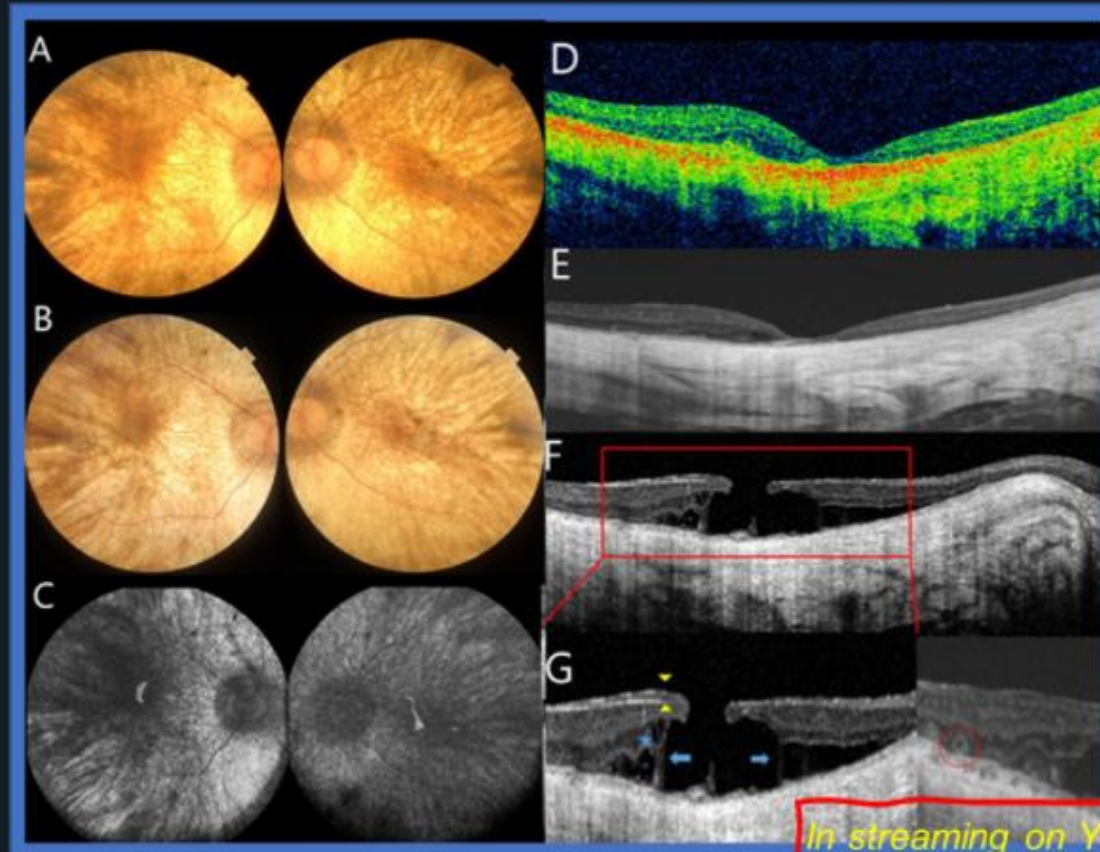


OCT retinico

Vittoria Murro (UNIFI)

21/01
15.00



In streaming on Youtube

Directed by
Giovanna Pacini



<https://www.youtube.com/user/caffescienza>



Light on Optics and Optometry

Series of scientific, technological and tutorial webinars



Centro di Riferimento
Regionale
Degenerazioni
Retiniche Ereditarie



La tomografia a Coerenza ottica è una tecnica diagnostica che consente un'analisi in vivo, non invasiva, e ad alta risoluzione degli strati corioretinici



OCT SLO
Newtech spa



3D OCT 1000 Topcon



RTVue OCT
OPTOVU



Copernicus OCT Polyoftalmica-New



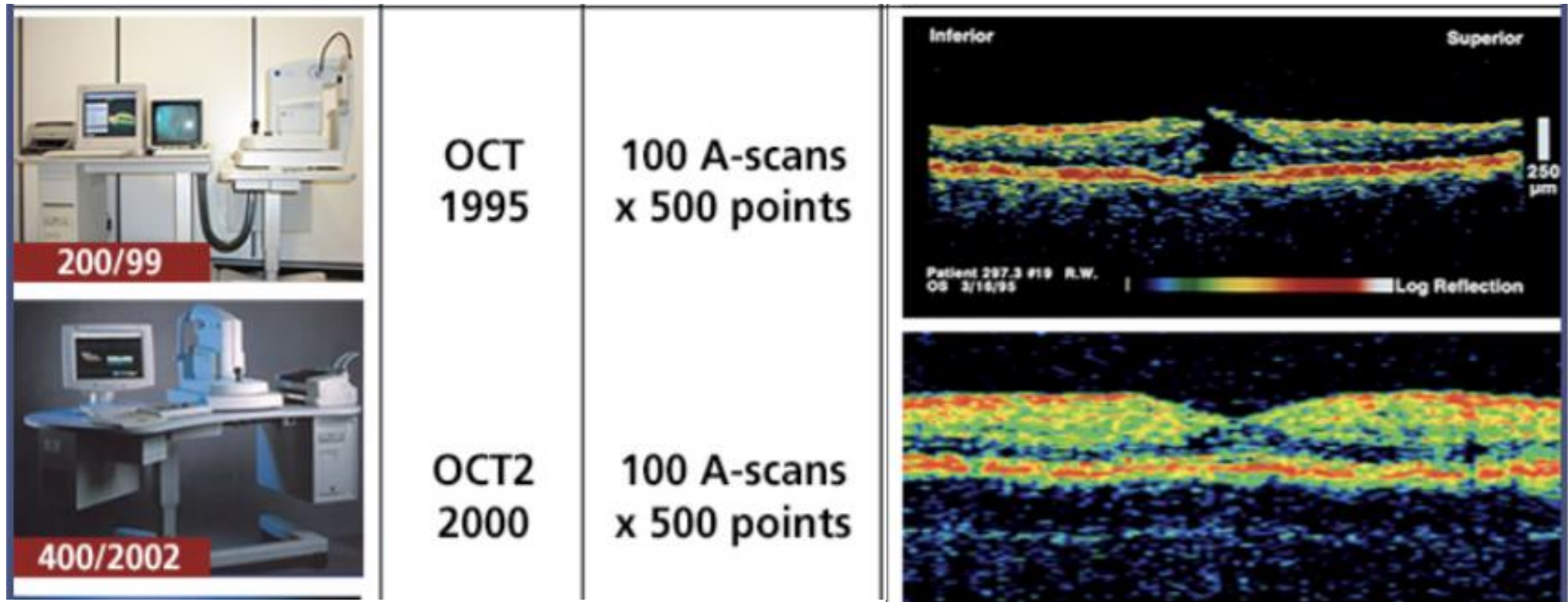
Un po' di storia...

1992

La prima azienda a sviluppare una tecnologia OCT per applicazioni oftalmologiche nel 1992 è stata l'Advanced Ophthalmic Devices (AOD), fondata da James Fujimoto e Carmen Puliafito, inglobata un anno dopo nella ditta Humphrey, a sua volta acquistata dalla Carl Zeiss Medit

1995 e 2000

In commercio prima OCT strutturale (OCT1 nel 1995 e OCT2 nel 2000)
Scarsa risonanza a causa della cattiva qualità e deficinizione delle immagini



2002

successo commerciale dello Stratus, terza ed ultima versione degli OCT Time Domain

2007
SD-OCT

Messo in commercio il primo Spectral domain (SD-OCT- il Cirrus HD)

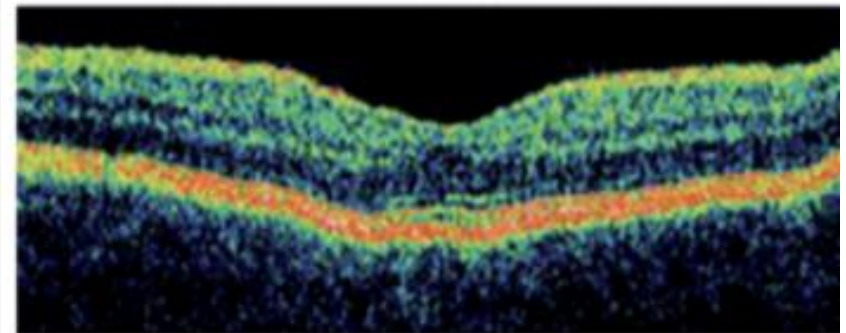
Lunghezza onda :circa 840 nm

L'aumentata velocità d'acquisizione degli A-scan sta alla base della migliore definizione delle immagini riducendo gli artefatti di movimento



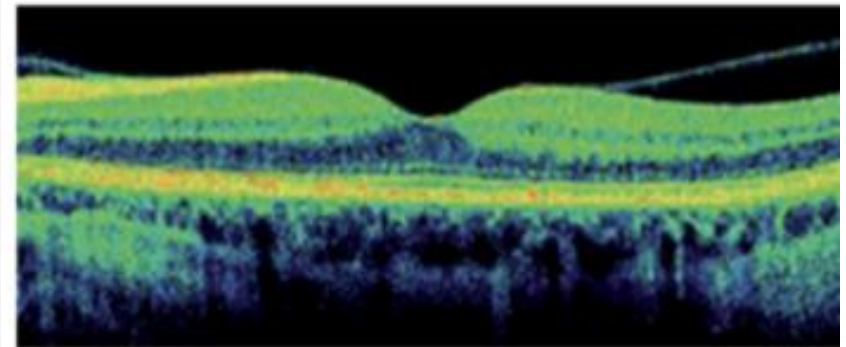
OCT3
STRATUS
2002

512 A-scans
x 1024 points



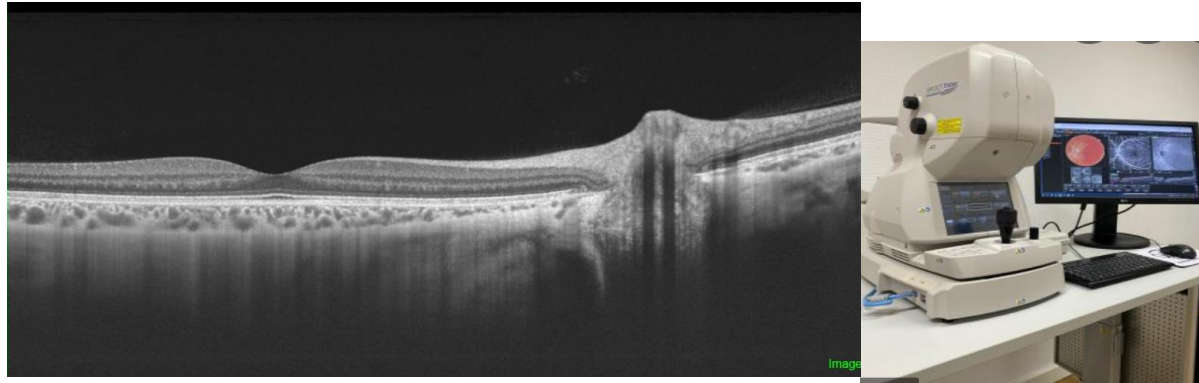
CIRRUS
HD-OCT
2007

4096 A-scans
x 1024 points



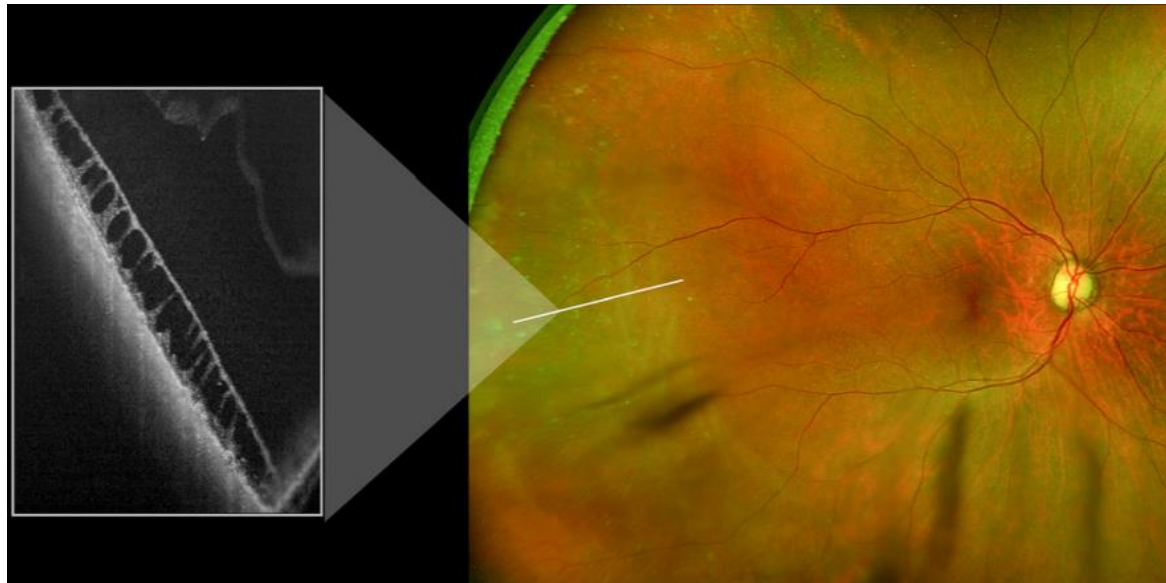
2012
SS-OCT

Grazie alla lunghezza d'onda maggiore del laser (1.050nm), è possibile penetrare meglio in profondità nel tessuto dell'occhio (superare lo scattering legato all'assorbimento dell'EPR)
Lunghezza d'onda: 1050 nm scan per sec: 100.000 A-scan/sec
Possibilità di scansione wide field (12x9)



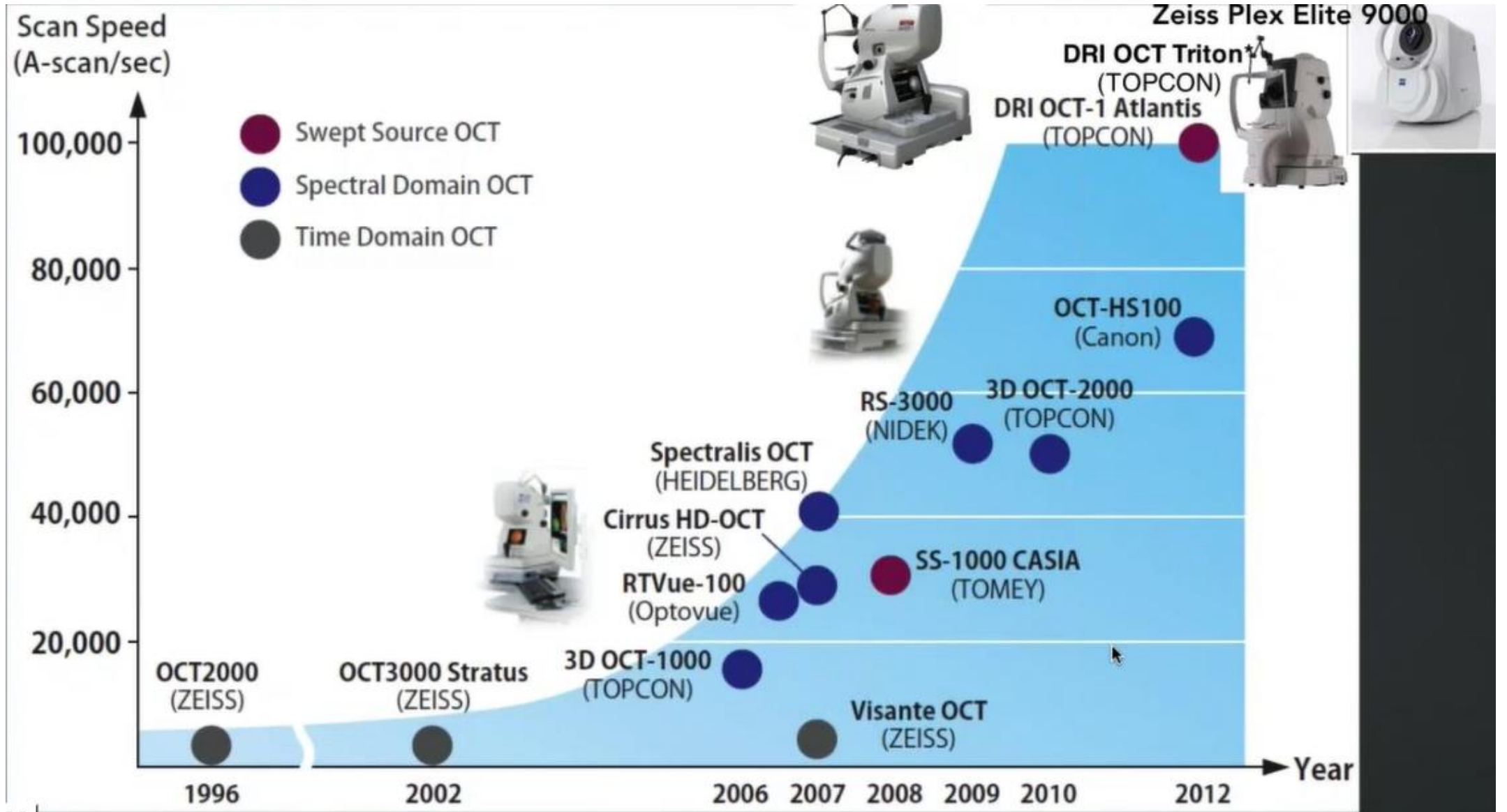
2019

Ultra wide field OCT permette di studiare la periferia retinica oltre le vene vorticose

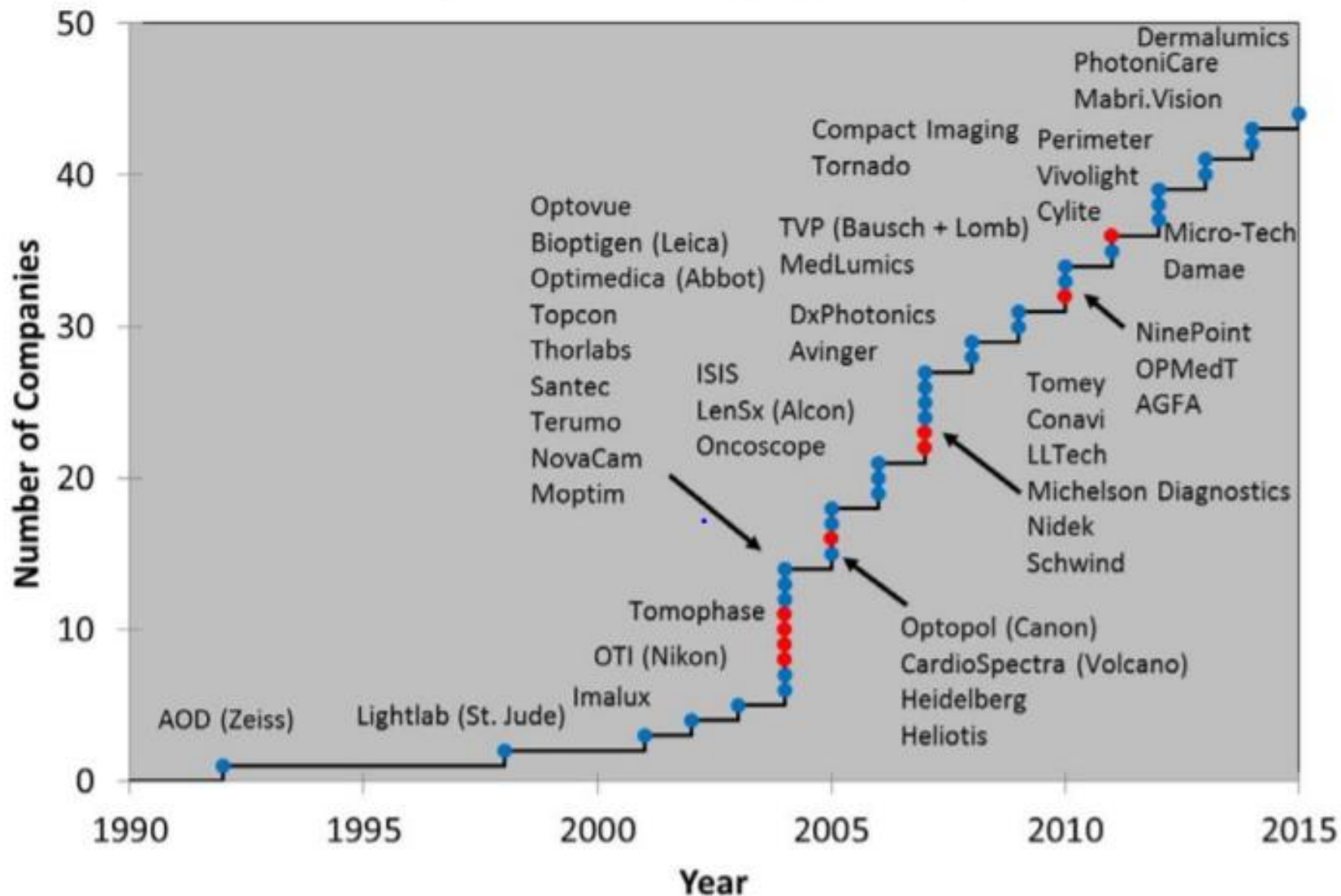


[A Brief History of OCT](#)
By Joel S. Schuman, MD
Annual Meeting 2019

EVOLUZIONE TECNOLOGIA OCT

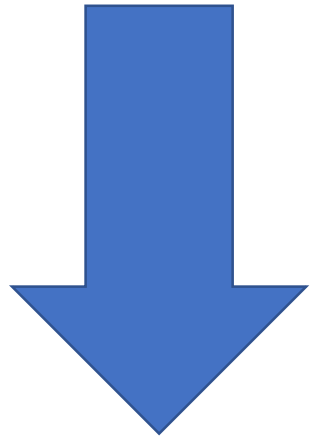
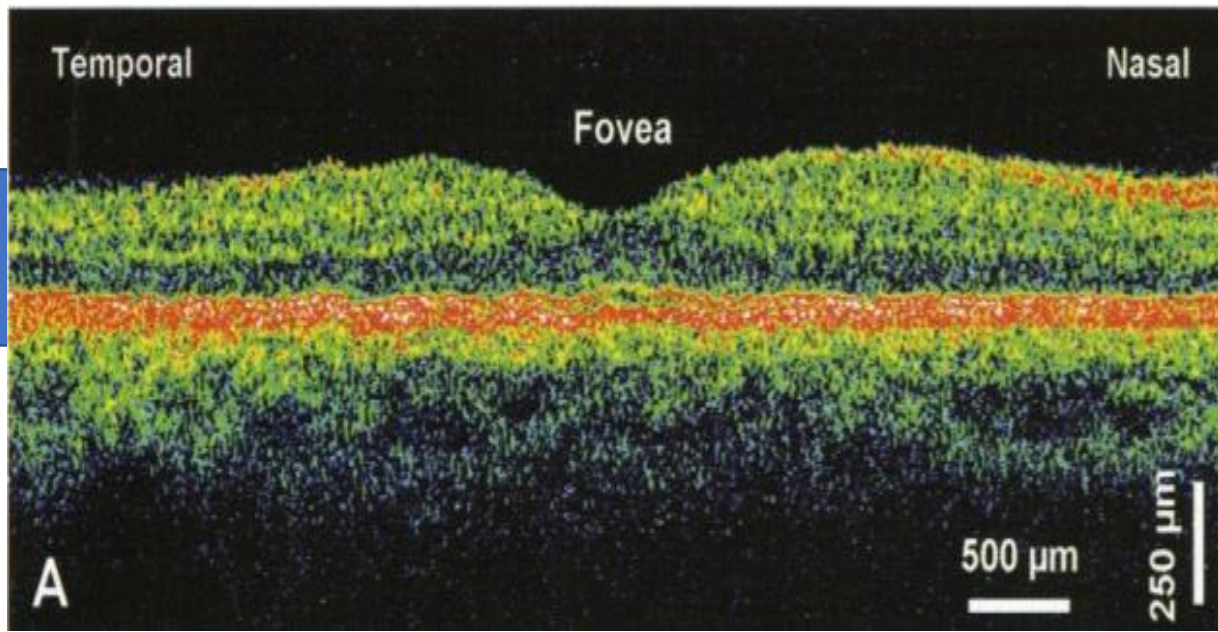


Companies Developing OCT Systems

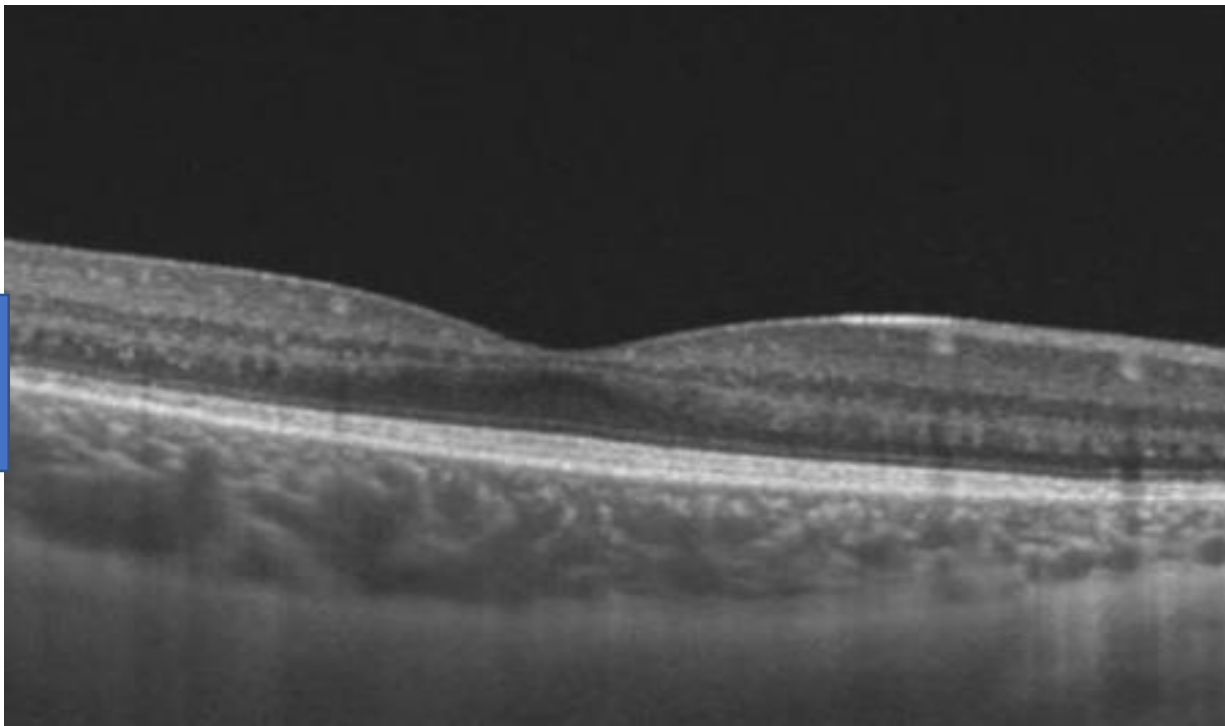


Fujimoto J, Swanson E. The Development, Commercialization, and Impact of Optical Coherence Tomography. *Invest Ophthalmol Vis Sci.* 2016;57(9):OCT1-OCT13. doi:10.1167/iovs.16-19963

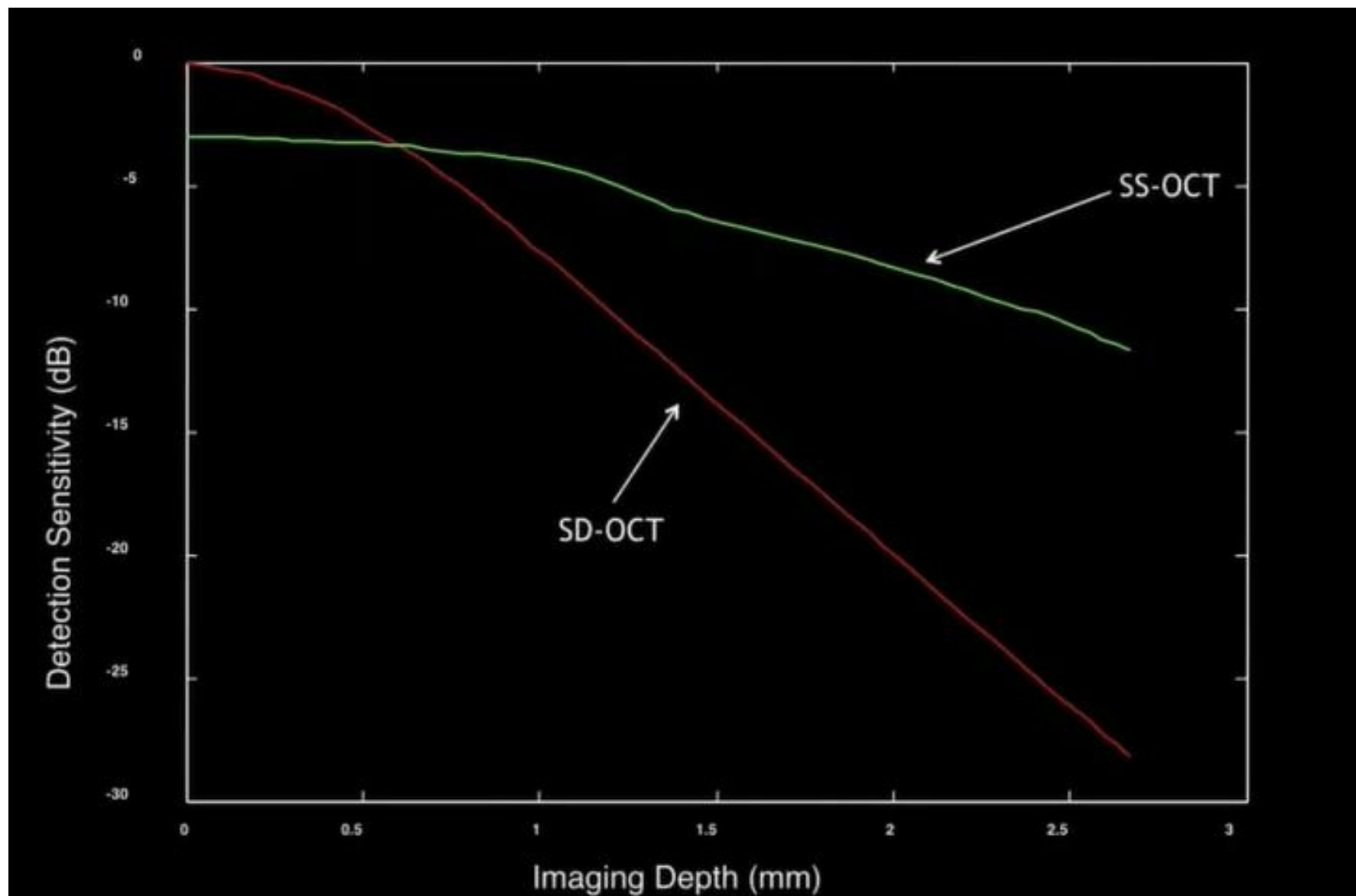
TD OCT
Stratus OCT3



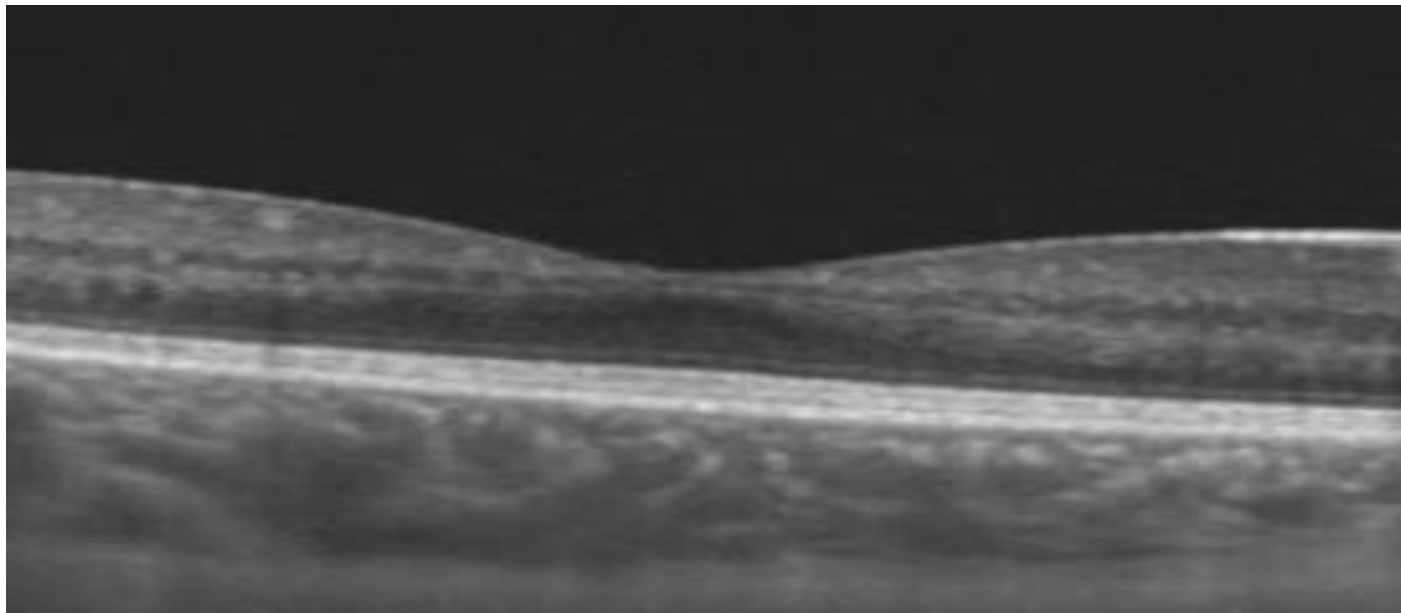
SS OCT
HD line



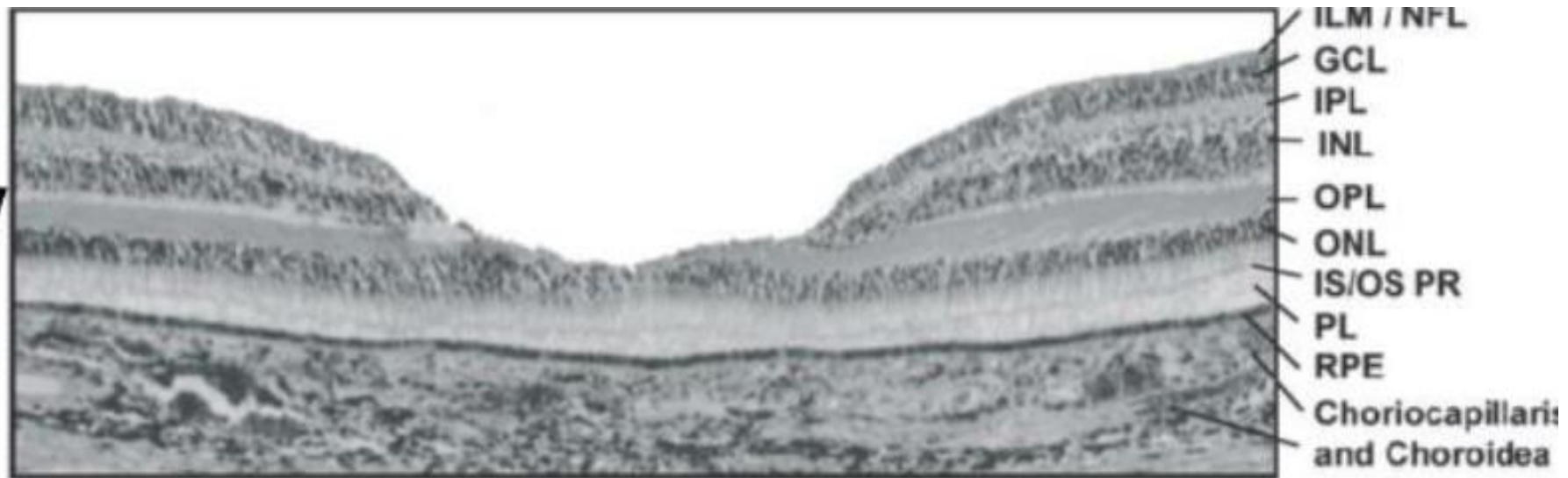
SD-OCT vs SS-OCT



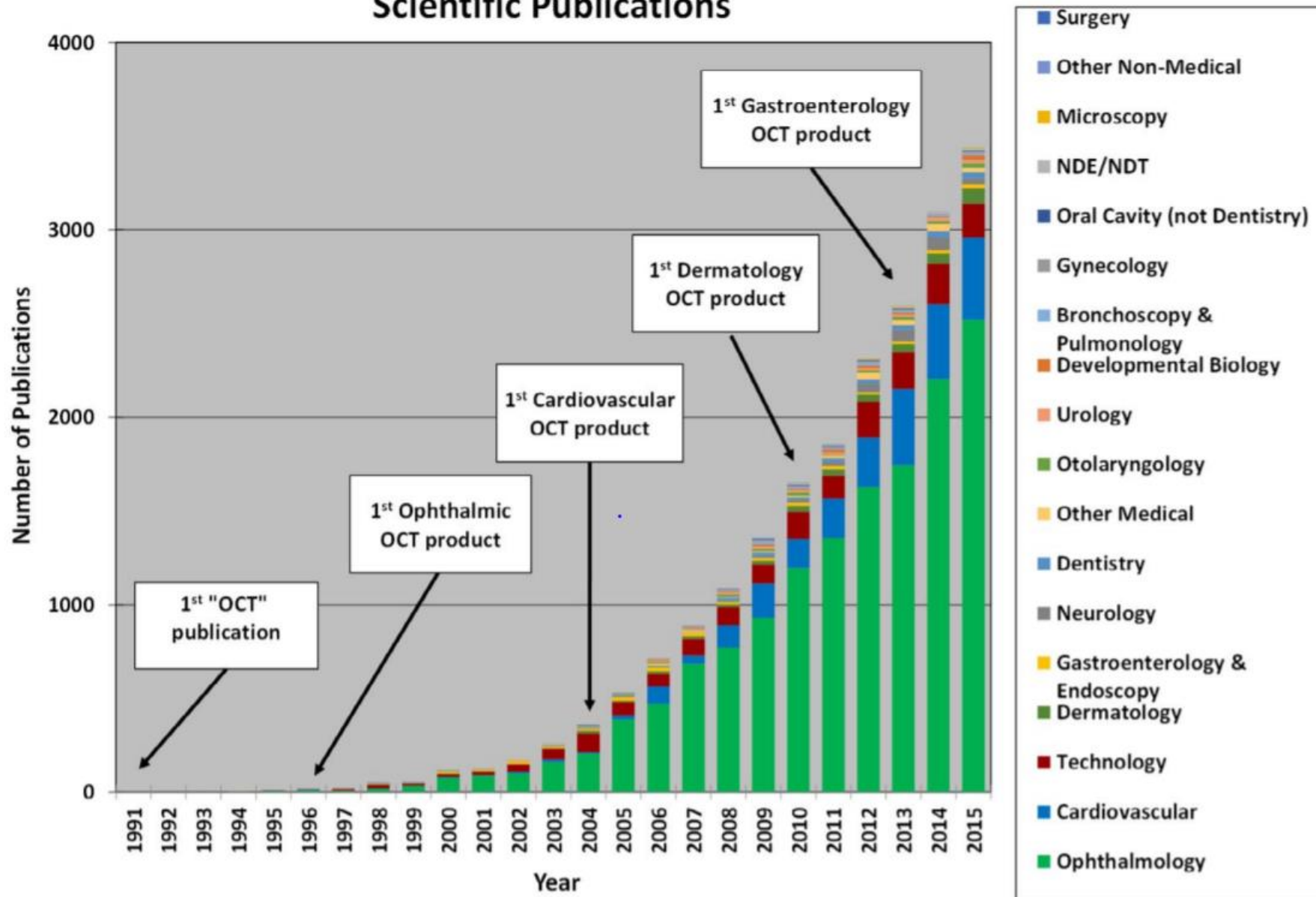
IMAGING IN VIVO
DELLA REGIONE
MACULARE



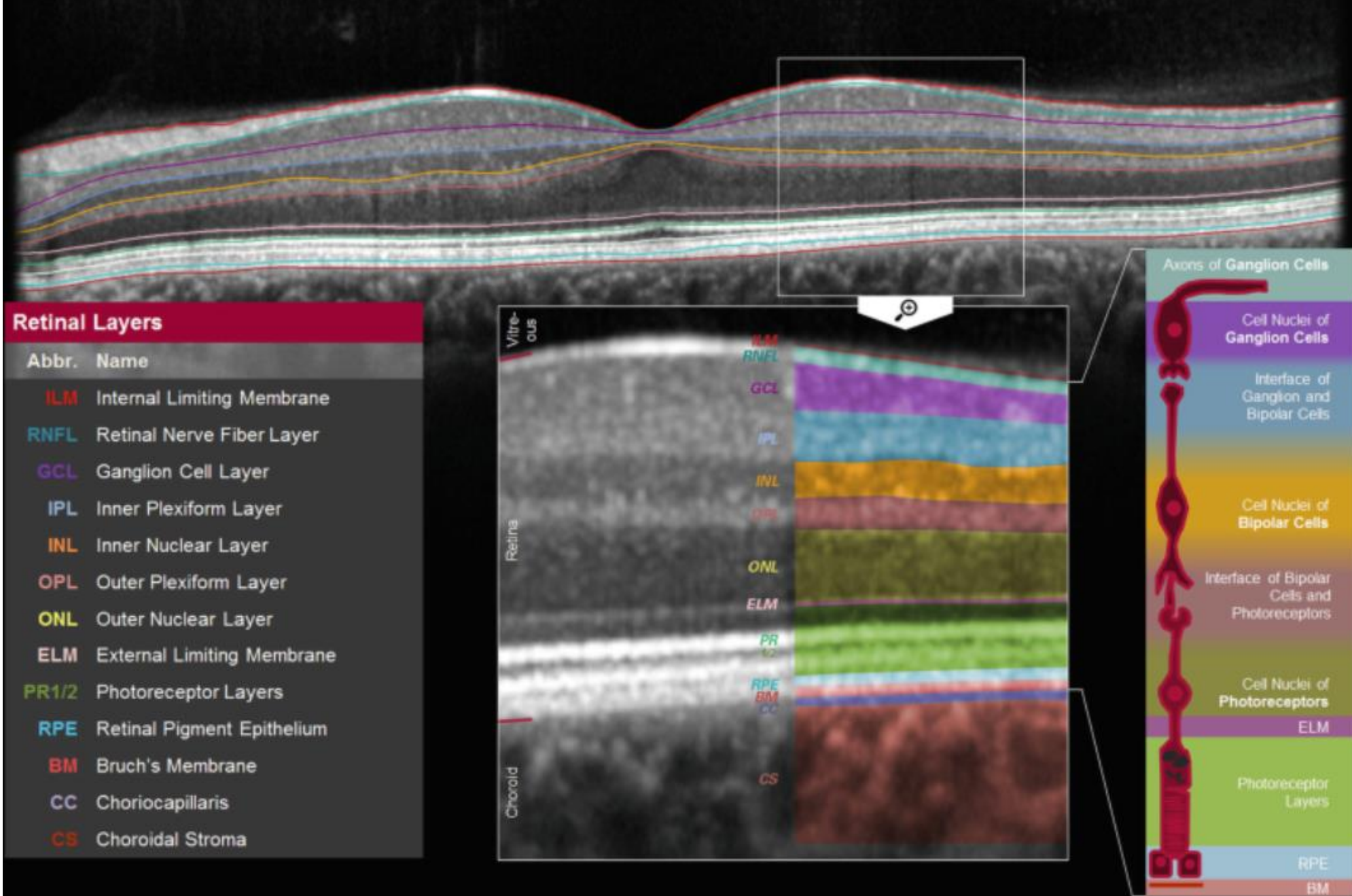
Histology



Scientific Publications



Fujimoto J, Swanson E. The Development, Commercialization, and Impact of Optical Coherence Tomography. *Invest Ophthalmol Vis Sci.* 2016;57(9):OCT1-OCT13. doi:10.1167/iovs.16-19963



Aumann S., et al. (2019) Optical Coherence Tomography (OCT): Principle and Technical Realization. In: Bille J. (eds) High Resolution Imaging in Microscopy and Ophthalmology. Springer, Cham.

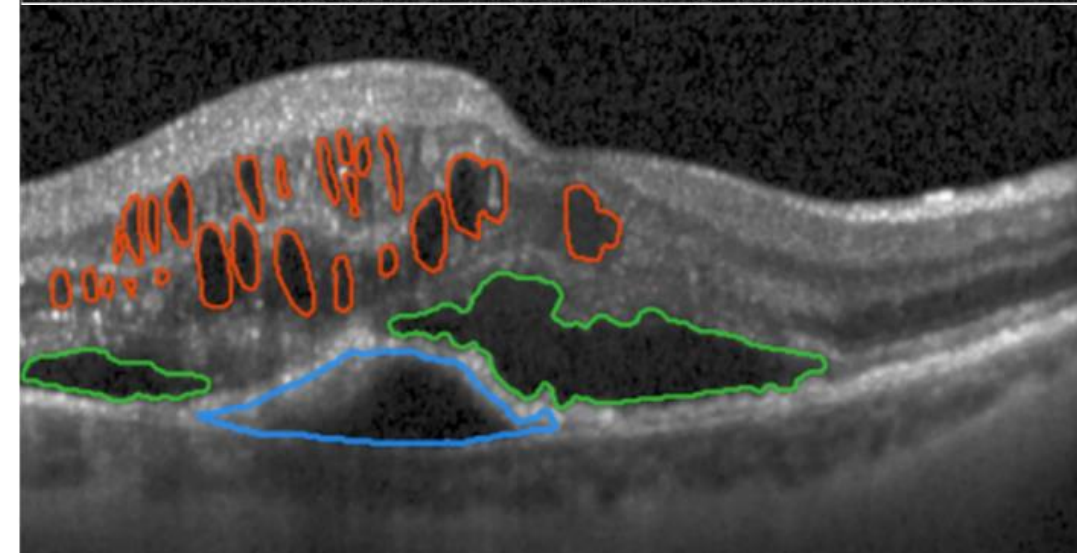
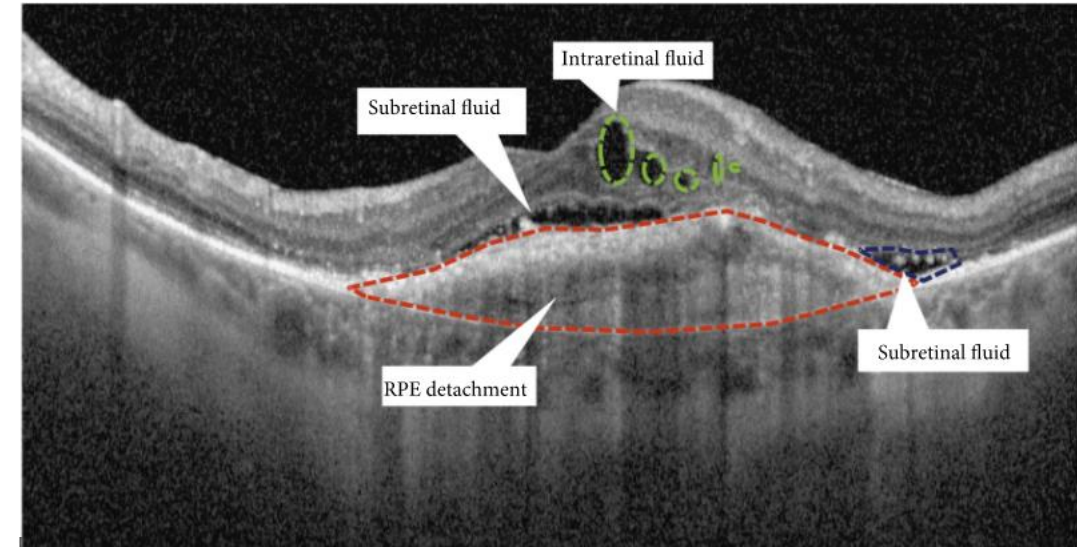
Analisi dell'OCT strutturale

QUALITATIVA

-MORFOLOGIA
REFLETTIVITA': IPERIFLETTENTE, IPORIFLETTENTE

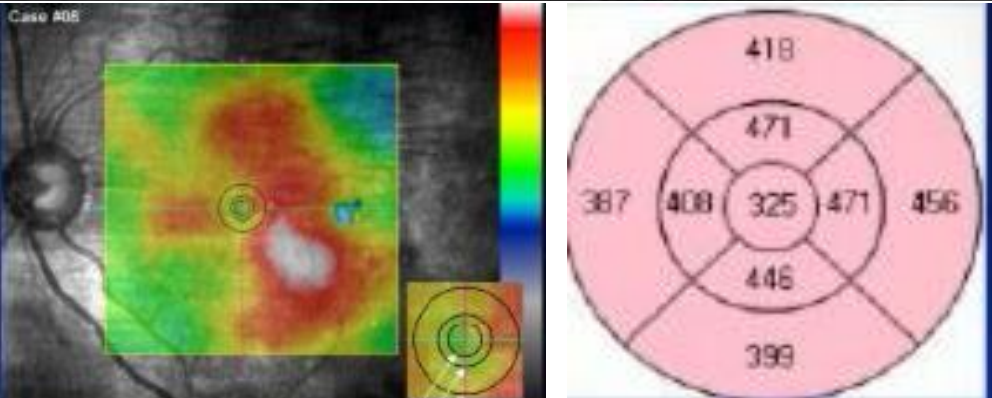
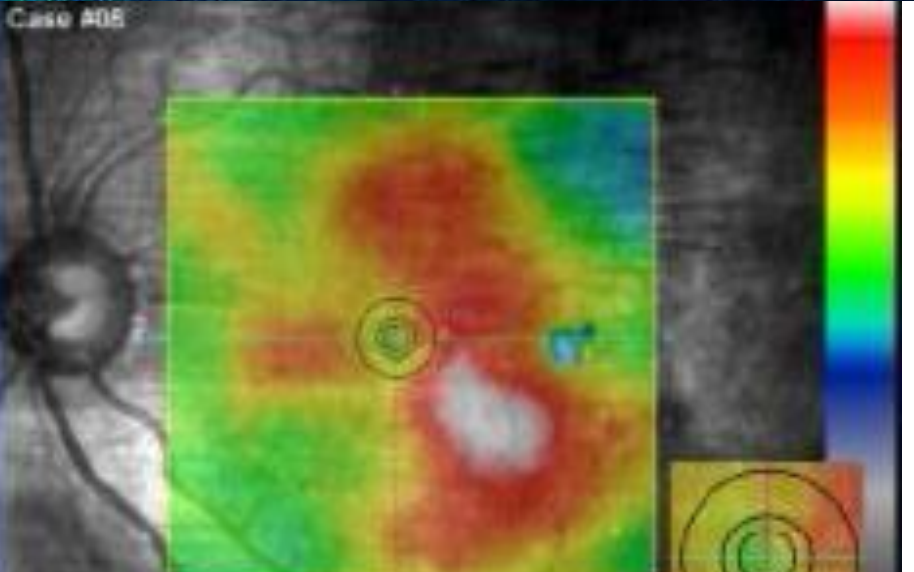
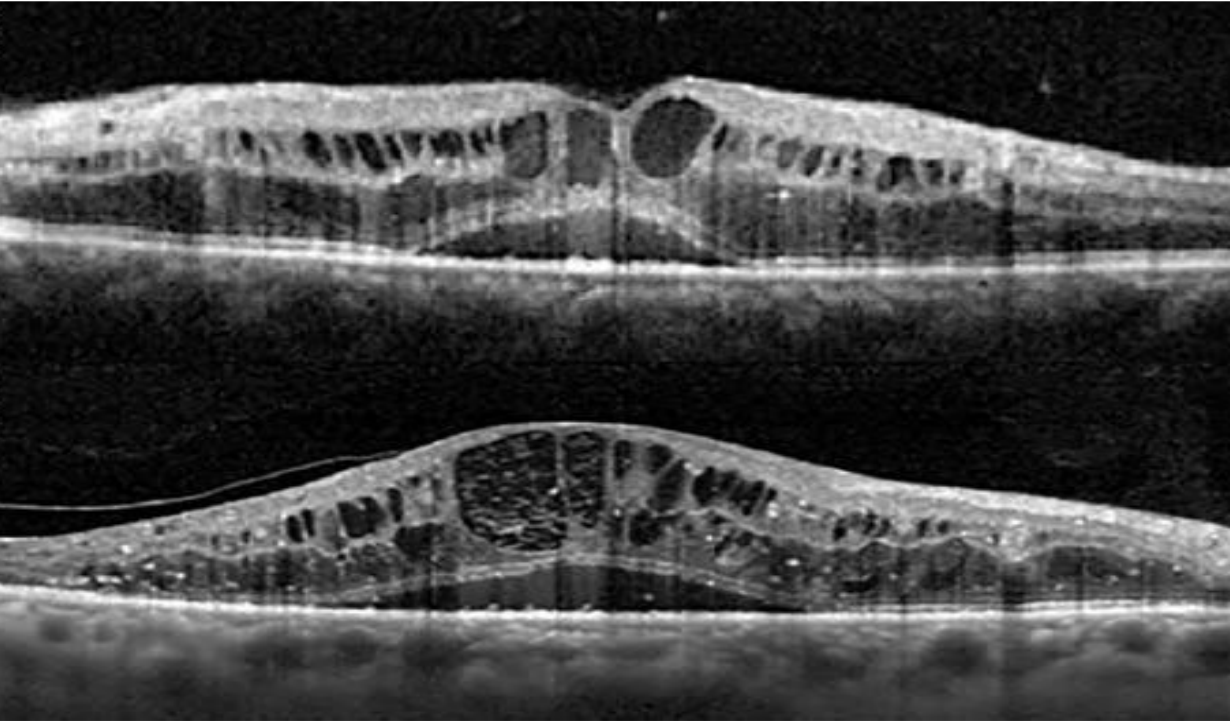
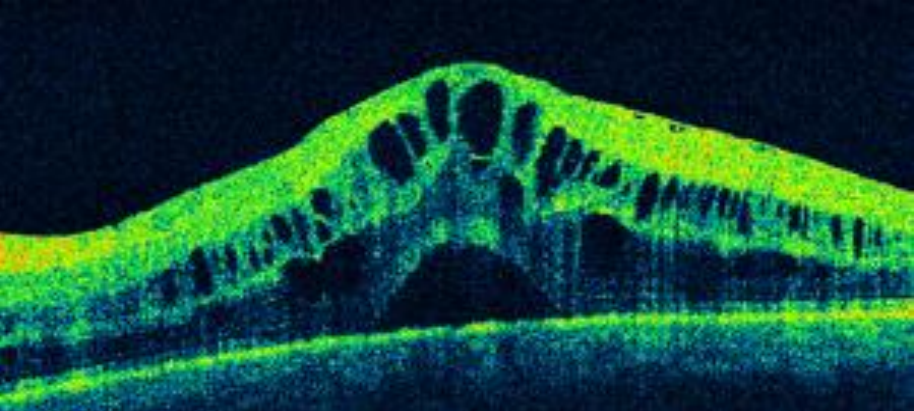
QUANTITATIVA

-SPESSORE
-VOLUME
-AREA

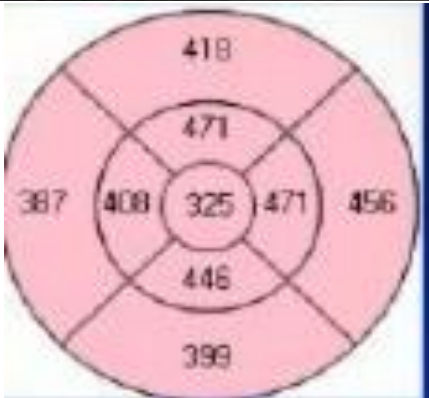


Mappatura delle edema

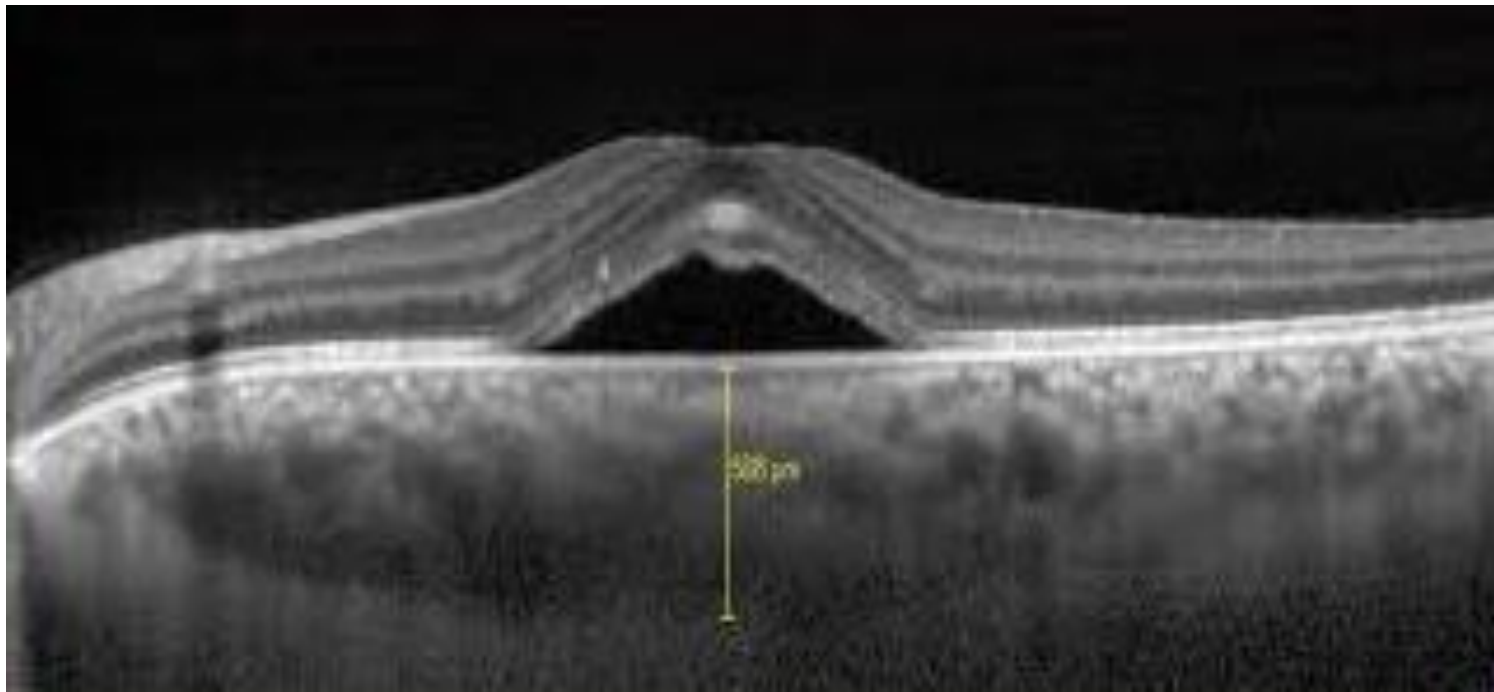
Con o senza coinvolgimento
foveale centrale



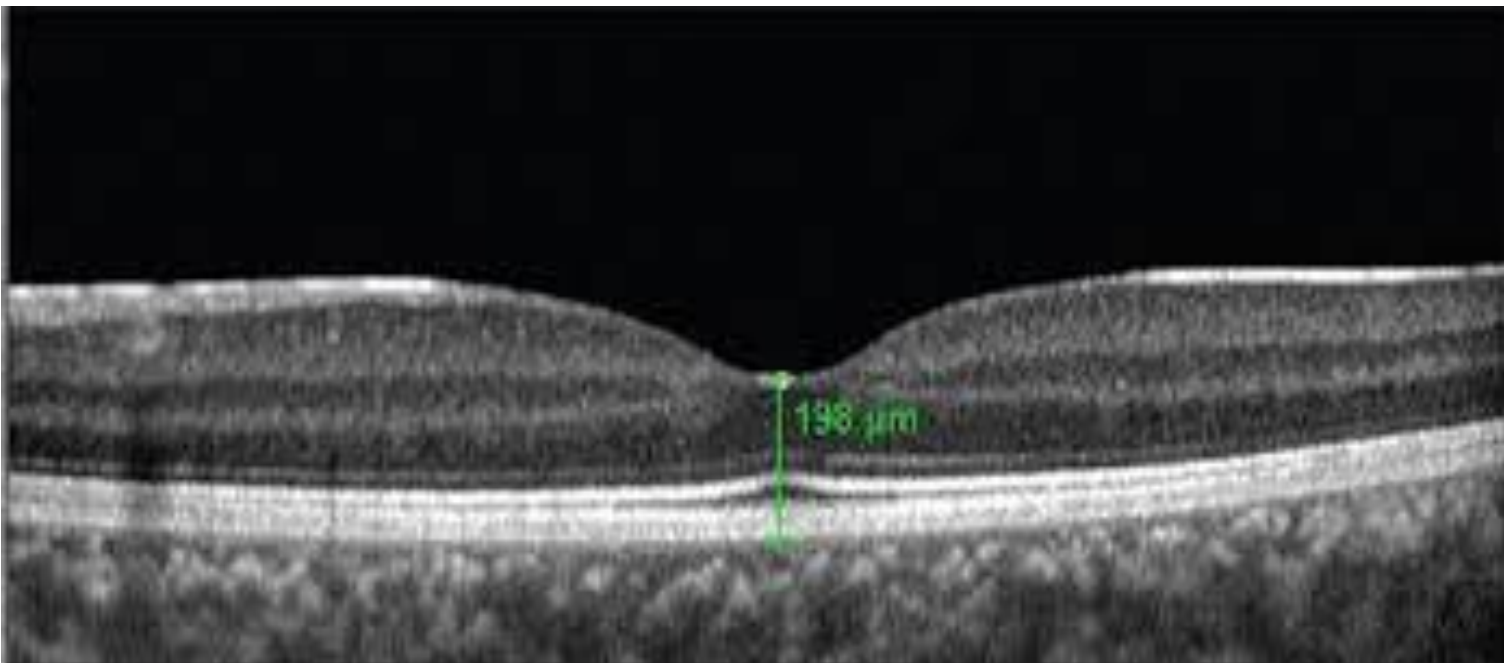
	Central Subfield Thickness (μm)	Cube Volume (mm^3)	Cube Average Thickness (μm)
ILM - RPE	325	14.7	409



Molte patologie retiniche sono state meglio comprese e dettagliatamente determinate nella loro fisiopatologia con l'uso di tale metodica.



**: SPESSORE COROIDEALE
CENTRALE (CCT)**



**SPESSORE RETINICO
CENTRALE (CRT)**

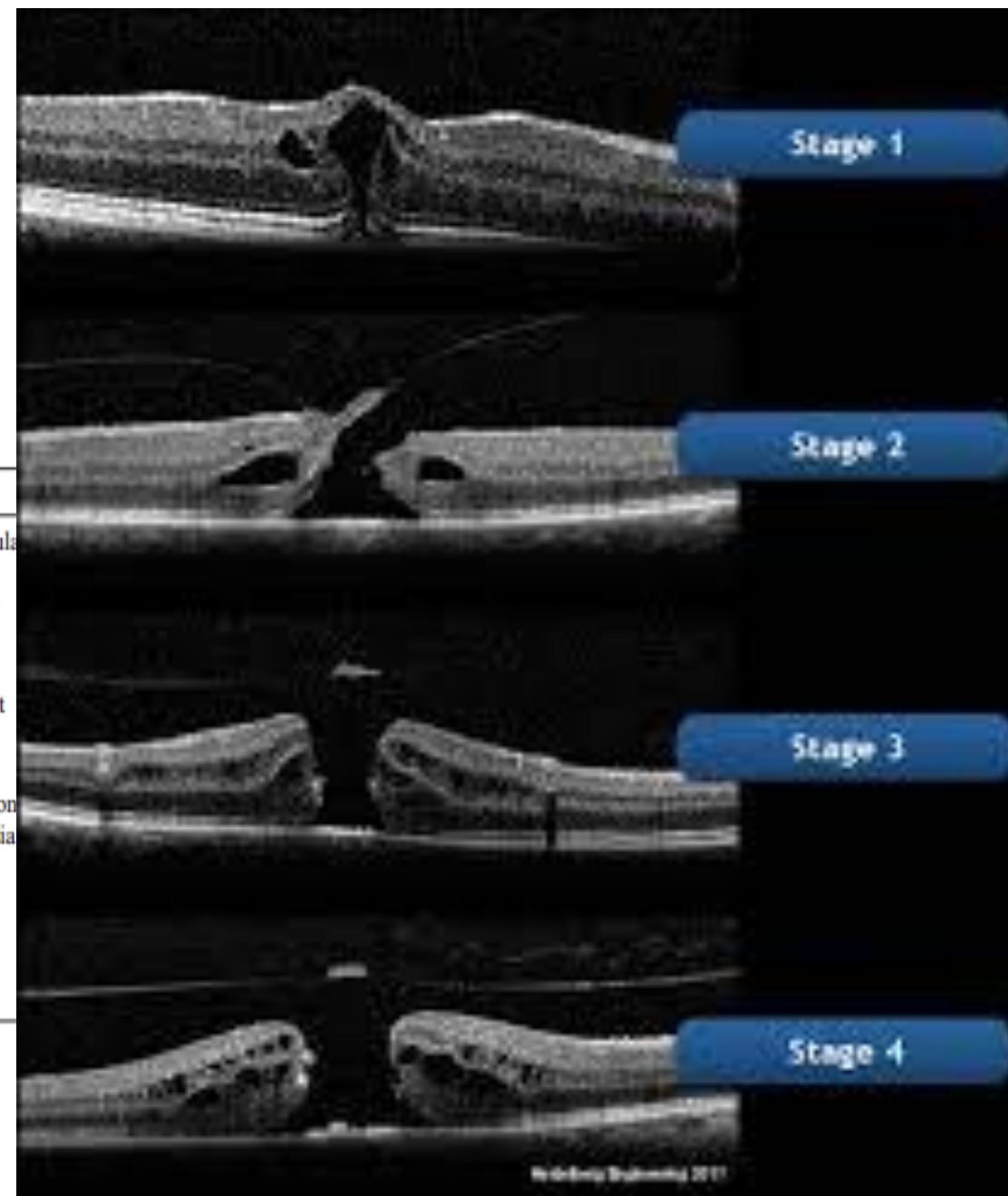
Reappraisal of Biomicroscopic Classification of Stages of Development of a Macular Hole

J. DONALD M. GASS M.D.

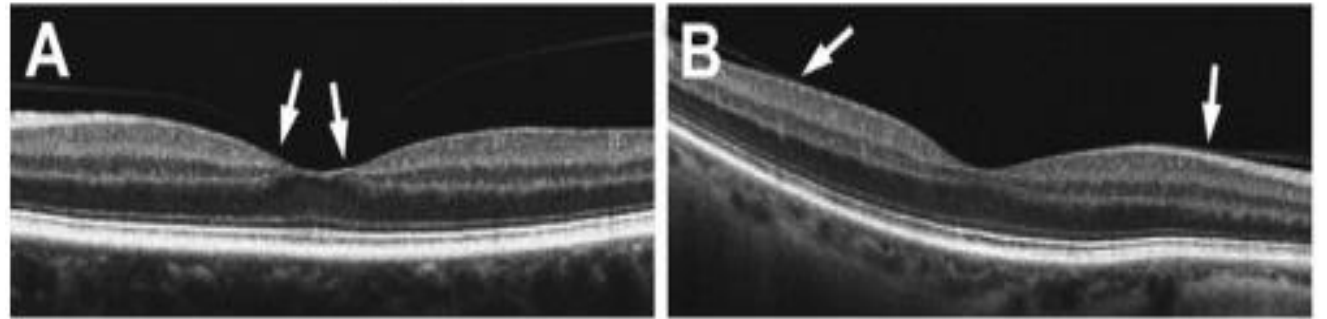
..

Table 1. Characteristics of stage 1-4 macular holes.

	Stage 1	Stage 2	Stage 3	Stage 4
Biomicroscopy	Yellow dot (stage 1a) or yellow ring (stage 1b)	Full thickness macular hole <400 μm in maximum diameter Round or oval Posterior vitreous attached	Full thickness macular hole >400 μm in maximum diameter Round Operculum may be seen Posterior vitreous attached	Full thickness macular hole >400 μm in maximum diameter Round Complete posterior vitreous detachment
Visual acuity	20/20-20/60	20/40-20/100	20/60-20/200	20/60-20/400
Symptoms	Asymptomatic or mild metamorphopsia	Metamorphopsia and loss of central vision	Loss of central vision and metamorphopsia	Loss of central vision and metamorphopsia
Prognosis	50% regress 40% progress to full thickness macular holes	15% close spontaneously 75% enlarge	< 5% close spontaneously 50% enlarge	<< 5% close spontaneously 20% enlarge
Candidacy for surgery	None	Excellent	Good	Possible



Vitreomacular adhesion (VMA)



Vitreomacular traction (VMT)

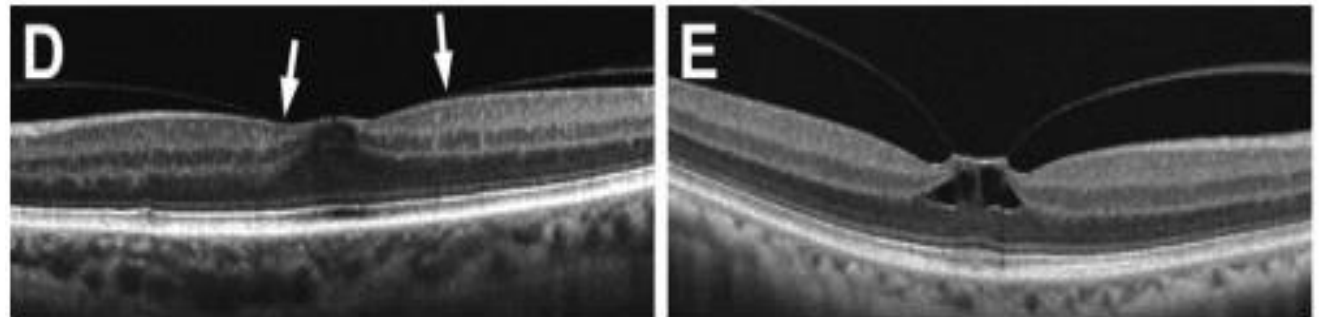
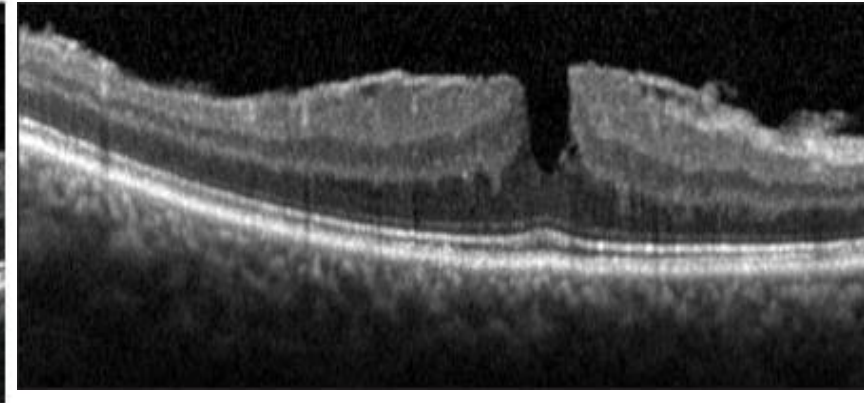
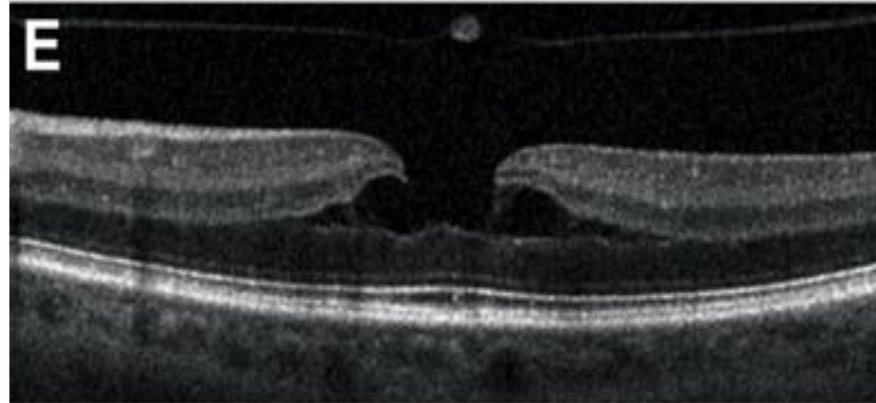
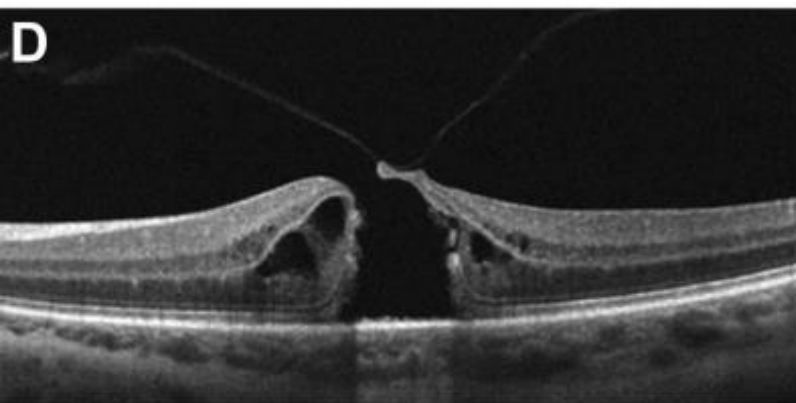


TABLE 1 Classification of Vitreomacular Interface Diseases*	
Classification	Description
VMA without a full-thickness hole	Perifoveal adhesion with normal retinal structure
VMT without a full-thickness hole	VMA with retinal structural abnormality
Impending macular hole	VMT in fellow eye of a FTMH
Lamellar hole	Partial-thickness foveal defect
Pseudohole	ERM with central foveal opening but no actual loss of retinal tissue
FTMH	Full-thickness retinal defect

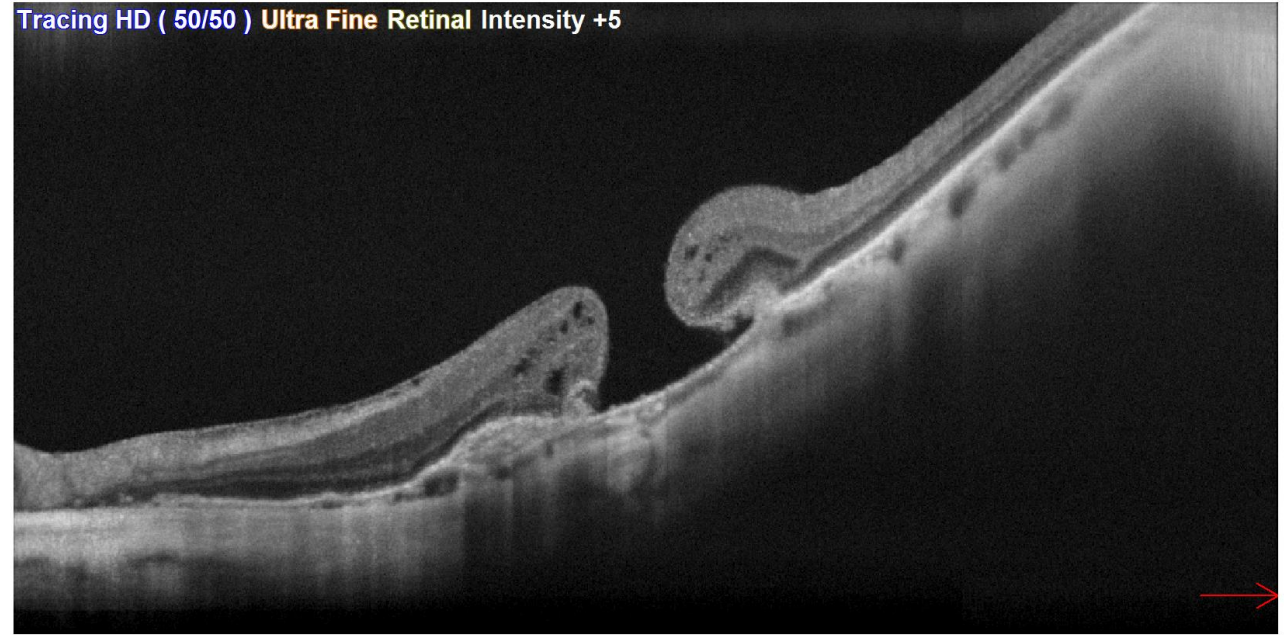
* Based on the International Classification System for Vitreomacular Adhesion, Traction, and Macular Hole.¹³
 VMA = vitreomacular adhesion; VMT = vitreomacular traction; FTMH = full-thickness macular hole; ERM = epiretinal membrane



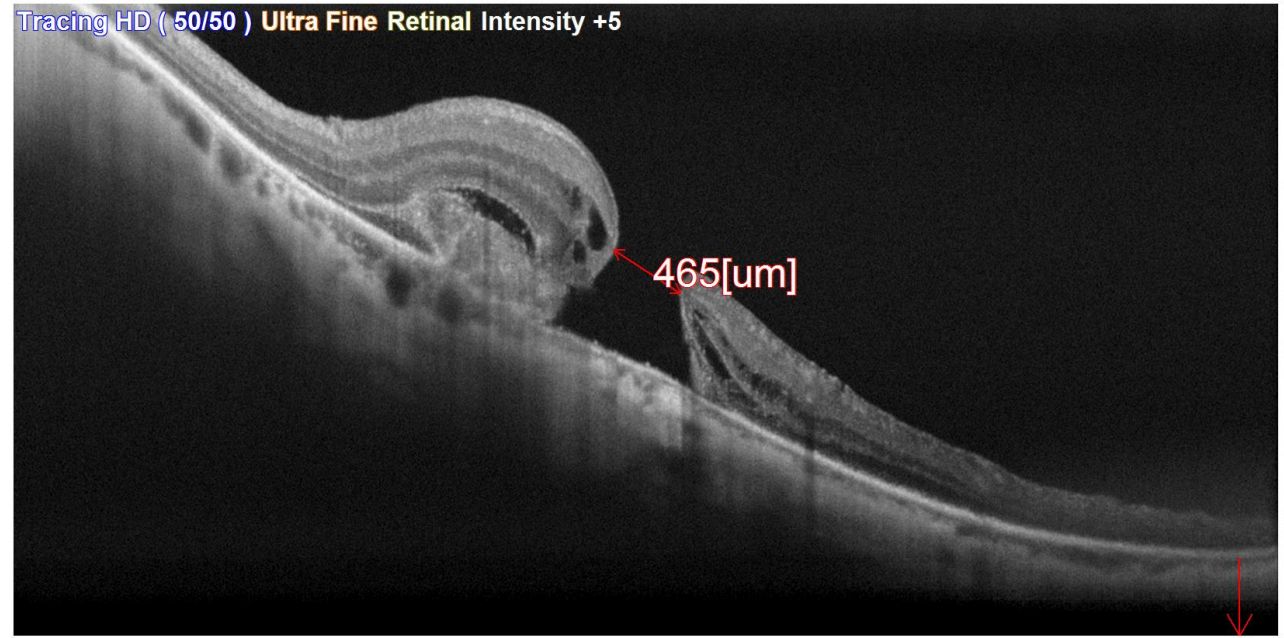
etting:MACULA CROSS(8,4mm[1024])

S/N	Version(F/S)	Date	SQI	SSI	SLO	Focus[D]	Axial[mm]
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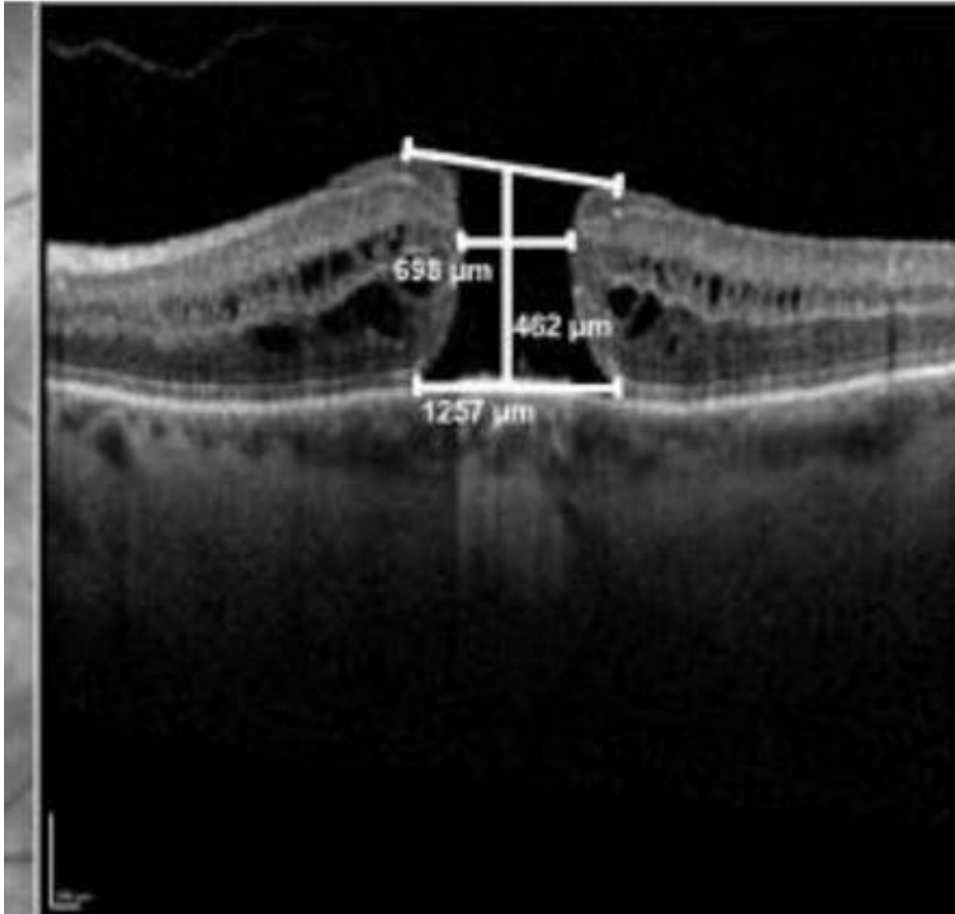
Tracing HD (50/50) Ultra Fine Retinal Intensity +5



Tracing HD (50/50) Ultra Fine Retinal Intensity +5



MISURARE IL DIAMETRO DI UN FORO MACULARE



Diametro del foro → fattore prognostico di outcome chirurgico

> Br J Ophthalmol. 2009 Nov;93(11):1488-91. doi: 10.1136/bjo.2008.153189. Epub 2009 Jul 26.

Predicting visual success in macular hole surgery

B Gupta ¹, D A H Laidlaw, T H Williamson, S P Shah, R Wong, S Wren

Anatomical outcomes of surgery for idiopathic macular hole as determined by optical coherence tomography.

Ip MS, Baker BJ, Duker JS, Reichel E, Bauman CR, Gangnon R, Puliafito CA.

Arch Ophthalmol. 2002 Jan;120(1):29-35. doi: 10.1001/archophth.120.1.29.

PMID: 11786054

> Br J Ophthalmol. 2002 Apr;86(4):390-3. doi: 10.1136/bjo.86.4.390.

Macular hole size as a prognostic factor in macular hole surgery

S Ullrich ¹, C Haritoglou, C Gass, M Schaumberger, M W Ulbig, A Kampik

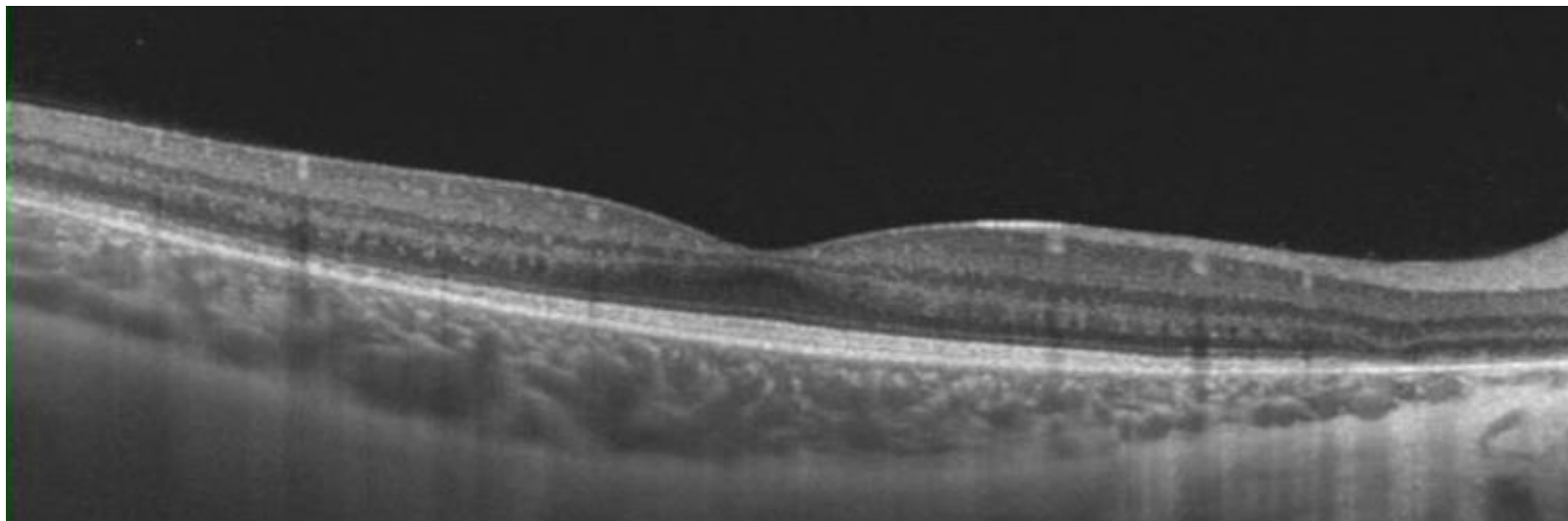
Assessment of OCT measurements as prognostic factors in myopic macular hole surgery without foveoschisis.

Alkabes M, Padilla L, Salinas C, Nucci P, Vitale L, Pichi F, Burès-Jelstrup A, Mateo C.

Graefes Arch Clin Exp Ophthalmol. 2013 Nov;251(11):2521-7. doi: 10.1007/s00417-013-2347-y. Epub 2013 May 22.

PMID: 23695656

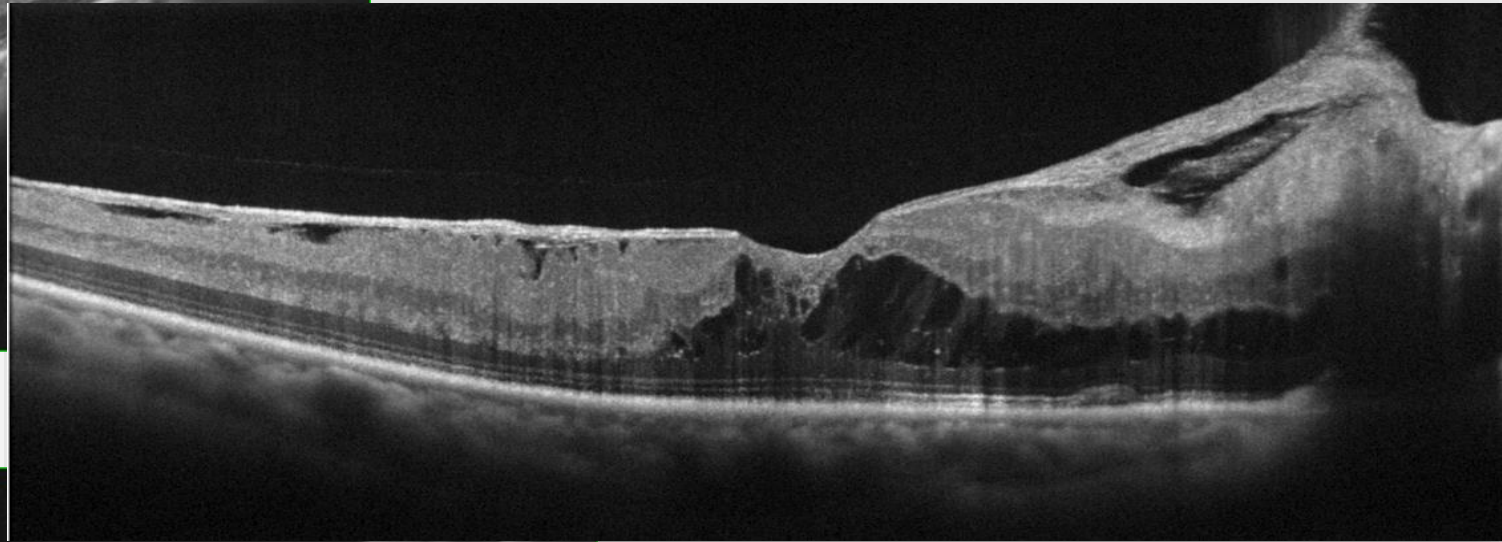
Normale profilo retinico



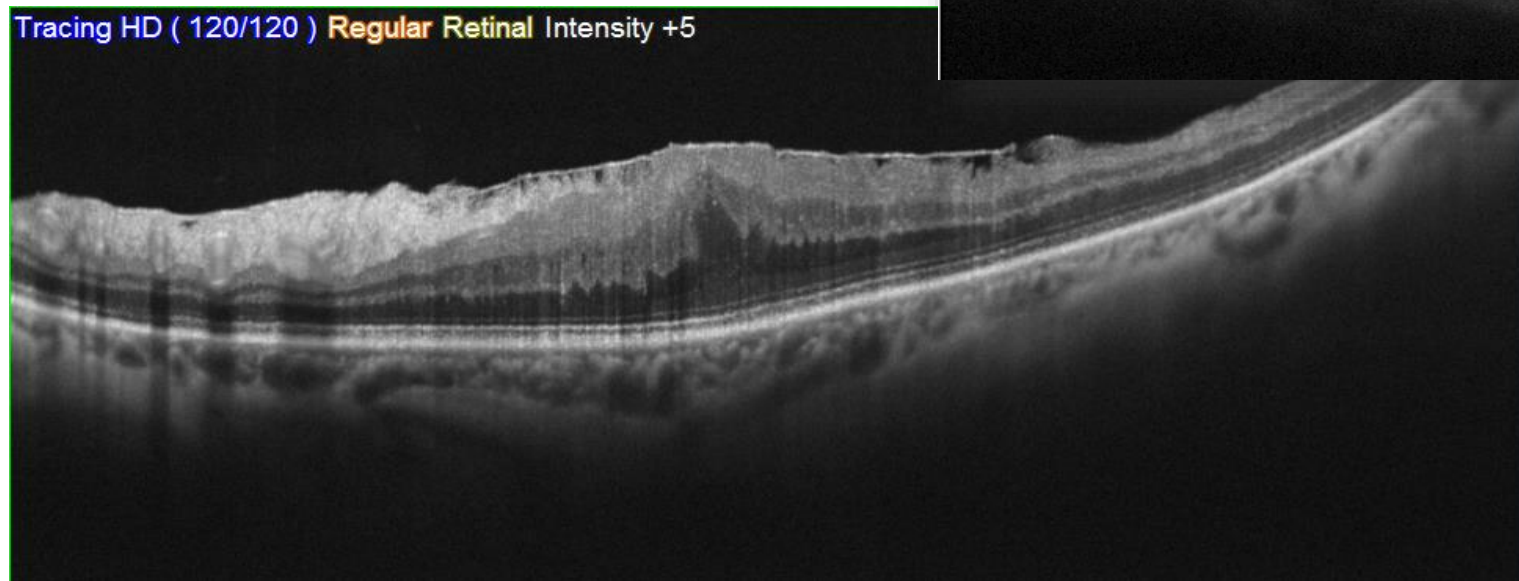
Membrana epiretinica maculare



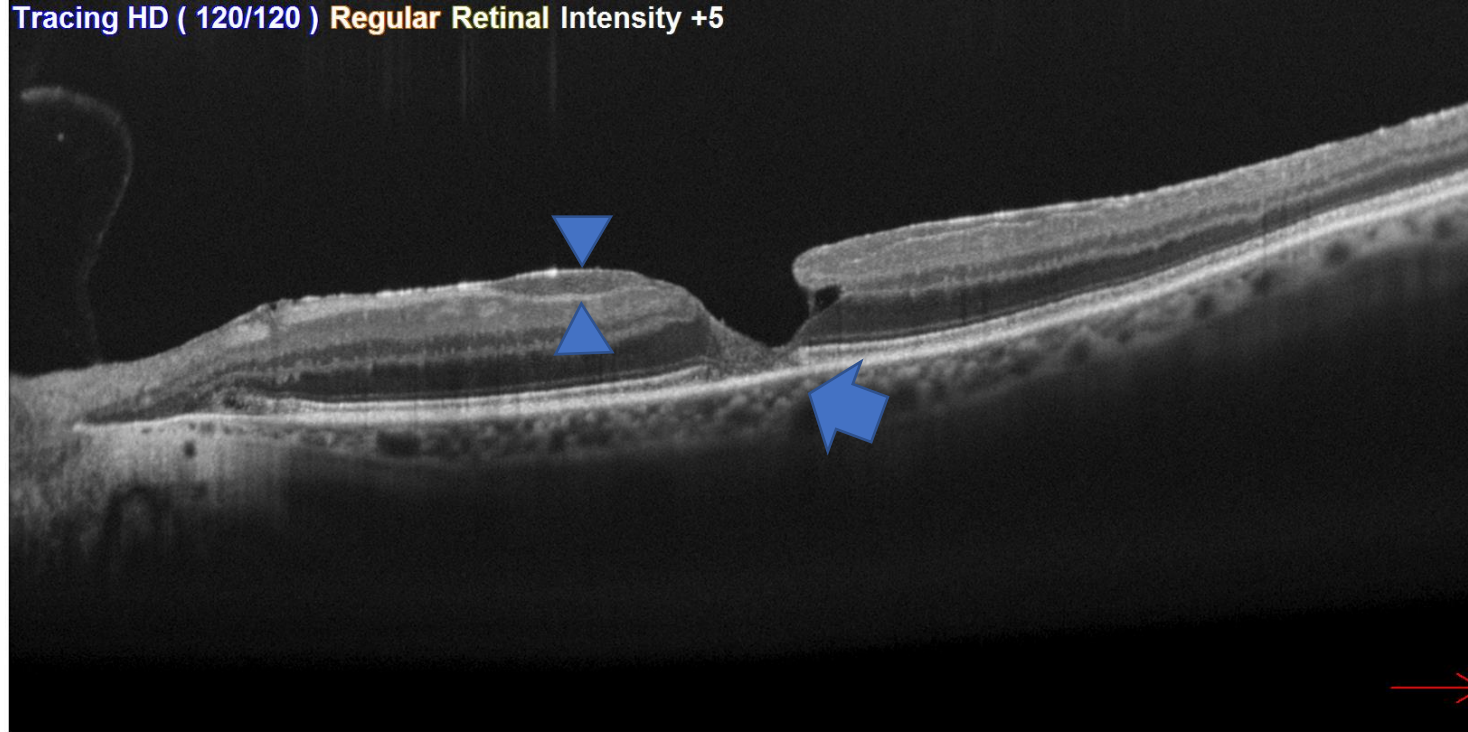
Tracing HD (120/120) Regular Retinal Intensity +5



Tracing HD (120/120) Regular Retinal Intensity +5

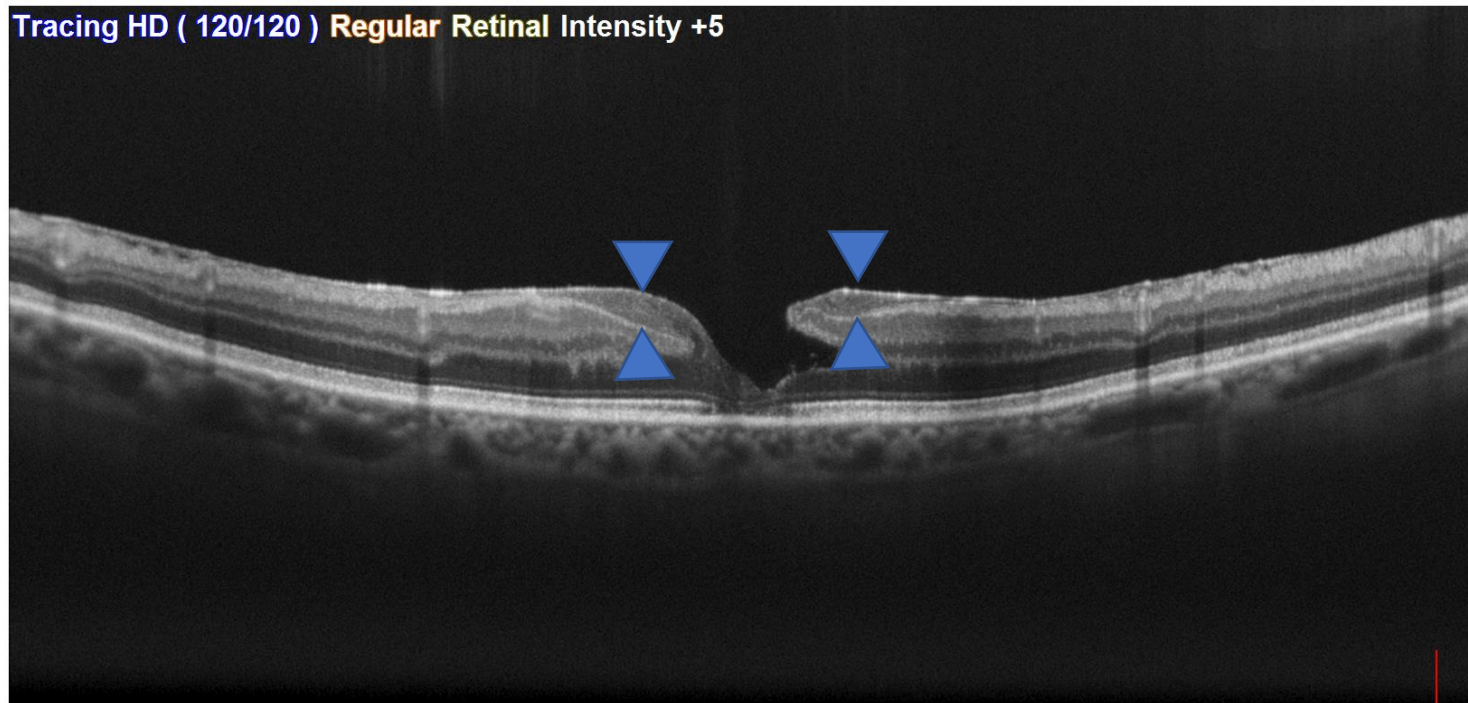


Tracing HD (120/120) Regular Retinal Intensity +5

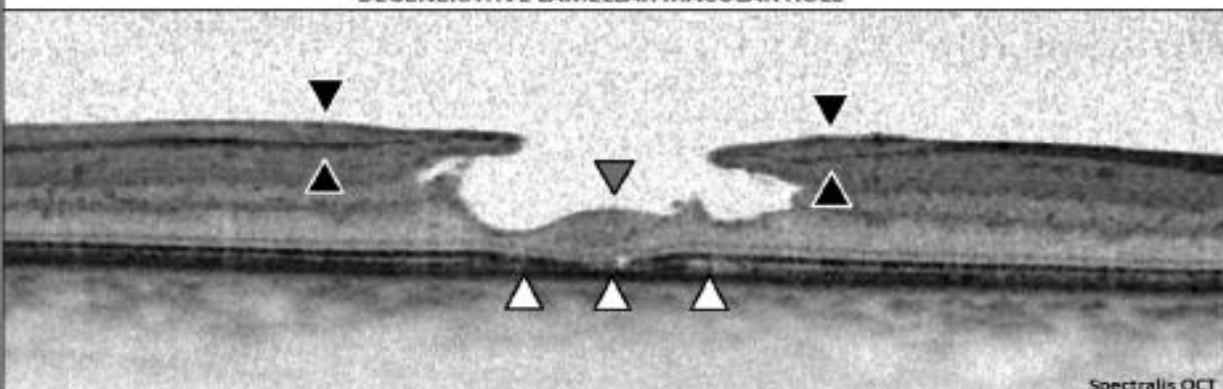


LHEP

Tracing HD (120/120) Regular Retinal Intensity +5



DEGENERATIVE LAMELLAR MACULAR HOLE



TRACTIONAL LAMELLAR MACULAR HOLE

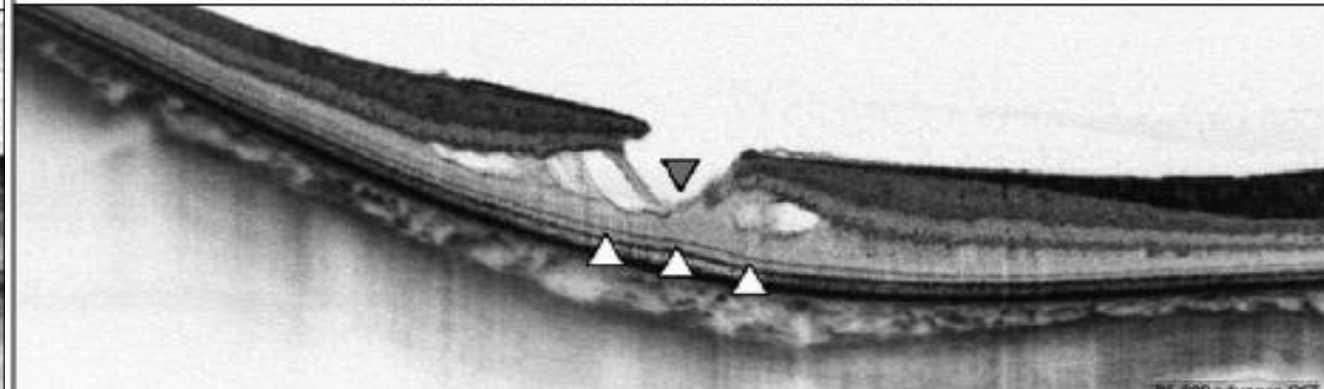
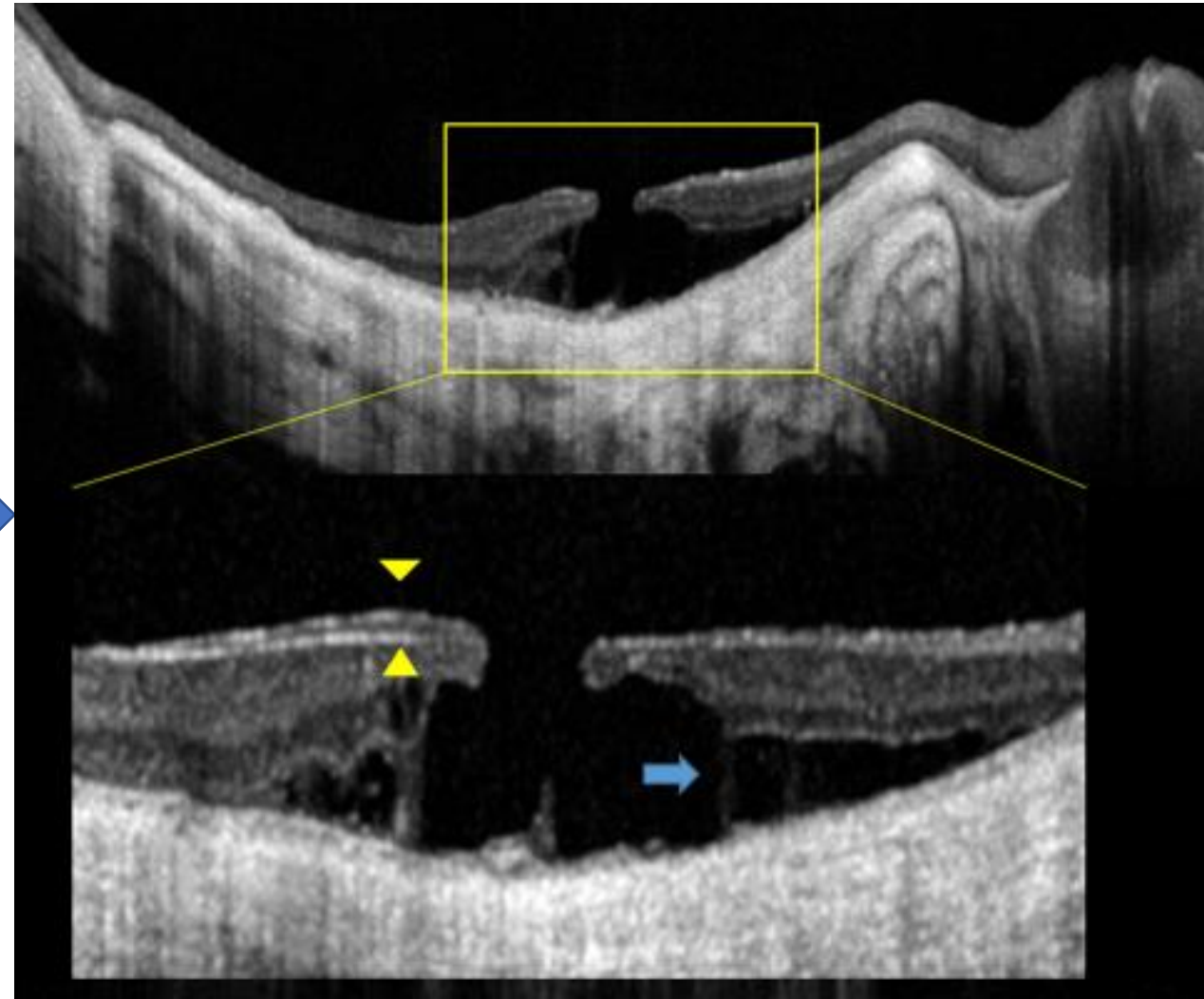
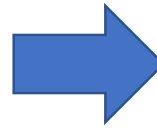
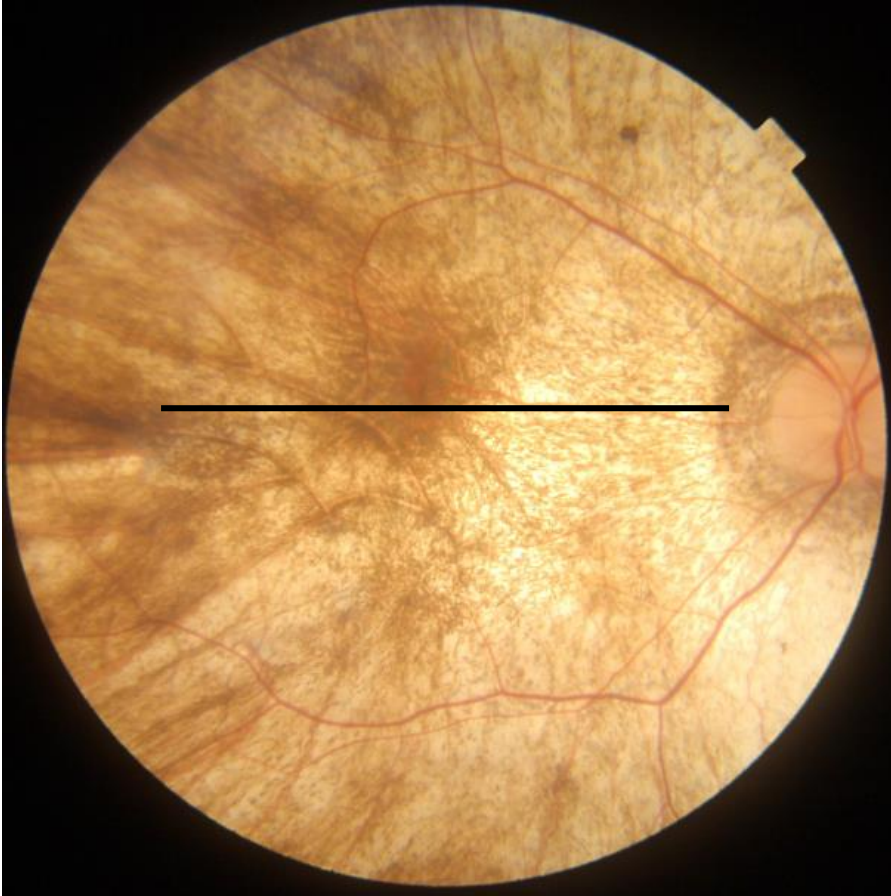


TABLE 1. Diagnostic Criteria for Degenerative and Tractional Lamellar Macular Holes

Diagnostic Criteria ^a			
Degenerative n = 48		Tractional n = 43	
Inner/outer diameter ratio > 1:2	n = 44 (91.67%)	Inner/outer diameter ratio < 1:2	n = 37 (86.05%)
Ellipsoid defect	n = 46 (95.83%)	Intact ellipsoid	n = 42 (97.67%)
Round-edged cavitation	n = 47 (97.92%)	Sharp-edged split	n = 43 (100%)
Foveal bump	n = 42 (87.50%)	Intraretinal cystoid spaces	n = 35 (81.40%)
Epiretinal proliferation	n = 46 (95.83%)	Epiretinal membrane	n = 42 (97.67%)

^aDiagnosis is made with a minimum of 3 out of 5 criteria. If the lesion does not match with both categories, it is classified as "mixed."

D.P età 48 anni,
pathogenic deletion
(c.1771-? _1962+? Del) on the CHM gene

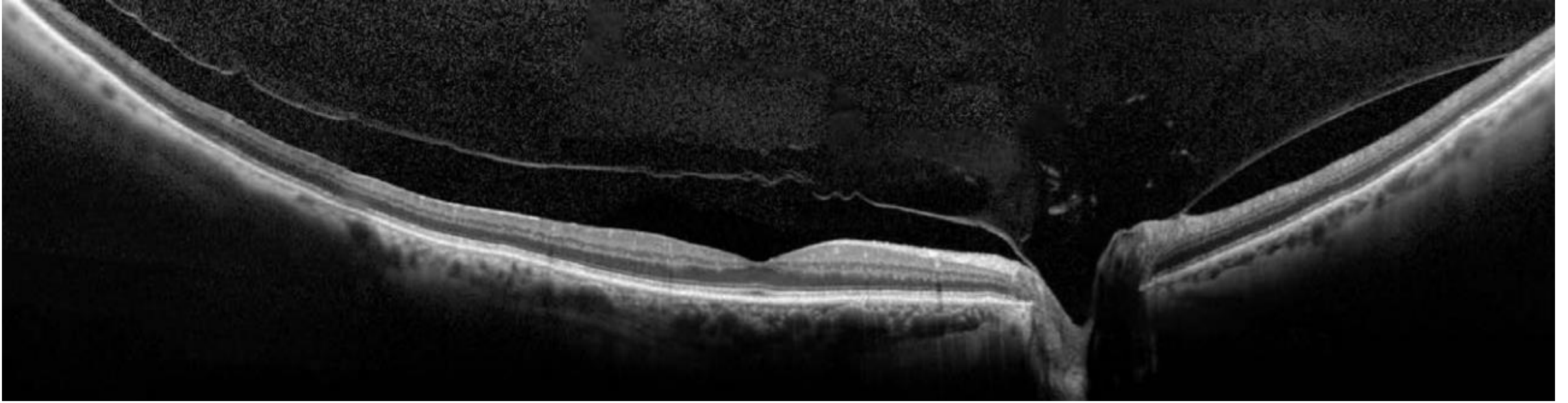


Lamellar Hole-associated Epiretinal Proliferation in choroideremia: a case report

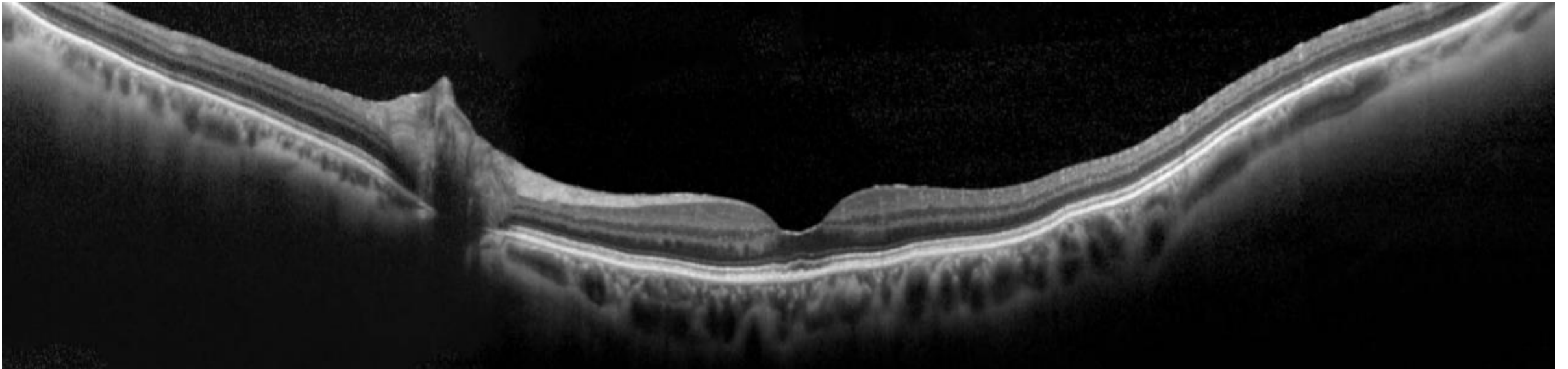
Vittoria Murro¹, Dario Pasquale Mucciolo^{1,2*}, Dario Giorgio¹, Tomaso Caporossi¹, Ilaria Passerini³, Daniele Bani⁴, Fabrizio Giansanti¹, Gianni Virgili^{1,5} and Andrea Sodi¹

Studiare il CORPO VITREO

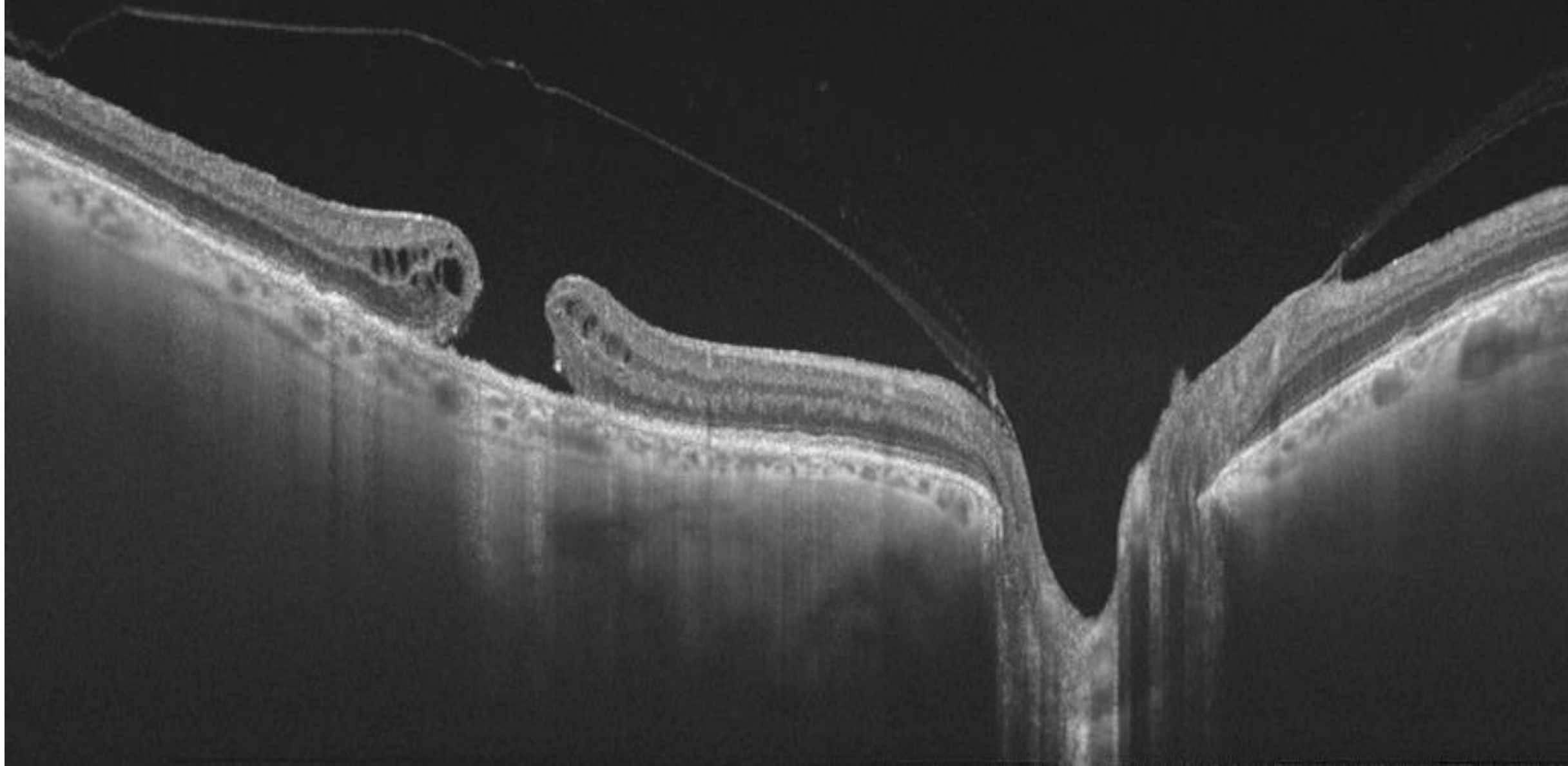
Distacco di vitreo incompleto con adesione vitreopapillare



Distacco posteriore di vitreo completo



12x9 mm SSOCT (high definition line scan)



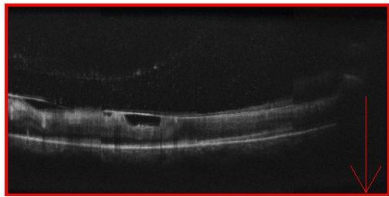
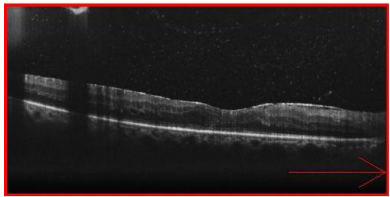
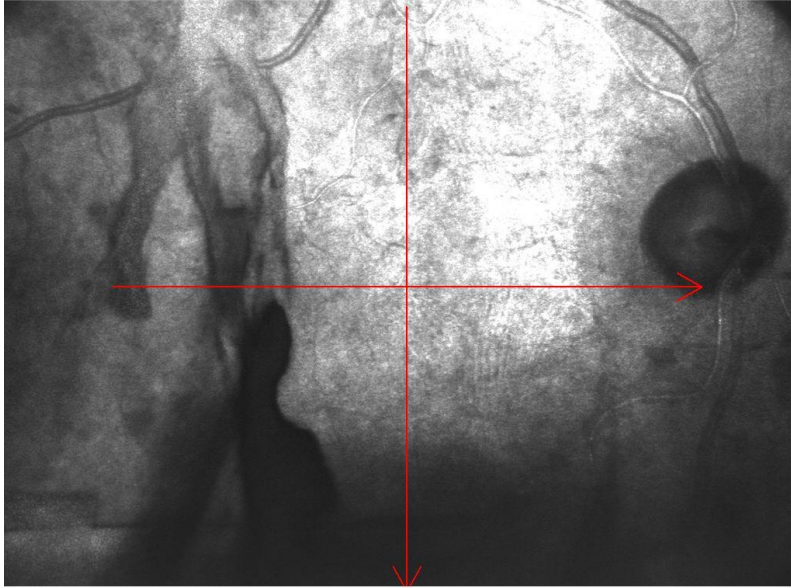
OCT Setting:MACULA CROSS(9,0mm[1024])

Eye:R

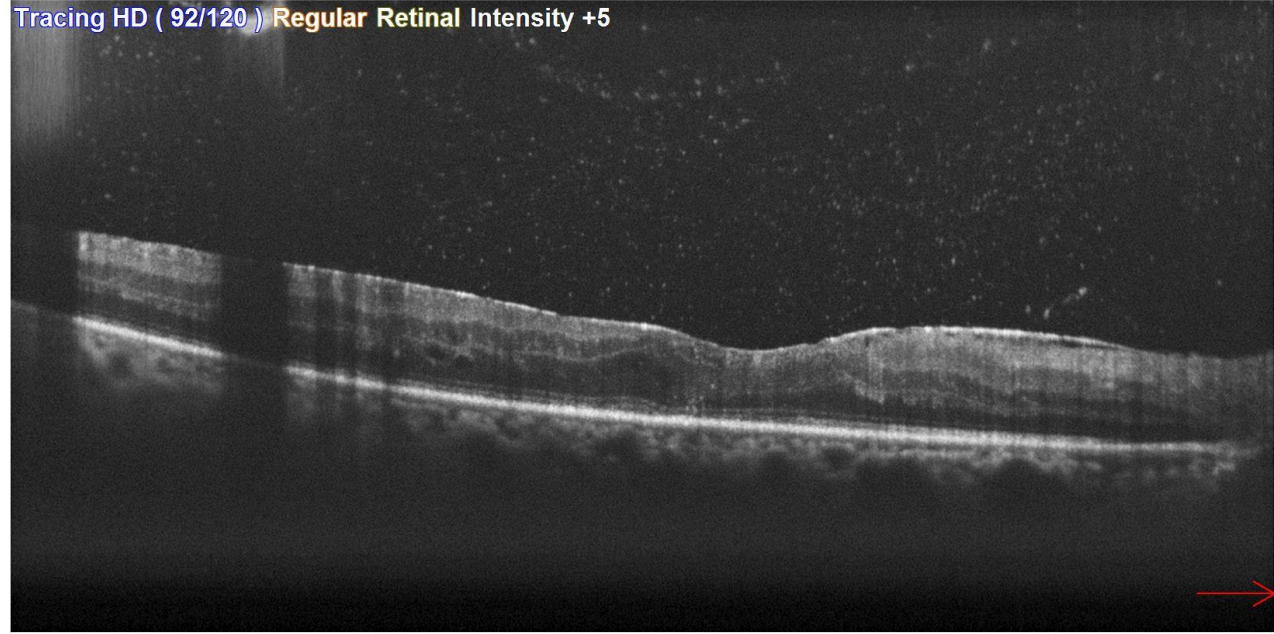


R

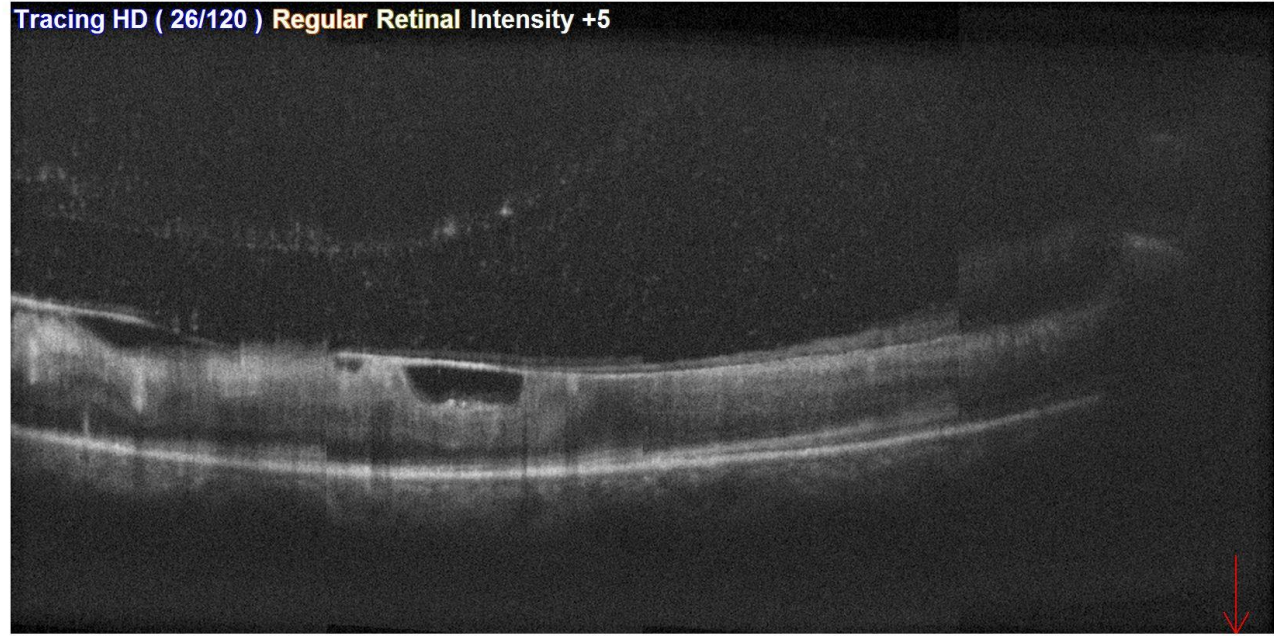
S/N	Version(F/S)	Date	SQI	SSI	SLO	Focus[D]	Axial[mm]
R 650907	22002/2.20.03	03/04/2019 13:35:46	4/5	5/10	Wide	+1,50	Gullstrand



Tracing HD (92/120) Regular Retinal Intensity +5



Tracing HD (26/120) Regular Retinal Intensity +5



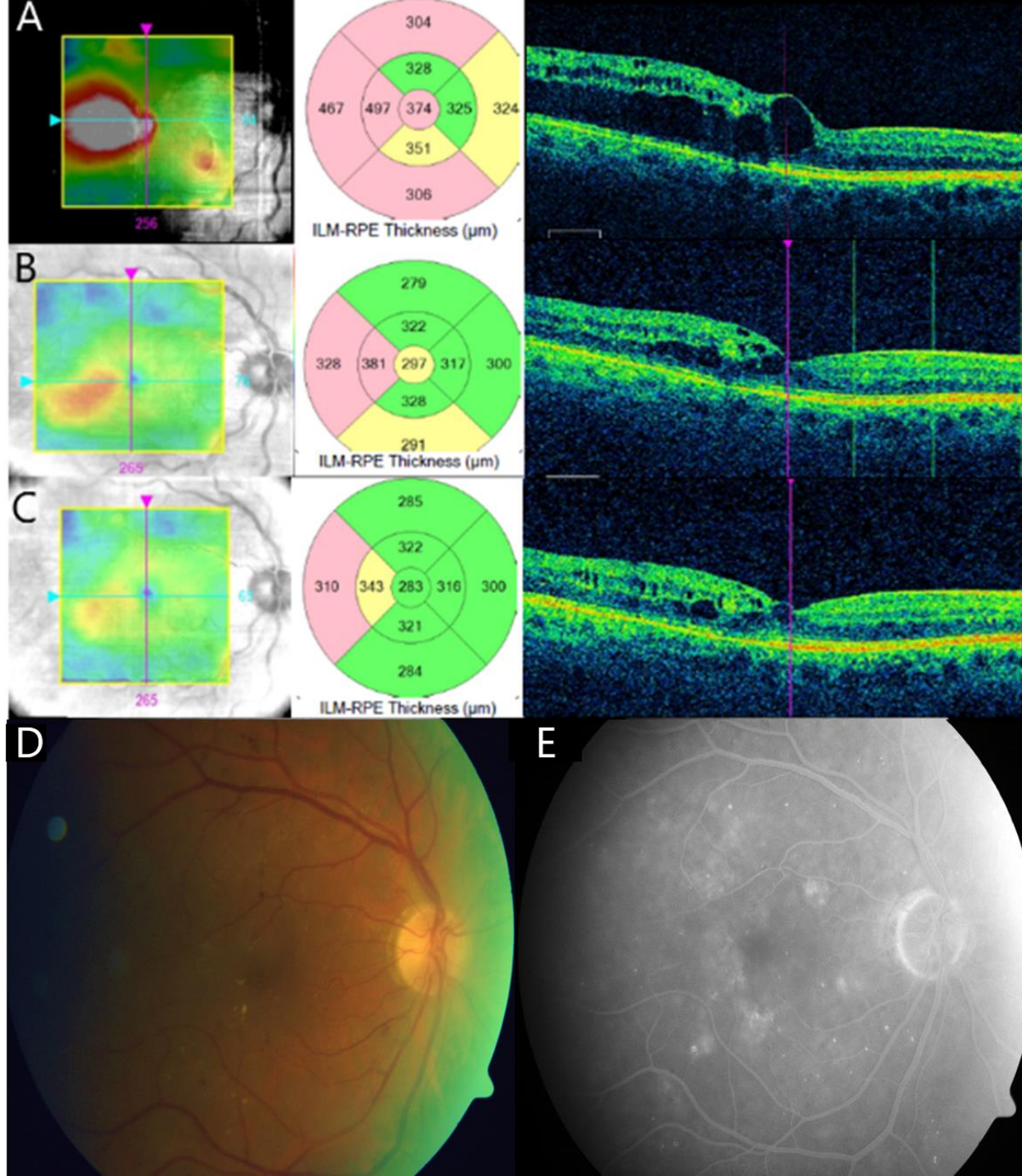
Follow-up dell'edema maculare

baseline

6 months FU

12 months FU

OCT COME STRUMENTO DI MONITORAGGIO DI TERAIA



Subthreshold yellow micropulse laser for treatment of diabetic macular edema
Comparison between fixed and variable treatment regimen

Maria Carla Donati, Vittoria Murro, Dario Pasquale Mucciolo , more...

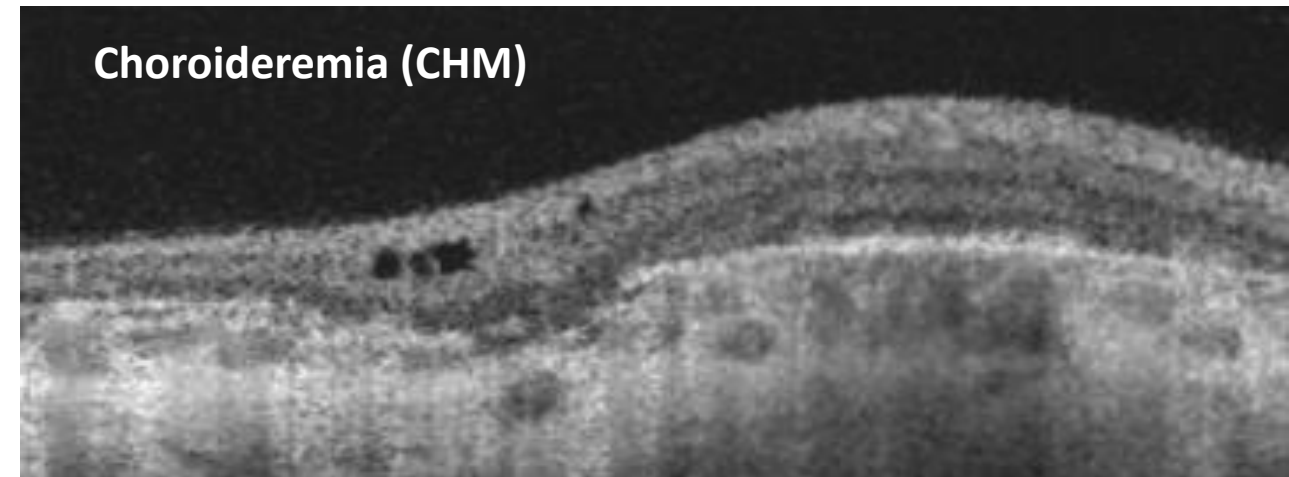
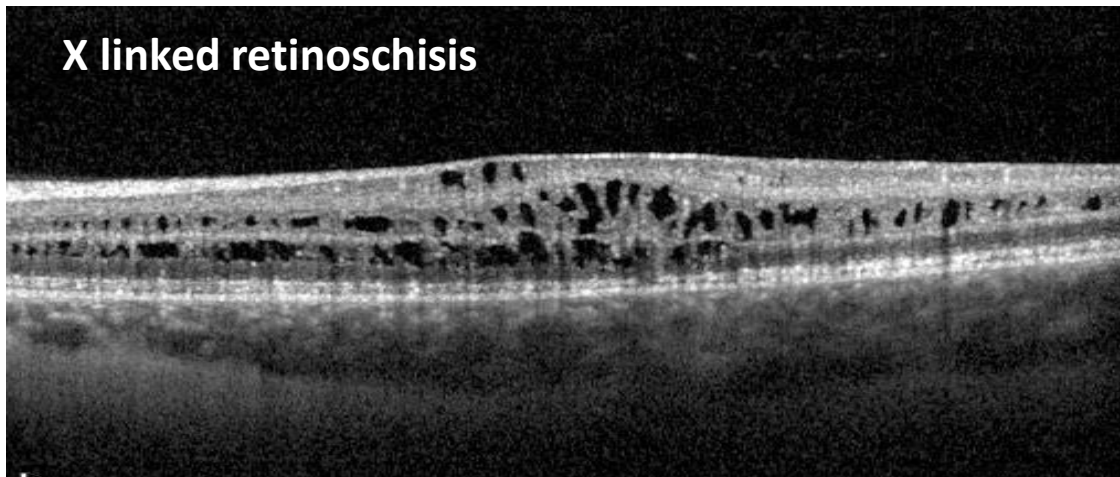
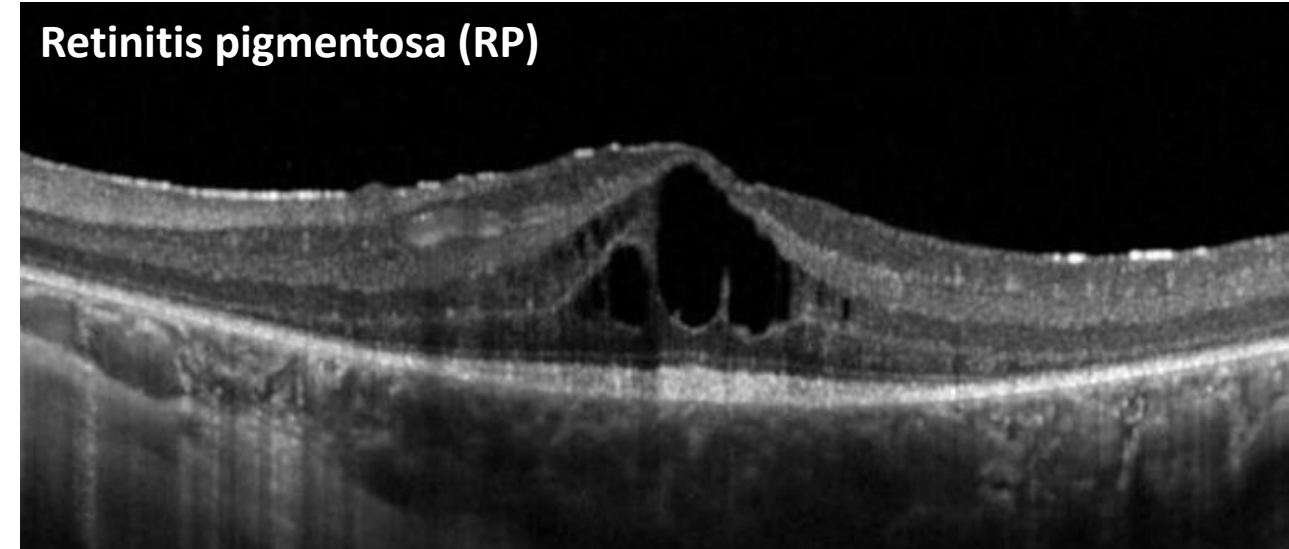
Sho

First Published April 14, 2020 | Research Article | [Find in PubMed](#) |  Check for updates

<https://doi.org/10.1177/1120672120915169>

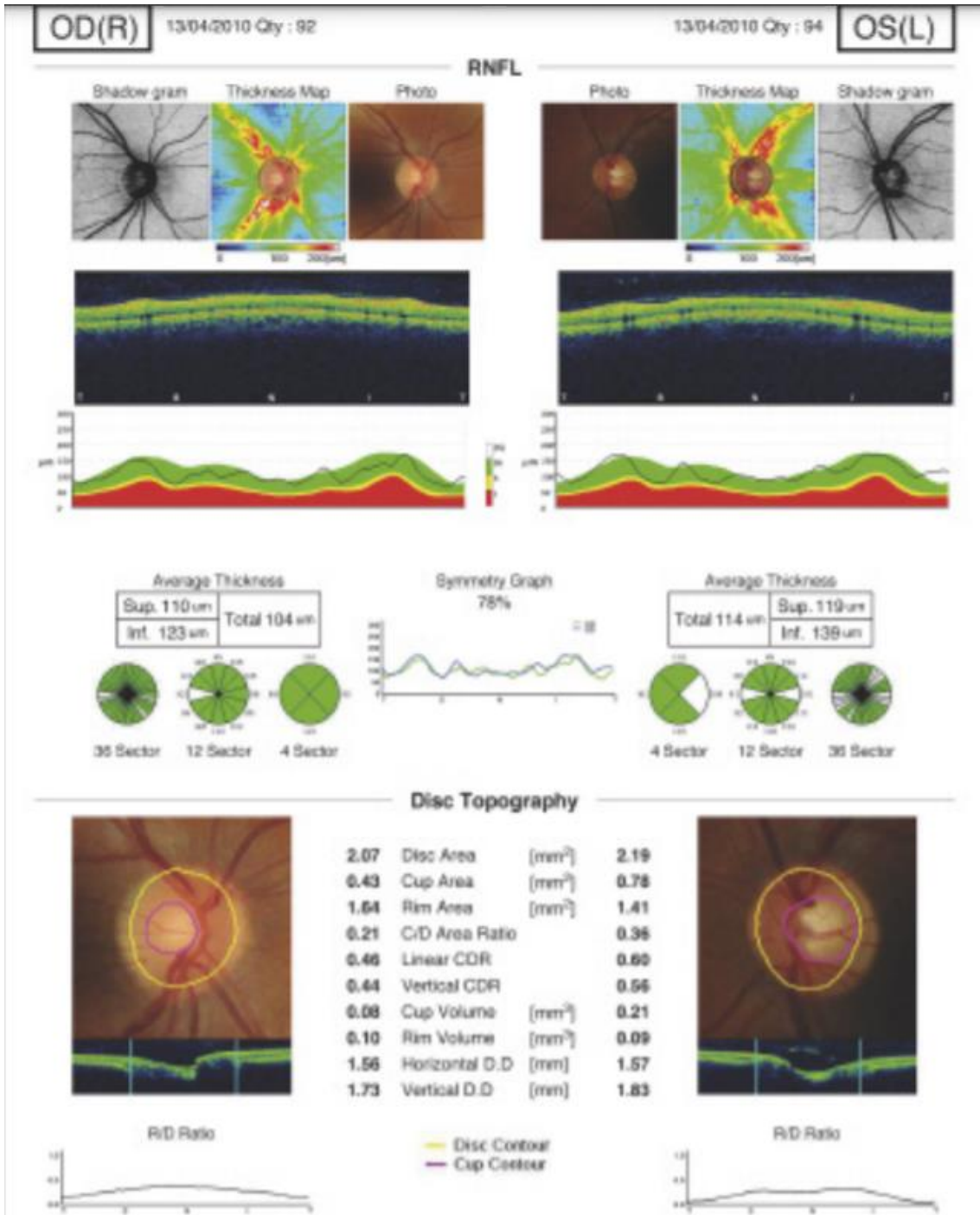
[Article information](#) ▾

Studiare la morfologia dell'edema maculare nelle distrofie retiniche ereditarie

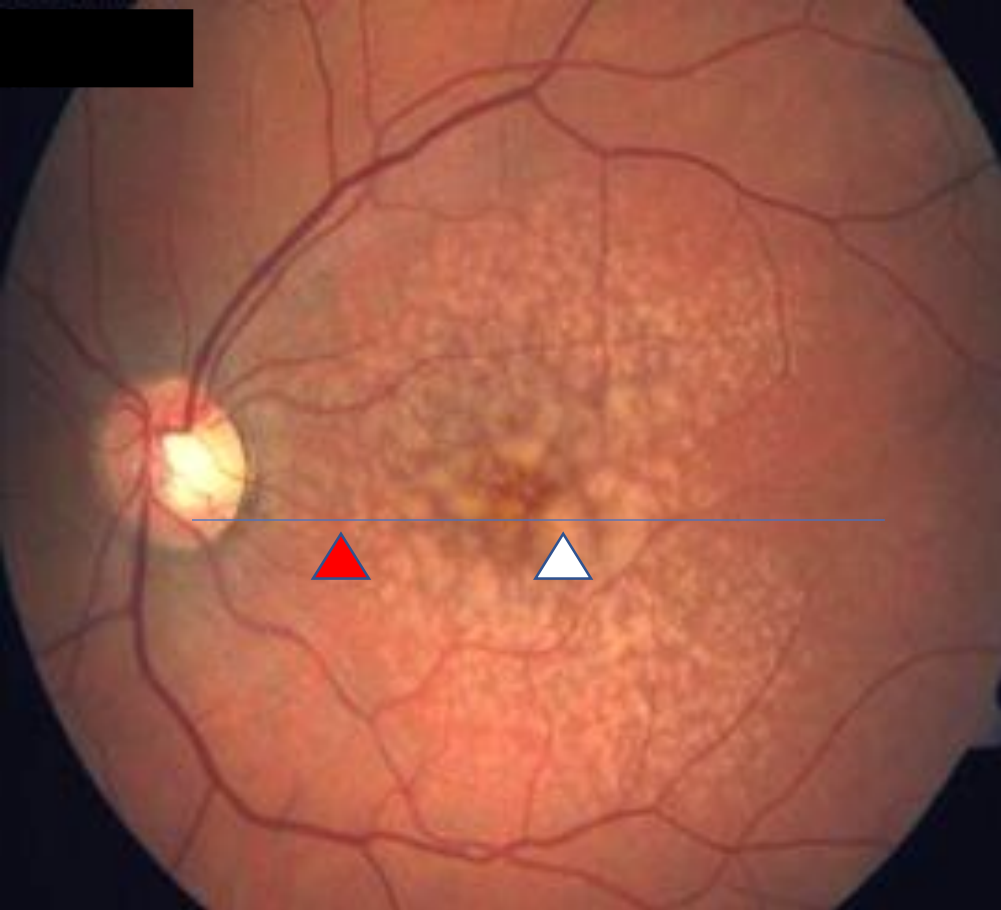


Cystoid spaces in RP, x-linked retinoschisis, enhanced S-cone syndrome, and gyrate atrophy are detected when RPE and outer retinal layers are preserved

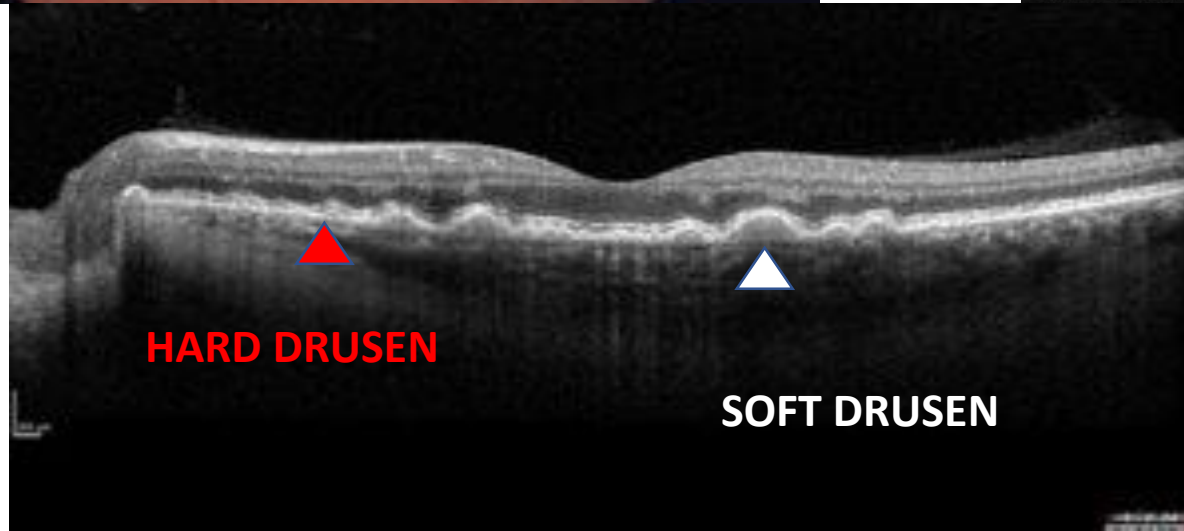
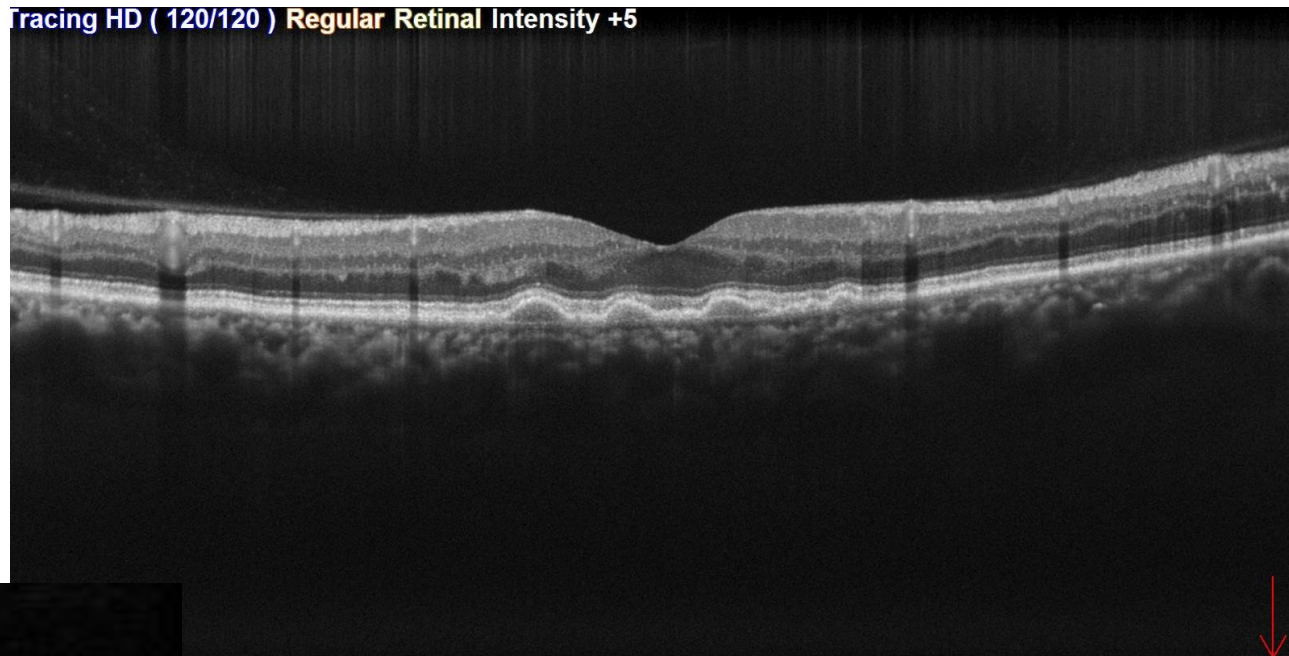
RNFL: spessore fibre nervo ottico



**Drusen maculari: hallmark della
degenerazione maculare senile**

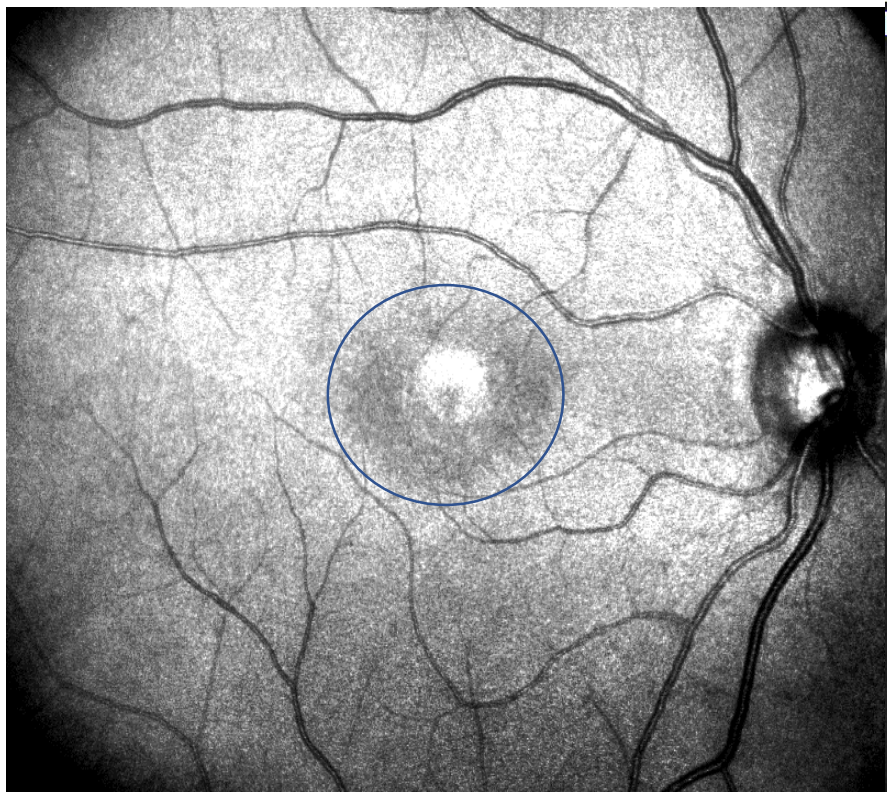


Tracing HD (120/120) Regular Retinal Intensity +5



HARD DRUSEN

SOFT DRUSEN



Tracing HD (120/120) Regular Retinal Intensity +5

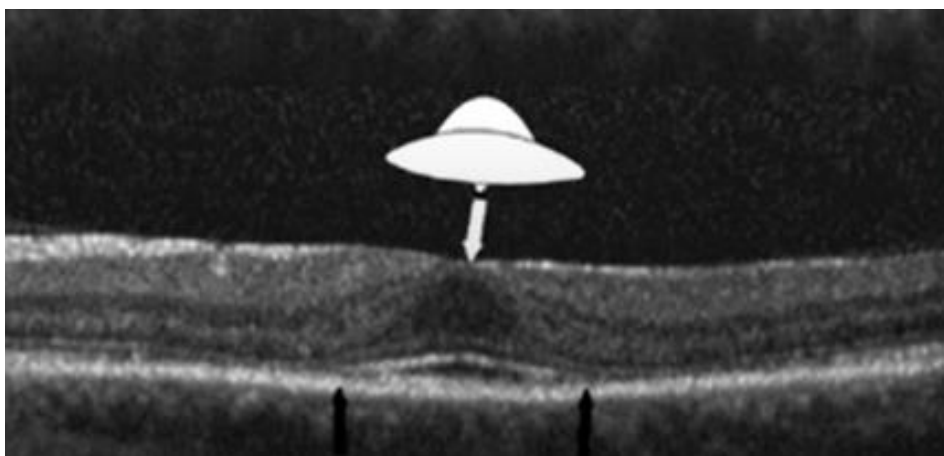
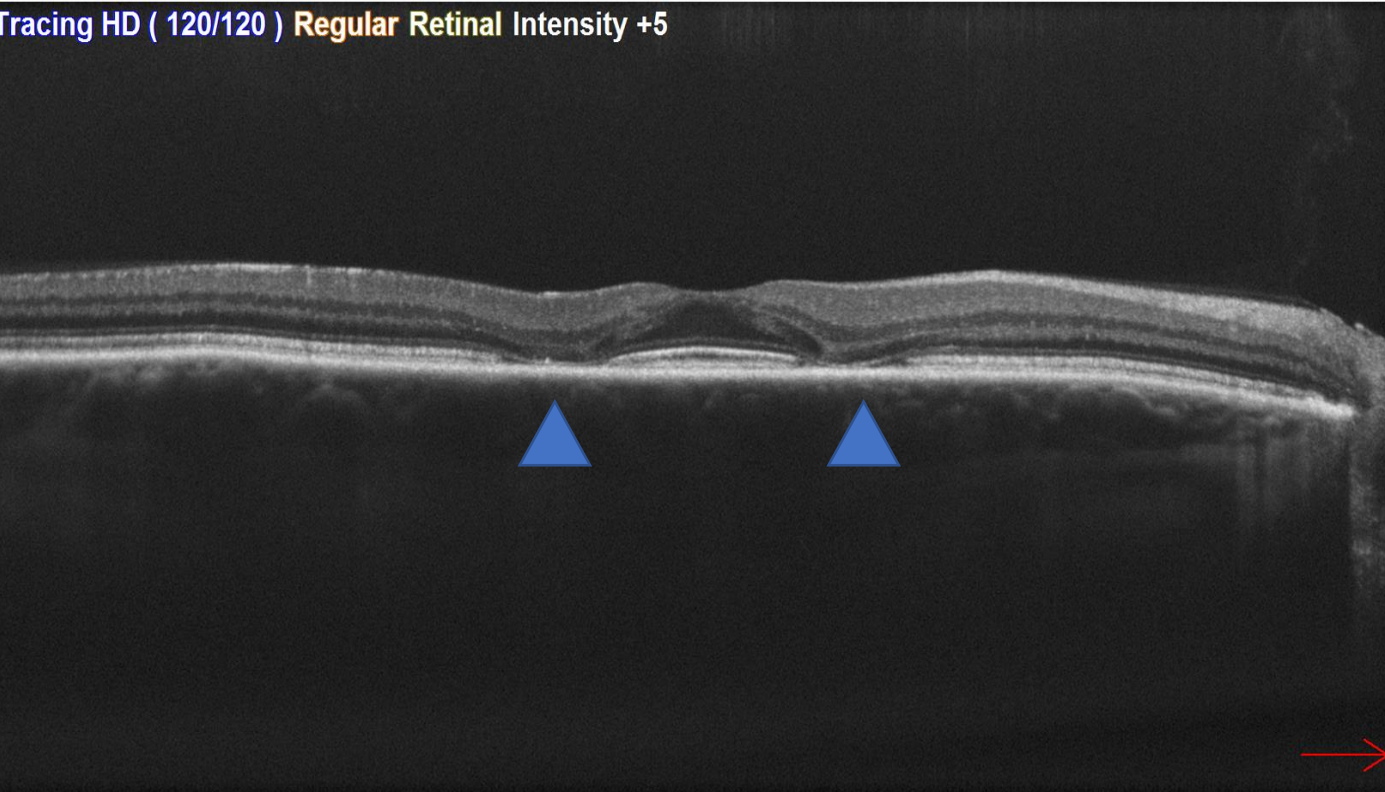


Table 3. Clinical Examination Techniques

Recommended Screening Tests

Primary tests: ideally do both

Automated visual fields (appropriate to race)

SD-OCT

Other objective tests (as needed or available):

mfERG

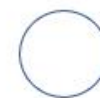
FAF

Recommendations on Screening for Chloroquine and Hydroxychloroquine Retinopathy (2016 Revision)

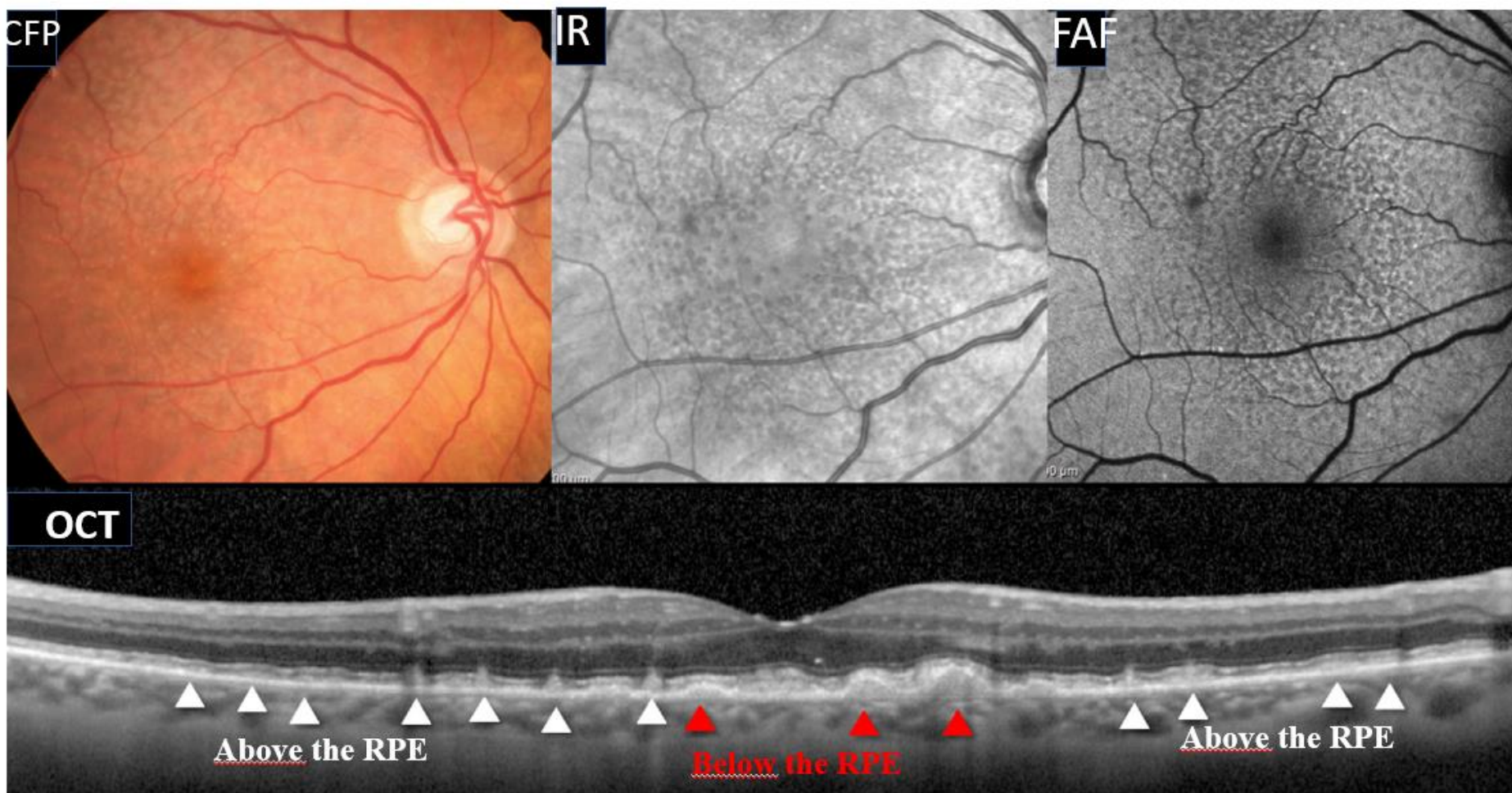
Caratterizzare la localizzazione delle drusen maculari. DRUSEN RETICOLARI



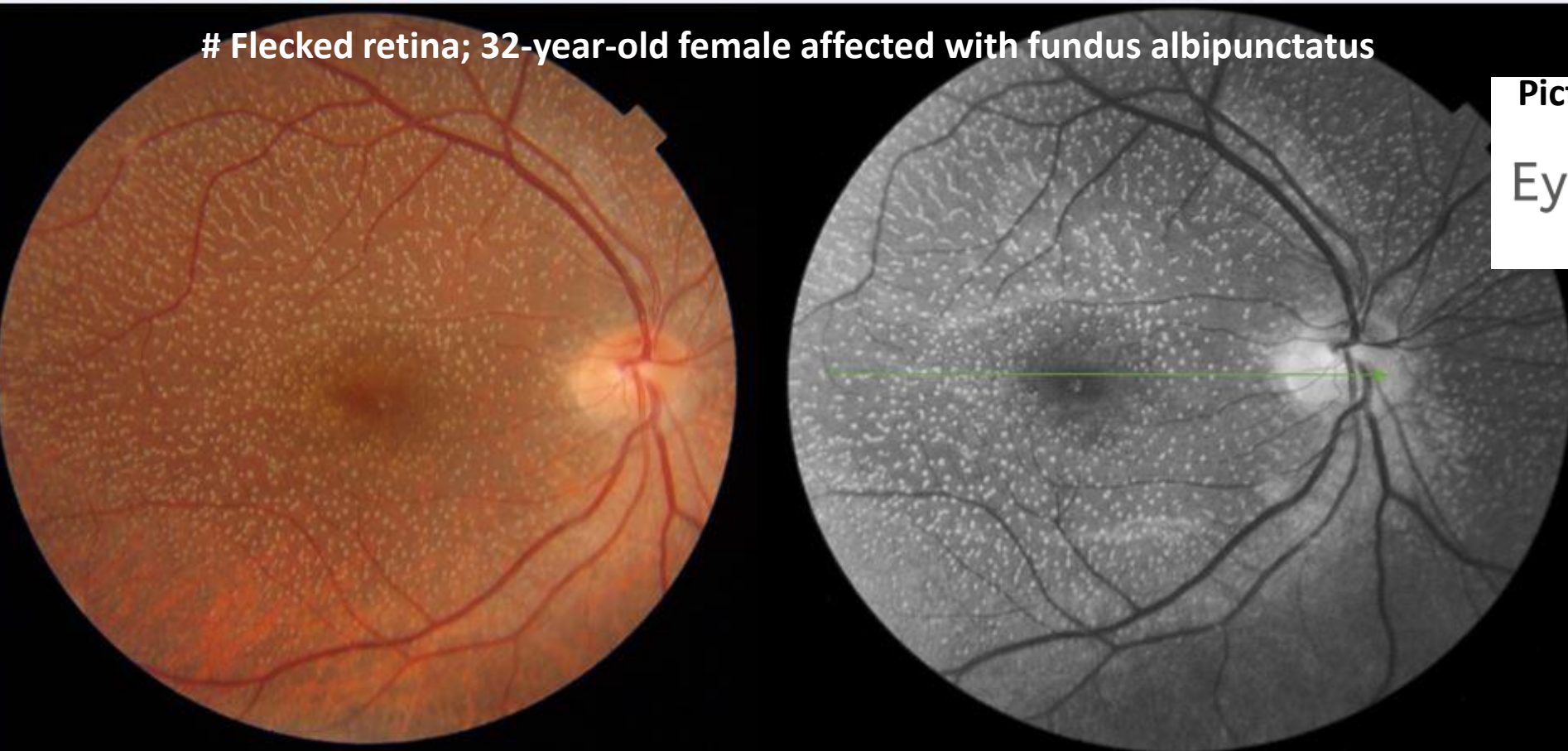
SOFT DRUSEN



SDD



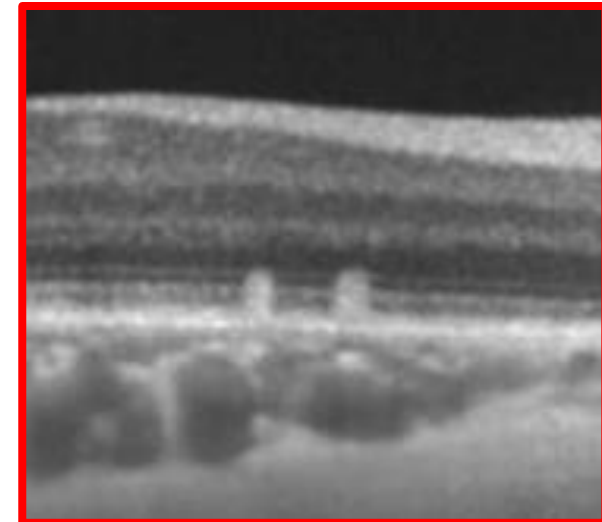
Flecked retina; 32-year-old female affected with fundus albipunctatus



Picture of the month OCT 2019 (ERN
Eye Diseases (ERN-EYE))



c.470G-A c712G-T in
RDH5



NUOVE TECNOLOGIE IN COMMERCIO.....

SD OCT montage using HRA spectralis OCT



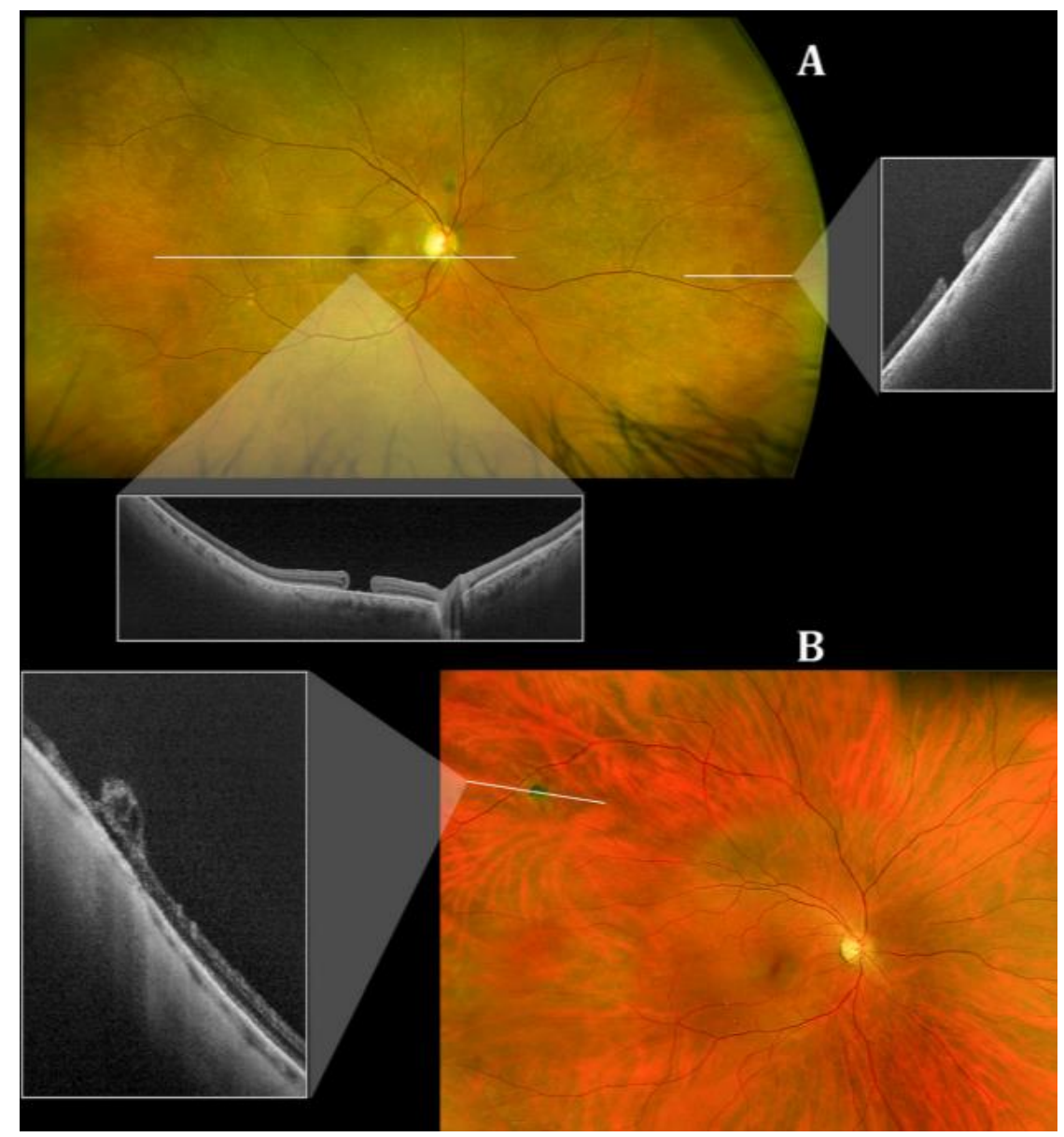
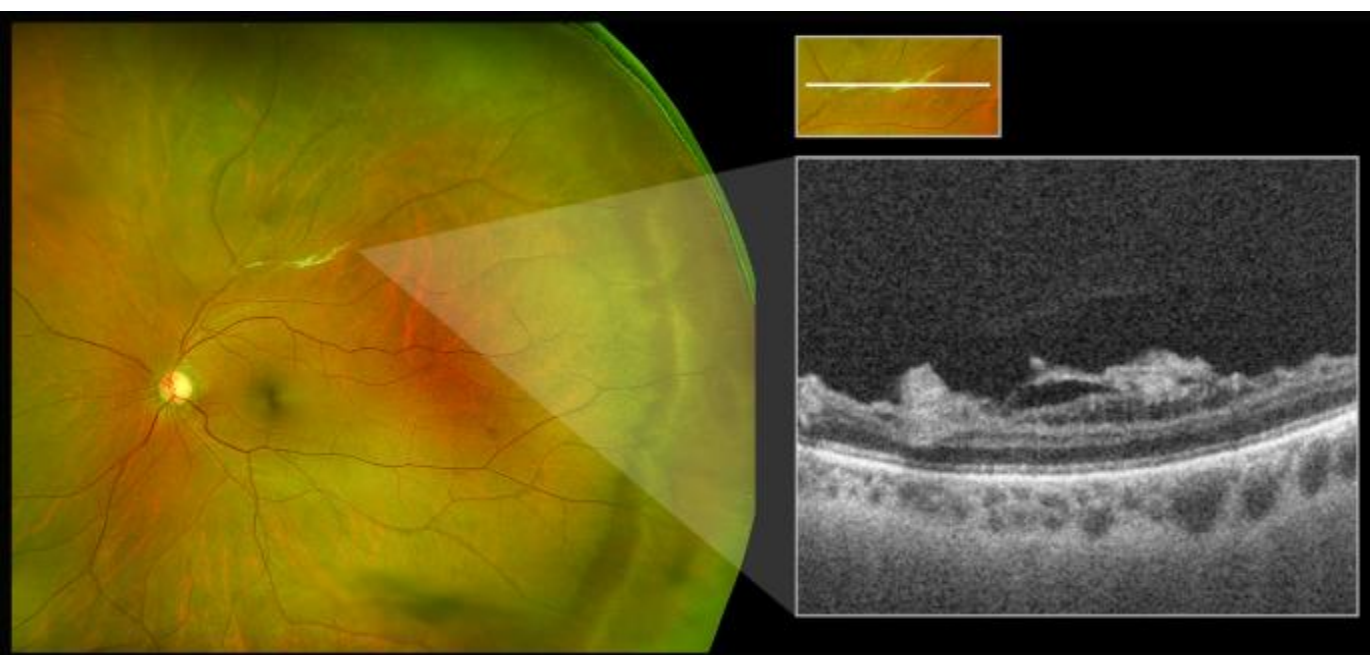
Imaging device

Optical coherence tomography
system
Heidelberg Spectralis OCT
system

Description

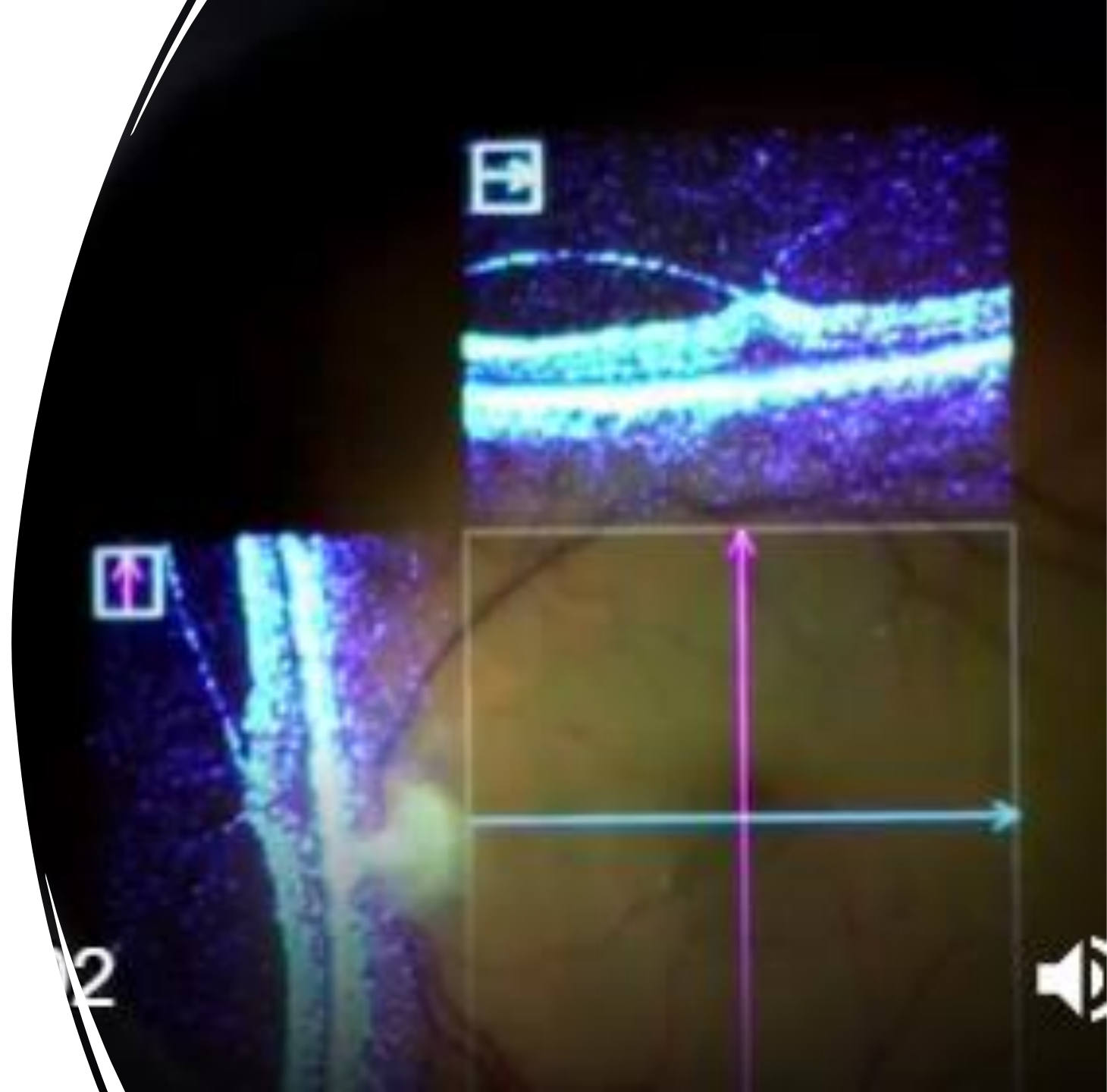
This is an SD-OCT montage
image of a 55 year old
male representing a wide-
field OCT spanning 130
degrees

Ultrawidefield OCT (UWF) OCT

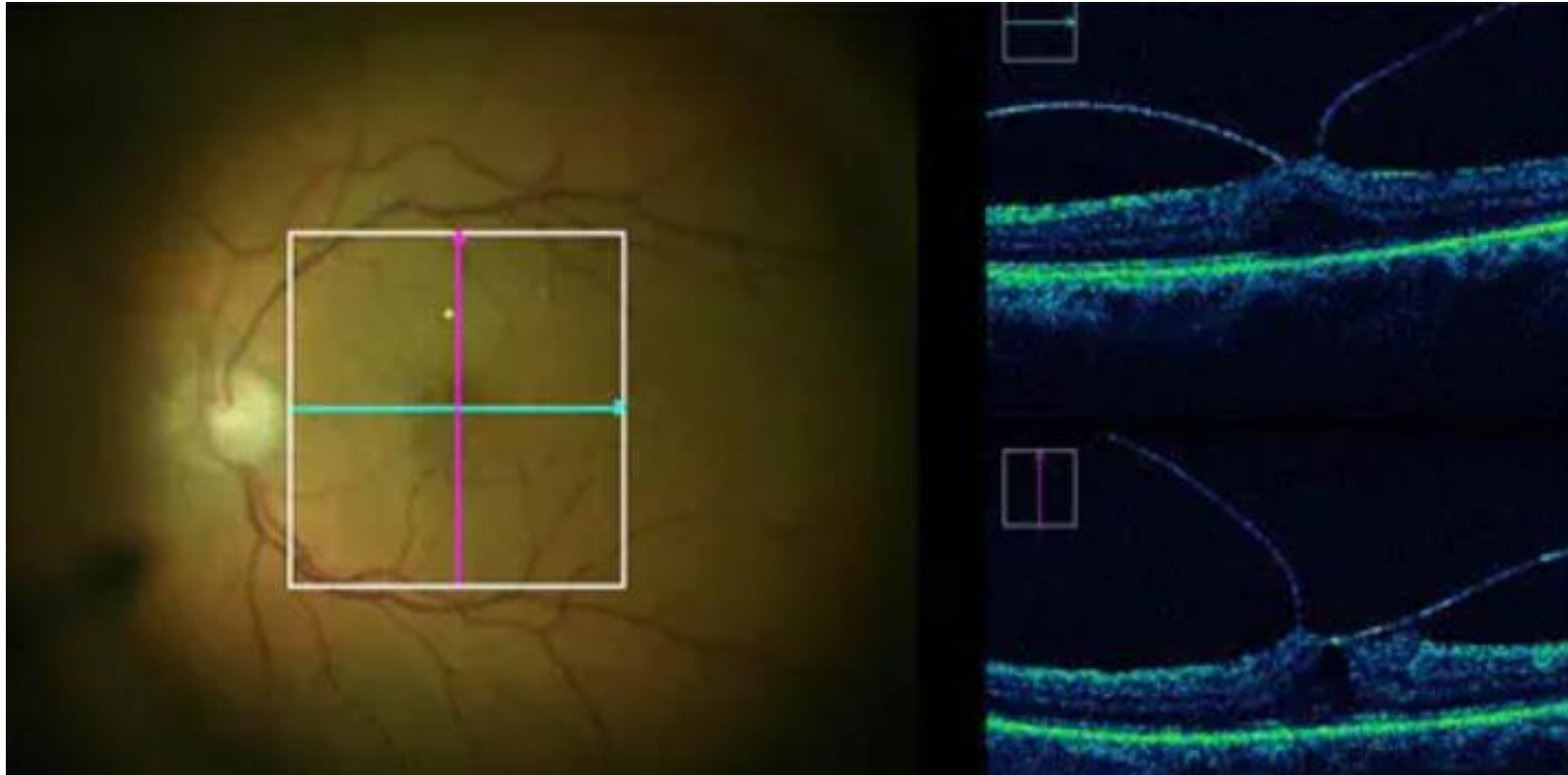


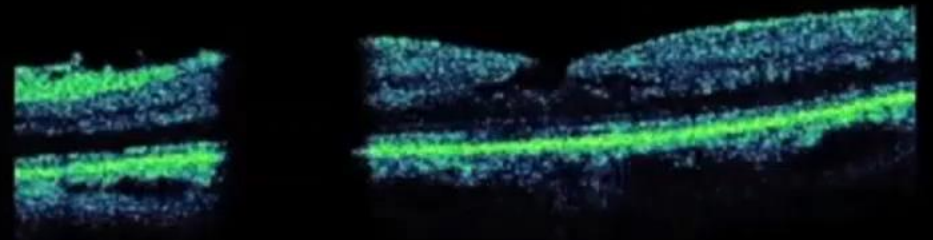
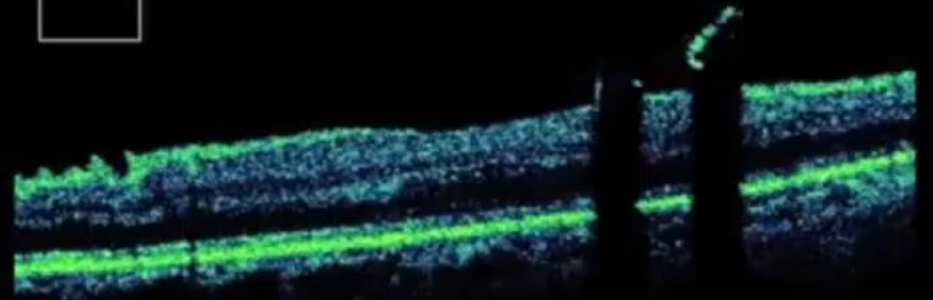
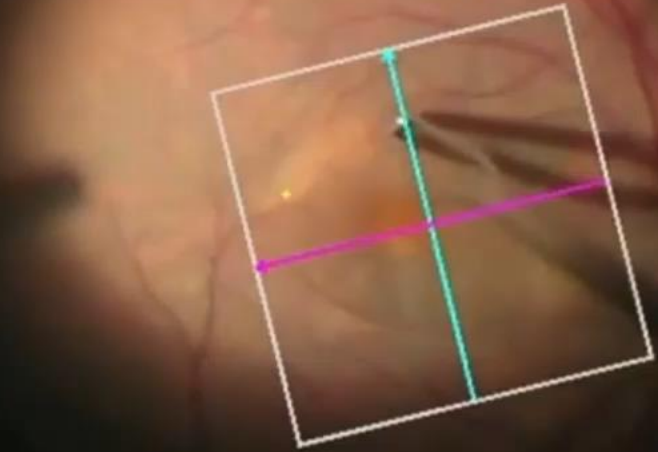
OCT retinico intraoperatorio(iOCT)

- Utile supporto nella chirurgia maculare (foro maculare, peeling ILM e pucker maculare)



- ❑ Monitorare il decorso operatorio durante la chirurgia
- ❑ Valutare outcome chirurgico post op (foro chiuso?)
- ❑ Studiare le possibili complicanze intraoperatorie (sanguinamento, rotture retiniche..)





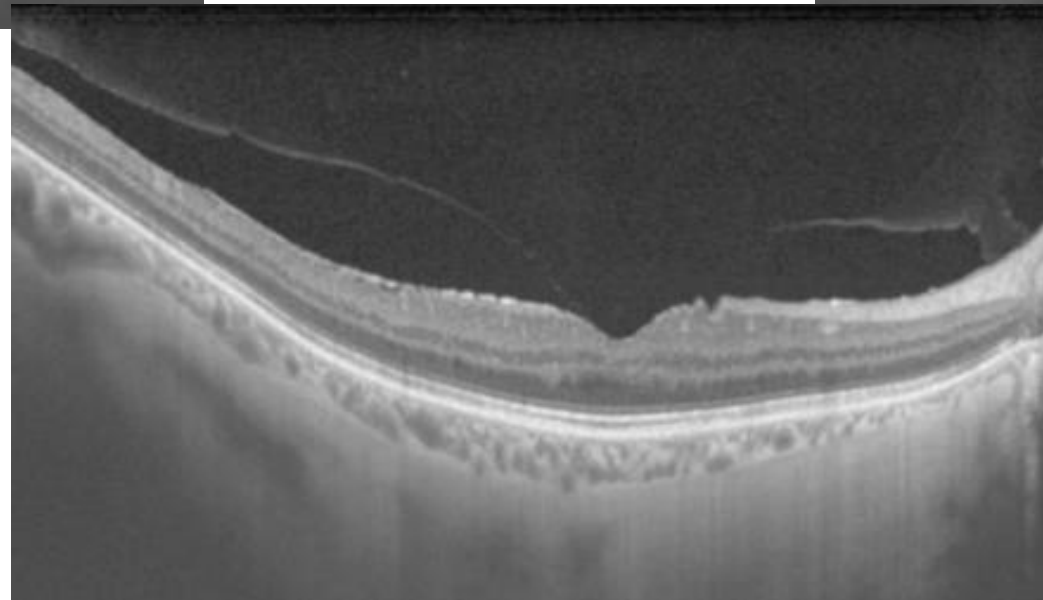
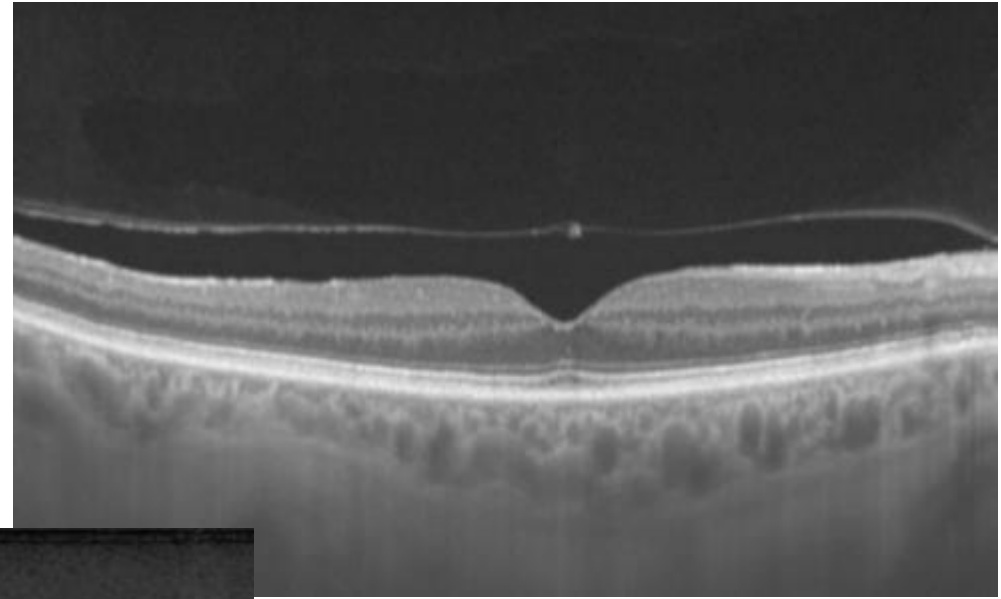
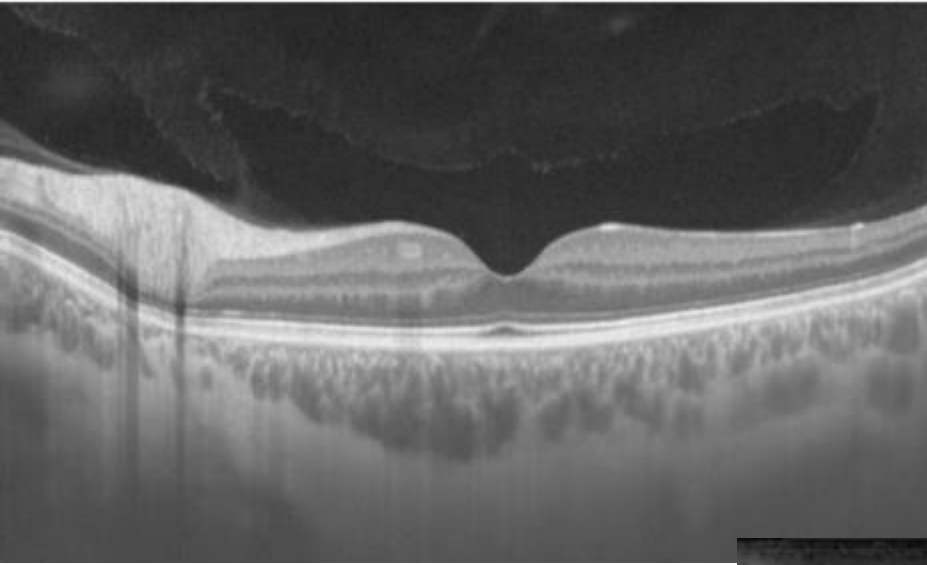
Il futuro degli OCT va verso un ulteriore miglioramento della definizione dei particolari strutturali...

...con possibilità di scansioni coroideali e vitreali AD ALTA RISOLUZIONE

...con la possibilità di un'indagine vascolare non invasiva mediante OCT angiografia (OCTA)

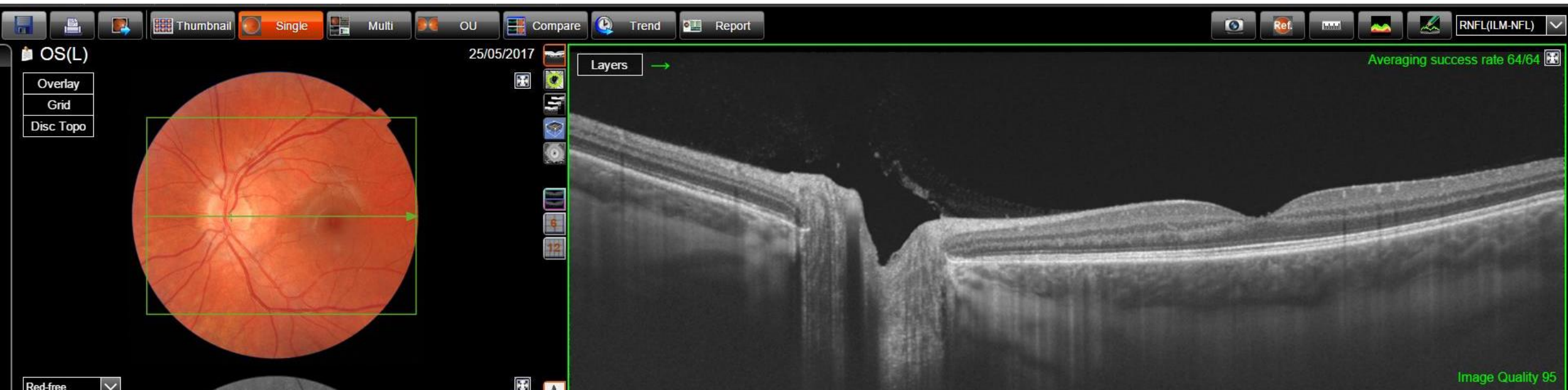
Vantaggi tecnologia swept source (SS-OCT)

Sensibilità ottimizzata per la visualizzazione di vitreo e coroide ad alta definizione

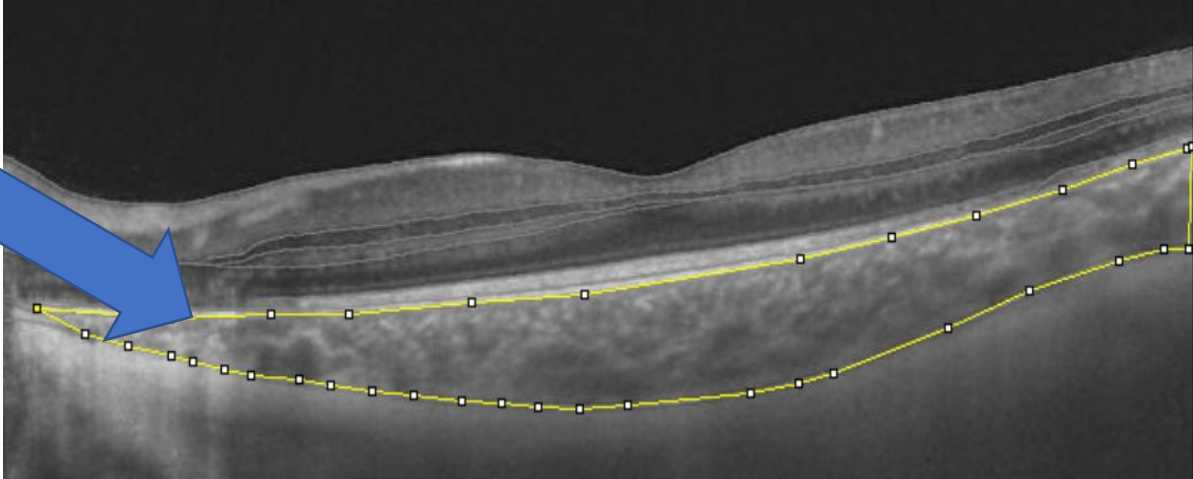


High definition OCT line 12x9 mm SS-OCT

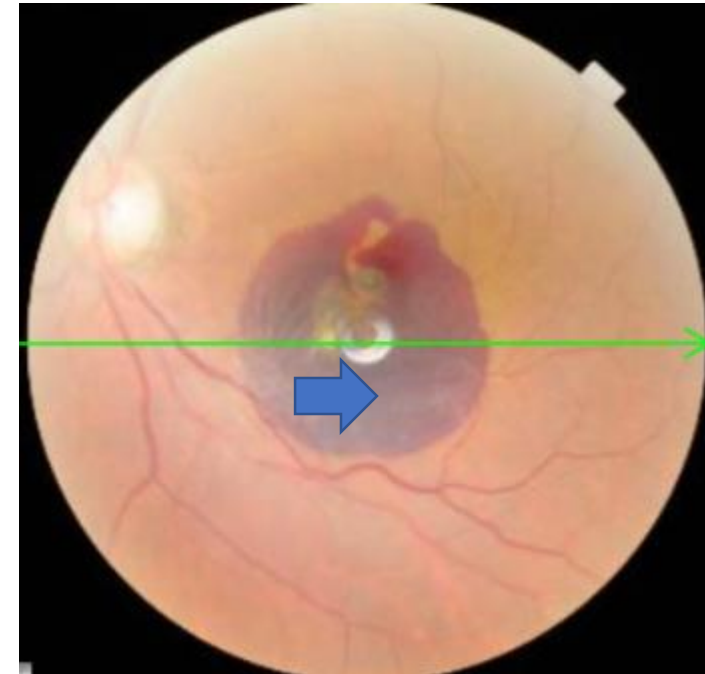
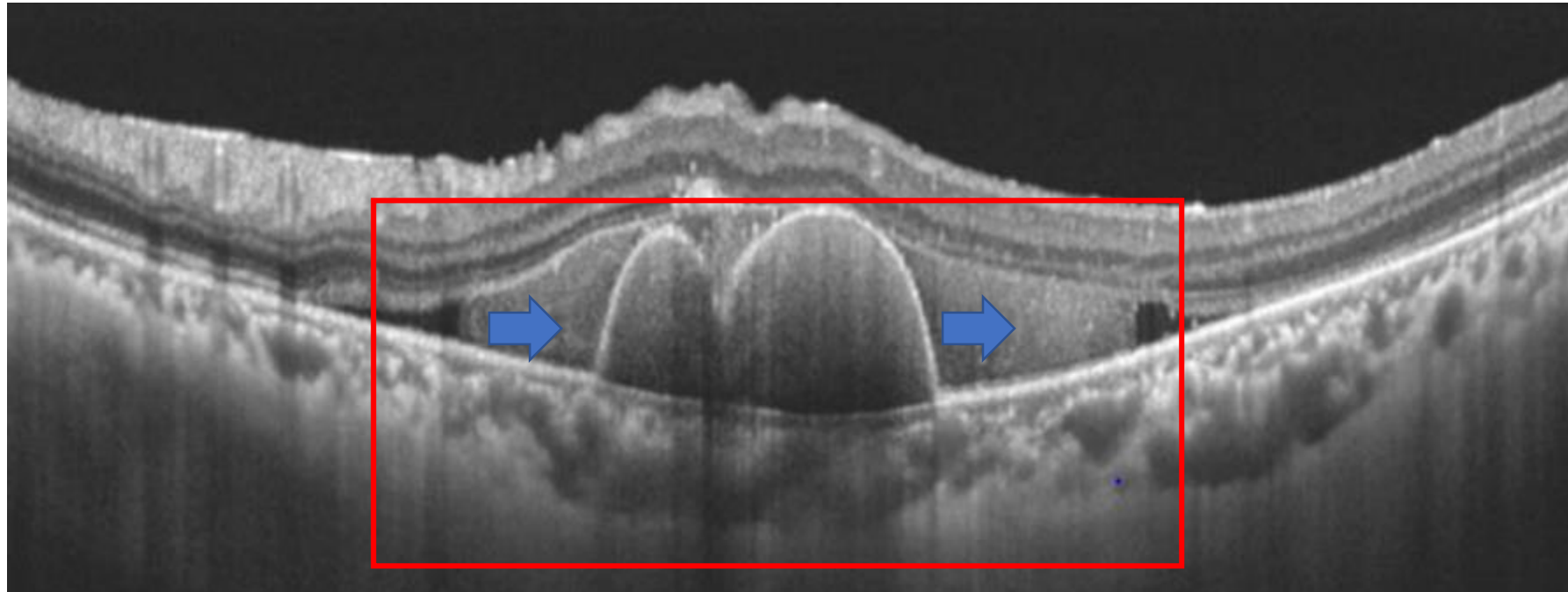
[DRI OCT Triton, OCT swept source](#)



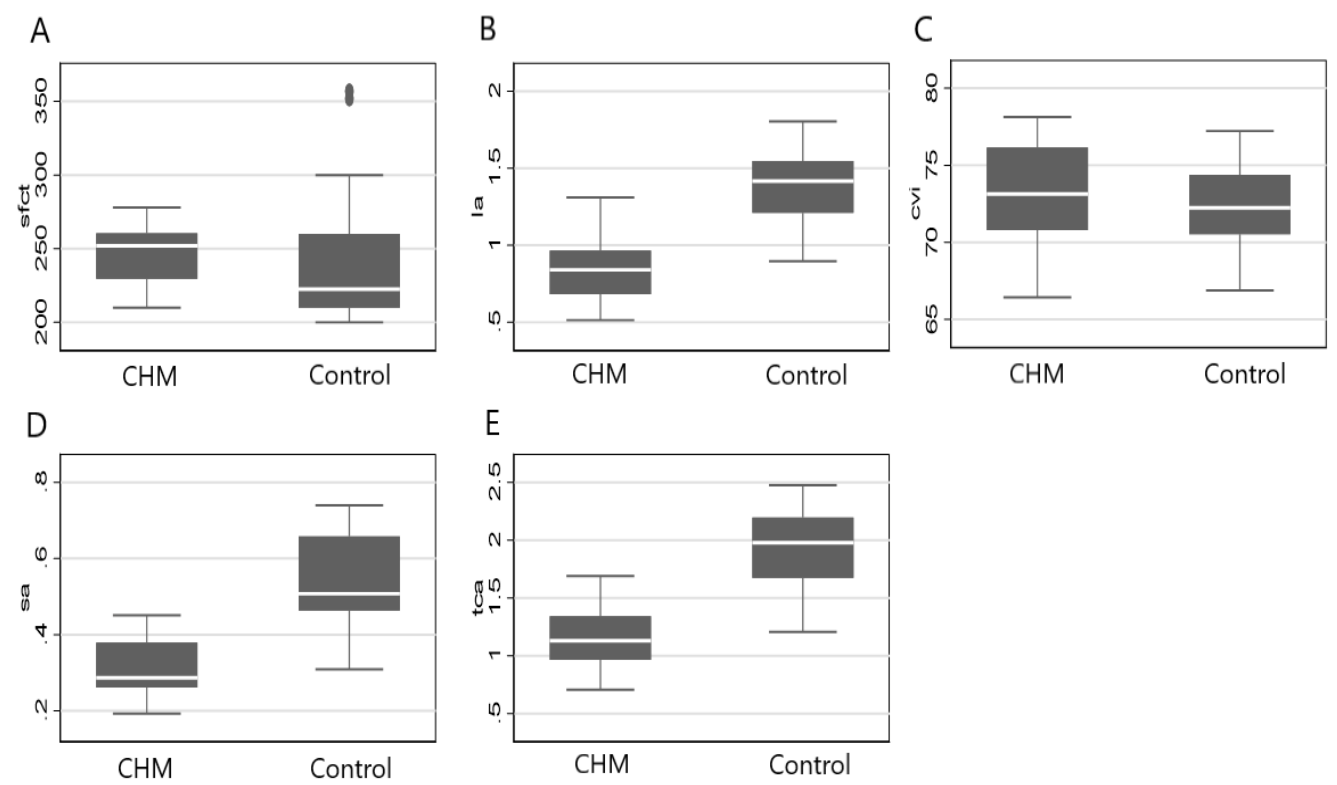
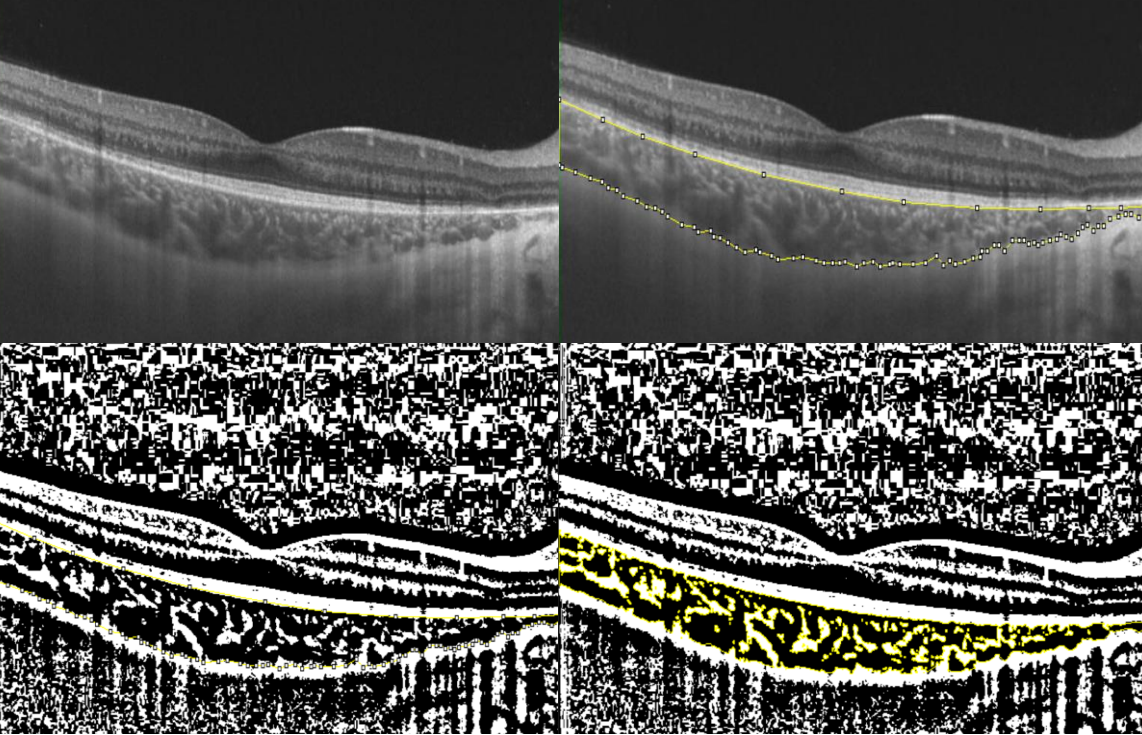
Choroidal mode- Per visualizzare la coroide



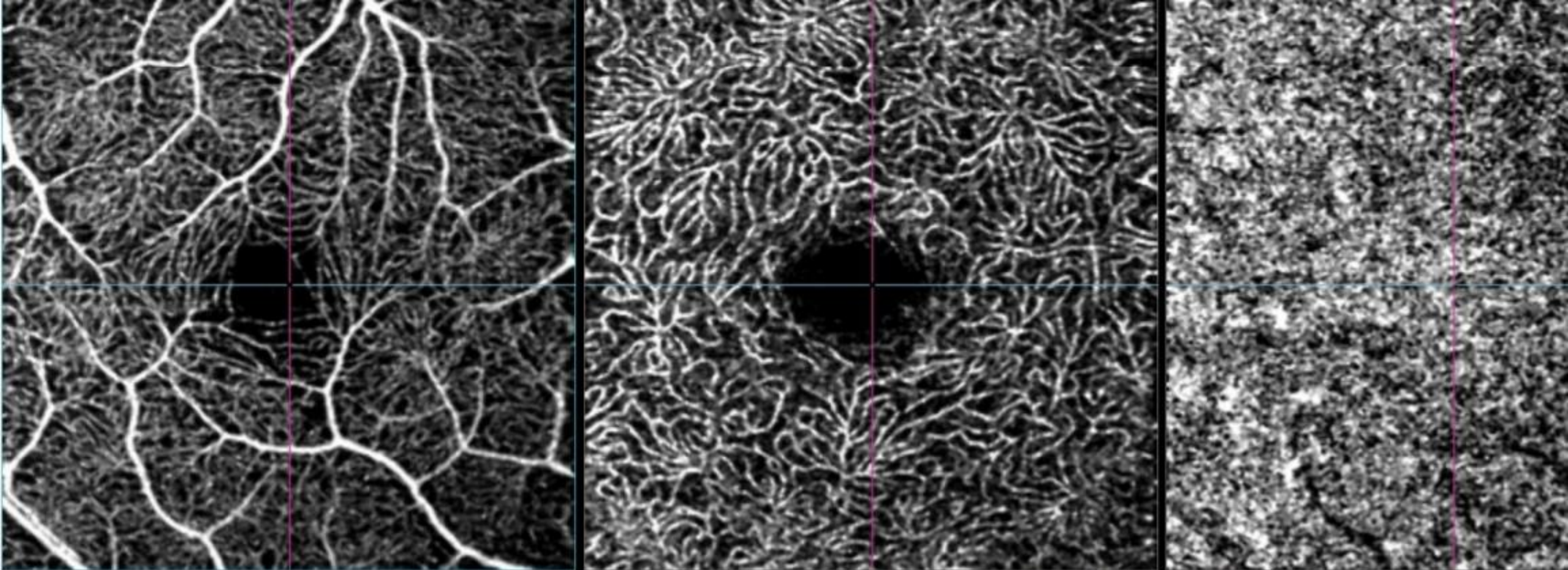
Migliore penetrazione attraverso opacità, cataratta, emorragie maculari



High-definition SS-OCT 9 mm scan



choroidal parameters (9 mm scan)	CHM patients	Control group	P
SFCT (micron)	247 ± 20,3 (210-278)	246 ± 53,5 (200-357)	0,959
LA (mm ²)	0,842 ± 0,20 (0,514-1,311)	1,400 ± 0,23 (0,897-1,803)	<0,01
SA (mm ²)	0,305 ± 0,07 (0,193-0,451)	0,539 ± 0,12 (0,309- 0,740)	<0,01
TCA (mm ²)	1,148 ± 0,27 (0,707- 1,690)	1,939 ± 0,34 (1,707-2,476)	<0,01
CVI (LA/TCA)	73,21 ± 3,64 (69,56-77,74)	72,35 ± 2,71 (66,87-75,89)	0,535



Superficial



Deep

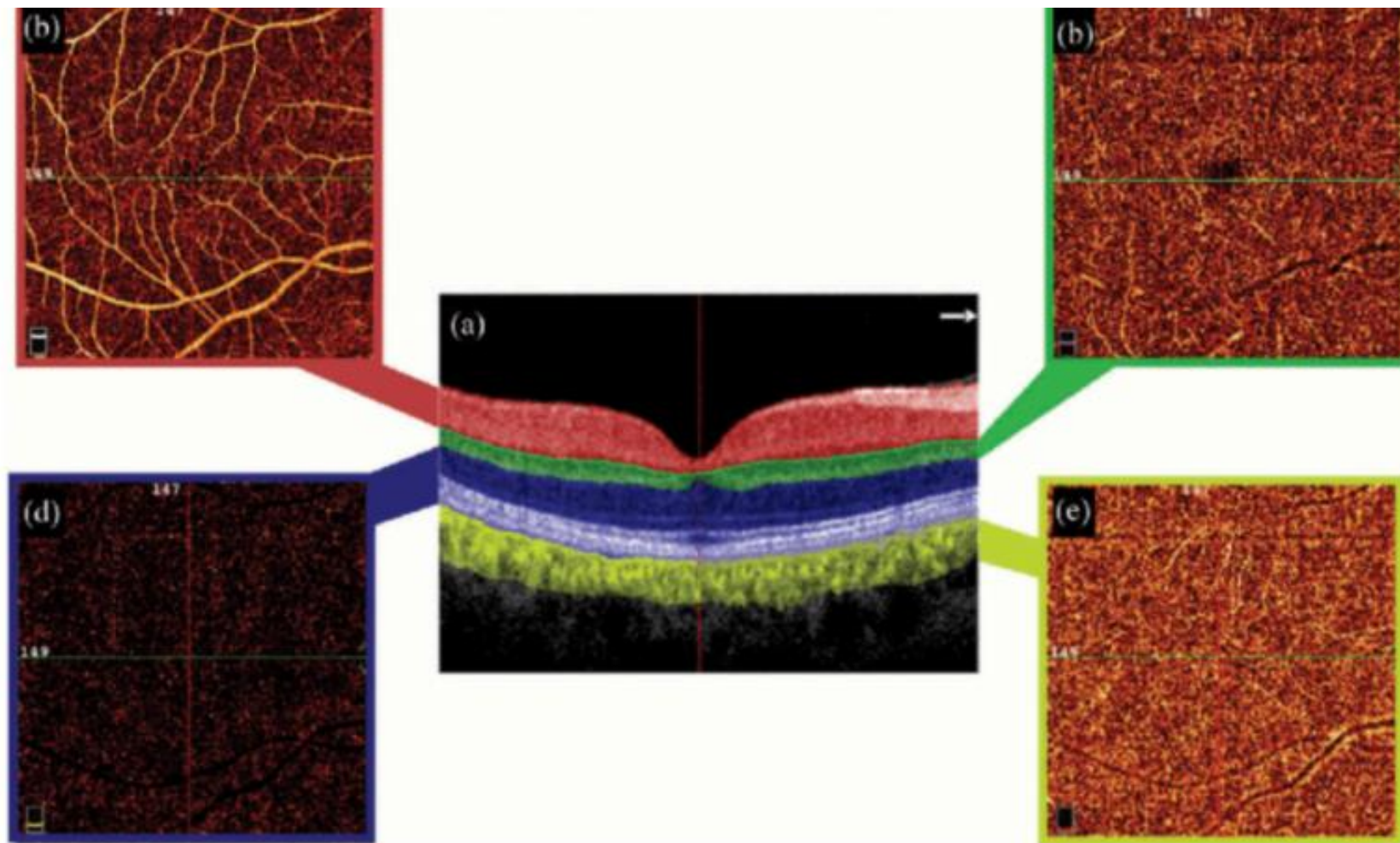


Choriocapillaris



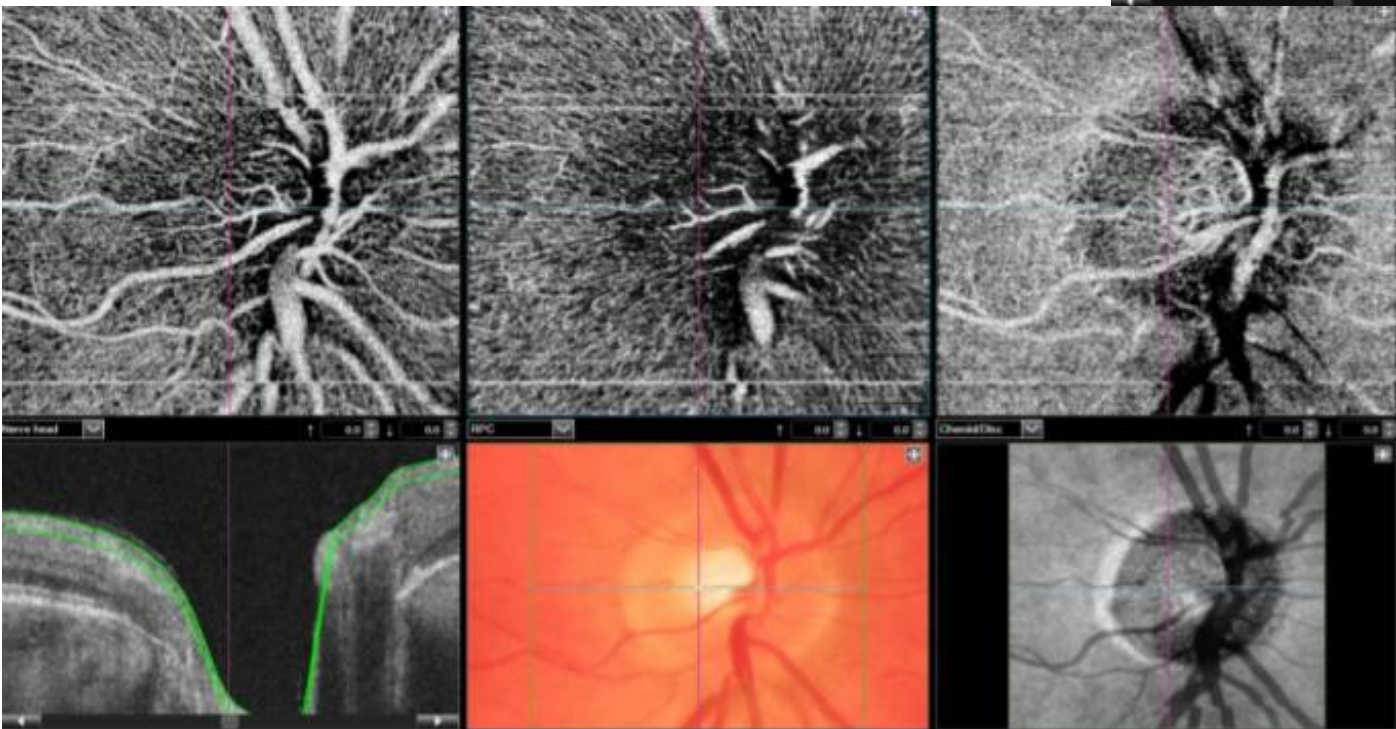
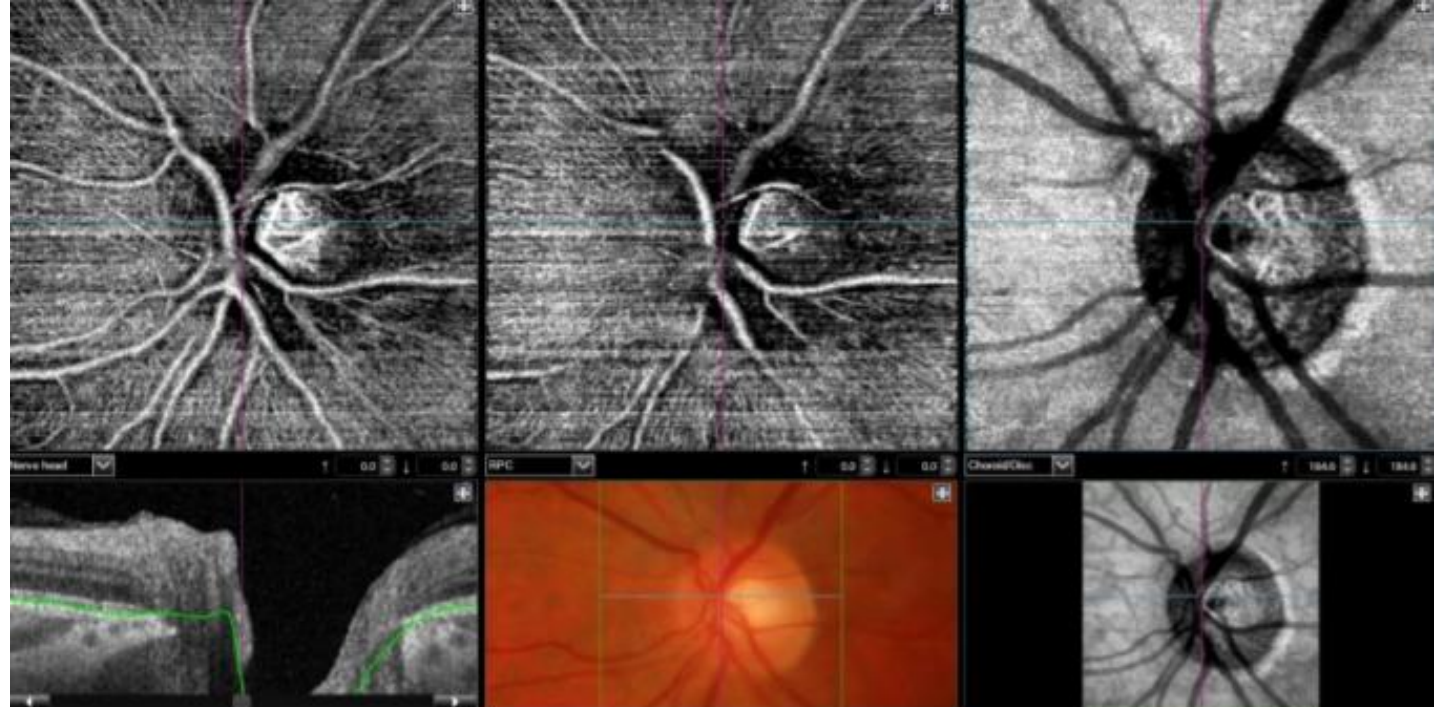
OCT angiografia



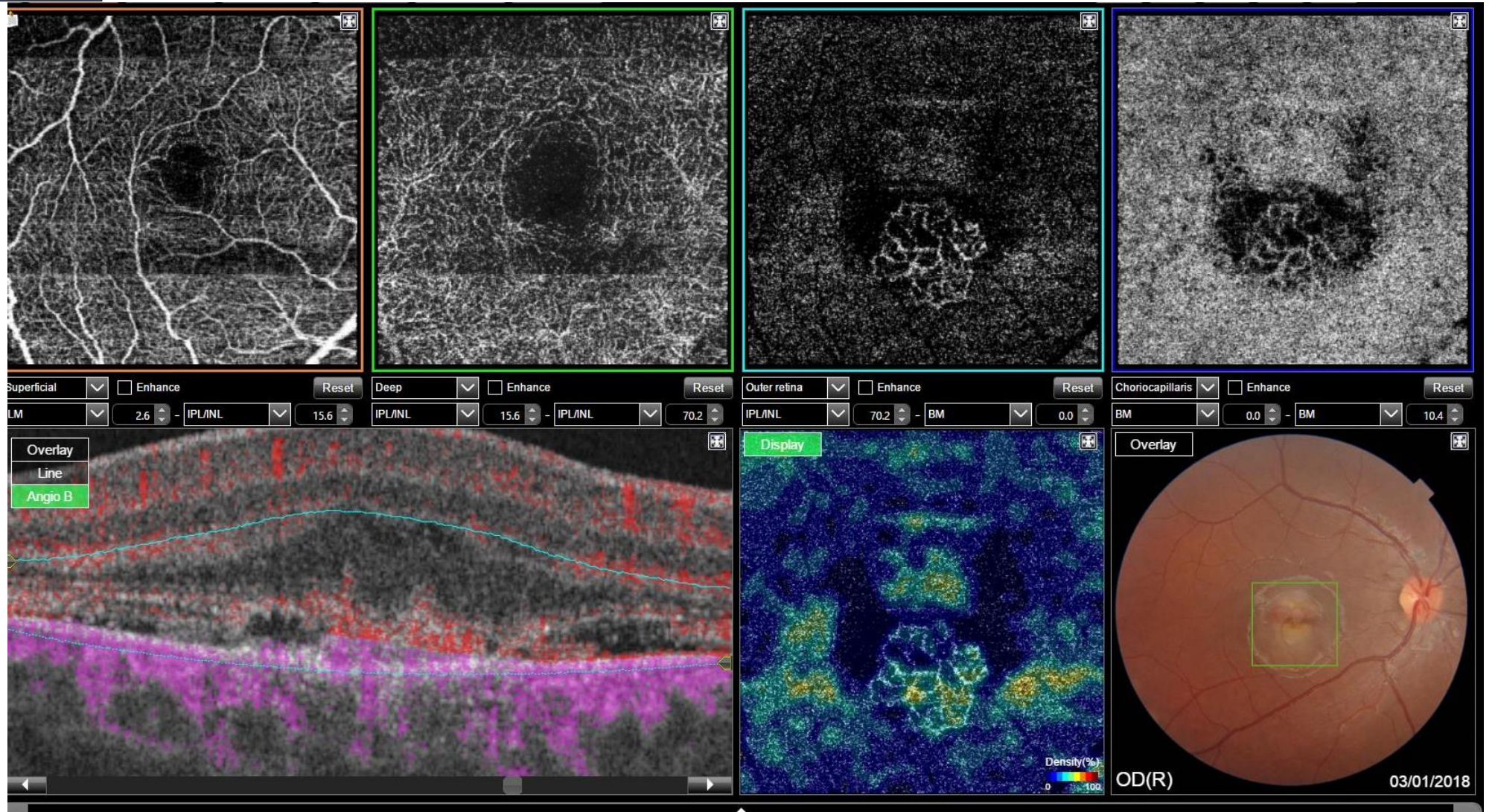


Depth localization of different OCTA segmentation slabs on B-Scan (a). Superficial Vascular plexus (b) correspond to area from internal limiting membrane to outer boundary of the inner plexiform layer. Deep capillary plexus (c) corresponds to an area between outer boundaries of the inner plexiform layer to outer boundary of the outer plexiform layer. Outer Retinal slab (d) is avascular area from outer nuclear layer to RPE, and Choriocapillaris segmentation (e) include Bruch's membrane and up to 20 μm below). Shadowing of larger vessels from superficial vascular plexus is evident on all three outer segmentations (c, d and e)

PAPILLA

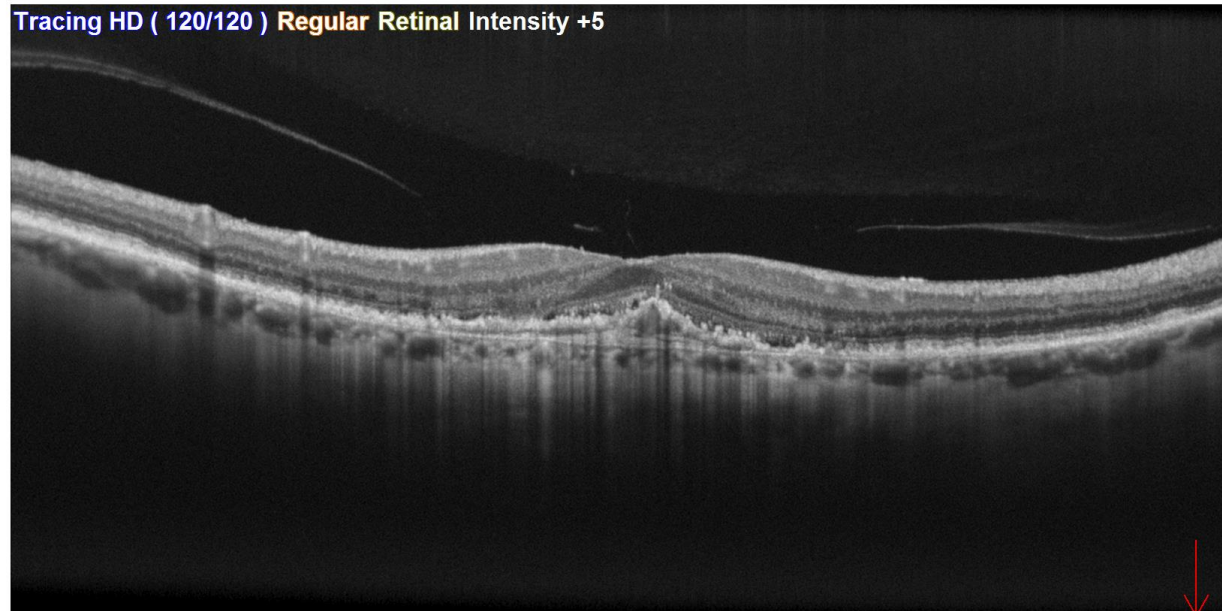


MACULA

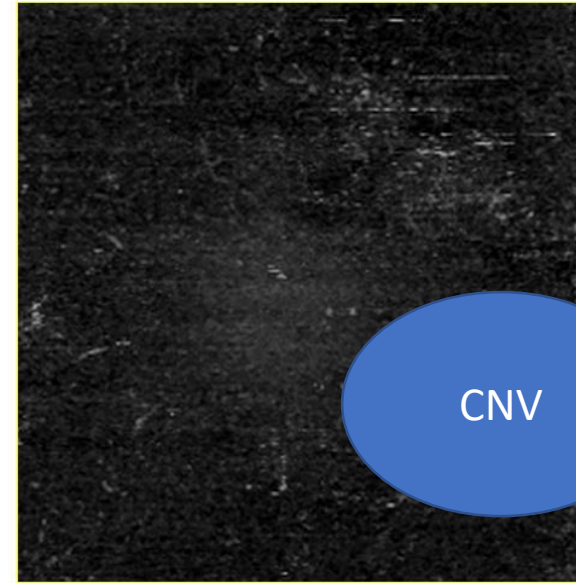


Utilizzata per caratterizzare e studiare in maniera non invasiva la vascolarizzazione retinica e coroideale di alcune malattie della retina

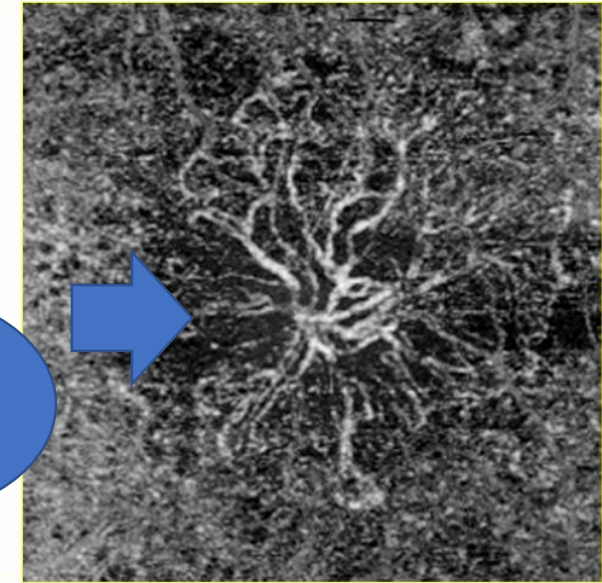
Degenerazione maculare senile



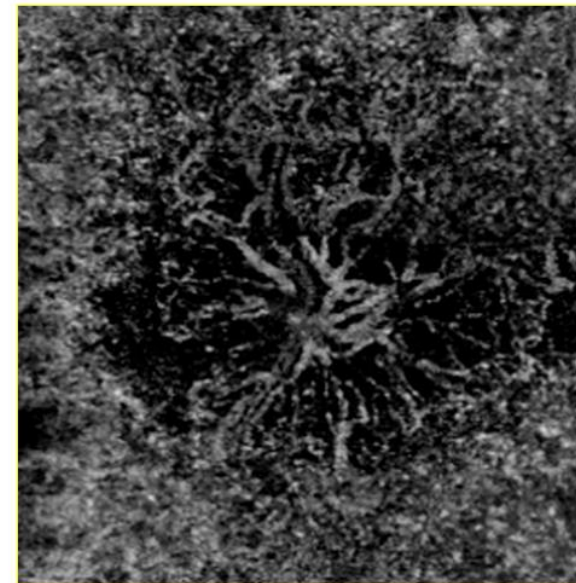
Outer retina



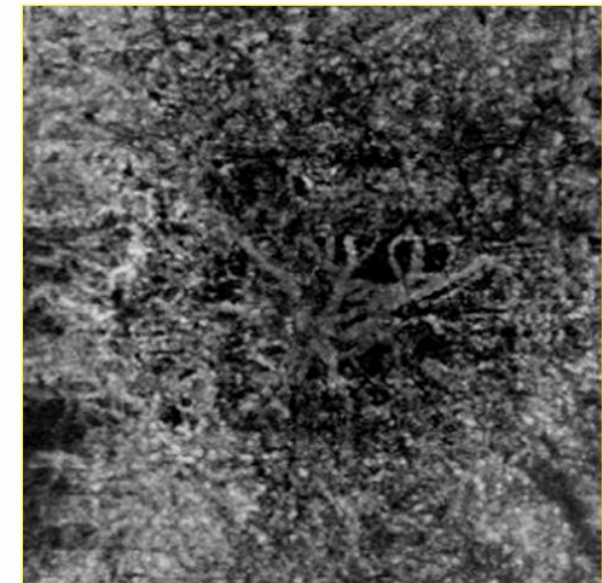
ORCC



Choriocapillaris

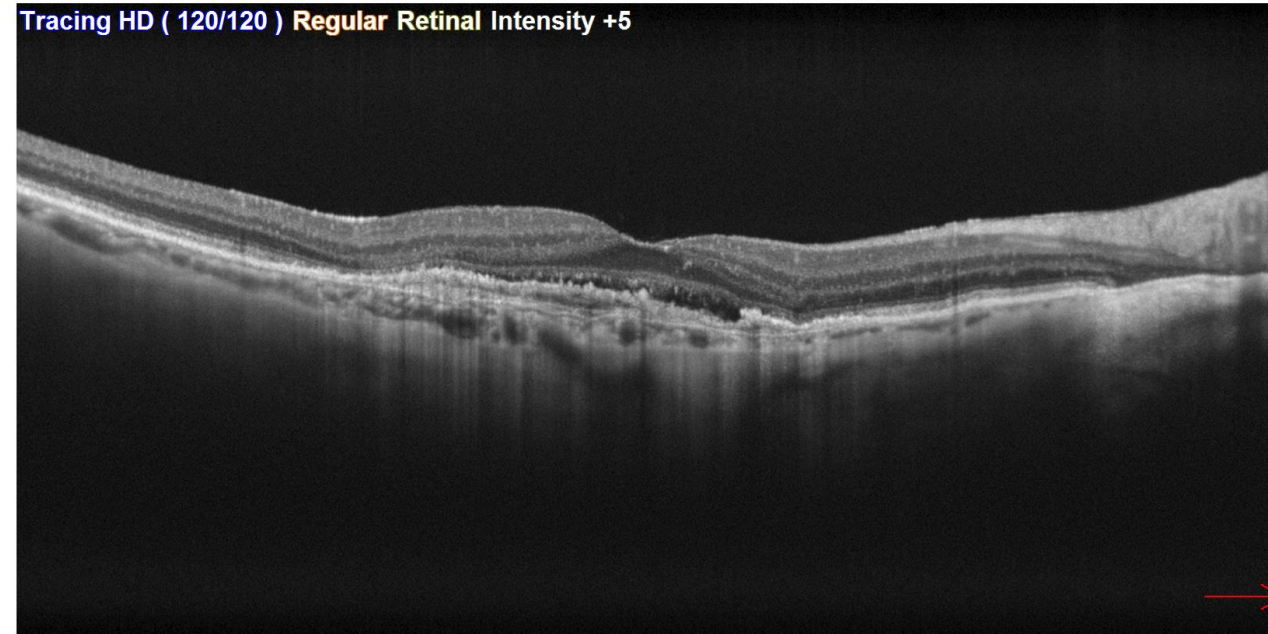


Choroid



h[1024]) Eye:R

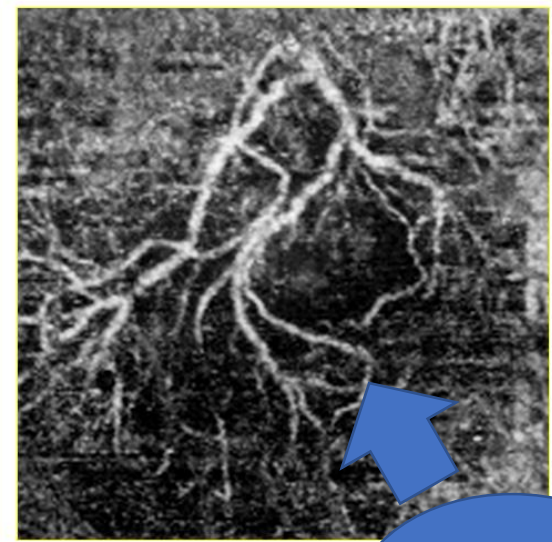
SLO Focus [D] Axial [mm]
Wide -0.25 Gullstrand



Outer retina



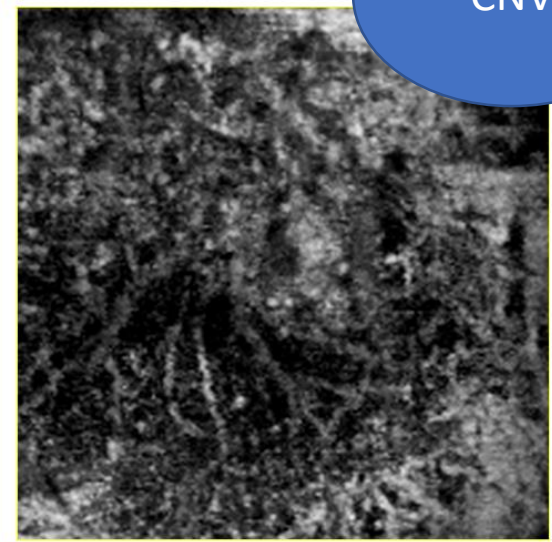
ORCC



Choriocapillaris



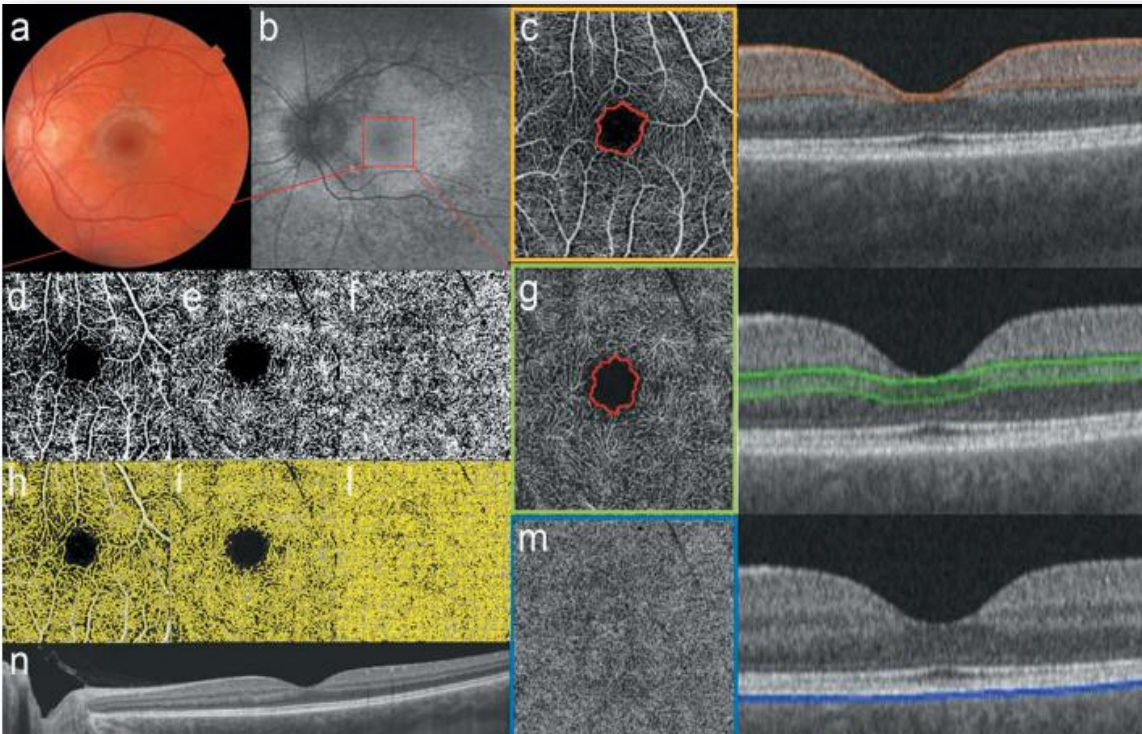
Choroid



CNV

Coroideremia

- BCVA 20/20 all
- 5/7 CHM genetically characterized
- All phakic ,
- All CHM patients were characterized by a preserved 3x3 central macular area



QUANTITATIVE ANALYSIS OF THE MACULAR VASCULAR DENSITY,FAZ AND STRUCTURAL PARAMETERS BETWEEN CHM PATIENTS AND CONTROLS

	PATIENTS	CONTROLS	P VALUE
SCP			
FAZ(μm^2)	198,99 \pm 83,68	288,708 \pm 45,05	P<0,001
VD (%)	76.239 \pm 4,56	105.322 \pm 4,10	P<0,001
DCP			
FAZ(μm^2)	243,98 \pm 86,11	320,16 \pm 48,21	P<0,001
VD(%)	73.059 \pm 3,30	104.740 \pm 4,26	P<0,001
CC (VD) (%)	51.622 \pm 11.85	74.530 \pm 2.565	P<0,01
CRT(μm)	245 \pm 21,2	212 \pm 8,01	P<0,01
CCT (μm)	234 \pm 53,7	259 \pm 52,5	P=0,342

- ***OCT-A examinations revealed early vascular abnormalities in both inner retinal layers and choriocapillaris.***
- ***A reduced vascular flow was also detectable in the presence of a preserved macular RPE at the color fundus, FA, and OCT examinations.***

Optical Coherence Tomography Angiography (OCT-A) in young choroideremia (CHM) patients.

Murro V, Mucciolo DP, Giorgio D, Sodi A, Passerini I, Virgili G, Rizzo S.

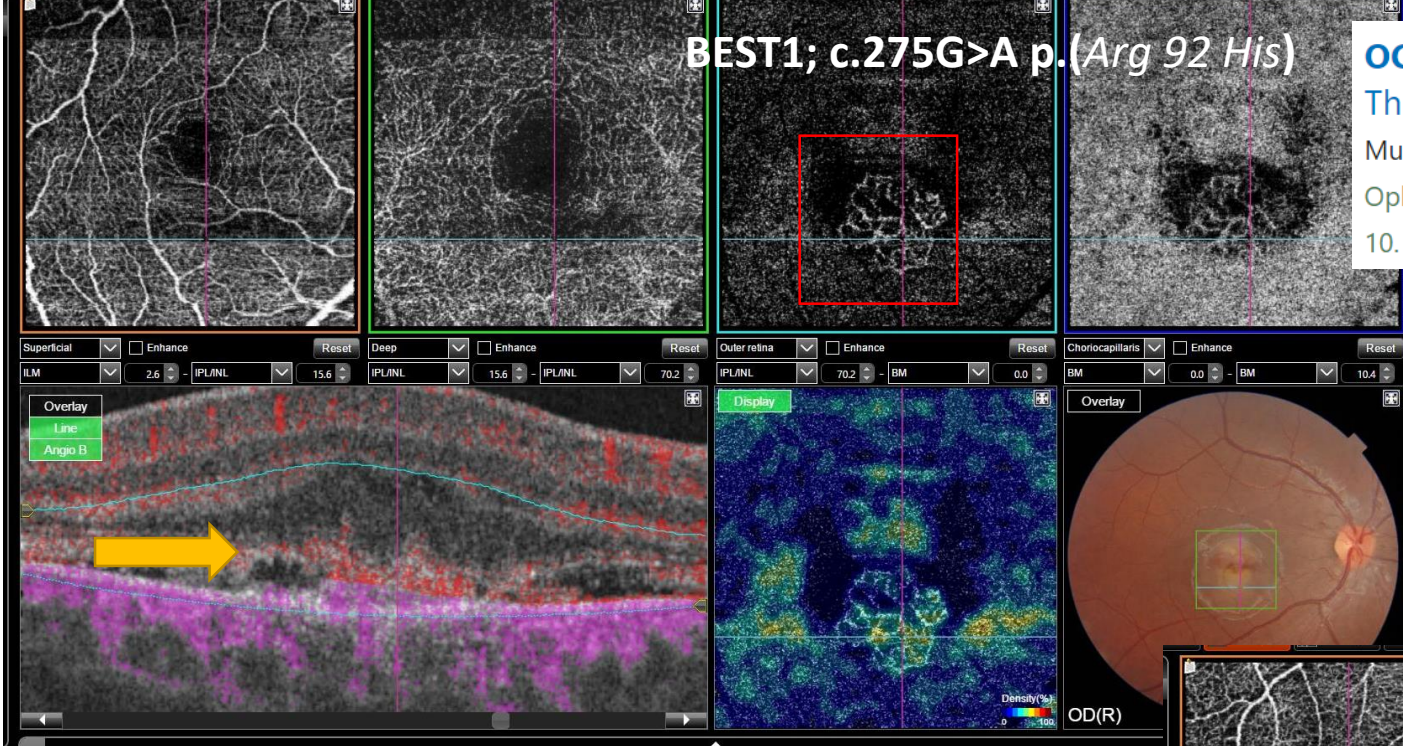
Ophthalmic Genet. 2019 Jun;40(3):201-206. doi: 10.1080/13816810.2019.1611880. Epub 2019 May 28.

BEST1; c.275G>A p.(Arg 92 His)

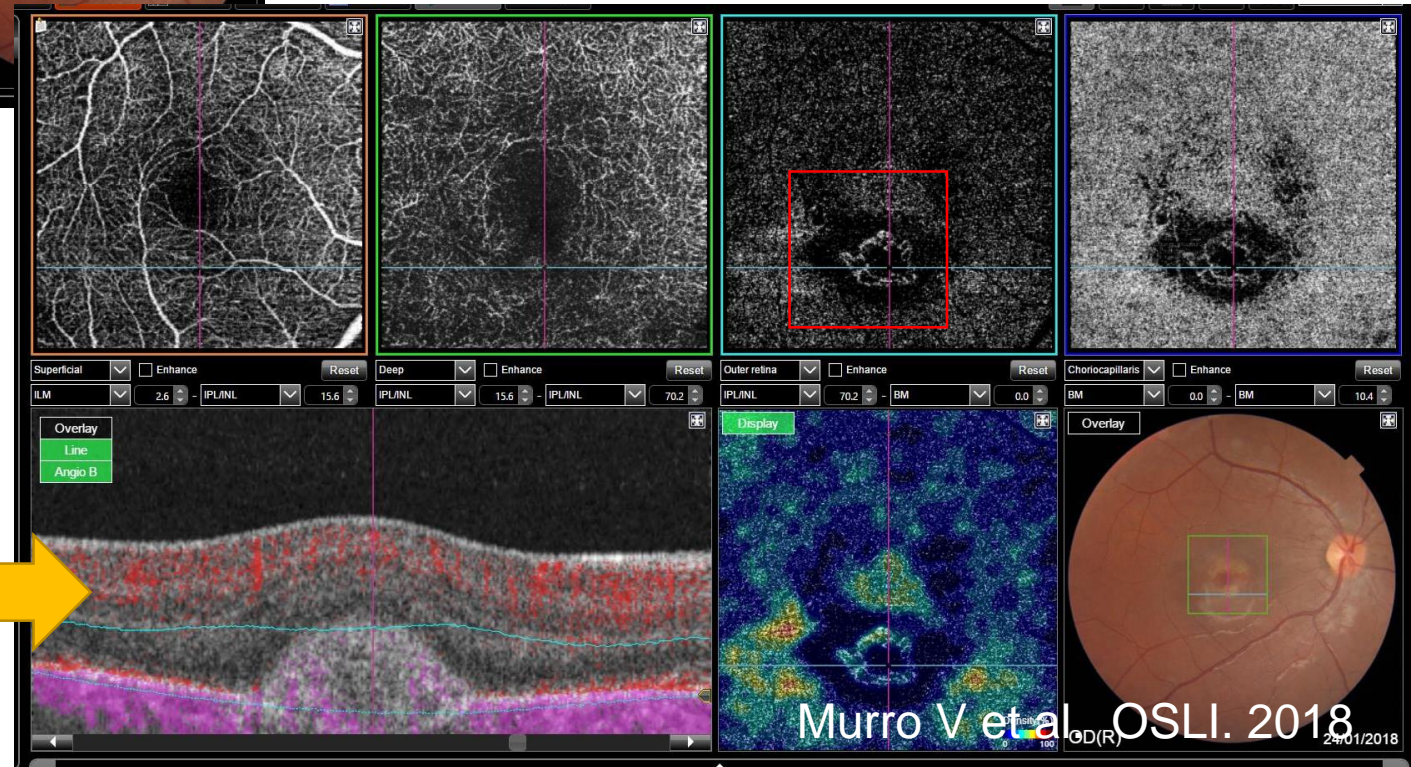
OCTA Imaging of Choroidal Neovascularization Treated Using Photodynamic Therapy in a Young Patient With Best Macular Dystrophy.

Murro V, Mucciolo DP, Giorgio D, Sodi A, Passerini I, Virgili G, Rizzo S.

Ophthalmic Surg Lasers Imaging Retina. 2018 Dec 1;49(12):969-973. doi: 10.3928/23258160-20181201-10.

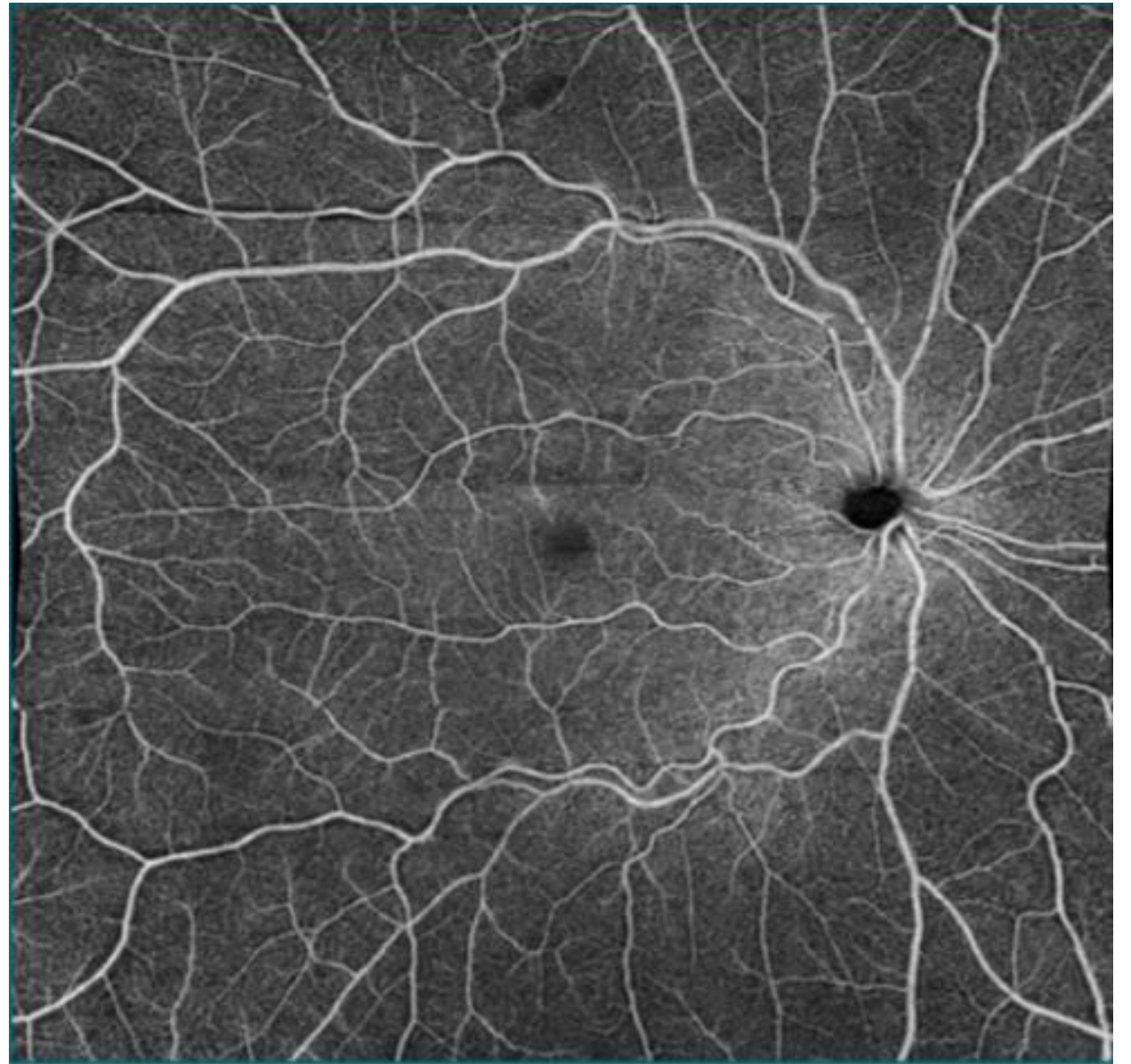


3 month post PDT



Evoluzione....

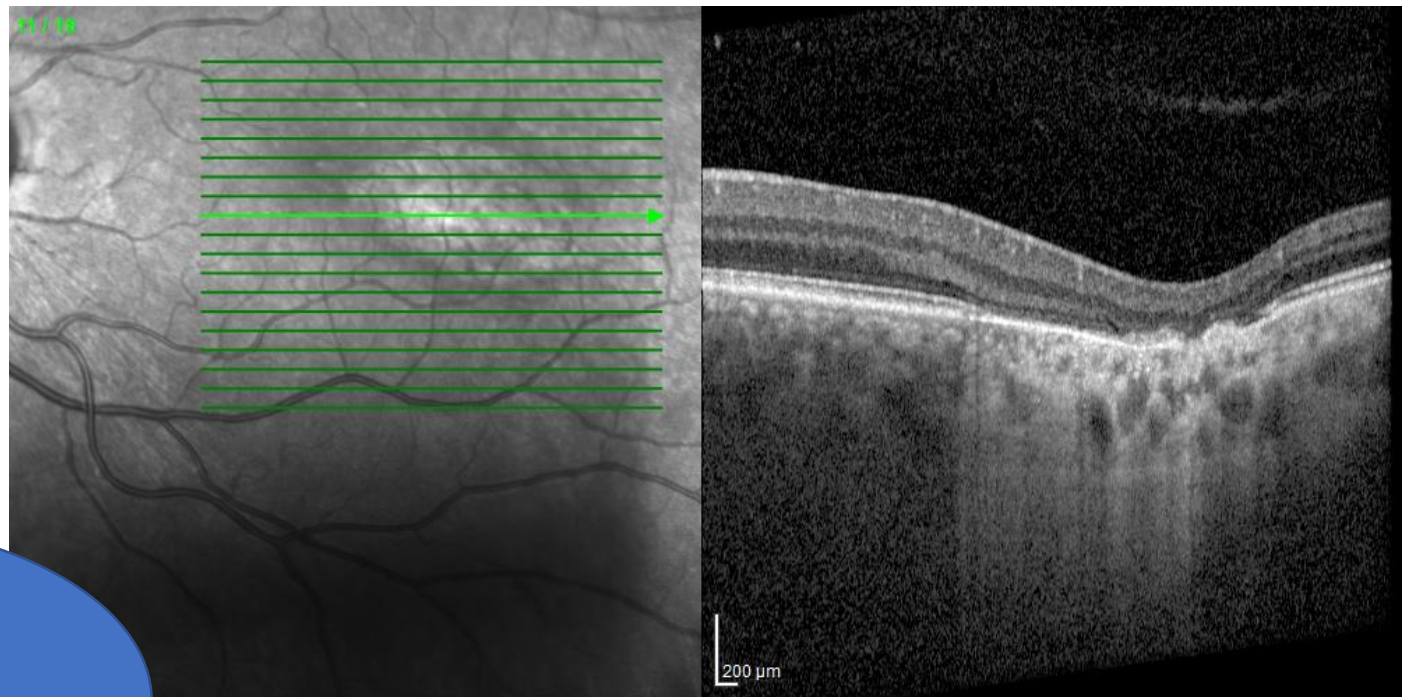
Studiare l'intera
vascolarizzazione
retinica



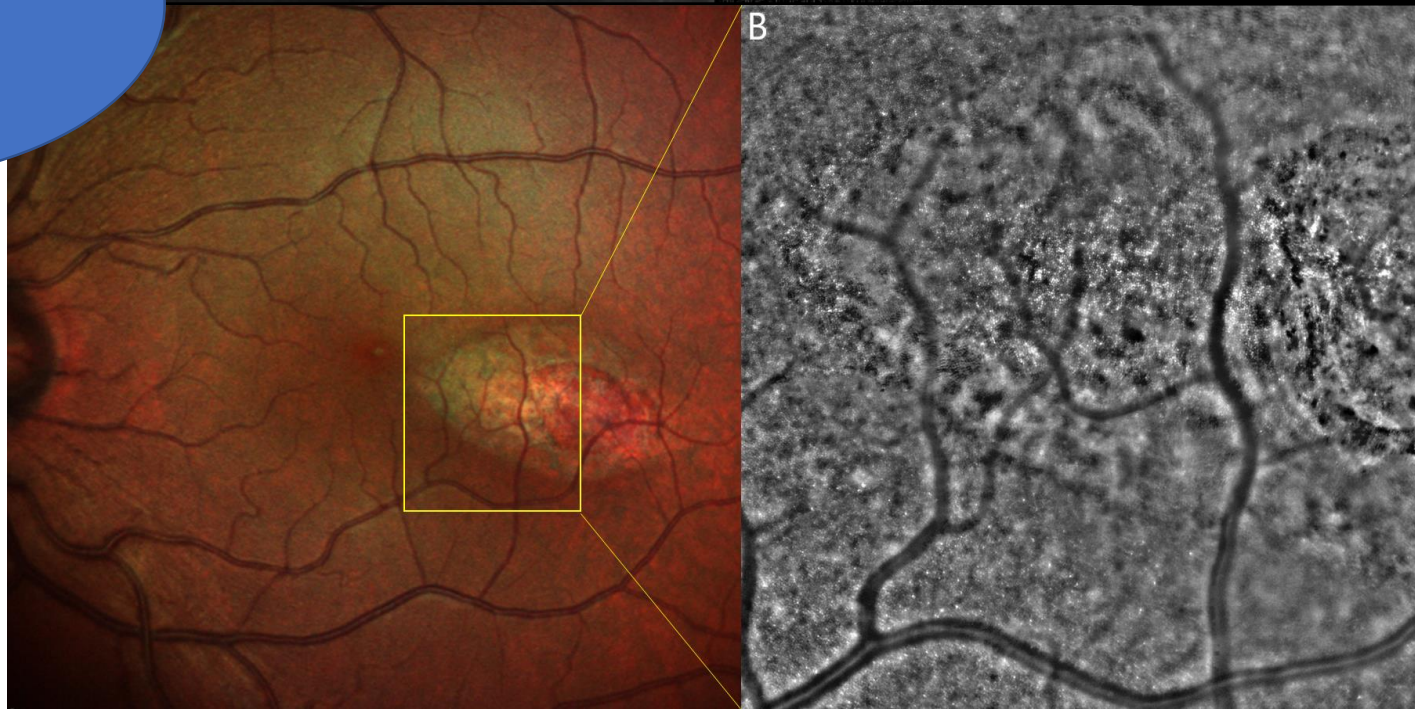
Montage 5 images 8x8mm con AngioPlex Cirrus Zeiss 5000

Per concludere

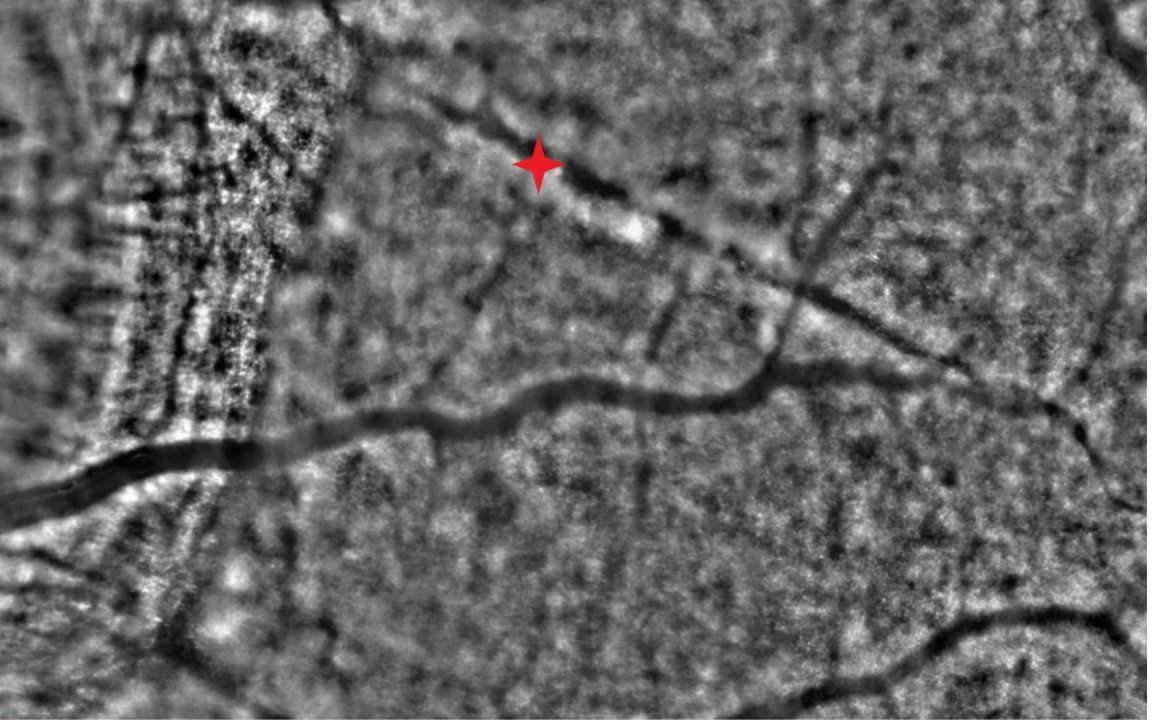
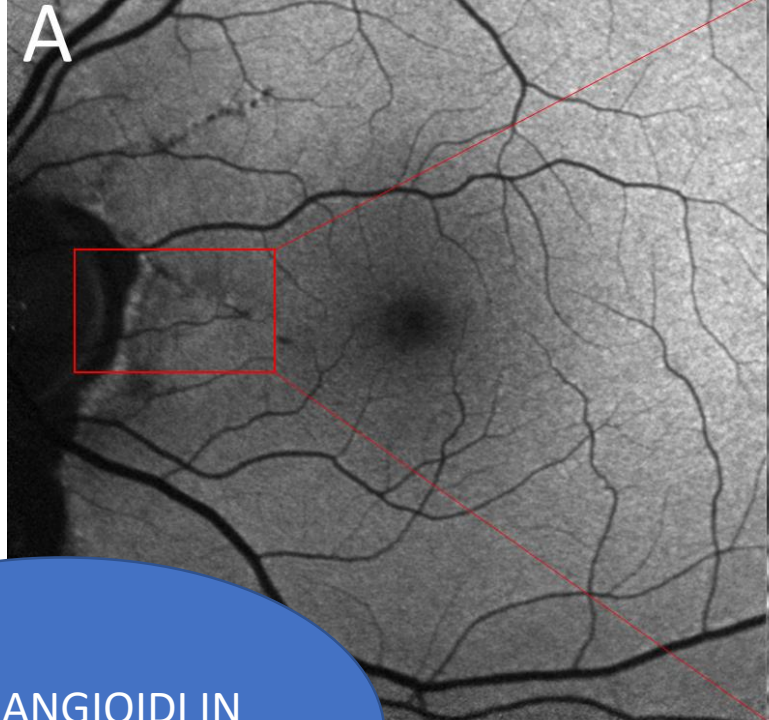
TORPEDO
MACULOPATHY



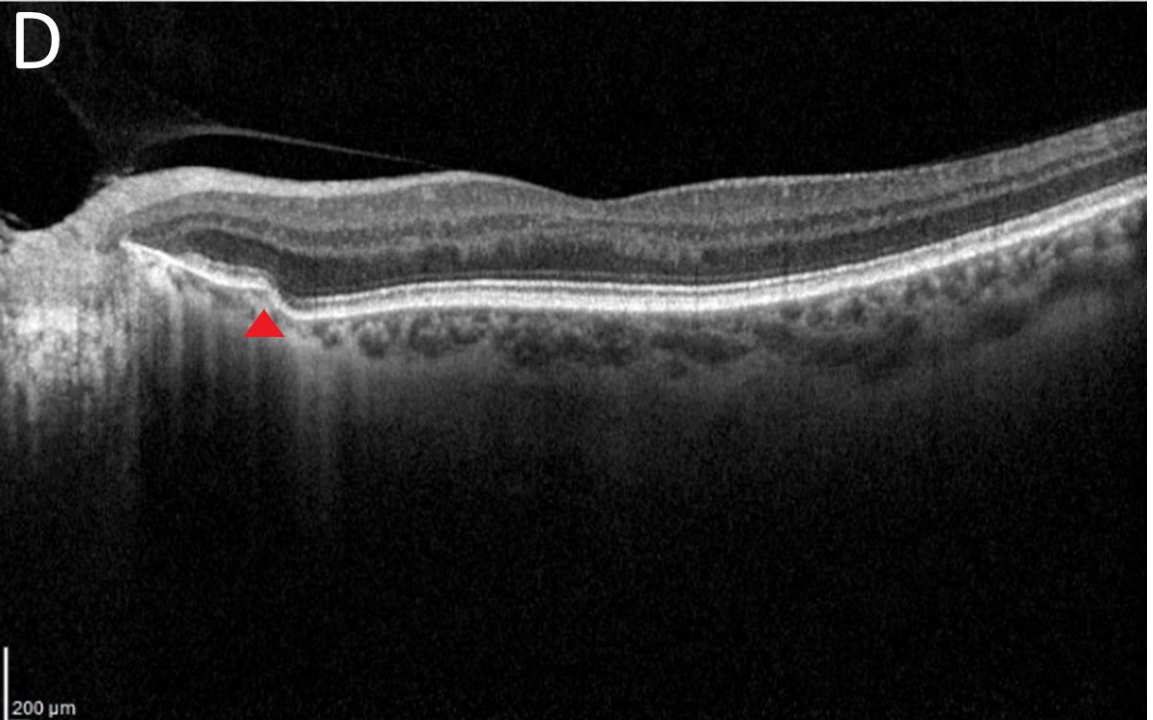
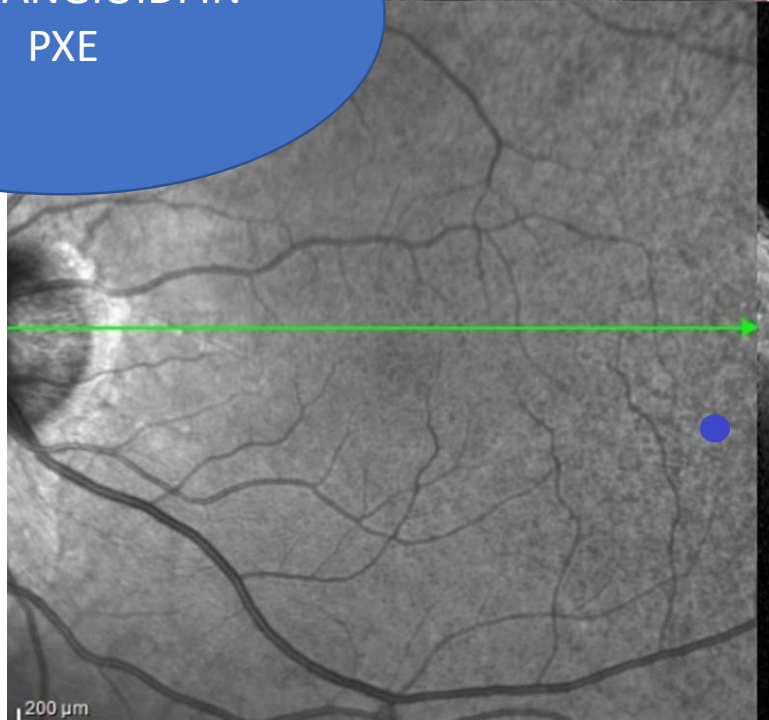
Tecnologia
OCT associata
a esame in
OTTICA
ADATTIVA



OTTICA
ADATTIVA



STRIE ANGIOIDI IN
PXE



Grazie per l'attenzione!

Vittoria.murro@unifi.it

