



Aux sources de l'œdème maculaire: les TelCaps

Michel Paques, Daniela Castro-Farias, Jean-François Girmens, José Alain Sahel,
Serge Meimon, Benedicte Dupas

Hopital des Quinze-Vingts, Sorbonne Université, et Hôpital Lariboisière, Université Paris 7, Paris, France

Pas de conflit d'intérêt

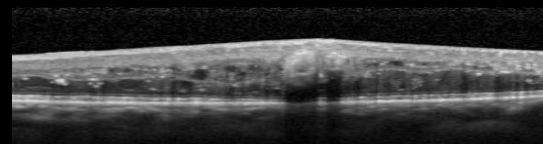
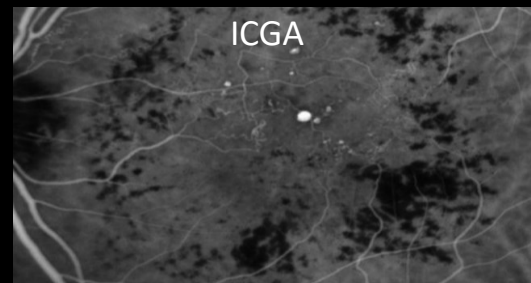
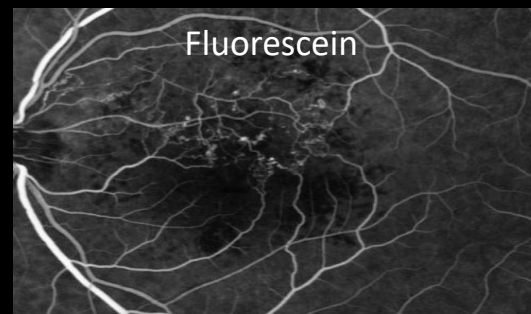
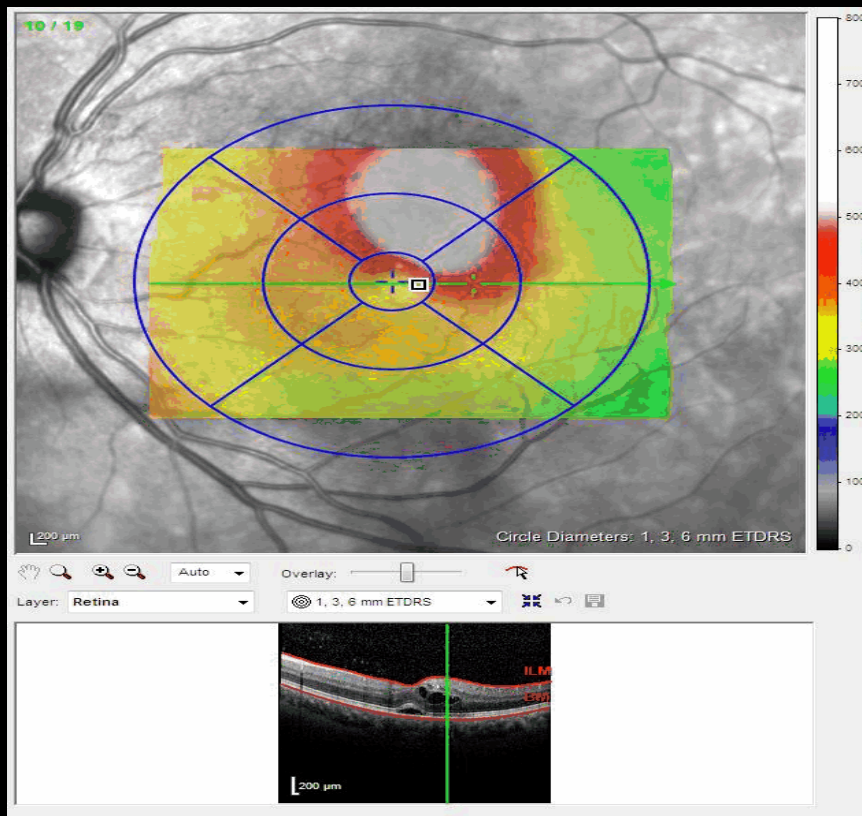


pariseyeimaging.com

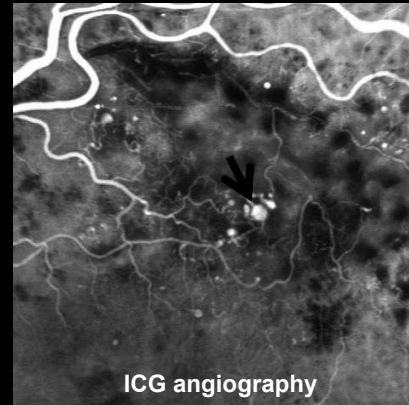
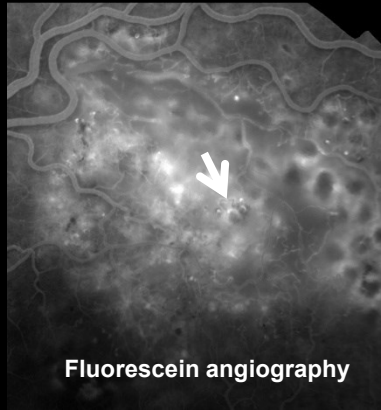
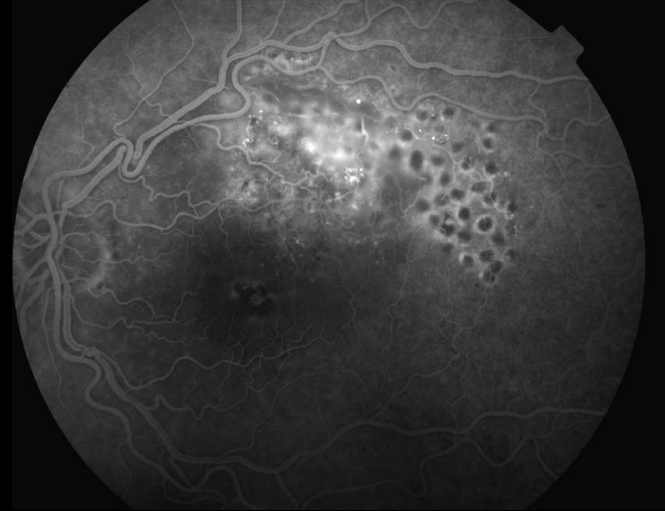
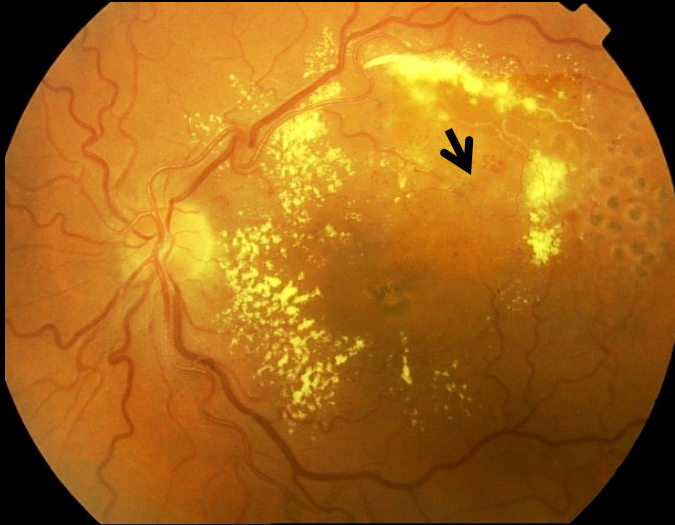
Laser pour l'œdème maculaire : nostalgie ou retour en grâce?

- Le laser « grid » était le traitement prédominant des OM jusqu'aux années 2000, lorsque les corticoides puis les antiVEGFs sont arrivés sur le marché.
- Preferred Practice Patterns AAO 2019: antiVEGF/steroids en traitement de première ligne

Management Recommendations for Patients with Diabetes					
Severity of Retinopathy	Presence of Macular Edema	Follow-up (Months)	Panretinal Photocoagulation (Scatter) Laser	Focal and/or Grid Laser*	Intravitreal Anti-VEGF Therapy
Normal or minimal NPDR	No	12	No	No	No
Mild NPDR	No	12	No	No	No
	NCI-DME	3-6	No	Sometimes	No
	CI-DME†	1*	No	Rarely	Usually
Moderate NPDR	No	6-12†	No	No	No
	NCI-DME	3-6	No	Sometimes	Rarely
	CI-DME†	1*	No	Rarely	Usually
Severe NPDR	No	3-4	Sometimes	No	Sometimes
	NCI-DME	2-4	Sometimes	Sometimes	Sometimes
	CI-DME†	1*	Sometimes	Rarely	Usually
Non-high-risk PDR	No	3-4	Sometimes	No	Sometimes
	NCI-DME	2-4	Sometimes	Sometimes	Sometimes
	CI-DME†	1*	Sometimes	Sometimes	Usually
High-risk PDR	No	2-4	Recommended	No	Sometimes ¹²
	NCI-DME	2-4	Recommended	Sometimes	Sometimes
	CI-DME†	1*	Recommended	Sometimes	Usually



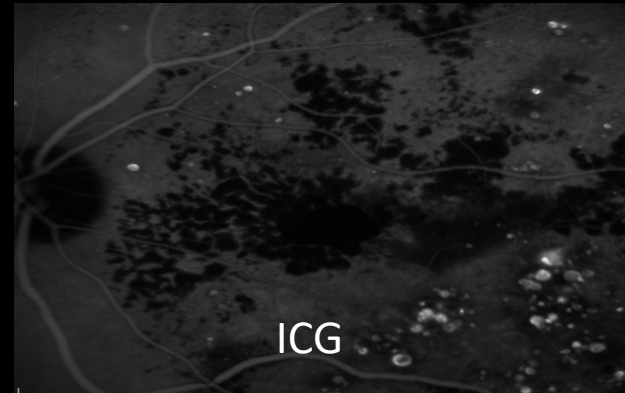
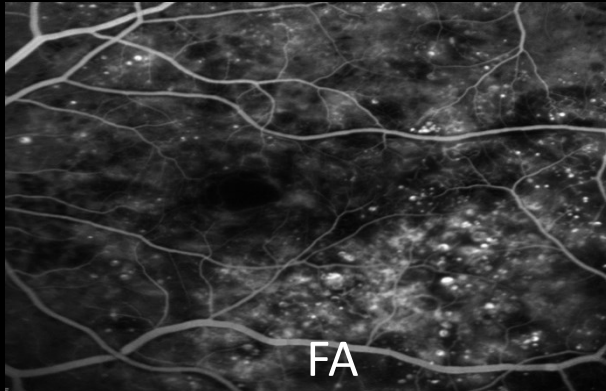
Detection of macroaneurysms by FA versus ICGA

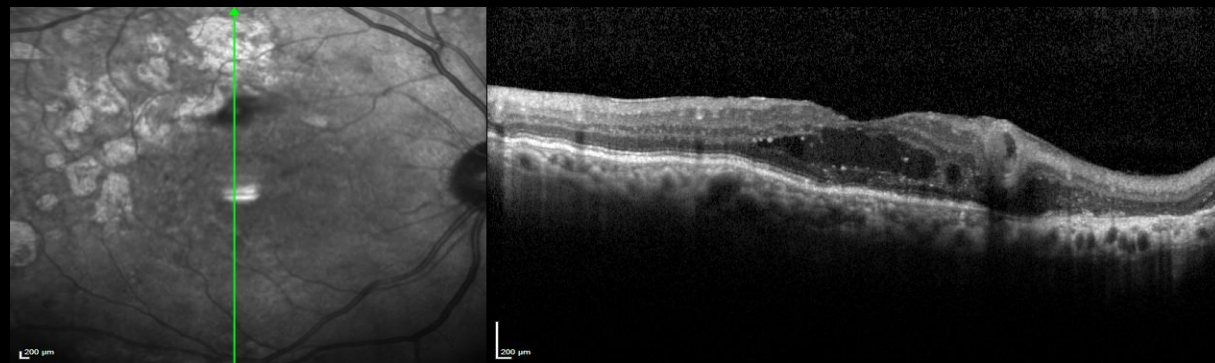
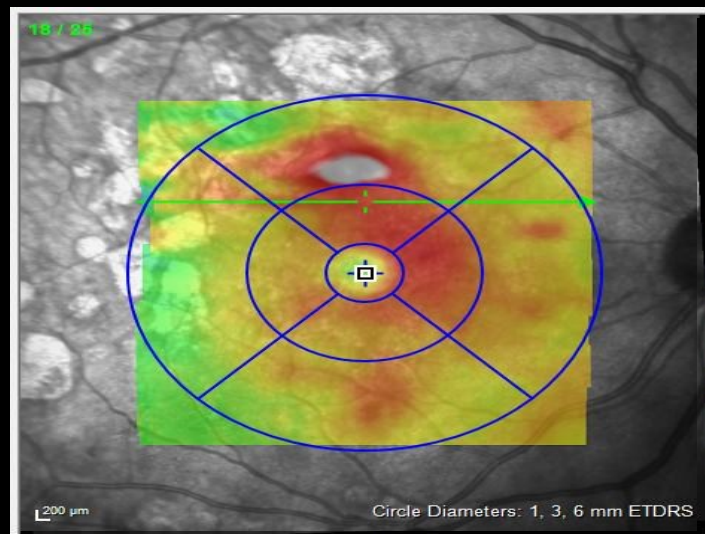


Ces lésions ICG-positive peuvent être uniques (typiquement, les OVR)...



... ou un groupe de lésions de taille variable (typiquement, l'OMD)





- Several authors reported the presence of large capillary abnormalities, mostly in RVO
 - Schulman et al. Large capillary aneurysms secondary to retinal venous obstruction. *Br J Ophthalmol* 1981;65:36–41
 - Cousins et al. Capillary macroaneurysms associated with retinal branch vein occlusion. *Am J Ophthalmol* 1990;109:567–70
 - Parodi et al. Branch retinal vein occlusion and macroaneurysms. *Int Ophthalmol*. 1997;21(3):161-4.
 - Battaglia Parodi et al. Capillary macroaneurysms in central retinal vein occlusion. *Ophthalmologica*. 1995;209(5):248-50.
 - Luckie et al. Adult Coats' disease in branch retinal vein occlusion. *Aust N Z J Ophthalmol*. 1994 Aug;22(3):203-6.
 - Apostolopoulos et al. Late complications in branch retinal vein occlusion. *Int Ophthalmol*. 1995-1996;19(5):281-5.
 - Bastawrous et al. Medical image. Retinal macroaneurysm following a branch retinal vein occlusion. *N Z Med J*. 2011 Oct 14;124(1344):103-5.
- Fewer noted their strong ICG staining
- of m
 - Bourhis et al. Imaging macroaneurysms occurring during retinal vein occlusion and diabetic retinopathy by indocyanine green angiography and high resolution optical coherence tomography. *Graefes Arch Clin Exp Ophthalmol*. 2010;248:161-6
 - Ueda et al. Usefulness of indocyanine green angiography to depict the distant retinal vascular anomalies associated with branch retinal vein occlusion causing serous macular detachment. *Retina* 2012;32:308-13
 - Ogura et al. Indocyanine Green Angiography-Guided Focal Laser Photocoagulation for Diabetic Macular Edema. *Ophthalmologica*. 2015;234(3):139-50.
 - Paques et al. Indocyanine-green-guided targeted laser photocoagulation of capillary macroaneurysms in macular oedema: a pilot study. *Br J Ophthalmol*. 2017;101:170-174
- No systematic search; no randomized trial

Our track record

2010: original description in RVO and diabetes

→ elective detection by ICGA

Bourhis et al Graefe's Arch 2010

2015: results of targeted photocoagulation in 8 cases

→ efficient in chronic DME cases

Paques et al BJO 2015

2017: screening in DME population

→ high incidence

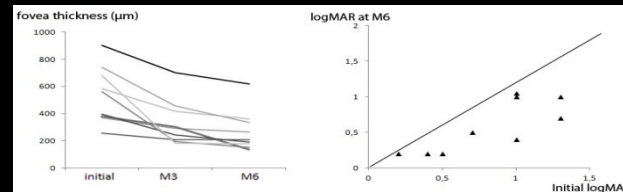
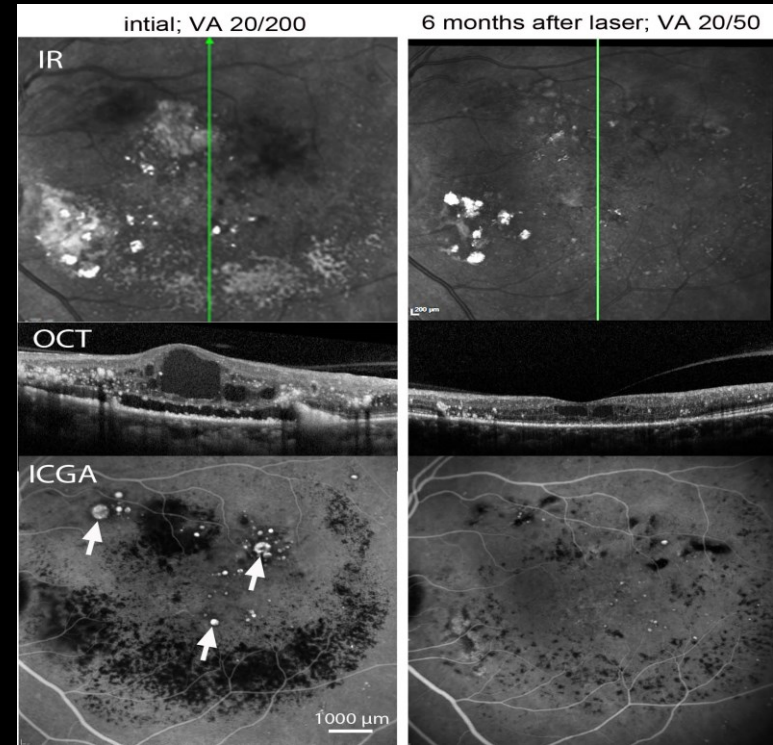
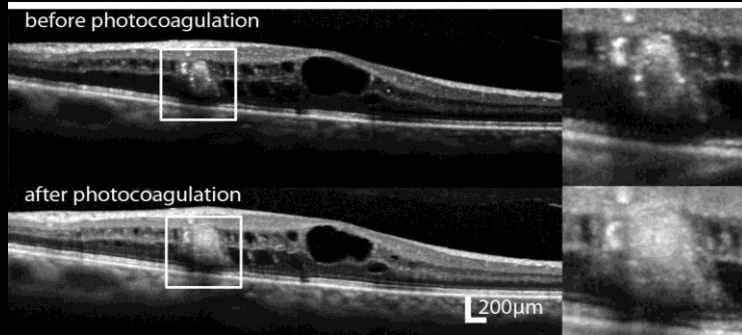
→ link with hard exsudates

→ concept of TelCap

Castro-Farias et al BJO 2019

2019 French randomized trial

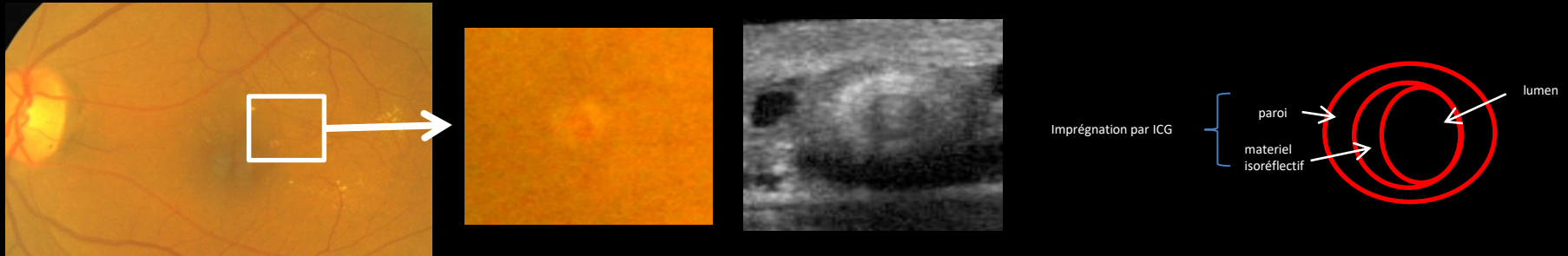
Le laser ciblé est souvent efficace



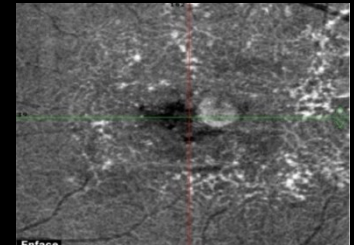
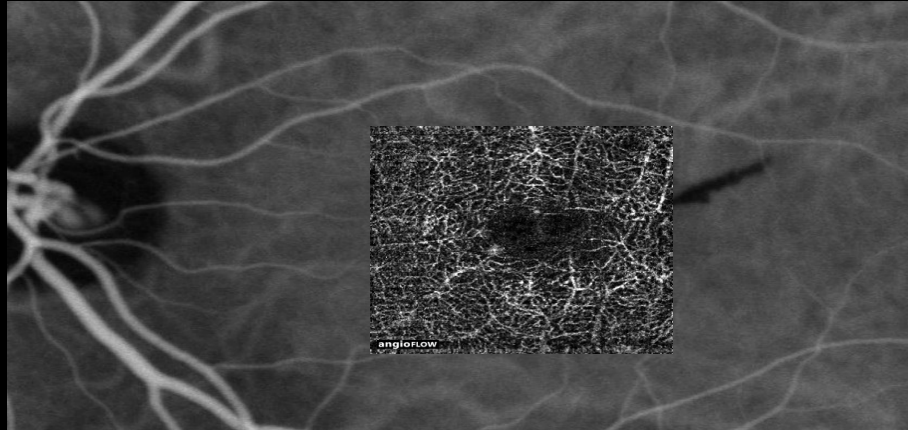
Pourquoi ce terme de TelCaps?

- « macroanévrisme »
 - Est source de confusion avec les macroanévrismes artériels
 - Est restrictif, puisqu'un agglomérat de petites lésions peut avoir le même effet
 - Nous avons proposé le terme de TelCaps (télangiectasies capillaires) pour des lésions microvasculaires ayant
 - En ophtalmoscopie: une paroi blanchâtre
 - En OCT: Une paroi épaisse et du matériel isoréfectif
 - En angio F: peu ou pas de coloration
 - En OCTA: non détectables
 - En ICGA: Coloration persistante à des temps très tardifs (souvent > 10mn)
 - *Ces lésions peuvent être uniques ou multiples; présence fréquente d'exsudats lipidiques*
 - *La taille critique pour la définition d'un TelCaps n'est pas encore clairement définie (>150 µm?)*
- Ceci peut expliquer le sous-diagnostic*
- 

L'OCT des TelCaps peut montrer une paroi épaisse et du matériel autour de la lumière



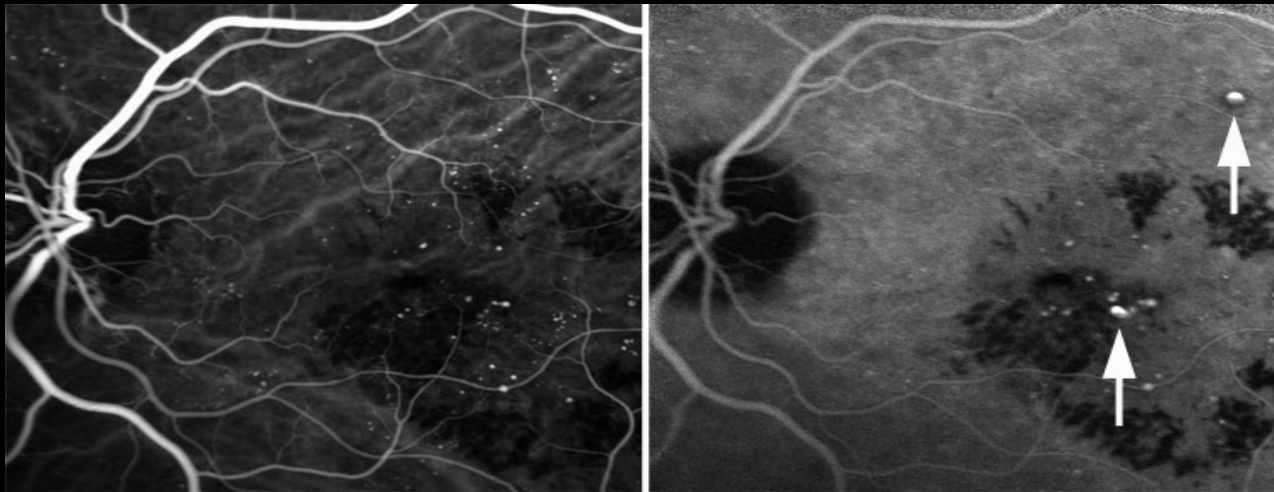
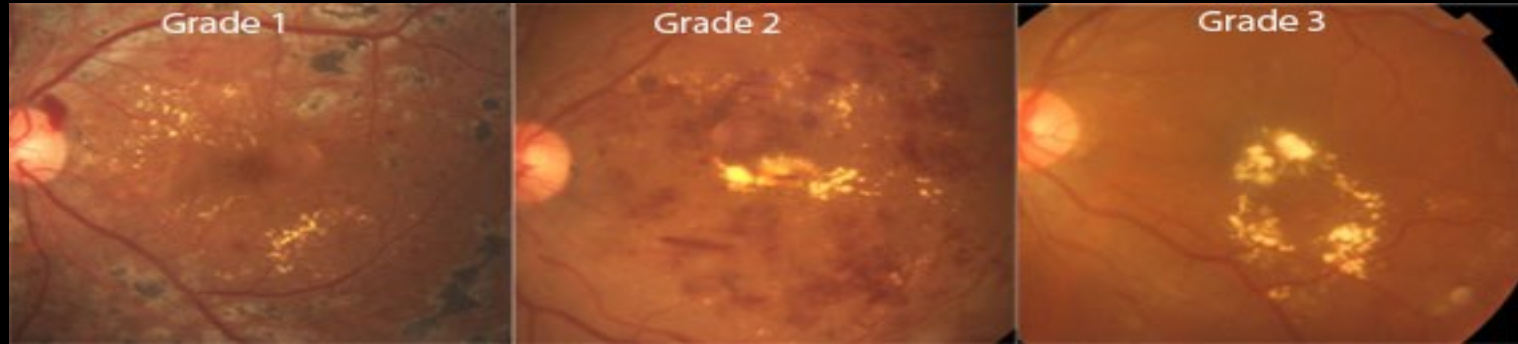
l'OCTA est peu utile car la perfusion esst très faible



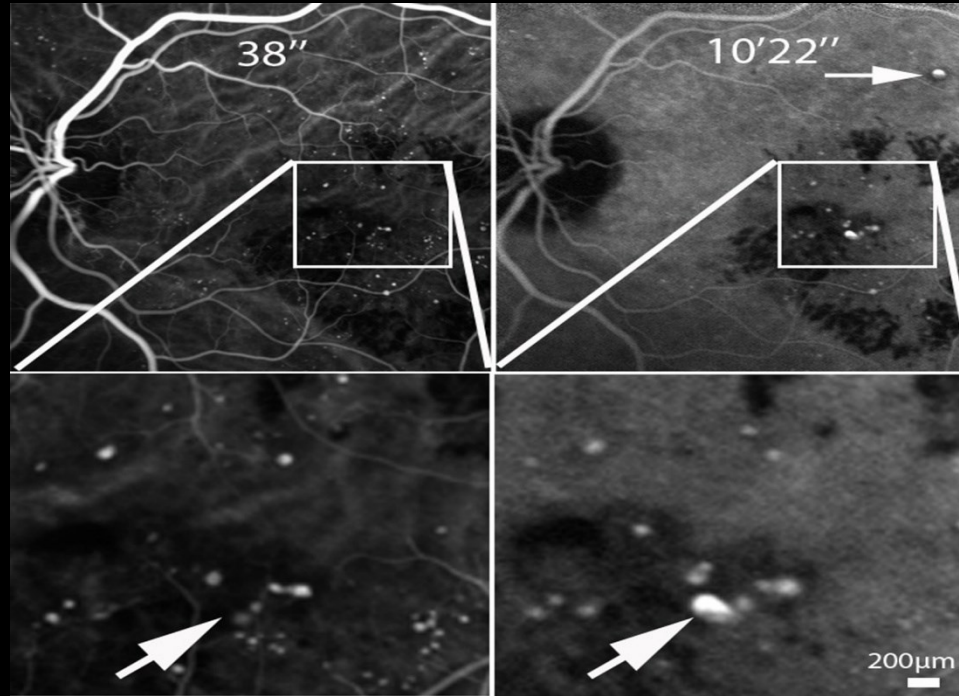
Incidence of TelCaps

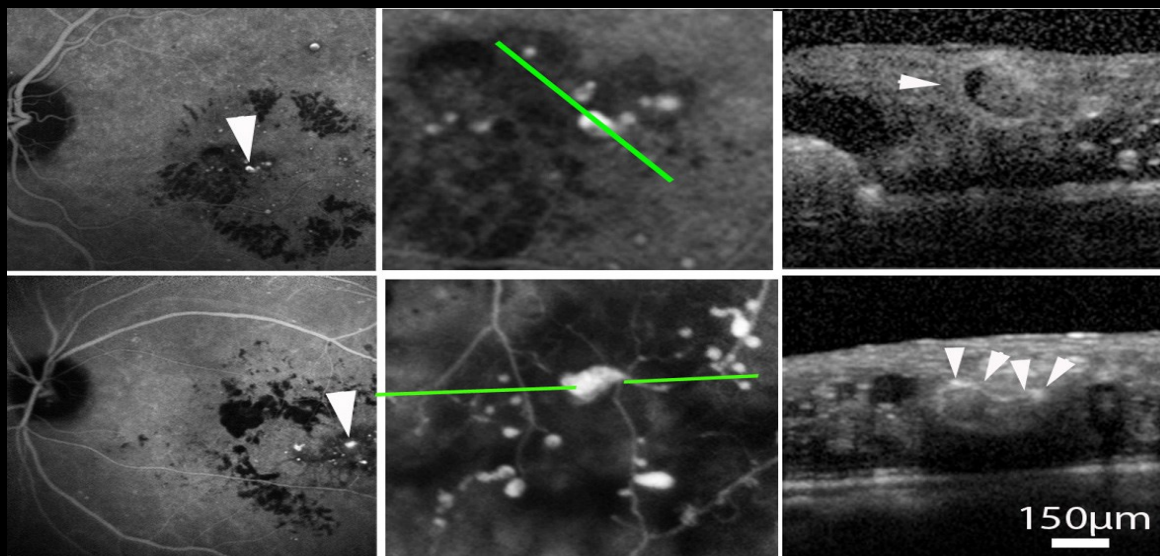
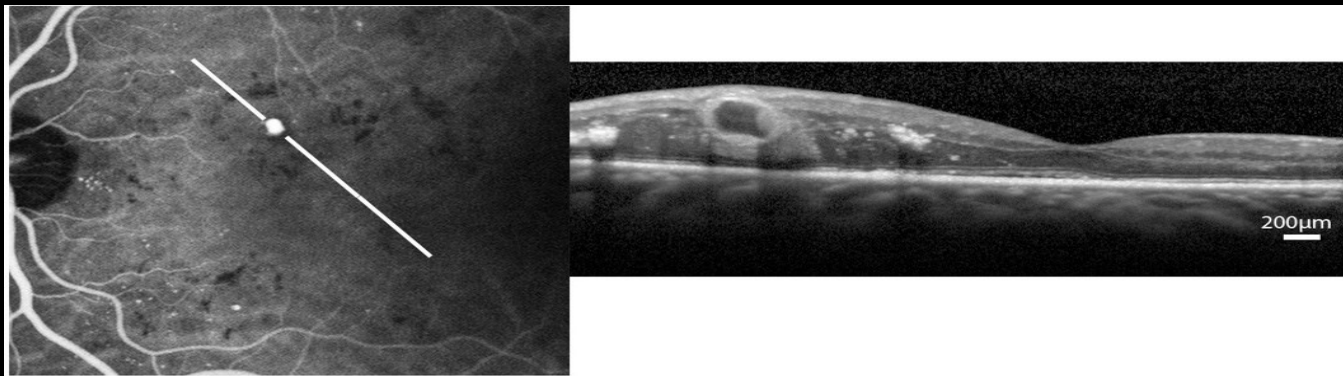
- Their incidence increases with both the duration and severity of macular edema
 - In DME: >90% if circinate hard exsudates
 - In RVO
 - only if >12 months duration
 - BRVO: 37% of 27 eyes (mean age 69 y; median duration 15 months)
 - CRVO: 24% of 18 eyes (mean age 61y; median duration 16 months)
 - 100% of eyes with severe hard exdsudates

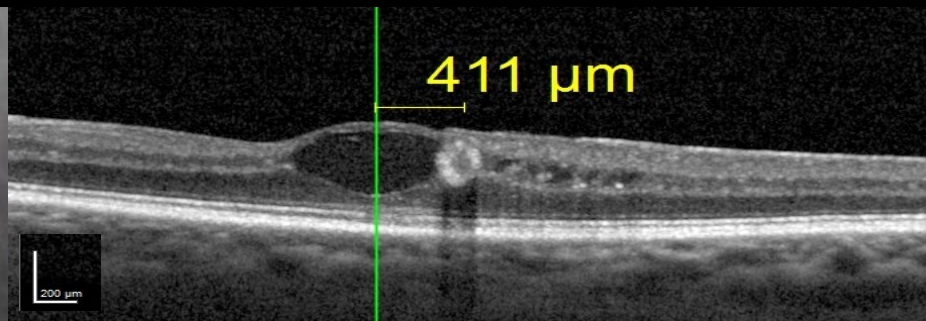
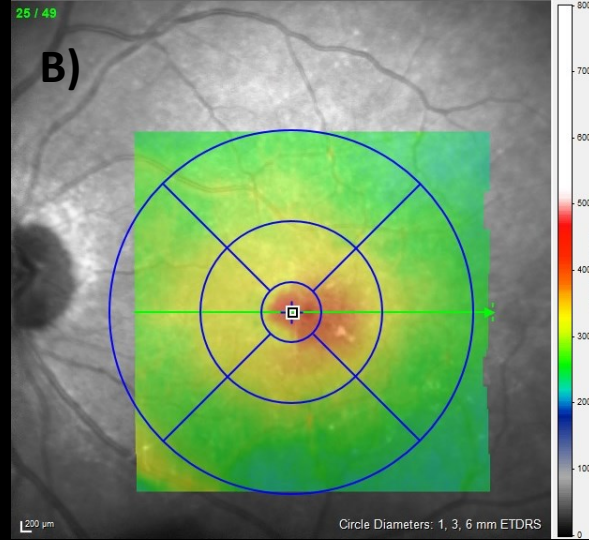
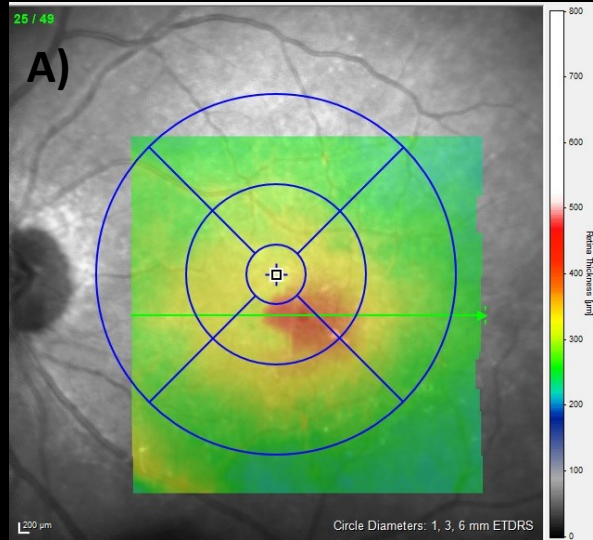
Association fréquente à des exsudats lipidiques; ils sont très fréquents au centre des couronnes d'exsudats



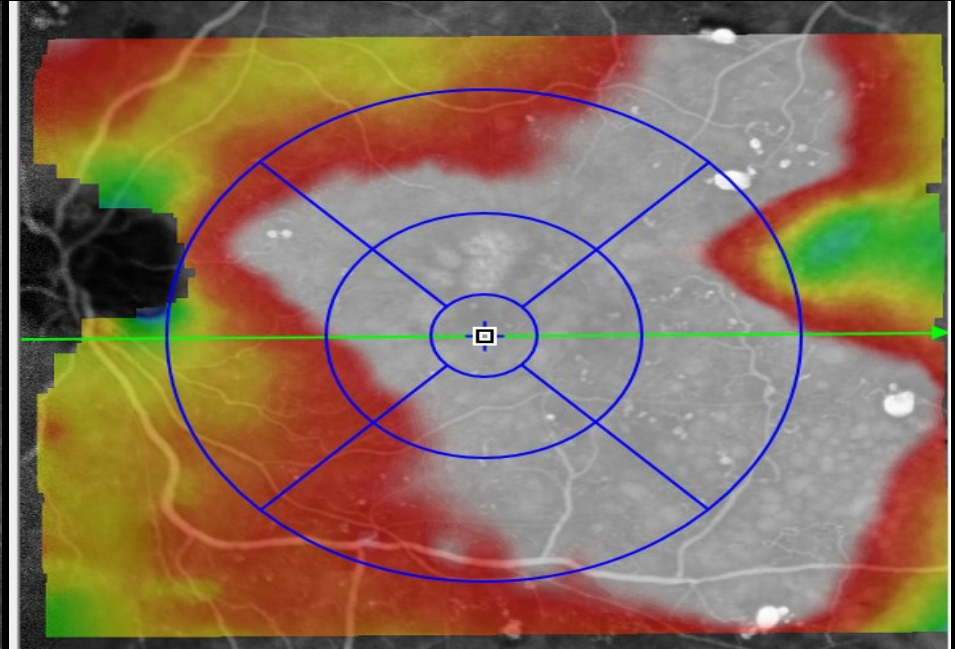
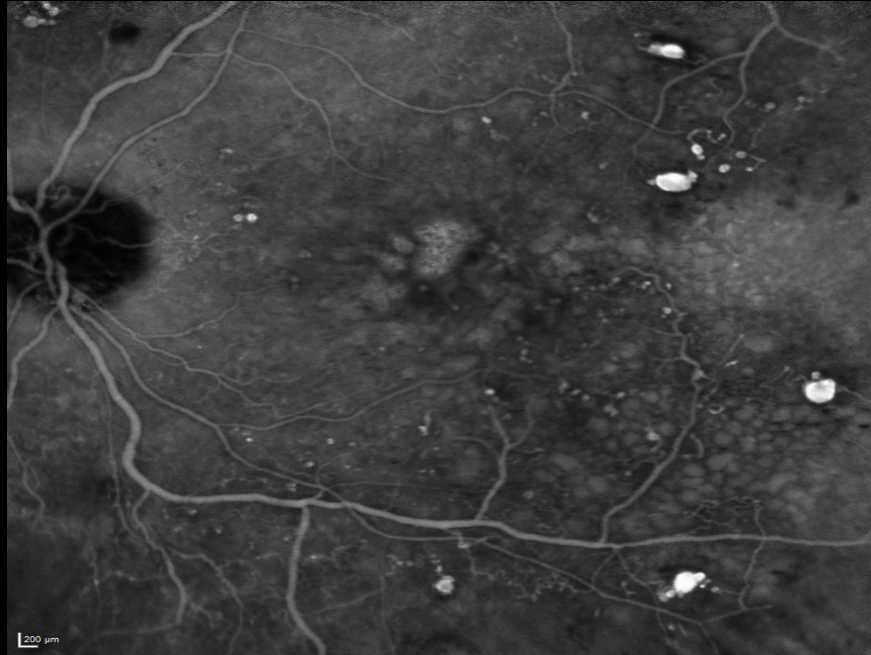
Pendant l'ICGA, les microanévrismes vont se remplir plus vite, mais ils vont disparaître au temps tardifs alors qu'au contraire les TelCaps vont se remplir et ainsi avoir un meilleur contraste sur les temps tardifs



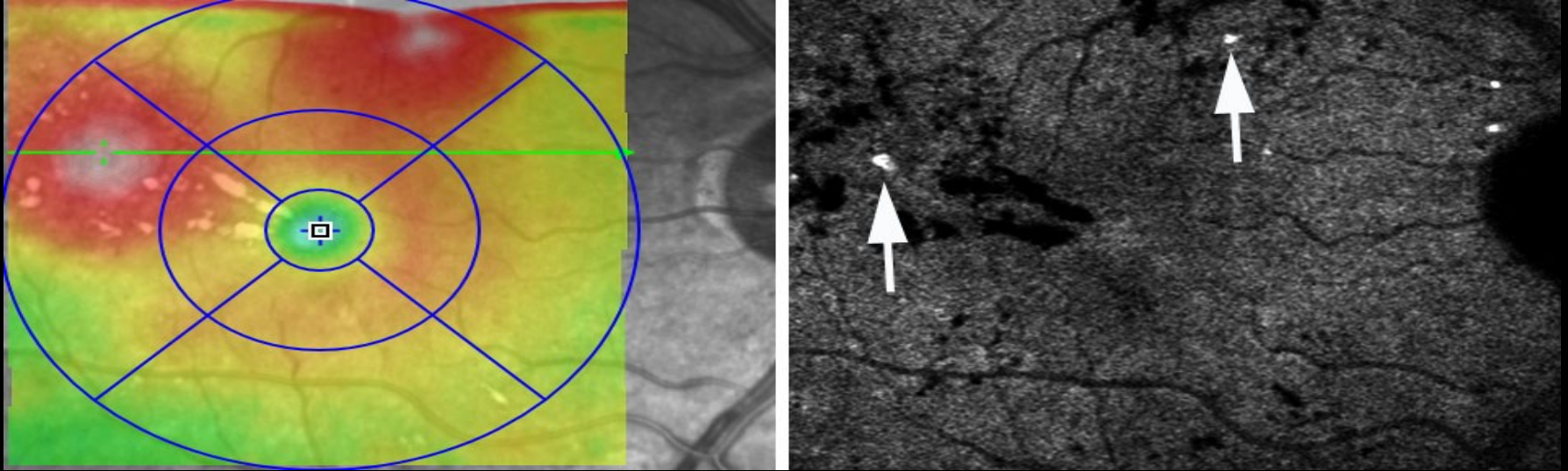




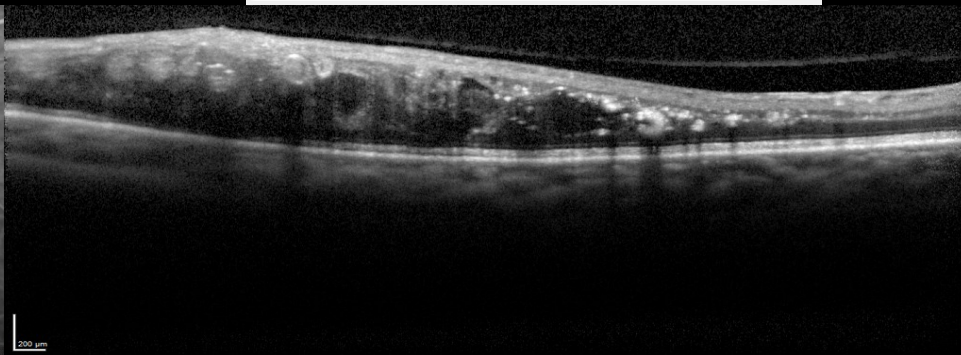
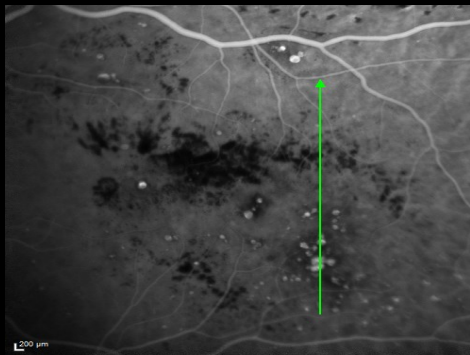
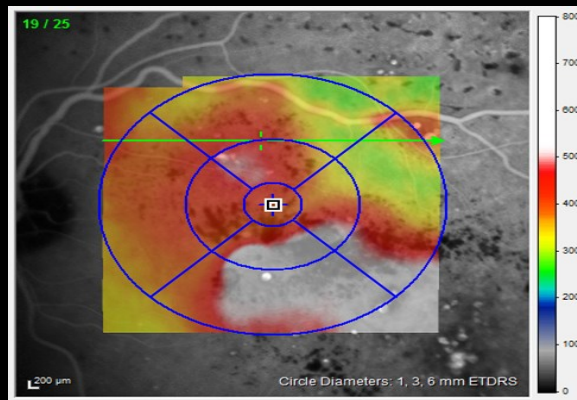
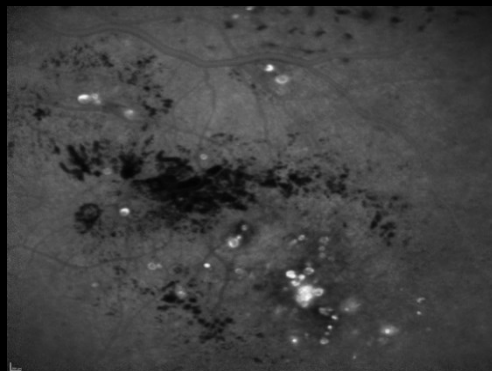
The presence of TelCaps may account for the topography of edema

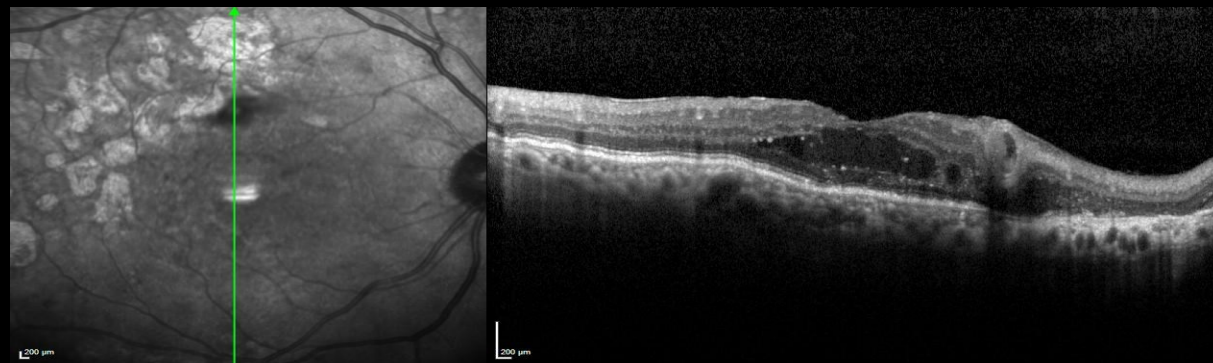
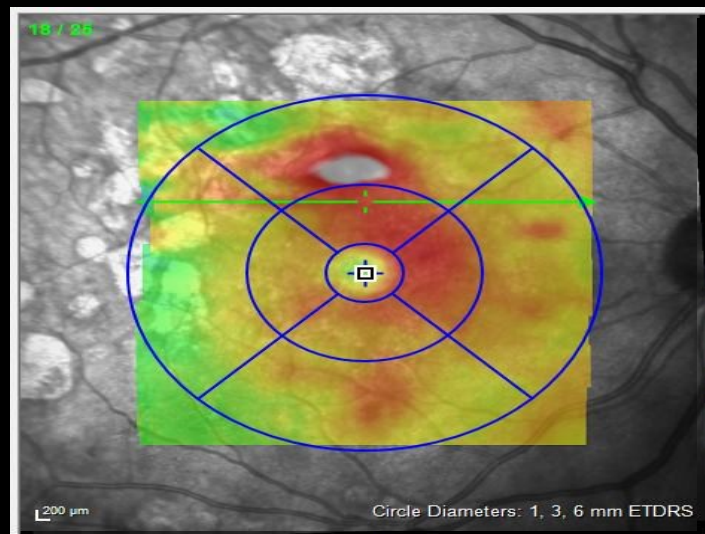


Mapping as a screening tool for TelCaps

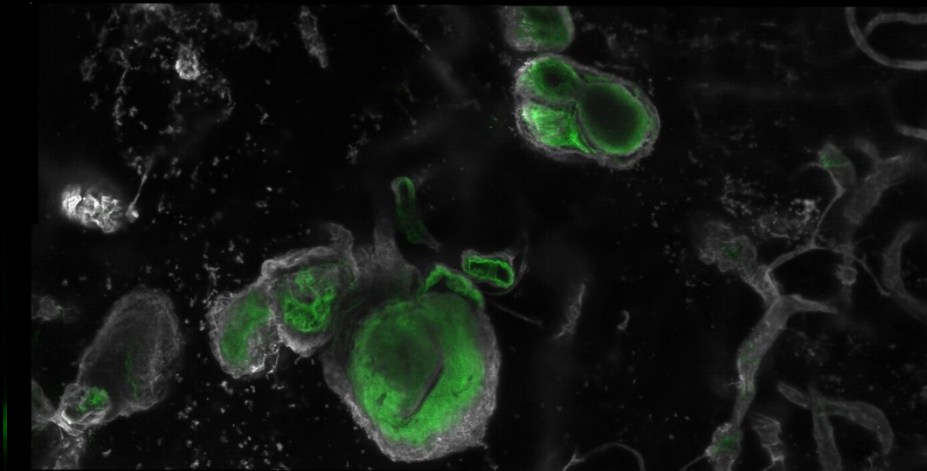


OCT of clustered macroaneurysms





Confocal microscopy of a human macroaneurysm



50 μ m



vWF



Collagen 4

Darche, soumis

Histologie TelCaps

Réévaluer le laser « grid »

- Le mécanisme d'action du laser « grid » n'a pas été élucidé
 - « Stimulation » des RPE?
 - Effet vasoconstricteur de l'oxygène?
- Notre expérience des TelCaps nous amène à postuler que le gris laser peut contribuer à réduire l'œdème lorsque par inadvertence il occlus un telcaps de petite taille
 - Plus les lésions sont petites, plus elles sont sensibles à l'effet du laser
- Cependant, les essais cliniques sur la photocoagulation ont été décevants à ce jour
 - Mais aucune n'a spécifiquement chercher à identifier et traiter les macroanévrismes.

Le nouveau laser de l'oedème maculaire: le laser ciblé guidé par l'ICG

- L'identification des TelCaps va-t-elle modifier nos pratiques?
 - Un traitement laser plus personnalisé des patients avec un OM sévère semble possible
- Dans ma pratique:
 - Je cherche et je traite les telcaps en présence de
 - Exsudats secs circlinés/abondants/sous-fovéolaires
 - OM persistant après une série d'IVT
- Ce qu'il reste à faire
 - Obtenir une définition plus claire des TelCaps
 - Des essais randomisés (étude TalaDME en cours)
 - Des procédures diagnostiques et thérapeutiques plus claires (peut-on se passer de l'ICG?)
- *La recherche sur les TelCaps peut amener à un traitement plus personnalisé et plus rentable de l'OMD*

Indications du laser

Mes paramètres: 50 microns, 100ms, impacts en rafale (8/s) jusqu'à obtenir un changement de coloration de la lésion (même un changement minime suffit)

Peut-être des impacts de plus courte durée ?

Précautions

-  Lésion de la membrane de Bruch/EP et risque de néovascularisation
 - Contre-indication en cas de drusen / DMLA
 - Minimisé par la faible taille d'impact et focus à la surface du MA, puissance la plus faible efficace
 - Avant IIV (MA plus éloigné de l'EP)

Comment je fais le laser ciblé

Eviter le laser ciblé (et le grid aussi, d'ailleurs) si

-drusen

contre-indication formelle au laser

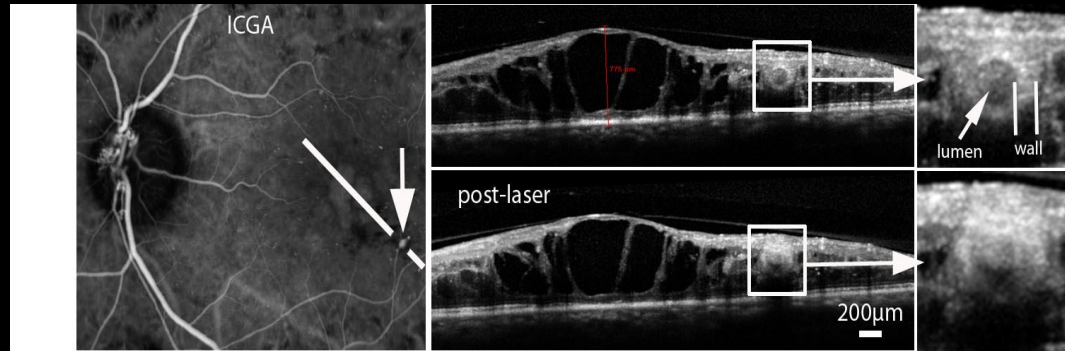
-membrane épirétinienne

Si MEM: discuter d'opérer la membrane dans un premier temps ?

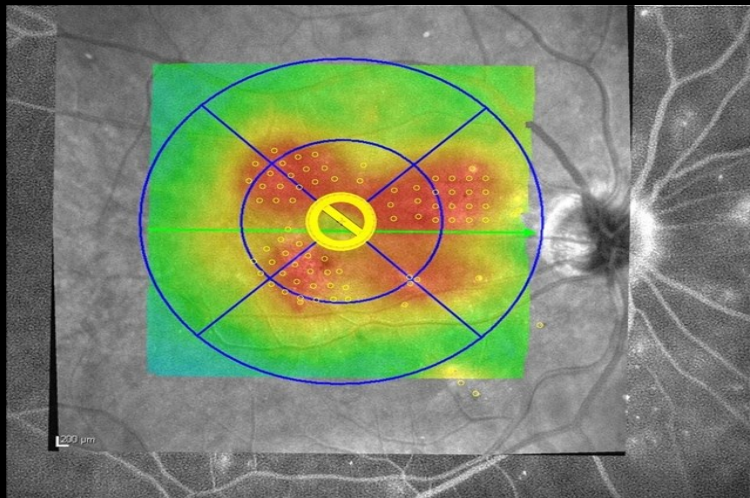
Lésion trop proche du centre (< 500µm)

- But : altérer la paroi du macroanévrisme
- Laser vert ou jaune
- Lentille de contact (Centralis Direct)
- Identification des cibles au fond d'œil
 - En comparant à l'ICG
- Eviter de déformer l'œil; avoir la main légère sur l'œil
 - Petit spot (50 µm)
 - Puissance 100-150mw (à moduler selon l'effet)
 - Durée 0.1 s (*voire plus court?*)
 - Mode rafale 8/s
- 5 à 10 tirs en rafale sont en général suffisants pour obtenir un changement de coloration de celui-ci
- Un OCT immédiatement après laser permet de s'assurer de l'efficacité du laser en cas de doute
- Retraiter si nécessaire
- Une IVT peut accompagner le laser
- Je vérifie deux mois plus tard l'efficacité; ICG au moindre doute

Need to control the effectiveness of energy transfer to the macroaneurysm



Navilas system



NAVILAS®

Patient Image **Plan** Treat Document Report Physician

OD FA Time: 0:37

Draw Plan

Caution Zones

Treatment Locations

16 spots planned

Pulse Duration 100
Spot Size 100
Spot Spacing 2.00
Grid Size 4
Inner Diameter 1000
Rotation 200°
Angle 90°

Actions

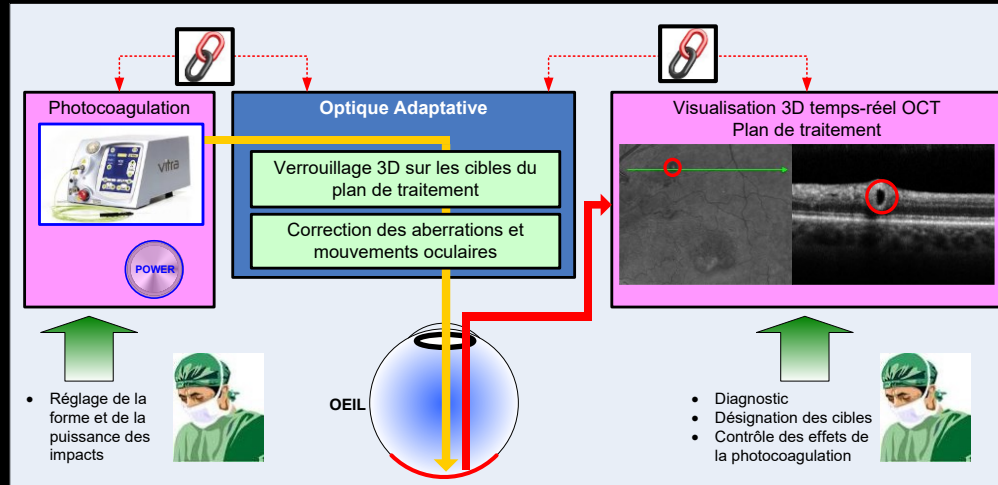
10° 30° 50° Custom

Navigation Plan

Patient: C, DME

A retinal fundus image showing a treatment plan overlay. The plan is overlaid on a grayscale fundus image. The color scale ranges from green (low intensity) to red (high intensity). Two yellow circles with diagonal lines through them are visible. A scale bar in the bottom left corner indicates 200 μm .

Le futur: Projet CLOVIS: laser avec eye tracker couplé à l'OCT



Serge Meimon (ONERA)
Michel Paques (CIC 1423)

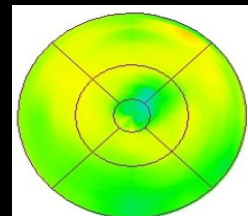
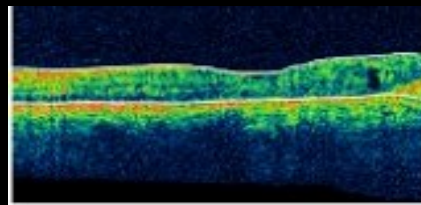
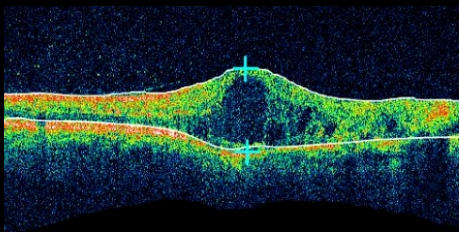
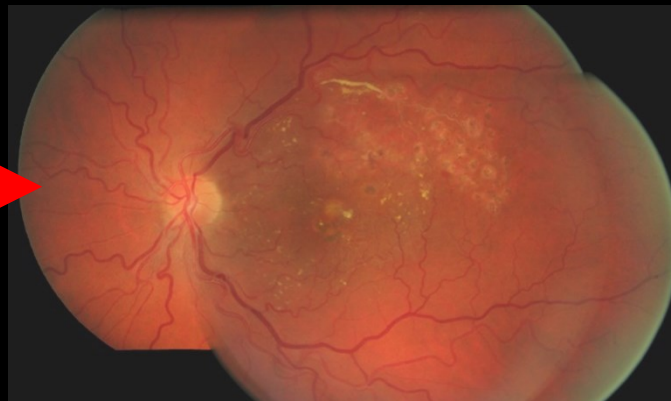
CLD

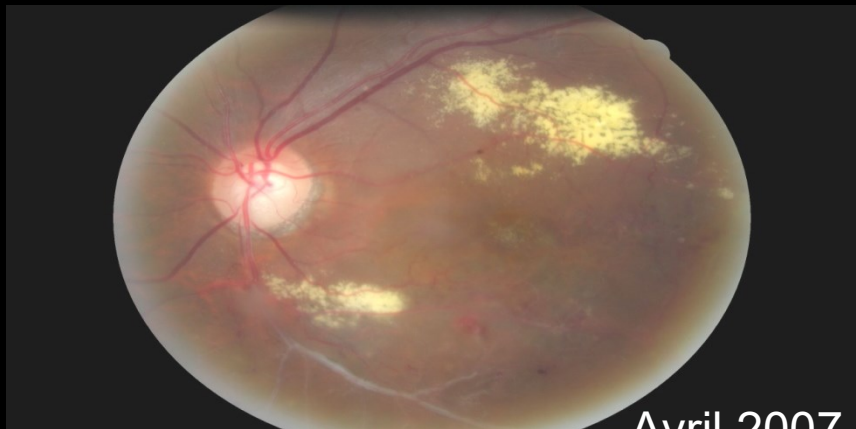


laser

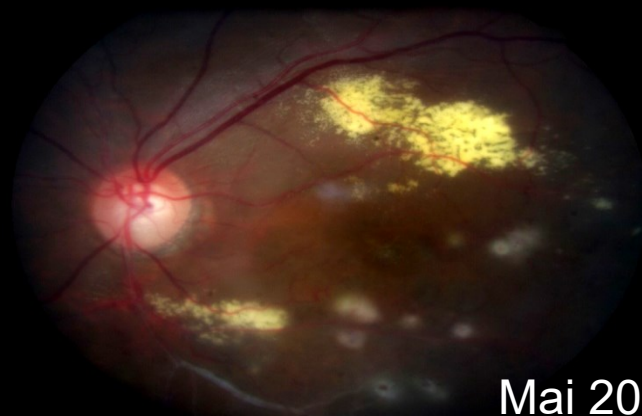


0.1





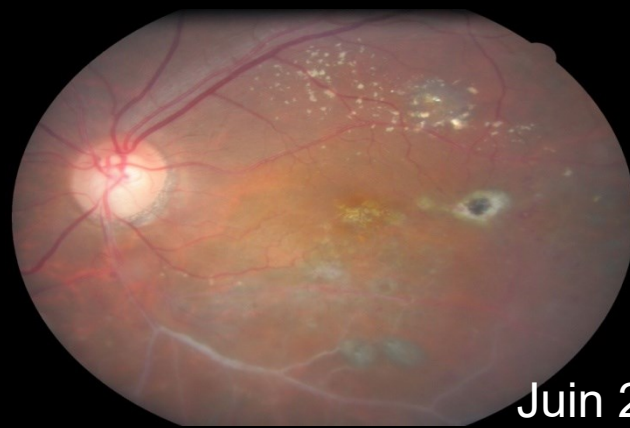
Avril 2007



Mai 2007

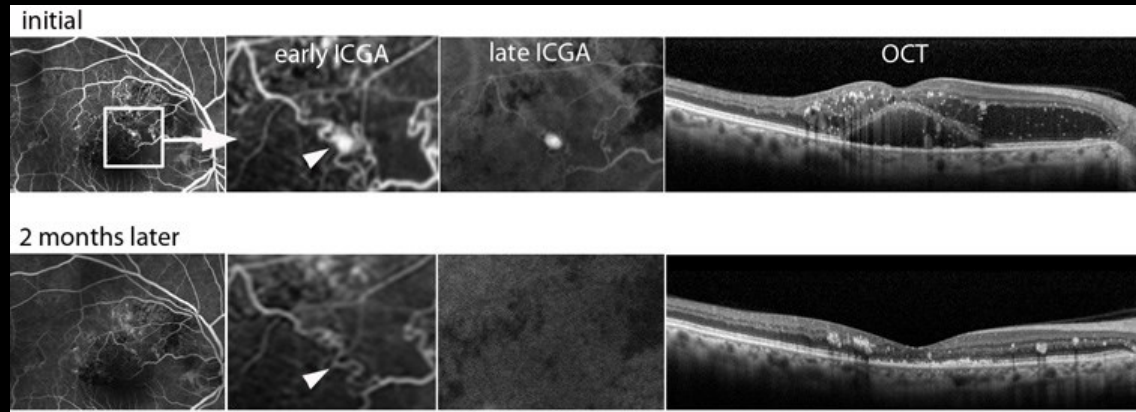


Déc 2007

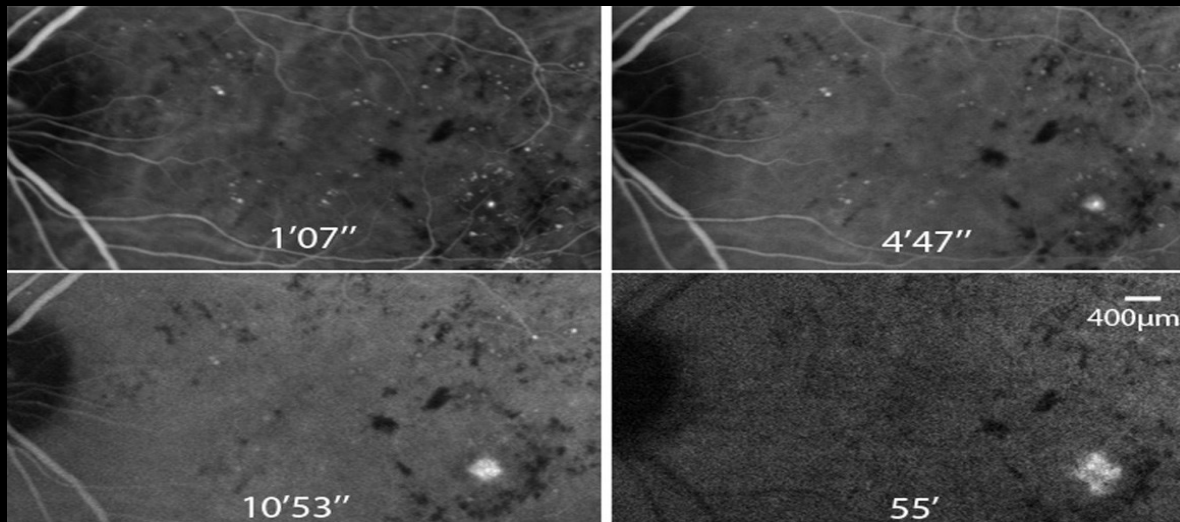


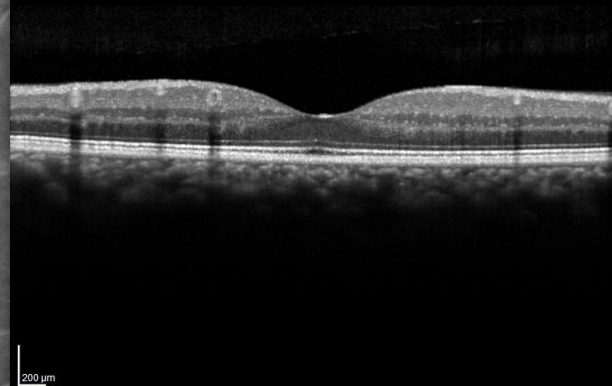
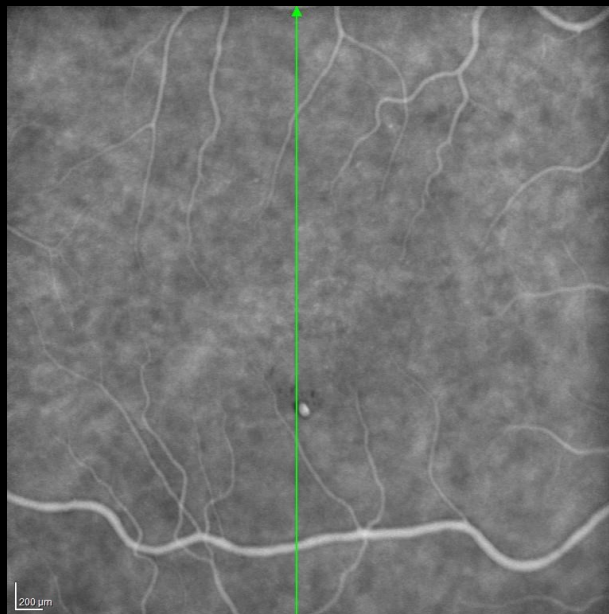
Juin 2008

L'IGTP affecte-t-elle la perméabilité des collatérales?



Quelques cas particuliers





25/09/2009, OD

ICGA&OCT 0.47.82 15° ART 15° ART [HR] ART(61) Q: 40

Color

fovea

late ICGA

1

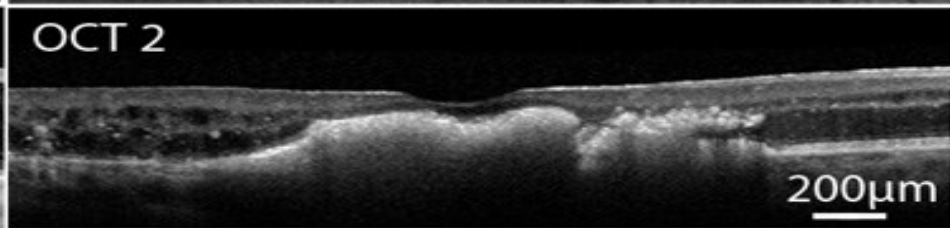
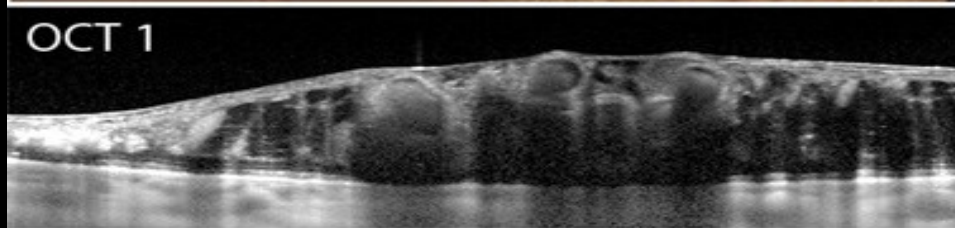
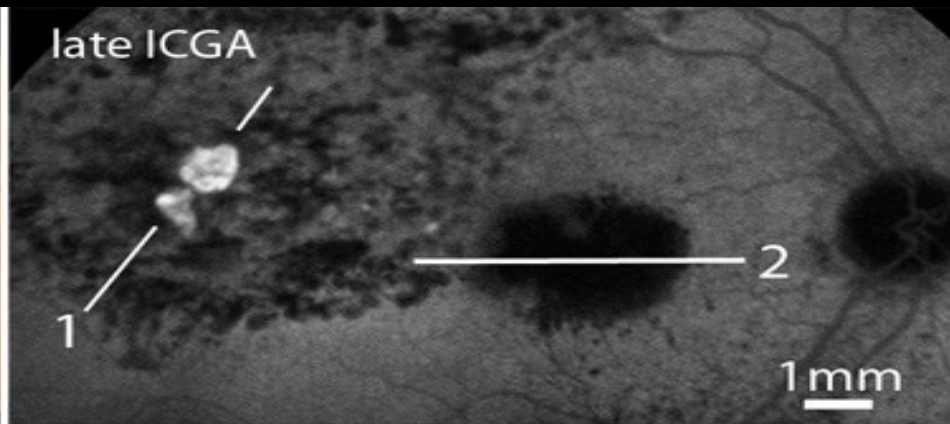
2

1mm

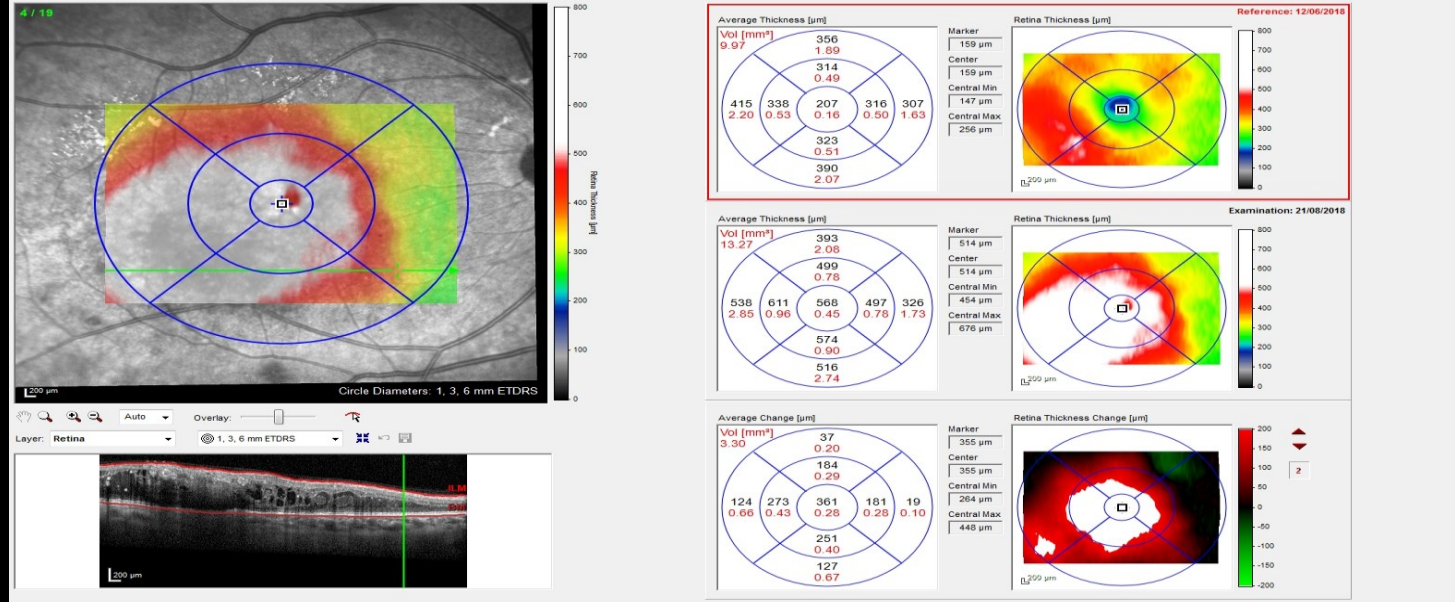
OCT 1

OCT 2

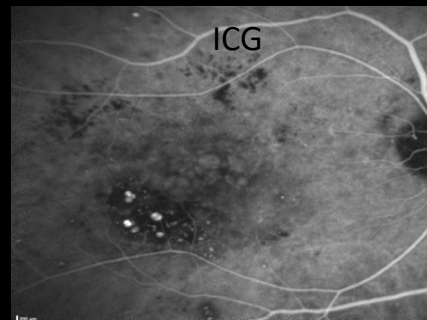
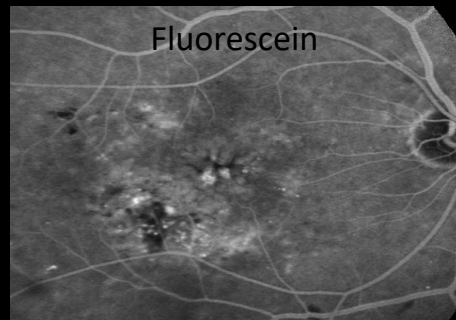
200μm







21/08/2018, OD



Peut-on se passer d'ICG pour le diagnostic des TelCaps?

- L'ICGA est pour moi le gold standard
- Cependant, de nombreux centres dans le monde n'y ont pas accès
- Dépistages des cas suspects:
 - le mapping OCT est assez performant
 - Tout comme la présence d'exsudats secs
- Localisation des cibles à traiter:
 - Pour les TelCaps unique, le raster scan de l'OCT est assez efficace (si les coupes sont assez rapprochées!) tout comme l'image SLO
 - Pour les TelCaps agrégés, aucune solution de substitution n'est satisfaisante à l'heure actuelle
 - *La combinaison SLO IR et mapping OCT permet au moins de d*
- Le futur:
 - l'Intelligence Artificielle (Samira travaux en cours au CHNO des 1520)
 - la photo couleur haute résolution ?

French randomized clinical study

- TalaDME study
- PI: Dr Benedicte Dupas (Lariboisière) & Pr Michel Paques (Quinze-Vingts)
- Supported by FCRIN , CCAH and PHRC 2017
- 10 centers, 270 patients
- Inclusions: telcaps in DME and RVO eyes
- Exclusion: drusen
- 2 arms: conventional treatment with or without targeted laser as an add-on
- Endpoint: number of intravitreal injections at 12 monthts

Take-home messages

- In longstanding macular edema due to DME or RVO, capillary macroaneurysms are present in a significant number of cases
- ICG angiography shows a high sensitivity and specificity for their detection
- The presence of hard exudates is highly suggestive of their presence
- Even if far from the fovea, the photocoagulation of those larger than 150 μ m may contribute the resolution of macular edema
- For large lesions, OCT is useful to assess photothrombosis
- Combinations treatment with intravitreal injection may be of interest

Merci de votre attention

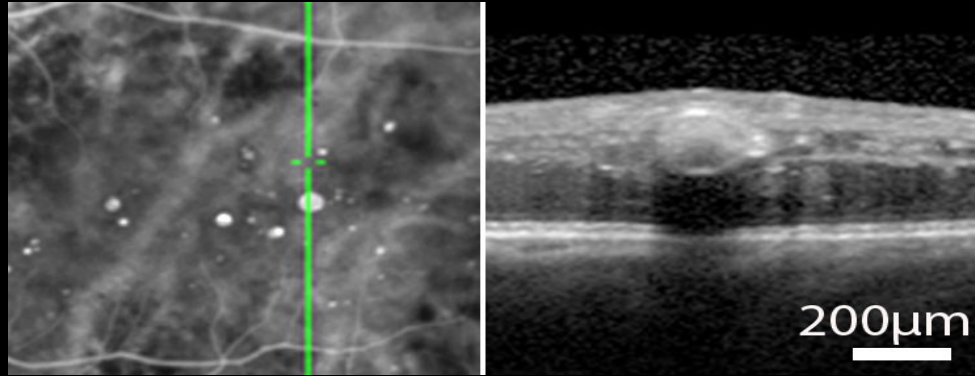
- 35 eyes with DME
- 22 (63%) had at least one focal area of microvascular abnormalities showing prolonged ICG staining (i.e. beyond 10mn after injection).
- In particular, all eyes with circinate hard exudates (n=9) showed foci of late ICG staining in the center of exudative rings.
- These areas most often featured an ill-defined cluster of abnormalities, sometimes with one predominant ectasy.
- During ICGA, 94% of such lesions showed an increase in their contrast and apparent size in late frames relative to early frames, while 77% of microaneurysms showed reduced contrast on late frames.
- OCTA was not contributive for the detection of these lesions.

Take home message

- In any chronic macular edema, consider searching for and treating TelCaps
 - In particular
 - If persistence after intravitreal injections
 - If hard exsudates
- A yearly ICG may be of interest

Is it the presence of a thick wall?

→ Some CMs show a rather thin wall

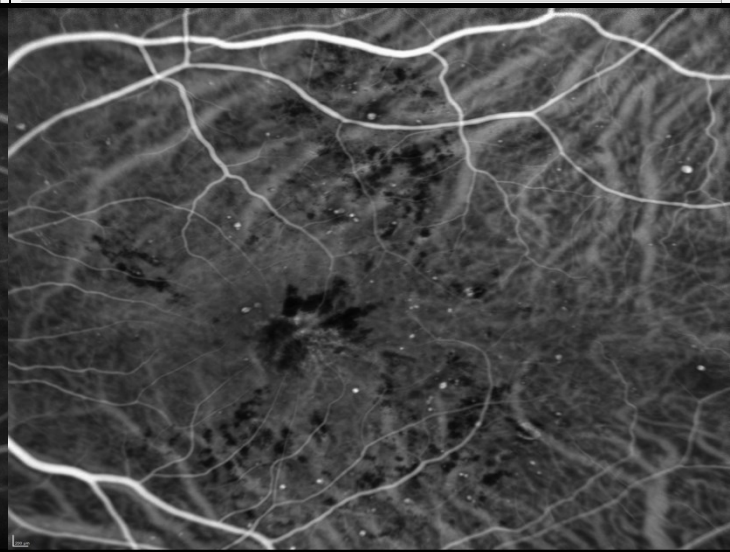
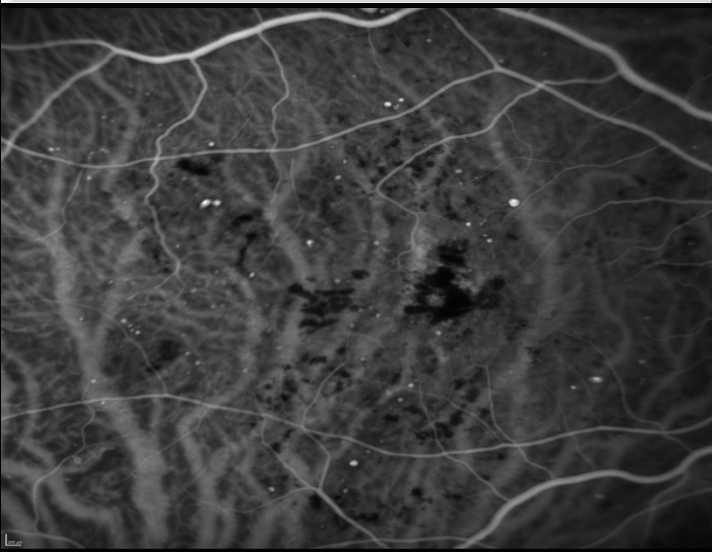
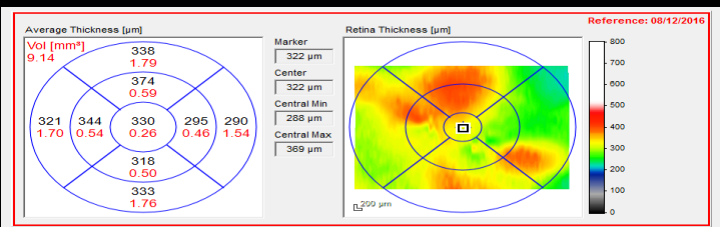
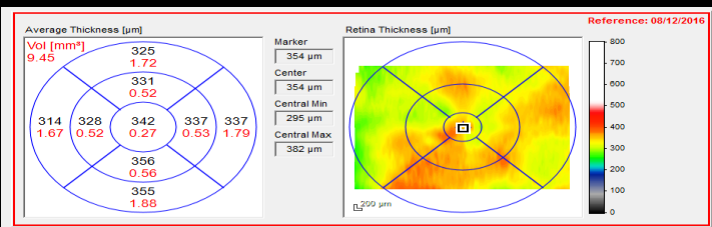


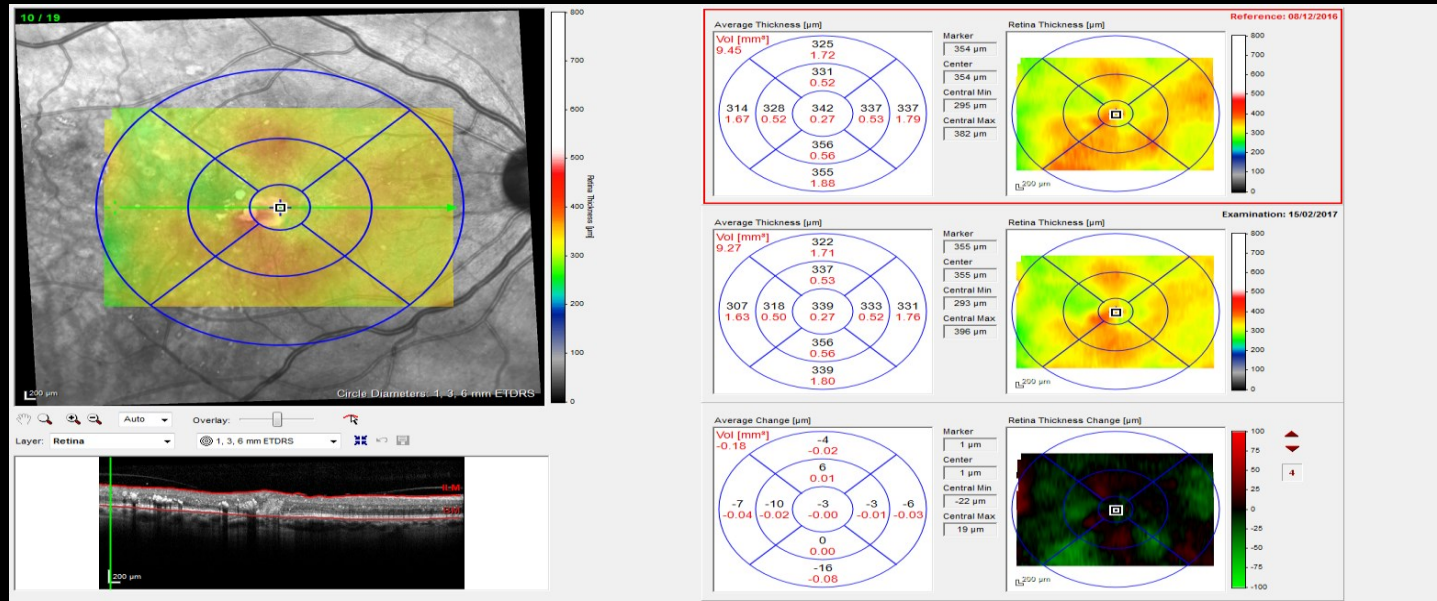
conclusions

- During macular edema with severe hard exsudates due to DME or RVO, systematic detection of capillary macroaneurysms by ICGA followed by their OCT-controlled photocoagulation may be of interest.
- These results may contribute to reevaluate the role of laser photocoagulation in the management of longstanding macular edema.
- The presence of hard exsudates is highly suggestive of the presence of targets for photocoagulation; this may help for screening
- Randomized clinical trials are underway

Interêt du Navilas® ?





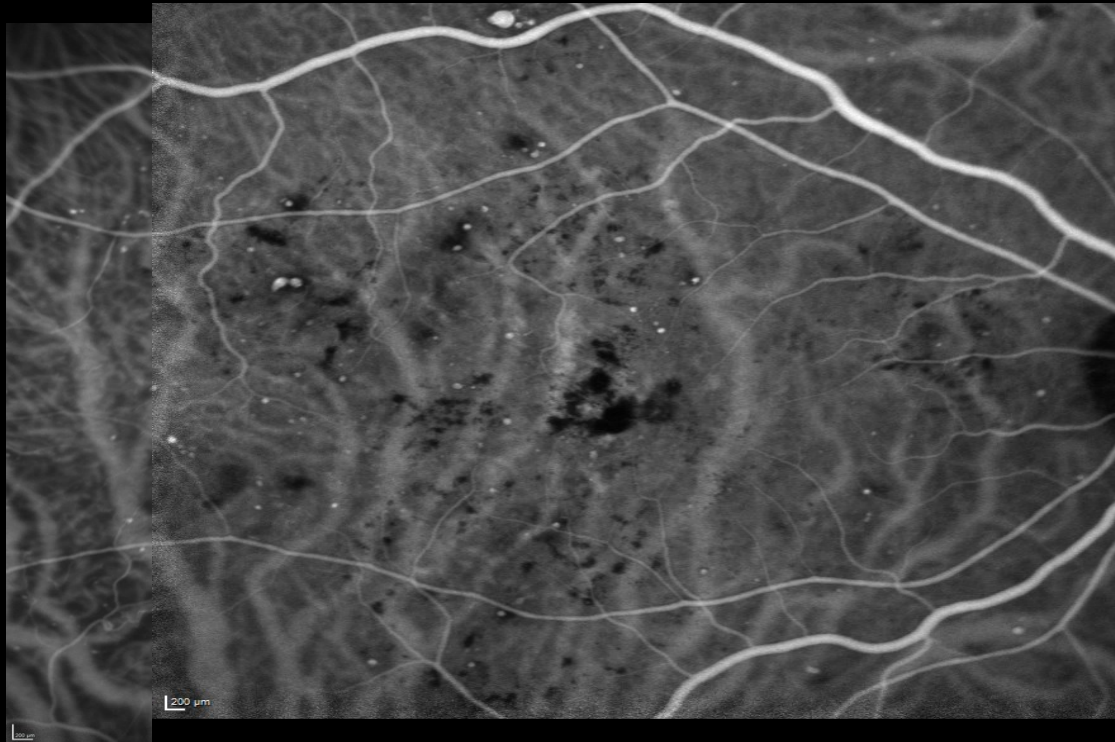


15/02/2017, OD



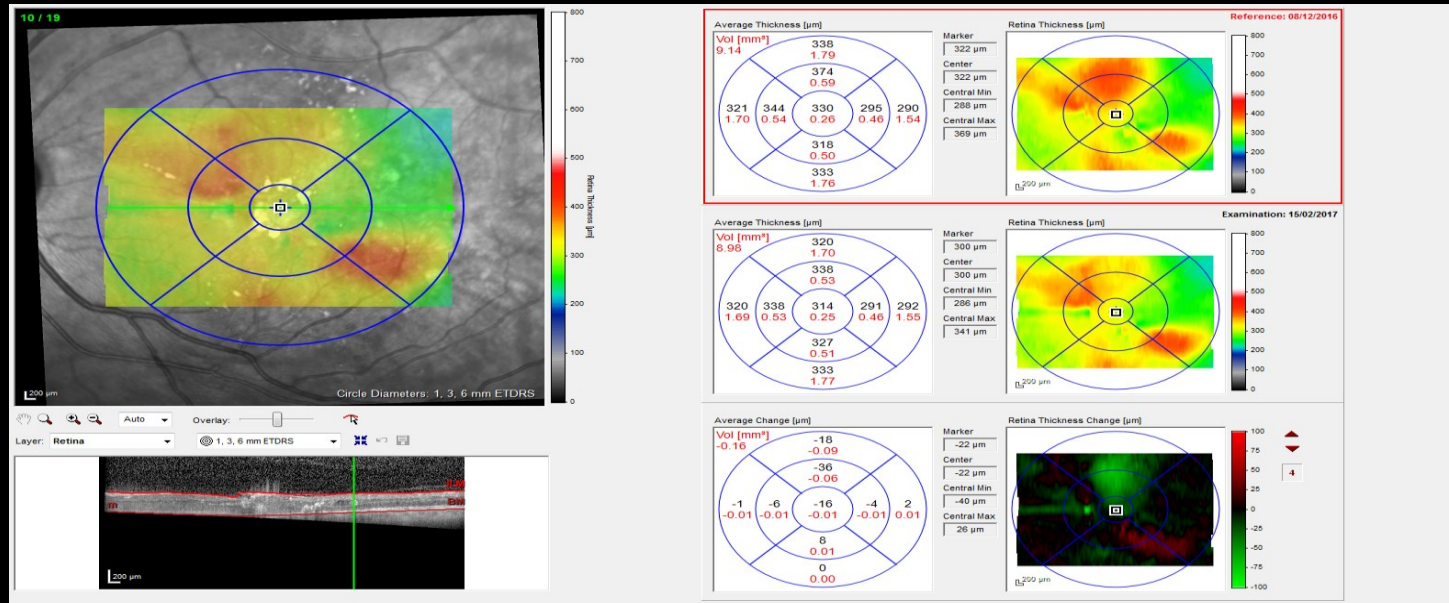
08/12/2016, OD
ICGA 1:16.76 30" ART(27) [HR]

HEIDELBERG
ENGINEERING

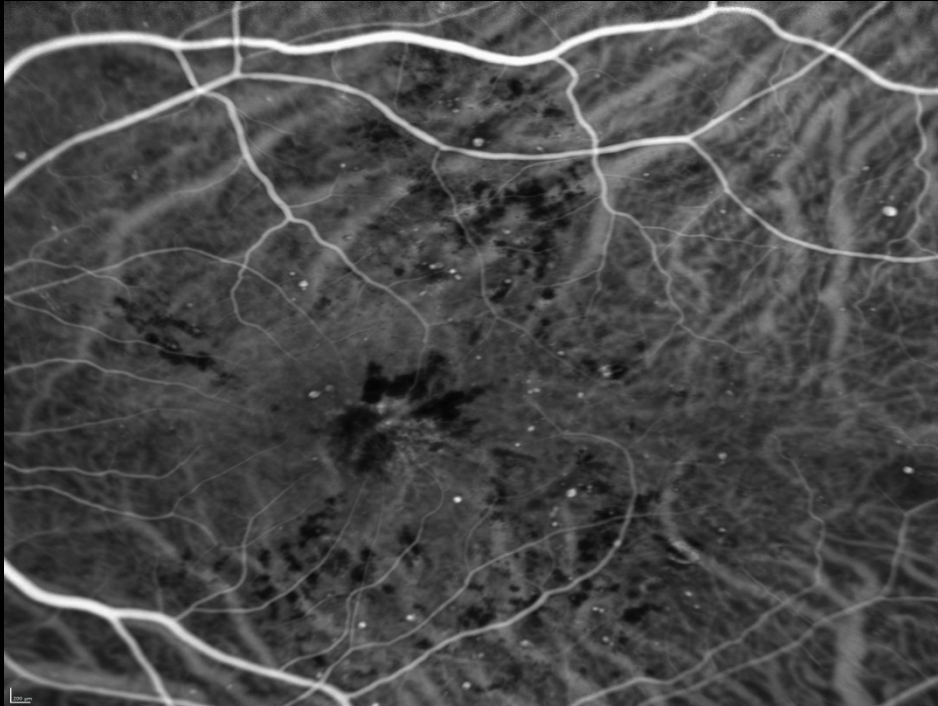


08/12/2016, OD
ICGA 1:16.76 30° ART(27) [H#

15/02/2017, OD
ICGA 2:53.06 30° ART(11)

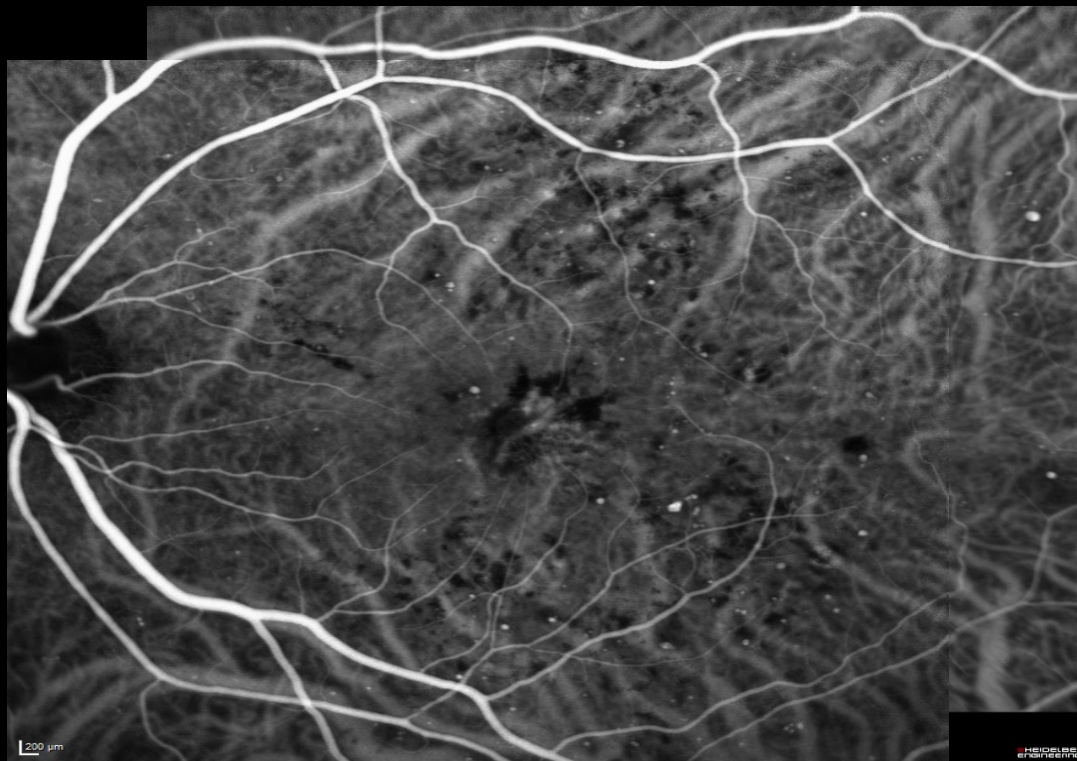


15/02/2017, OS



08/12/2016, OS
ICGA 0:54:06 30° ART(29) [HR]

NEOLIS
ENGINEERING



15/02/2017, OS
ICGA 0:51.12 30° ART(7)