(9):2458. doi: 10.3390/jcm13092458. PMID: 38730989; PMCID: PMC11084906.

The future



2019

The future



Voluntary pupil movements (e.g. near response) are not eliminated

2019

More

Objectivity

Patient engagement

Feasibility/portability

needed

The future

Virtual reality Perimetry (VRP)

VR: *an immersive technology*

-Includes:

Goggle-like head-mounted device (HMD)

AND

Bluetooth connected handpiece

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Demirel S, Johnson CA. Incidence and prevalence of short wavelength automated perimetry deficits in ocular hypertensive patients. Am J Ophthalmol. 2001 Jun;131(6):709-15. doi: 10.1016/s0002-9394(00)00946-6. PMID: 11384565.

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Virtual reality Perimetry
(VRP)

The first VR based perimetry prototype:

Periscreener

low-cost Google Cardboard headset,

two ordinary android smartphones,

a Bluetooth clicker.

suprathreshold testing, crude.

2018

Demirel S, Johnson CA. Incidence and prevalence of short wavelength automated perimetry deficits in ocular hypertensive patients. Am J Ophthalmol. 2001 Jun;131(6):709-15. doi: 10.1016/s0002-9394(00)00946-6. PMID: 11384565.

The future

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The first VR based perimetry prototype:

Periscreener

low-cost Google Cardboard headset,

two ordinary android smartphones,

a Bluetooth clicker.

Suprathreshold testing - crude

2018

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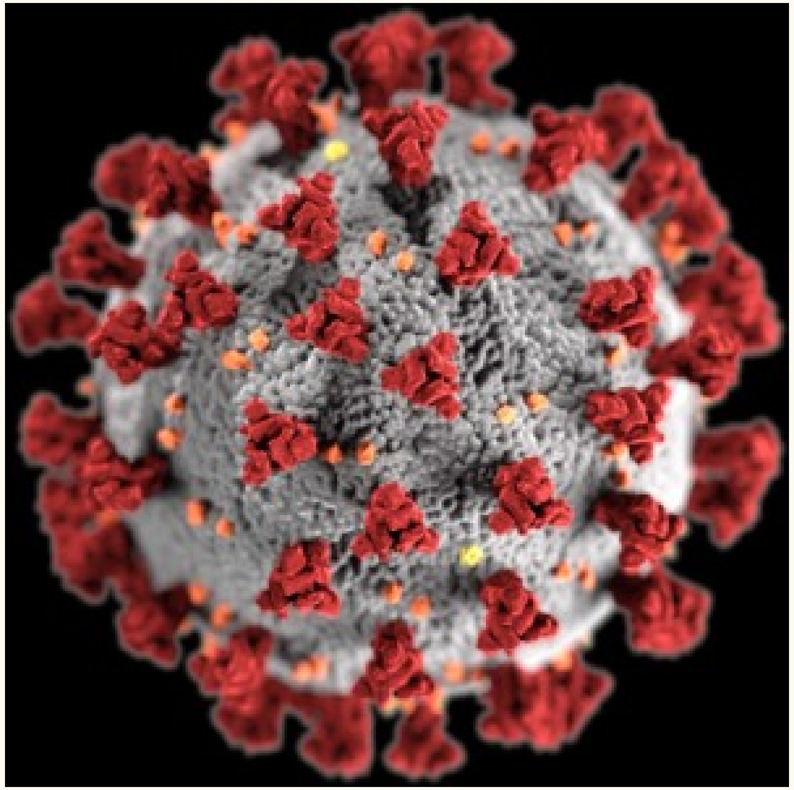
Akkara JD, Kuriakose A. Review of recent innovations in ophthalmology. Kerala Journal of Ophthalmology. 2018;30(1):54. doi:10.4103/kjo.kjo_24_18

~~The future~~ (Hopefully never again!)



2020

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Virtual reality Perimetry (VRP)

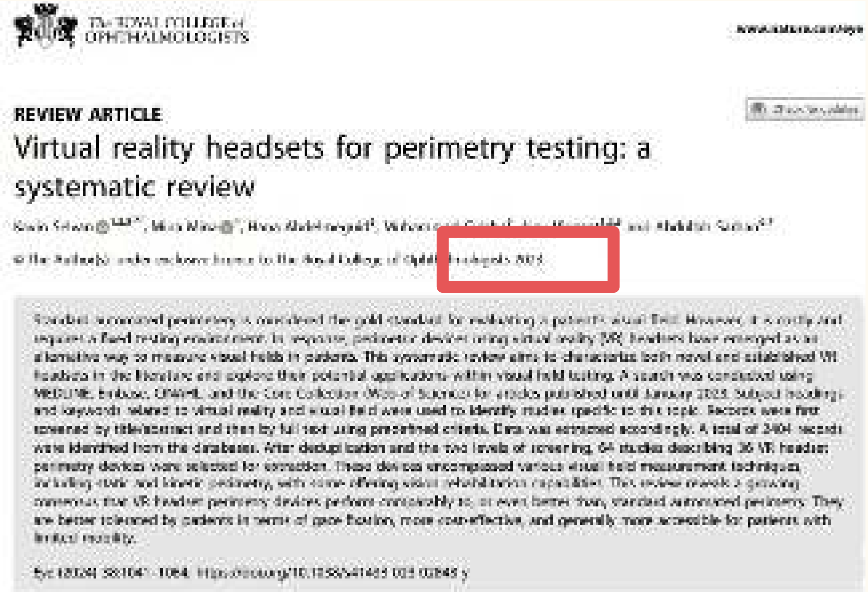
Too many devices!

2020

The future

Virtual reality Perimetry (VRP)

Too many devices!

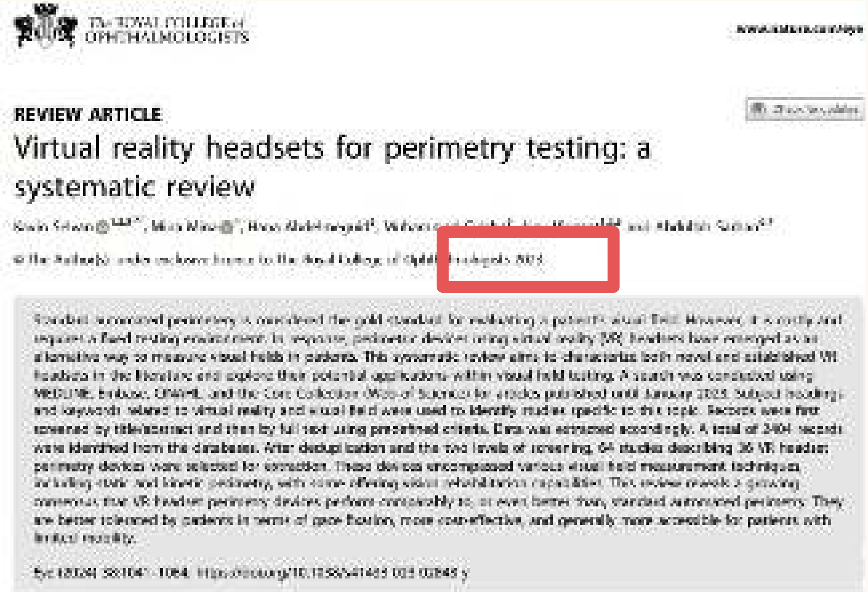


2023

The future

Virtual reality Perimetry (VRP)

Too many devices!

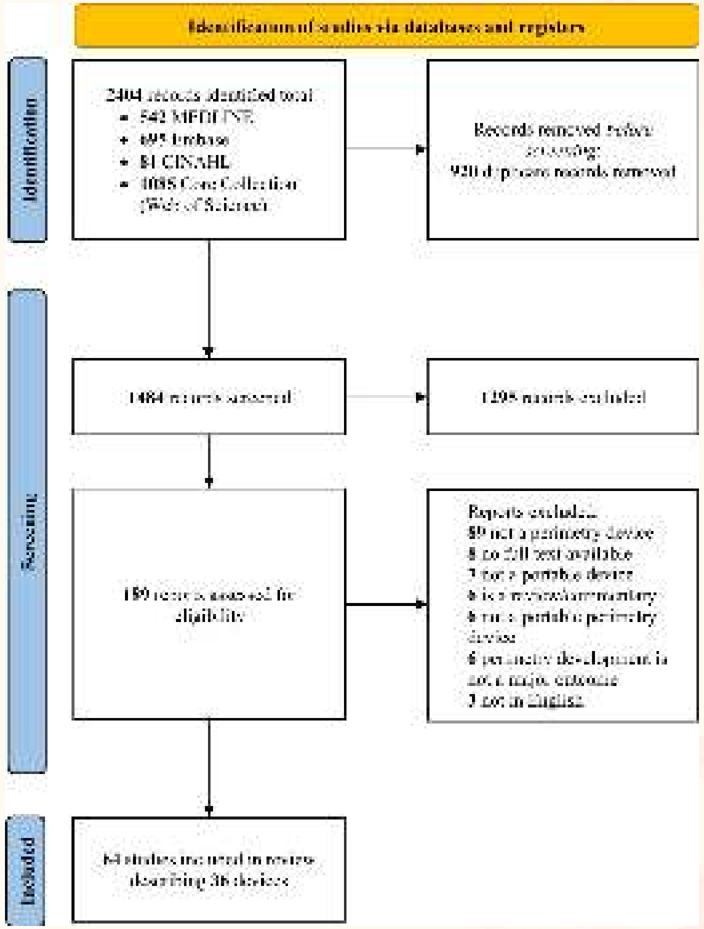


THE ROYAL COLLEGE of OPHTHALMOLOGISTS

REVIEW ARTICLE

Virtual reality headsets for perimetry testing: a systematic review

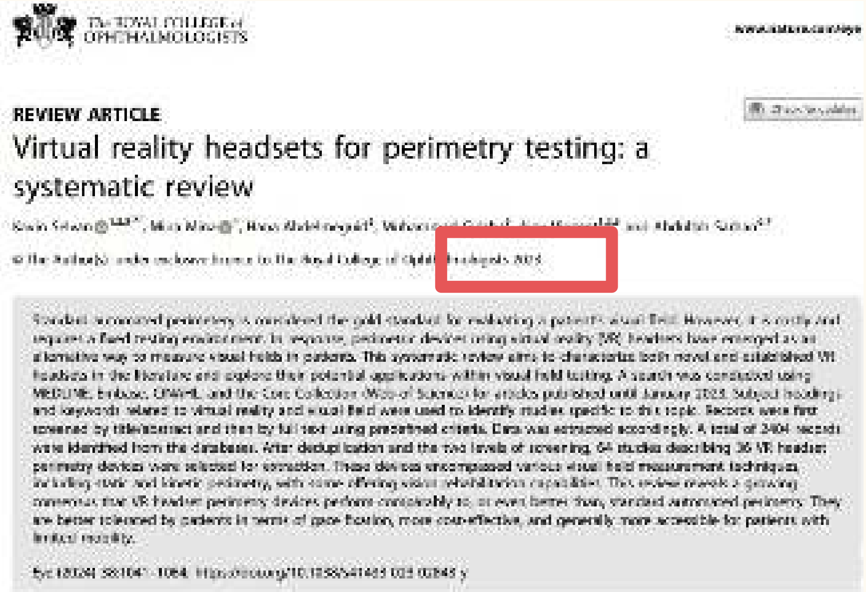
Standard automated perimetry is considered the gold standard for evaluating a patient's visual field. However, it is costly and requires a fixed testing environment. In response, perimetric devices using virtual reality (VR) headsets have emerged as an alternative way to measure visual fields in patients. This systematic review aims to characterize both novel and established VR headsets in the literature and explore their potential applications within visual field testing. A search was conducted using MEDLINE, Embase, CINAHL, and the Core Collection (Web of Science) for articles published until January 2023. Subject headings and keywords related to virtual reality and visual field were used to identify studies specific to this topic. Records were first screened by title/abstract and then by full text using predefined criteria. Data was extracted accordingly. A total of 2404 records were identified from the databases. After deduplication and the two levels of screening, 64 studies describing 36 VR headset perimetry devices were selected for extraction. These devices encompassed various visual field measurement techniques, including static and kinetic perimetry, with some offering vision rehabilitation capabilities. This review reveals a growing consensus that VR headset perimetry devices perform comparably to, or even better than, standard automated perimetry. They are better tolerated by patients in terms of gaze fixation, more cost-effective, and generally more accessible for patients with limited mobility.



2023

Virtual reality Perimetry (VRP)

Too many devices!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REVIEW ARTICLE

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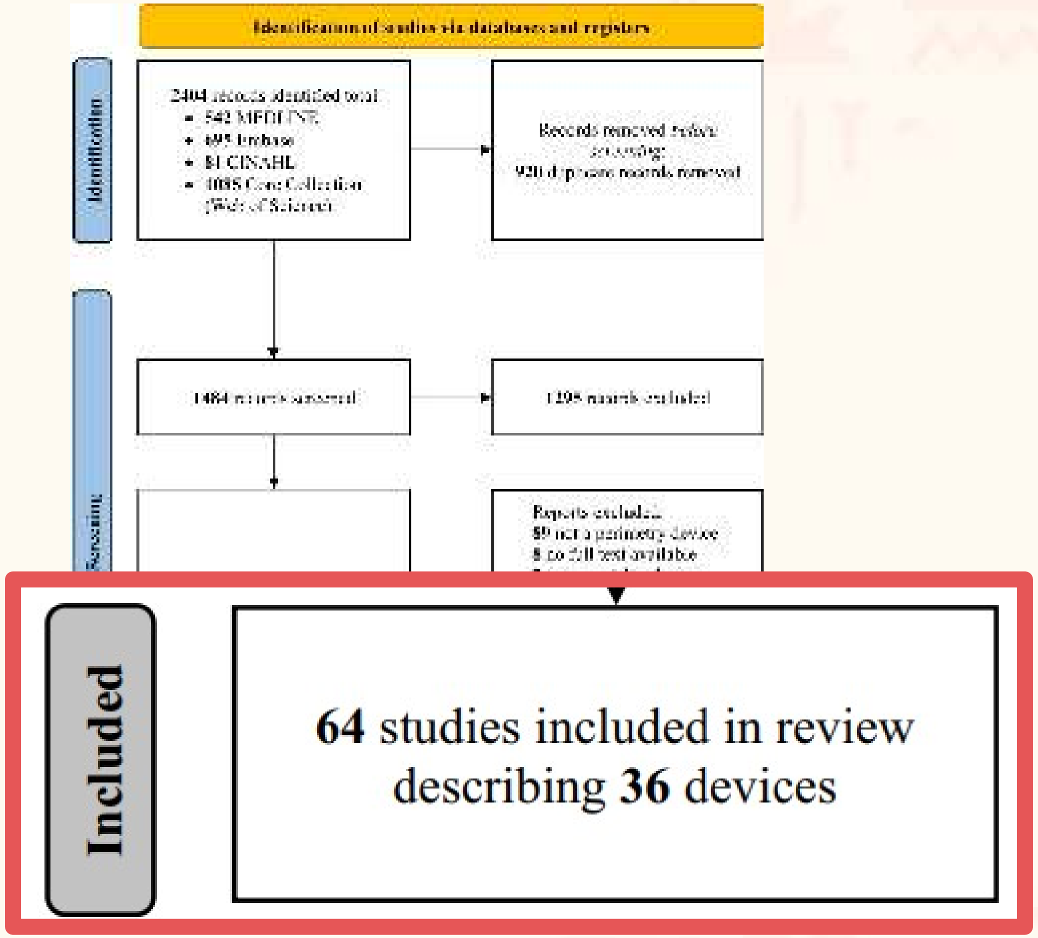


2023

The future

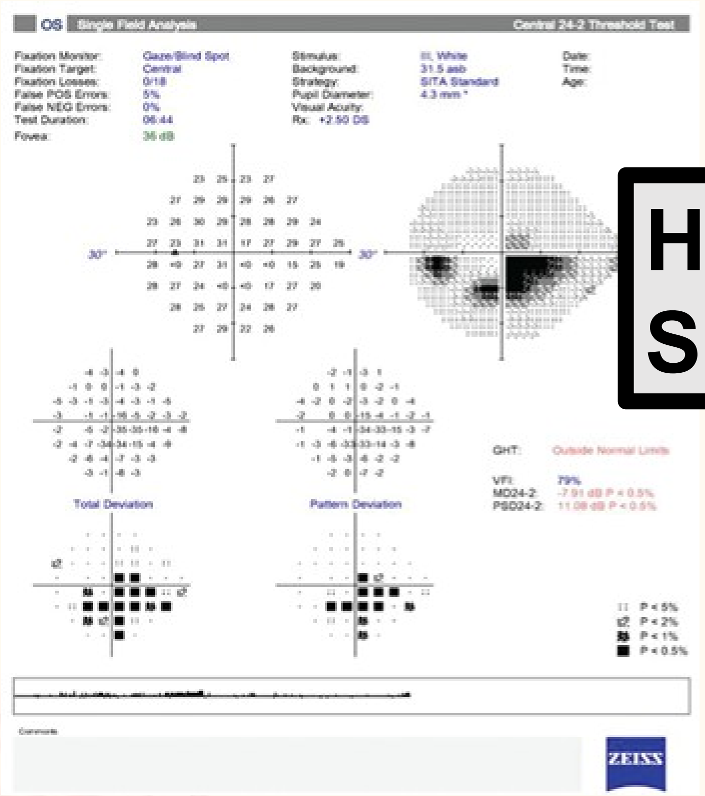
Virtual reality Perimetry (VRP)

Too many devices!

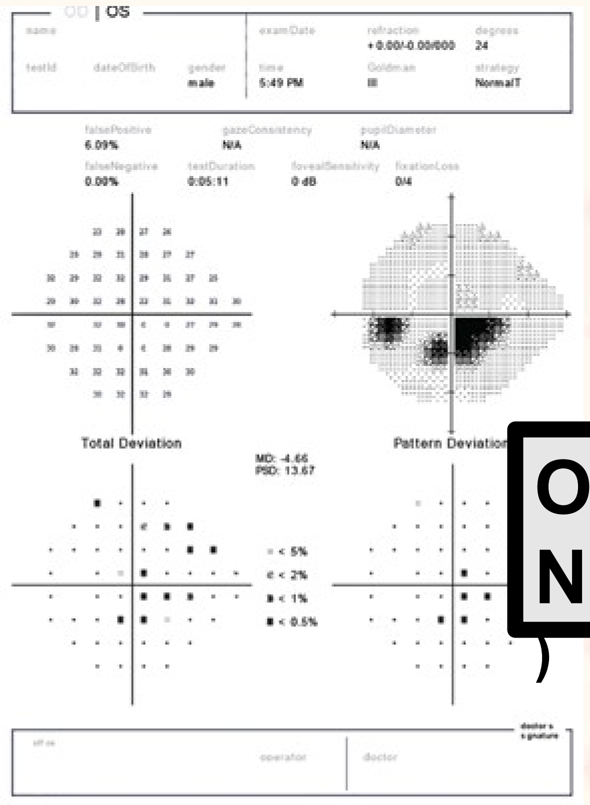
Device	*Company*	*Location*
Advanced Vision Analyzer	Elisar	Chennai, India
nGoggle	nGoggle, Inc.	San Diego, CA
PalmScan VF2000	Micro Medical Devices	Calabasas, CA
re:Vive 2.0	Heru, Inc.	Miami, FL
Smart Systems VR Headsets	M&S Technologies	Niles, IL
Virtual Field	Virtual Field Inc.	New York, NY
VirtualEye C3 Fields Analyzer	Alfaleus Technology Pvt LTd.	India
VisuALL	Olleyes	Summit, NJ
Vivid Vision Perim-etry	Vivid Vision Vivid Vision Perimetry	San Francisco, CA

2024

Virtual reality Perimetry (VRP)



HFA SITA-standard



Olleyes-VisuALL NormalT(Threshold)

2024

Groth, S. L. (2021). New strategies for automated perimetry: Historical perspective and future innovations. Journal of Current Glaucoma Practice, 15(3), 103.

The future

Virtual reality Perimetry (VRP)

Visu*ALL* Tests/Protocols

Perimetry

- 24-2 Adults & Pediatrics
- 10-2 Adults & Pediatrics
- Supra-threshold Adults & Pediatrics
- Other

Visual Acuity Test

- Landolt C

2024

Groth, S. L. (2021). New strategies for automated perimetry: Historical perspective and future innovations. Journal of Current Glaucoma Practice, 15(3), 103.

Virtual reality Perimetry (VRP)

Extras:

Visual grasp:

Eye tracker detects change in gaze in response to a stimulus, instead of patient's response with a click

Wroblewski, D., Francis, B. A., Sadun, A., Vakili, G., & Chopra, V. (2014). Testing of visual field with virtual reality goggles in manual and visual grasp modes. BioMed research international, 2014(1), 206082.

Virtual reality Perimetry (VRP)

Extras:

Visual grasp:

nGoogles:

Another tool for objective assessment via detection of multifocal steady-state VEP; incorporating EOG and EEG

Shalaby, W. S., Sinha, S., Myers, J. S., & Razeghinejad, R. (2023). Virtual Peri
in Ophthalmology and Optometry, 8(1), 213-237.

Virtual reality Perimetry
(VRP)

Extras:

Visual grasp:

nGoogles:

Gaze tracking:

Available in most of the newer VRP devices

Shalaby, W. S., Sinha, S., Myers, J. S., & Razeghinejad, R. (2023). Virtual Peri
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Virtual reality Perimetry (VRP)

Applications:

Screening

Telemedicine

Special situations:

Bed ridden-wheel chair- neck problems

Children

Shalaby, W. S., Sinha, S., Myers, J. S., & Razeghinejad, R. (2023). Virtual Peri
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Virtual reality Perimetry (VRP)

Comparable to SAP, but:

- **Lack of sensitivity in early disease**
- **Claustrophobia/Discomfort with VR sets**

Shalaby, W. S., Sinha, S., Myers, J. S., & Razeghinejad, R. (2023). Virtual Peri
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More

Objectivity ☑

Patient engagement ☑

Feasibility/portability ☑

2024

achieved

More

Affordability ☑

achieved

2024

2025- …..

Thank you

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