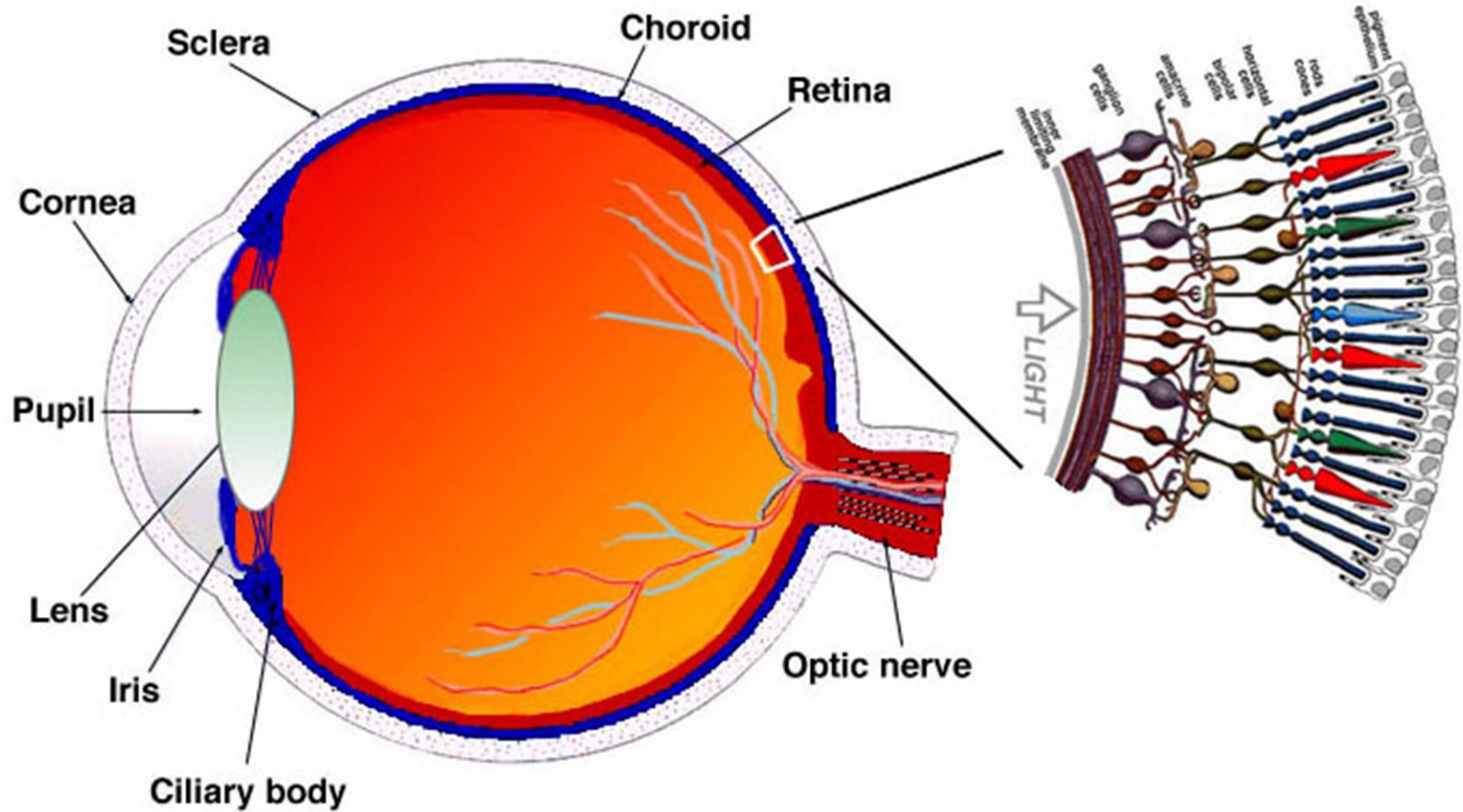


THE OPHTHALMOLOGIST'S NEEDS FOR THE ANALYSIS OF THE RETINA

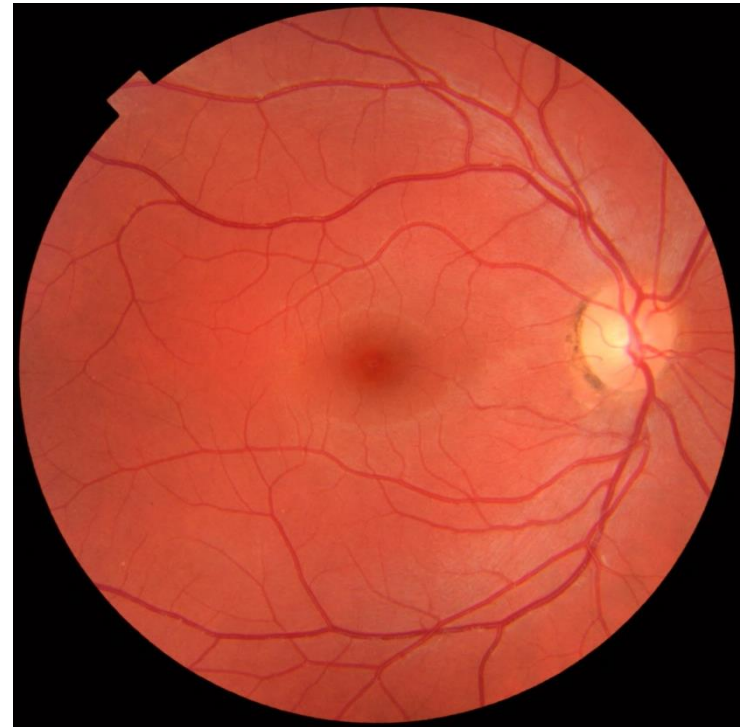
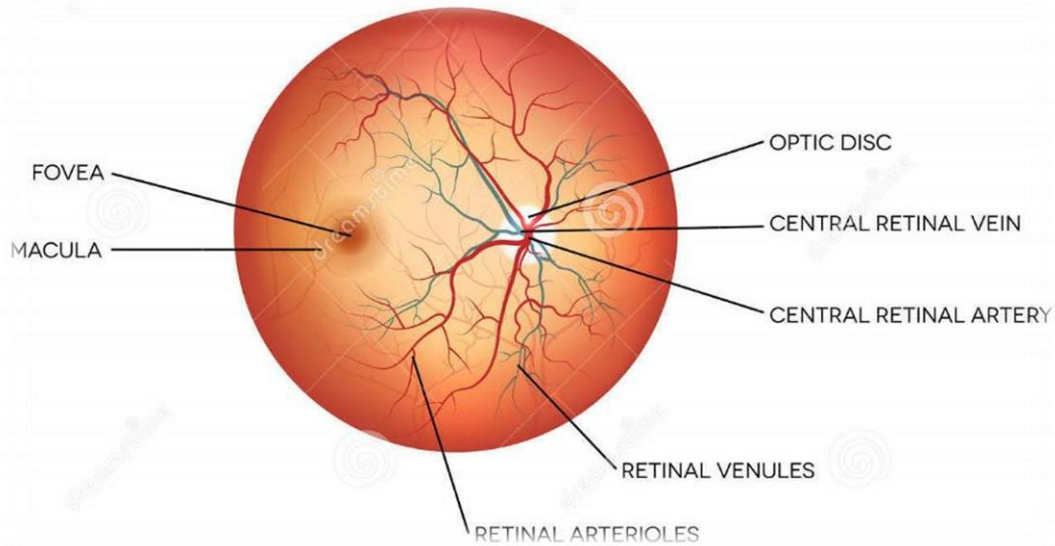
Dr Matonti Frédéric

**CHU Nord / INT AMU
Marseille**

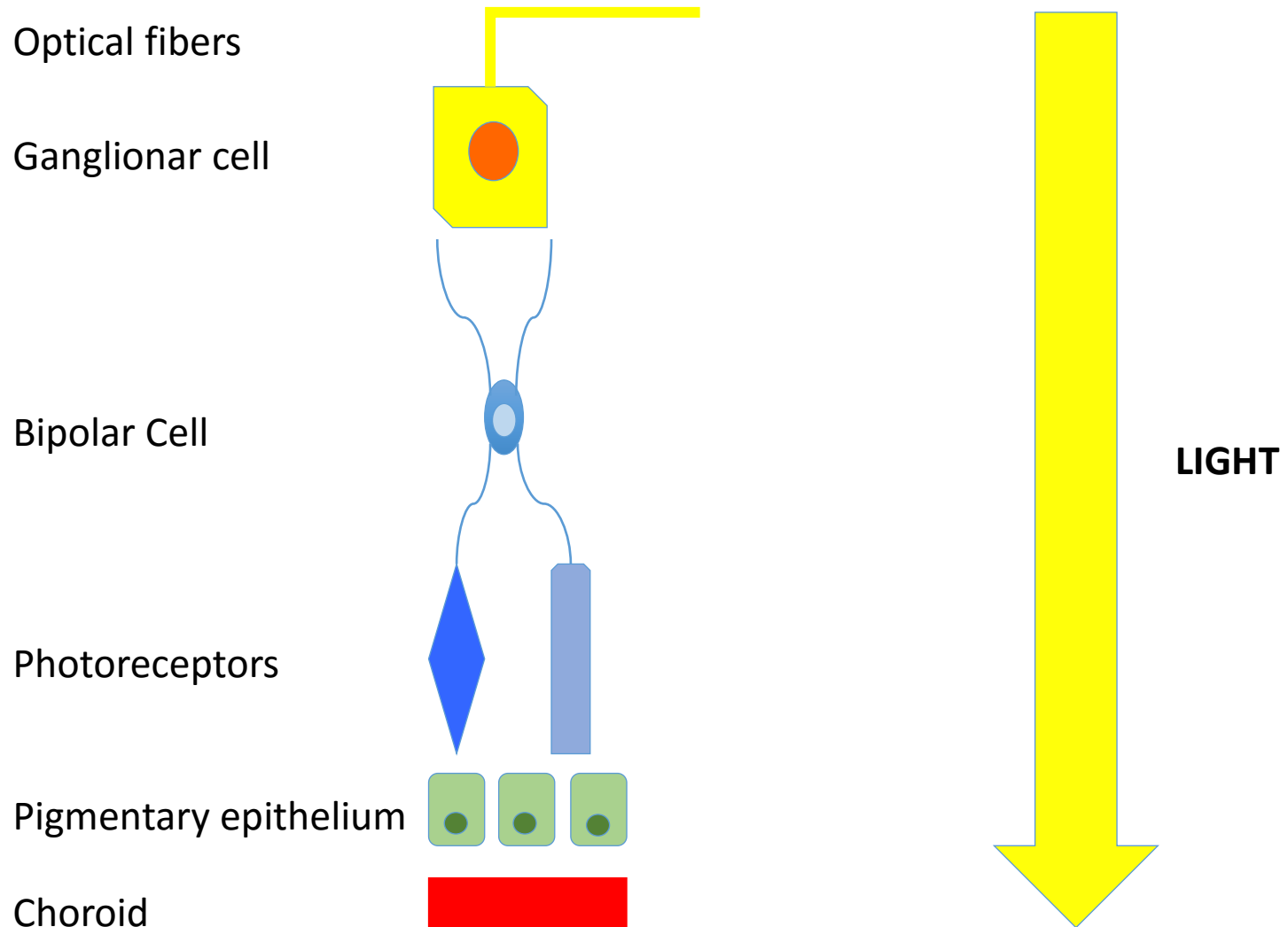
ANATOMY OF THE RETINA



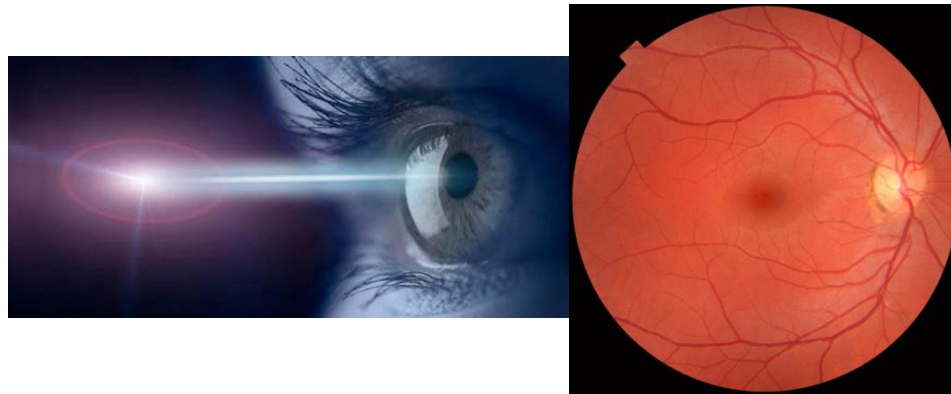
ANATOMY OF THE RETINA



ANATOMY OF THE RETINA



The visual function and retinal structure
are parameters intimately connected



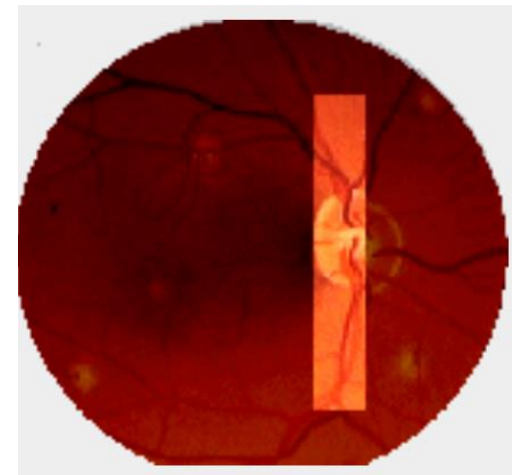
structural examination of the retina

Clinical examination

Indirect or direct ophthalmoscopy

Ophthalmoscopy

- What we actually do at each consultation
- The fundus is seen through a slit lamp
- Uses a light source and an aspherical convergent lens
- Stereo vision but only a small field visible



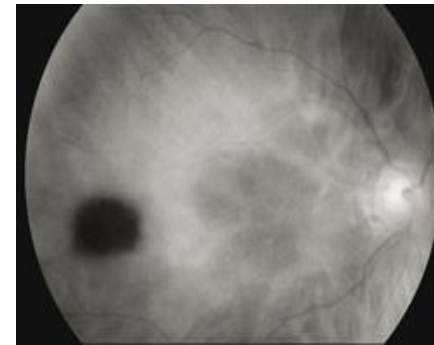
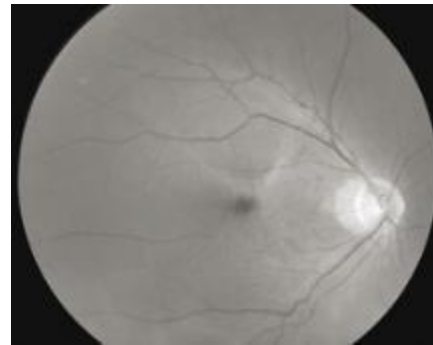
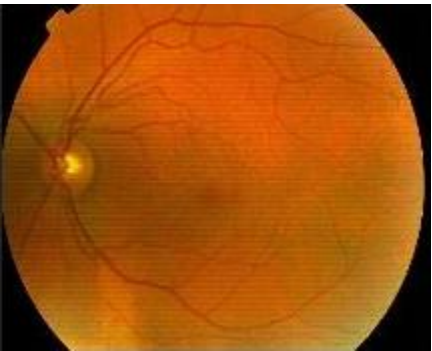
Paraclinical exams

RETINOGRAPHY

RETINOGRAPHY

- **Objective:**

pictures of the eye fundus with different wavelengths

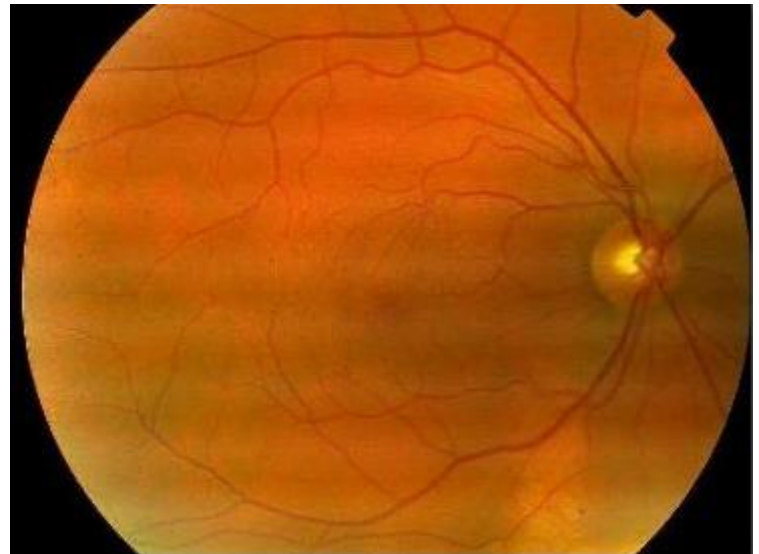


RETINOGRAPHY

- **Colored pictures:**

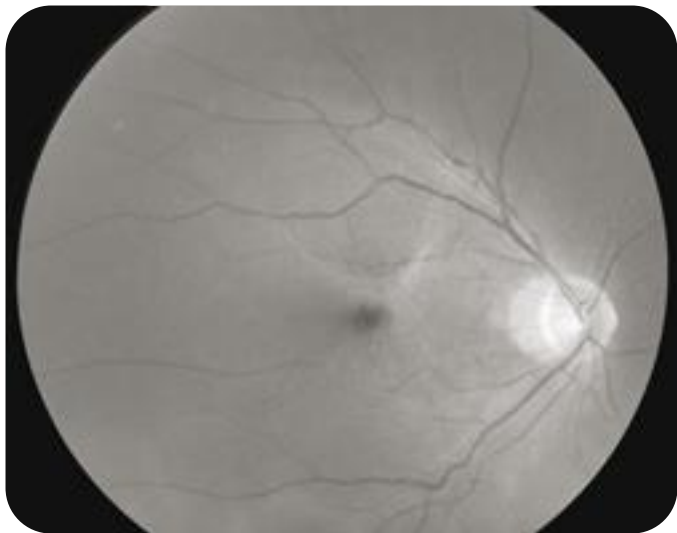
Uses white light

Stereoscopic pictures are possible



Monochromatic light:

Blue (500nm) => surface of the retina
xantophyle pigment, optical fibers



Optical fibers

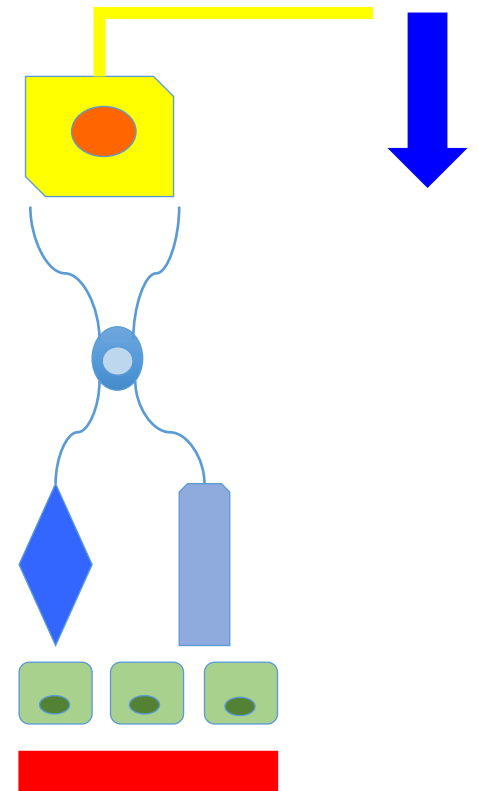
Ganglionar cell

Bipolar Cell

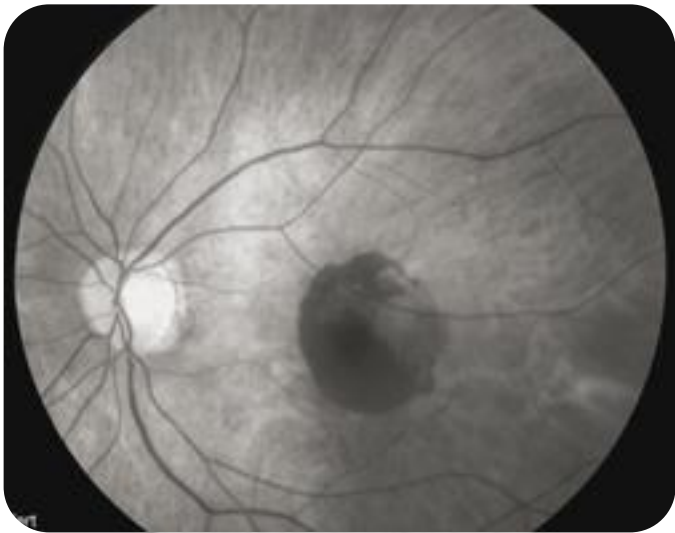
Photoreceptors

Pigmentary epithelium

Choroid



Green (570nm) => vessels and hemorrhages
no vision of the choroid



Optical fibers

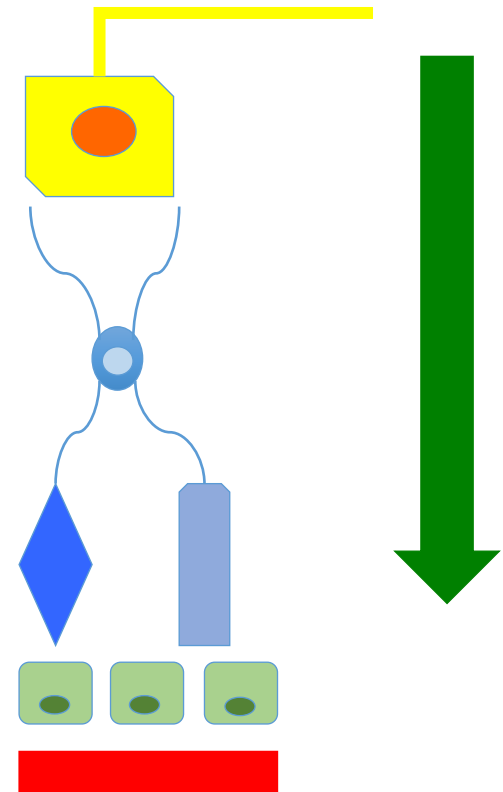
Ganglionar cell

Bipolar Cell

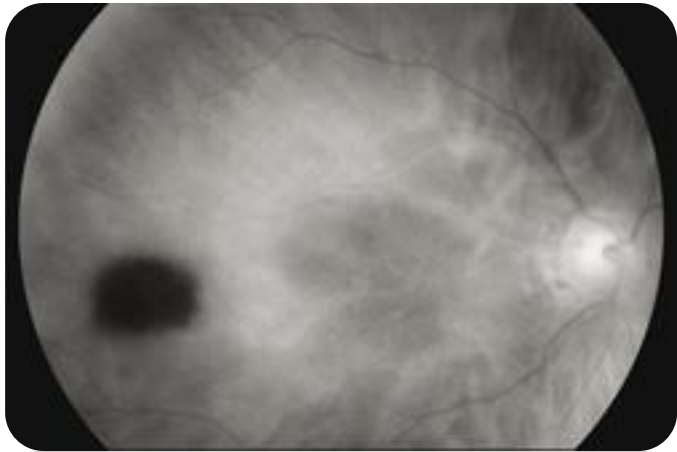
Photoreceptors

Pigmentary epithelium

Choroid



Red (645 nm) => pigments atrophy, detached EP and under the EP



Optical fibers

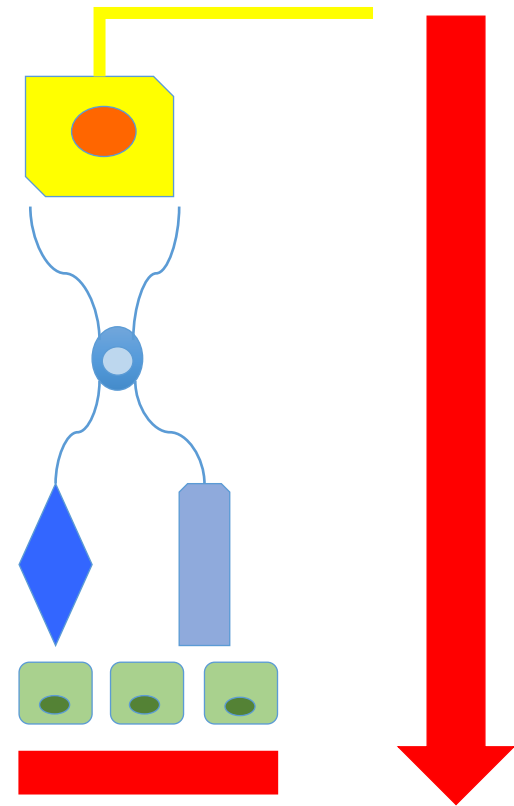
Ganglionar cell

Bipolar Cell

Photoreceptors

Pigmentary epithelium

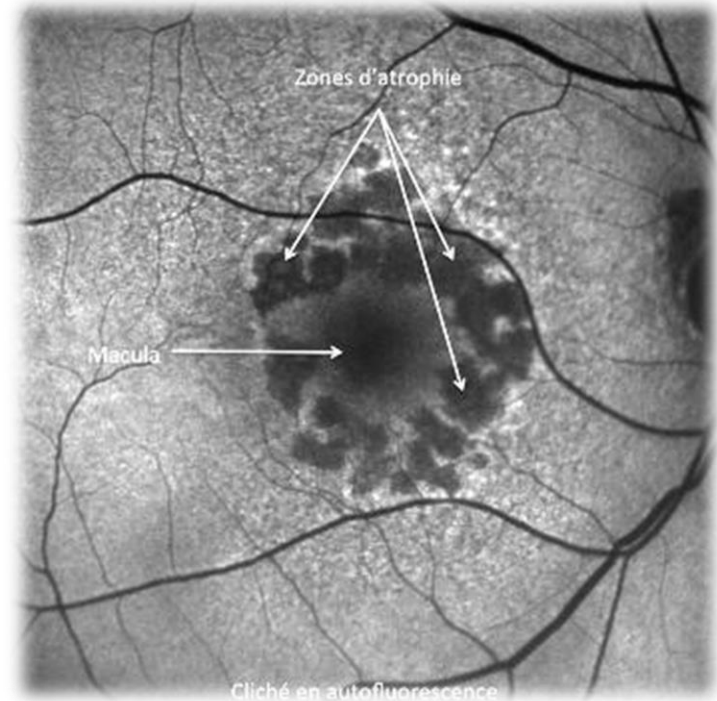
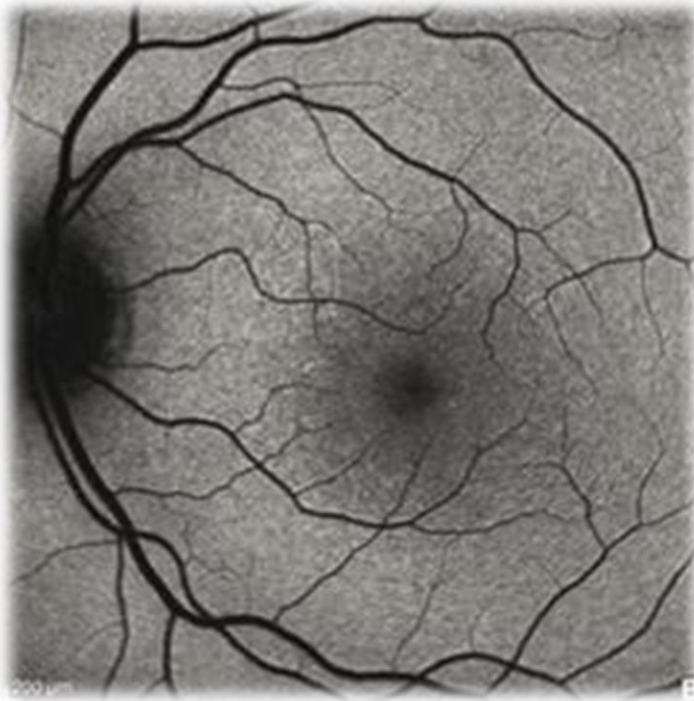
Choroid



- Autofluorescent

480nm with a barrier : fluorescence light

dysfunctions of the RPE



Paraclinical exams

ANGIOGRAPHY

ANGIOGRAPHY

Study the vascularization of the retina



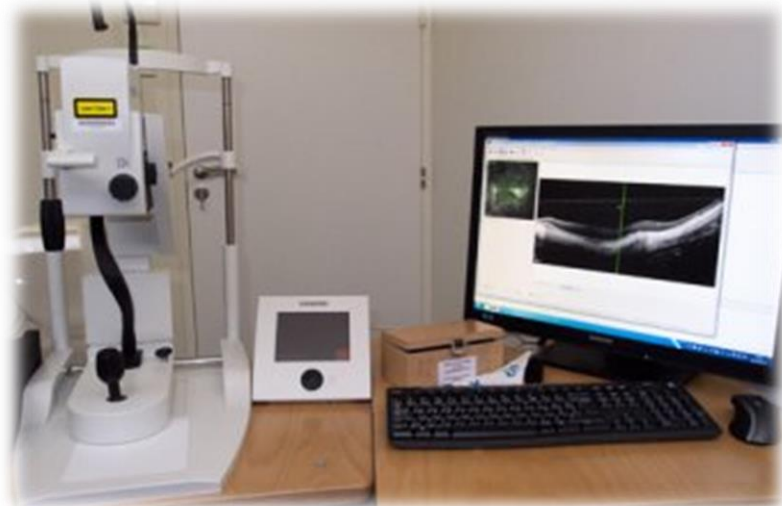
Conventional angiographs

- 1st conventional angiographs with flash light
- The light was glared and time acquisition long



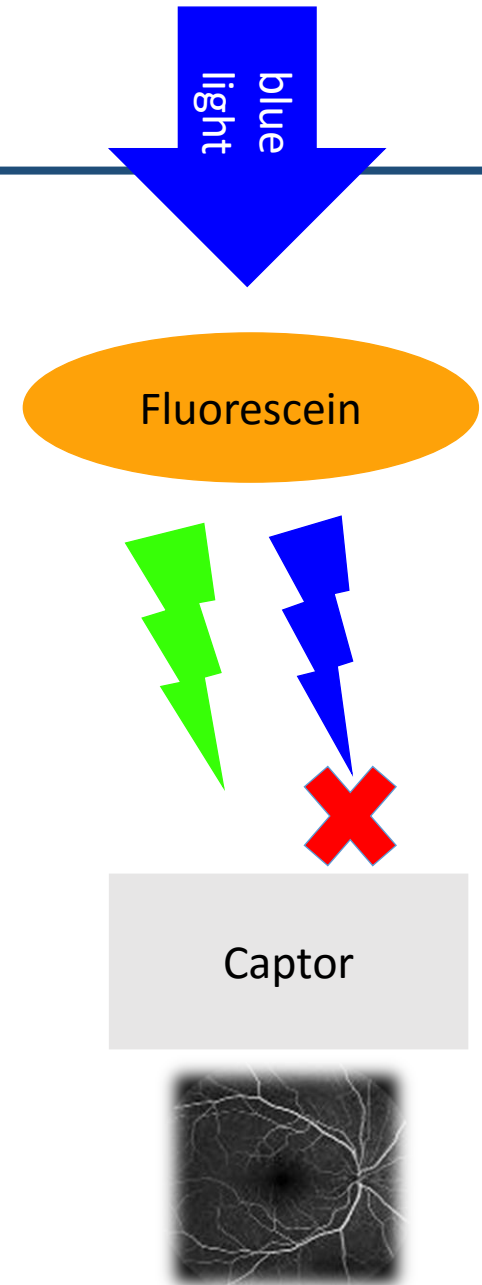
SLO

- Now we use Scanning Laser Ophthalmoscopy =SLO
- It uses a laser beam that scans the retina in a confocal system



Fluoro angiography

- fluorescence of the dye
- Fluorescein is excited by 465-470 nm light
- Fluorescence light : 520-530 nm



- **Interests:**

Shows us:

- Leakage of the vessels
- Neovascularization
- Abnormalities of the vessels:
aneurysms, stenosis,,
ischaemia...



Paraclinical exams

Indocyanine Green angiography

- **Objective:**

Shows the deep vascularization = below the EP =the choroidal vascularization

Optical fibers

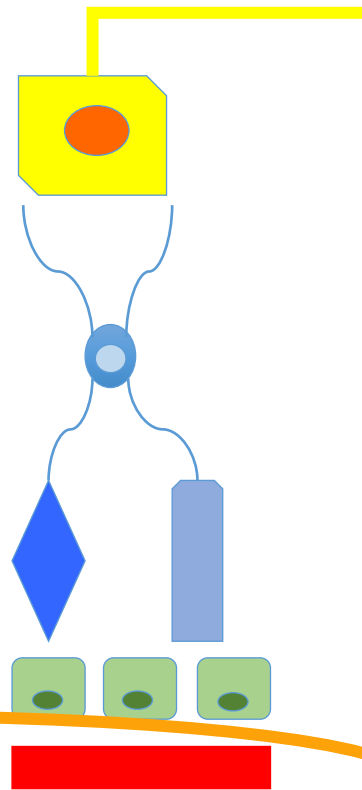
Ganglionar cell

Bipolar Cell

Photoreceptors

Pigmentary epithelium

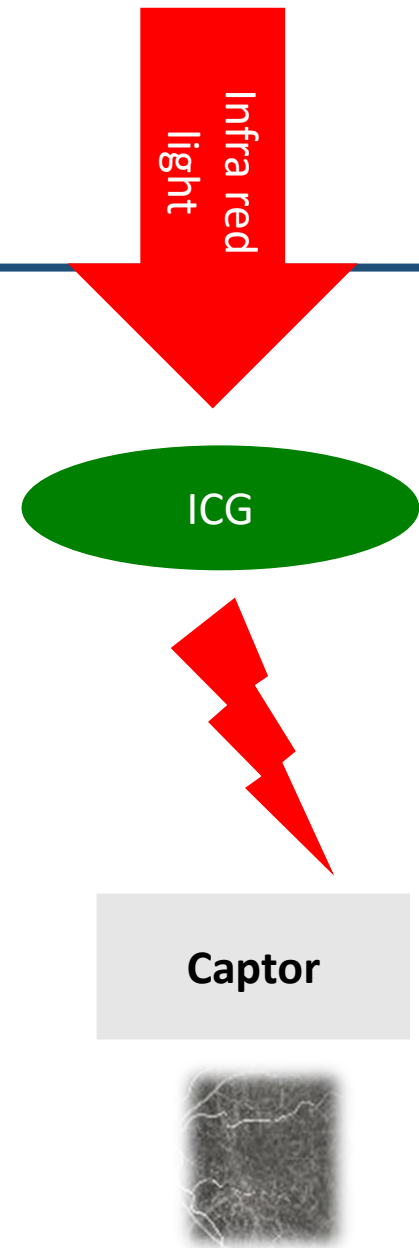
Choroid



ICG Angiography

Green indocyanin is excited with infrared light

Infrared light has a poor absorption by the RPE => the choroid below is visible



ICG Angiography

- **Interests:**

Shows the choroidal vascularization

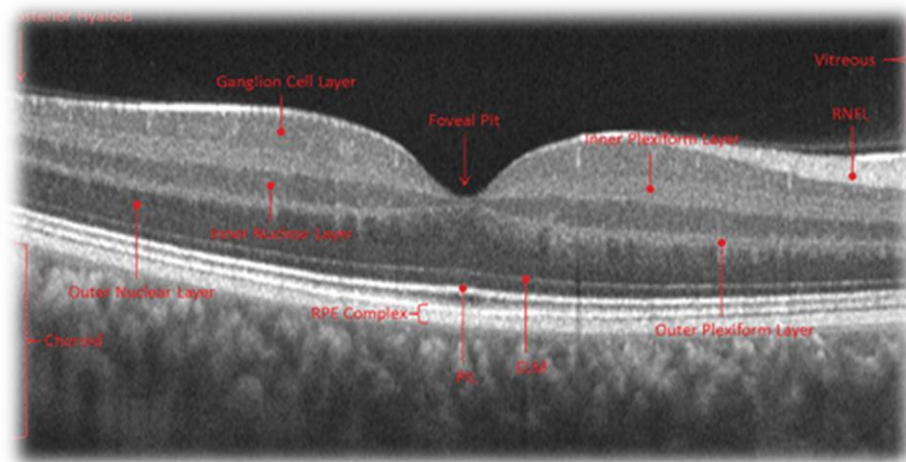
Less allergenic

Used for ARMD diagnosis +++

- **Limits:**

Limited resolution

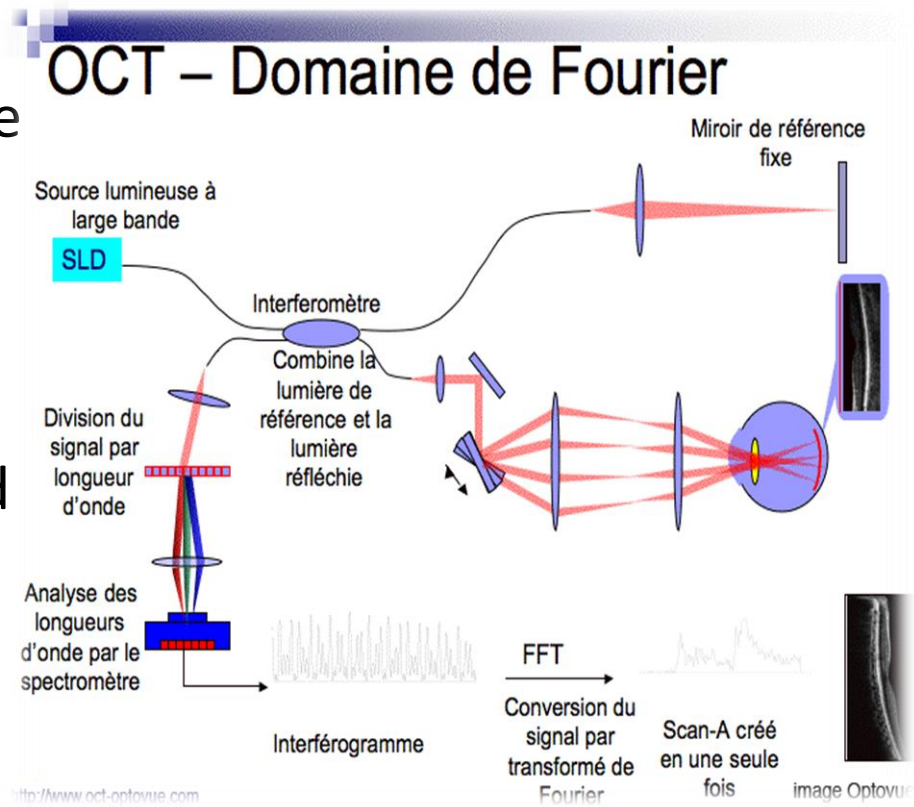
Optical Coherence Tomography = OCT



Optical Coherence Tomography

Analysis of the light reflectivity in the different layers of the retina using spectrometry

2 to 3 seconds to perform a hundred cross-sectional images on a square of 6x6 mm

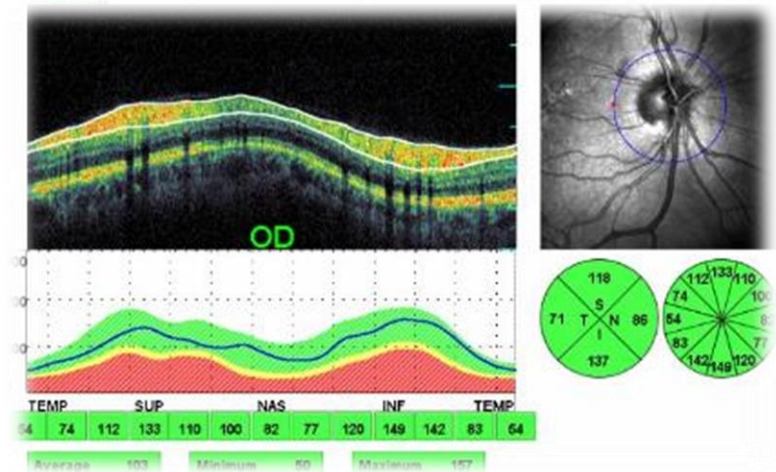
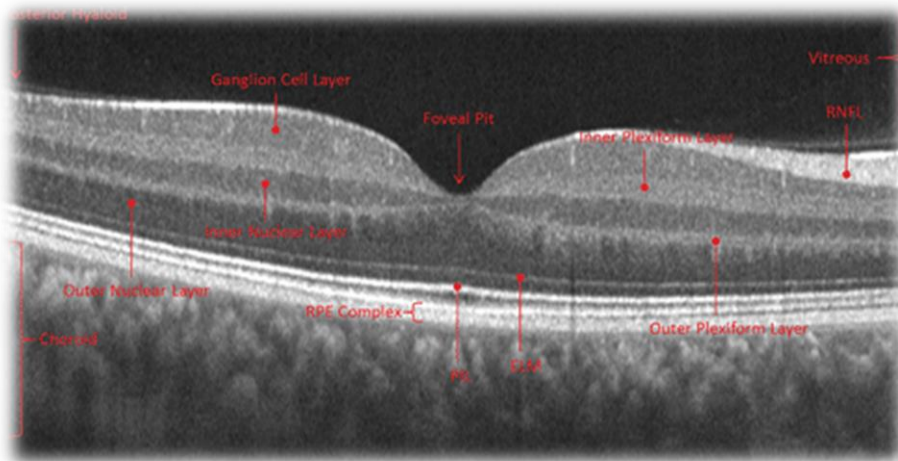


Optical Coherence Tomography

None invasive study of the retina : cross-sectional images

1st generation in the 90's : time domain (10 μm)

Actually: OCT spectral domain (5 μm)

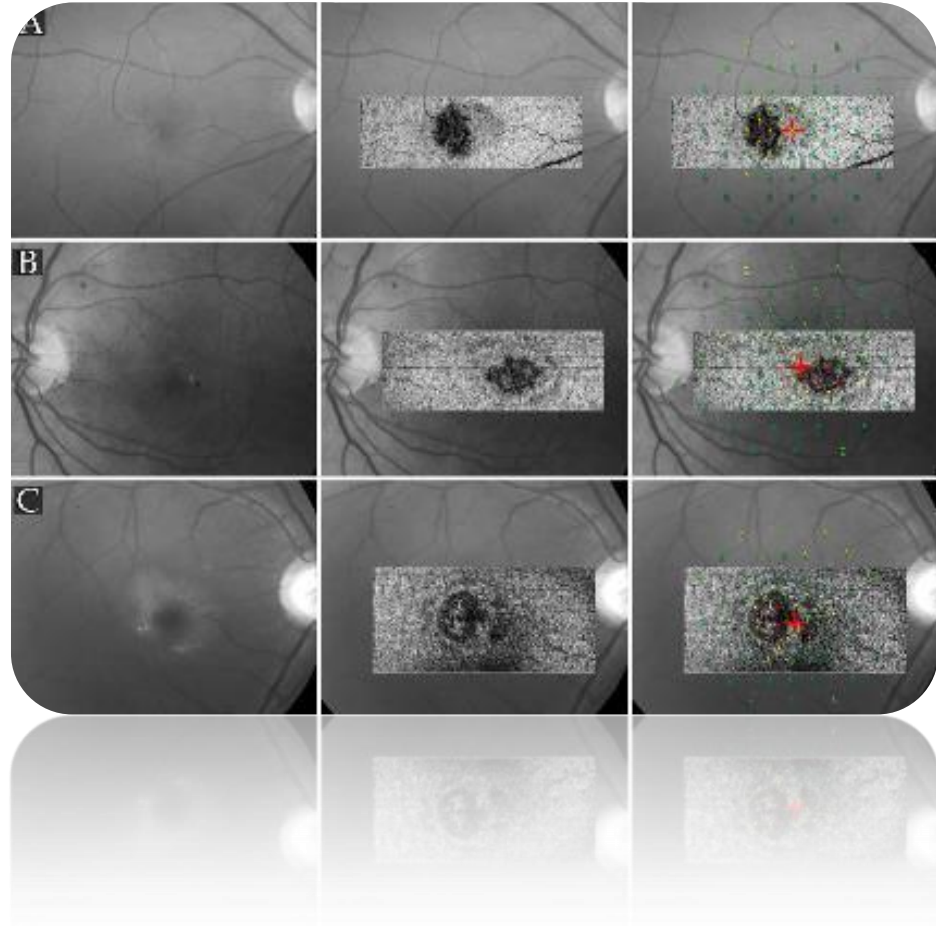


- OCT en face:

Analyses the different layers of the retina not with cross sectionnal images but in the frontal plan

⇒ **To detect the path of the neovessels**

⇒ **Surface of the lesions...**



- **Limits:**

Not a dynamic examination

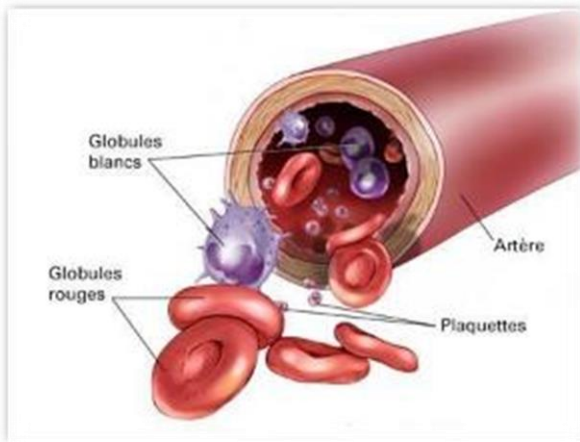


Paraclinical exams

Angio-OCT

Angio-OCT

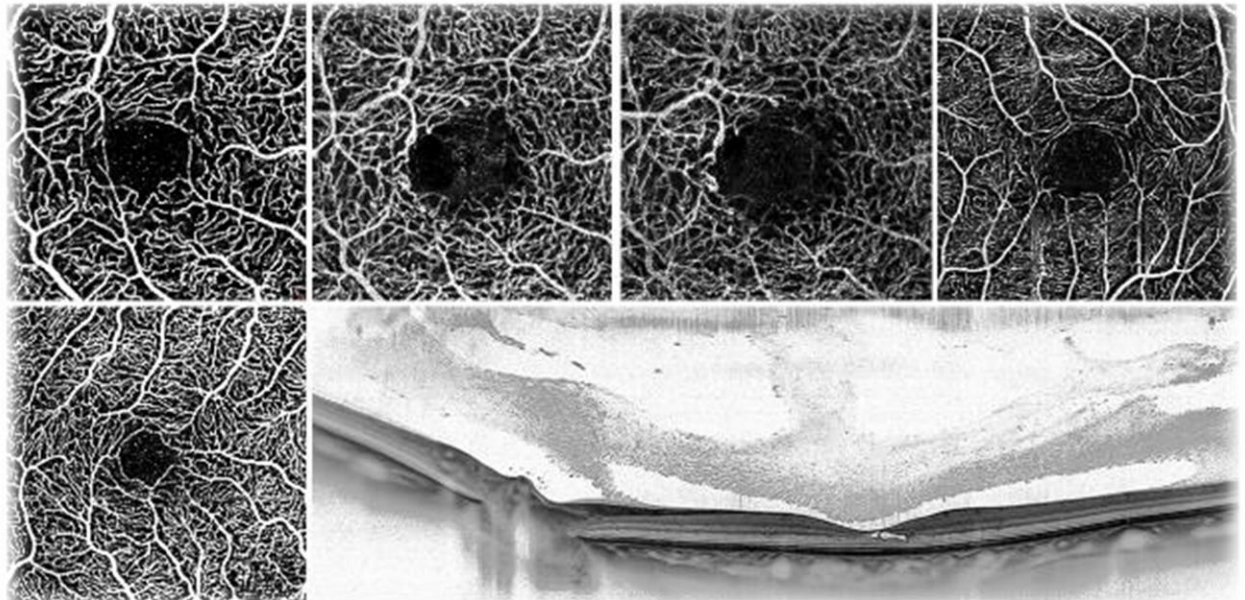
Based on the concept that the only movable structures in the eye are the blood particles



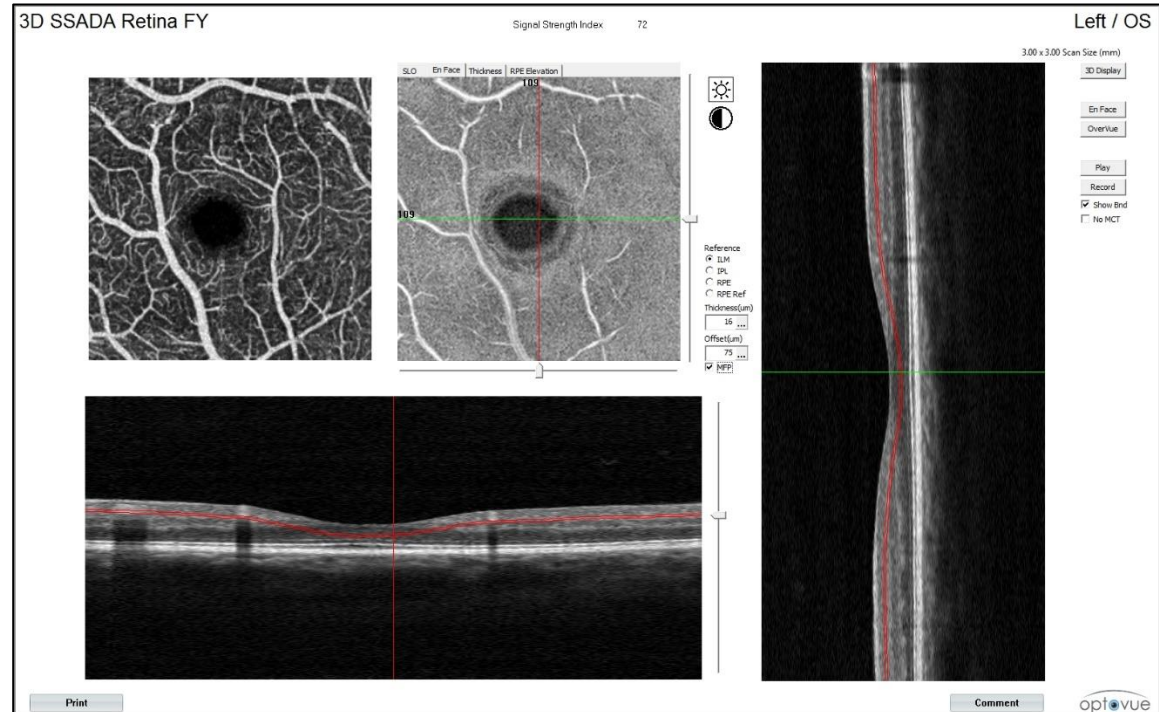
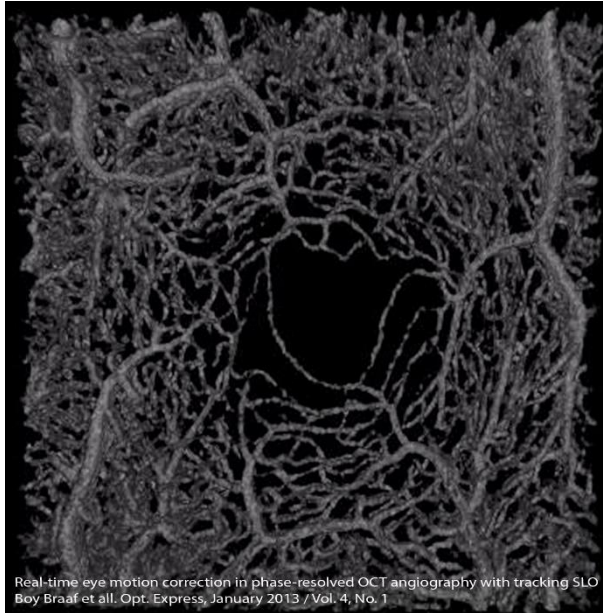
Angio-OCT

Analyses the vascularization of the retina
WITHOUT dye

To obtain a 3D visualization of the microvascularization
of the retina

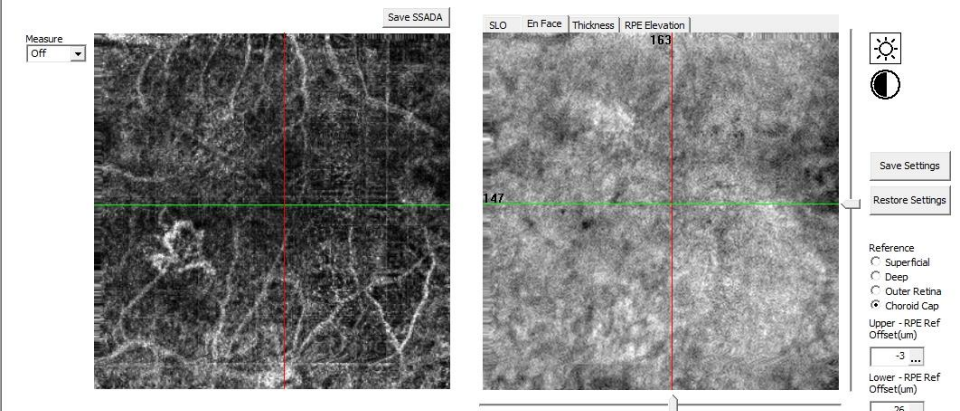


Angio-OCT



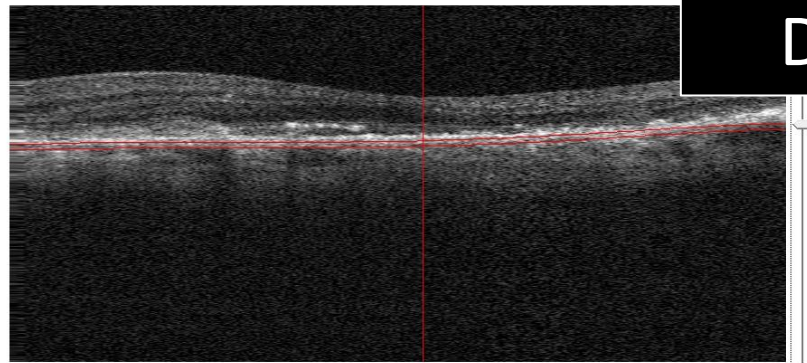
Optovue XR ADVANTI
 Module SSADA : Split-Spectrum Amplitude Decorrelation Algorithm
 Use movement of cells in vessels

But if the movement is too fast or too slow there is no signal

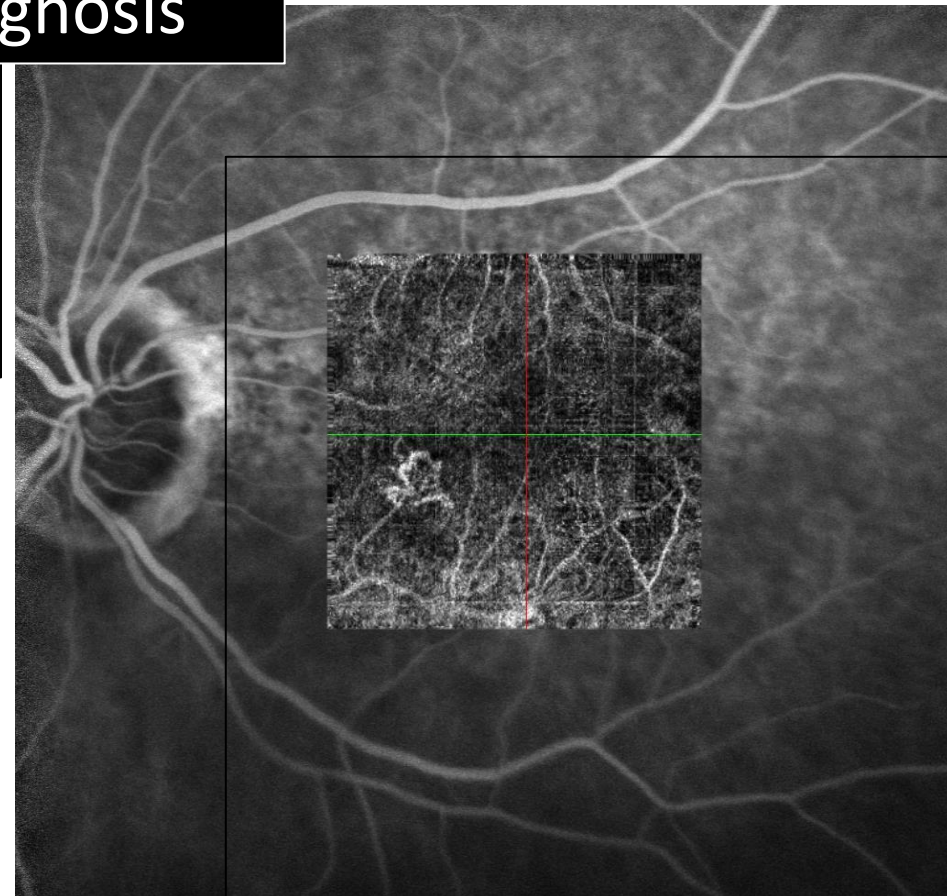


Avantages
Direct visualization of CNV

Diagnosis



Limits
No staining
No diffusion analysis



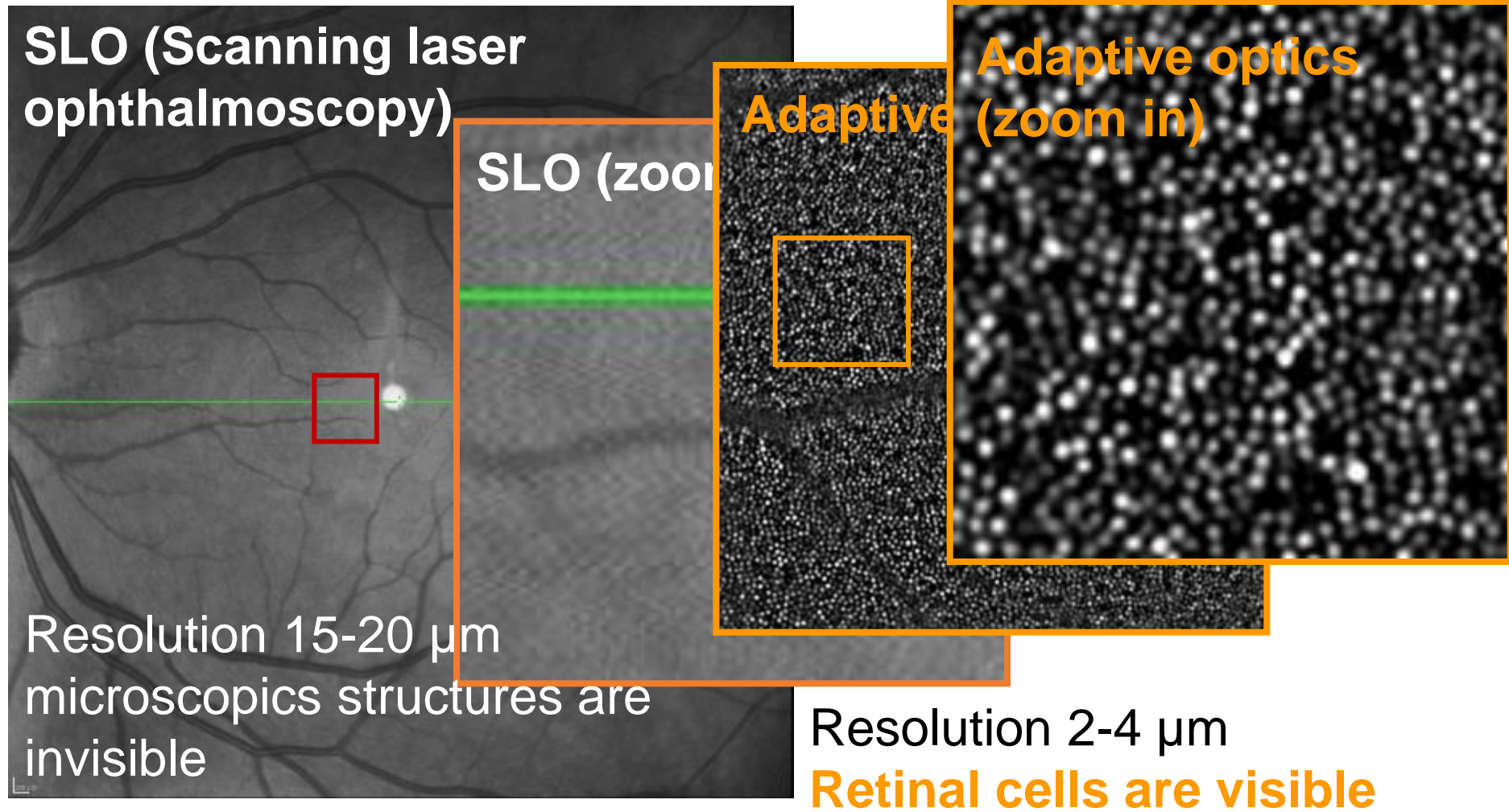
Adaptative Optics

- The first in vivo retinal « microscope »
- Visualisation of cells and vascular walls



The **rtx1** adaptive optics retinal camera from Imagine Eyes

Cellular resolution



ODi2k-Retina image stitching software

Fovea

Nasal

Rétine normale

OS

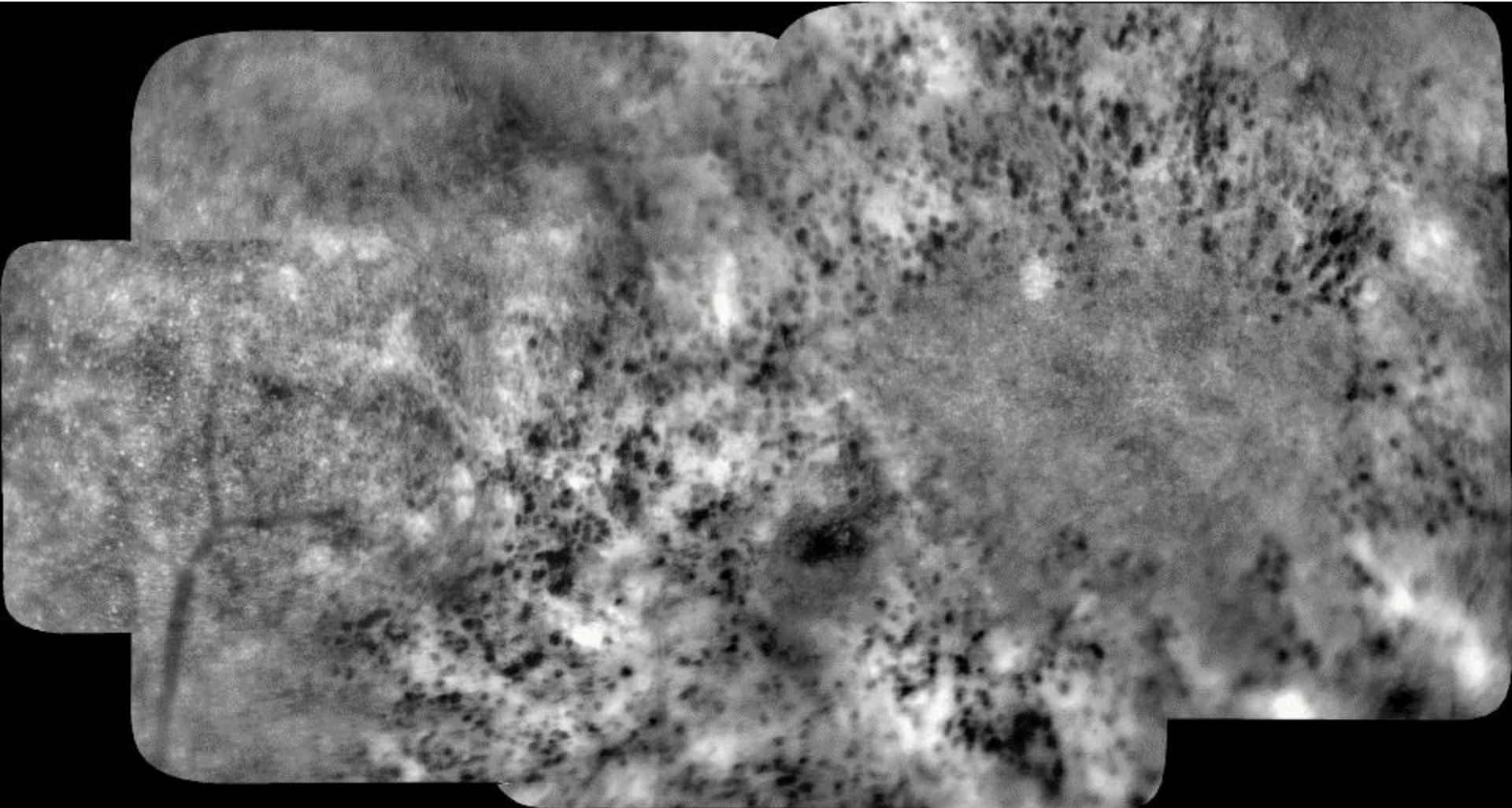
Temporal

Fovea

Courtesy Gocho & Pâques, Quinze-Vingts National Hospital, Paris

I2k is a registered trademark of DualAlign L

i2k-Retina image stitching software









Courtesy Gocho & Pâques, Quinze-Vingts National Hospital, Paris

Cone-rod dystrophy (CRD)

i2k is a registered trademark of DualAlign L

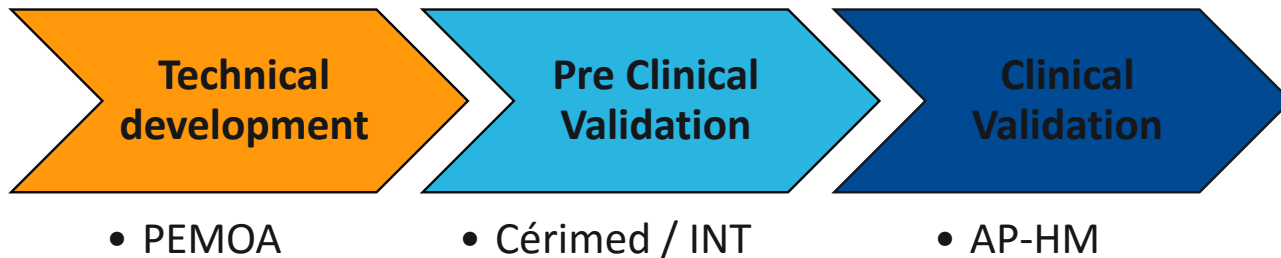
- The cluster OPTITEC in partnership with ONERA and Astrophysics Laboratory of Marseille (LAM) have opened the pooled European platform for adaptive optics (PEMOA)



	Clinic	Learning	Pre clinical
PEMOA   <small>Plate-forme Européenne Mutualisée en Optique Adaptative</small>	Finance research	logistics organization	Finance research Installation project
	RTX1 + RH		technical validation
Cerimed 	-	Provision of lecture halls	project partnership Last available lab expertise
Imagine Eyes 	Expertise	Devices	project partnership development Industrialization and Commercialization
AP HM  	Facilities Clinical trials Doctors	Clinical learning	Animal models
Other parteners		Fresnel	Technical or academic partner (Pharmaceutical group?)

Partnership POMA / CERIMED

Promote the transfer of technology for the development of innovative products in the field of medical imaging



Partenaires



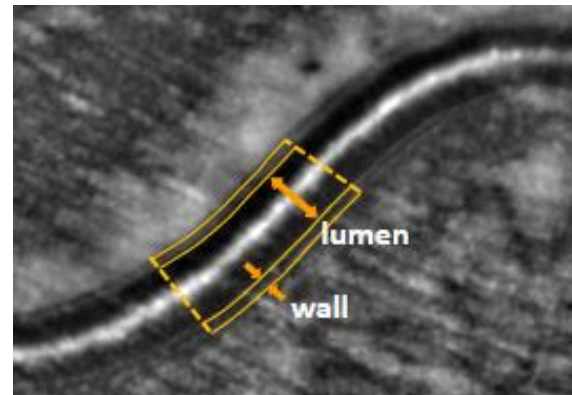
Consortium PEMOA



Financeurs



- The PEMOA platform is active since the end of 2014, is the result of a successful collaboration between various public and private actors on the theme of adaptive optics (AO).



Conclusion

- Retinal imaging and ophthalmological imaging is a changing world
- The expectations of practitioners in their daily practice are mainly directed towards :
 - higher resolution : cellular imaging
 - Higher speed and larger field of view
 - Combined imaging (multimodal and/or functional imaging)
 - Dynamic imaging (vessels)
 - Targeted imaging (cell markers)
- Partnerships with all actors are key to progress



Thank you for your
attention



Dr F. Matonti – Marseille

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