Roma, 7 ottobre 2022

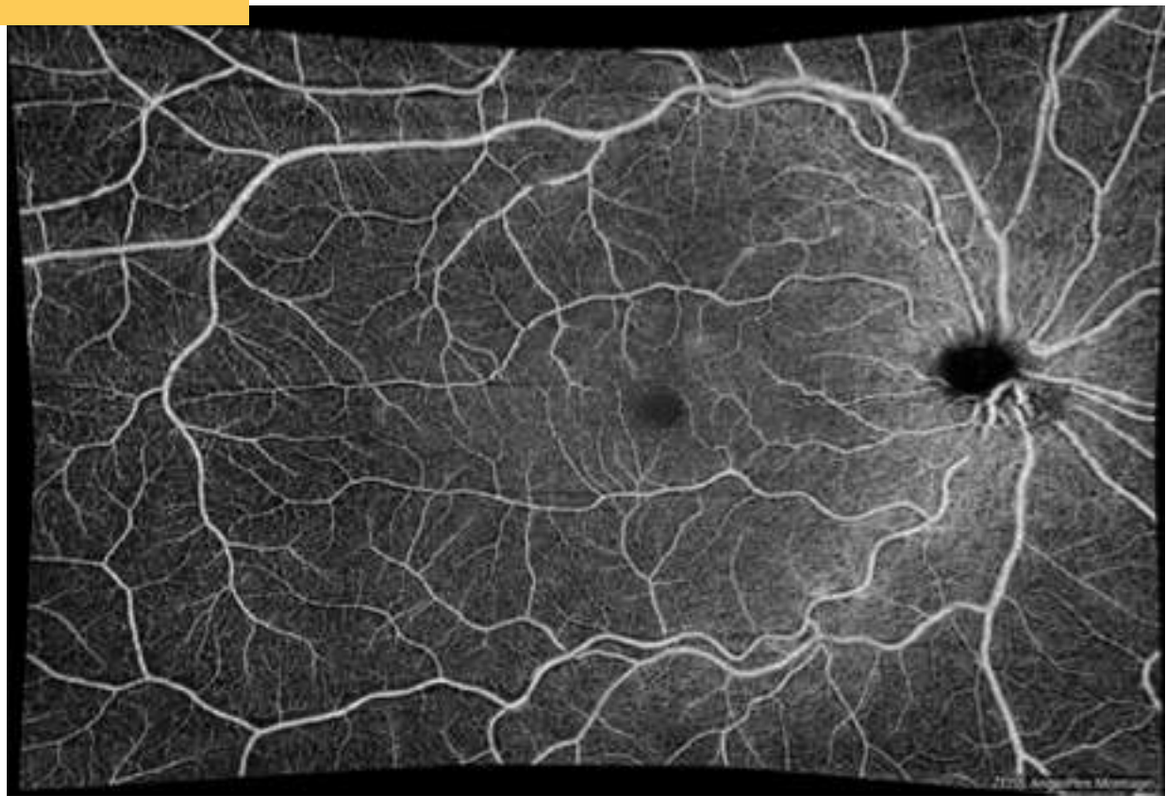
ANGIO – OCT DEL NERVO OTTICO
WHERE WE ARE NOW

MATTEO SACCHI

Responsabile Centro Glaucoma
Ospedale San Giuseppe Milano
Università degli Studi di Milano

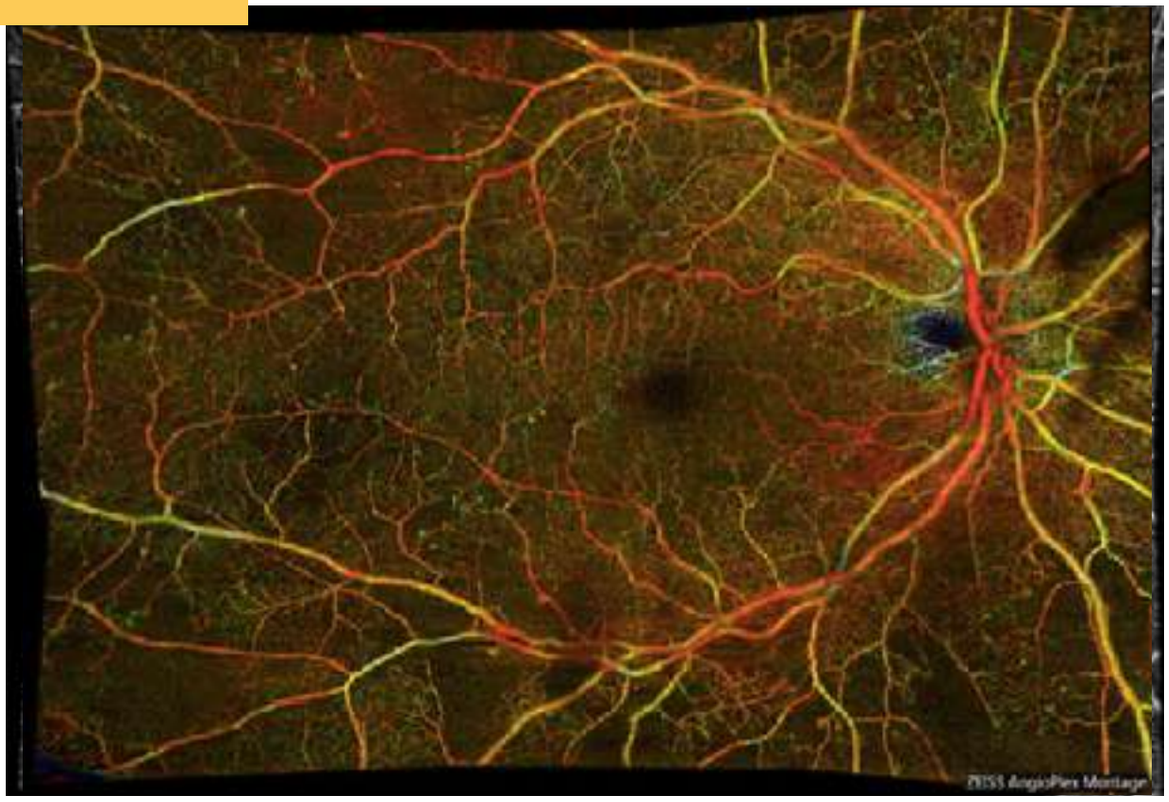
CIRRUS HD OCT – ANGIOPLEX

FROM..



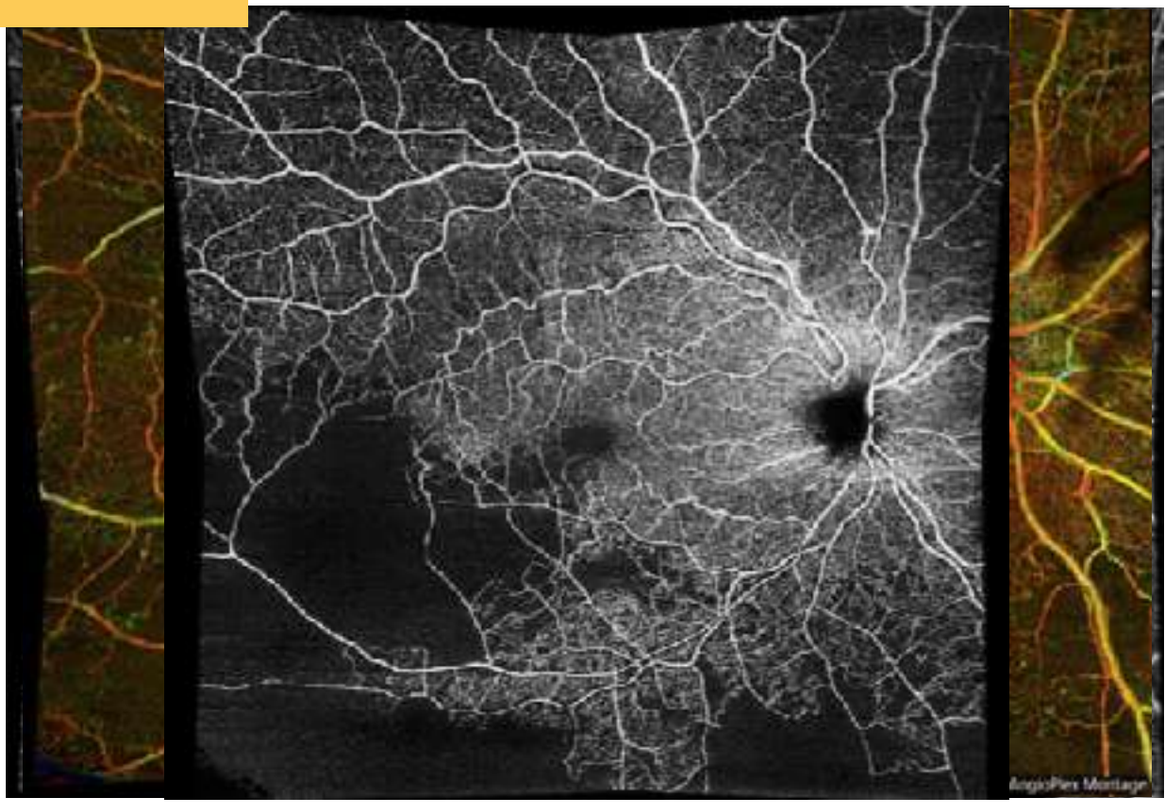
CIRRUS HD OCT – ANGIOPLEX

FROM..



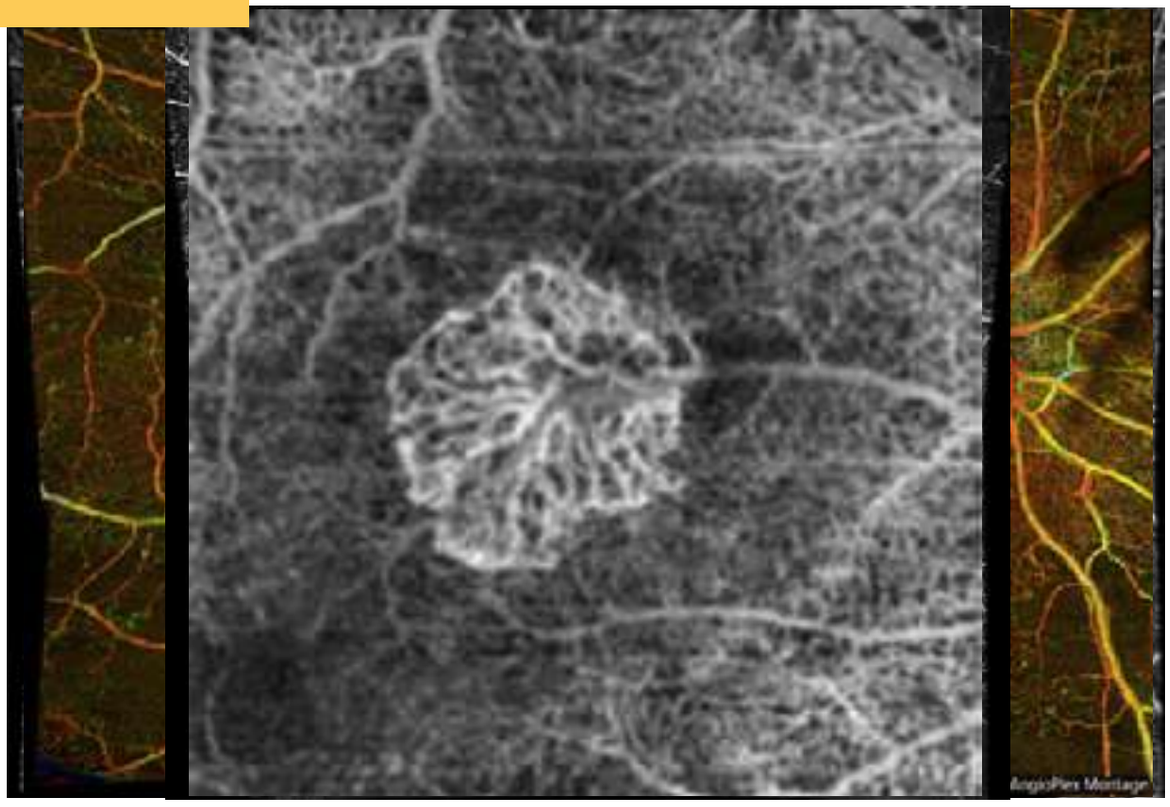
CIRRUS HD OCT – ANGIOPLEX

FROM..



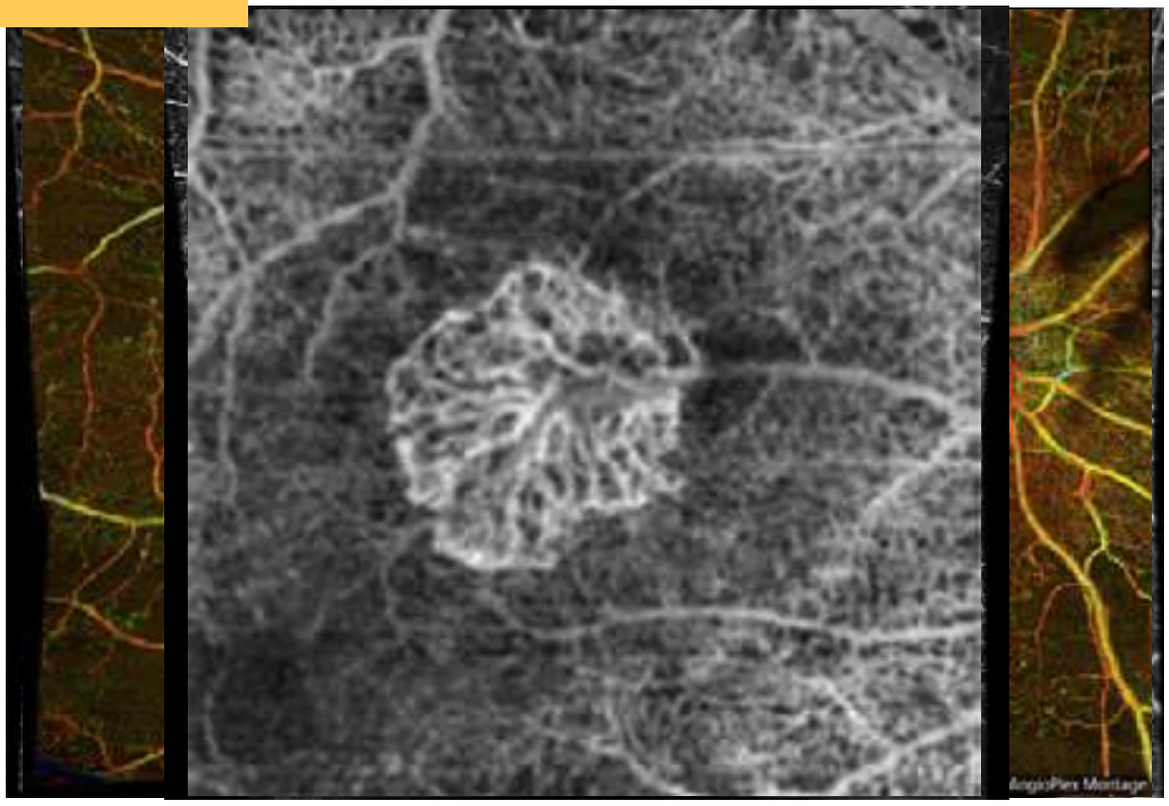
CIRRUS HD OCT – ANGIOPLEX

FROM..

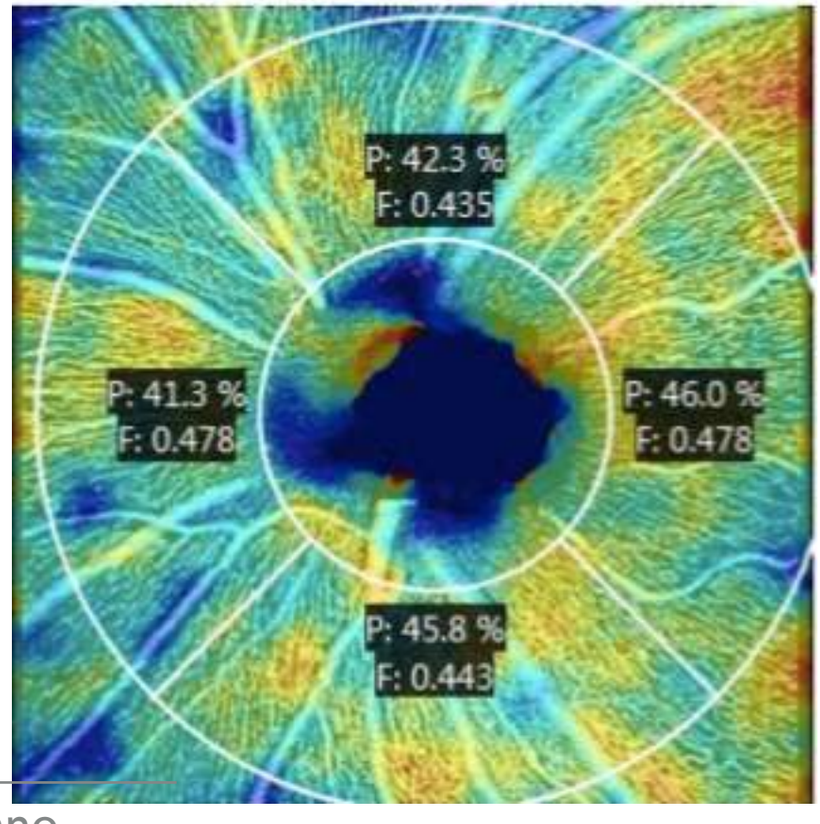


CIRRUS HD OCT – ANGIOPLEX

FROM..



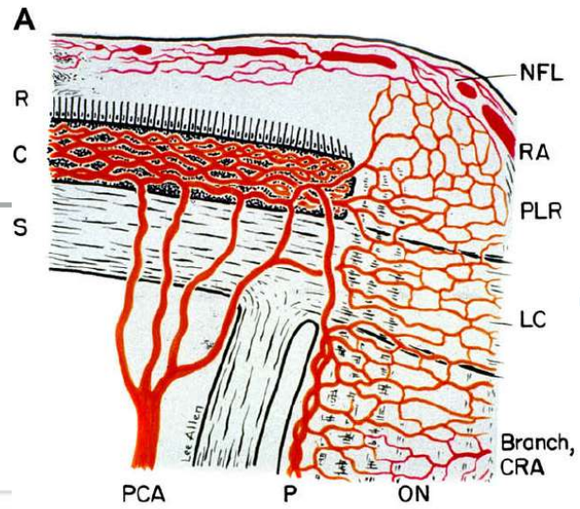
TO.. OPTIC NERVE HEAD

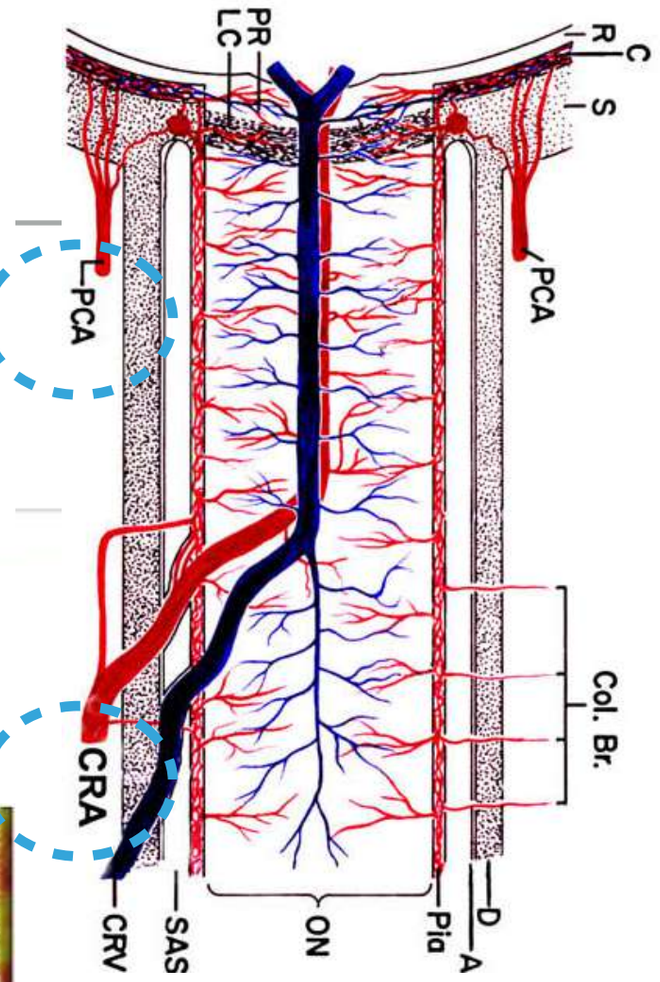


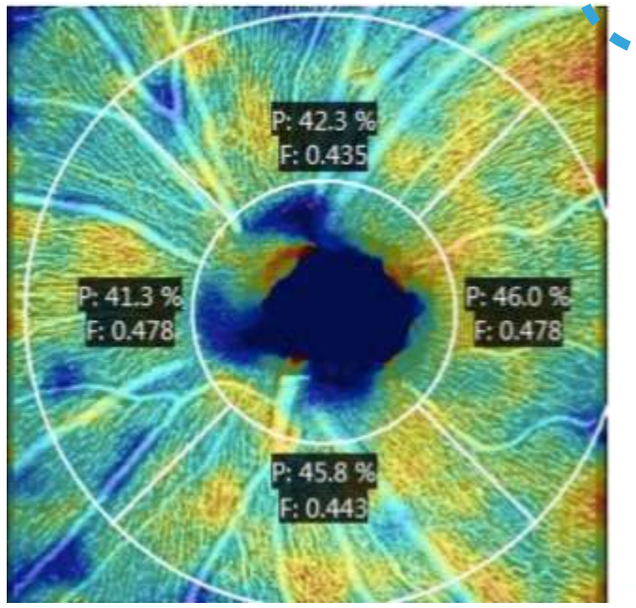
CIRRUS HD OCT – ANGIOPLEX

What do we know about OCTA and the Optic Disc?

- Blood flow of the ONH is supplied by two main sources[1]:
  - Central retinal artery (CRA), which supplies the superficial RNFL layer of the ONH
  - Posterior ciliary artery (PCA) circulation
- Blood flow to the RNFL is supplied by the microcirculation coming from the retinal radial peripapillary capillaries (RPC)
- OCTA can visualize the RPC network but traditional fluorescein angiography cannot[2]
- OCTA for GLAUCOMA: It has been reported that optic disc perfusion may be useful in the evaluation of glaucoma and glaucoma progression[3,4]





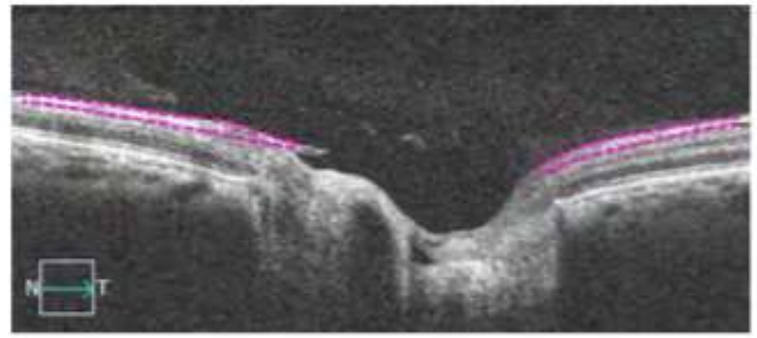


1. Hayreh SS. Blood supply of the optic nerve head and its role in optic atrophy, glaucoma, and oedema of the optic disc. *Br J Ophthalmol* 1969;53:721-748.
2. Spaide RF, Klancnik JM, Cooney MJ. Retinal Vascular Layers Imaged by Fluorescein Angiography and Optical Coherence Tomography Angiography. *JAMA Ophthalmol* 2015;133:45-50.
3. Chen CL, Bojikian KD, Gupta D, Wen JC, Zhang Q, Xin C, Kono R, Mudumbai RC, Johnstone MA, Chen PP, Wang, RK. "Optic nerve head perfusion in normal eyes and eyes with glaucoma using optical coherence tomography-based microangiography." Quant Imaging Med Surg. 2016 Apr;6(2):125-133.
4. Chen CL, Zhang A, Bojikian KD, Wen, JC, Zhang, Q, Xin, C, Mudumbai, RC, Johnstone, MA, Chen, PP, Wang, RK. "Peripapillary Retinal Nerve Fiber Layer Vascular Microcirculation in Glaucoma using Optical Coherence Tomography–based Microangiography." Invest Ophthalmol Vis Sci. 2016 Jul;57(9):OCT475–OCT485.

CIRRUS HD OCT – ANGIOPLEX FOR ONH

NEW: **AngioPlex ONH scans**

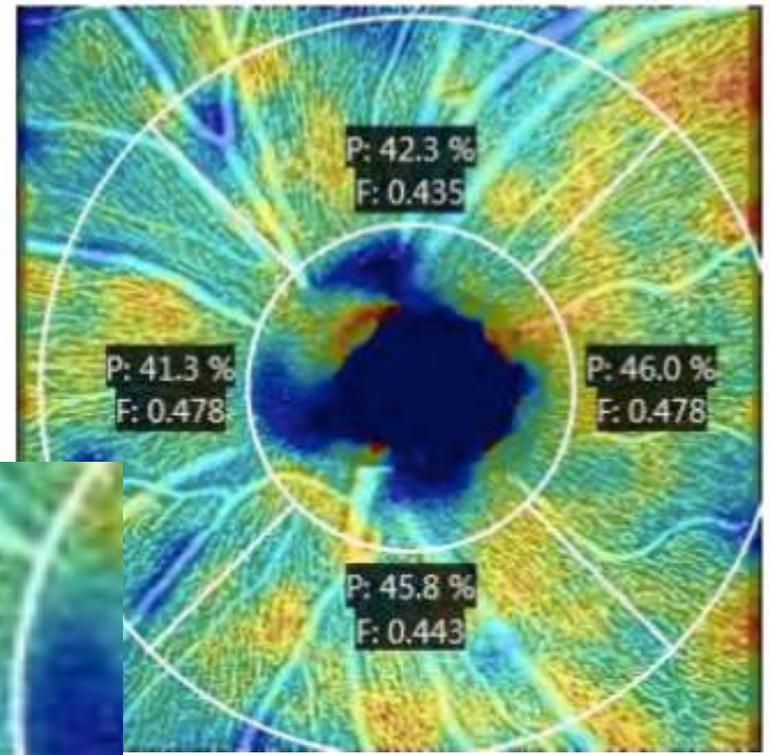
- 4.5x4.5 mm scan
- 350x350 pixels (2x averaged)



Quantification of the Radial Peripapillary Capillaries (RPC): ILM to RNFL

NEW: AngioPlex Metrix for ONH

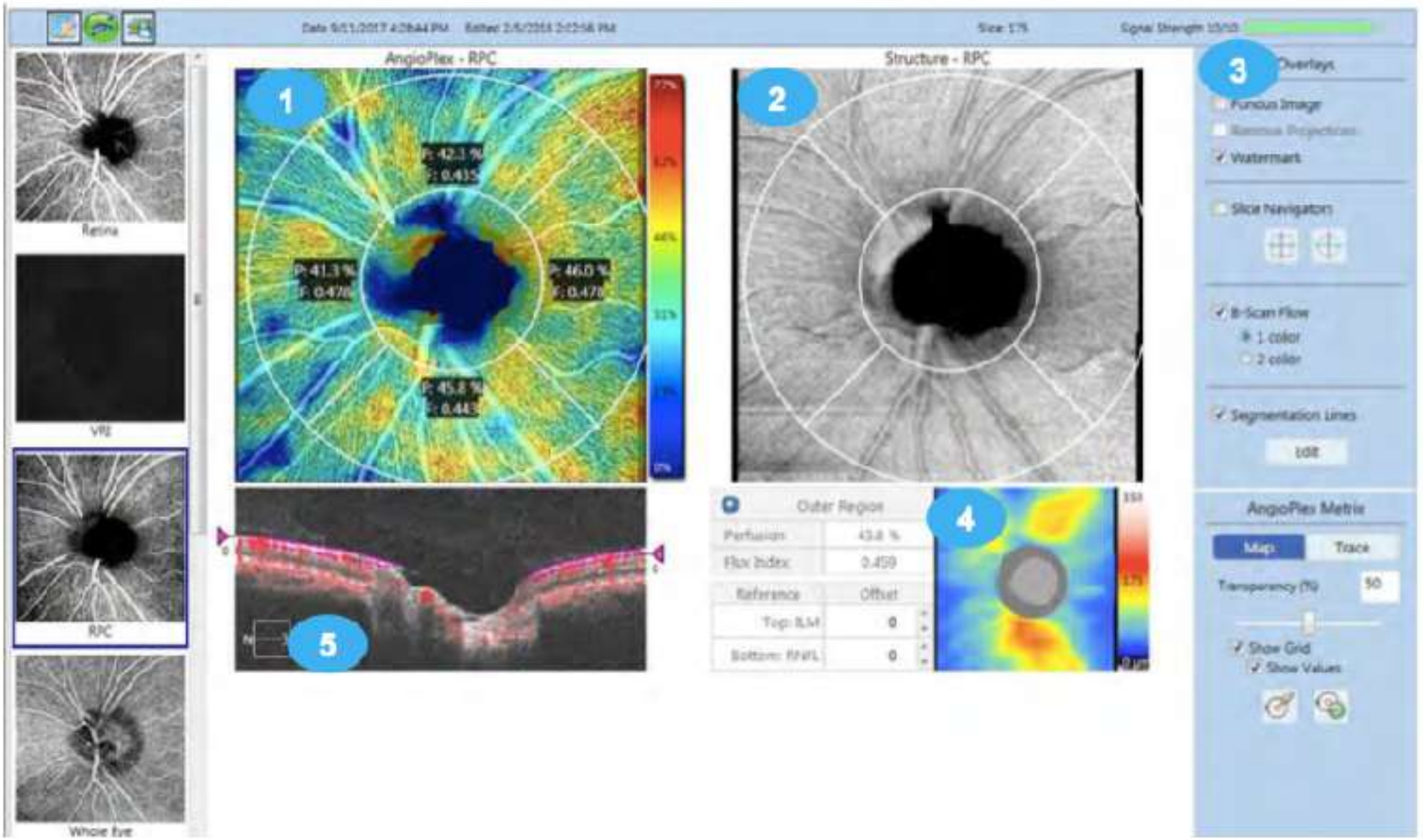
- **Capillary Perfusion (P)**
  - percentage of an area that contains perfused vasculature
  - may provide useful information for detecting and monitoring glaucoma[1]
- **Capillary Flux Index (F)**
  - capillary perfusion, weighted by the intensity of the flow signal
  - may help physicians monitor glaucoma[2]



[1]Chen CL et al., "Optic nerve head perfusion in normal eyes and eyes with glaucoma using optical coherence tomography-based microangiography," *Quant Imaging Med Surg*, 2016 Apr;6(2):125-133
[2]Chen CL, Zhang A, Bojikian KD, et al., "Peripapillary retinal nerve fiber layer vascular microcirculation in glaucoma using optical coherence tomography–based microangiography," *Invest Ophthalmol Vis Sci*, 2016 Jul;57(9):OCT475–OCT485

CIRRUS HD OCT – ANGIOPLEX FOR ONH

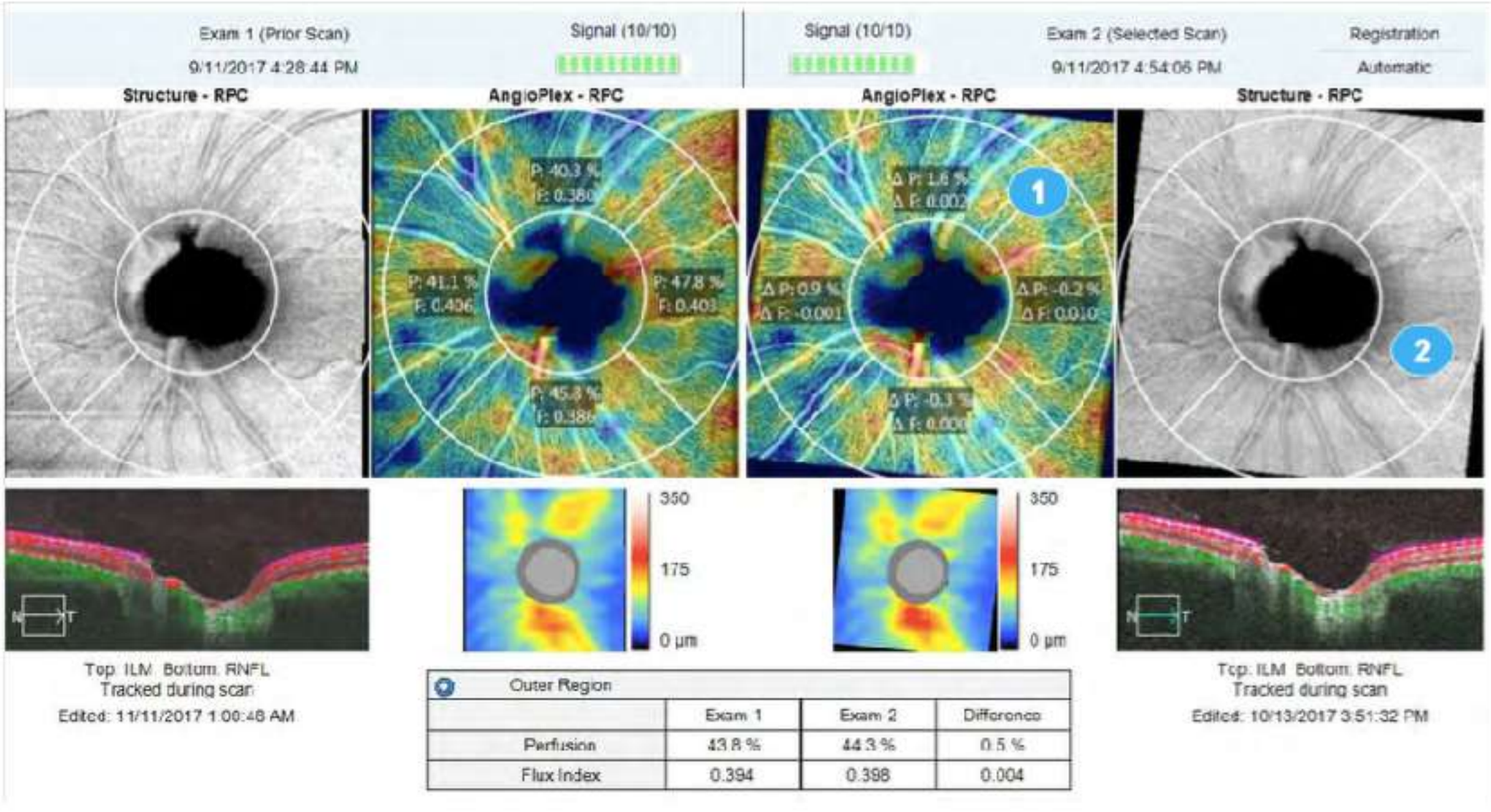
AngioPlex® for ONH
Analysis Screen (Single Visit)



1. AngioPlex ONH with map and metrics
2. Structural *en face*
3. Overlay options
4. RNFL thickness map
5. B-scan with blood flow overlay

CIRRUS HD OCT – ANGIOPLEX FOR ONH

AngioPlex® Change Analysis for ONH (Two Visits)



Outer Region	Exam 1	Exam 2	Difference
Perfusion	43.8 %	44.3 %	0.5 %
Flux Index	0.394	0.398	0.004

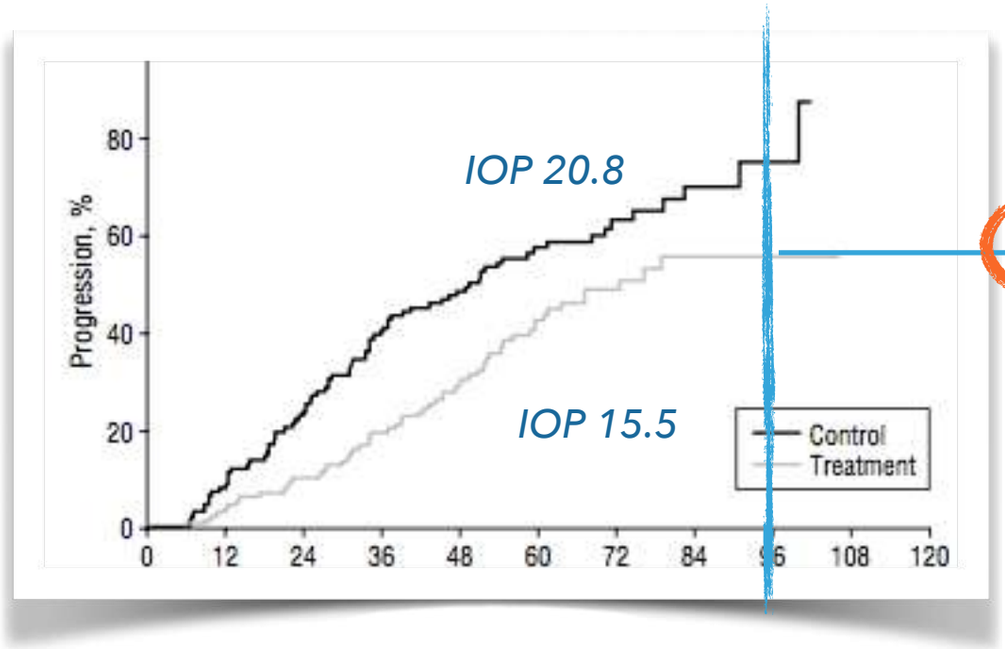
1 **Change in AngioPlex Metrix**

2 **Automatic registration of two visits**

PERCHÉ STUDIARE VASCOLARIZZAZIONE NERVO OTTICO?

- nonostante riduzione della IOP, molti pazienti continuano a peggiorare
- fattori *IOP-indipendenti*, tra questi *alterazione del flusso ematico**

EMGT, 2002



76% pazienti non trattati progressione

59% pazienti trattati progressione

IOP -25%

*

Gugleta K et al (2003) Choroidal vascular reaction to hand-grip stress in subjects with vasospasm and its relevance in glaucoma. Invest Ophthalmol Vis Sci 44:1573–1580

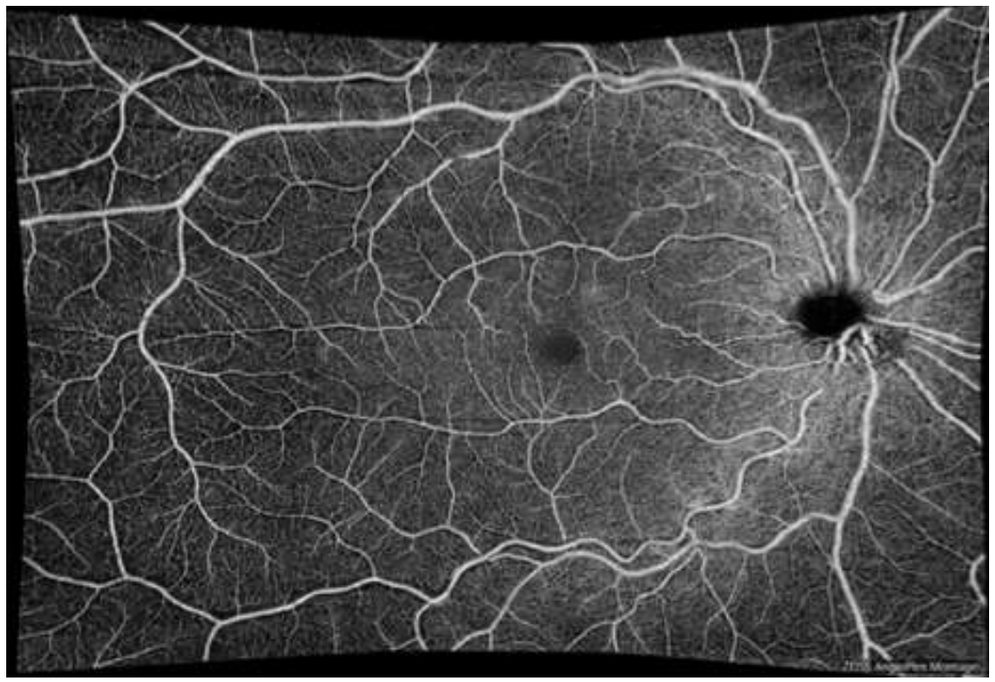
Grunwald JE, (1998) Optic nerve and choroidal circulation in glaucoma. Invest Ophthalmol Vis Sci 39:2329–2336

Flammer J, (1998) Optic nerve blood-flow abnormalities in glaucoma. Prog Retin Eye Res 17:267–289

Feke GT, (2008) Retinal blood flow response to posture change in glaucoma patients compared with healthy subjects. Ophthalmology 115:246–252.

PERCHÉ STUDIARE VASCOLARIZZAZIONE NERVO OTTICO?

- nonostante riduzione della IOP, molti pazienti continuano a peggiorare
- fattori *IOP-indipendenti*, tra questi *alterazione del flusso ematico**



*

Gugleta K et al (2003) Choroidal vascular reaction to hand-grip stress in subjects with vasospasm and its relevance in glaucoma. Invest Ophthalmol Vis Sci 44:1573–1580

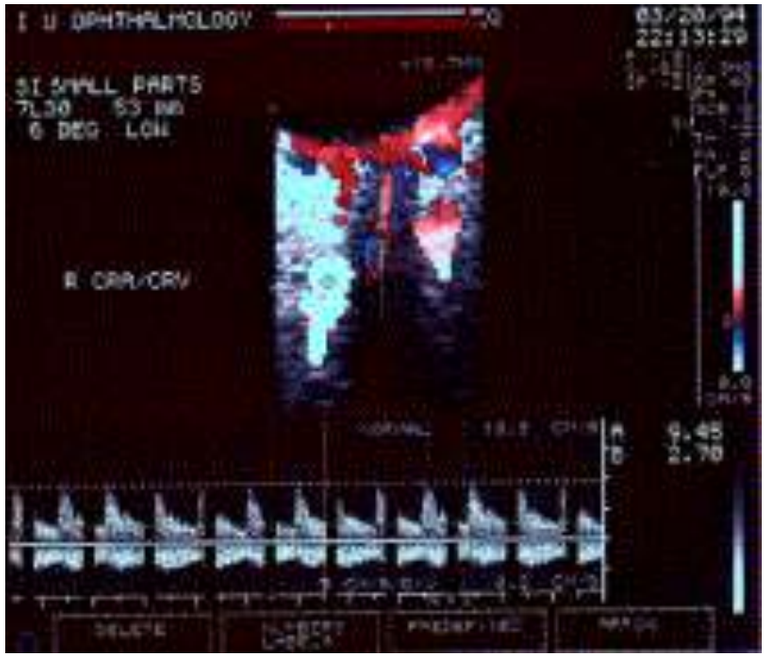
Grunwald JE, (1998) Optic nerve and choroidal circulation in glaucoma. Invest Ophthalmol Vis Sci 39:2329–2336

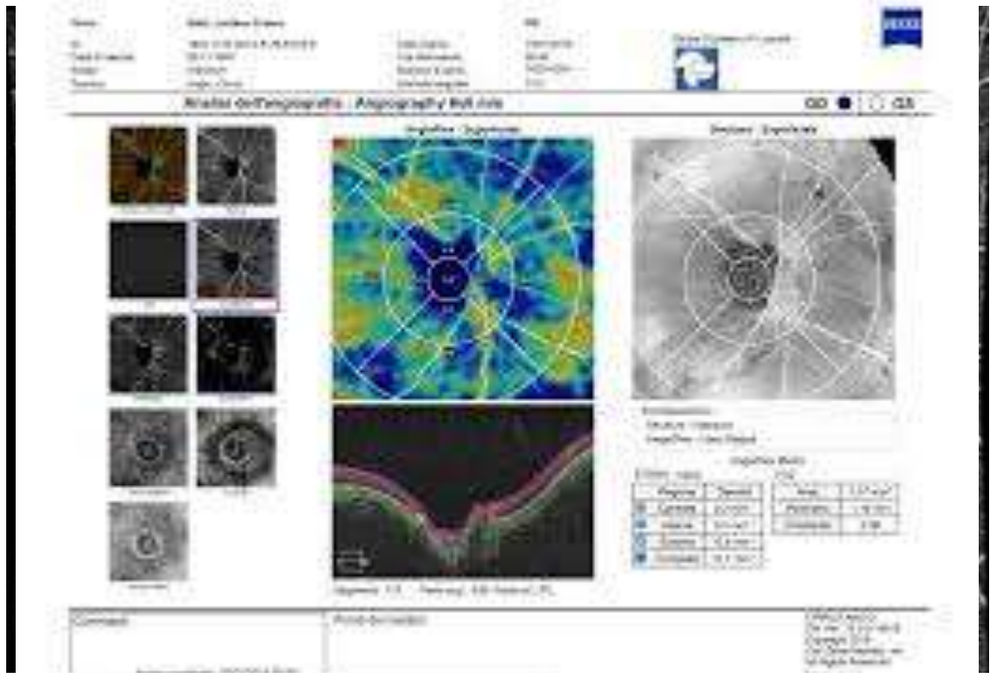
Flammer J, (1998) Optic nerve blood-flow abnormalities in glaucoma. Prog Retin Eye Res 17:267–289

Feke GT, (2008) Retinal blood flow response to posture change in glaucoma patients compared with healthy subjects. Ophthalmology 115:246–252.

PERCHÉ STUDIARE VASCOLARIZZAZIONE NERVO OTTICO?

- nonostante riduzione della IOP, molti pazienti continuano a peggiorare
- fattori *IOP-indipendenti*, tra questi *alterazione del flusso ematico**





misurazioni quantitative, riproducibili, perfusione testa nervo ottico

*

Gugleta K et al (2003) Choroidal vascular reaction to hand-grip stress in subjects with vasospasm and its relevance in glaucoma. Invest Ophthalmol Vis Sci 44:1573–1580

Grunwald JE, (1998) Optic nerve and choroidal circulation in glaucoma. Invest Ophthalmol Vis Sci 39:2329–2336

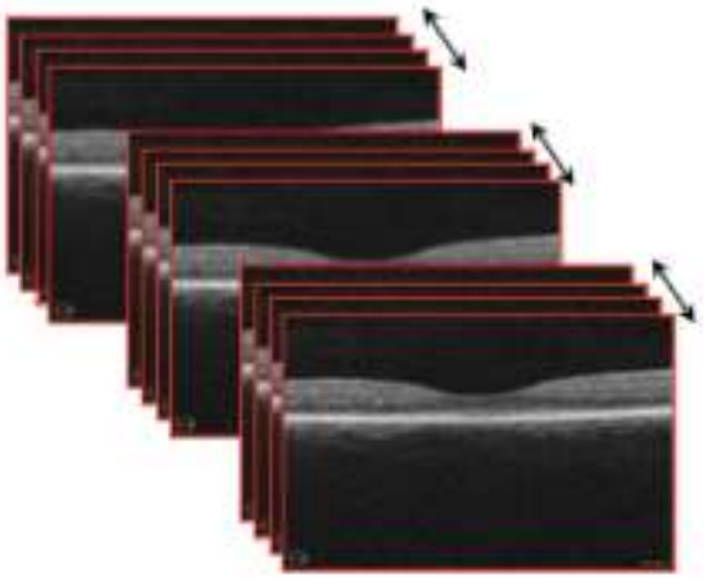
Flammer J, (1998) Optic nerve blood-flow abnormalities in glaucoma. Prog Retin Eye Res 17:267–289

Feke GT, (2008) Retinal blood flow response to posture change in glaucoma patients compared with healthy subjects. Ophthalmology 115:246–252.

Angiografia OCT con ZEISS AngioPlex
Principi tecnologici

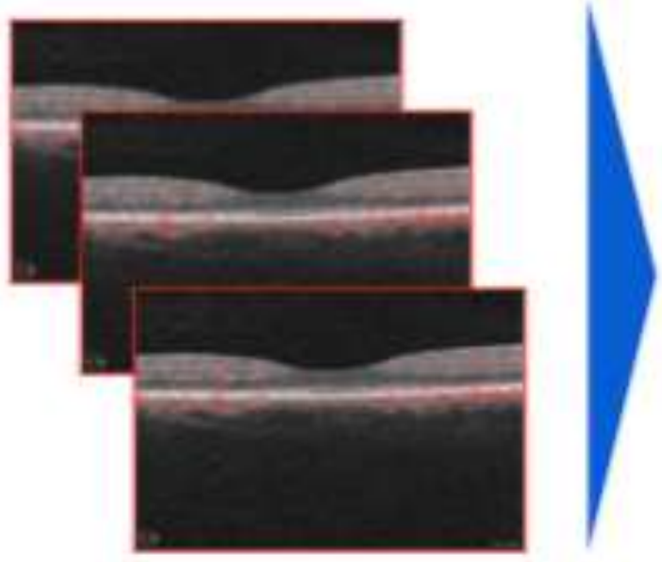
La tecnologia di AngioPlex ™ evidenzia il moto di corpuscoli quali i globuli rossi all'interno di una sequenza di B-scan OCT acquisite ripetutamente nella stessa posizione della retina.

Acquisizione con FastTrac

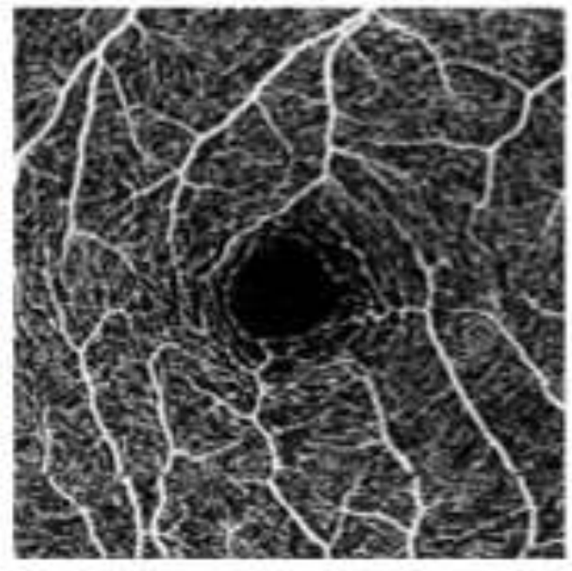


Gruppi di B-scan OCT.
Ogni gruppo è acquisto nella stessa posizione sulla retina

Elaborazione dati tramite algoritmo OMAGC

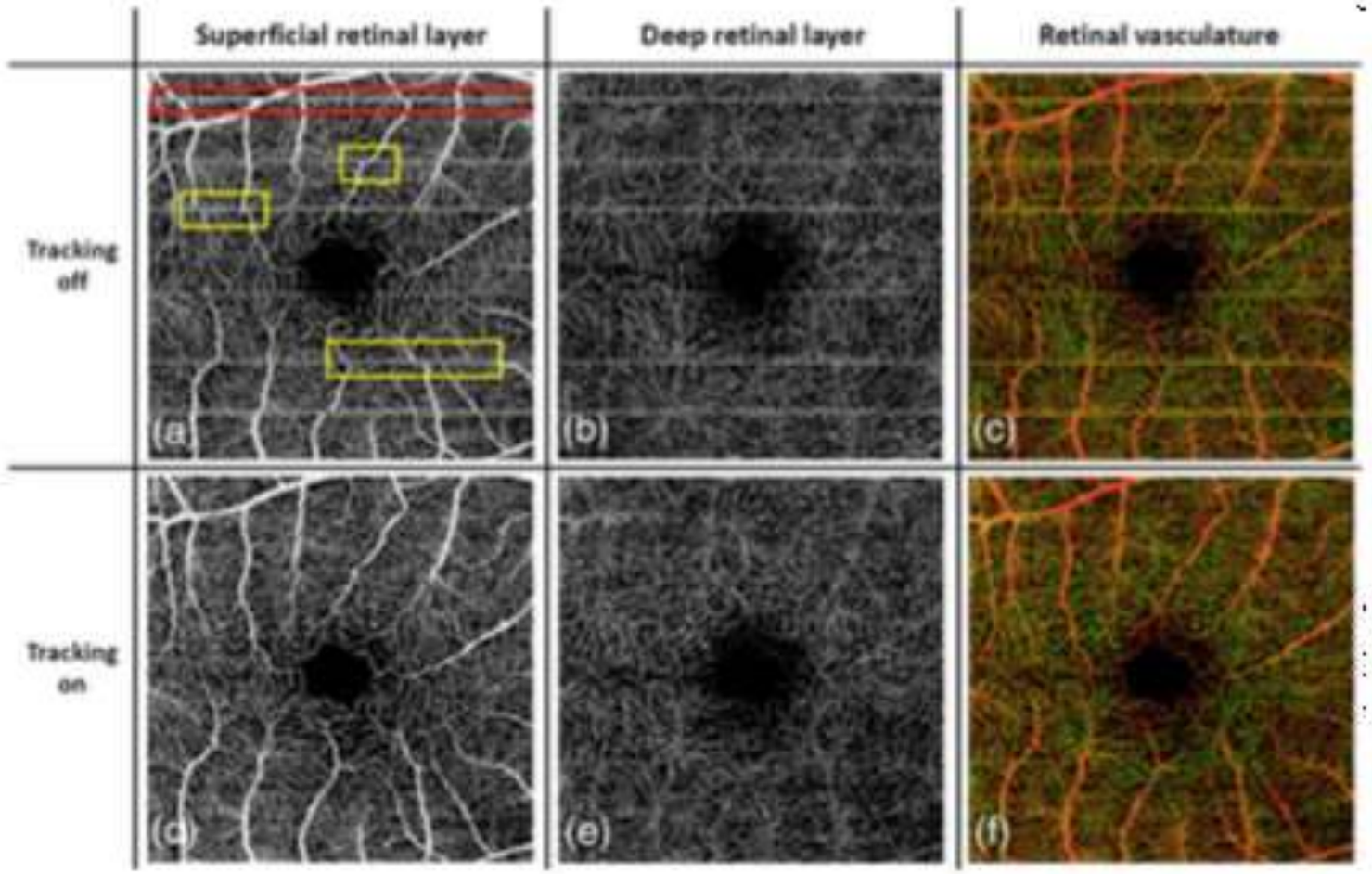


Flusso sanguigno nelle B-scan.
Ogni gruppo genera una B-scan con informazioni di flusso.



AngioPlex Map.
Mappa ricostruita della rete microvascolare perfusa all'interno di retina e coroide.

Artefatti da movimento
Importanza Eyetracker



Wide-field imaging of retinal vasculature using optical coherence tomography-based microangiography provided by motion tracking. [Qinqin Zhang et al., 2015]

L'angiografia OCT esalta le differenze di moto in scansioni ripetute.

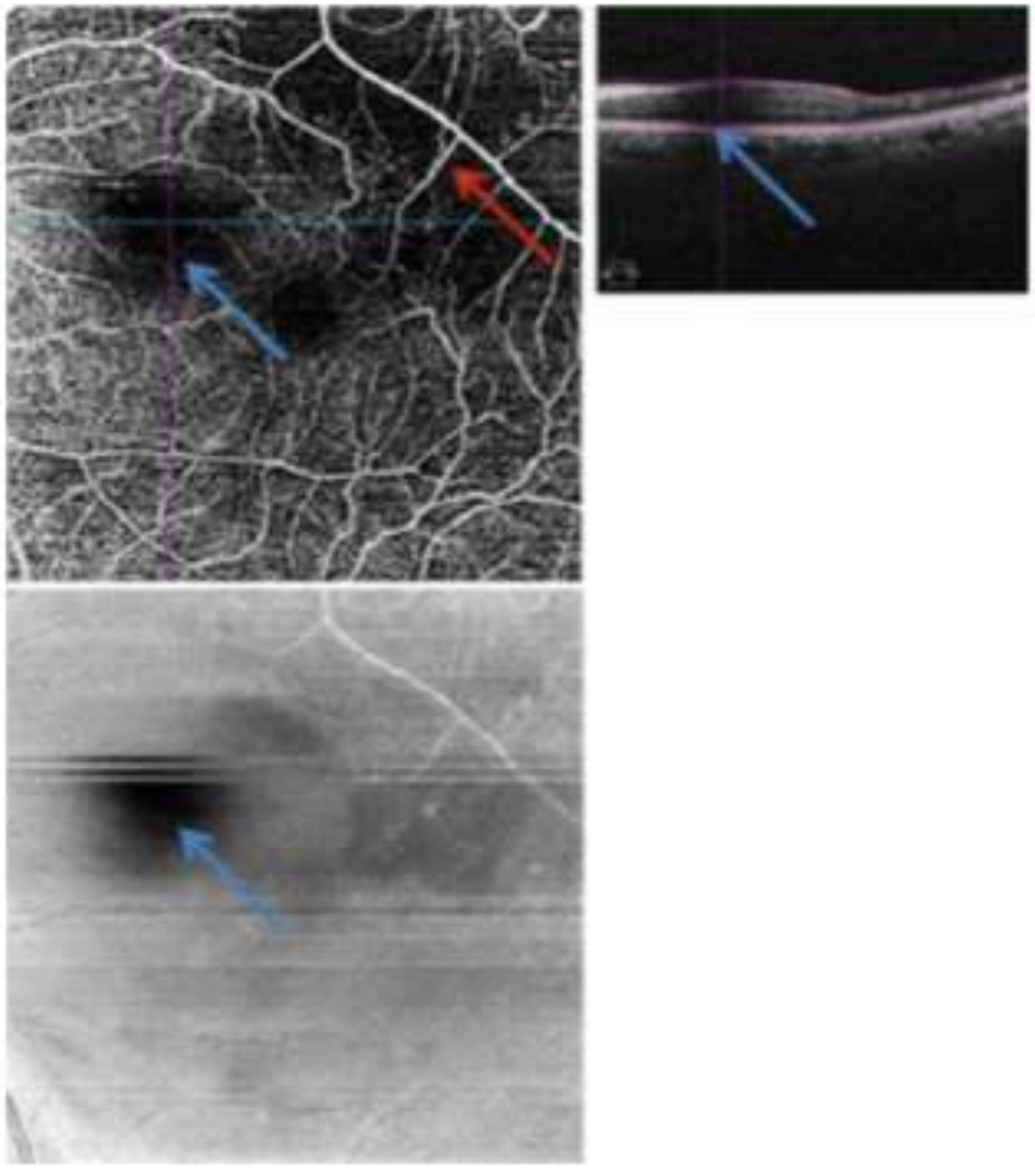
Gli artefatti da movimento risultano quindi importanti (bande che occupano tutta l'ampiezza della scansione).

L'utilizzo di un **eyetracker attivo** diviene fondamentale.

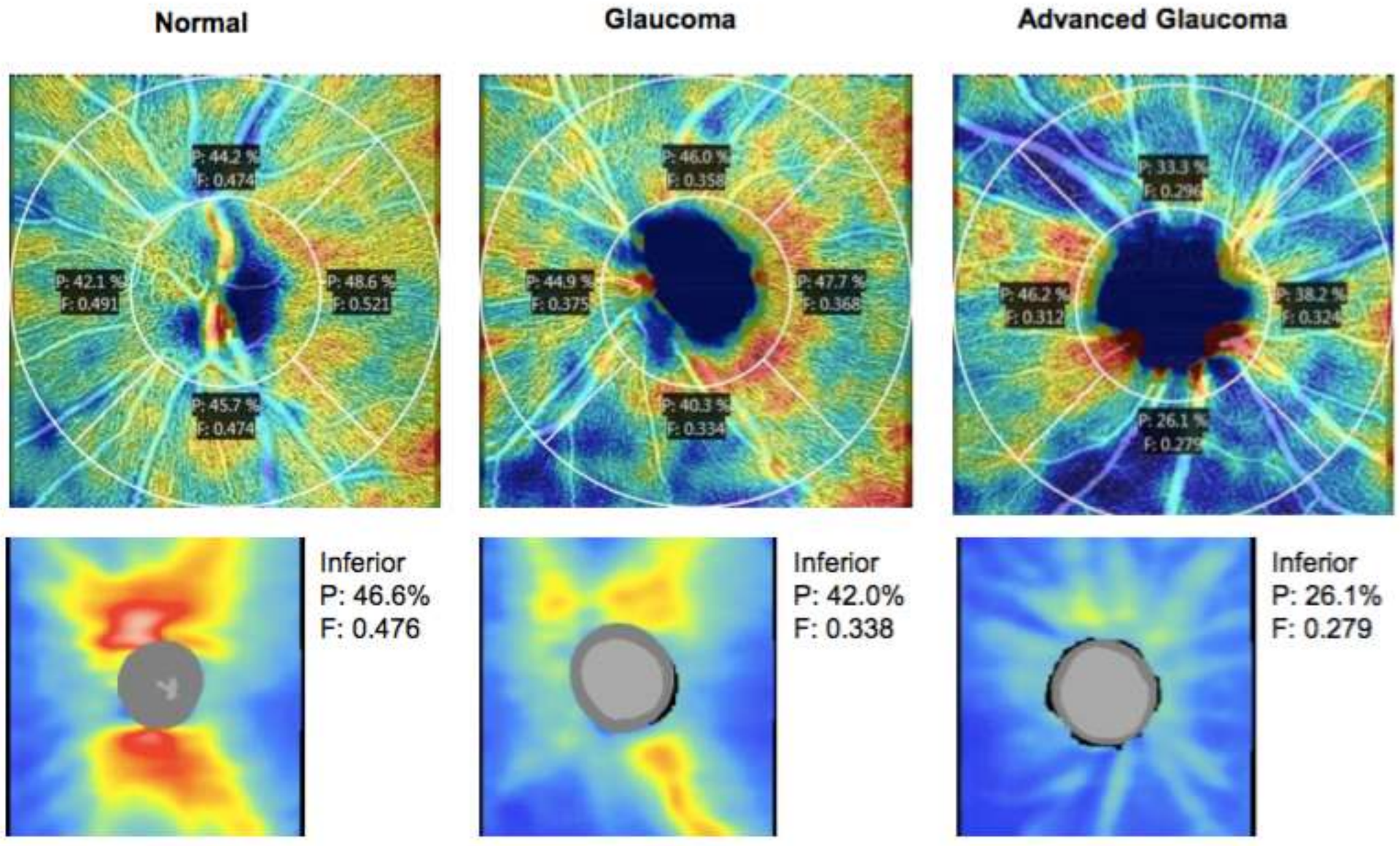
FastTrac™
Eye-tracker di CIRRUS

Valutazione delle acquisizioni OCTA: Qualità del segnale

- L'OCTA è derivato da un classico segnale OCT ripetuto, quindi presenta le medesime limitazioni dell'OCT tradizionale.
- Una bassa **intensità del segnale** può generare zone scure nella scansione oppure acquisizioni di scarsa qualità
  - Questo può essere dovuto a corpi mobili nel vitreo oppure ad altre opacità dei mezzi
- L'esempio sulla destra mostra un'immagine con scarsa qualità del segnale
  - Comparare l'OCT angiografico con en face strutturale e B-scan per identificare la fonte degli spot scuri



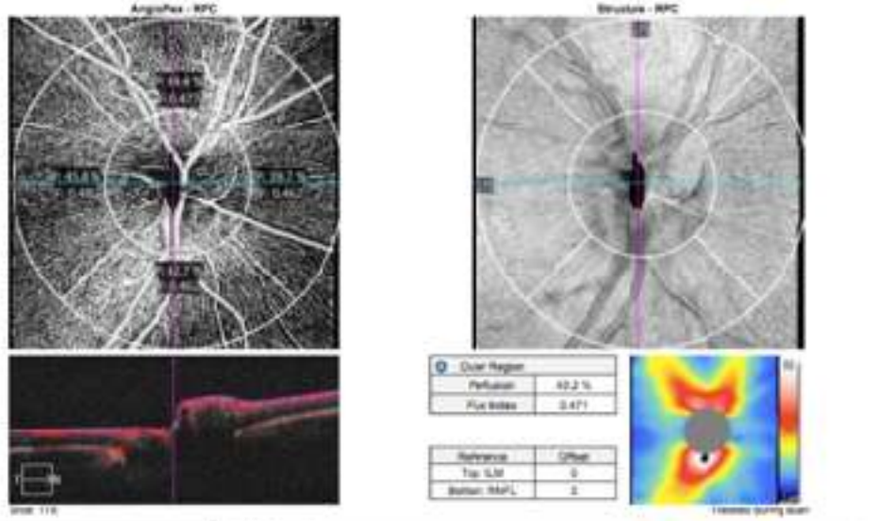
GLAUCOMA: RIDUZIONE PERFUSIONE



SANO

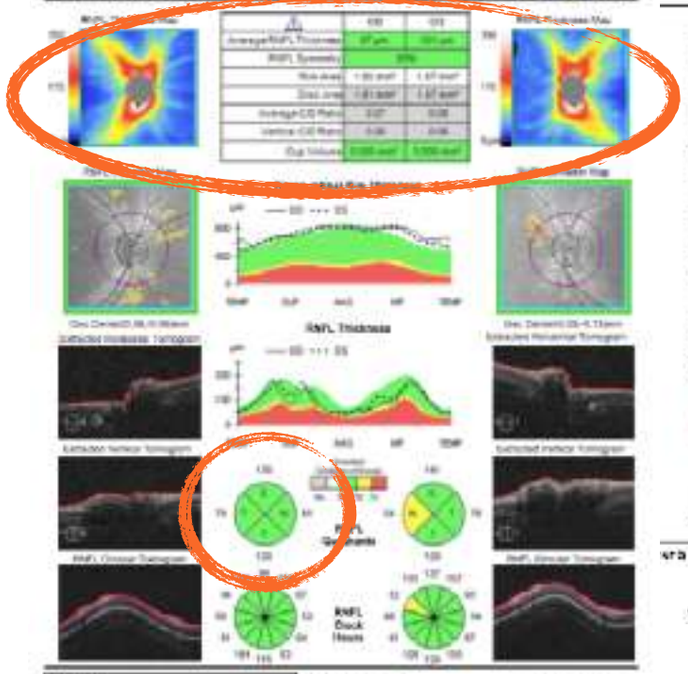
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm

OD ● OS



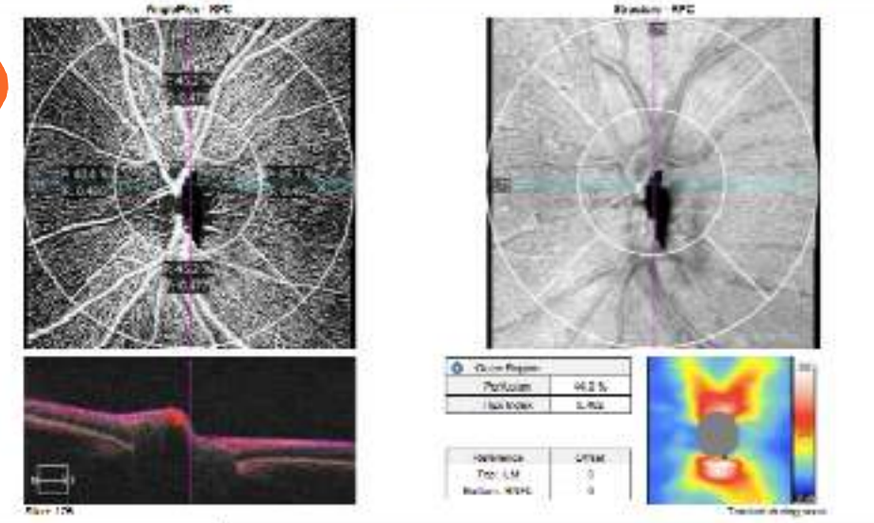
ONH and RNFL OU Analysis:Optic Disc Cube 200x200

OD ● OS



ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm

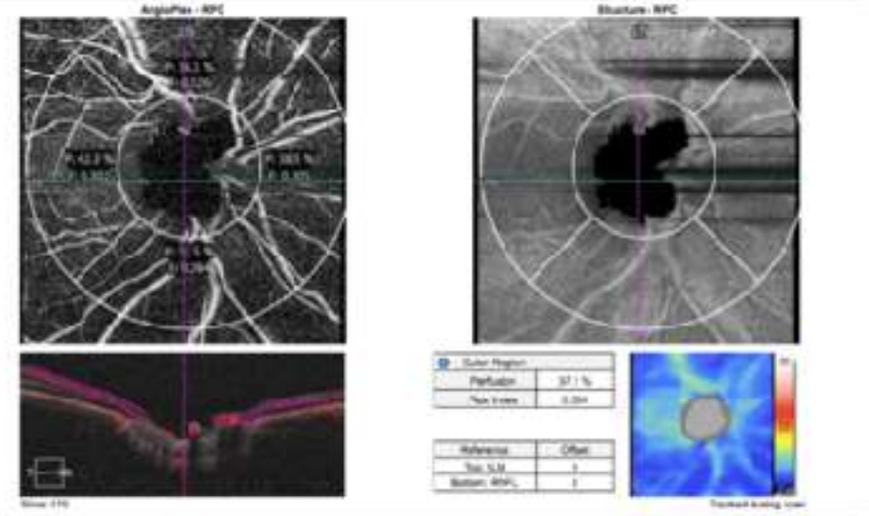
OD ○ ● OS



GLAUCOMA

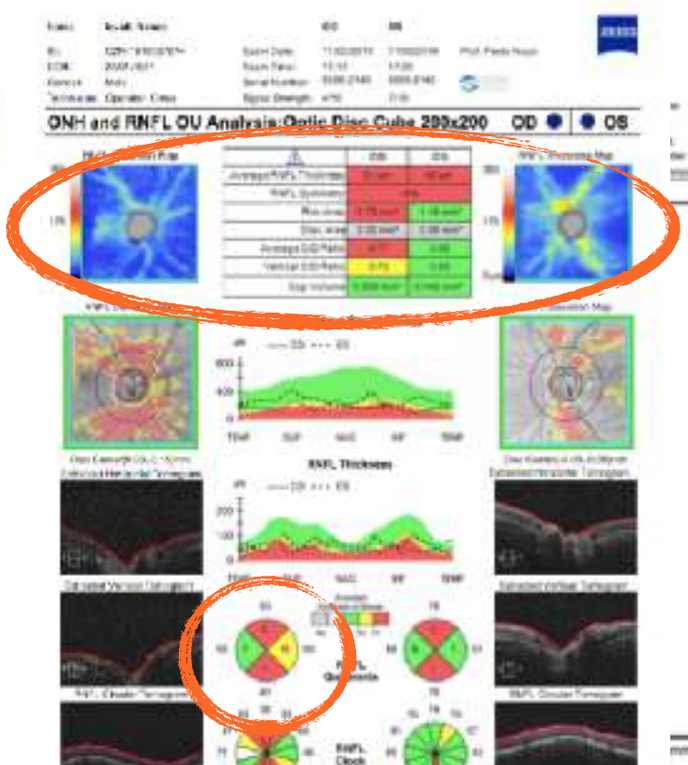
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm

OD ● ○ OS



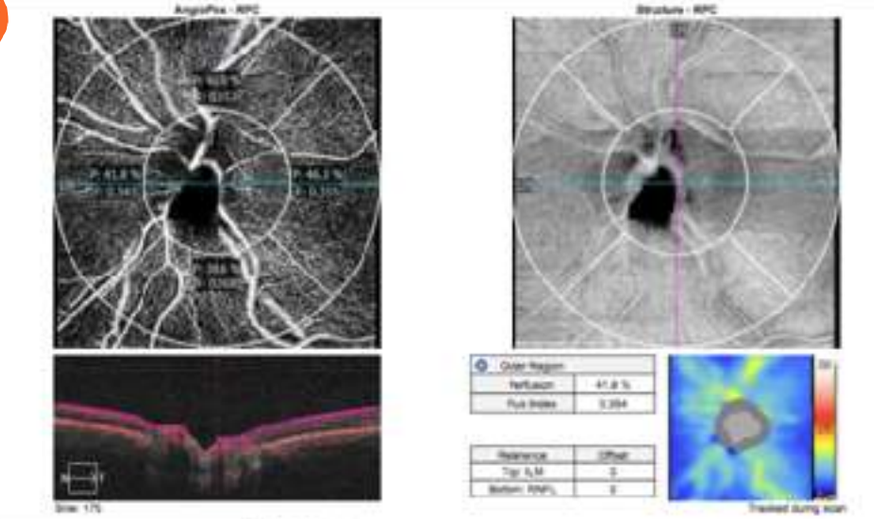
ONH and RNFL OU Analysis:Optic Disc Cube 200x200

OD ● ● OS

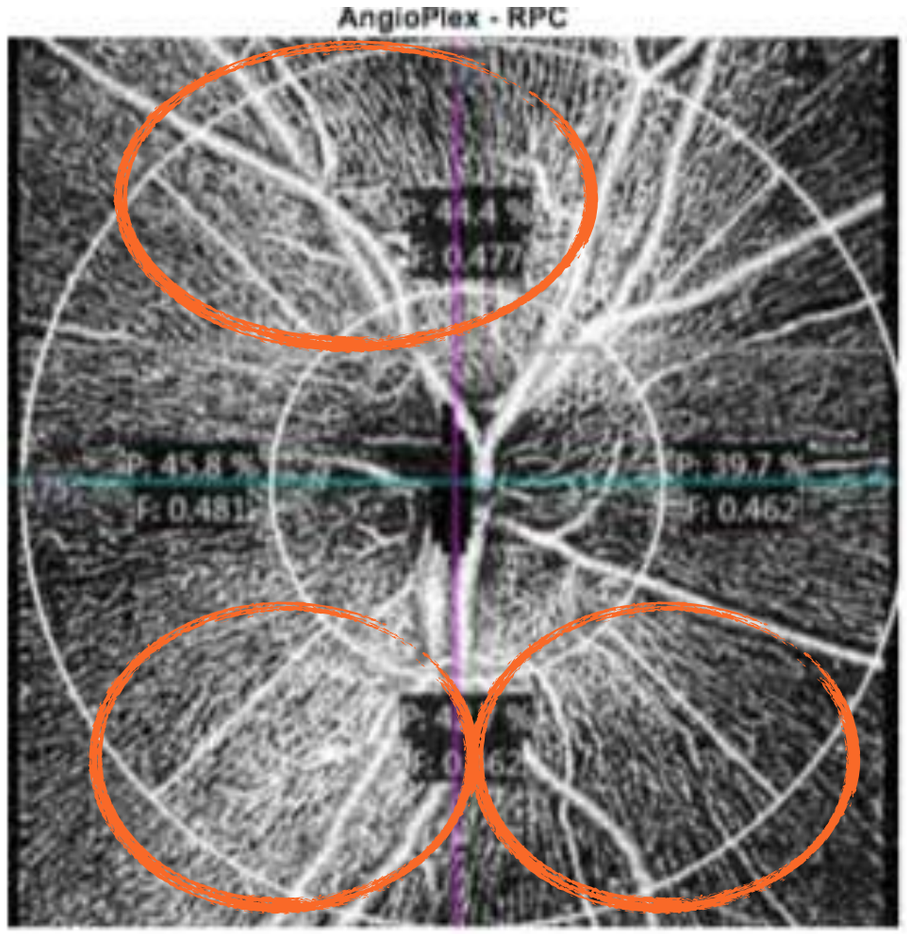


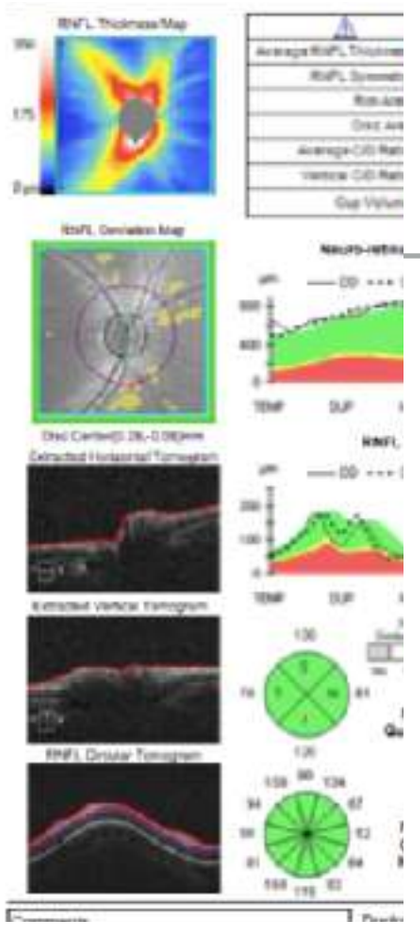
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm

OD ○ ● OS

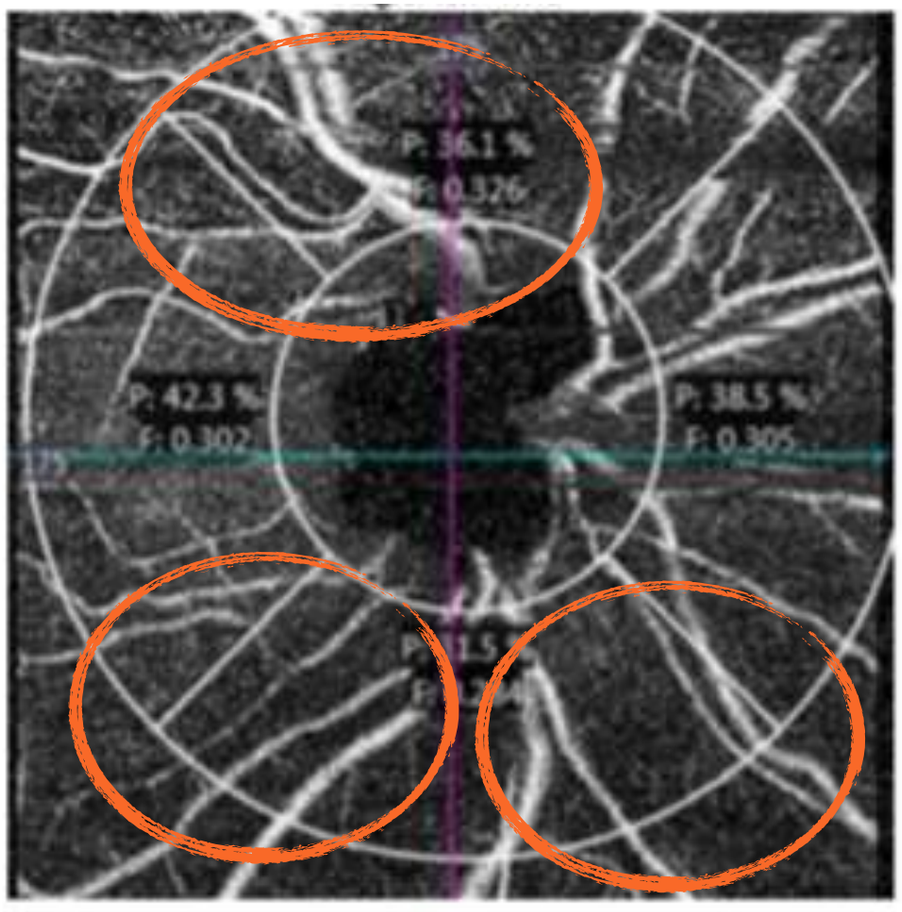


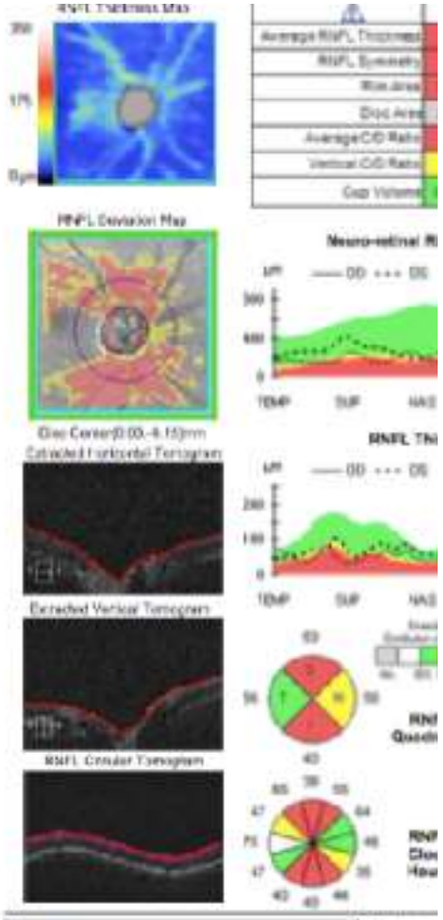
SANO

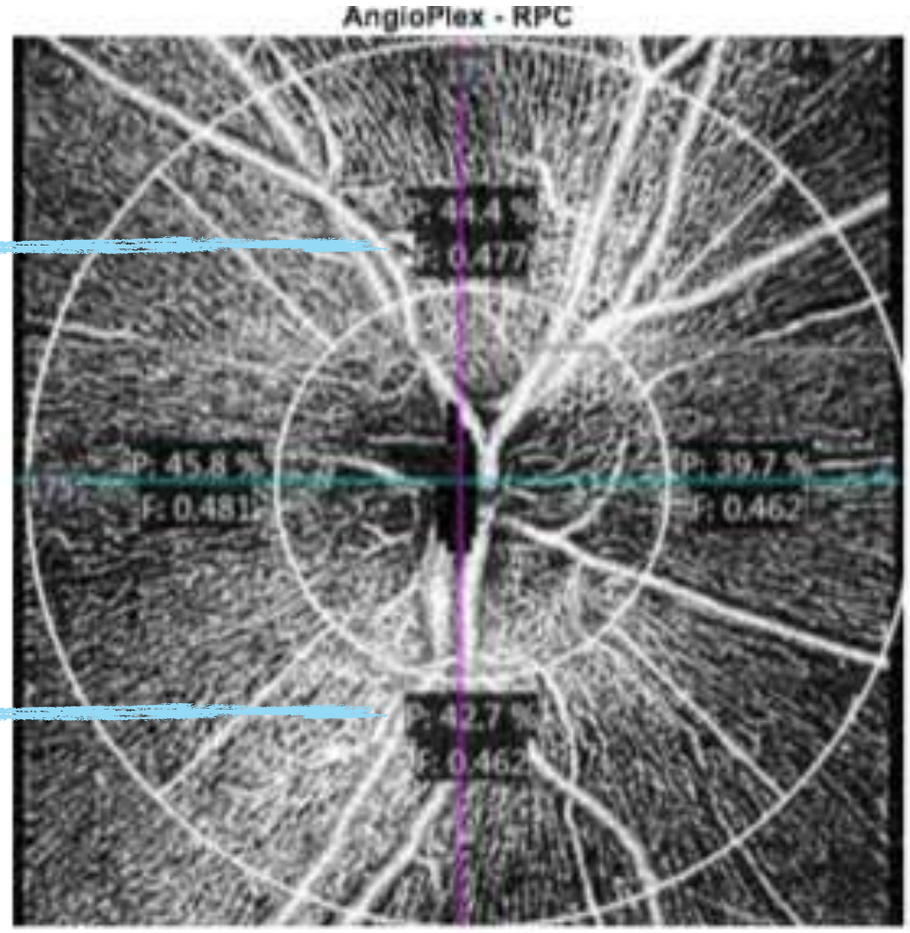


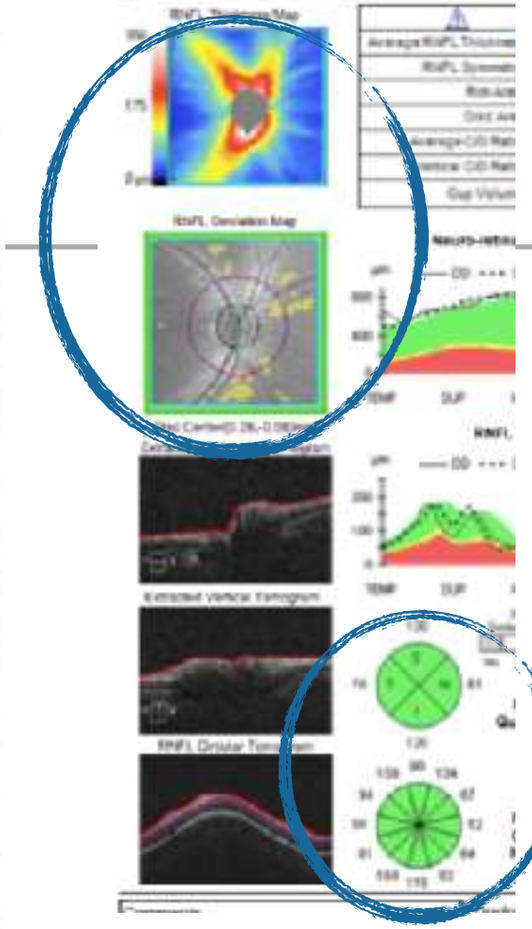


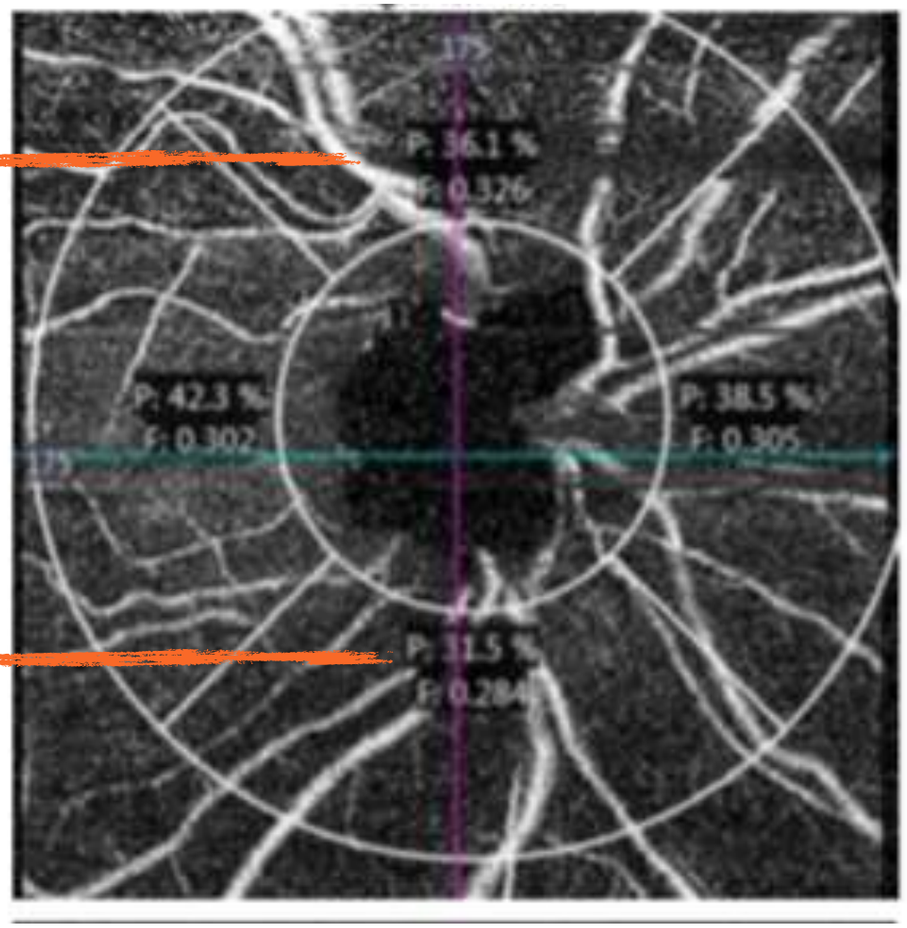
GLAUCOMA

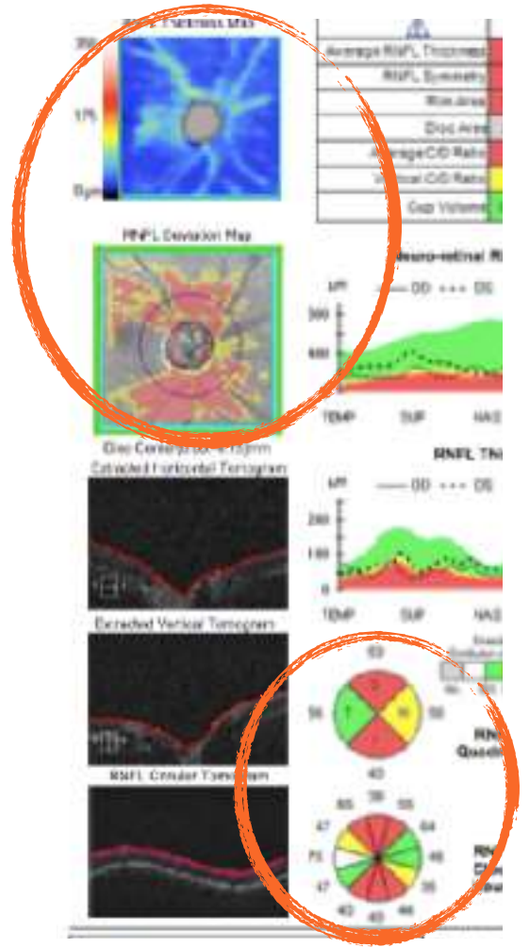





AngioPlex - RPC
P: 45.8 %
P: 39.7 %
F: 0.462




P: 42.3 %
F: 0.302
P: 38.5 %
F: 0.305



GLAUCOMA

Name: Iovati, franco — OD

ID: CZM1810327674 — Exam Date: 11/03/2019 — Prof. Paolo Nucci

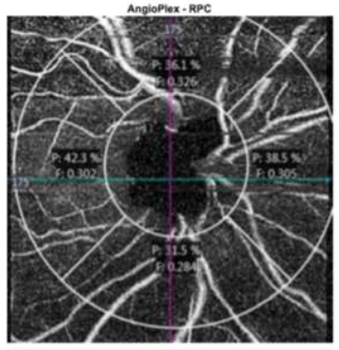
DOB: 28/01/1961 — Exam Time: 17:17

Gender: Male — Serial Number: 5000-2140

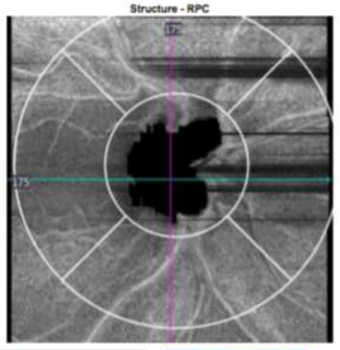
Technician: Operator, Cirrus — Signal Strength: 5/10

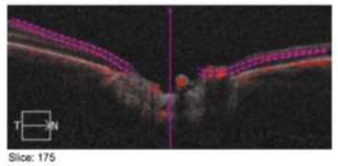
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm — OD ● ○ OS

AngioPlex - RPC



Structure - RPC

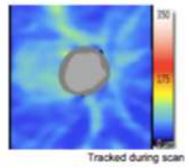




Slice: 175

Outer Region	
Perfusion	37.1 %
Flux Index	0.304

Reference	Offset
Top: ILM	0
Bottom: RNFL	0



Tracked during scan

Comments

Doctor's Signature

Name: Iovati, franco — CC — OS

ID: CZM1813327674 — Exam Date: 11/03/2019 — 11/03/2019 — Prof. Paolo Nucci

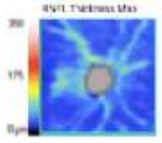
DOB: 28/01/1961 — Exam Time: 17:17 — 17:23

Gender: Male — Serial Number: 5000-2140 — 5000-2140

Technician: Operator, Cirrus — Signal Strength: 4/10 — 7/10

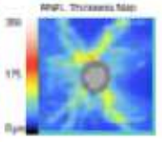
ONH and RNFL OU Analysis:Optic Disc Cube 200x200 — OD ● ● OS

RNFL Thickness Map



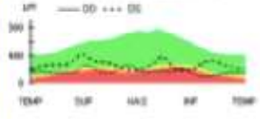
	OD	OS
Average RNFL Thickness	91 µm	90 µm
RNFL Symmetry	0%	
Rim Area	1.79 mm²	1.76 mm²
Disc Area	2.02 mm²	2.08 mm²
Average C/D Ratio	0.77	0.68
Vertical C/D Ratio	0.73	0.62
Cup Volume	0.305 mm³	0.142 mm³

RNFL Thickness Map

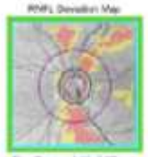


RNFL Deviation Map

Neuro-retinal Rim Thickness

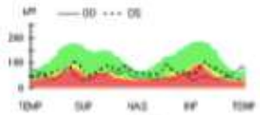


RNFL Deviation Map

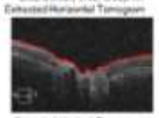


Disc Center(0.03,-4.15)mm
Extracted Horizontal Tomogram

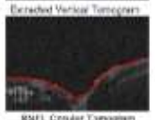
RNFL Thickness



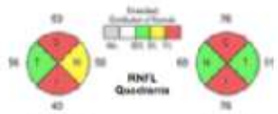
Disc Center(-0.01,-0.06)mm
Extracted Horizontal Tomogram



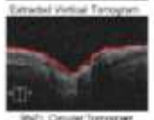
Extracted Vertical Tomogram



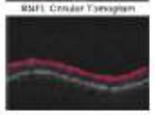
RNFL Quadrants



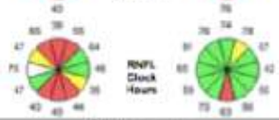
Extracted Vertical Tomogram



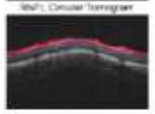
RNFL Circular Tomogram



RNFL Clock Hours



RNFL Circular Tomogram



Comments

Doctor's Signature

Name: Iovati, franco — OS

ID: CZM1810327674 — Exam Date: 11/03/2019

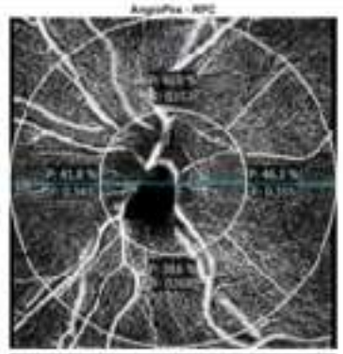
DOB: 28/01/1961 — Exam Time: 17:24

Gender: Male — Serial Number: 5000-2140

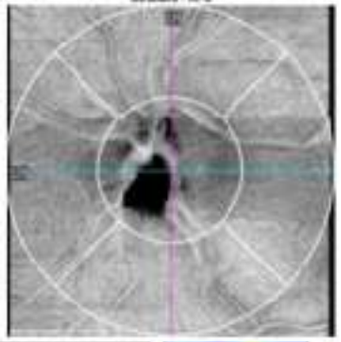
Technician: Operator, Cirrus — Signal Strength: 7/10

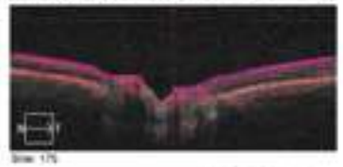
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm — OD ○ ● OS

AngioPlex - RPC



Structure - RPC

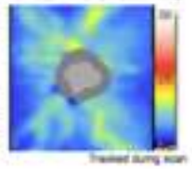




Slice: 175

Outer Region	
Perfusion	41.8 %
Flux Index	0.394

Reference	Offset
Top: ILM	0
Bottom: RNFL	0



Tracked during scan

Comments

Doctor's Signature

Name: Iovati, franco — OD

ID: CZM1810327674 — Exam Date: 11/03/2019 — Prof. Paolo Nucci

DOB: 28/01/1961 — Exam Time: 17:22

Gender: Male — Serial Number: 5000-2140

Technician: Operator, Cirrus — Signal Strength: N/A

Montage Angio Analysis : Montage Angio 6x6 mm — OD ● ○ OS

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

Comments

Doctor's Signature

Name: Iovati, franco — OS

ID: CZM1810327674 — Exam Date: 11/03/2019

DOB: 28/01/1961 — Exam Time: 17:51

Gender: Male — Serial Number: 5000-2140

Technician: Operator, Cirrus — Signal Strength: N/A

Montage Angio Analysis : Montage Angio 6x6 mm — OD ○ ● OS

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

Comments

Doctor's Signature

GLAUCOMA

Name: Iovati, franco
ID: CZM1810327674
DOB: 28/01/1961
Gender: Male
OD
Exam Date: 11/03/2019
Exam Time: 17:17
Serial Number: 5000-2140
Prof. Paolo Nucci

OD ● ○ OS

Tracked during scan

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

OD ● ○ OS

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● ● OS

RNFL Thickness Map

	OD	OS
Average RNFL Thickness	91 µm	90 µm
RNFL Symmetry	0%	
Rim Area	1.19 mm²	1.16 mm²
Disc Area	2.02 mm²	2.08 mm²
Average C/D Ratio	0.77	0.68
Vertical C/D Ratio	0.73	0.62
Cup Volume	0.305 mm³	0.142 mm³

RNFL Deviation Map

Neuro-retinal Rim Thickness

RNFL Thickness

RNFL Quadrants

RNFL Clock Hours

Disc Center(0.03,-0.15)mm
Extracted Horizontal Tomogram

Disc Center(-0.01,-0.00)mm
Extracted Horizontal Tomogram

Extracted Vertical Tomogram

RNFL Circular Tomogram

Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Name: Iovati, franco
ID: CZM1810327674
DOB: 28/01/1961
Gender: Male
Technician: Operator, Gina

Montage

OD ○ ● OS

Tracked during scan

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

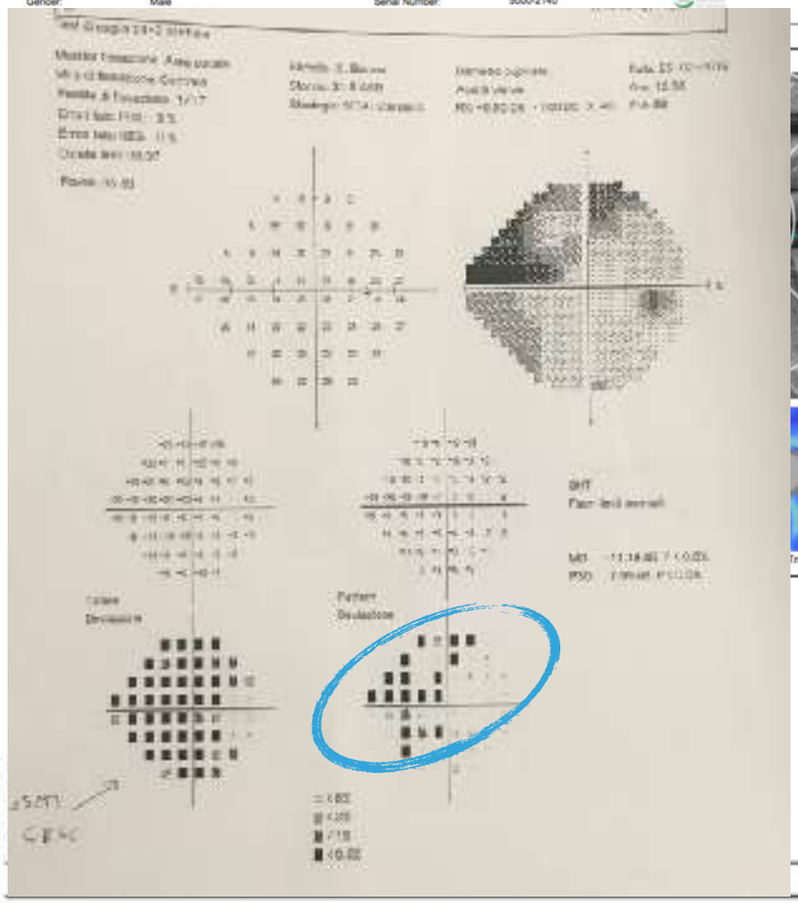
Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

GLAUCOMA

Name: Iovati, franco
ID: CZM1810327674
DOB: 28/01/1961
Gender: Male
OD
Exam Date: 11/03/2019
Exam Time: 17:17
Serial Number: 5000-2140
Prof. Paolo Nucci



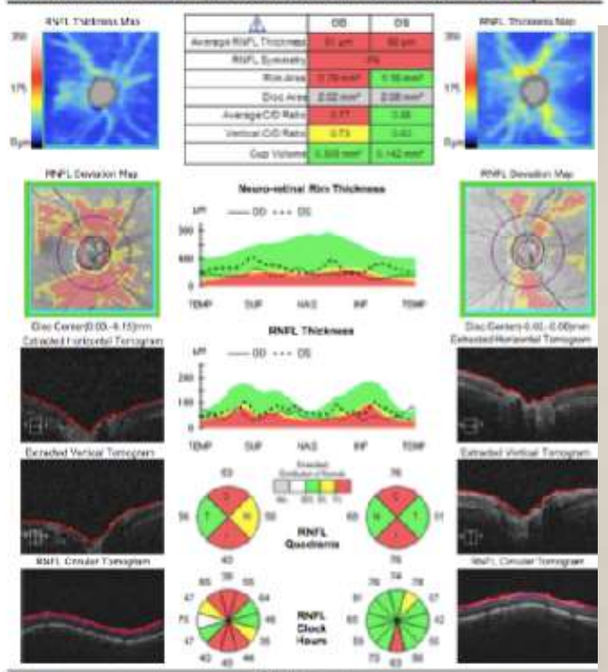
OD ● ○ OS

Tracked during scan

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Name: Iovati, franco
ID: CZM1810327674
DOB: 28/01/1961
Gender: Male
Technician: Operator, Circ
Exam Date: 11/03/2019
Exam Time: 17:17
Serial Number: 5000-2140
Prof. Paolo Nucci

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● ○ OS



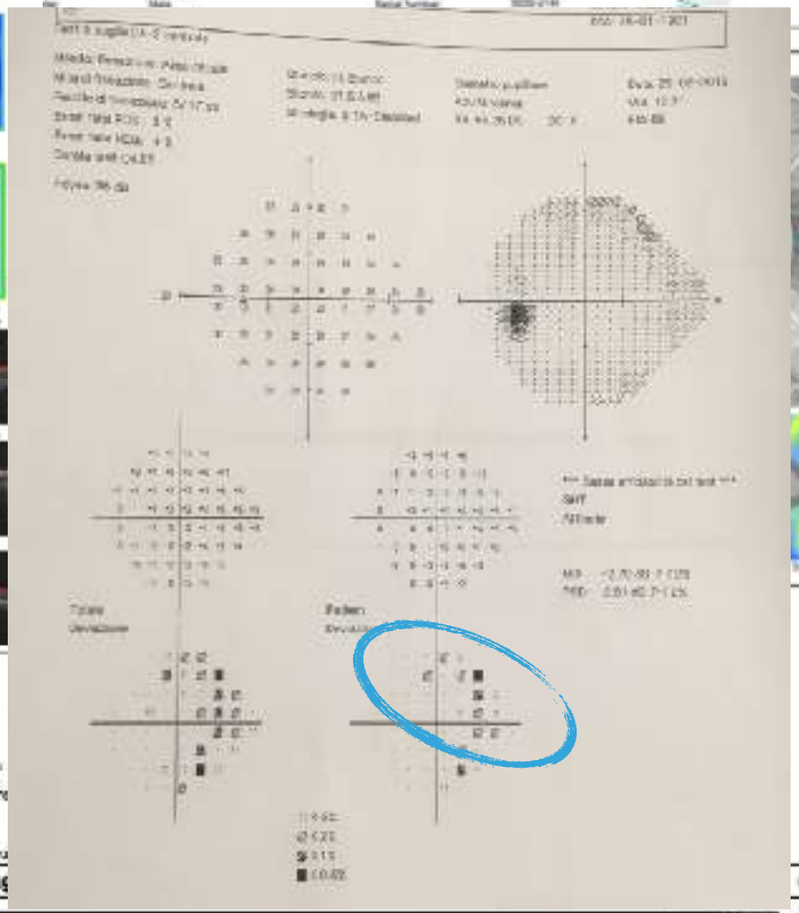
	OD	OS
Average RNFL Thickness	91 µm	90 µm
RNFL Symmetry	0%	
Rim Area	1.19 mm²	1.16 mm²
Disc Area	2.02 mm²	2.08 mm²
Average C/D Ratio	0.77	0.68
Vertical C/D Ratio	0.73	0.62
Cup Volume	0.305 mm³	0.142 mm³

Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Name: Iovati, franco
ID: CZM1810327674
DOB: 28/01/1961
Gender: Male
Technician: Operator, Circ
Exam Date: 11/03/2019
Exam Time: 17:24
Serial Number: 5000-2140



OD ○ ● OS

Tracked during scan

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

Superficial
AngioPlex

Top
ILM, Offset: 0

Bottom
IPL, Offset: 0

Comments

Doctor's Signature

SW Ver: 11.0.0.29946
Copyright 2018
Carl Zeiss Meditec, Inc
All Rights Reserved
Page 1 of 1

applicazioni cliniche

GLAUCOMA A TENSIONE NORMALE

M. Sacchi - Ospedale San Giuseppe Milano

NORMAL TENSION GLAUCOMA

Graefe's Archive for Clinical and Experimental Ophthalmology (2018) 256:1179–1186
https://doi.org/10.1007/s00417-018-3930-z

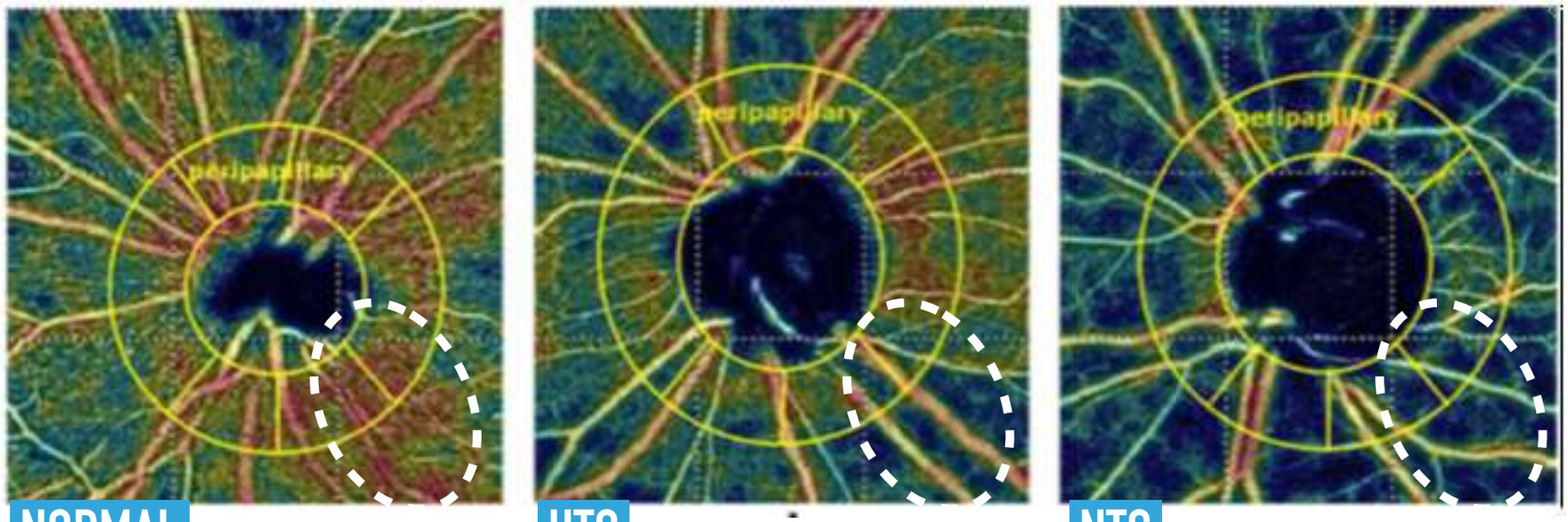
GLAUCOMA

Comparison of retinal microvascular changes in eyes with high-tension glaucoma or normal-tension glaucoma: a quantitative optic coherence tomography angiographic study

Huan Xu[1,2,3] · Ruyi Zhai[1,2,3] · Yuan Zong[1,2,3] · Xiangmei Kong[1,2,3] · Chunhui Jiang[1,2,3] · Xinghuai Sun[1,2,3,4] · Yi He[5,6] · Xiqi Li[5,6]

Table 1 Subject characteristics

Characteristics	Normal ($n = 51$ eyes)	HTG ($n = 43$ eyes)	NTG ($n = 33$ eyes)	P^a	P^b	P^c
RNFL thickness	104.53 ± 12.53	77.09 ± 12.78	72.73 ± 18.82	< 0.001*	< 0.001*	0.586
Peripapillary region	63.29 ± 3.34	55.57 ± 5.77	49.78 ± 9.21	< 0.001*	< 0.001*	< 0.001*
MD (dB)	–	− 9.11 ± 7.36	− 9.76 ± 6.61	–	–	0.691



NORMAL TENSION GLAUCOMA

Graefe's Archive for Clinical and Experimental Ophthalmology (2018) 256:1179–1186
https://doi.org/10.1007/s00417-018-3930-z

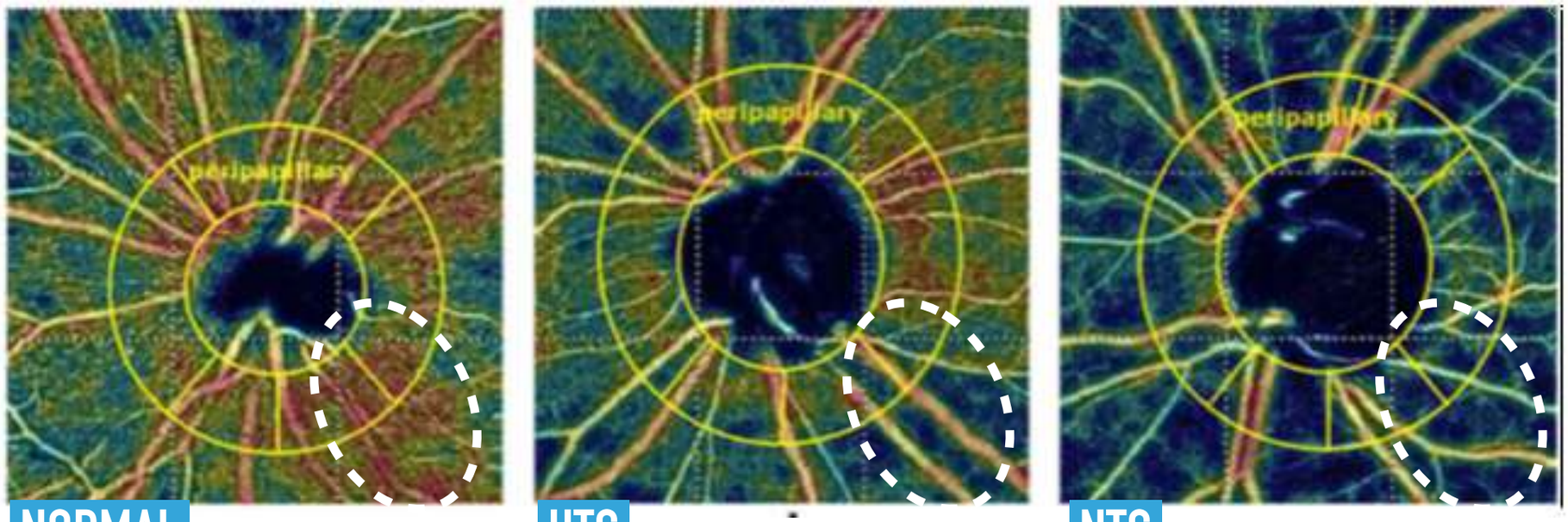
GLAUCOMA

Comparison of retinal microvascular changes in eyes with high-tension glaucoma or normal-tension glaucoma: a quantitative optic coherence tomography angiographic study

Huan Xu[1,2,3] · Ruyi Zhai[1,2,3] · Yuan Zong[1,2,3] · Xiangmei Kong[1,2,3] · Chunhui Jiang[1,2,3] · Xinghuai Sun[1,2,3,4] · Yi He[5,6] · Xiqi Li[5,6]

RIDUZIONE PERFUSIONE NEI PAZIENTI CON GLAUCOMA (HTG, NTG) RISPETTO AI CONTROLLI SANI

RNFL thickness	104.53 ± 12.53	77.09 ± 12.78	72.73 ± 18.82	< 0.001*	< 0.001*	0.586
Peripapillary region	63.29 ± 3.34	55.57 ± 5.77	49.78 ± 9.21	< 0.001*	< 0.001*	< 0.001*
MD (dB)	–	− 9.11 ± 7.36	− 9.76 ± 6.61	–	–	0.691



NORMAL TENSION GLAUCOMA

Graefe's Archive for Clinical and Experimental Ophthalmology (2018) 256:1179–1186
https://doi.org/10.1007/s00417-018-3930-z

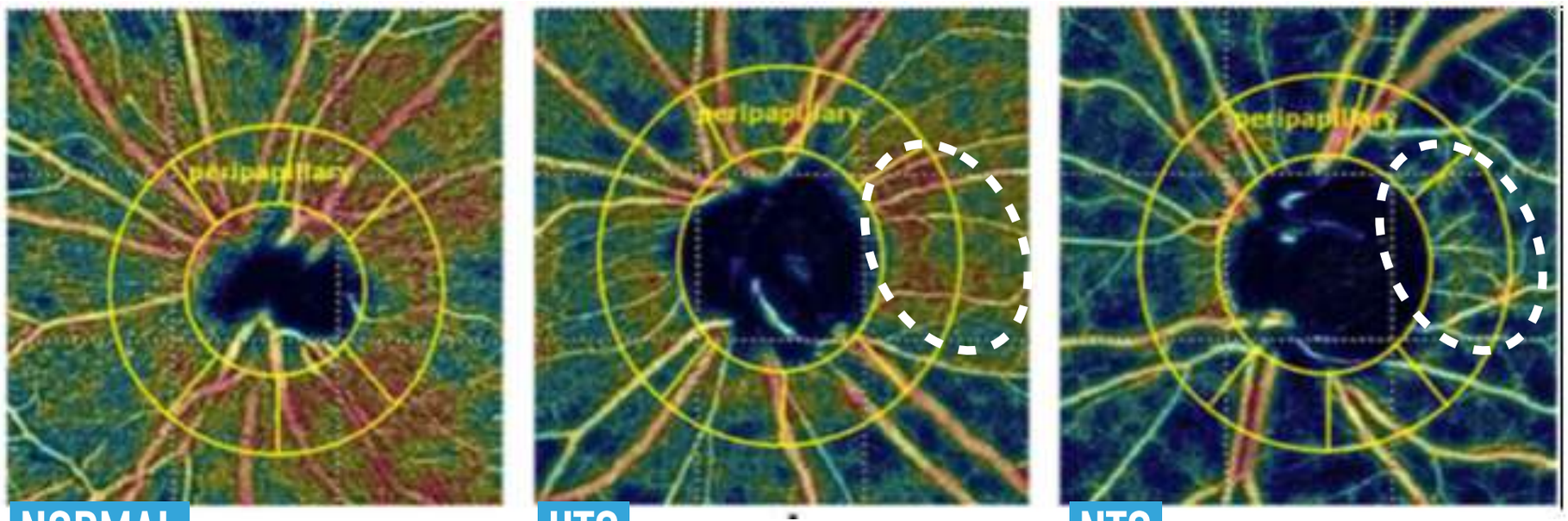
GLAUCOMA

Comparison of retinal microvascular changes in eyes with high-tension glaucoma or normal-tension glaucoma: a quantitative optic coherence tomography angiographic study

Huan Xu[1,2,3] · Ruyi Zhai[1,2,3] · Yuan Zong[1,2,3] · Xiangmei Kong[1,2,3] · Chunhui Jiang[1,2,3] · Xinghuai Sun[1,2,3,4] · Yi He[5,6] · Xiqi Li[5,6]

Table 1 Subject characteristics

Characteristics	Normal ($n = 51$ eyes)	HTG ($n = 43$ eyes)	NTG ($n = 33$ eyes)	P^a	P^b	P^c
RNFL thickness	104.53 ± 12.53	77.09 ± 12.78	72.73 ± 18.82	< 0.001*	< 0.001*	0.586
Peripapillary region	63.29 ± 3.34	55.57 ± 5.77	49.78 ± 9.21	< 0.001*	< 0.001*	< 0.001*
MD (dB)	–	−9.11 ± 7.36	−9.76 ± 6.61	–	–	0.691



NORMAL TENSION GLAUCOMA

Graefe's Archive for Clinical and Experimental Ophthalmology (2018) 256:1179–1186
https://doi.org/10.1007/s00417-018-3930-z

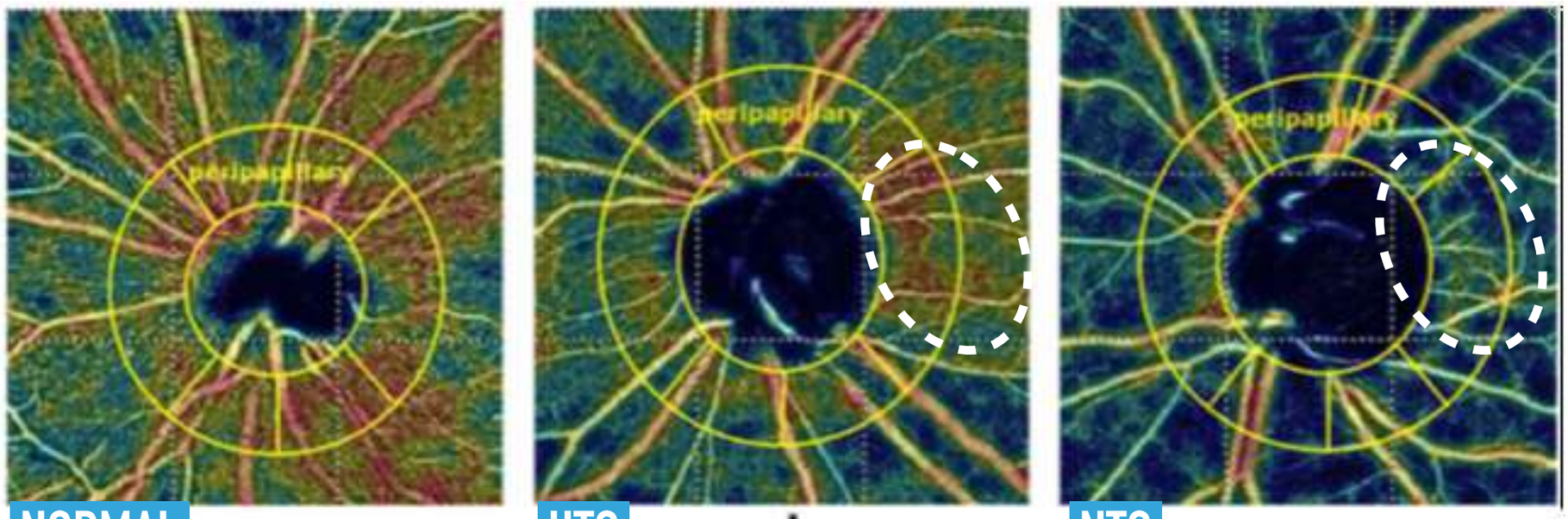
GLAUCOMA

Comparison of retinal microvascular changes in eyes with high-tension glaucoma or normal-tension glaucoma: a quantitative optic coherence tomography angiographic study

Huan Xu[1,2,3] · Ruyi Zhai[1,2,3] · Yuan Zong[1,2,3] · Xiangmei Kong[1,2,3] · Chunhui Jiang[1,2,3] · Xinghuai Sun[1,2,3,4] · Yi He[5,6] · Xiqi Li[5,6]

GLAUCOMA TENSIONE NORMALE: RIDUZIONE PERFUSIONE, INDIPENDENTE DALLO SPESSORE RNFL

RNFL thickness	104.53 ± 12.53	77.09 ± 12.78	72.73 ± 18.82	< 0.001*	< 0.001*	0.586
Peripapillary region	63.29 ± 3.34	55.57 ± 5.77	49.78 ± 9.21	< 0.001*	< 0.001*	< 0.001*
MD (dB)	–	− 9.11 ± 7.36	− 9.76 ± 6.61	–	–	0.691



NORMAL TENSION GLAUCOMA

Graefe's Archive for Clinical and Experimental Ophthalmology (2018) 256:1179–1186
https://doi.org/10.1007/s00417-018-3930-z

GLAUCOMA

Comparison of retinal microvascular changes in eyes with high-tension glaucoma or normal-tension glaucoma: a quantitative optic coherence tomography angiographic study

Huan Xu[1,2,3] · Ruyi Zhai[1,2,3] · Yuan Zong[1,2,3] · Xiangmei Kong[1,2,3] · Chunhui Jiang[1,2,3] · Xinghuai Sun[1,2,3,4] · Yi He[5,6] · Xiqi Li[5,6]

Table 1 Subject characteristics

Characteristics	Normal ($n = 51$ eyes)	HTG ($n = 43$ eyes)	NTG ($n = 33$ eyes)	P^a	P^b	P^c
RNFL thickness	104.53 ± 12.53	77.09 ± 12.78	72.73 ± 18.82	< 0.001*	< 0.001*	0.586
Peripapillary region	63.29 ± 3.34	55.57 ± 5.77	49.78 ± 9.21	< 0.001*	< 0.001*	< 0.001*
MD (dB)	–	−9.11 ± 7.36	−9.76 ± 6.61	–	–	0.691
Parafovea region	51.58 ± 4.01	47.27 ± 4.86	45.56 ± 5.52	< 0.001*	< 0.001*	0.363

riduzione *perfusione testa ottico*, ma non a livello maculare

ipossia relativa testa nervo ottico potrebbe spiegare la maggior incidenza di *emorragie papillari*, tipiche del glaucoma a tensione normale

questo dato supporta l'*associazione tra NTG* e disturbi vascolari come *l'emicrania* e il *fenomeno di Raynaud*

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

AJO 2022

YOUNHEA JUNG, HAE-YOUNG LOPILLY PARK, HEEJONG SHIN, SI EUN OH, SEONG AH KIM, JI-YOUNG LEE, DA YOUNG SHIN, SOO JI JEON, YONG-CHAN KIM, HYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK

Variables	Progression to NTG (n=73)	Nonprogression to NTG (n=234)	*P* Value
Demographics			
Age at diagnosis (y)	54.47 ± 13.98	49.91 ± 15.06	.022[a]
Female, n (%)	39 (53.4)	156 (66.7)	.051[b]
Family history of glaucoma, n (%)	16 (21.9)	32 (13.7)	.099[b]
Systemic demographics			
Medication of DM, n (%)	4 (5.5)	10 (4.3)	.748[b]
Medication of HTN, n (%)	18 (24.7)	25 (10.7)	.006[b]
Ocular demographics			
Best-corrected visual acuity	0.94 ± 0.11	0.93 ± 0.13	.595[a]
Axial length (mm)	24.97 ± 1.85	24.59 ± 1.48	.079[a]
Central corneal thickness (μm)	551.61 ± 41.41	554.27 ± 38.13	.617[a]
IOP parameters			
Baseline IOP (mm Hg)	16.32 ± 4.14	16.21 ± 3.73	.829[a]
Mean follow-up IOP (mm Hg)	14.98 ± 3.15	15.56 ± 4.26	.552[a]
OCT parameters			
Baseline average pRNFL thickness (μm)	86.96 ± 8.45	91.21 ± 9.78	.001[a]
Baseline average mGC-IPL thickness (μm)	75.88 ± 8.33	77.56 ± 12.52	.344[a]
VF parameters			
Baseline MD of SAP (dB)	-1.60 ± 1.99	-1.21 ± 1.61	.093[a]
Baseline PSD of SAP (dB)	2.15 ± 1.19	1.73 ± 0.69	<.001[a]
Disc parameters			
Presence of DH, n (%)	6 (8.2)	2 (0.9)	.003[b]
Disc area by HRT (mm^2)	2.39 ± 0.44	2.27 ± 0.47	.285[a]
Vertical cup-to-disc ratio by HRT (mm^2)	0.71 ± 0.12	0.63 ± 0.11	.005[a]
Measured ONH parameters			
Disc tilt ratio	1.17 ± 0.34	1.14 ± 0.15	.235[a]
Disc torsion degree	-1.46 ± 15.97	1.72 ± 8.47	.032[a]
Disc-foveal angle	6.94 ± 4.39	7.06 ± 3.53	.818[a]
Presence of β-zone PPA, n (%)	59 (80.8)	154 (65.8)	.019[b]
PPA area (pixel area)	24,883.28 ± 26,329.61	21,443.24 ± 19,025.01	.304[a]
OCT angiography parameters			
Presence of MvD, n (%)	37 (50.7)	15 (6.4)	<.001[b]
Macular superficial VD (%)	34.38 ± 3.07	35.38 ± 3.93	.126[a]
Macular deep VD (%)	35.52 ± 4.91	37.71 ± 4.55	.006[a]
Peripapillary superficial VD (%)	40.46 ± 4.52	40.72 ± 4.19	.726[a]
Peripapillary deep VD (%)	63.97 ± 5.95	64.11 ± 6.79	.835[a]
Laminar deep VD (%)	25.55 ± 14.19	31.50 ± 10.92	.004[a]
Follow-up duration (mo)	55.31 ± 10.98	52.73 ± 10.68	.270[a]

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

AJO 2022

YOUNHEA JUNG, HAE-YOUNG LOPILLY PARK, HEEJONG SHIN, SI EUN OH, SEONG AH KIM, JI-YOUNG LEE, DA YOUNG SHIN, SOO JI JEON, YONG-CHAN KIM, HYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK

Variables	Progression to NTG (n=73)	Nonprogression to NTG (n=234)	*P* Value
Demographics			
Age at diagnosis (y)	54.47 ± 13.98	49.91 ± 15.06	.022[a]
Female, n (%)	39 (53.4)	156 (66.7)	.051[b]
Family history of glaucoma, n (%)	16 (21.9)	32 (13.7)	.099[b]
Systemic demographics			
Medication of DM, n (%)	4 (5.5)	10 (4.3)	.748[b]
Medication of HTN, n (%)	18 (24.7)	25 (10.7)	.006[b]
Ocular demographics			
Best-corrected visual acuity	0.94 ± 0.11	0.93 ± 0.13	.595[a]
Axial length (mm)	24.97 ± 1.85	24.59 ± 1.48	.079[a]
Central corneal thickness (μm)	551.61 ± 41.41	554.27 ± 38.13	.617[a]
IOP parameters			
Baseline IOP (mm Hg)	16.32 ± 4.14	16.21 ± 3.73	.829[a]
Mean follow-up IOP (mm Hg)	14.98 ± 3.15	15.56 ± 4.26	.552[a]
OCT parameters			
Baseline average pRNFL thickness (μm)	86.96 ± 8.45	91.21 ± 9.78	.001[a]
Baseline average mGC-IPL thickness (μm)	75.88 ± 8.33	77.56 ± 12.52	.344[a]
VF parameters			
Baseline MD of SAP (dB)	-1.60 ± 1.99	-1.21 ± 1.61	.093[a]
Baseline PSD of SAP (dB)	2.15 ± 1.19	1.73 ± 0.69	<.001[a]
Disc parameters			
Presence of DH, n (%)	6 (8.2)	2 (0.9)	.003[b]
Disc area by HRT (mm^2)	2.39 ± 0.44	2.27 ± 0.47	.285[a]
Vertical cup-to-disc ratio by HRT (mm^2)	0.71 ± 0.12	0.63 ± 0.11	.005[a]
Measured ONH parameters			
Disc tilt ratio	1.17 ± 0.34	1.14 ± 0.15	.235[a]
Disc torsion degree	-1.46 ± 15.97	1.72 ± 8.47	.032[a]
Disc-foveal angle	6.94 ± 4.39	7.06 ± 3.53	.818[a]
Presence of β-zone PPA, n (%)	59 (80.8)	154 (65.8)	.019[b]
PPA area (pixel area)	24,883.28 ± 26,329.61	21,443.24 ± 19,025.01	.304[a]
OCT angiography parameters			
Presence of MvD, n (%)	37 (50.7)	15 (6.4)	<.001[b]
Macular superficial VD (%)	34.38 ± 3.07	35.38 ± 3.93	.126[a]
Macular deep VD (%)	35.52 ± 4.91	37.71 ± 4.55	.006[a]
Peripapillary superficial VD (%)	40.46 ± 4.52	40.72 ± 4.19	.726[a]
Peripapillary deep VD (%)	63.97 ± 5.95	64.11 ± 6.79	.835[a]
Laminar deep VD (%)	25.55 ± 14.19	31.50 ± 10.92	.004[a]
Follow-up duration (mo)	55.31 ± 10.98	52.73 ± 10.68	.270[a]

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

AJO 2022

YOUNHEA JUNG, HAE-YOUNG LOPILLY PARK, HEEJONG SHIN, SI EUN OH, SEONG AH KIM, JI-YOUNG LEE, DA YOUNG SHIN, SOO JI JEON, YONG-CHAN KIM, HYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK

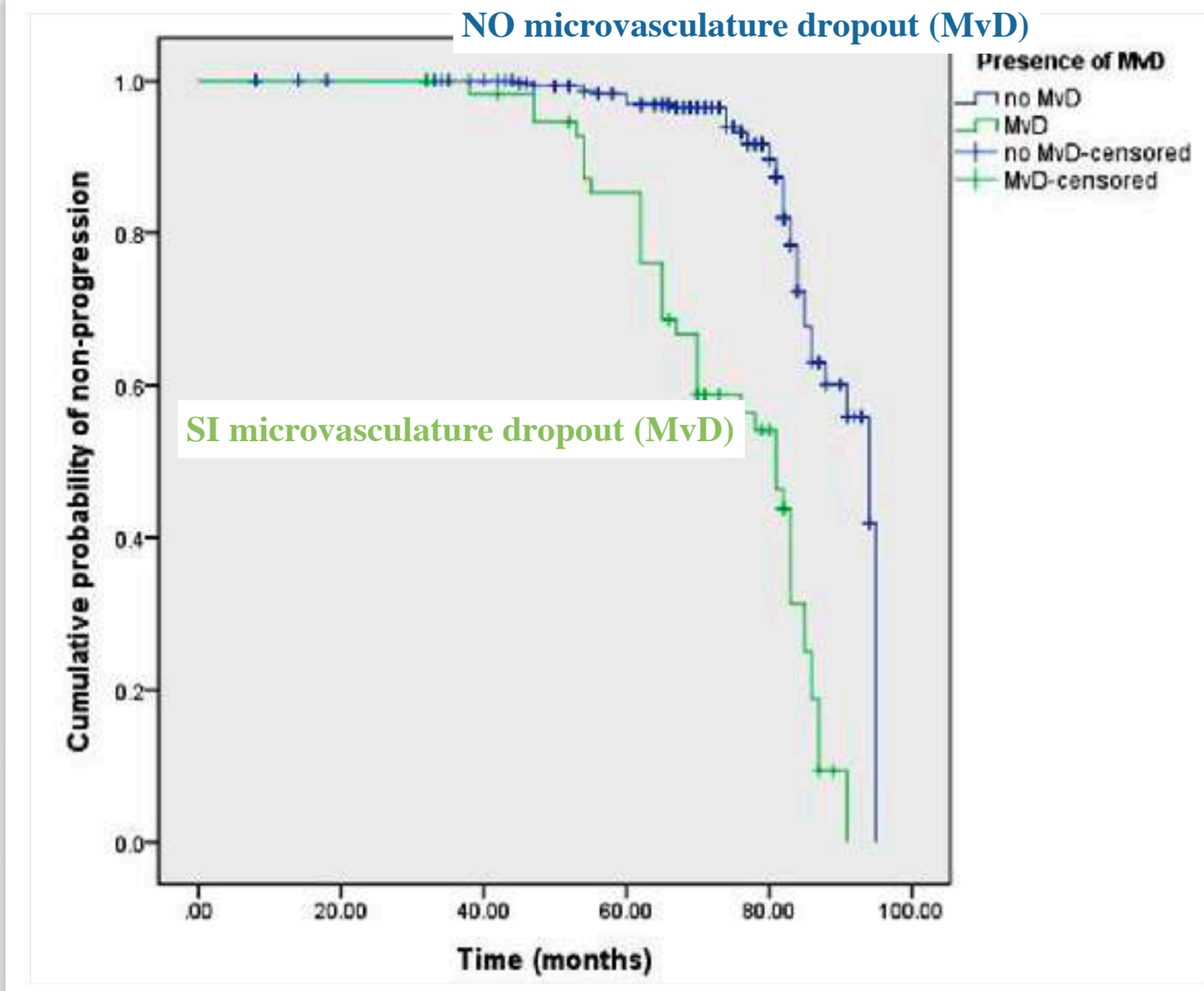
Variables	Progression to NTG (n=73)	Nonprogression to NTG (n=234)	*P* Value
Demographics			
Age at diagnosis (y)	54.47 ± 13.98	49.91 ± 15.06	.022[a]
Female, n (%)	39 (53.4)	156 (66.7)	.051[b]
Family history of glaucoma, n (%)	16 (21.9)	32 (13.7)	.099[b]
Systemic demographics			
Medication of DM, n (%)	4 (5.5)	10 (4.3)	.748[b]
Medication of HTN, n (%)	18 (24.7)	25 (10.7)	.006[b]
Ocular demographics			
Best-corrected visual acuity	0.94 ± 0.11	0.93 ± 0.13	.595[a]
Axial length (mm)	24.97 ± 1.85	24.59 ± 1.48	.079[a]
Central corneal thickness (μm)	551.61 ± 41.41	554.27 ± 38.13	.617[a]
IOP parameters			
Baseline IOP (mm Hg)	16.32 ± 4.14	16.21 ± 3.73	.829[a]
Mean follow-up IOP (mm Hg)	14.98 ± 3.15	15.56 ± 4.26	.552[a]
OCT parameters			
Baseline average pRNFL thickness (μm)	86.96 ± 8.45	91.21 ± 9.78	.001[a]
Baseline average mGC-IPL thickness (μm)	75.88 ± 8.33	77.56 ± 12.52	.344[a]
VF parameters			
Baseline MD of SAP (dB)	-1.60 ± 1.99	-1.21 ± 1.61	.093[a]
Baseline PSD of SAP (dB)	2.15 ± 1.19	1.73 ± 0.69	<.001[a]
Disc parameters			
Presence of DH, n (%)	6 (8.2)	2 (0.9)	.003[b]
Disc area by HRT (mm^2)	2.39 ± 0.44	2.27 ± 0.47	.285[a]
Vertical cup-to-disc ratio by HRT (mm^2)	0.71 ± 0.12	0.63 ± 0.11	.005[a]
Measured ONH parameters			
Disc tilt ratio	1.17 ± 0.34	1.14 ± 0.15	.235[a]
Disc torsion degree	-1.46 ± 15.97	1.72 ± 8.47	.032[a]
Disc-foveal angle	6.94 ± 4.39	7.06 ± 3.53	.818[a]
Presence of β-zone PPA, n (%)	59 (80.8)	154 (65.8)	.019[b]
PPA area (pixel area)	24,883.28 ± 26,329.61	21,443.24 ± 19,025.01	.304[a]
OCT angiography parameters			
Presence of MvD, n (%)	37 (50.7)	15 (6.4)	<.001[b]
Macular superficial VD (%)	34.38 ± 3.07	35.38 ± 3.93	.126[a]
Macular deep VD (%)	35.52 ± 4.91	37.71 ± 4.55	.006[a]
Peripapillary superficial VD (%)	40.46 ± 4.52	40.72 ± 4.19	.726[a]
Peripapillary deep VD (%)	63.97 ± 5.95	64.11 ± 6.79	.835[a]
Laminar deep VD (%)	25.55 ± 14.19	31.50 ± 10.92	.004[a]
Follow-up duration (mo)	55.31 ± 10.98	52.73 ± 10.68	.270[a]

microvasculature dropout (MvD)

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

AJO 2022

YOUNHEA JUNG, HAE-YOUNG LOPILLY PARK, HEEJONG SHIN, SI EUN OH, SEONG AH KIM, JI-YOUNG LEE, DA YOUNG SHIN, SOO JI JEON, YONG-CHAN KIM, HYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK



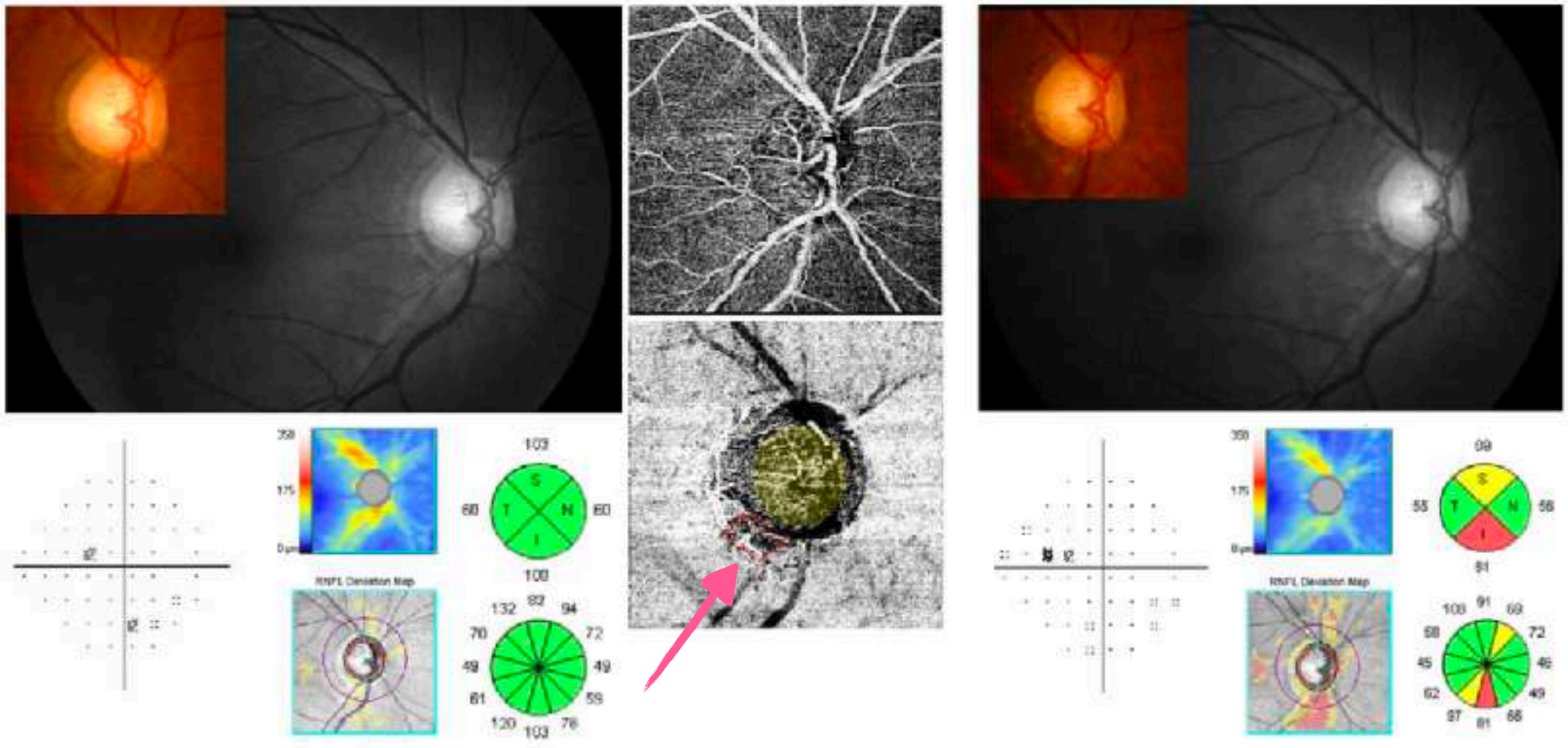
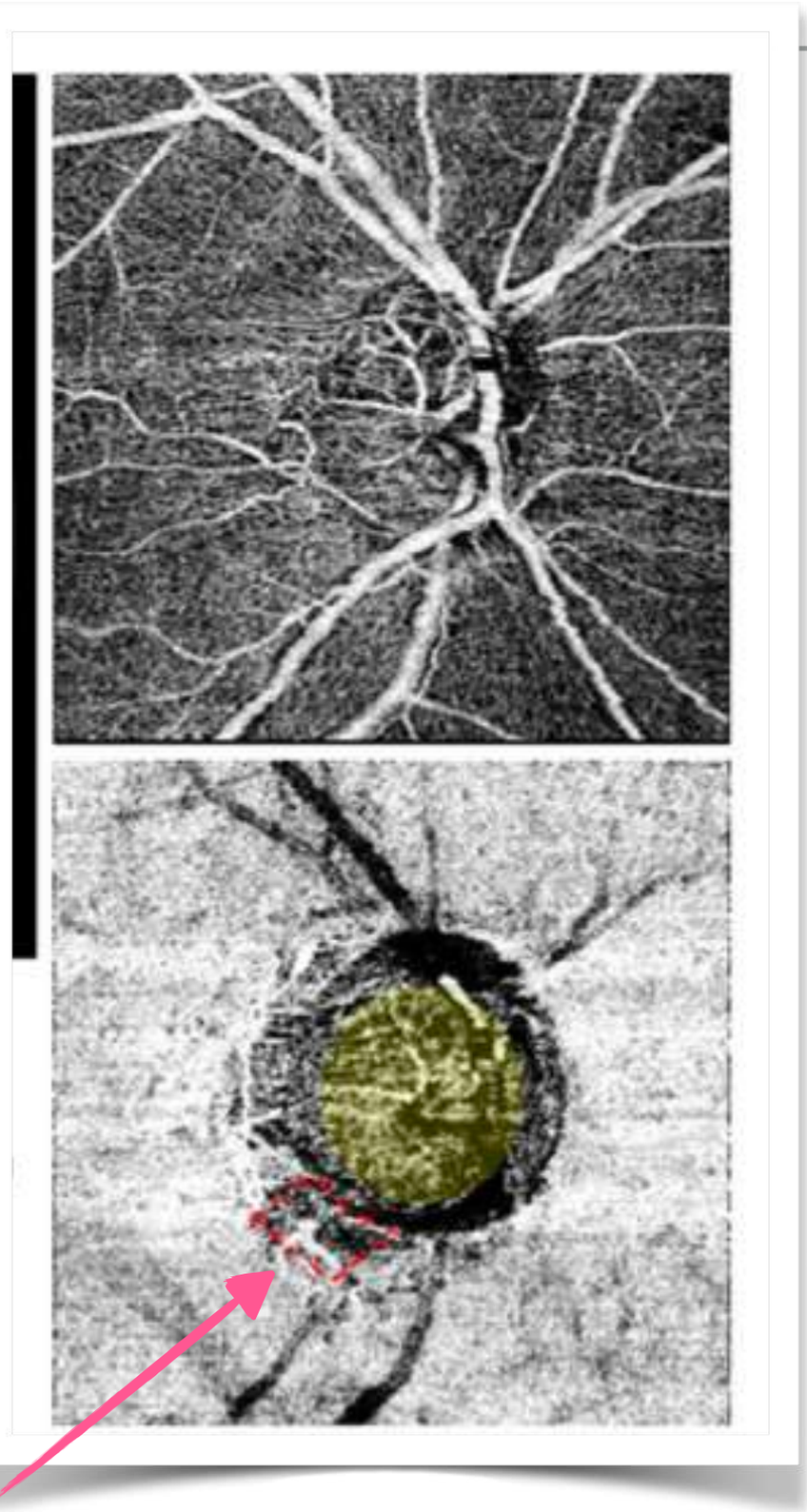


FIGURE 3. Representative case showing that the presence of MvD on OCT-A scans is associated with NTG conversion in NTG suspects. A 54-year-old man with a concentric enlargement of cup-to-disc ratio in the right eye who had been followed up for 5 years. This patient had no retinal nerve fiber layer (RNFL) defect on baseline red-free RNFL photos (upper left) and normal OCT and VF (lower left). There was no vessel density loss in the superficial layer on OCT-A (upper middle), but inferotemporal MvD was found in the laminar cribrosa/choroidal layer on baseline OCT-A (lower middle), and he progressed to NTG showing inferotemporal RNFL defects on red-free RNFL photos (upper right) and on OCT scans with newly developed abnormal points on VF (lower right).



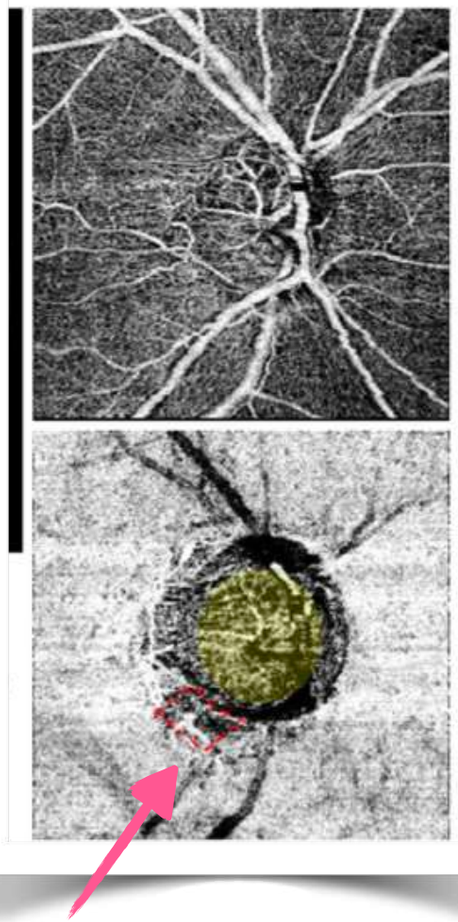
Microvasculature Dropout and Development of Normal Tension Glaucoma in Glaucoma Suspects: The Normal Tension Glaucoma Suspect Cohort Study

AJO 2022

YOUNHEA JUNG, HAE-YOUNG LOPILLY PARK, HEEJONG SHIN, SI EUN OH, SEONG AH KIM, JI-YOUNG LEE, DA YOUNG SHIN, SOO JI JEON, YONG-CHAN KIM, HYE-YOUNG SHIN, JIN A. CHOI, NA YOUNG LEE, AND CHAN KEE PARK

ANGIO-OCT

- **ruolo nel glaucoma a pressione normale**
- **individuare precocemente i pazienti a rischio di progressione**
- **pratica clinica vs clinical trial**



applicazioni cliniche

GLAUCOMA AD ANGOLO STRETTO

M. Sacchi - Ospedale San Giuseppe Milano

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

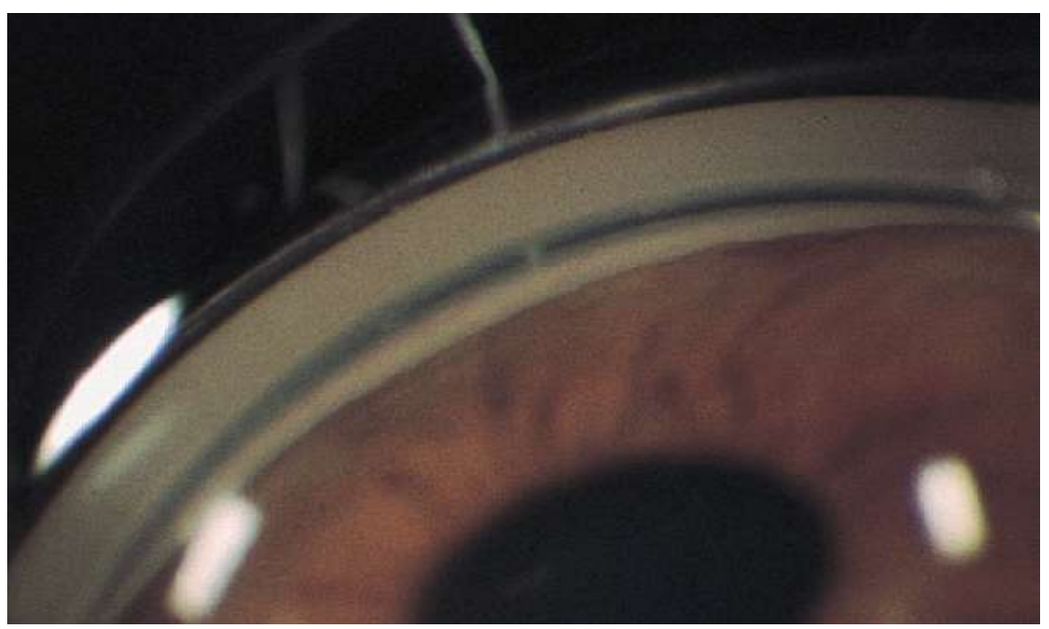
Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

- **glaucoma ad angolo stretto** il danno agli assoni avviene per *chiusure d'angolo intermittenti* che provocano ***spikes pressori*** e conseguente ***danno ischemico***
- il **ruolo** della **componente vascolare** nel **PACG** è più rilevante rispetto al POAG



Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

- **c'è concordanza tra *angio-OCT*, *RNFL* e *campo visivo*?**
- **quale parametro correla meglio con campo visivo? Angio-OCT o RNFL ?**

***perfusione*/funzione VS *struttura*/funzione**

angioOCT RNFL

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

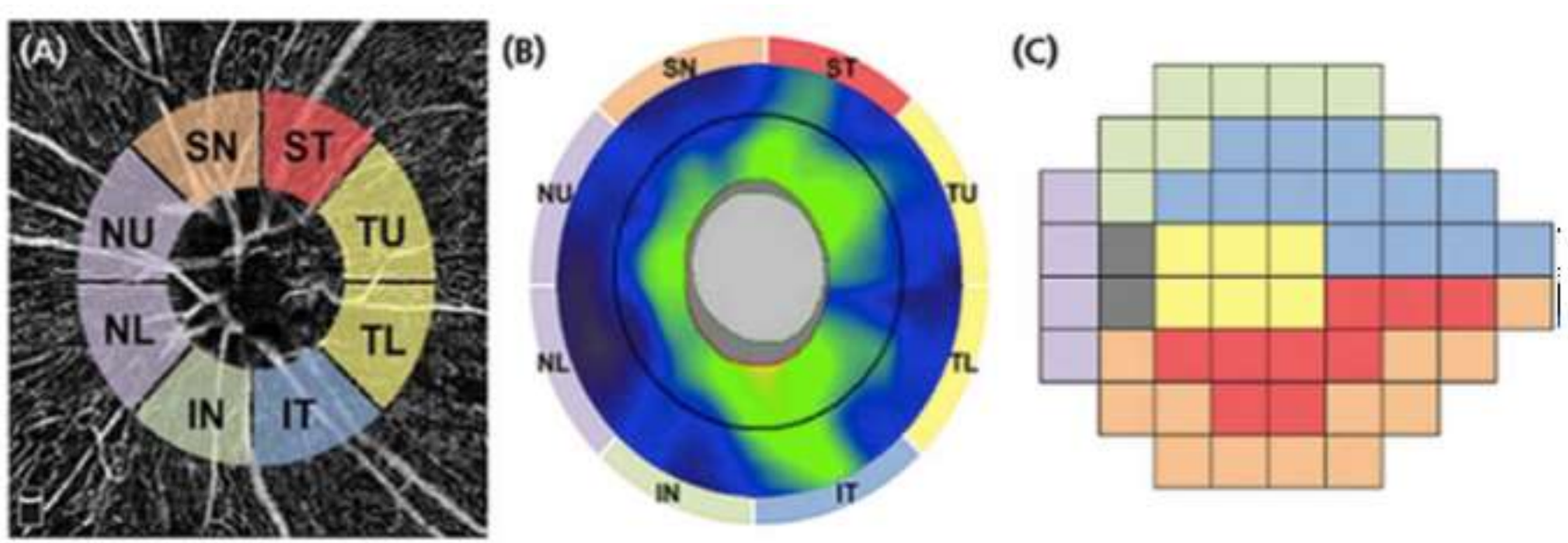
[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

- **c'è concordanza tra** *angio-OCT*, *RNFL* **e** *campo visivo*?

SI, CONCORDANZA TRA ANGIO OCT, RNFL E DIFETTO AL CAMPO VISIVO



Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

?

- **quale parametro correla meglio con campo visivo? Angio-OCT o RNFL ?**

***struttura*/funzione VS *perfusione*/funzione**

ANGOLO STRETTO

4 SETTORI

5 SETTORI

TABLE 2. The Semipartial Correlation Between cpVD, RNFLT, and VFMS for Each Sector, After Controlling for Confounding Factors

	RNFL-cpVD			RNFL-VFMS			cpVD-VFMS		
Groups	sr	sr^2	*P*	sr	sr^2		sr	sr^2	
PACG									
Global	0.659	0.434	<0.001*	0.338	0.114	0.012*	0.418	0.175	<0.001*
ST	0.697	0.486	<0.001*	0.544	0.296	<0.001*	0.514	0.264	<0.001*
SN	0.571	0.326	<0.001*	0.336	0.113	0.011*	0.384	0.147	0.002*
IT	0.738	0.545	<0.001*	0.495	0.245	0.001*	0.567	0.321	<0.001*
IN	0.761	0.579	<0.001*	0.451	0.203	0.001*	0.445	0.198	0.001*
NU	0.471	0.222	<0.001*	0.074	0.005	0.575	0.162	0.026	0.175
NI	0.492	0.242	<0.001*	0.047	0.002	0.713	0.144	0.021	0.208
TU	0.63	0.397	<0.001*	0.206	0.042	0.106	0.196	0.038	0.101
TI	0.341	0.116	0.017*	0.177	0.031	0.242	0.437	0.191	0.001*

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

?

- **quale parametro correla meglio con campo visivo? Angio-OCT o RNFL ?**

***struttura*/funzione VS *perfusione*/funzione**

RNFL angioOCT

TABLE 2. The Semipartial Correlation Between cpVD, RNFLT, and VFMS for Each Sector, After Controlling for Confounding Factors

	RNFL-cpVD			RNFL-VFMS			cpVD-VFMS		
Groups	sr	sr^2	*P*	sr	sr^2		sr	sr^2	
PACG									
Global	0.659	0.434	<0.001*	0.338	0.114	0.012*	0.418	0.175	<0.001*
ST	0.697	0.486	<0.001*	0.544	0.296	<0.001*	0.514	0.264	<0.001*
SN	0.571	0.326	<0.001*	0.336	0.113	0.011*	0.384	0.147	0.002*
IT	0.738	0.545	<0.001*	0.495	0.245	0.001*	0.567	0.321	<0.001*
IN	0.761	0.579	<0.001*	0.451	0.203	0.001*	0.445	0.198	0.001*
NU	0.471	0.222	<0.001*	0.074	0.005	0.575	0.162	0.026	0.175
NI	0.492	0.242	<0.001*	0.047	0.002	0.713	0.144	0.021	0.208
TU	0.63	0.397	<0.001*	0.206	0.042	0.106	0.196	0.038	0.101
TL	0.341	0.116	0.017*	0.177	0.031	0.242	0.437	0.191	0.001*

ANGOLO STRETTO

4 SETTORI

5 SETTORI

PACG: *angio-OCT miglior correlazione* **con campo visivo rispetto a RNFL**

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

?

- **quale parametro correla meglio con campo visivo? Angio-OCT o RNFL ?**

***struttura*/funzione VS *perfusione*/funzione**

ANGOLO STRETTO

ANGOLO APERTO

4 SETTORI

5 SETTORI

8 SETTORI

8 SETTORI

TABLE 2. The Semipartial Correlation Between cpVD, RNFLT, and VFMS for Each Sector, After Controlling for Confounding Factors

	RNFL-cpVD			RNFL-VFMS			cpVD-VFMS		
Groups	sr	sr^2	*P*	sr	sr^2		sr	sr^2	
PACG									
Global	0.659	0.434	<0.001*	0.338	0.114	0.012*	0.418	0.175	<0.001*
ST	0.697	0.486	<0.001*	0.544	0.296	<0.001*	0.514	0.264	<0.001*
SN	0.571	0.326	<0.001*	0.336	0.113	0.011*	0.384	0.147	0.002*
IT	0.738	0.545	<0.001*	0.495	0.245	0.001*	0.567	0.321	<0.001*
IN	0.761	0.579	<0.001*	0.451	0.203	0.001*	0.445	0.198	0.001*
NU	0.471	0.222	<0.001*	0.074	0.005	0.575	0.162	0.026	0.175
NI.	0.492	0.242	<0.001*	0.047	0.002	0.713	0.144	0.021	0.208
TU	0.63	0.397	<0.001*	0.206	0.042	0.106	0.196	0.038	0.101
TL	0.341	0.116	0.017*	0.177	0.031	0.242	0.437	0.191	0.001*
POAG									
Global	0.567	0.322	<0.001*	0.427		<0.001*	0.444		0.001*
ST	0.546	0.298	<0.001*	0.543		<0.001*	0.574		<0.001*
SN	0.518	0.268	<0.001*	0.339		0.009*	0.469		<0.001*
IT	0.738	0.545	<0.001*	0.507	0.257	<0.001*	0.508	0.258	<0.001*
IN	0.539	0.291	<0.001*	0.360	0.129	0.002*	0.383	0.147	0.001*
NU	0.359	0.129	0.002*	0.247	0.061	0.050*	0.252	0.064	0.040*
NI.	0.301	0.091	0.010*	0.216	0.047	0.074*	0.246	0.061	0.025*
TU	0.444	0.197	<0.001*	0.258	0.067	0.036*	0.261	0.068	0.044*
TL	0.480	0.230	<0.001*	0.188	0.035	0.014*	0.283	0.080	0.011*

The sr was determined in multiple linear regression models controlling for the effects of age, sex, axial length, IOP, and SSI.
* Statistically significant values for $P < 0.05$.

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

?

- **quale parametro correla meglio con campo visivo? Angio-OCT o RNFL ?**

***struttura*/funzione VS *perfusione*/funzione**

RNFL angioOCT

TABLE 2. The Semipartial Correlation Between cpVD, RNFLT, and VFMS for Each Sector, After Controlling for Confounding Factors

	RNFL-cpVD			RNFL-VFMS			cpVD-VFMS		
Groups	sr	sr^2	*P*	sr	sr^2		sr	sr^2	
PACG									
Global	0.659	0.434	<0.001*	0.338	0.114	0.012*	0.418	0.175	<0.001*
ST	0.697	0.486	<0.001*	0.544	0.296	<0.001*	0.514	0.264	<0.001*
SN	0.571	0.326	<0.001*	0.336	0.113	0.011*	0.384	0.147	0.002*
IT	0.738	0.545	<0.001*	0.495	0.245	0.001*	0.567	0.321	<0.001*
IN	0.761	0.579	<0.001*	0.451	0.203	0.001*	0.445	0.198	0.001*
NU	0.471	0.222	<0.001*	0.074	0.005	0.575	0.162	0.026	0.175
NI	0.492	0.242	<0.001*	0.047	0.002	0.713	0.144	0.021	0.208
TU	0.63	0.397	<0.001*	0.206	0.042	0.106	0.196	0.038	0.101
TI	0.341	0.116	0.017*	0.177	0.031	0.242	0.437	0.191	0.001*
POAG									
Global	0.567	0.322	<0.001*	0.427		<0.001*	0.444		0.001*
ST	0.546	0.298	<0.001*	0.54		<0.001*	0.574		<0.001*
SN	0.518	0.268	<0.001*	0.33		0.009*	0.469		<0.001*
				7	0.257	<0.001*	0.508	0.258	<0.001*
				0	0.129	0.002*	0.383	0.147	0.001*
				7	0.061	0.050*	0.252	0.064	0.040*
				6	0.047	0.074*	0.246	0.061	0.025*
				8	0.067	0.036*	0.261	0.068	0.044*
				8	0.035	0.014*	0.283	0.080	0.011*

...trolling for the effects of age, sex, axial length, IOP, and SSI.

ANGOLO STRETTO

4 SETTORI

5 SETTORI

ANGOLO APERTO

8 SETTORI

8 SETTORI

POAG: non differenze:
***angioOCT*, *RNFL* stessa correlazione con campo visivo**

Glaucoma

The Relationship Between Peripapillary Vascular Density and Visual Field Sensitivity in Primary Open-Angle and Angle-Closure Glaucoma

IOVS, 2018

Youn Hye Jo,[1] Kyung Rim Sung,[1] and Sung-Cheol Yun[2]

[1]Department of Ophthalmology, University of Ulsan, College of Medicine, Asan Medical Center, Seoul, Korea
[2]Department of Clinical Epidemiology and Biostatistics, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

PACG

GLAUCOMA AD ANGOLO STRETTO

- **nel glaucoma ad angolo stretto (PACG): angio OCT maggior correlazione con campo visivo rispetto a RNFL**
- **in PACG: angio-OCT può individuare alterazioni vascolari (ischemie ripetute) che precedono il danno morfologico (RNFL)**
- **nuovo parametro: rapporto vasi/funzione, oltre al noto struttura/funzione**
- **evidenze che il rapporto vasi/funzione sia *più forte* rispetto a struttura/funzione ***

*

Yarmohammadi A al. Optical coherence tomography angiography vessel density in healthy, glaucoma suspect, and glaucoma eyes. Invest Ophthalmol Vis Sci. 2016.

Shin JW et al. Regional vascular density-visual field sensitivity relationship in glaucoma according to disease severity. Br J Ophthalmol. 2017

previous study performed with POAG eyes.[11] This stronger relationship between vascular and function characteristics may be because vascular flow is reduced in eyes with sick or damaged ganglion cells, even before obvious RNFLT reduction.

applicazioni cliniche

INDIVIDUARE LA PROGRESSIONE

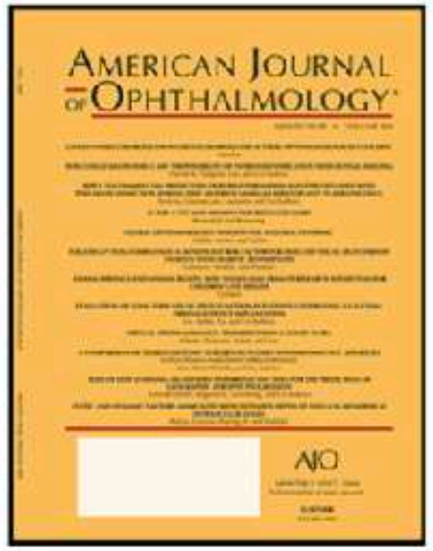
M. Sacchi - Ospedale San Giuseppe Milano

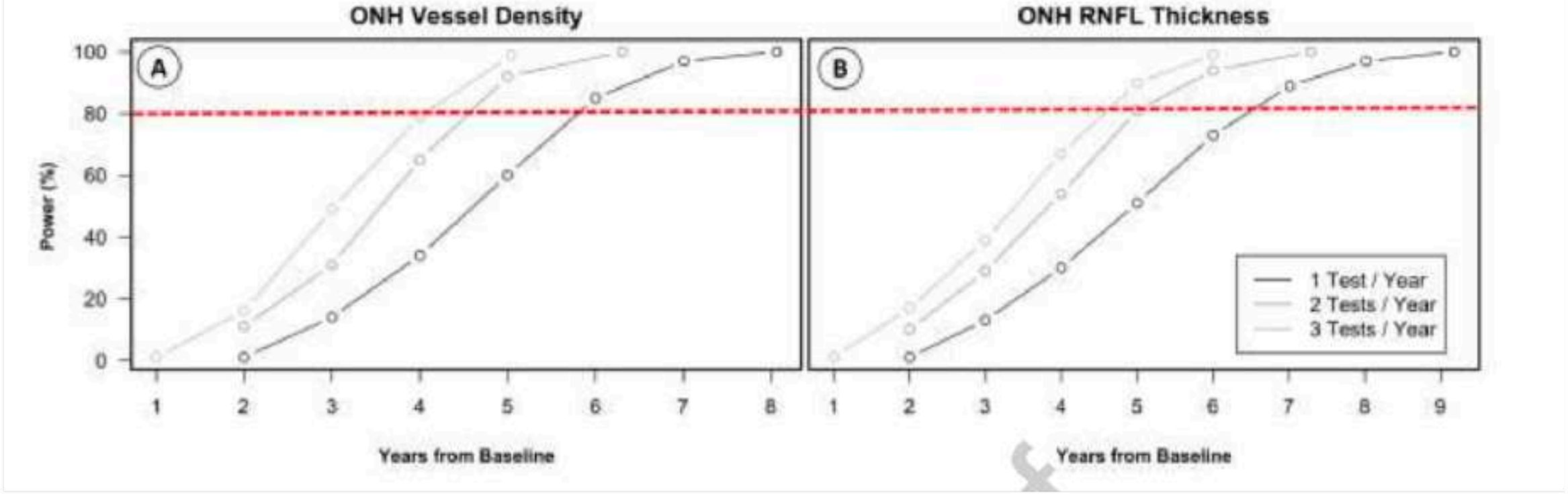
Journal Pre-proof

AJO 2022

Effect of Testing Frequency on the Time to Detect Glaucoma Progression with OCT and OCT Angiography

Golnoush Mahmoudinezhad , Sasan Moghimi , James A. Proudfoot MSc , Nicole Brye , Takashi Nishida , Adeleh Yarmohammadi , Alireza Kamalipour , Linda M. Zangwill , Robert N Weinreb





Progressione:

RNFL: - 1micron/anno

Angio OCT: - 1%/anno

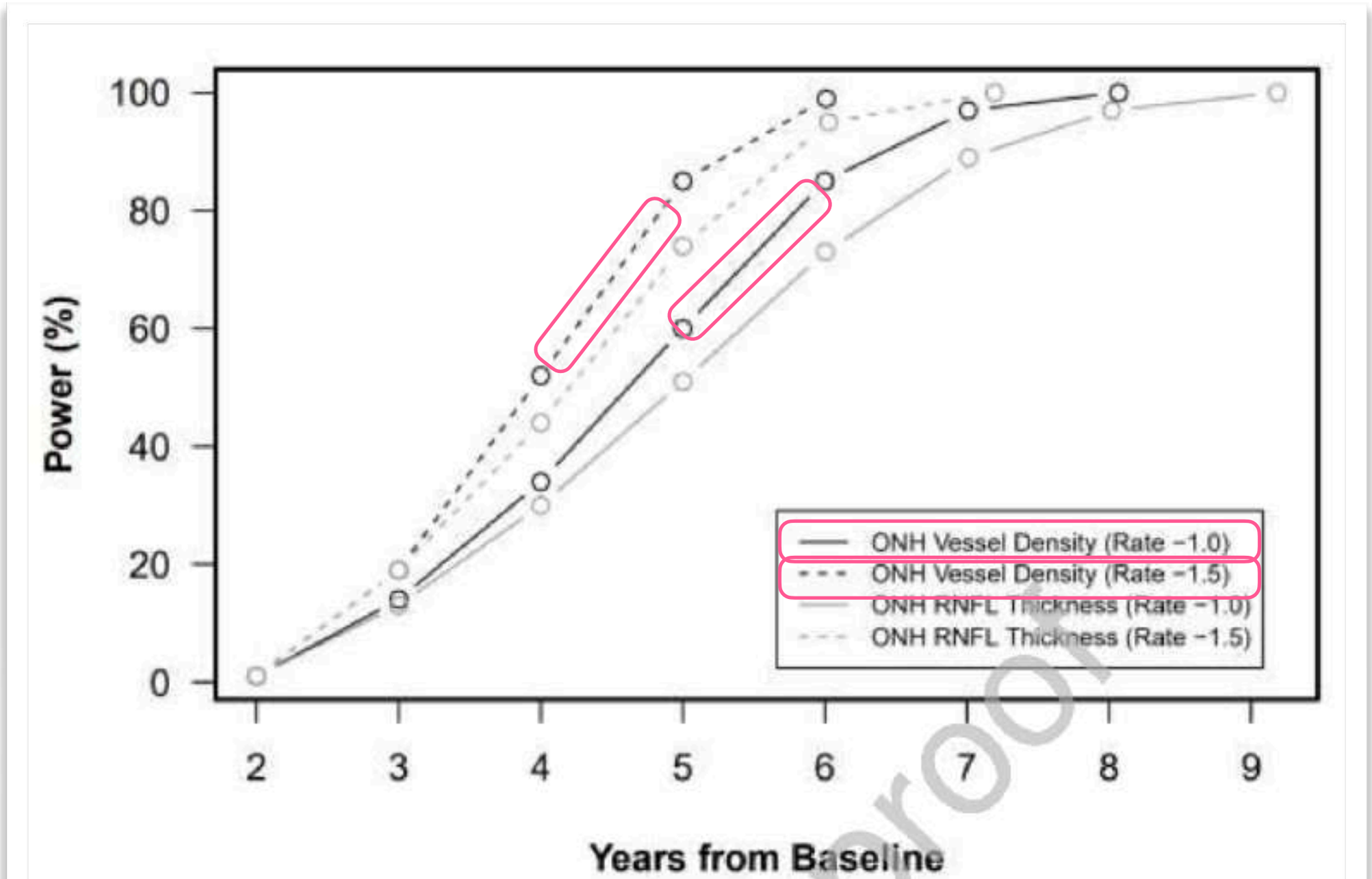
Journal Pre-proof

AJO 2022

Effect of Testing Frequency on the Time to Detect Glaucoma Progression with OCT and OCT Angiography

Golnoush Mahmoudinezhad , Sasan Moghimi , James A. Proudfoot MSc , Nicole Brye , Takashi Nishida , Adeleh Yarmohammadi , Alireza Kamalipour , Linda M. Zangwill , Robert N Weinreb

Previous studies showed that the average rate of RNFL change in glaucoma patients varies between −0.5 to −1.0μm/year depending on the severity of disease, treatment, and population samples.[32-36] Average rate of cpCD change −0.5 to −1.3 %/year was reported.[37]


100
80
60
40
20
0
Power (%)
2
3
4
5
6
7
8
9
Years from Baseline
ONH Vessel Density (Rate −1.0)
ONH Vessel Density (Rate −1.5)
ONH RNFL Thickness (Rate −1.0)
ONH RNFL Thickness (Rate −1.5)

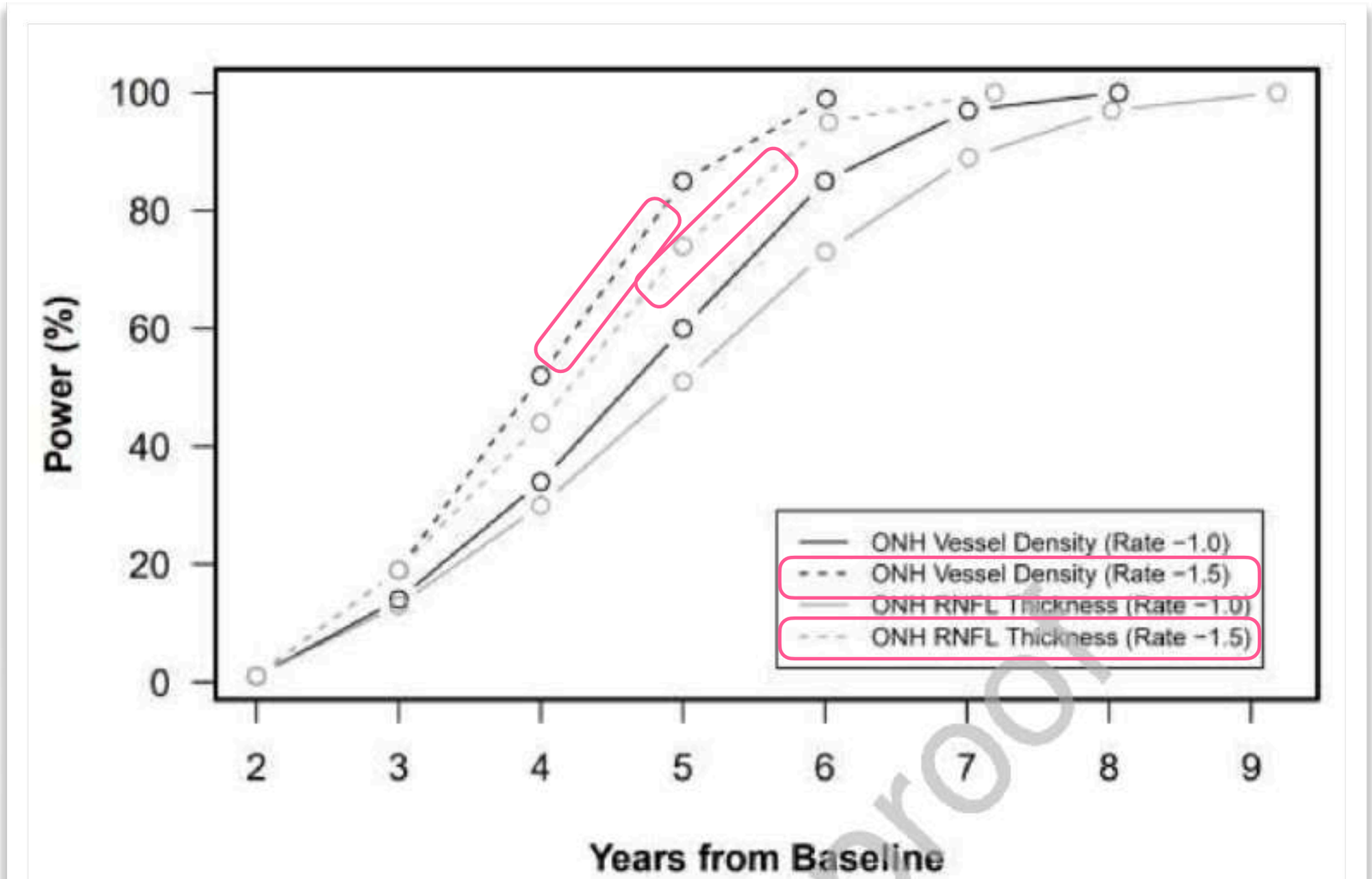

100
80
60
40
20
0
Power (%)
2
3
4
5
6
7
8
9
Years from Baseline
ONH Vessel Density (Rate −1.0)
ONH Vessel Density (Rate −1.5)
ONH RNFL Thickness (Rate −1.0)
ONH RNFL Thickness (Rate −1.5)

Table 3. Required time and power (proportion of eyes progressing) to detect different rates of circumpapillary capillary density change.

	Rate of vessel density change (%/yr)	Time to Detect progression (Years)				Power to Detect progression (%)	
		Mean	SD	80% power	90% power	2 years	5 years
1 observations/year	−0.5	6.4	2.3	8.2	9.2	4.7	35
	−1	4.5	1.4	6.0	6.1	7.7	75.6
	−1.5	3.8	1.1	5.0	5	11.1	95.1
	−2	3.4	0.9	4	4.5	14.5	99.6
2 observations /year	−0.5	4.7	1.9	6.6	7.2	12	60.5
	−1	3.2	1.1	4.2	5	21.5	96.9
	−1.5	2.6	0.9	3.8	4	34.6	100
	−2	2.3	0.7	3	3.1	49.6	100
3 observations /year	−0.5	3.9	1.7	5.9	6.3	17.3	75.1
	−1	2.7	1.0	4	4.0	32	99.6
	−1.5	2.1	0.8	3	3.2	51.3	100
	−2	1.8	0.6	3	3	69.7	100

Table 3. Required time and power (proportion of eyes progressing) to detect different rates of circumpapillary capillary density change.

	Rate of vessel density change (%/yr)	Time to Detect progression (Years)				Power to Detect progression (%)	
		Mean	SD	80% power	90% power	2 years	5 years
1 observations/year	−0.5	6.4	2.3	8.2	9.2	4.7	35
	−1	4.5	1.4	6.0	6.1	7.7	75.6
	−1.5	3.8	1.1	5.0	5	11.1	95.1
	−2	3.4	0.9	4	4.5	14.5	99.6
2 observations /year	−0.5	4.7	1.9	6.6	7.2	12	60.5
	−1	3.2	1.1	4.2	5	21.5	96.9
	−1.5	2.6	0.9	3.8	4	34.6	100
	−2	2.3	0.7	3	3.1	49.6	100
3 observations /year	−0.5	3.9	1.7	5.9	6.3	17.3	75.1
	−1	2.7	1.0	4	4.0	32	99.6
	−1.5	2.1	0.8	3	3.2	51.3	100
	−2	1.8	0.6	3	3	69.7	100

Table 3. Required time and power (proportion of eyes progressing) to detect different rates of circumpapillary capillary density change.

	Rate of vessel density change (%/yr)	Time to Detect progression (Years)				Power to Detect progression (%)	
		Mean	SD	80% power	90% power	2 years	5 years
1 observations/year	−0.5	6.4	2.3	8.2	9.2	4.7	35
	−1	4.5	1.4	6.0	6.1	7.7	75.6
	−1.5	3.8	1.1	5.0	5	11.1	95.1
	−2	3.4	0.9	4	4.5	14.5	99.6
2 observations /year	−0.5	4.7	1.9	6.6	7.2	12	60.5
	−1	3.2	1.1	4.2	5	21.5	96.9
	−1.5	2.6	0.9	3.8	4	34.6	100
	−2	2.3	0.7	3	3.1	49.6	100
3 observations /year	−0.5	3.9	1.7	5.9	6.3	17.3	75.1
	−1	2.7	1.0	4	4.0	32	99.6
	−1.5	2.1	0.8	3	3.2	51.3	100
	−2	1.8	0.6	3	3	69.7	100

Table 3. Required time and power (proportion of eyes progressing)

capillary density change.

	Rate of vessel density change (%/yr)	Time to Detect progression (Y		
		Mean	SD	80
1 observations/year	−0.5	6.4	2.3	8.2
	−1	4.5	1.4	6.0
	−1.5	3.8	1.1	5.0
	−2	3.4	0.9	4
2 observations /year	−0.5	4.7	1.9	6.6
	−1	3.2	1.1	4.2
	−1.5	2.6	0.9	3.8
	−2	2.3	0.7	3
3 observations /year	−0.5	3.9	1.7	5.9
	−1	2.7	1.0	4
	−1.5	2.1	0.8	3
	−2	1.8	0.6	3

Table 2. Required time and power (proportion of eyes progressing

nerve fiber layer (cpRNFL) thickness

	Rate of cpRNFL thinning (µm/year)	Time to Detect progression		
		Mean	SD	80
1 observation/year	−0.5	7.1	2.7	9.6
	−1	4.9	1.6	6.3
	−1.5	4.1	1.2	5.0
	−2	3.7	1.0	4.5
2 observations /year	−0.5	5.2	2.2	7.6
	−1	3.5	1.3	5.0
	−1.5	2.8	1.0	4.0
	−2	2.4	0.8	3.3
3 observations /year	−0.5	4.4	2.0	6.7
	−1	2.9	1.2	4.2
	−1.5	2.3	0.9	3.6
	−2	2.0	0.7	3.0

Table 3. Required time and power (proportion of eyes progressing)

capillary density change.

	Rate of vessel density change (%/yr)	Time to Detect progression (Y		
		Mean	SD	80
1 observations/year	−0.5	6.4	2.3	8.2
	−1	4.5	1.4	6.0
	−1.5	3.8	1.1	5.0
	−2	3.4	0.9	4
2 observations /year	−0.5	4.7	1.9	6.6
	−1	3.2	1.1	4.2
	−1.5	2.6	0.9	3.8
	−2	2.3	0.7	3
3 observations /year	−0.5	3.9	1.7	5.9
	−1	2.7	1.0	4
	−1.5	2.1	0.8	3
	−2	1.8	0.6	3

Table 2. Required time and power (proportion of eyes progressing

nerve fiber layer (cpRNFL) thickness

	Rate of cpRNFL thinning (µm/year)	Time to Detect progression		
		Mean	SD	80
1 observation/year	−0.5	7.1	2.7	9.6
	−1	4.9	1.6	6.3
	−1.5	4.1	1.2	5.0
	−2	3.7	1.0	4.5
2 observations /year	−0.5	5.2	2.2	7.6
	−1	3.5	1.3	5.0
	−1.5	2.8	1.0	4.0
	−2	2.4	0.8	3.3
3 observations /year	−0.5	4.4	2.0	6.7
	−1	2.9	1.2	4.2
	−1.5	2.3	0.9	3.6
	−2	2.0	0.7	3.0

Practical recommendations for measuring rates of visual field change in glaucoma

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

BJO 2008

(b)

Total MD change (dB)	Annual examinations: 2 years	3 years	5 years
−1.0	7	6	4
−2.0	5	4	3
−4.0	3	3	2

3 campi visivi all'anno per i primi 2 anni

identificare pazienti con rapida progressione (> 2dB/anno)

Journal Pre-proof

AJO 2022

Effect of Testing Frequency on the Time to Detect Glaucoma Progression with OCT and OCT Angiography

Golnoush Mahmoudinezhad , Sasan Moghimi , James A. Proudfoot MSc , Nicole Brye , Takashi Nishida , Adeleh Yarmohammadi , Alireza Kamalipour , Linda M. Zangwill , Robert N Weinreb

capillary density e RNFL: comparable in detecting glaucoma progression

2 observations/year: sufficient information for detecting progression

alterazioni della perfusione più precoci rispetto a RNFL

ruolo nella patogenesi??

Table 1. Demographics and Baseline Characteristics of included eyes.

Variables	
Age (years)	69.1 (66.9, 71.2)
Gender (M/F)	51(52.0%)/47(48.0%)
Race	
African Descents (%)	24 (24.5%)
Non-African Descents (%)	74 (75.5%)
Axial Length (mm)	24.3 (24.2, 24.4)
CCT (μm)	534.8 (531.4, 538.2)
Spherical Equivalent (D)	−1 (−1.1, −0.8)
Mean IOP (mmHg)	15.3 (14.6,16.0)
Diagnosis	
Early, n (%)	12[illegible] (81.4%)
Moderate to advance, n (%)	29 (18.6%)
Baseline 24-2 VF MD (dB)	−3.3 (−4.1, −2.5)
ONH	
Average cpCD (%)	43.9 (42.9, 44.8)
Average cpRNFL (μm)	78.7 (76.0, 81.3)
Average SSI	62.9 (61.4, 64.3)

ANGIO OCT e fluttuazioni

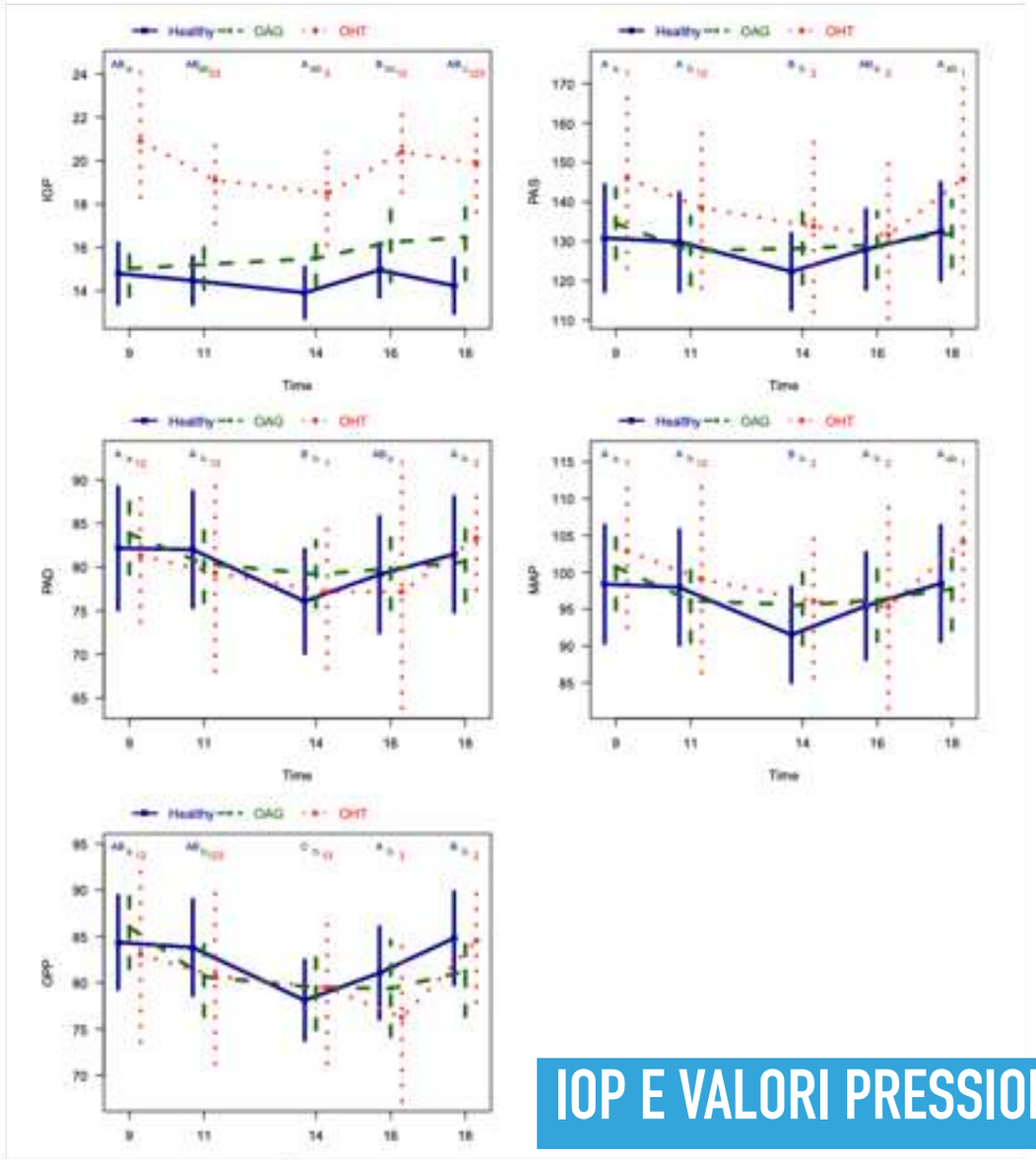
M. Sacchi - Ospedale San Giuseppe Milano

Graefe's Archive for Clinical and Experimental Ophthalmology (2020) 258:1237–1251
https://doi.org/10.1007/s00417-020-04635-6

GLAUCOMA

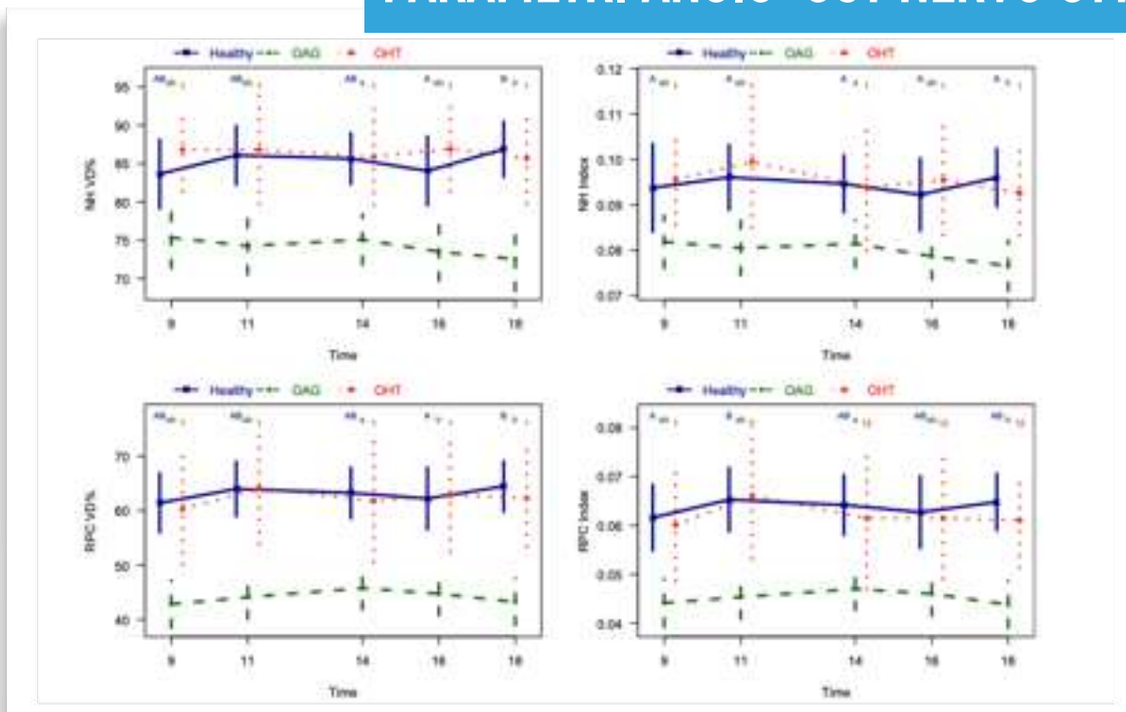
Optic nerve head diurnal vessel density variations in glaucoma and ocular hypertension measured by optical coherence tomography angiography

Alice C. Verticchio Vercellin[1,2,3] · Alon Harris[3] · Lucia Tanga[2] · Brent Siesky[3] · Luciano Quaranta[1] · Lucas W. Rowe[4] · Rana Torabi[4] · Luca Agnifili[5] · Ivano Riva[2] · Francesco Oddone[2]



IOP E VALORI PRESSIONE SISTEMICA

PARAMETRI ANGIO-OCT NERVO OTTICO



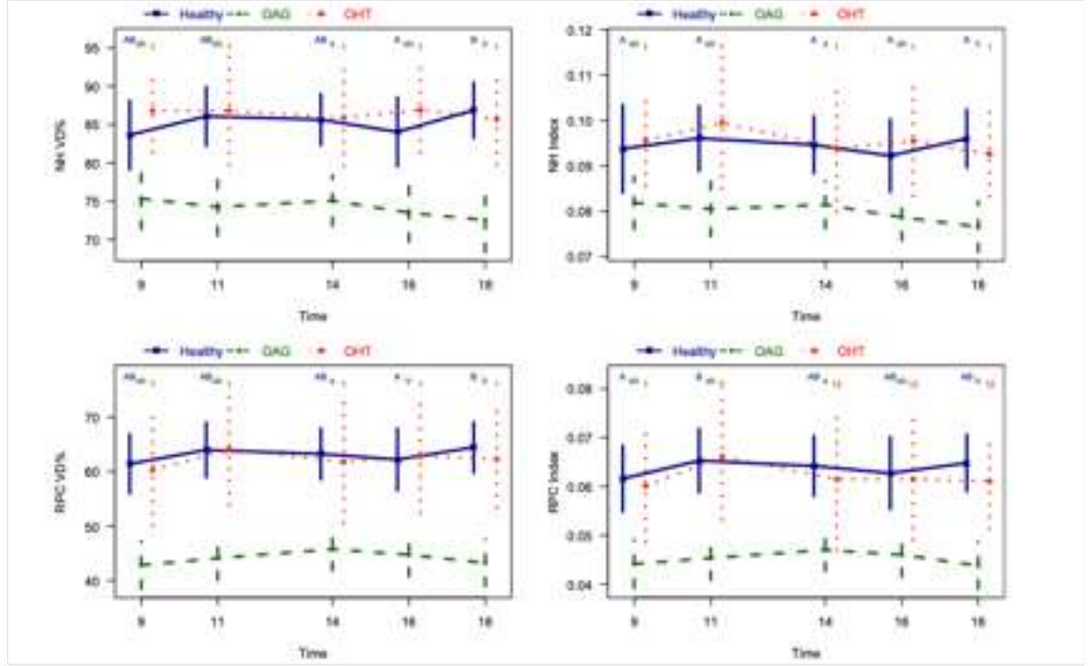
Graefe's Archive for Clinical and Experimental Ophthalmology (2020) 258:1237–1251
https://doi.org/10.1007/s00417-020-04635-6

GLAUCOMA

Optic nerve head diurnal vessel density variations in glaucoma and ocular hypertension measured by optical coherence tomography angiography

Alice C. Verticchio Vercellin[1,2,3] · Alon Harris[3] · Lucia Tanga[2] · Brent Siesky[3] · Luciano Quaranta[1] · Lucas W. Rowe[4] · Rana Torabi[4] · Luca Agnifili[5] · Ivano Riva[2] · Francesco Oddone[2]

PARAMETRI ANGIO-OCT NERVO OTTICO



Conclusion In healthy subjects, OHT and OAG patients, the variations in the OCT-A derived parameters were relatively small. These results suggest that in the clinical practice the OCT-A assessment can be performed independently of the time of the day, contrasting IOP evaluation.

applicazioni cliniche

POST TRABECULECTOMIA

M. Sacchi - Ospedale San Giuseppe Milano

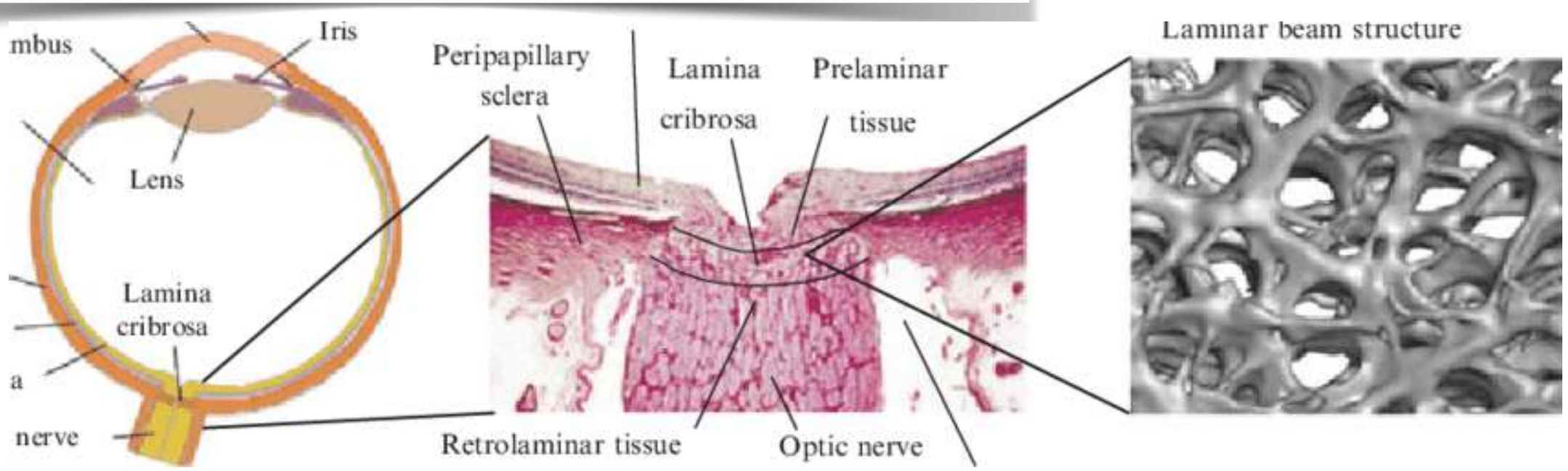
Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

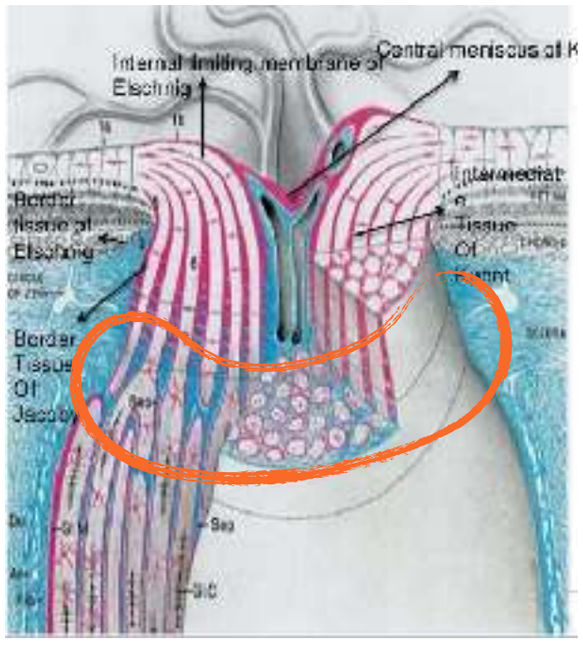
Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018



- **lamina cribrosa**: sito anatomico del danno assonale



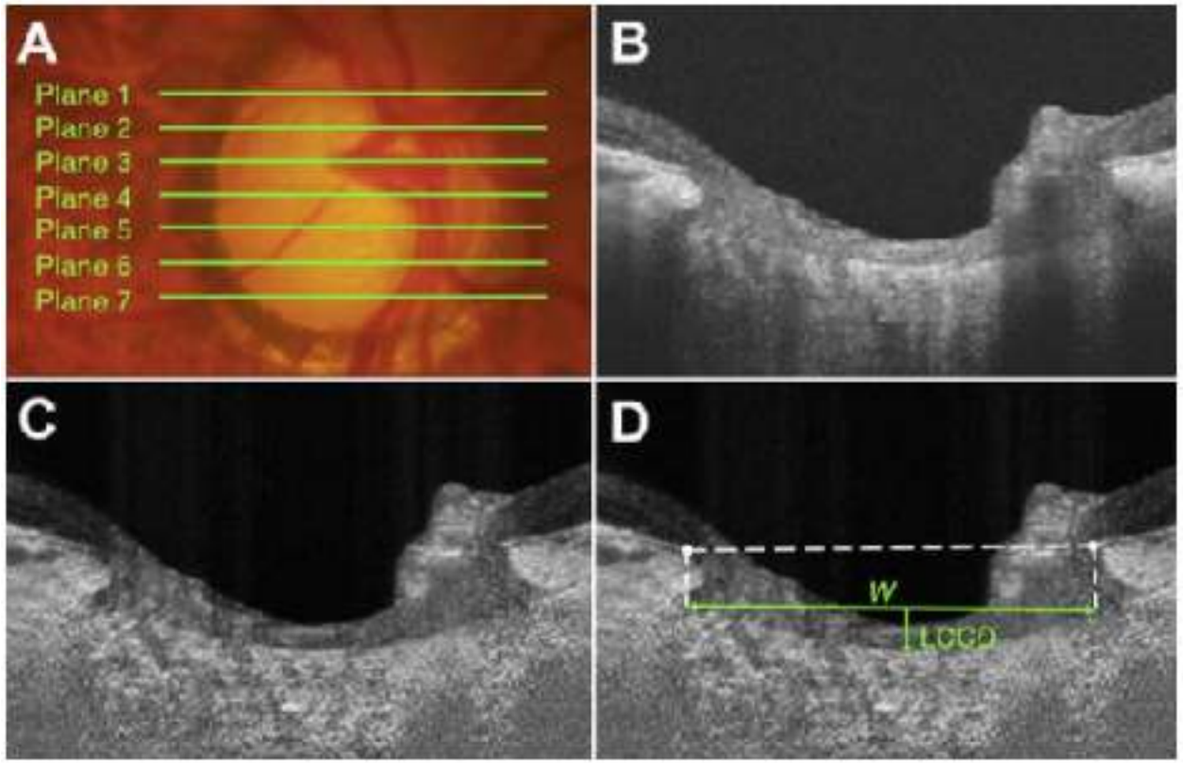
Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018



- con **OCT** è possibile studiare la curvatura della lamina cribrosa

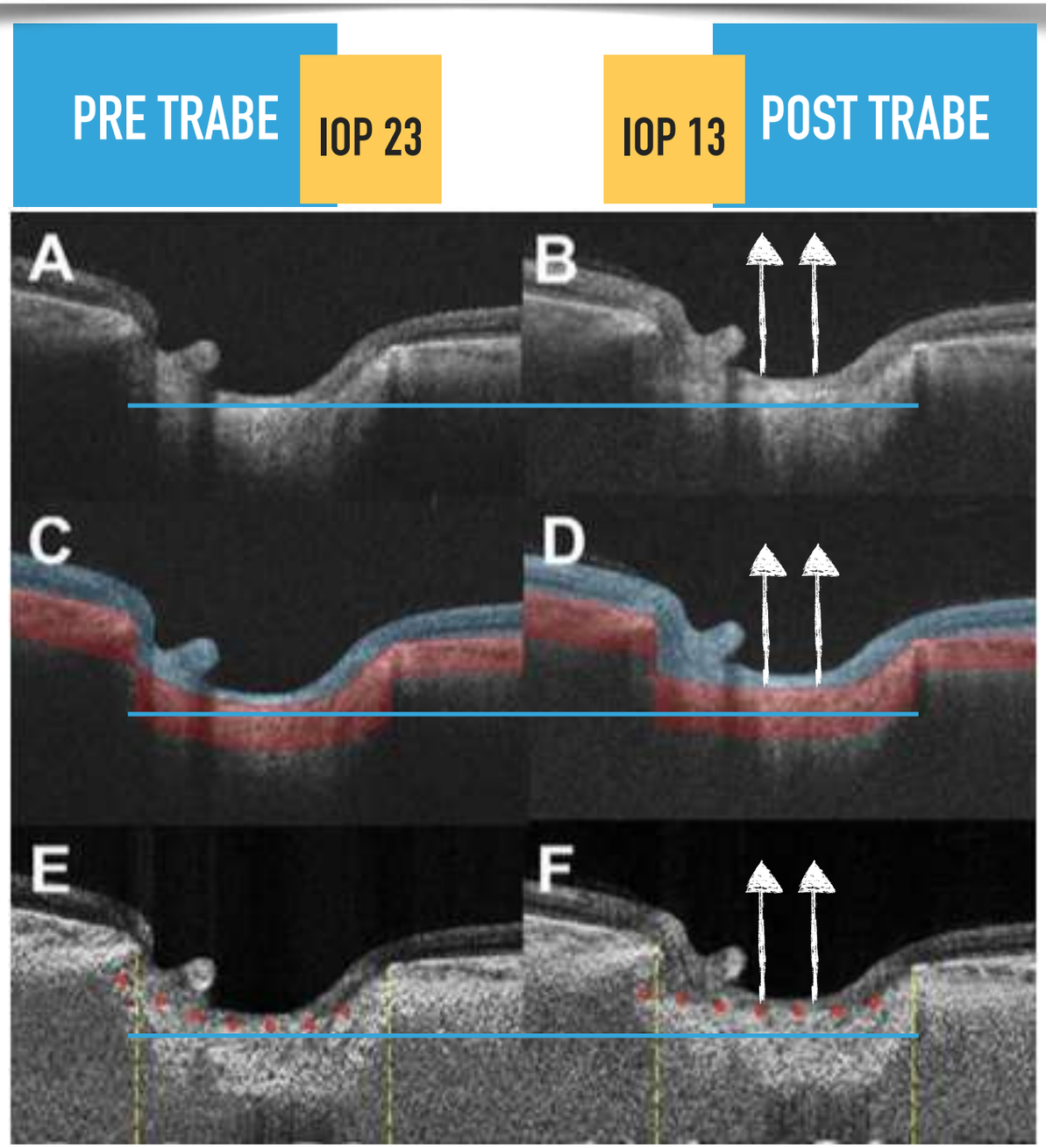
Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018



- **POST TRABE**

con la *riduzione della IOP* si osserva una ***riduzione*** della ***curvatura della lamina cribrosa***

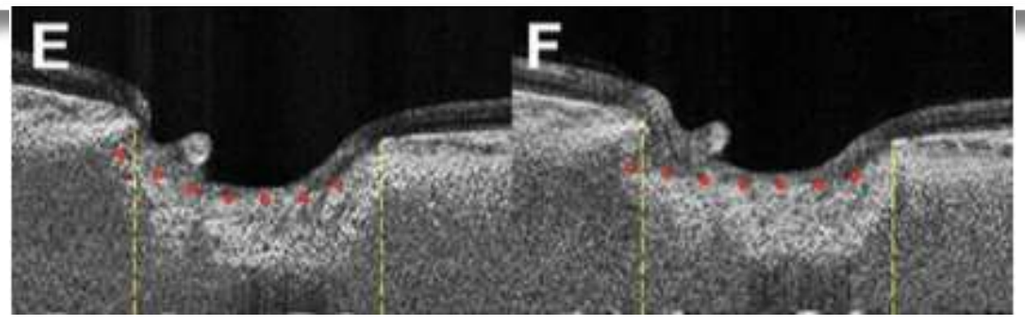
Glaucoma

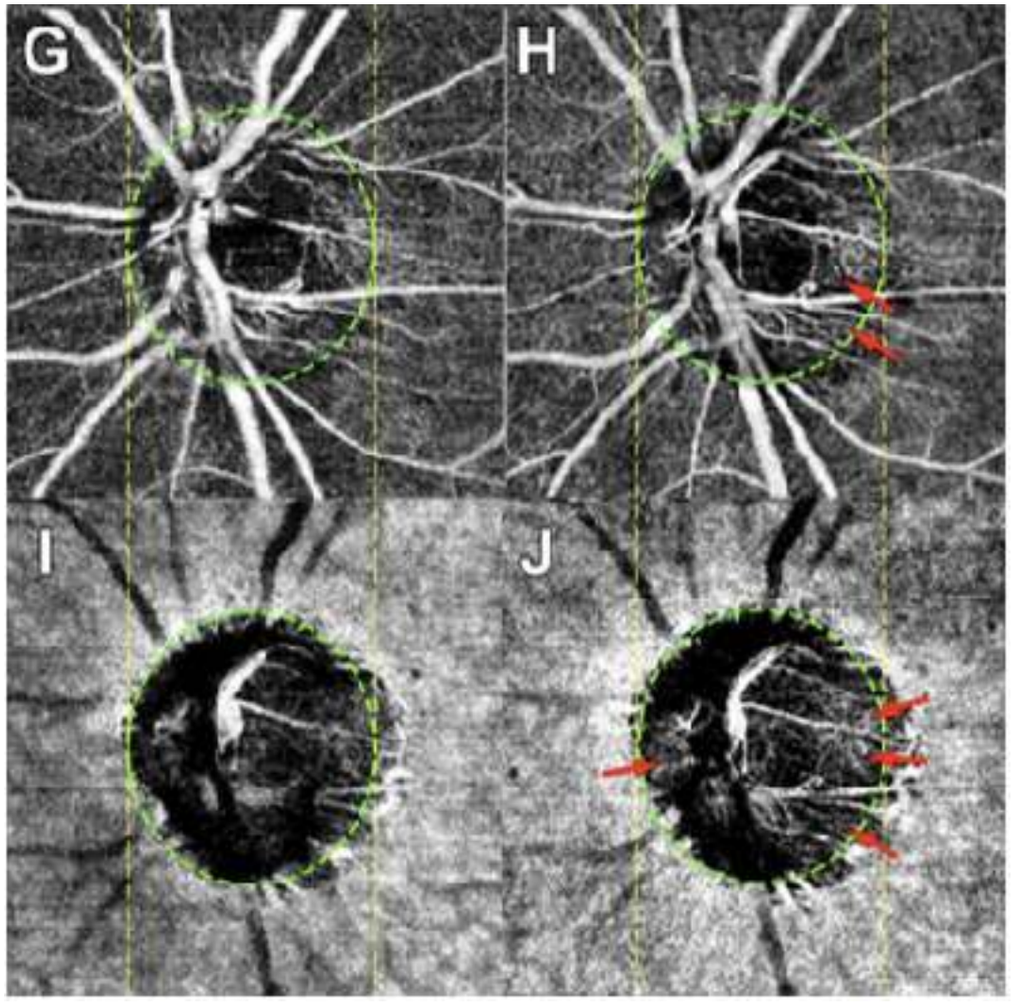
Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018





- valutare la **perfusione del nervo** ottico in seguito a **trabeculectomia**
  - riduzione della IOP
  - riduzione della curvatura della lamina cribrosa

Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018

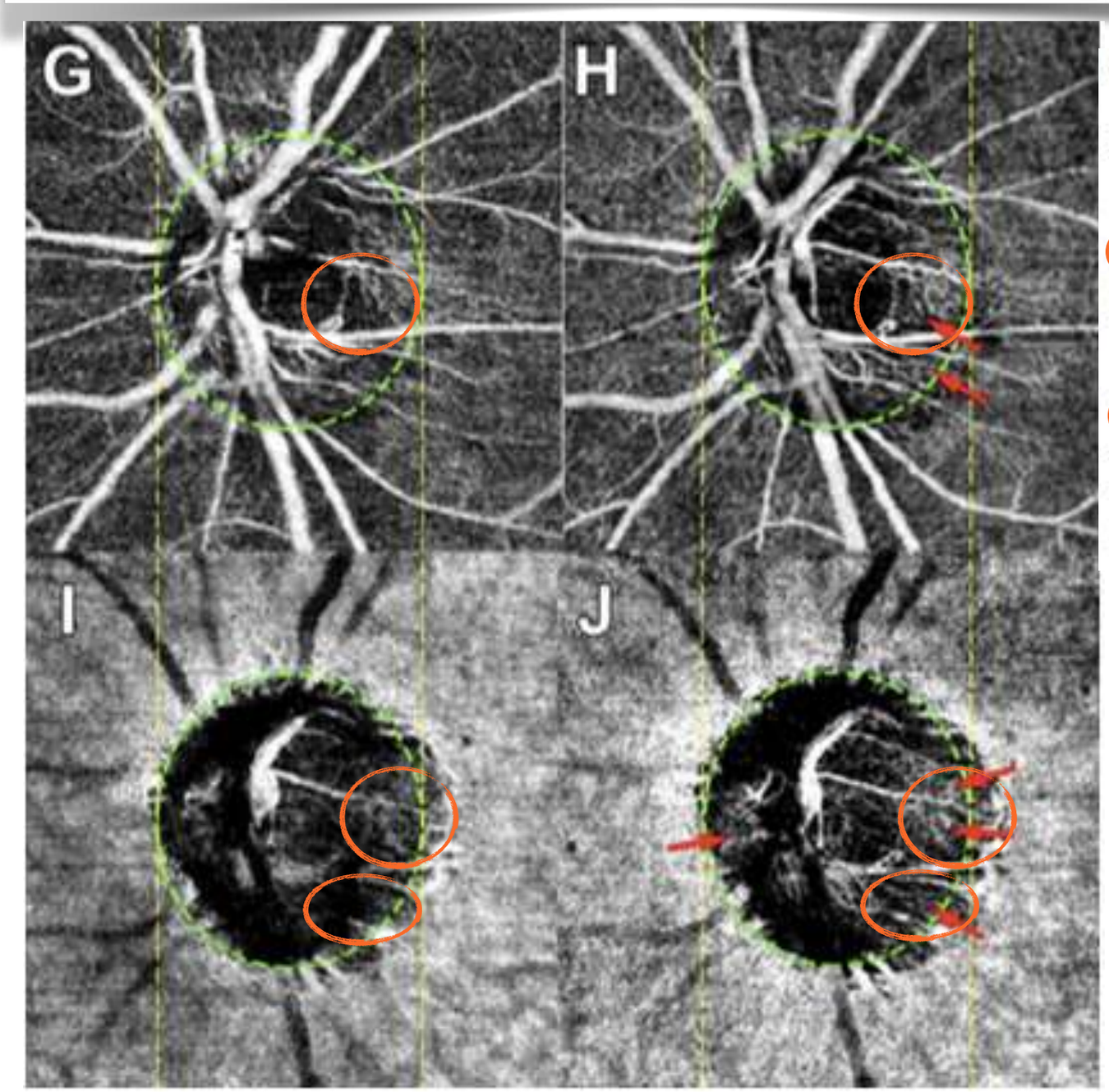


Table 2. Pre- and Postoperative Measurements of IOP, LCCI, VD in the prelaminar tissue, LC, PR, and PPC, and Quality Scores of OCTA Images

	Preoperative	Postoperative	*P*
IOP, mm Hg	23.1 ± 7.5	13.0 ± 4.9	**< 0.001**
LCCI	13.2 ± 2.7	10.8 ± 2.2	**< 0.001**
VD in the prelaminar tissue, %	31.6 ± 9.6	32.6 ± 10.6	0.307
VD in the LC, %	10.2 ± 4.7	11.9 ± 6.0	**0.006**
VD in the PR, %	28.6 ± 7.4	28.2 ± 7.7	0.558
VD in the PPC, %	75.4 ± 10.4	75.7 ± 10.5	0.637
Image quality score	62.5 ± 6.2	61.8 ± 6.9	0.437

- **aumento della perfusione a livello della lamina cribrosa**

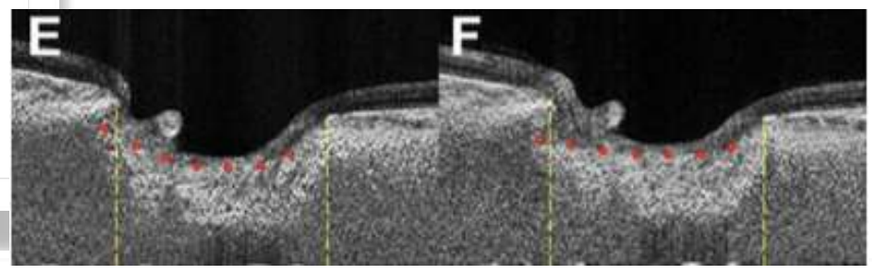
Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018



AUMENTO DELLA PERFUSIONE SEMBRA ESSERE CORRELATO ALLA RIDUZIONE DELLA CURVATURA DELLA LAMINA CRIBROSA PIÙ CHE ALLA SOLA RIDUZIONE DELLA IOP

TABLE 4. Factors Associated With the Increase of VD in the LC at Postoper

Variables	Univariate β (95% CI)	P				
Age, per 1 y older	−0.039 (−0.114 to 0.035)	0.293				
Female sex	1.557 (−1.083 to 4.197)	0.242				
CCT, per 1 μm larger	−0.013 (−0.042 to 0.016)	0.383				
AXL, per 1 mm larger	0.027 (−0.545 to 0.600)	0.924				
Global RNFL thickness, per 1 μm larger	0.028 (−0.024 to 0.081)	0.285				
VF MD, per 1 dB higher	−0.022 (−0.141 to 0.097)	0.711				
Baseline IOP, per 1 mm Hg higher	0.085 (−0.073 to 0.243)	0.287				
% IOP reduction, per 1% larger	**0.060 (0.003 to 0.116)**	**0.040**	0.055 (−0.001 to 0.111)	0.055		
Baseline LCCI, per 1 unit larger	0.281 (−0.163 to 0.726)	0.210				
% LCCI reversal, per 1% larger	**0.199 (0.107 to 0.292)**	**<0.001**			**0.188 (0.095 to 0.281)**	**<0.001**
Baseline VD in the LC, per 1% larger	−0.109 (−0.361 to 0.142)	0.388				
SBP, per 1 mm Hg higher	−0.038 (−0.118 to 0.042)	0.346				
DBP, per 1 mm Hg higher	−0.039 (−0.155 to 0.076)	0.498				
MAP, per 1 mm Hg higher	−0.045 (−0.152 to 0.062)	0.402				
MOPP, per 1 mm Hg higher	−0.076 (−0.199 to 0.048)	0.225				
Self-reported hypertension	−0.540 (−3.271 to 2.191)	0.693				
Self-reported diabetes	−0.942 (−4.023 to 2.139)	0.542				
Family history of glaucoma	−0.260 (−4.857 to 4.338)	0.910				
Cold extremities	2.028 (−0.722 to 4.777)	0.145				
Migraine	3.730 (−0.297 to 7.756)	0.069	3.341 (−0.605 to 7.287)	0.095	2.372 (−1.247 to 5.991)	0.194
Image quality score	0.106 (−0.072 to 0.283)	0.238				

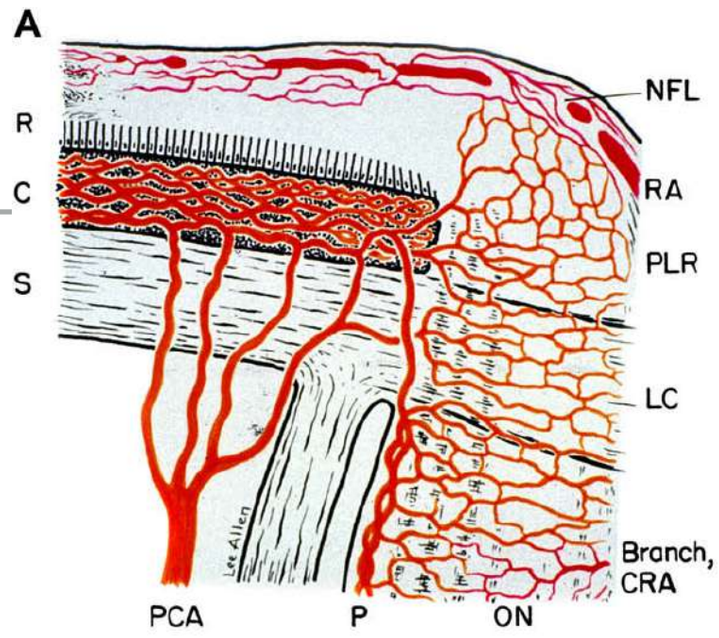
Glaucoma

Microvascular Changes in Peripapillary and Optic Nerve Head Tissues After Trabeculectomy in Primary Open-Angle Glaucoma

Ji-Ah Kim,[1] Tae-Woo Kim,[1] Eun Ji Lee,[1] Michaël J. A. Girard,[2,3] and Jean Martial Mari[4]

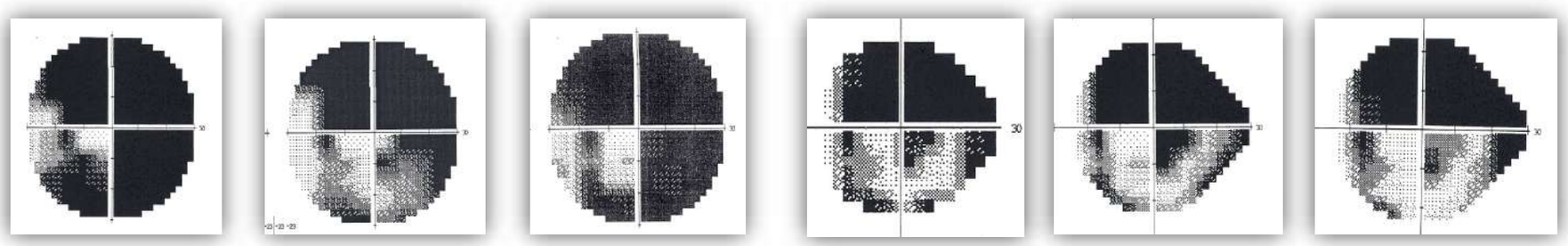
[1]Department of Ophthalmology, Seoul National University College of Medicine, Seoul National University Bundang Hospital, Seongnam, Korea
[2]Department of Biomedical Engineering, National University of Singapore, Singapore
[3]Singapore Eye Research Institute, Singapore National Eye Centre, Singapore
[4]GePaSud, Université de la Polynésie Française, Tahiti, French Polynesia

IOVS, 2018



ANGIO OCT: patogenesi glaucoma - efficacia del trattamento

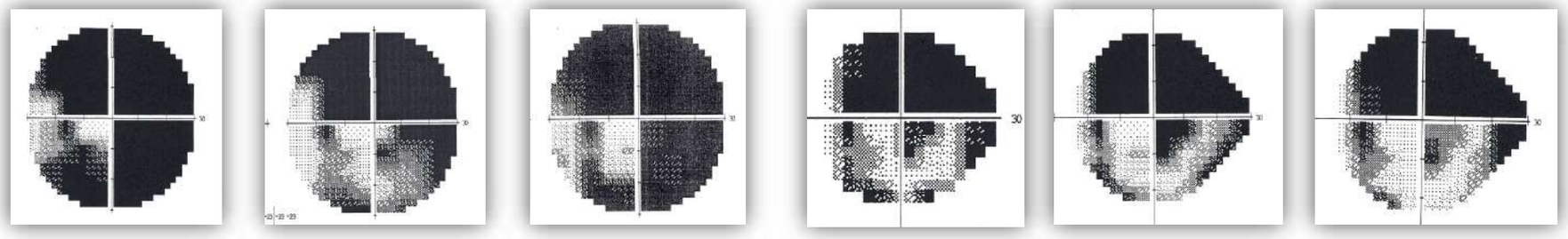
- efficacia del trattamento terapeutico potrebbe essere legato a una migliore perfusione del nervo ottico, con conseguente miglioramento del metabolismo e del flusso assoplasmatico

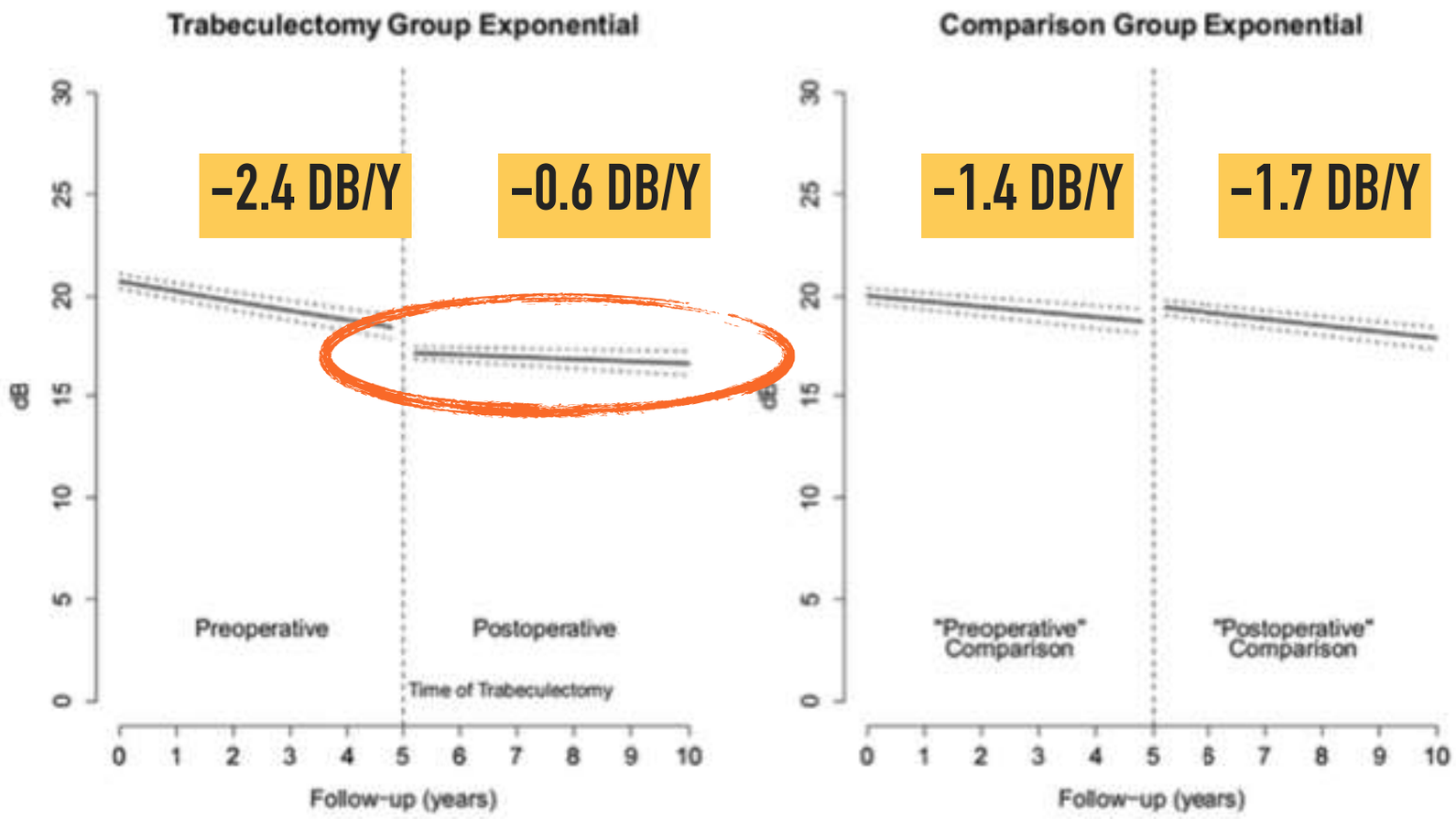


Trabeculectomy Can Improve Long-Term Visual Function in Glaucoma

ophthalmology, 2016

Joseph Caprioli, MD,[1] John Mark de Leon, MD,[1] Parham Azarbod, MD,[1] Andrew Chen, BS, MD,[1] Esteban Morales, MS,[1] Kouros Nouri-Mahdavi, MD,[1] Anne Coleman, MD, PhD,[1] Fei Yu, PhD,[1,2] Abdelmonem Afifi, PhD[2]





expanding indications

ANTERIOR SEGMENT

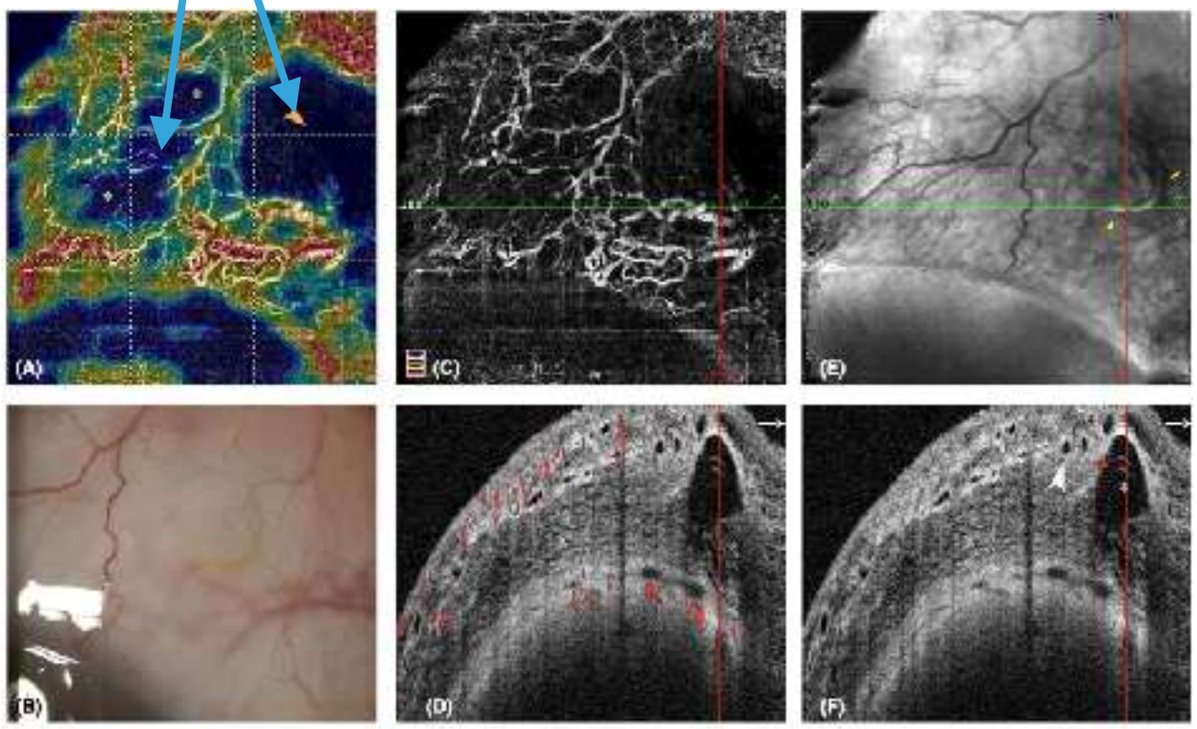
M. Sacchi - Ospedale San Giuseppe Milano

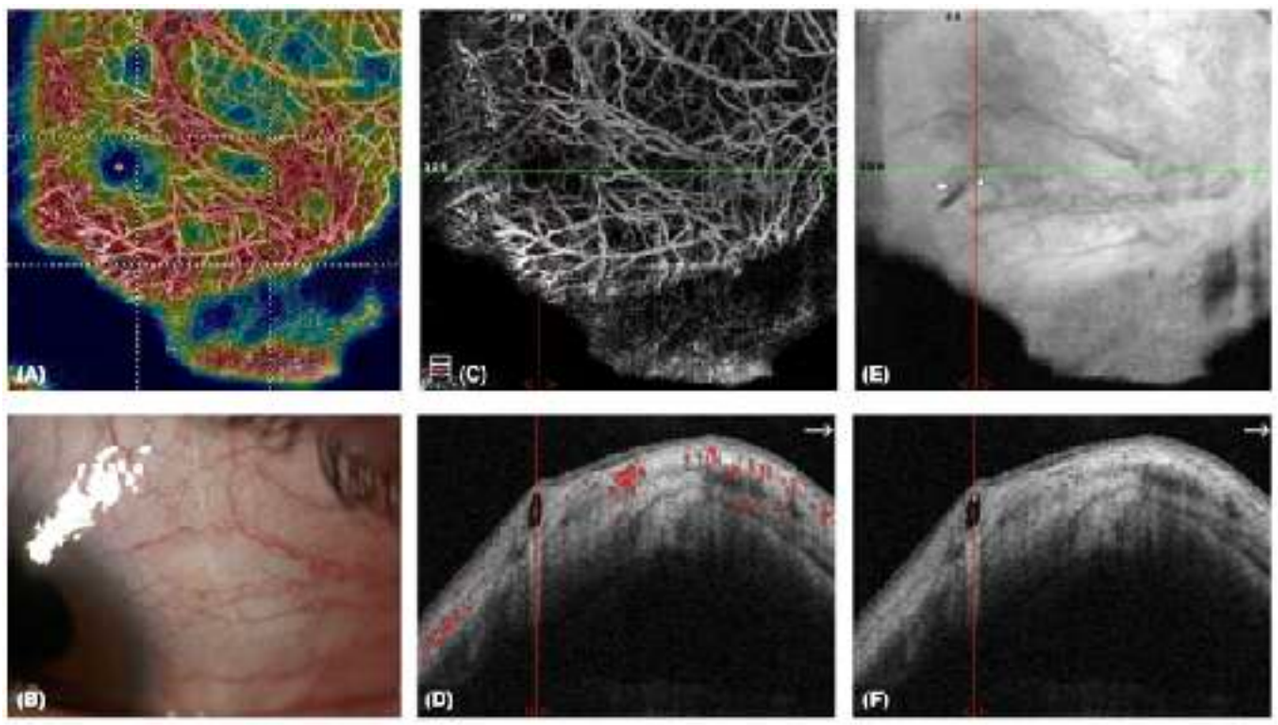
Angiographic biomarkers of filtering bleb function after XEN gel implantation for glaucoma: an optical coherence tomography-angiography study

Rodolfo Mastropasqua,[1] Lorenza Brescia,[2] Luca Di Antonio,[2] Daniele Guarini,[2] Dario Giattini,[2] Eduardo Zuppardi[2] and Luca Agnifili[2]

Acta Ophthalmologica 2020

VESSEL DISPLACEMENT AREA (VDA)





BOZZA FILTRANTE

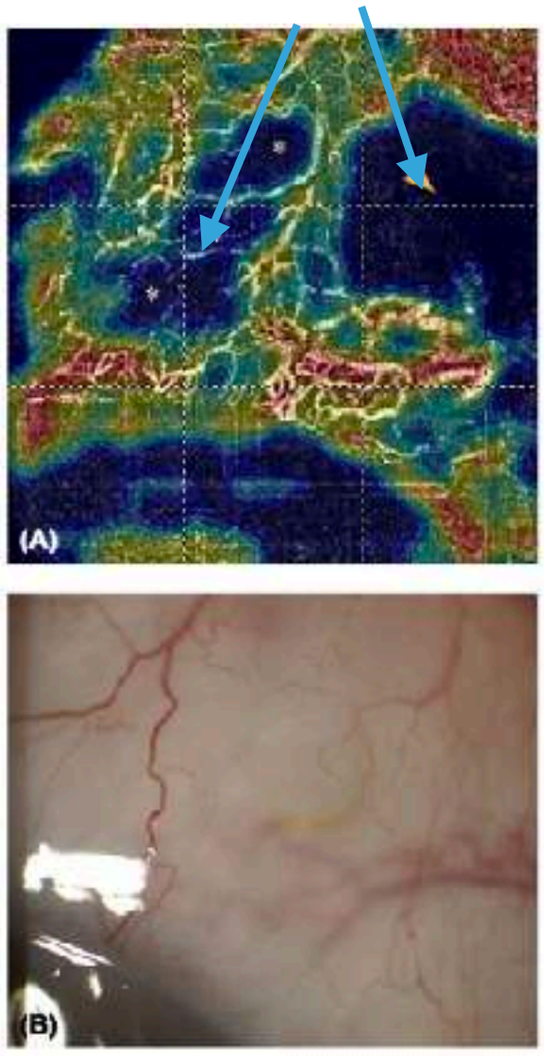
BOZZA FALLITA

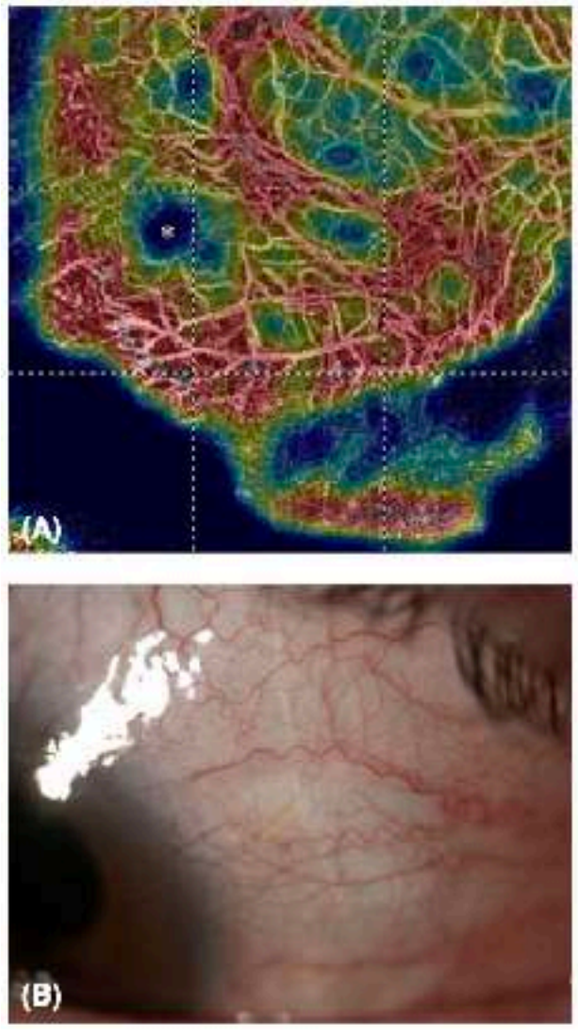
Angiographic biomarkers of filtering bleb function after XEN gel implantation for glaucoma: an optical coherence tomography-angiography study

Rodolfo Mastropasqua,[1] Lorenza Brescia,[2] Luca Di Antonio,[2] Daniele Guarini,[2] Dario Giattini,[2] Eduardo Zuppardi[2] and Luca Agnifili[2]

Acta Ophthalmologica 2020

VESSEL DISPLACEMENT AREA (VDA)





BOZZA FILTRANTE

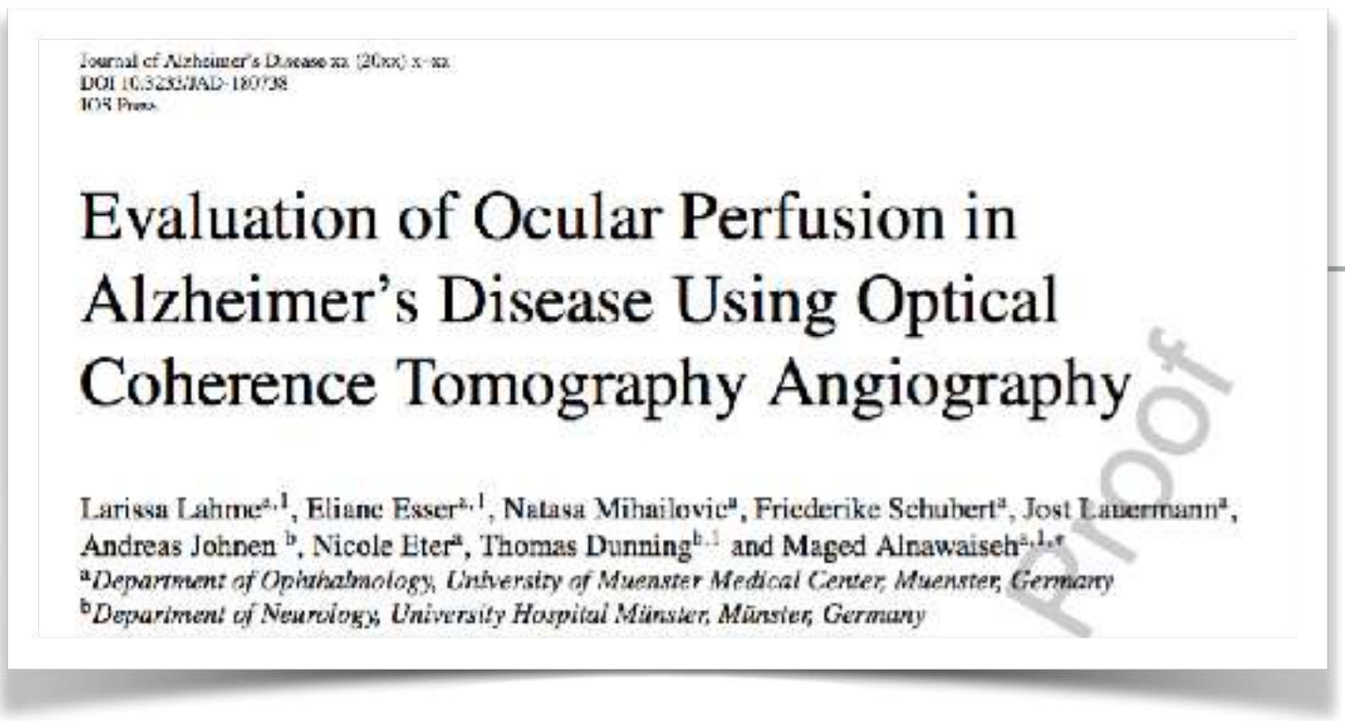
BOZZA FALLITA

expanding indications

from eye TO BRAIN

EYE: WINDOW TO THE BRAIN

possibile studiare processi degenerativi sistema nervoso centrale (nervosi e vascolari) attraverso le strutture oculari



Journal of Alzheimer's Disease xx (20xx) x–xx
DOI 10.3233/JAD-180738
IOS Press

Evaluation of Ocular Perfusion in Alzheimer's Disease Using Optical Coherence Tomography Angiography

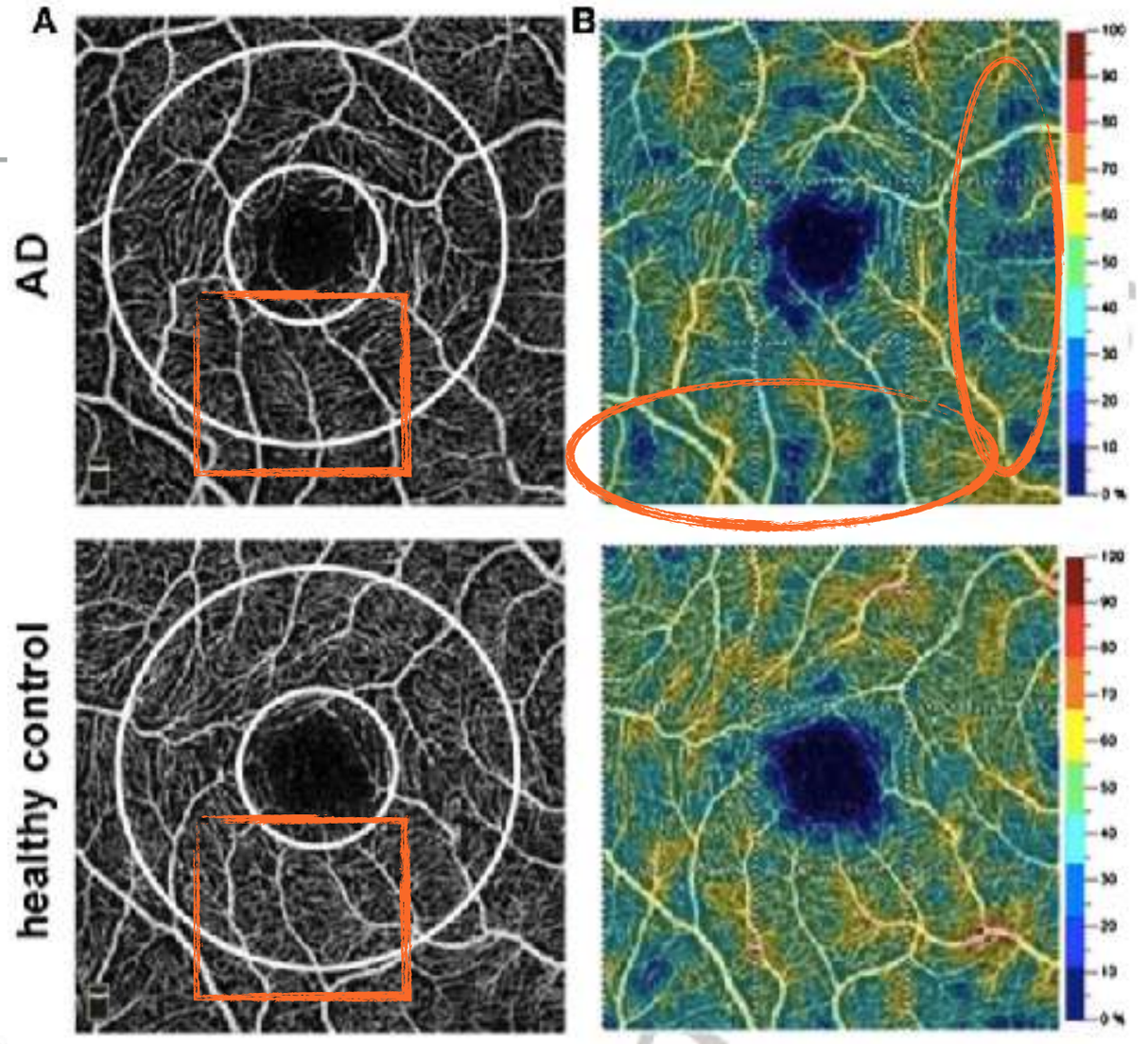
Larissa Lahme[a,1], Eliane Esser[a,1], Natasa Mihailovic[a], Friederike Schubert[a], Jost Lauermann[a], Andreas Johnen [b], Nicole Eter[a], Thomas Dunning[b,1] and Maged Alnawaiseh[a,1,*]
[a]*Department of Ophthalmology, University of Muenster Medical Center, Muenster, Germany*
[b]*Department of Neurology, University Hospital Münster, Münster, Germany*

- **demenza**: ruolo del *microcircolo vascolare*
- **AD**: disfunzione vascolare, alterazione della *perfusione cerebrale*
- **retina** e **nervo ottico**: estensione *sistema nervoso centrale*
- possibilità di studiare il microcircolo cerebrale attraverso angio OCT retina e nervo ottico

Journal of Alzheimer's Disease xx (20xx) x–xx
DOI 10.3233/JAD-180738
IOS Press

Evaluation of Ocular Perfusion in Alzheimer's Disease Using Optical Coherence Tomography Angiography

Larissa Lahme[a,1], Eliane Esser[a,1], Natasa Mihailovic[a], Friederike Schubert[a], Jost Lauermann[a], Andreas Johnen [b], Nicole Eter[a], Thomas Dunning[b,1] and Maged Alnawaiseh[a,1,*]
[a]*Department of Ophthalmology, University of Muenster Medical Center, Muenster, Germany*
[b]*Department of Neurology, University Hospital Münster, Münster, Germany*



***Angio-OCT* mostra una riduzione nella perfusione del nervo ottico in pazienti con iniziale demenza senile**

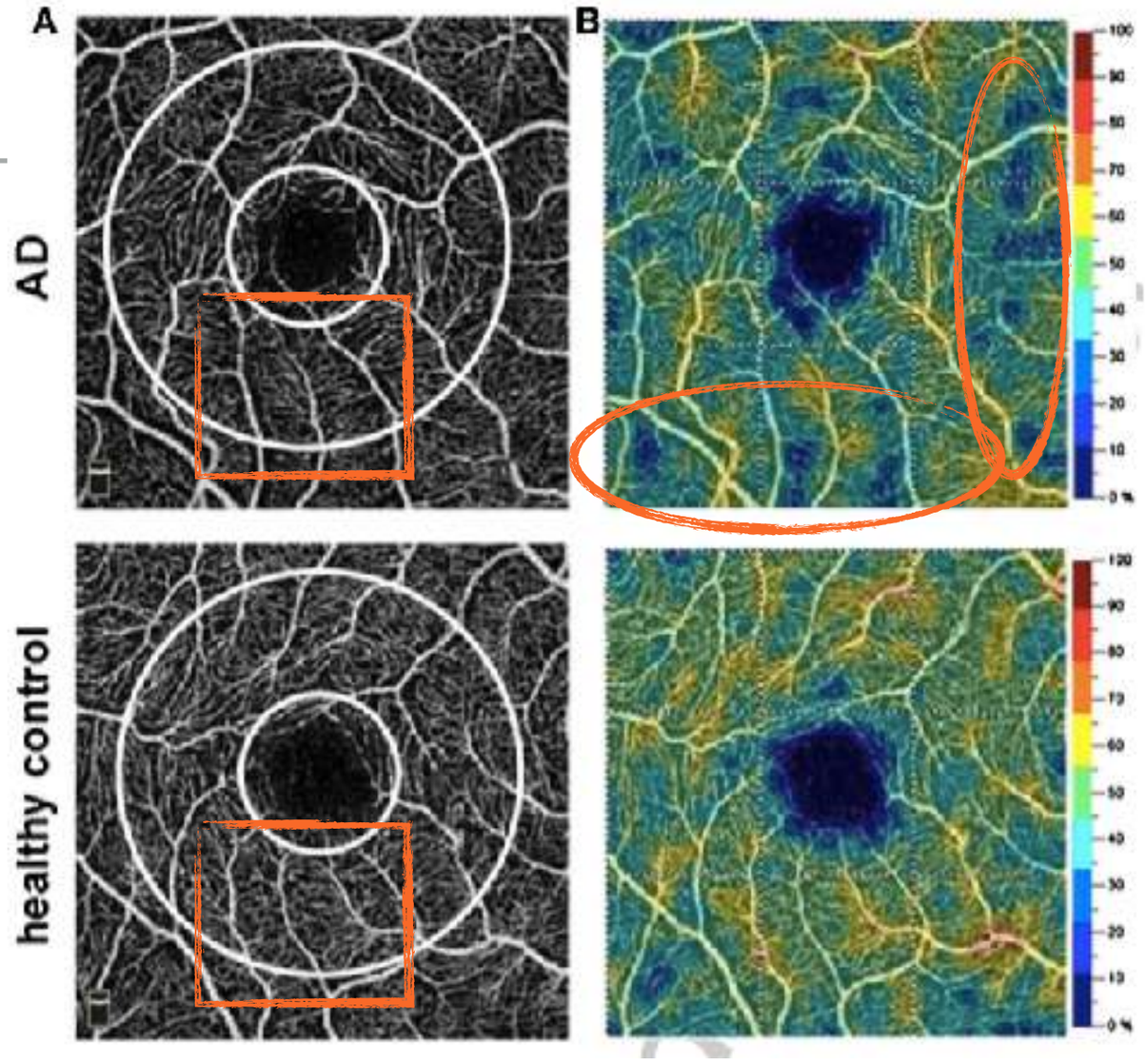
Table 2
Values of flow density (%) obtained in the regions indicated. Bold, statistically significant differences between the two groups

	Study group Mean ± SD; (median [25,75 percentile])	Control group Mean ± SD; (median [25,75 percentile])	*p*
OCT-A superficial			
whole en face	48.77 ± 3.92 (49.58 [45.05, 51.91])	51.64 ± 3.28 (52.49 [49.91, 54.04])	**0.001**
fovea	29.40 ± 5.72 (29.35 [25.94, 32.50])	31.06 ± 5.35 (31.72 [26.63, 34.42])	0.171
parafovea	50.93 ± 4.05 (52.60 [47.21, 53.92])	53.55 ± 3.31 (53.73 [51.97, 55,78])	**0.003**
OCT-A deep			
whole en face	55.35 ± 3.16 (56.13 [52.75, 58.12])	56.72 ± 2.21 (57.02 [55.53, 57.93])	0.090
fovea	31.21 ± 6.60 (29–97 [26.49, 35.27])	29.32 ± 6.67 (29.22 [25.09, 32.14])	0.234
parafovea	57.97 ± 3.30 (59.20 [54.83, 60.60])	58.38 ± 4.64 (59.15 [57.90, 60.37])	0.339
OCT-A Disc			
whole en face	53.07 ± 3.80 (53.34 [50.37, 56.35])	55.39 ± 3.76 (55.55 [53.67, 57.68])	**0.015**
peripapillary	60.89 ± 4.51 (61.27 [59.17,64.41])	62.83 ± 3.98 (63.85 [60.37, 65.34])	0.067

Journal of Alzheimer's Disease xx (20xx) x–xx
DOI 10.3233/JAD-180738
IOS Press

Evaluation of Ocular Perfusion in Alzheimer's Disease Using Optical Coherence Tomography Angiography

Larissa Lahme[a,1], Eliane Esser[a,1], Natasa Mihailovic[a], Friederike Schubert[a], Jost Lauermann[a], Andreas Johnen [b], Nicole Eter[a], Thomas Dunning[b,1] and Maged Alnawaiseh[a,1,*]
[a]*Department of Ophthalmology, University of Muenster Medical Center, Muenster, Germany*
[b]*Department of Neurology, University Hospital Münster, Münster, Germany*



Angio-OCT :

perfusione nervo ottico offre una rappresentazione del circolo cerebrale

Alzheimer:

evidenza di riduzione perfusione oculare proporzionale alle alterazioni vascolari cerebrali

Future applications:

Angio OCT come biomarker demenza senile (diagnosi precoce, efficacia terapia, monitoraggio)

expanding indications

STENOSI CAROTIDEA

M. Sacchi - Ospedale San Giuseppe Milano

SCIENTIFIC REPORTS

OPEN

2018

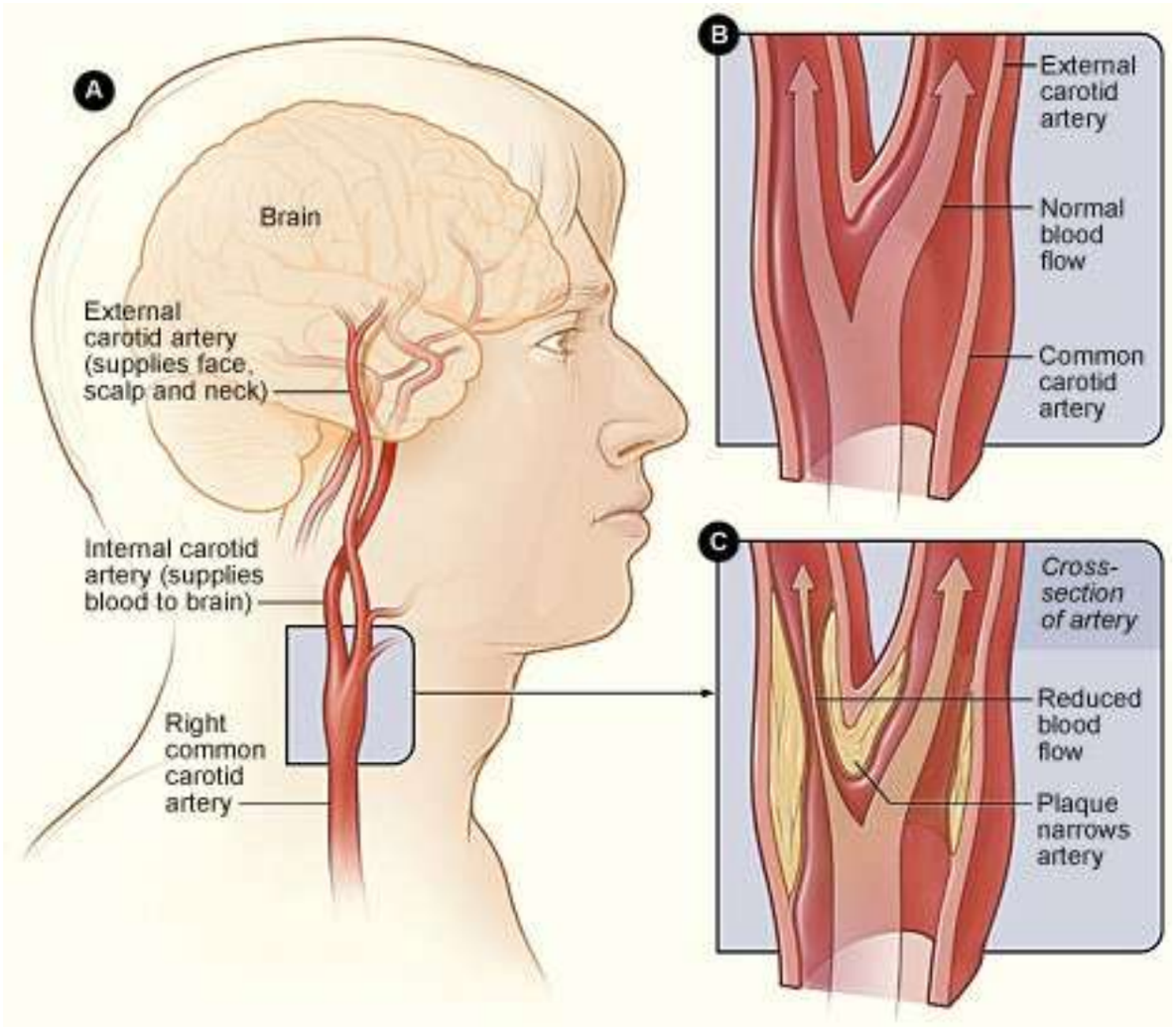
Changes in retinal flow density measured by optical coherence tomography angiography in patients with carotid artery stenosis after carotid endarterectomy

Larissa Lahme[1], Elena Marchiori[1], Giuseppe Panuccio[1], Pieter Nelis[1], Friederike Schubert[1], Natasa Mihailovic[1], Giovanni Torsello[1], Nicola Eter[1] & Maged Alnawaiseh[1]

Patients with **asymptomatic severe internal carotid artery stenosis**

- to evaluate the ***retinal*** and ***optic nerve head*** (ONH) ***perfusion*** compared to healthy controls

- to evaluate the ***impact of carotid endarterectomy***



SCIENTIFIC REPORTS

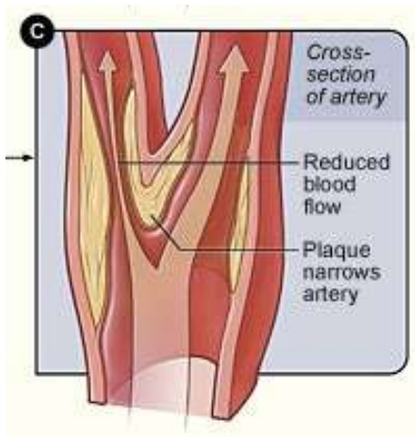
OPEN

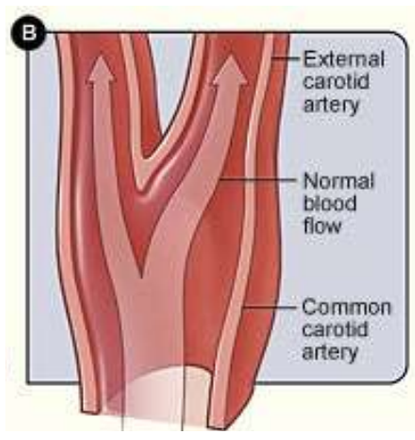
Changes in retinal flow density measured by optical coherence tomography angiography in patients with carotid artery stenosis after carotid endarterectomy

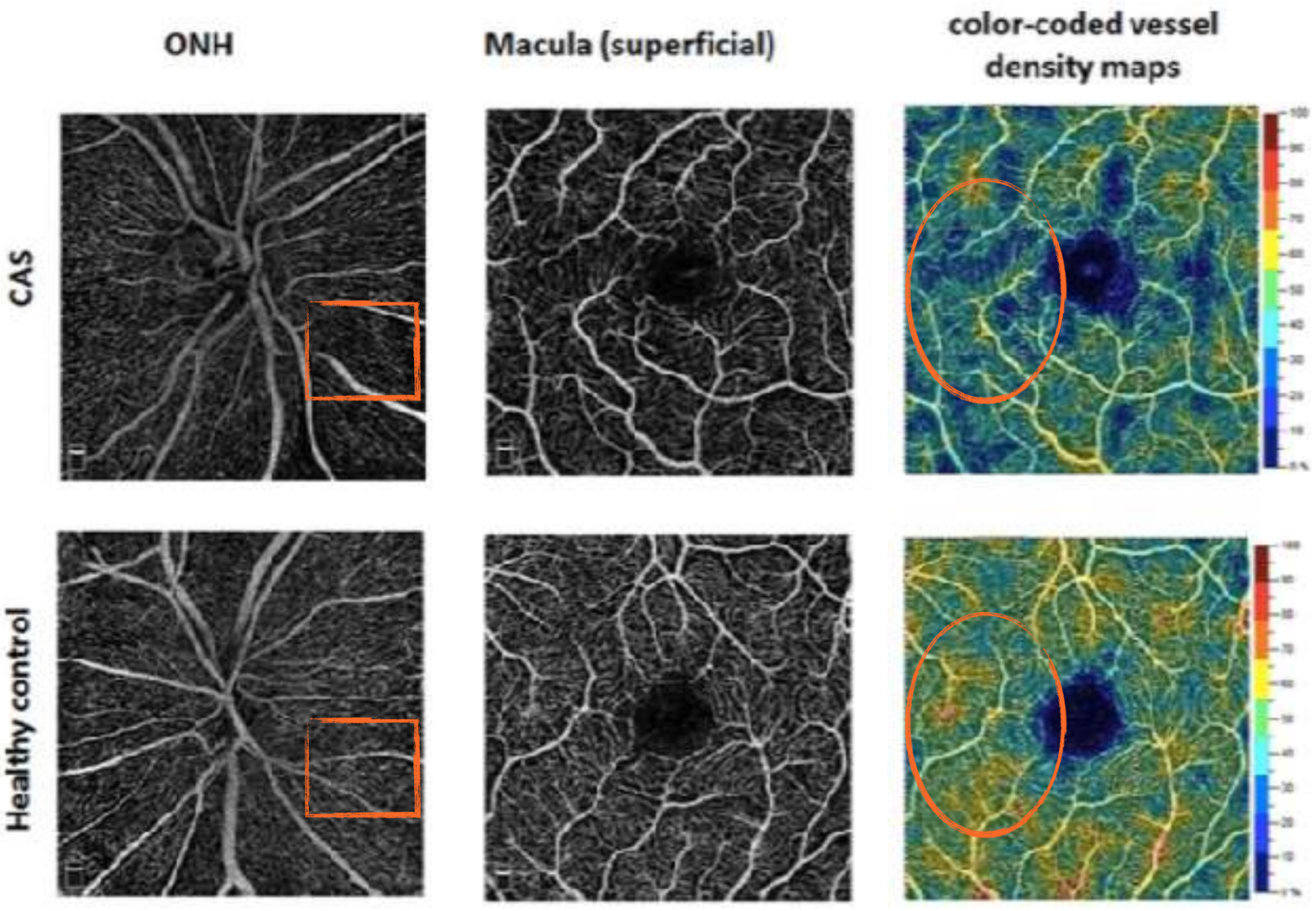
2018

Larissa Lahme[1], Elena Marchiori[1], Giuseppe Panuccio[1], Pieter Nelis[1], Friederike Schubert[1], Natasa Mihailovic[1], Giovanni Torsello[1], Nicola Eter[1] & Maged Alnawaiseh[1]

	Study group	Control group	
	mean ± SD	mean ± SD	p-Value
OCT-A superficial			
whole en face	48.52 ± 4.46	51.88 ± 2.70	**0.003**
fovea	28.31 ± 7.95	28.84 ± 6.04	0.726
parafovea	50.72 ± 4.39	54.08 ± 2.57	**0.002**
OCT-A deep			
whole en face	54.88 ± 4.44	55.07 ± 4.77	0.892
fovea	32.79 ± 8.31	31.81 ± 9.31	0.706
parafovea	57.03 ± 4.73	57.05 ± 5.41	0.989
OCT-A RPC			
whole en face	51.53 ± 3.72	54.17 ± 3.43	**0.013**
inside Disc	40.02 ± 9.12	47.88 ± 6.61	**<0.001**
peripapillary	58.96 ± 6.10	60.43 ± 5.43	0.376







riduzione perfusione in pazienti con stenosi carotidea

pazienti sani

SCIENTIFIC REPORTS

OPEN

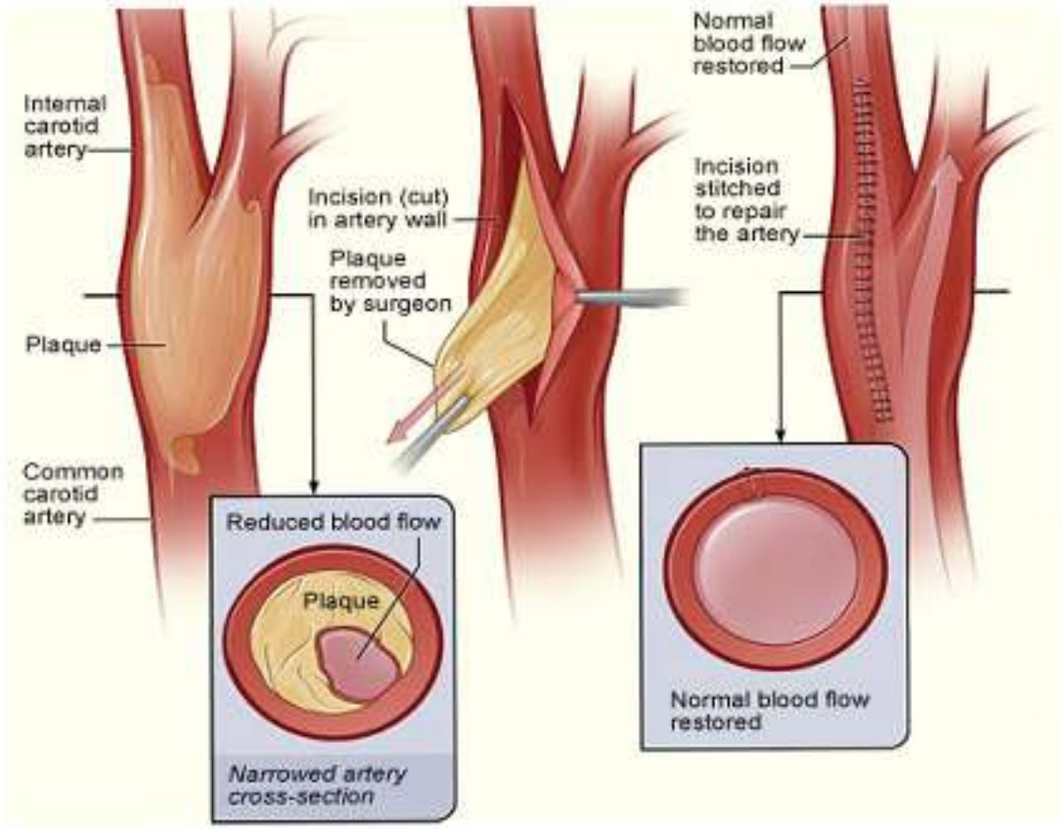
Changes in retinal flow density measured by optical coherence tomography angiography in patients with carotid artery stenosis after carotid endarterectomy

Larissa Lahme[1], Elena Marchiori[1], Giuseppe Panuccio[1], Pieter Neis[1], Friederike Schubert[1], Natasa Mihailovic[1], Giovanni Torsello[1], Nicola Eter[1] & Maged Alnawaiseh[1]

2018

n = 18	preopertive mean ± SD	postoperative mean ± SD	Relative change (%)	p-Value
OCT-A superficial				
whole en face	50.21 ± 2.23	50.38 ± 2.32	0.34	0.720
fovea	30.82 ± 6.21	29.50 ± 5.36	−4.28	0.238
parafovea	52.25 ± 2.69	52.29 ± 2.62	0.08	0.857
OCT-A deep				
whole en face	56.84 ± 2.12	56.57 ± 2.09	−0.48	0.590
fovea	33.58 ± 8.36	32.13 ± 5.81	−4.32	0.399
parafovea	59.08 ± 2.46	58.60 ± 2.63	−0,81	0.483
OCT-A RPC				
whole en face	53.06 ± 2.69	54.59 ± 2.39	2.88	**0.004**
inside Disc	37.58 ± 8.60	39.03 ± 8.16	3.86	0.265
peripapillary	62.21 ± 2.12	63.62 ± 2.43	2.27	**0.005**

miglioramento perfusione dopo endoarteriectomia



ANGIO OCT

potenziale ruolo nella diagnosi e nel monitoraggio di pazienti con stenosi carotidea

ruolo nel valutare l'efficacia dell'intervento

expanding indications

EMICRANIA

M. Sacchi - Ospedale San Giuseppe Milano

Acta Neurologica Belgica
https://doi.org/10.1007/s13760-019-01094-7

ORIGINAL ARTICLE

Retinal vascular density evaluation of migraine patients with and without aura and association with white matter hyperintensities

Mahmut Oğuz Ulusoy[1] · Bahriye Horasanlı[2] · Ali Kal[1]

Received: 10 December 2018 / Accepted: 5 February 2019

riduzione perfusione nervo ottico in pazienti con emicrania (con e senza aura) rispetto ai controlli sani

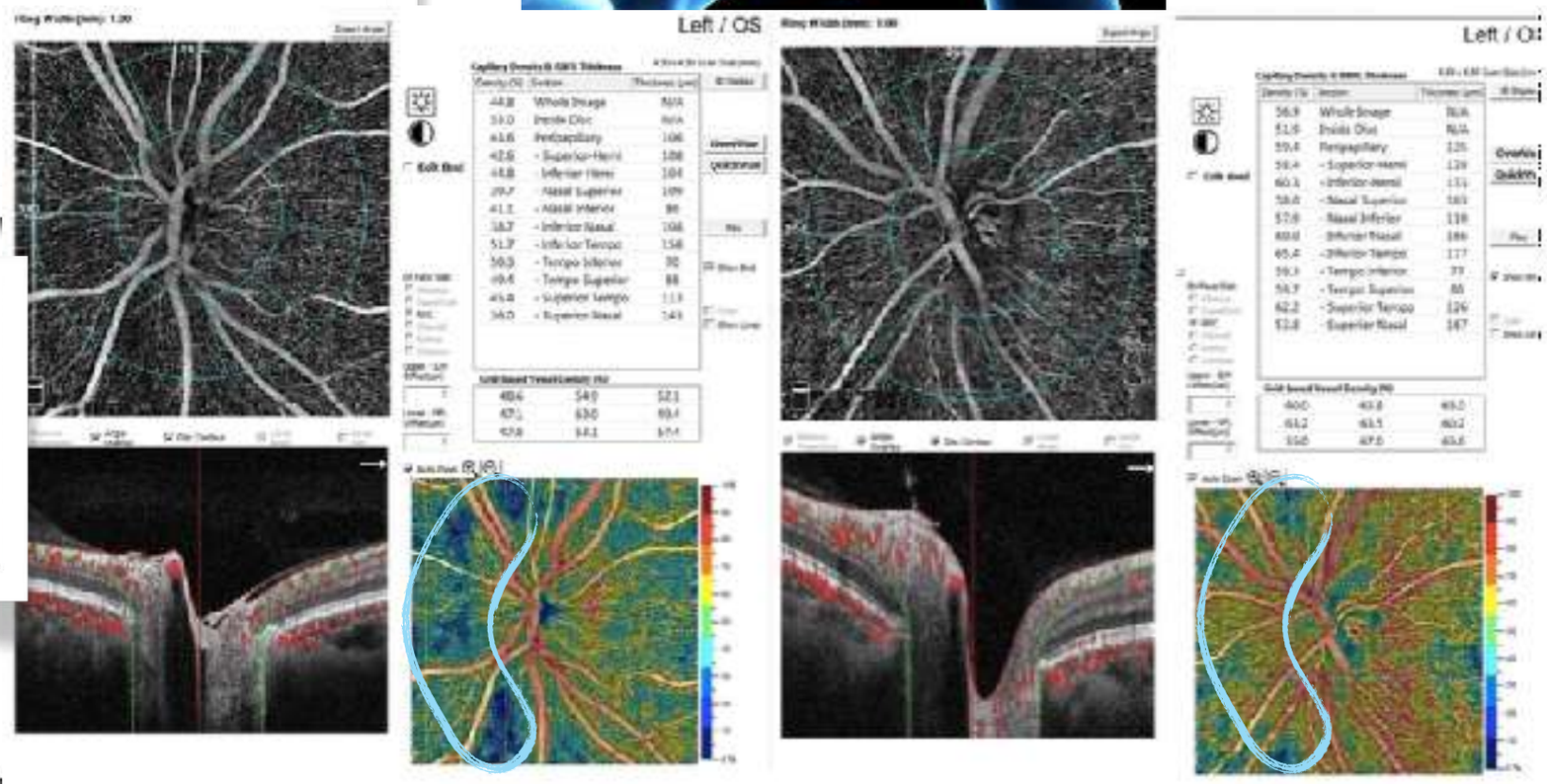


Table 4 Comparison of peripapillary OCTA findings among the groups

	MWA	MWO	Control	*P*		
				MWA vs MWO	MWA vs control	MWO vs control
OD Whole VD	48.4±3.1	49.2±2.8	52.8±3.2	0.64	0.036	0.042
OD Inside VD	51.4±5.6	52.6±3.5	53.6±2.7	0.72	0.58	0.68
Peripapillary VD	50.3±3.6	51.6±4.7	54.2±3.4	0.77	0.028	0.033
Superior hemisphere VD	49.2±3.2	50.8±4.7	54.5±3.9	0.91	0.024	0.029
Inferior hemisphere VD	51.4±4.5	52.5±2.5	52.8±3.9	0.67	0.71	0.74
Superior VD	48.9±4.6	51.1±6.1	54.6±3.9	0.048	0.019	0.031
Inferior VD	51.4±4.5	52.5±2.5	53.5±37	0.89	0.75	0.82
Temporal VD	49.7±4.5	50.4±4.34	55.4±5.2	0.79	0.012	0.017
Nasal VD	53.5±7.4	54.1±5.6	55.8±6.8	0.96	0.88	0.91

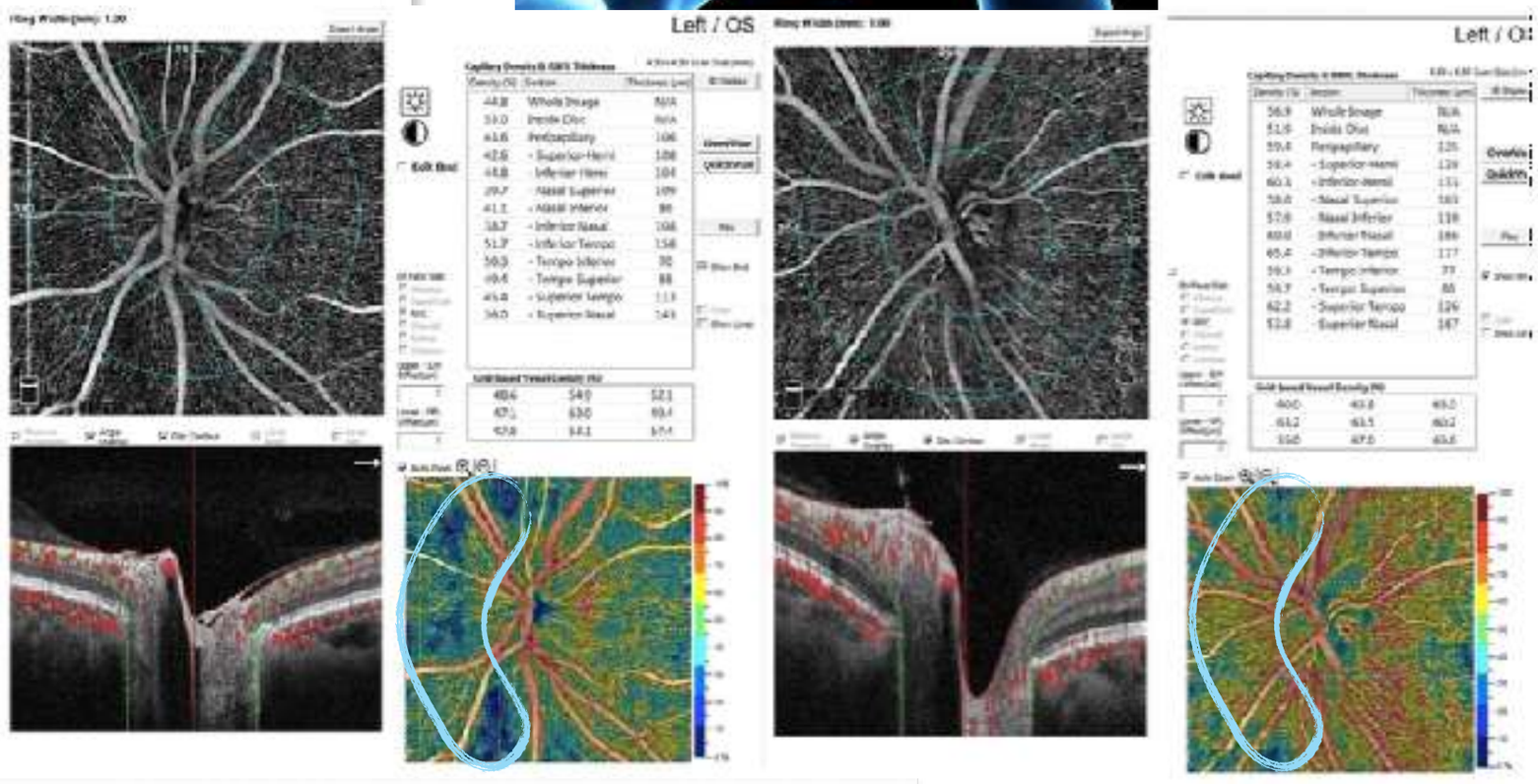
Acta Neurologica Belgica
https://doi.org/10.1007/s13760-019-01094-7

ORIGINAL ARTICLE

Retinal vascular density evaluation of migraine patients with and without aura and association with white matter hyperintensities

Mahmut Oğuz Ulusoy[1] · Bahriye Horasanlı[2] · Ali Kal[1]

Received: 10 December 2018 / Accepted: 5 February 2019



i pazienti sono stati divisi per presenza di lesioni della sostanza bianca (esiti ipossici)

in pazienti con emicrania con AURA, la riduzione dei valori di perfusione è correlata con la presenza di lesioni sostanza bianca

questo suggerisce una eziologia ischemica nell'emicrania con AURA

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

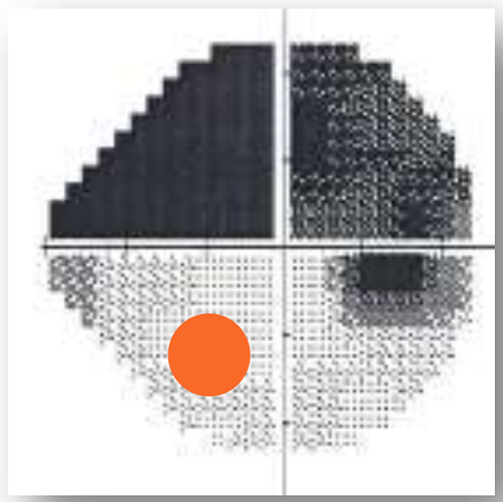
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

How can OCTA findings affect clinical practice?

Is it helpful in early detection of glaucoma?

- vascular density in a group of glaucoma patients with a single hemifield was reduced in perimetrically ***intact hemiretina*** of these eyes.



Yarmohammadi A et al. Peripapillary and macular vessel density in patients with glaucoma and single-hemifield visual field defect. Ophthalmology. 2017

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

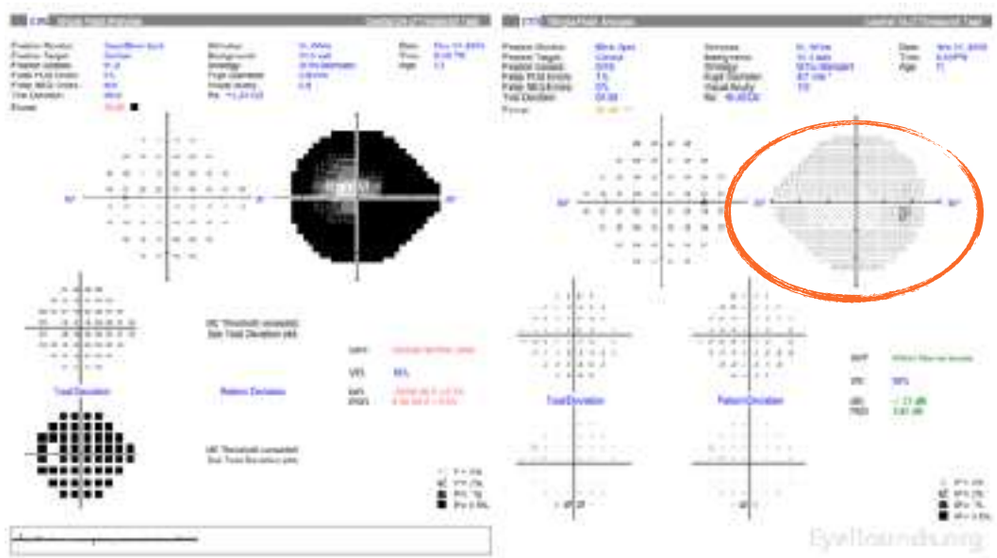
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

How can OCTA findings affect clinical practice?

Is it helpful in early detection of glaucoma?

we measured the vascular densities in the macula and the peripapillary area in eyes with **unilateral glaucoma** and demonstrated that OCTA measurements detect changes in **retinal microvasculature** before visual field damage in ***unaffected eyes***.



Yarmohammadi A et al. Peripapillary and macular vessel density in patients with primary open-angle glaucoma and unilateral visual field loss. Ophthalmology. 2018

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

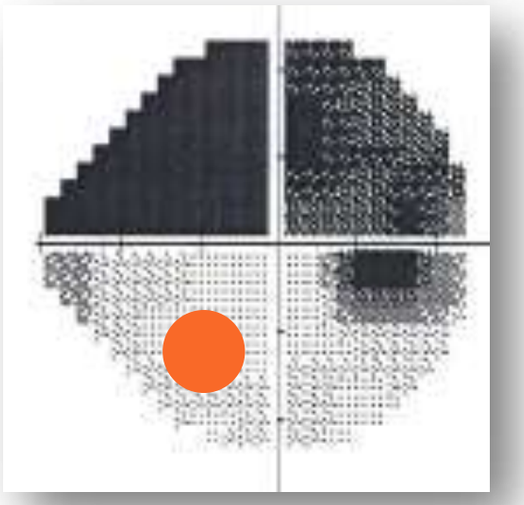
Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

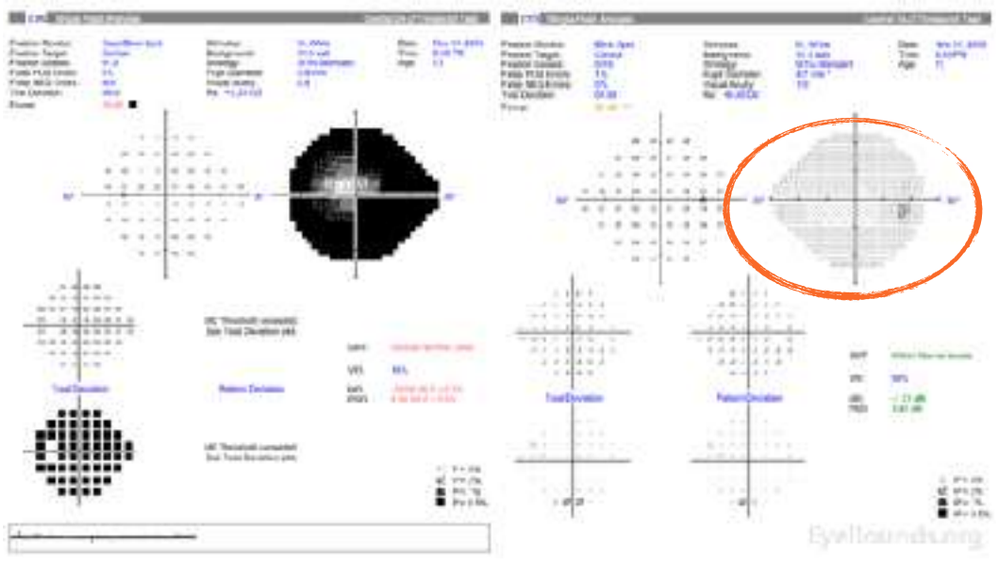
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

How can OCTA findings affect clinical practice?

Is it helpful in early detection of glaucoma?



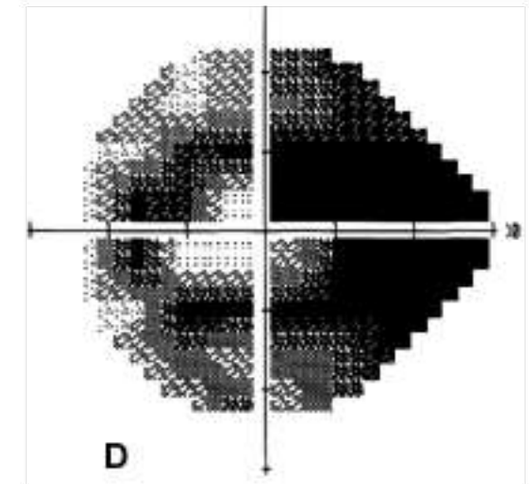


We can conclude from these studies that there are some cases that microvascular attenuation occurs before changes in retinal nerve fiber layer (RNFL) thickness or function.

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)



Can OCTA help us in the later course of the disease?

We have reported a stronger relationship between vasculature and function, compared to thickness and function, in eyes with **advanced glaucoma**. *

OCTA promises to be a tool that can provide a more informative outcome measure in advanced glaucoma, compared to ganglion cell complex (GCC) and RNFL thickness, and could extend the dynamic range of the OCT measurements.

* Bowd C, Zangwill LM, Weinreb RN, Medeiros FA, Belghith A. Estimating optical coherence tomography structural measurement floors to improve detection of progression in advanced glaucoma. Am J Ophthalmol. 2017

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

What useful information can we obtain from OCTA beyond thickness? Is it useful for prediction of glaucoma progression?

a longitudinal study showed that lower baseline macular and peripapillary vessel densities were associated with a *faster rate of RNFL progression* *

Importantly, they showed that this association was **independent** of the structural baseline RNFL thickness, suggesting that **OCTA** may offer *additional information* to the evaluation of the risk of glaucoma progression and prediction of rates of disease worsening.

* Moghimi S et al. Macular and optic nerve head vessel density and progressive retinal nerve fiber layer loss in glaucoma. Ophthalmology. 2018.

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

What useful information can we obtain from OCTA beyond thickness? Is it useful for prediction of glaucoma progression?

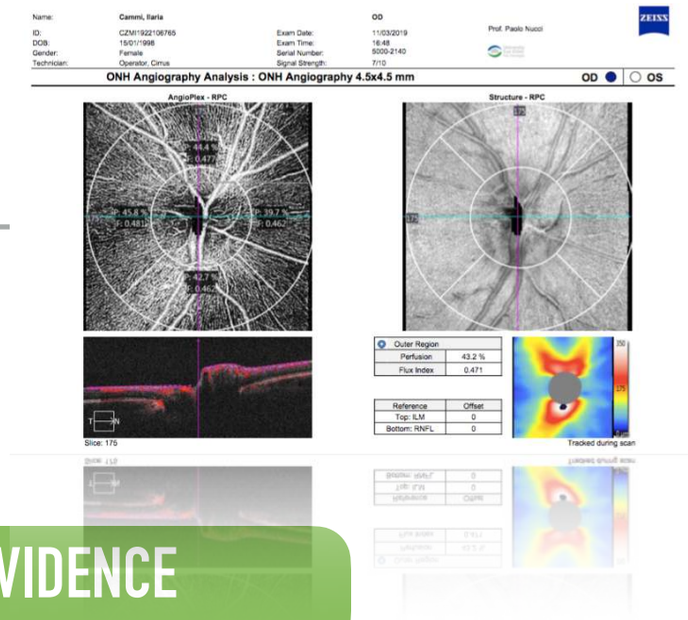
One reason might be that reduced optic disc and retina perfusion leads to faster retinal ganglion cell (RGC) death.

What if reduced perfusion on OCTA were a biomarker for sick dysfunctional RGCs with lower metabolic demands?

Characterizing the vasculature by detection of flowing red blood cells to meet the metabolic needs of cells could be a *surrogate* for neural tissue oxygenation and **metabolism** and may reflect ***functional status*** of the RGCs before structural changes occur.

* Moghimi S et al. Macular and optic nerve head vessel density and progressive retinal nerve fiber layer loss in glaucoma. Ophthalmology. 2018.

CONCLUSIONI: ANGIO OCT & GLAUCOMA



- individuare glaucomi vs sani — SI
- individuare glaucoma precocemente — GROWING EVIDENCE
- chiarire patogenesi — SI
- individuare progressione *RNFL-independent* — GROWING EVIDENCE

- expanding indications:
  - patologie sistema nervoso centrale (vascolari e neurodegenerative)
  - studio della bozza

BACK-UP SLIDES

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

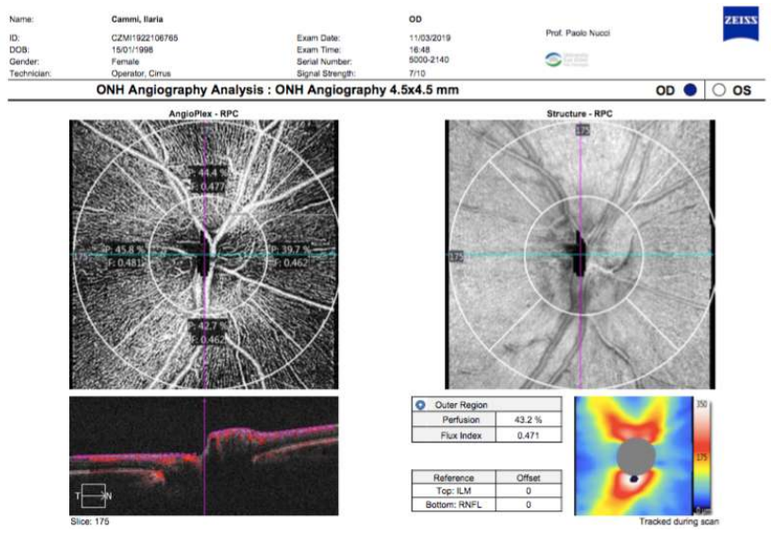
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

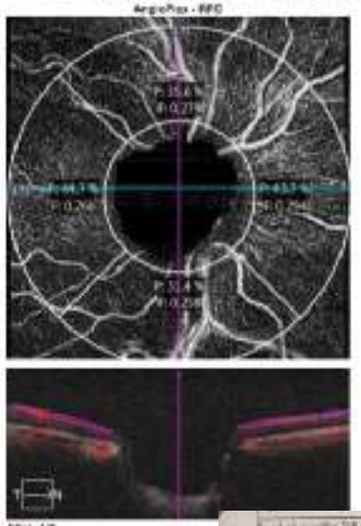
What *ocular*, *systemic*, and *physiologic* parameters affect vessel density measurements?

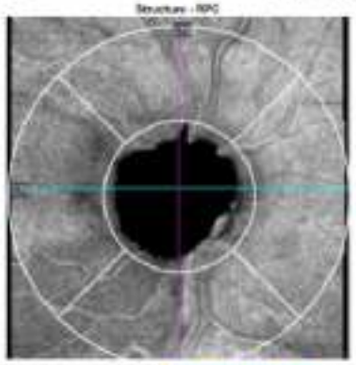
Do *systemic medications* affect retinal perfusion? How about *topical medications*?

Is there any diurnal variation? Is there any change in vessel density when we are lying down?



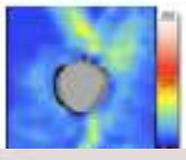
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ● ○ OS





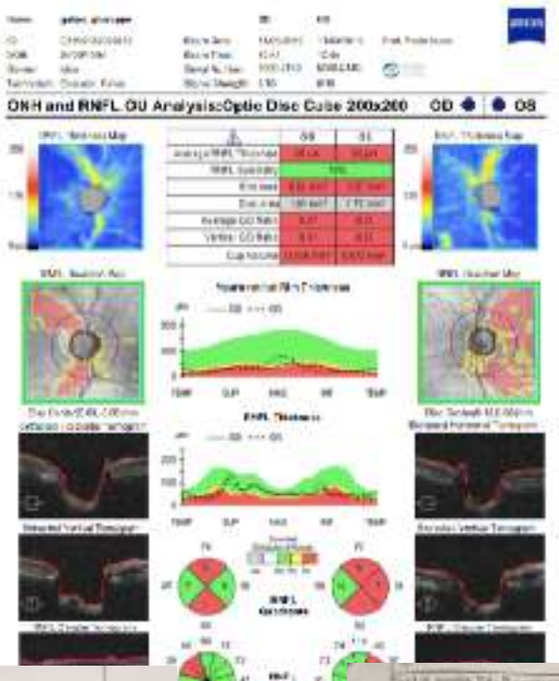
Outer Region	
Perfusion	59.1 %
Flux Index	0.278

Reference	Offset
Top Rim	0
Bottom RNFL	0

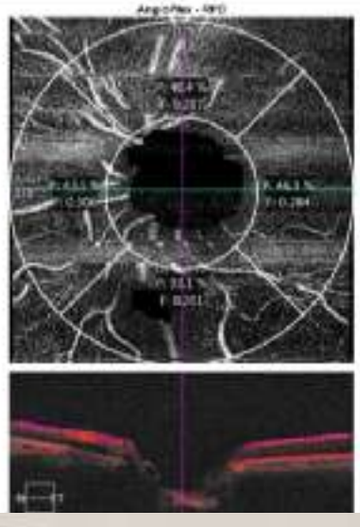


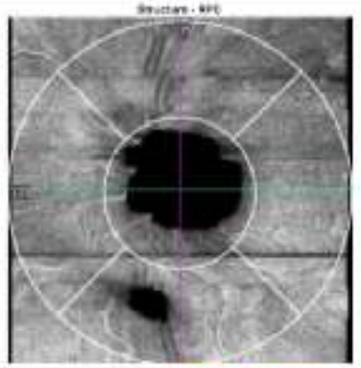
Comments

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● ● OS



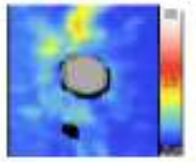
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ○ ● OS

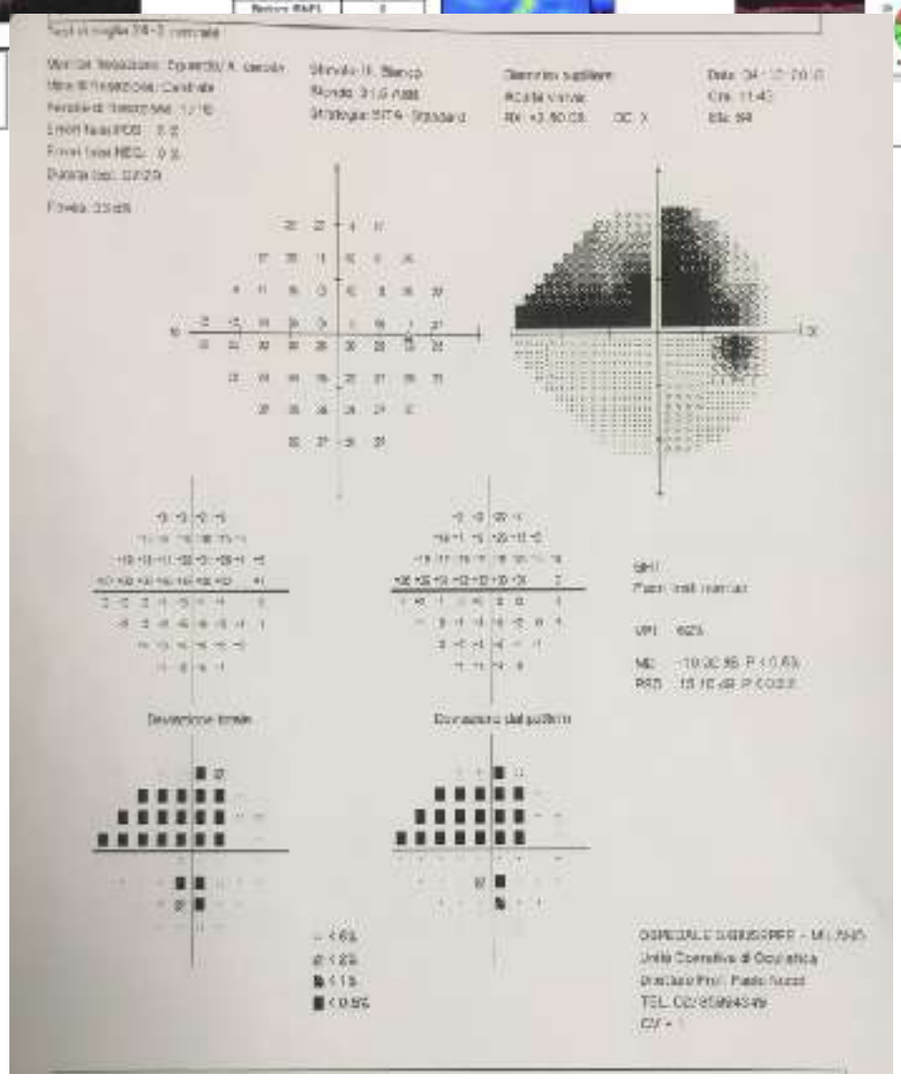


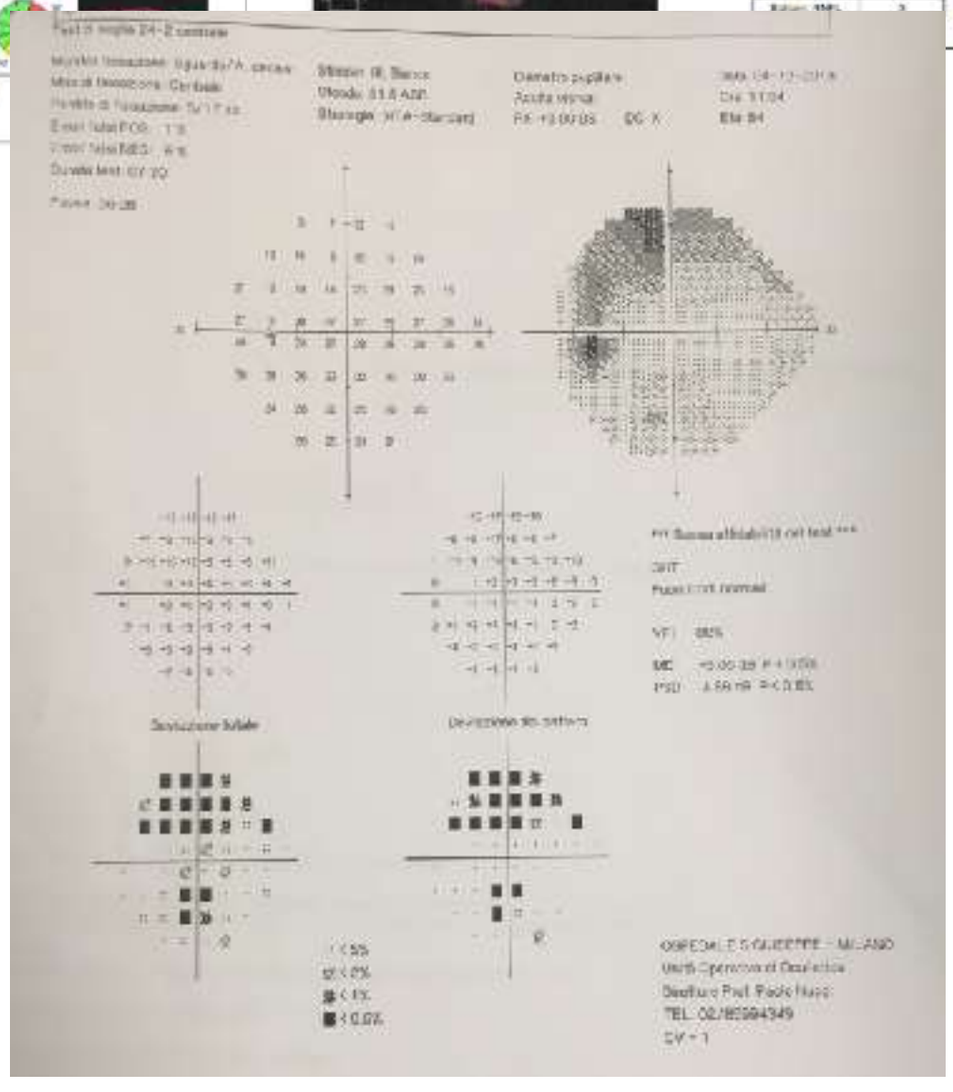


Outer Region	
Perfusion	43.6 %
Flux Index	0.249

Reference	Offset
Top Rim	0
Bottom RNFL	0

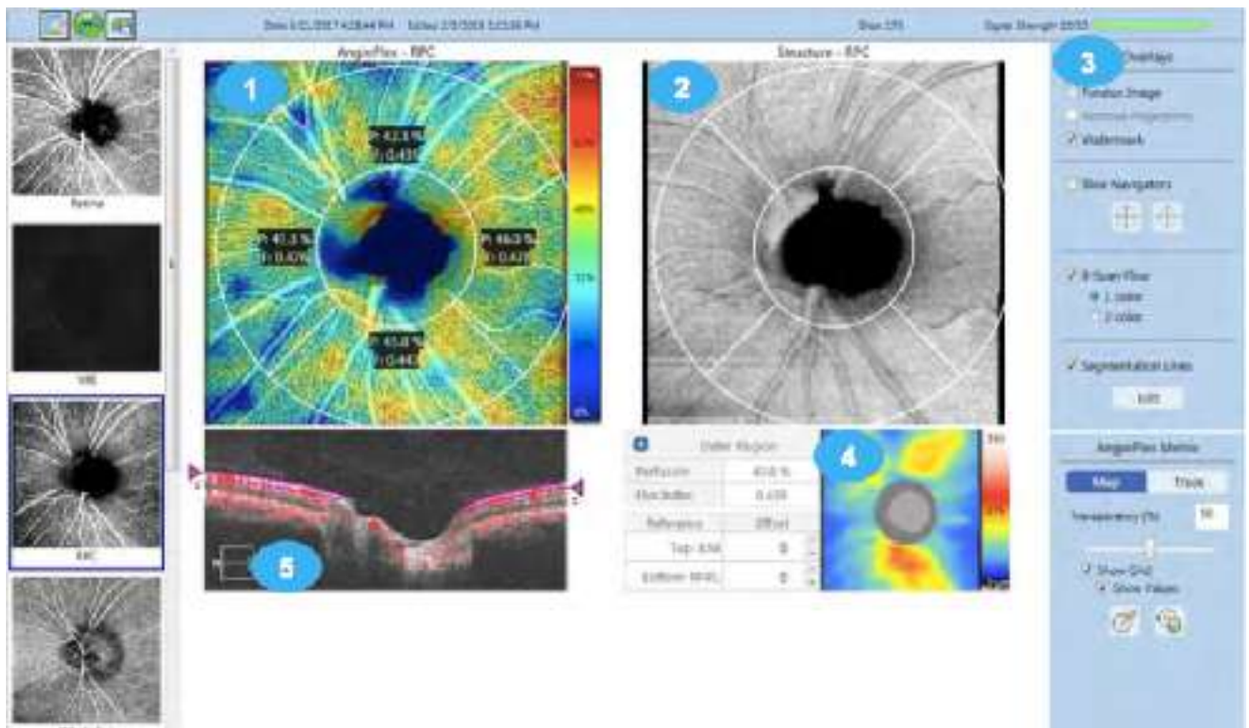






ANGIO-OCT: BACKGROUND E RAZIONALE

- patogenesi glaucoma - apoptosi cellule ganglionari
- teoria meccanica: compressione assoni
- teoria vascolare: ischemia assoni



Diagnostic performance of optical coherence tomography angiography in glaucoma: a systematic review and meta-analysis

Ana I M Miguel,[1,2] André B Silva,[3] Luis F Azevedo[1]

BJO, 2019

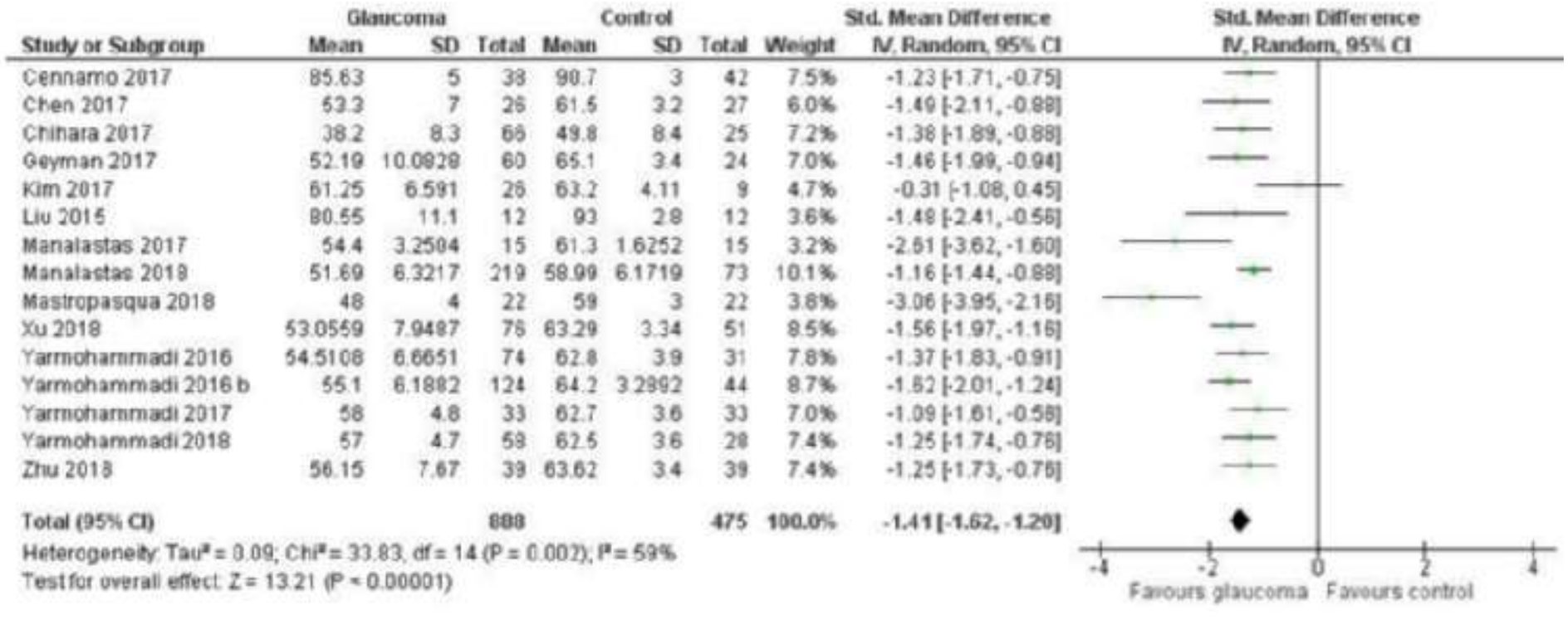
The mean peripapillary Vassel Density:

glaucoma 57.53%

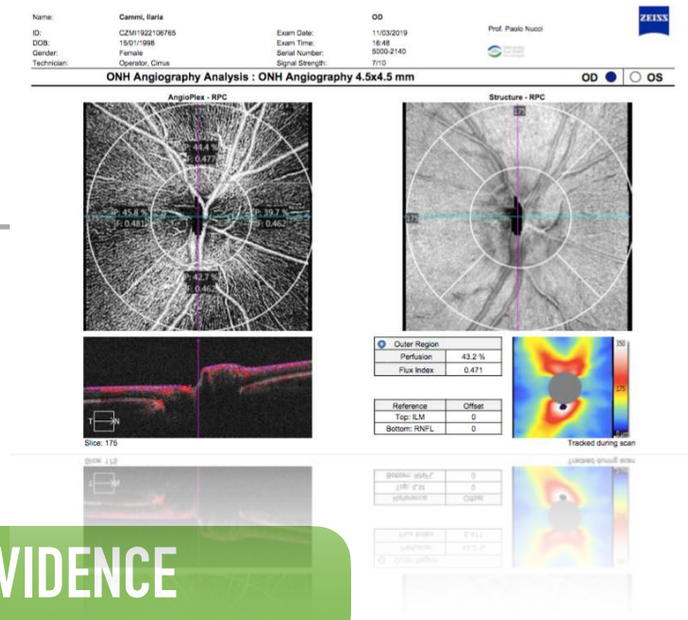
controls 65.47% *SMD, –1.41, 95% CI –1.62 to –1.20, p<0.05*

888 glaucomatous eyes and 475 healthy eyes

OCTA COULD FACILITATE THE DIAGNOSIS OF GLAUCOMA, ESTABLISHING THAT THE VD IS MARKEDLY LOWER IN GLAUCOMA COMPARED WITH HEALTHY CONTROLS, IN ALL THE REGIONS TESTED.



CONCLUSIONI: ANGIO OCT & GLAUCOMA



- individuare glaucomi vs sani — SI
- individuare glaucoma precocemente — GROWING EVIDENCE
- chiarire patogenesi — SI
- individuare progressione *RNFL-independent* — GROWING EVIDENCE

- expanding indications:
  - patologie sistema nervoso centrale (vascolari e neurodegenerative)
  - studio della bozza

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

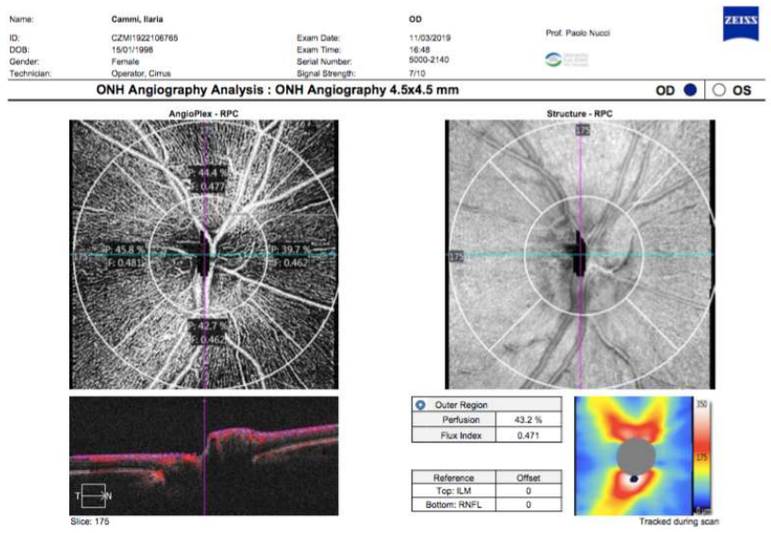
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

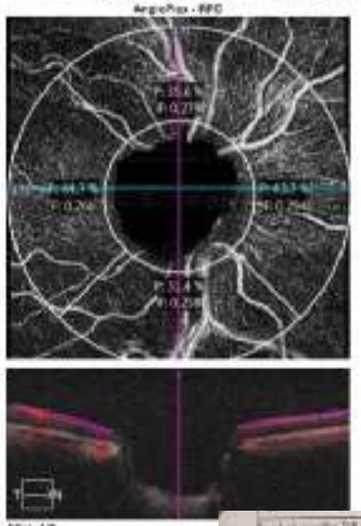
What *ocular*, *systemic*, and *physiologic* parameters affect vessel density measurements?

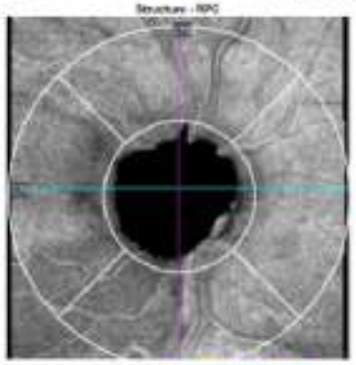
Do *systemic medications* affect retinal perfusion? How about *topical medications*?

Is there any diurnal variation? Is there any change in vessel density when we are lying down?



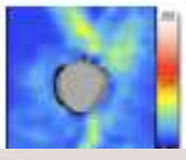
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ● ○ OS





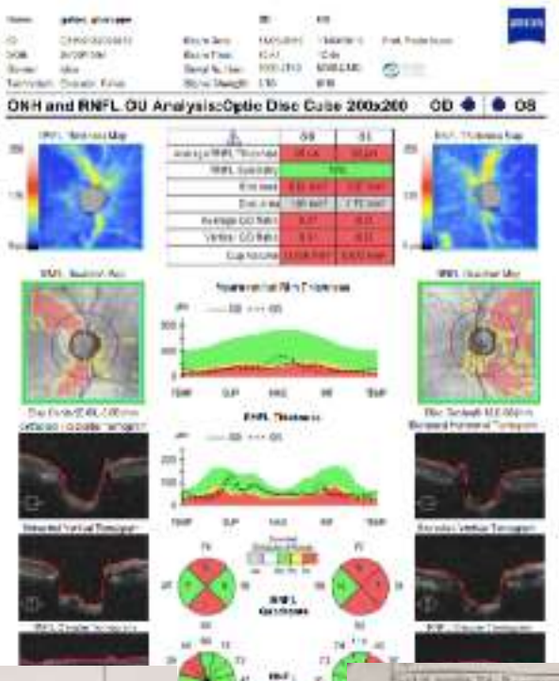
Outer Region	
Perfusion	59.1 %
Flux Index	0.278

Reference	Offset
Top Rim	0
Bottom RNFL	0

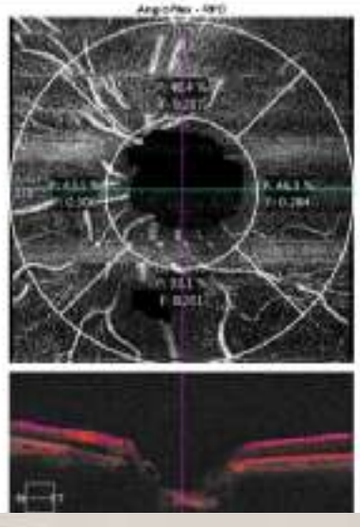


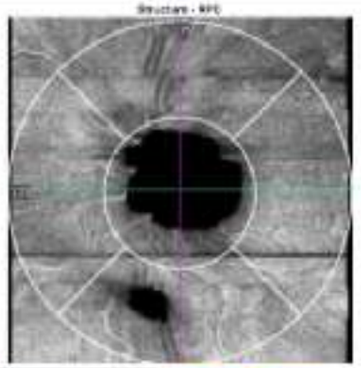
Comments

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● ● OS



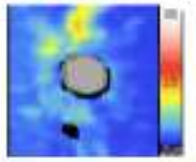
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ○ ● OS

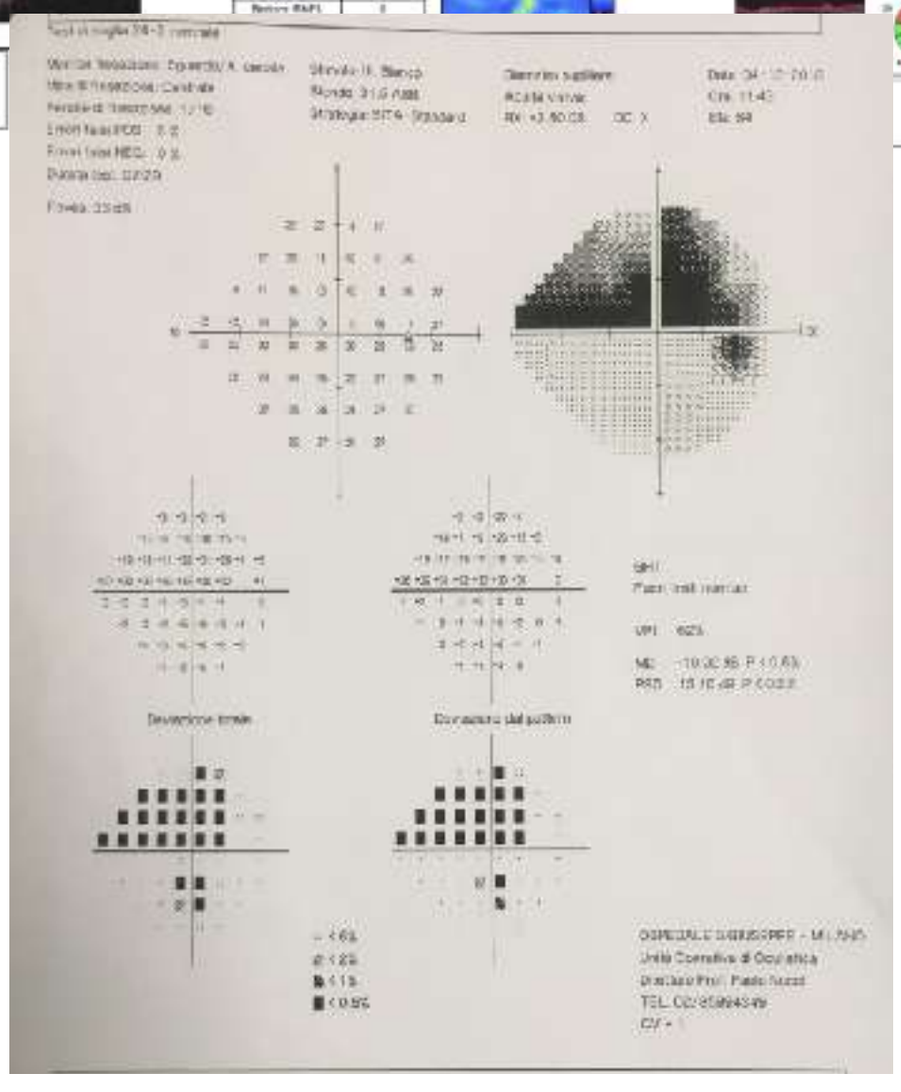


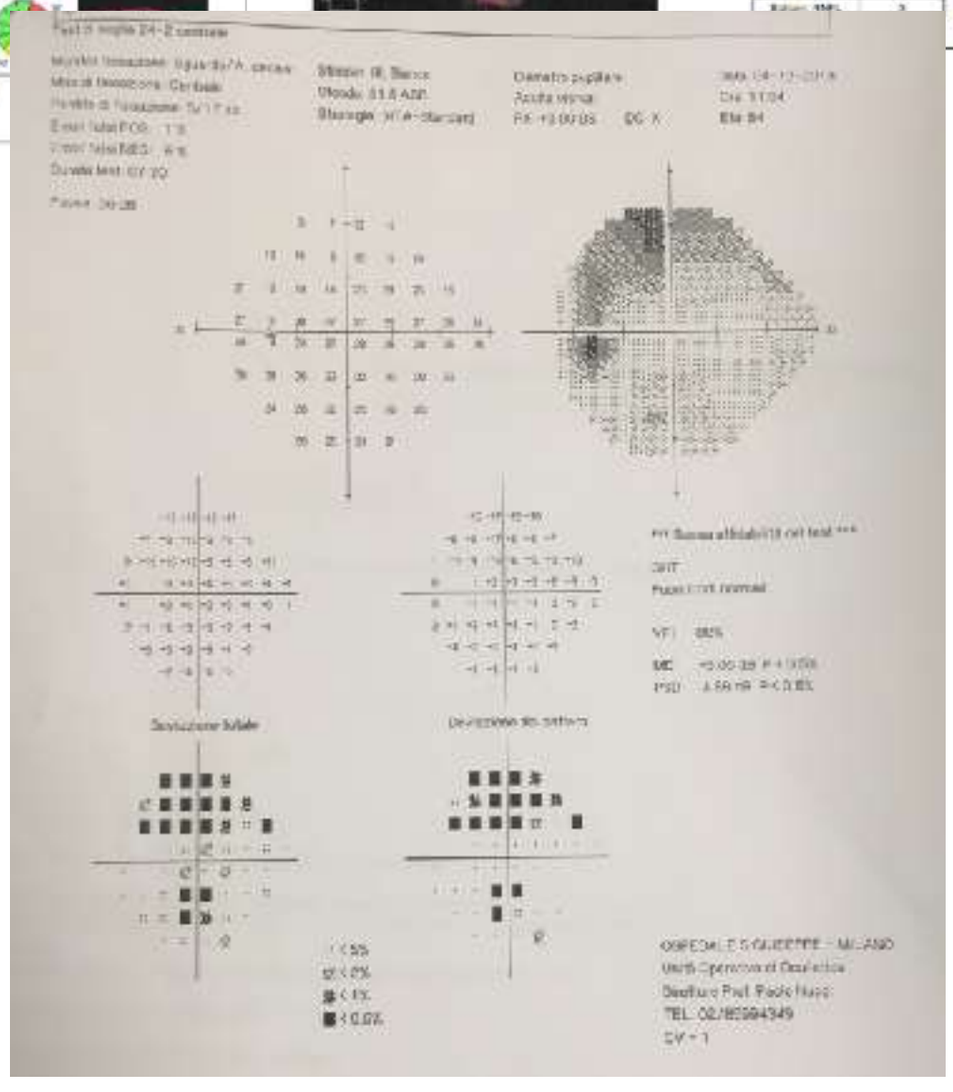


Outer Region	
Perfusion	43.6 %
Flux Index	0.249

Reference	Offset
Top Rim	0
Bottom RNFL	0

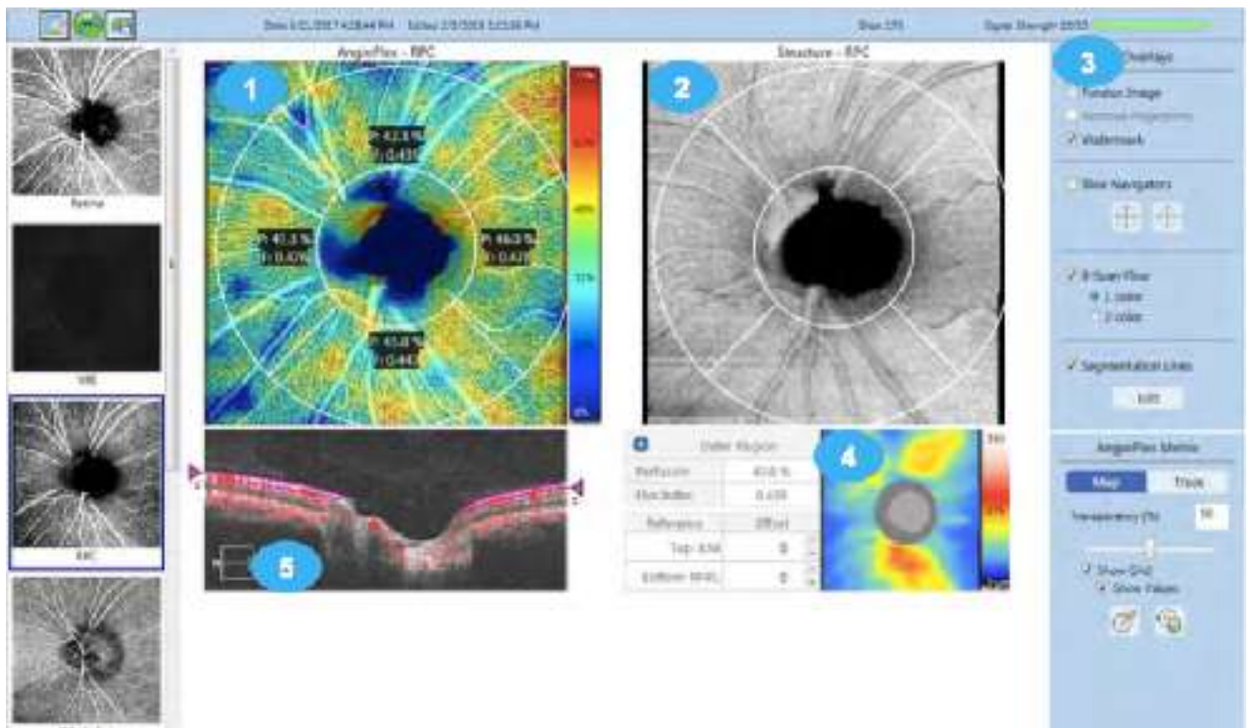






ANGIO-OCT: BACKGROUND E RAZIONALE

- patogenesi glaucoma - apoptosi cellule ganglionari
- teoria meccanica: compressione assoni
- teoria vascolare: ischemia assoni



Diagnostic performance of optical coherence tomography angiography in glaucoma: a systematic review and meta-analysis

Ana I M Miguel,[1,2] André B Silva,[3] Luis F Azevedo[1]

BJO, 2019

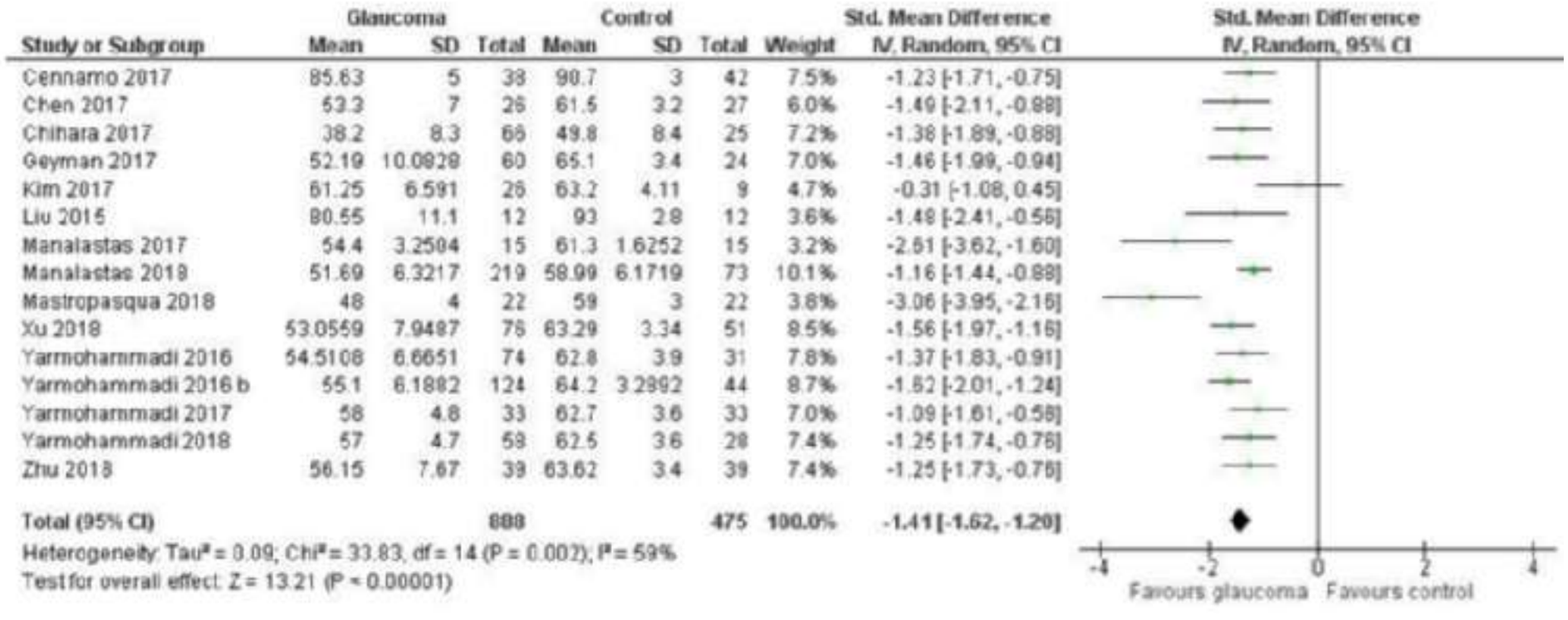
The mean peripapillary Vassel Density:

glaucoma 57.53%

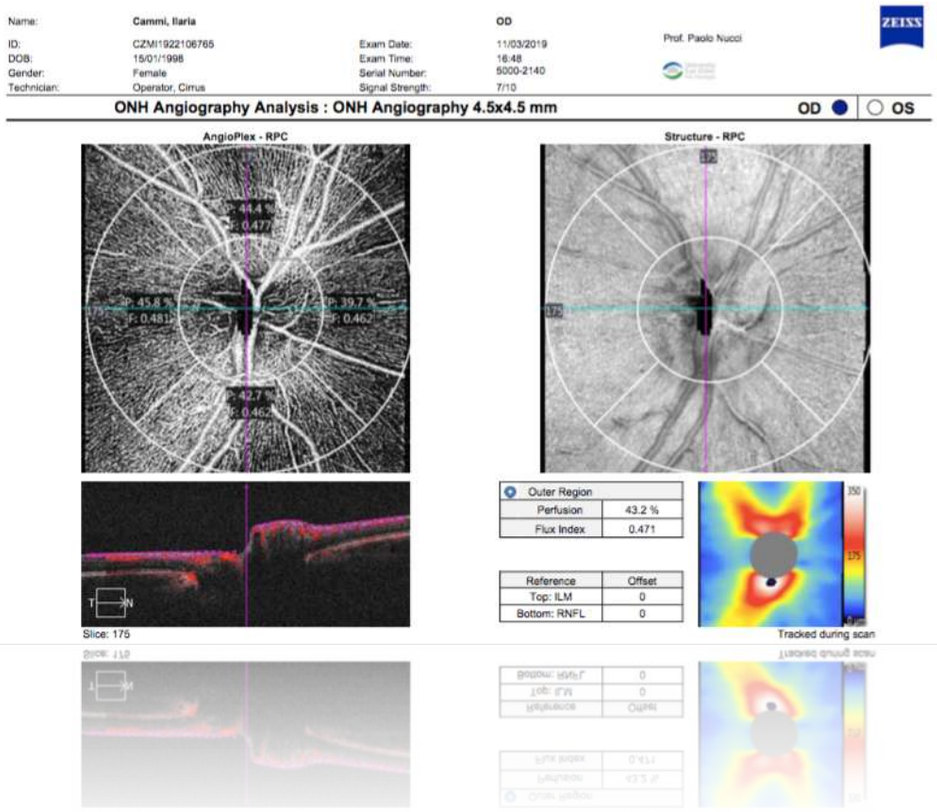
controls 65.47% *SMD, –1.41, 95% CI –1.62 to –1.20, p<0.05*

888 glaucomatous eyes and 475 healthy eyes

OCTA COULD FACILITATE THE DIAGNOSIS OF GLAUCOMA, ESTABLISHING THAT THE VD IS MARKEDLY LOWER IN GLAUCOMA COMPARED WITH HEALTHY CONTROLS, IN ALL THE REGIONS TESTED.



CONCLUSIONI: ANGIO OCT & GLAUCOMA



OCTA is promising in

- improving *early diagnosis*
- detecting *progression*
- and possibly detecting *dysfunctional RGCs* for future *neuroprotective* therapies.

Editorial

Potential clinical applications of optical coherence tomography angiography in glaucoma

Journal of Current Ophthalmology 30 (2018)

Robert N. Weinreb
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

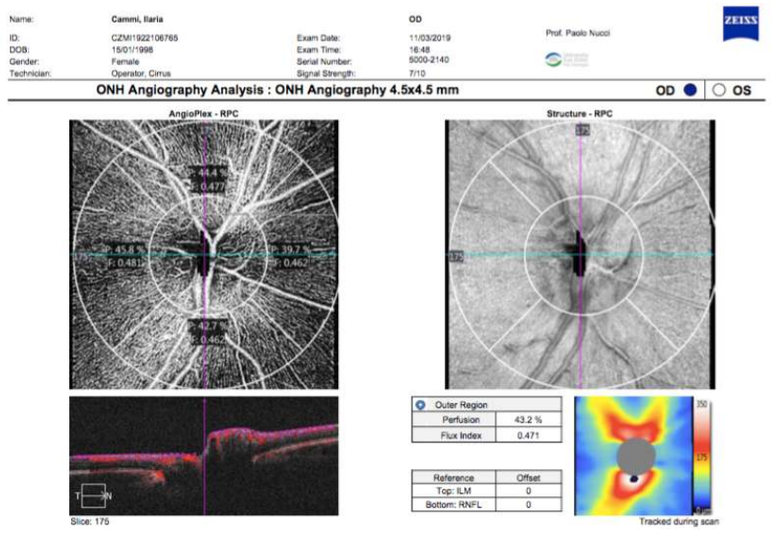
Sasan Moghimi*
Hamilton Glaucoma Center, Shiley Eye Institute, Department of Ophthalmology, University of California, San Diego, CA, United States

Tehran University of Medical Sciences, Tehran, Iran

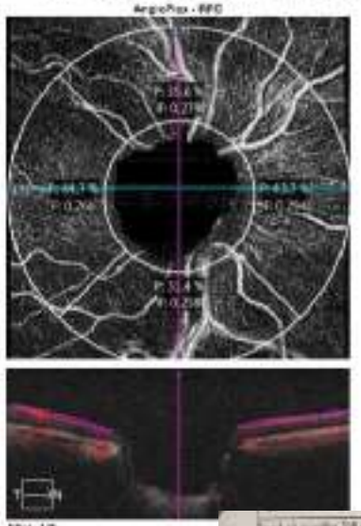
What *ocular*, *systemic*, and *physiologic* parameters affect vessel density measurements?

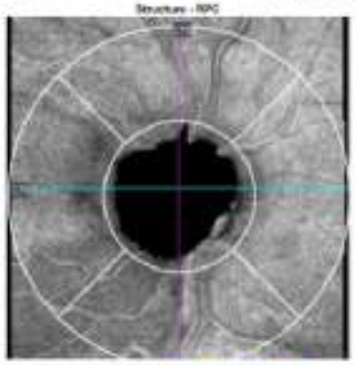
Do *systemic medications* affect retinal perfusion? How about *topical medications*?

Is there any diurnal variation? Is there any change in vessel density when we are lying down?



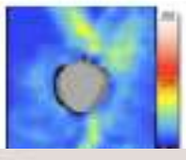
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ● ○ OS





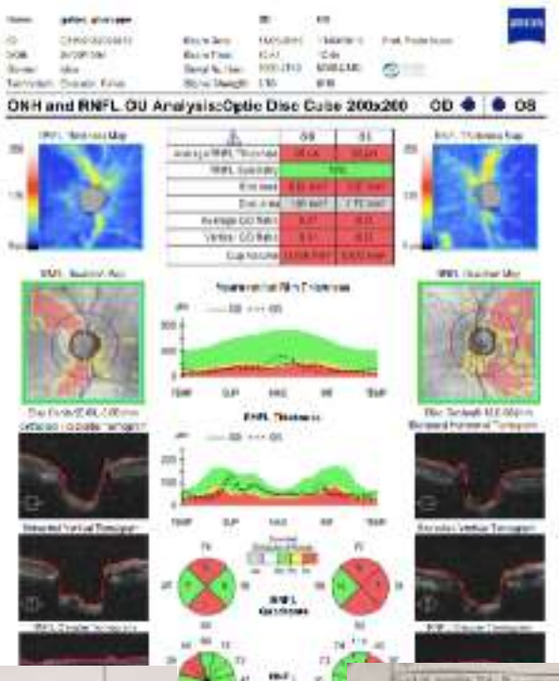
Outer Region	
Perfusion	59.1 %
Flux Index	0.278

Reference	Offset
Top Rim	0
Bottom RNFL	0

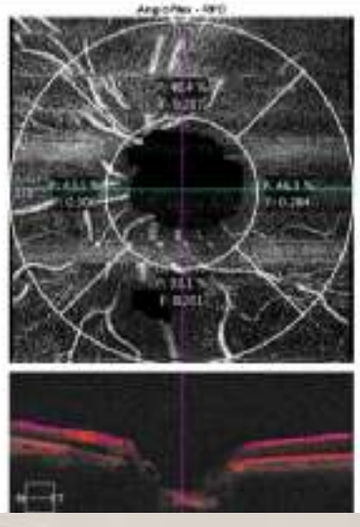


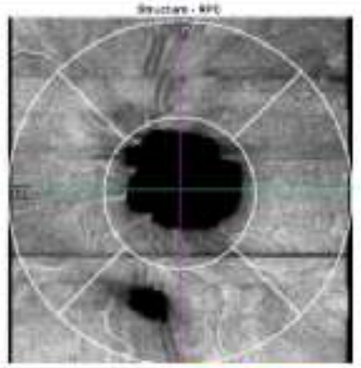
Comments

ONH and RNFL OU Analysis:Optic Disc Cube 200x200 OD ● ● OS



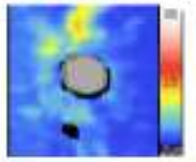
ONH Angiography Analysis : ONH Angiography 4.5x4.5 mm OD ○ ● OS

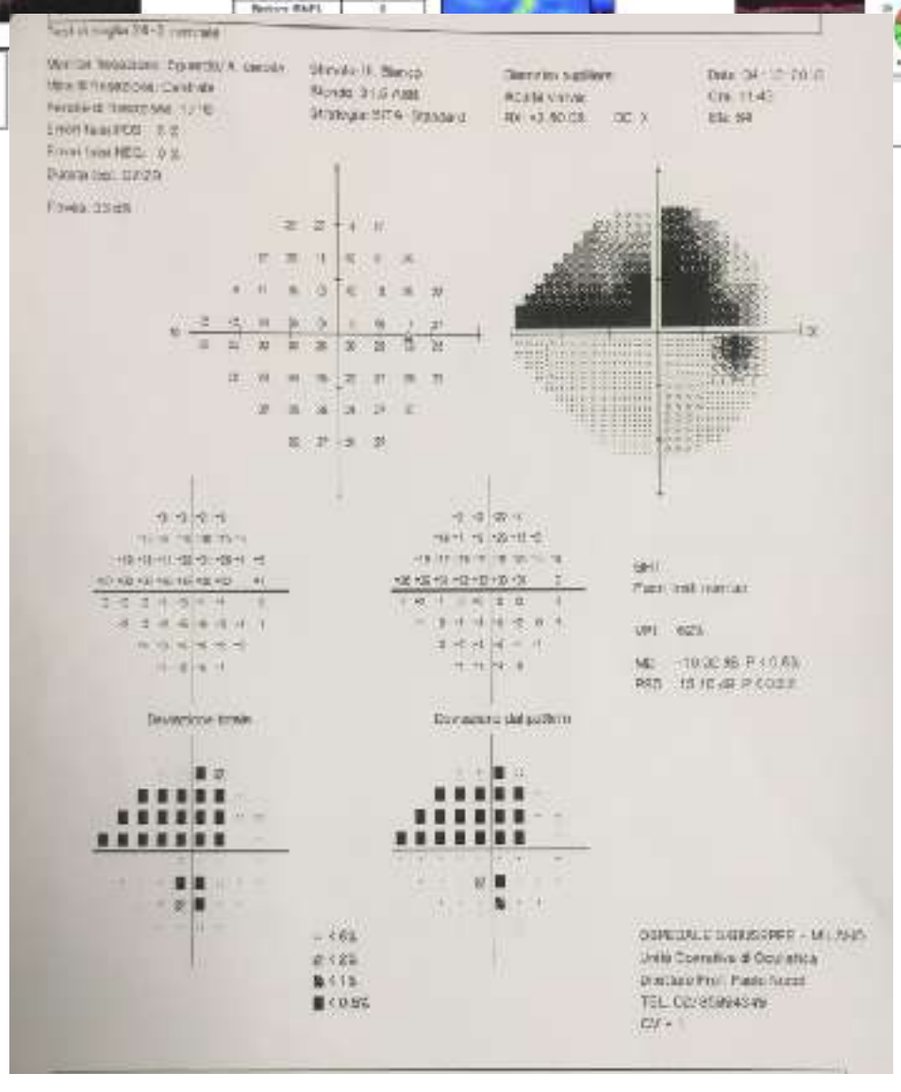


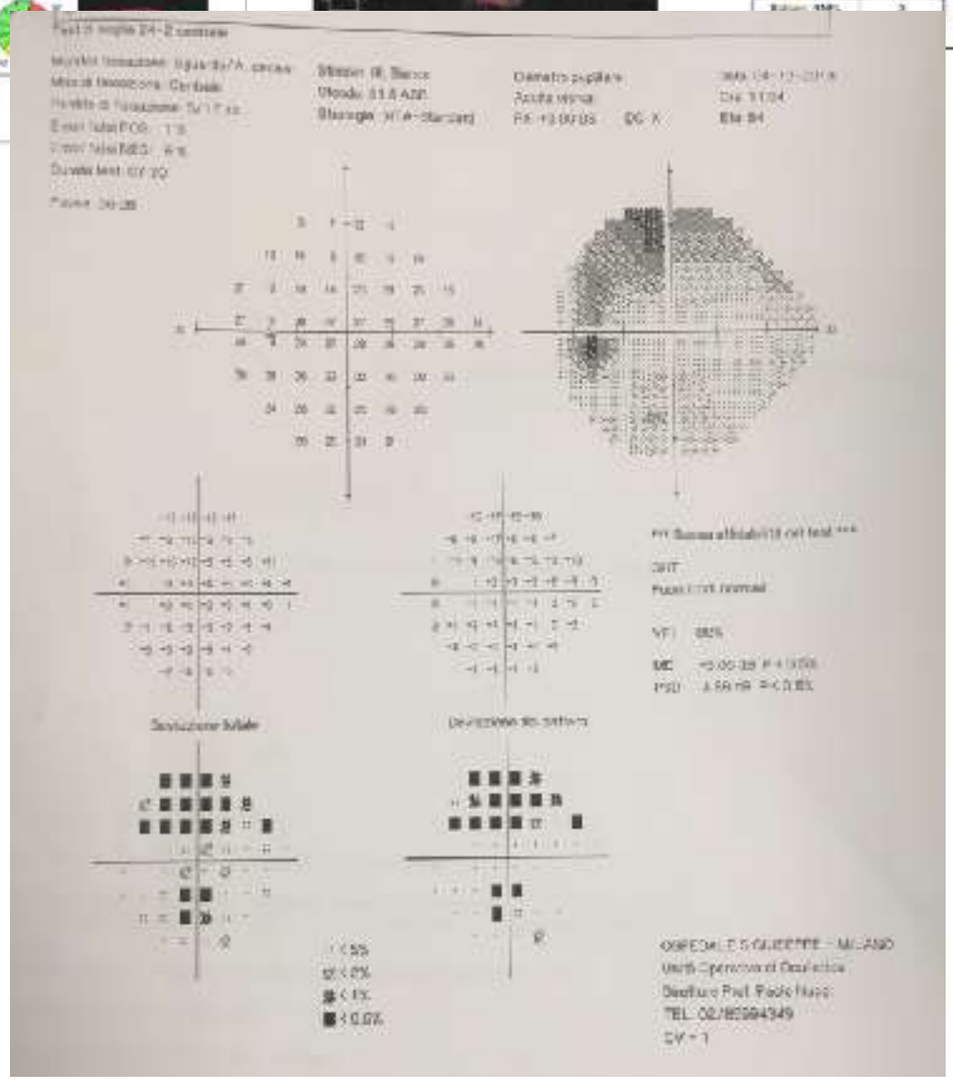


Outer Region	
Perfusion	43.6 %
Flux Index	0.249

Reference	Offset
Top Rim	0
Bottom RNFL	0

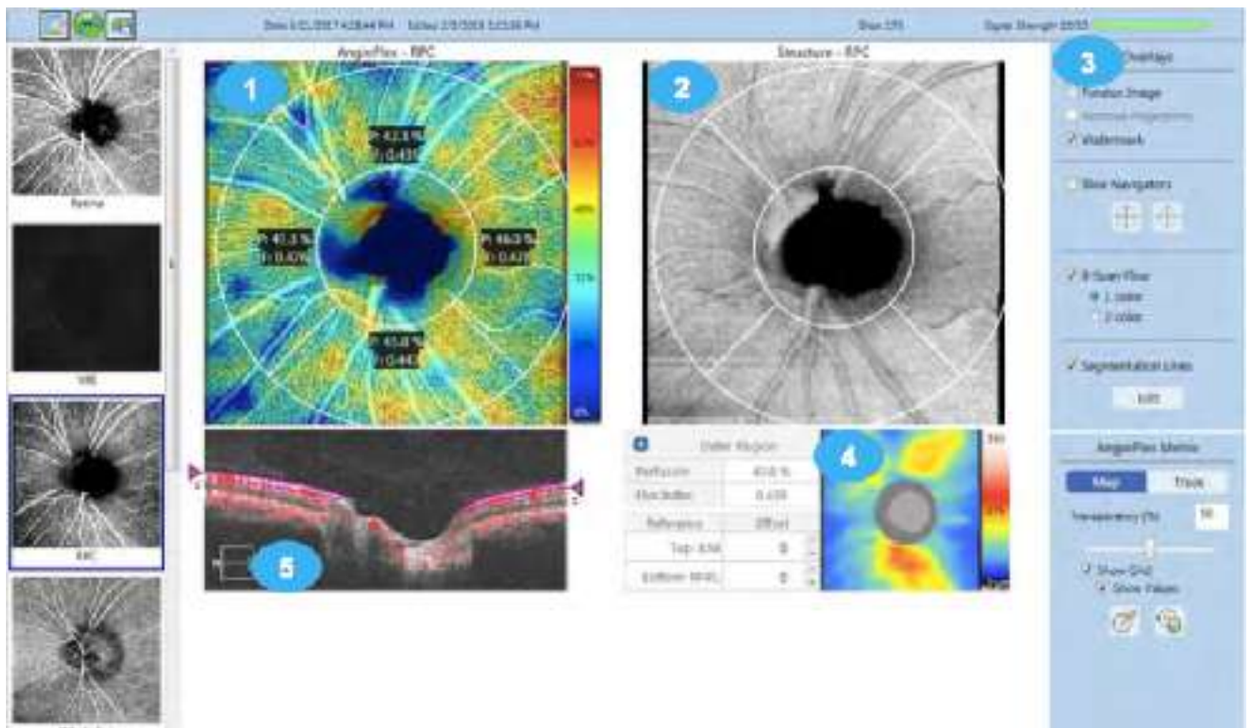






ANGIO-OCT: BACKGROUND E RAZIONALE

- patogenesi glaucoma - apoptosi cellule ganglionari
- teoria meccanica: compressione assoni
- teoria vascolare: ischemia assoni



Diagnostic performance of optical coherence tomography angiography in glaucoma: a systematic review and meta-analysis

Ana I M Miguel,[1,2] André B Silva,[3] Luis F Azevedo[1]

BJO, 2019

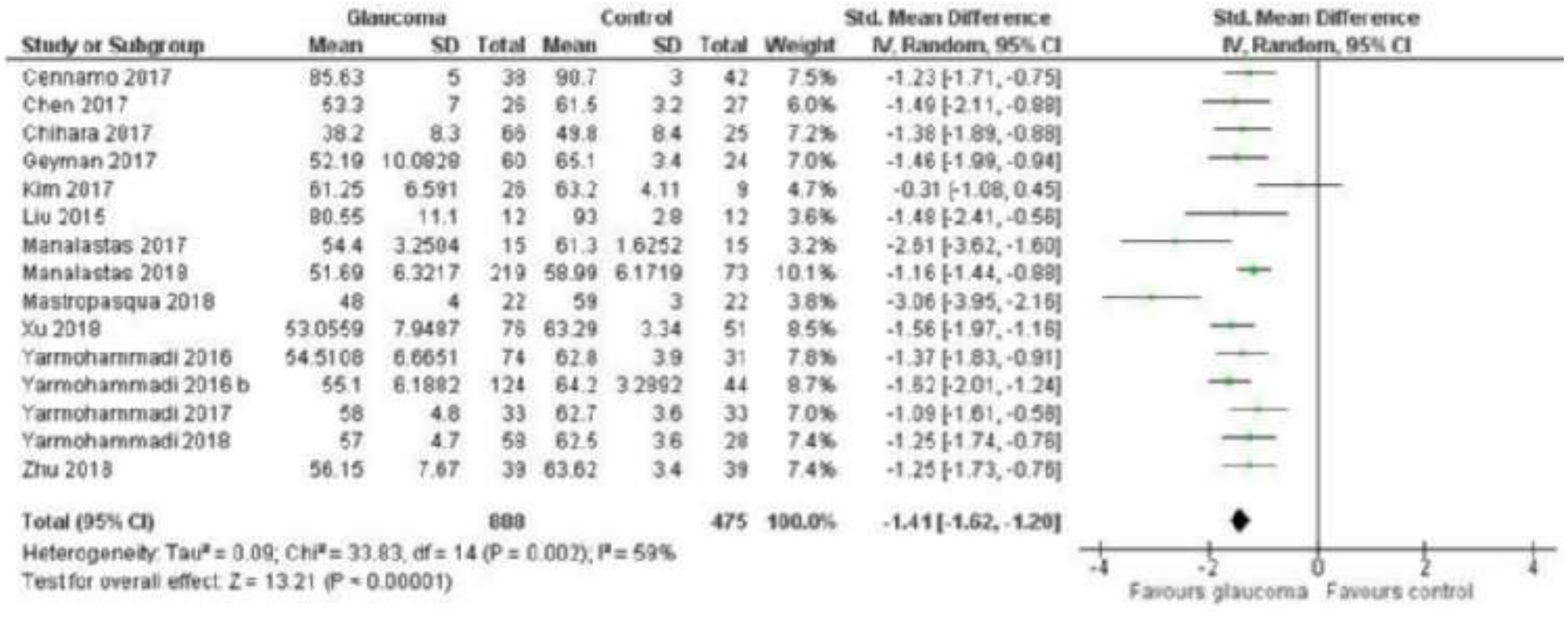
The mean peripapillary Vassel Density:

glaucoma 57.53%

controls 65.47% *SMD, –1.41, 95% CI –1.62 to –1.20, p<0.05*

888 glaucomatous eyes and 475 healthy eyes

OCTA COULD FACILITATE THE DIAGNOSIS OF GLAUCOMA, ESTABLISHING THAT THE VD IS MARKEDLY LOWER IN GLAUCOMA COMPARED WITH HEALTHY CONTROLS, IN ALL THE REGIONS TESTED.



CONCLUSIONI: ANGIO OCT & GLAUCOMA

- valutazione **quantitativa** del **microcircolo ONH**
- nel glaucoma si osserva una diminuzione della densità dei vasi rispetto al normale
- ruolo nella **diagnosi**: angio OCT ONH può discriminare tra malati e sani con un potere diagnostico sovrapponibile allo studio RNFL
- angio OCT ha mostrato una buona **correlazione** con *riduzione RNFL* e *danno perimetrico*
- ruolo nel **monitoraggio**: individuare modifiche nella densità dei vasi in modo longitudinale
- informazioni sulla circolazione del nervo ottico contribuiscono a aumentare la conoscenza sulla **eziopatogenesi** del danno glaucomatoso e sull'**efficacia del trattamento** (medico, chirurgico, neuroprotettivo)

- expanding indications

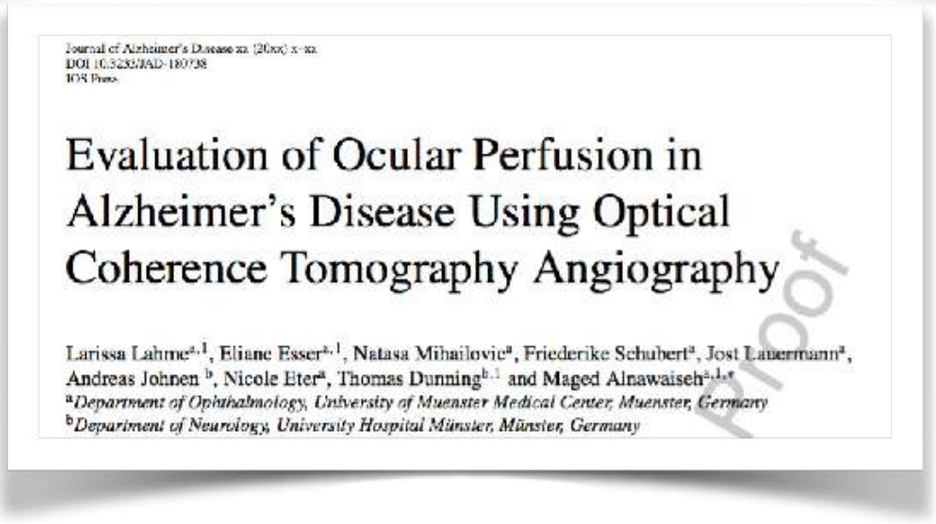

Lee et al. Eye and Vision (2019) 6:4
https://doi.org/10.1186/s40662-019-0129-2

Eye and Vision

REVIEW Open Access

Optical coherence tomography angiography for the anterior segment

Wen Di Lee[1], Kavya Devarajan[1], Jacqueline Chua[1,2], Leopold Schmetterer[1,2,3,4,5], Jodhbir S. Mehta[1,2,5] and Marcus Ang[1,2*]

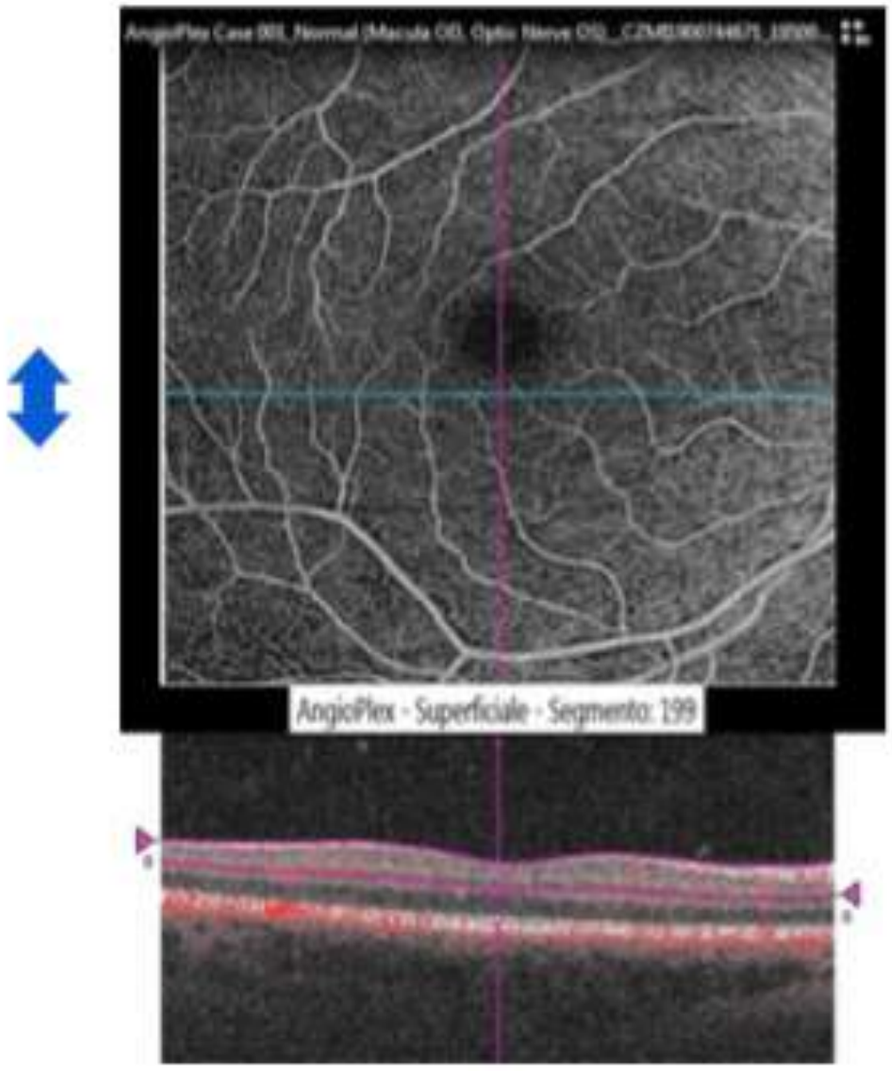

Journal of Alzheimer's Disease xx (20xx) x–xx
DOI 10.3233/JAD-180738
IOS Press

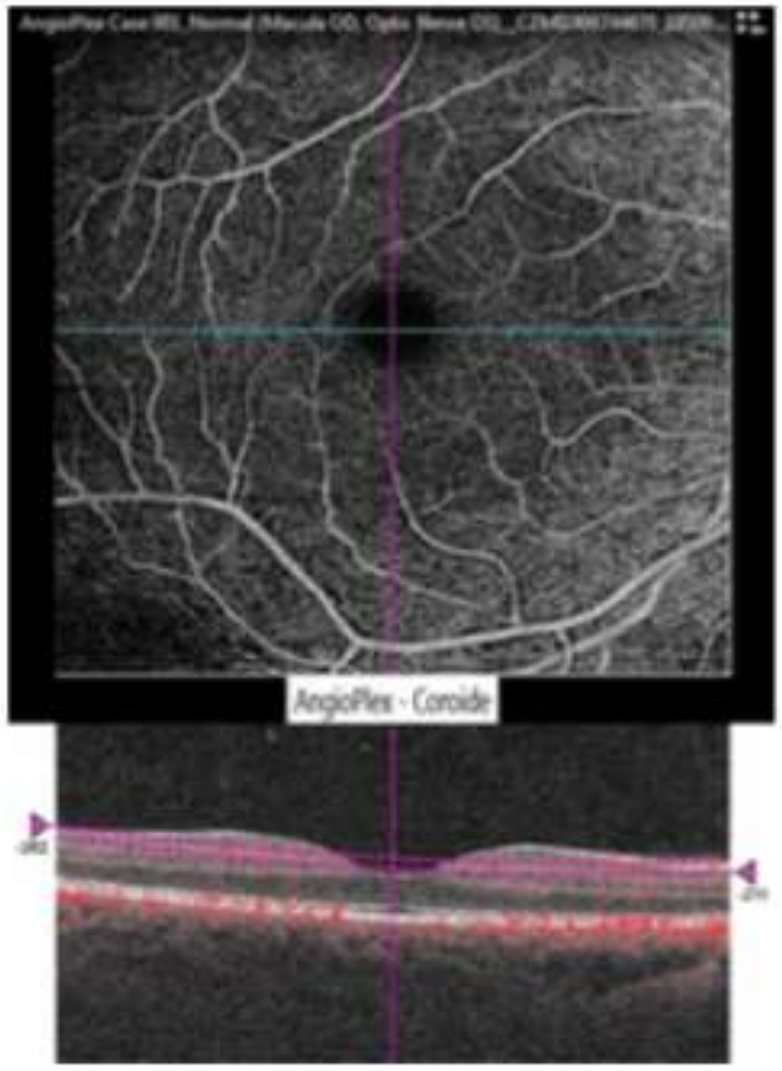
Evaluation of Ocular Perfusion in Alzheimer's Disease Using Optical Coherence Tomography Angiography

Larissa Lahme[a,1], Eliane Esser[b,1], Natasa Mihailovic[a], Friederike Schubert[a], Jost Labermann[a], Andreas Johnen[b], Nicole Eter[a], Thomas Dunning[b,1] and Maged Alnawaiseh[a,1,*]
[a]*Department of Ophthalmology, University of Muenster Medical Center, Muenster, Germany*
[b]*Department of Neurology, University Hospital Münster, Münster, Germany*

- rapid
- non invasive
- high resolution
- depth-resolved analysis
- dye-free
- quantitative evaluation

OCTA ed Enface
Visualizzazione di un dato 3D

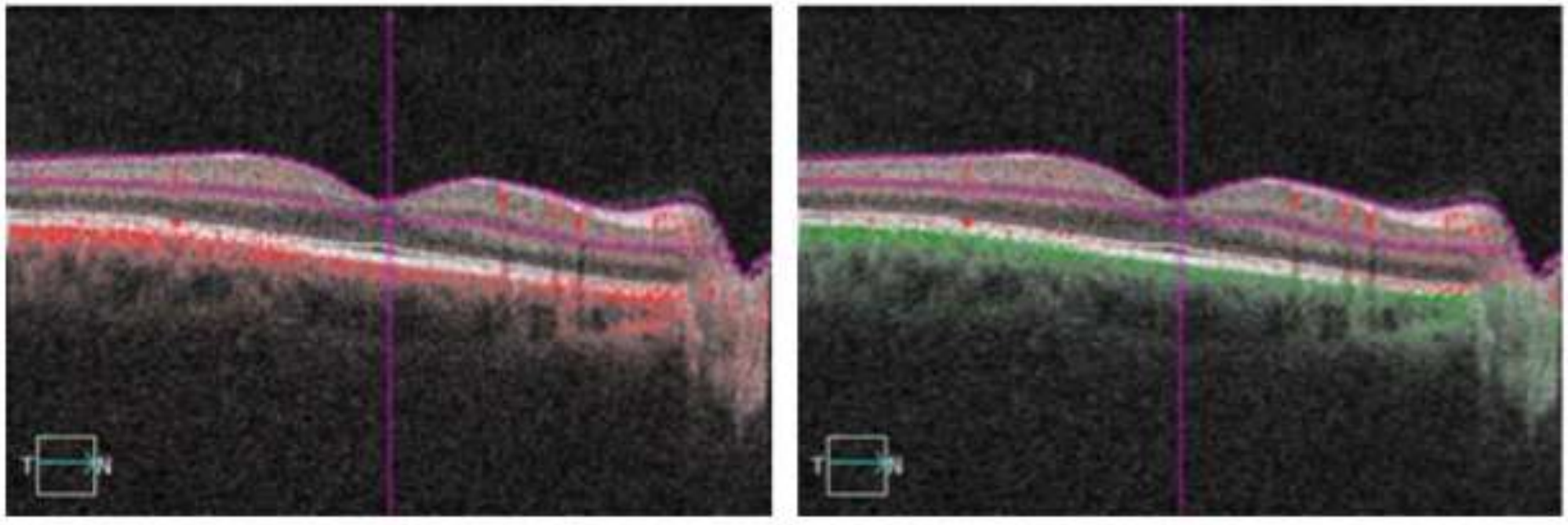




Angiografia OCT con ZEISS AngioPlex

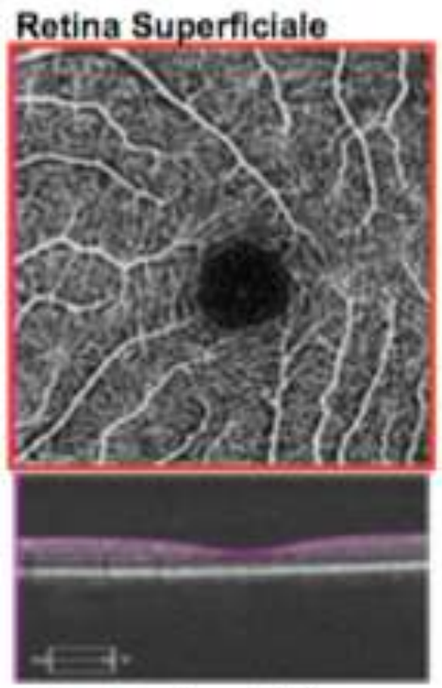
Visualizzazione nelle B-scan delle informazioni di flusso permette di:

- Osservare a che **profondità** si trova il vaso
- Osservare corrispondenza tra vasi e informazioni **strutturali**
- Distinguere **artefatti**
- Valutare qualità della **segmentazione** degli strati

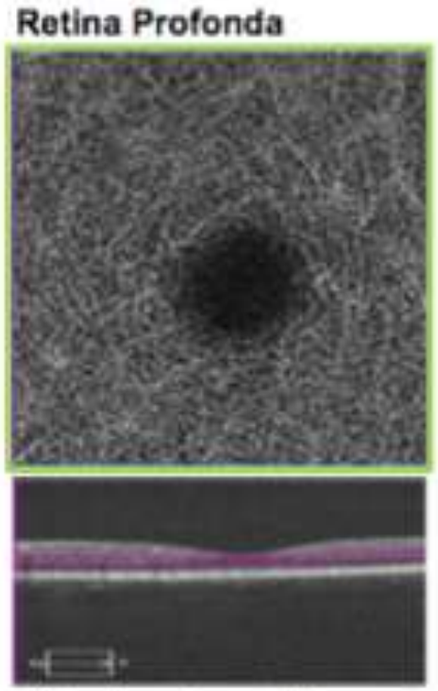


AngioPlex Maps

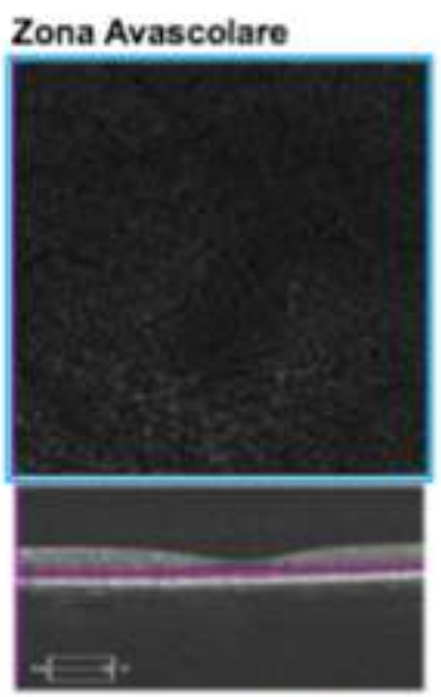
OCTA permette la rappresentazione 2D della rete vascolare 3D di una particolare regione di interesse.



Visualizzazione del flusso ematico nella retina superficiale.



Visualizzazione del flusso ematico nella retina profonda.



Regione avascolare della retina in occhi sani. Permette la visualizzazione di proliferazione patologica dei vasi.