

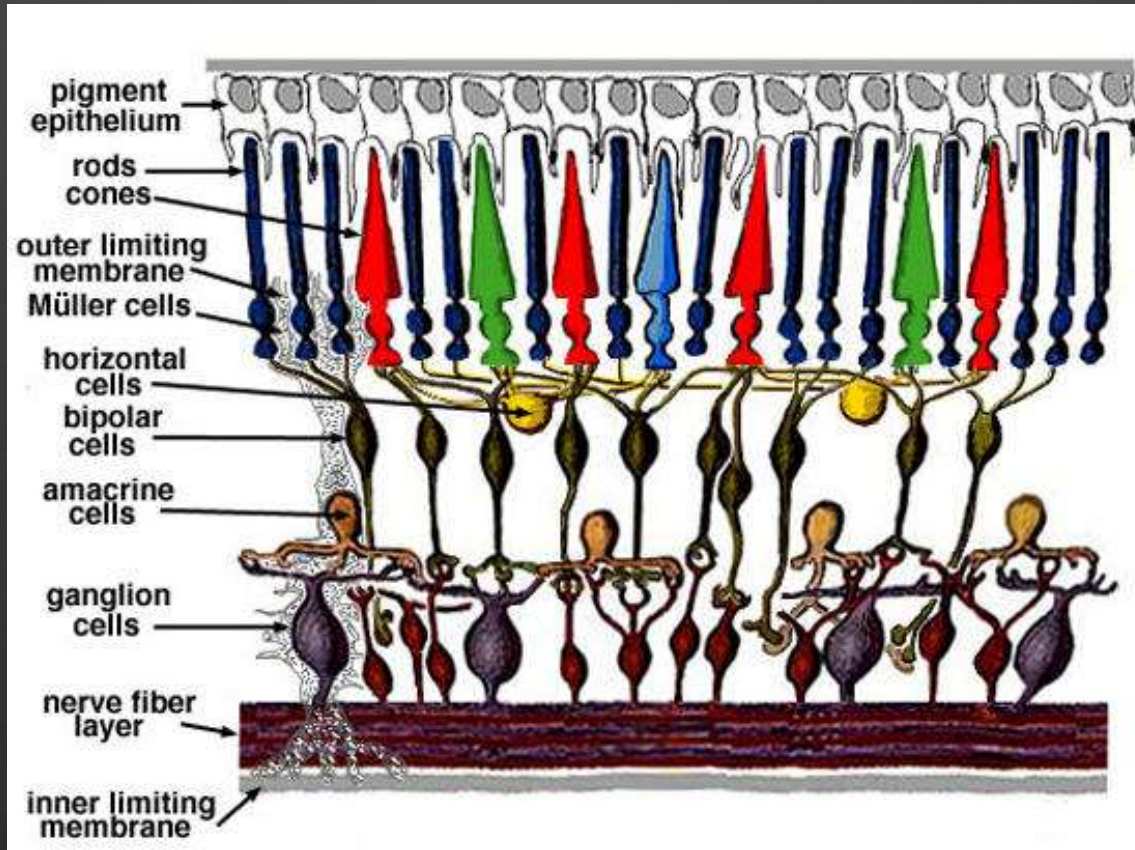
FUNDUS AUTOFLUORESCENCE

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INTRODUCTION

- ⦿ Spontaneous emission of light by biological structures after absorption of light – used to distinguish light originating from artificially added fluorescent markers
- ⦿ ‘Fluorophores’ – chemical structures that possess fluorescent properties when exposed to light of an appropriate wavelength
- ⦿ Absorb light moving to a higher energy state triggering light at a wavelength longer than the source

Layers of the retina



Retinal Pigment Epithelium

- Vit A circulation
 - Synthesise extra-cellular matrix
 - Transport molecules
 - Phagocytose outer disc of photoreceptors
-
- Affected by age and in disease
 - Leads to accumulation of '*lipofuscin*'
 - Plays a role in AMD and other hereditary macular disease

Lipofuscin

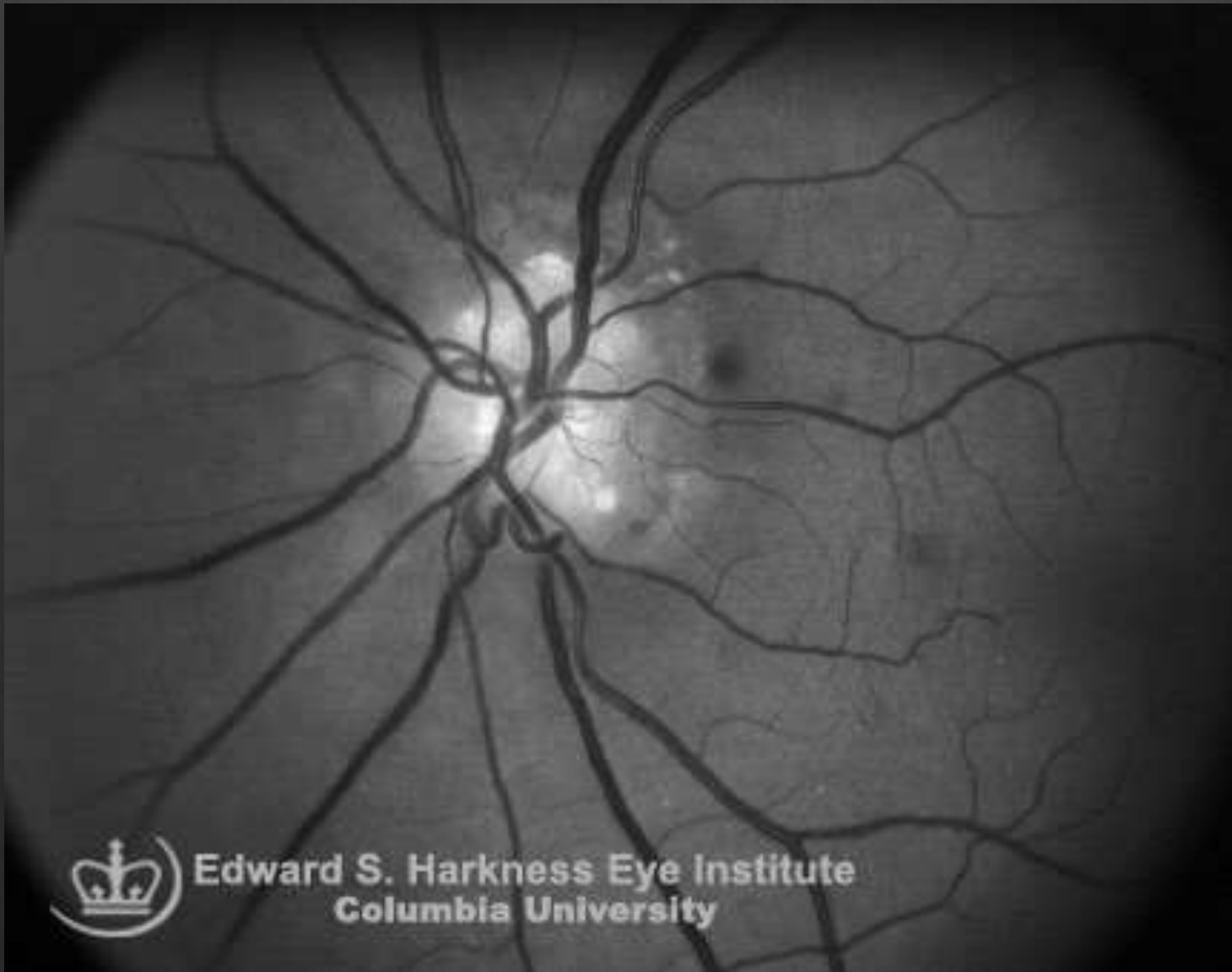
- ⊗ Intrinsic fundus AF due to lipofuscin
- ⊗ Excitation with short to medium wavelength, leads to autofluorescence with peak emission of 630 nm
- ⊗ Other fluorophores also identified ~10
- ⊗ One of the major fluorophores of lipofuscin is A2E

Retinal conditions identifiable from AF patterns

- ⊗ Hereditary
- ⊗ Age-related
- ⊗ Inflammatory
- ⊗ Retinal pigment change due to laser therapy

Natural fluorophores

- ⊗ Lipofuscin
- ⊗ Optic nerve drusen
- ⊗ Astrocytic hamartomas
- ⊗ Aging crystalline lens



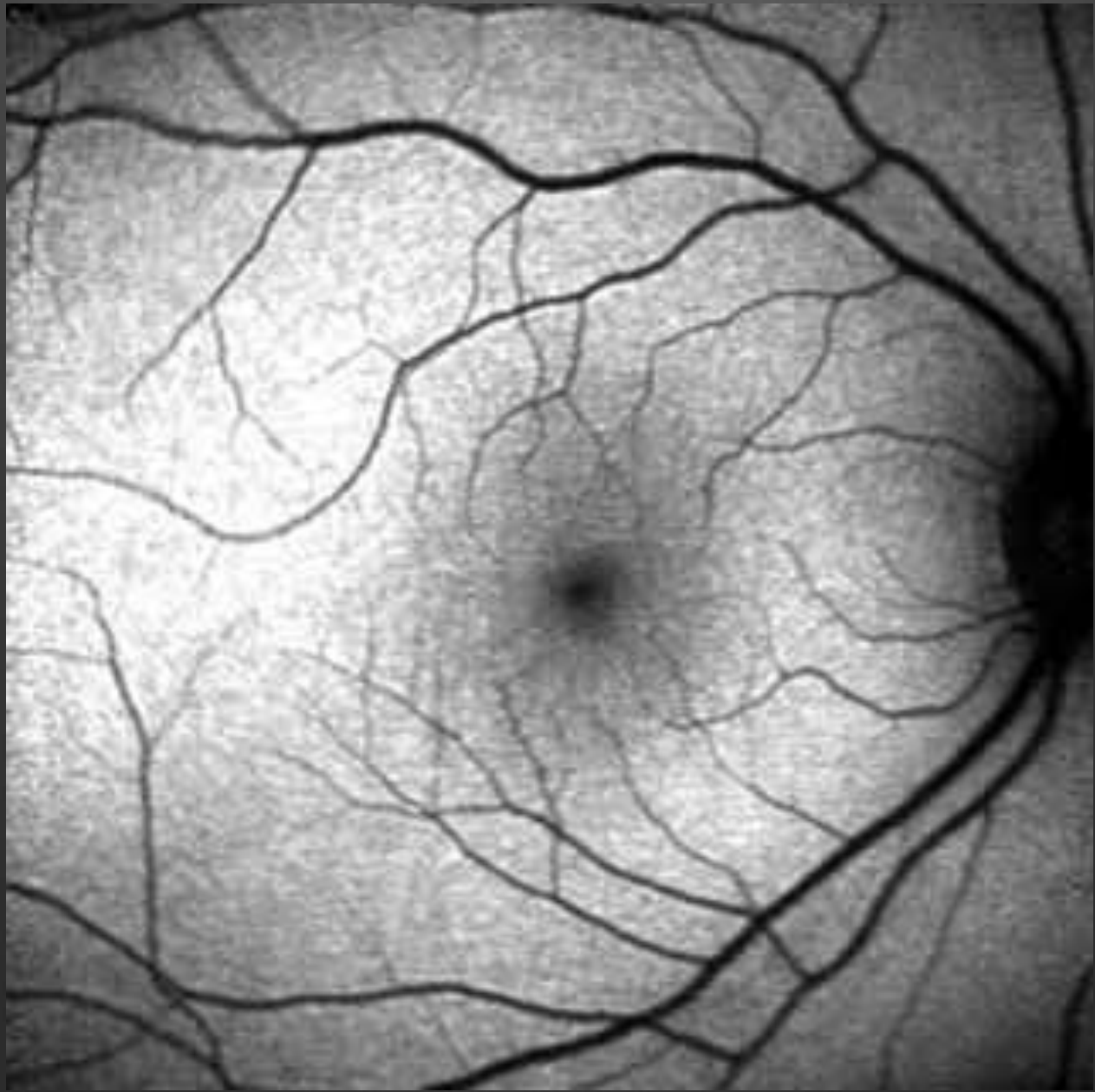
Edward S. Harkness Eye Institute
Columbia University

Clinical applications

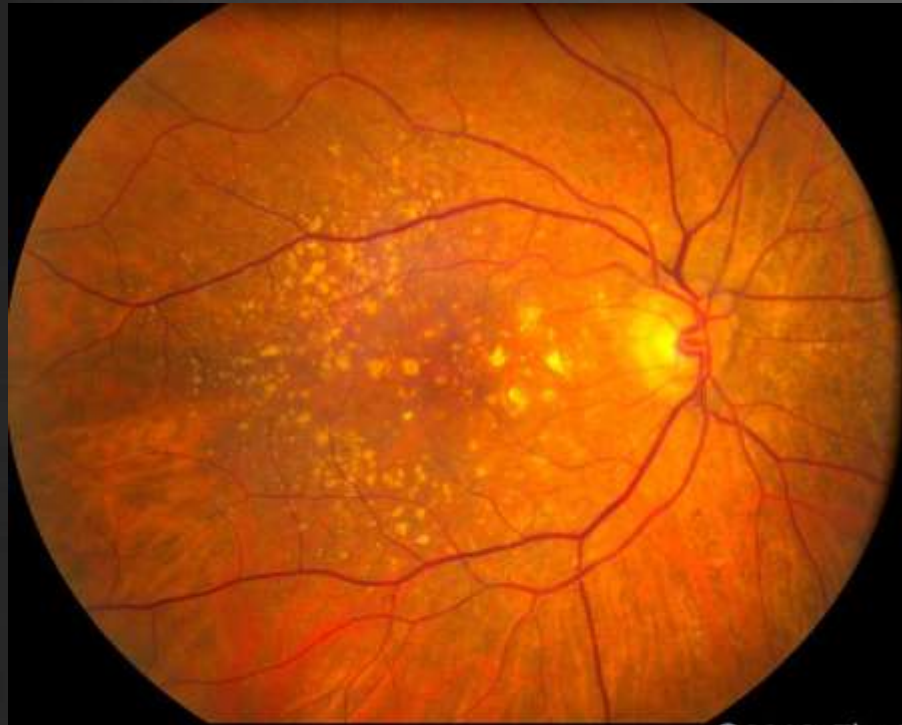
- ⊗ Macula pigment density and pigment densities elsewhere in the retina to evaluate diseases
- ⊗ Newer applications using macula pigment density to evaluate oxygen dependent cell metabolism

Normal AF pattern

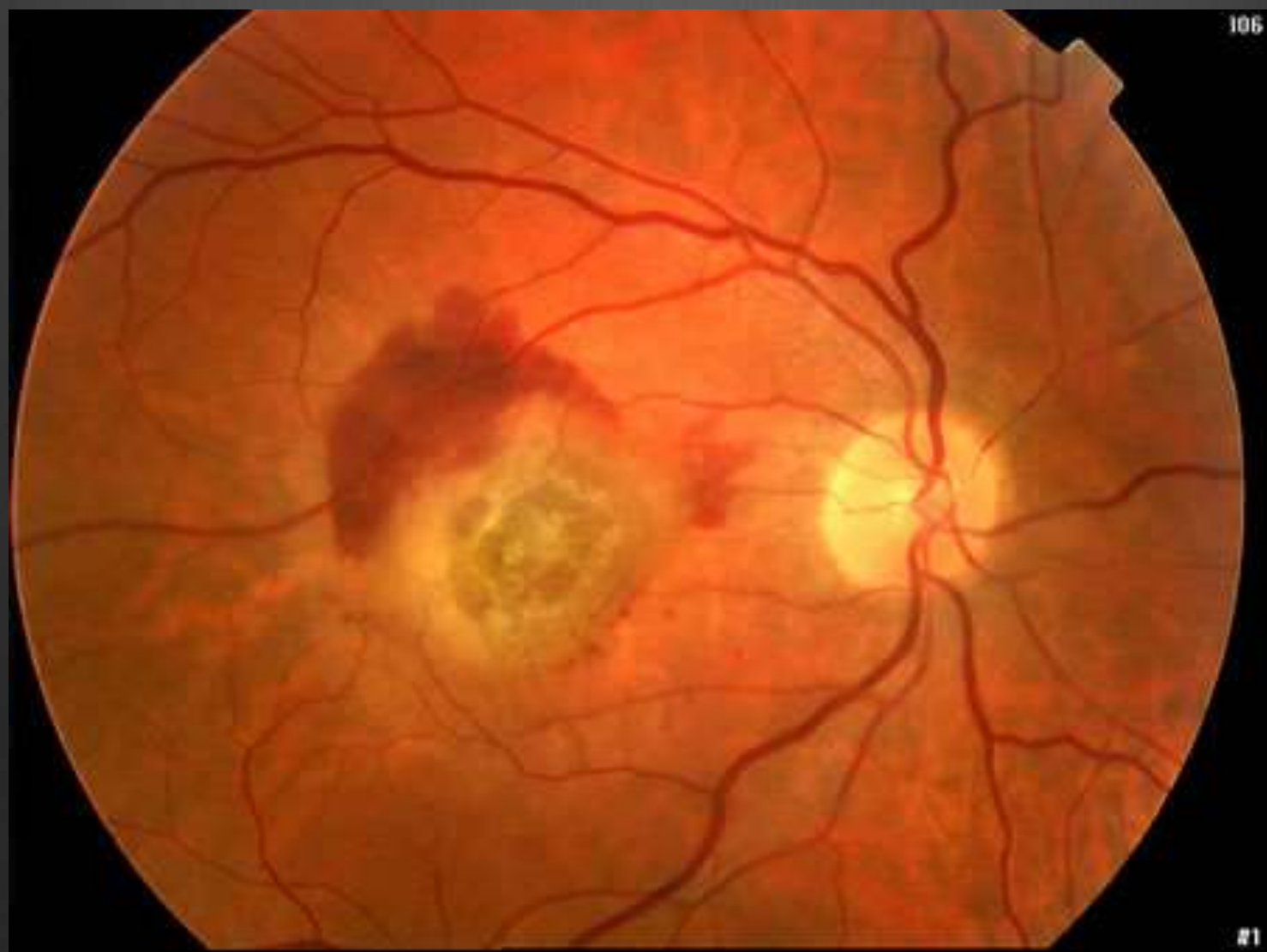
- ⊗ Decreased AF in perifoveal area – lutein and zeaxanthin
- ⊗ ON and vessels appear dark
- ⊗ Area around vessel arcades has the highest intensity of AF decreasing towards the periphery



AGE RELATED
MACULAR
DEGENERATION

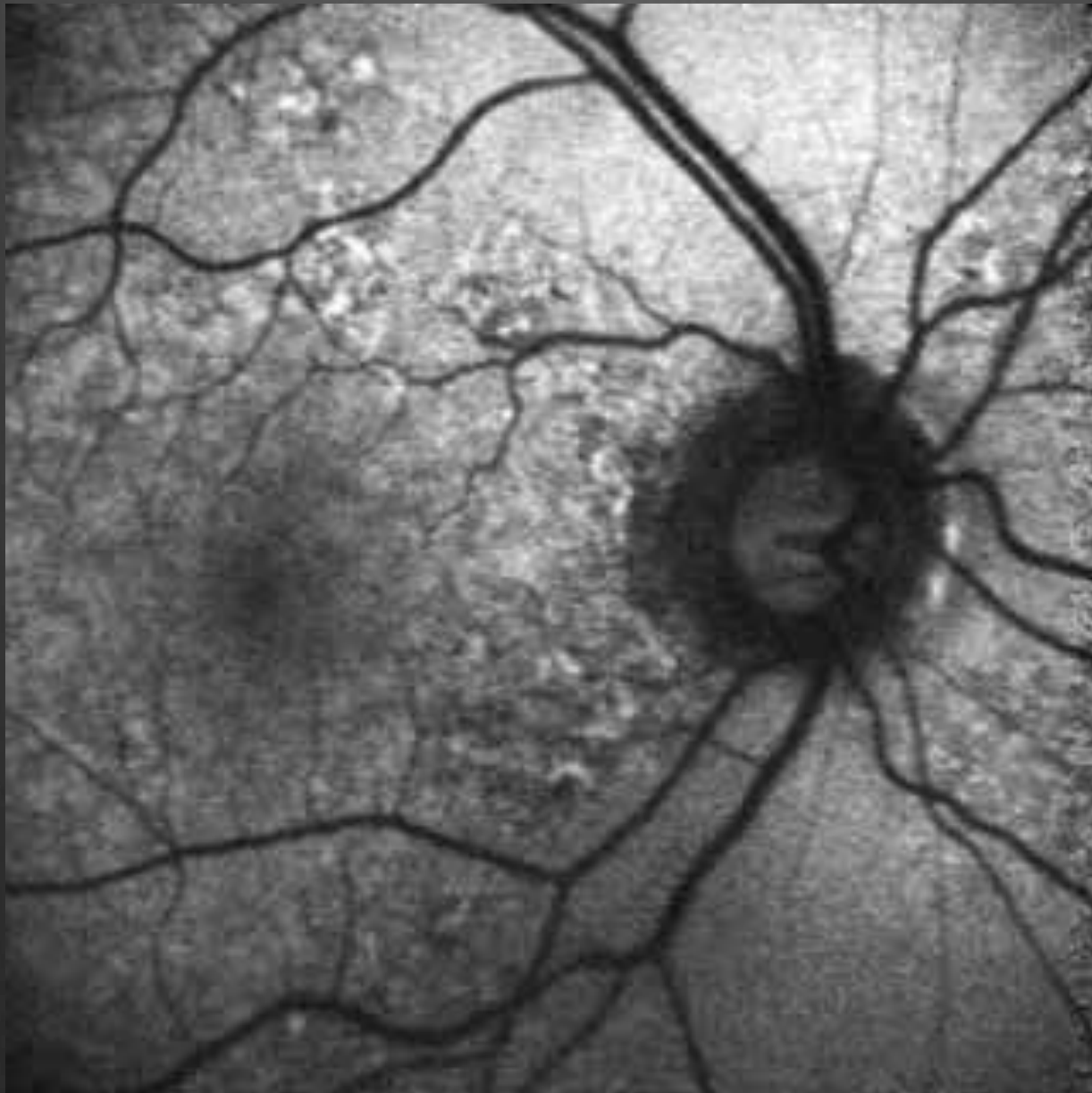


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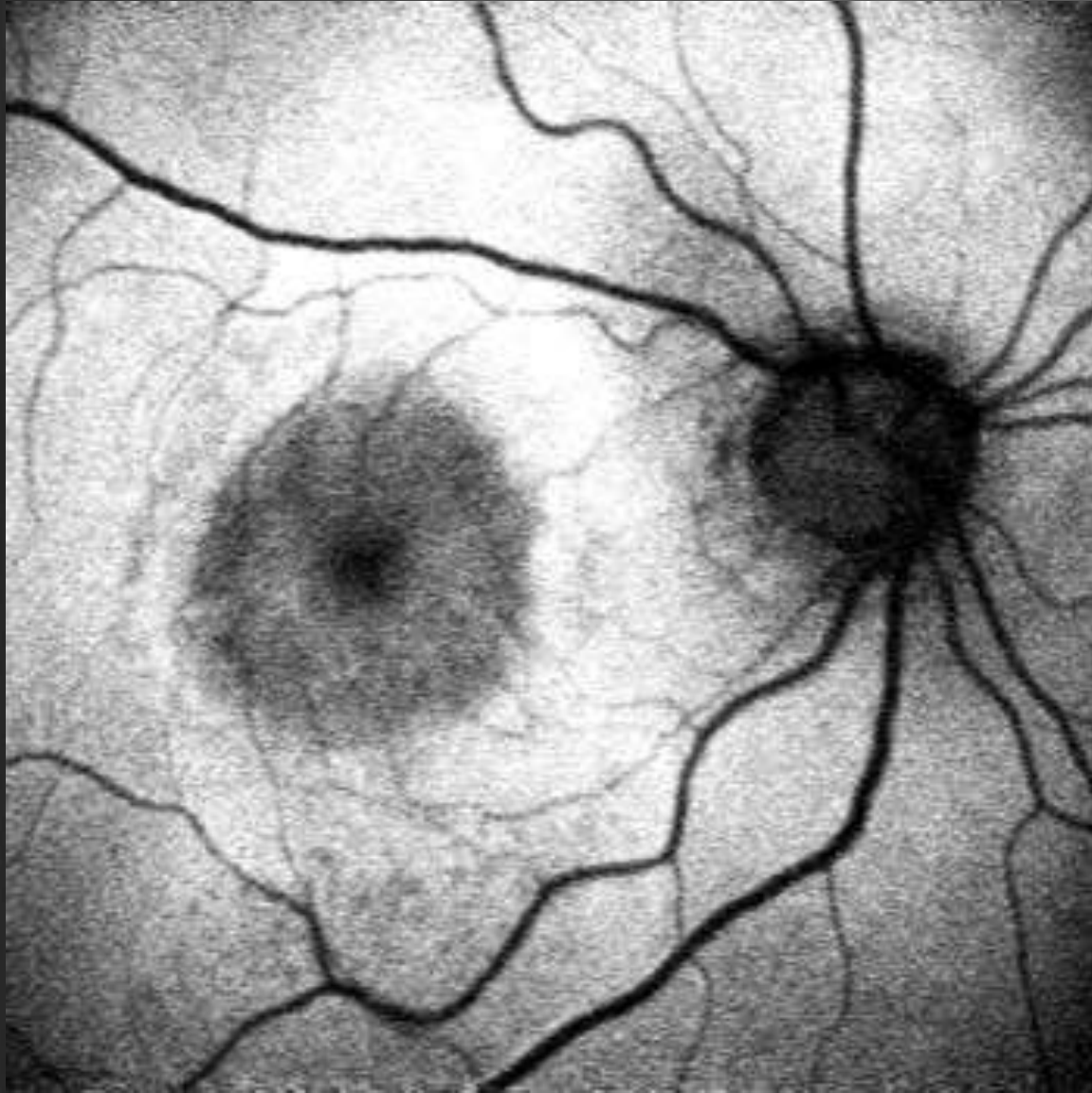
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#1





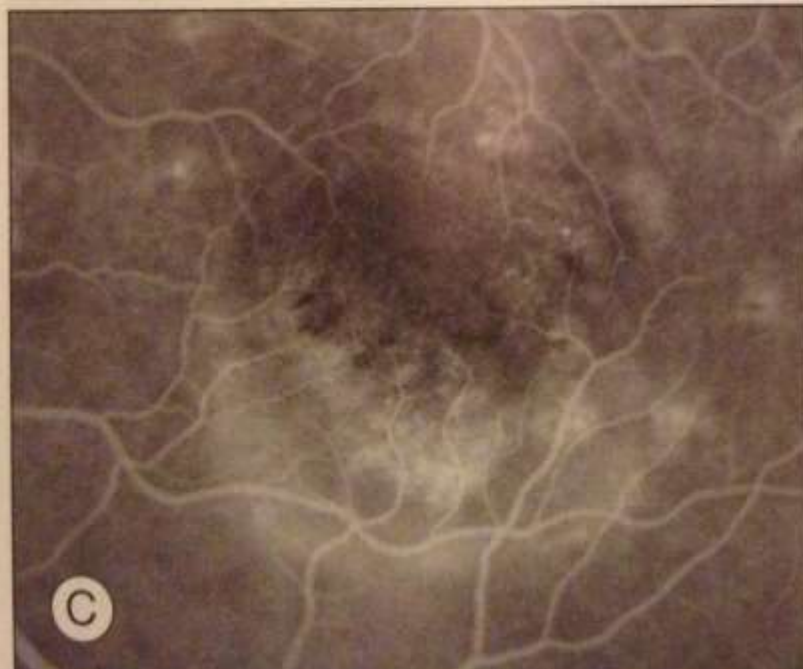
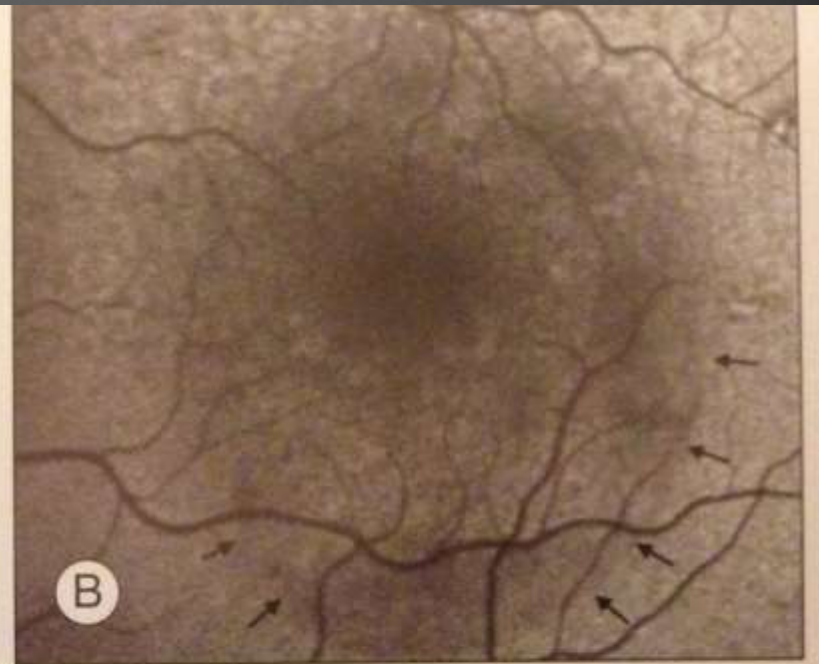
- Geographic atrophy – Advanced AMD. RPE cell loss causes dark AF
- Increased AF in the junctional zone – lipofuscin accumulation
- Atrophy will spread to areas of increased AF



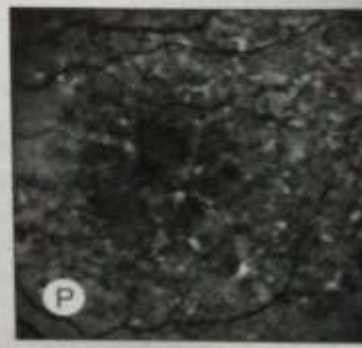
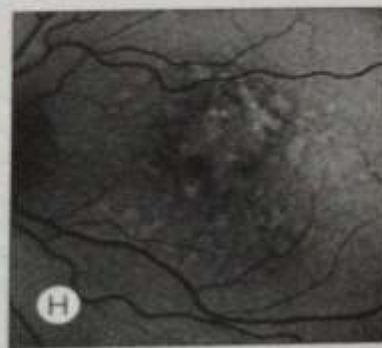
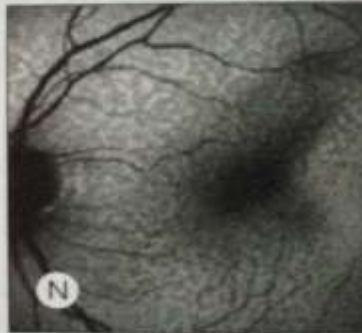
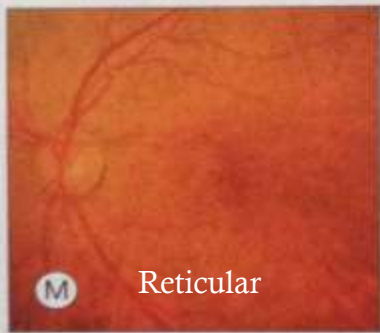
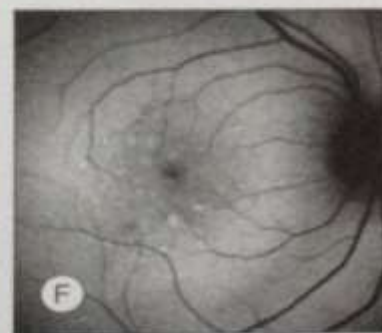
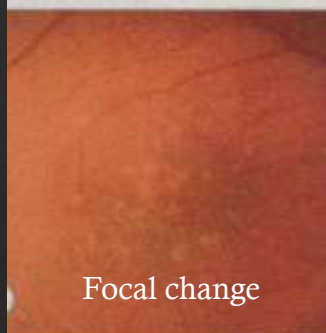
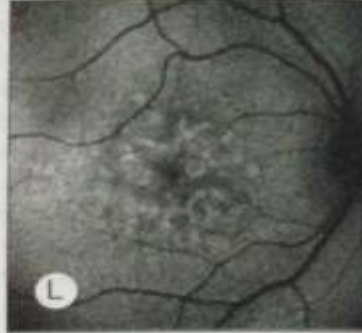
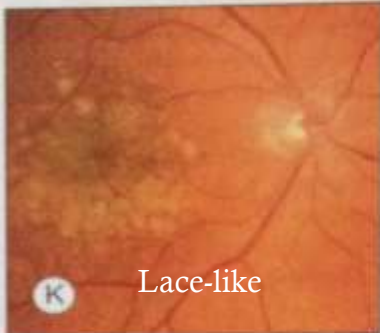
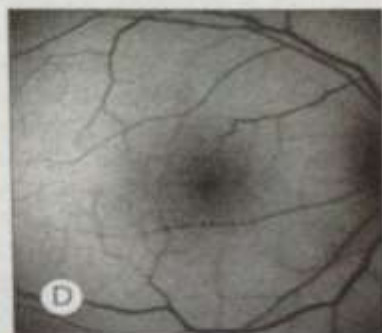
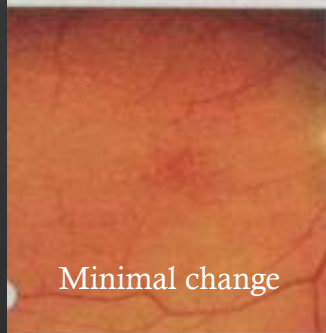
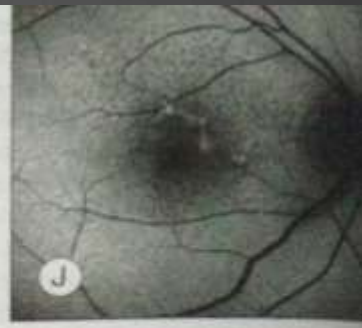
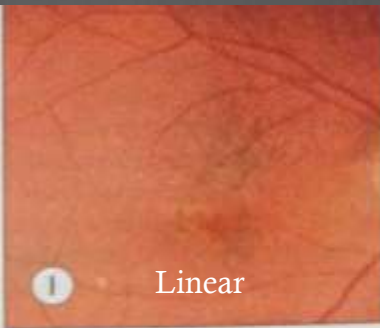
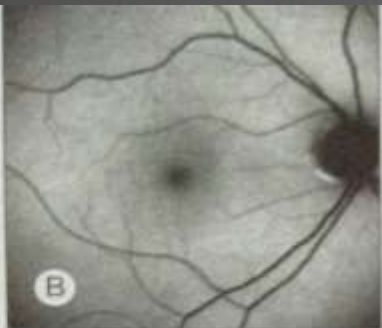
- Well demarcated blockade of AF due to CNVM lying above RPE



- Corresponding FA shows a classic CNVM due to advanced AMD



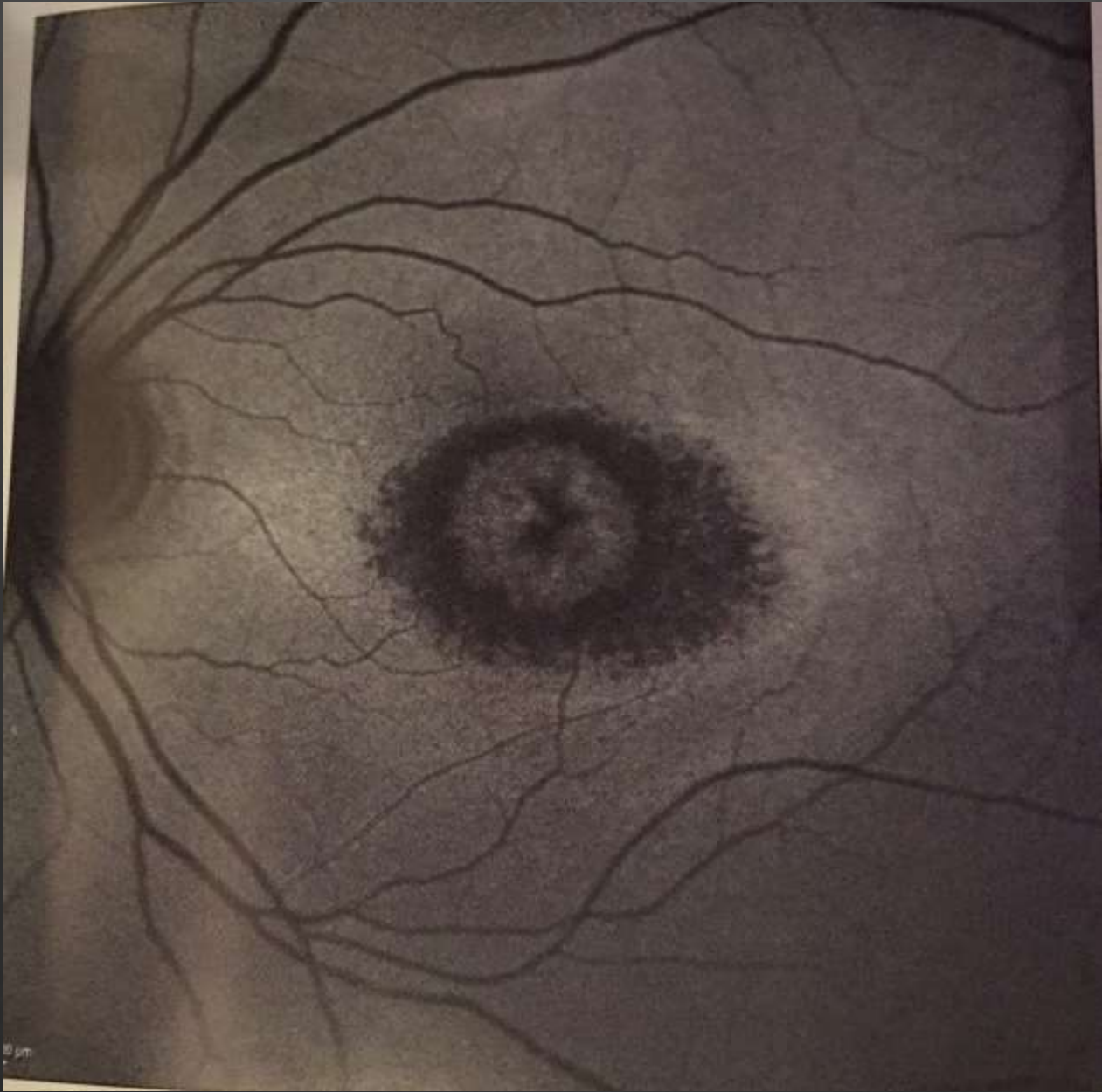
- ⊗ AF patterns vary in early forms of AMD – define and characterize the clinical picture
- ⊗ Tool for giving valuable prognosis in those with early AMD
 - ⊗ Enhanced perifoveal AF might lead to earlier and faster progression to geographic atrophy (higher levels of intracellular lipofuscin in the junctional zone and thus higher risk of cell death)
- ⊗ Distinguish between classic and occult CNVM
 - ⊗ Decreased AF in classic over the whole area surrounded by slightly enhanced AF; slightly irregular and enhanced AF in occult
- ⊗ Heterogenous AF patterns in CNVM indicates progression to sudden irreversible visual loss – macular oedema, SRH and scarring



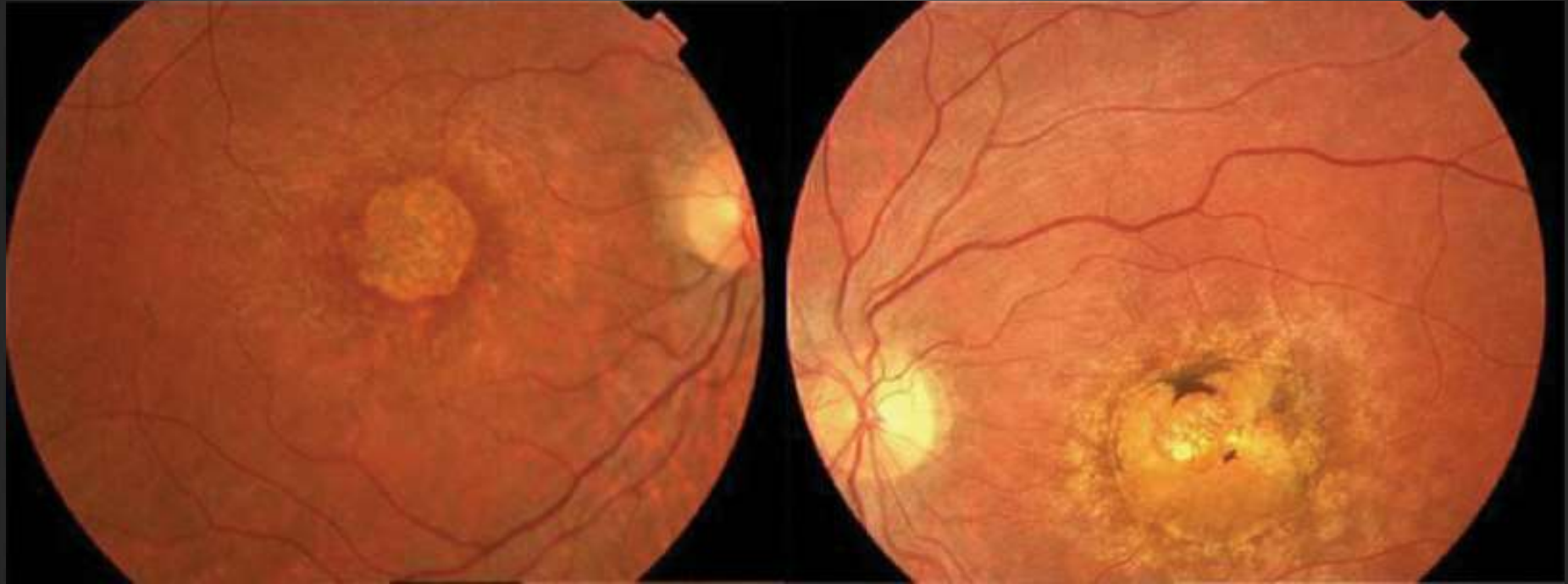
DRUG TOXICITY

Chloroquine & Hydroxychloroquine

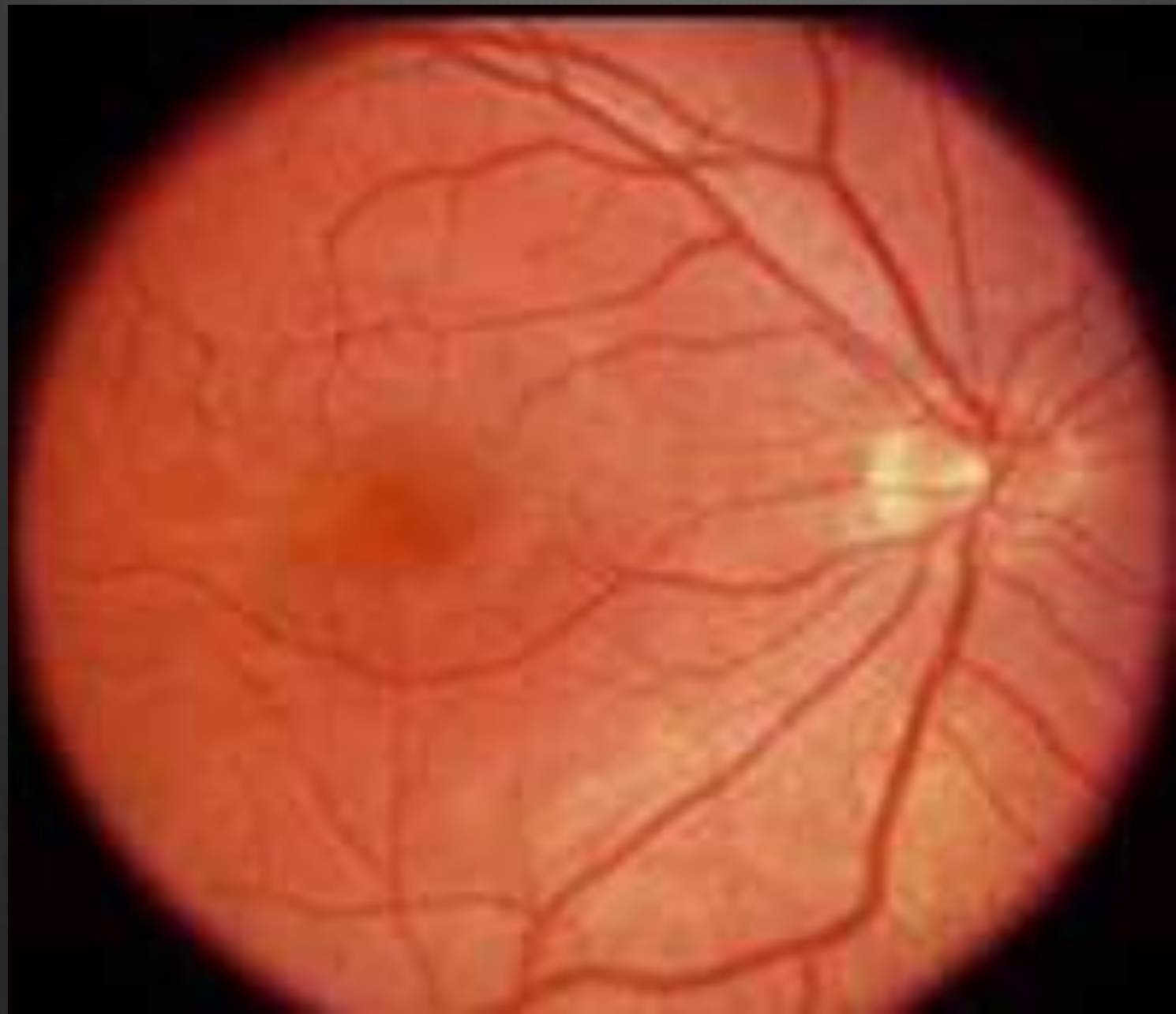
- ⊗ Early on – a pericentral ring of increased AF intensity
 - ⊗ Associated with pericentral reduction in multifocal ERG amplitudes and pericentral disruption of PRC IS –OS junction on OCT imaging
- ⊗ Advanced stages – mottled appearance with increased and decreased AF intensity in the pericentral macula



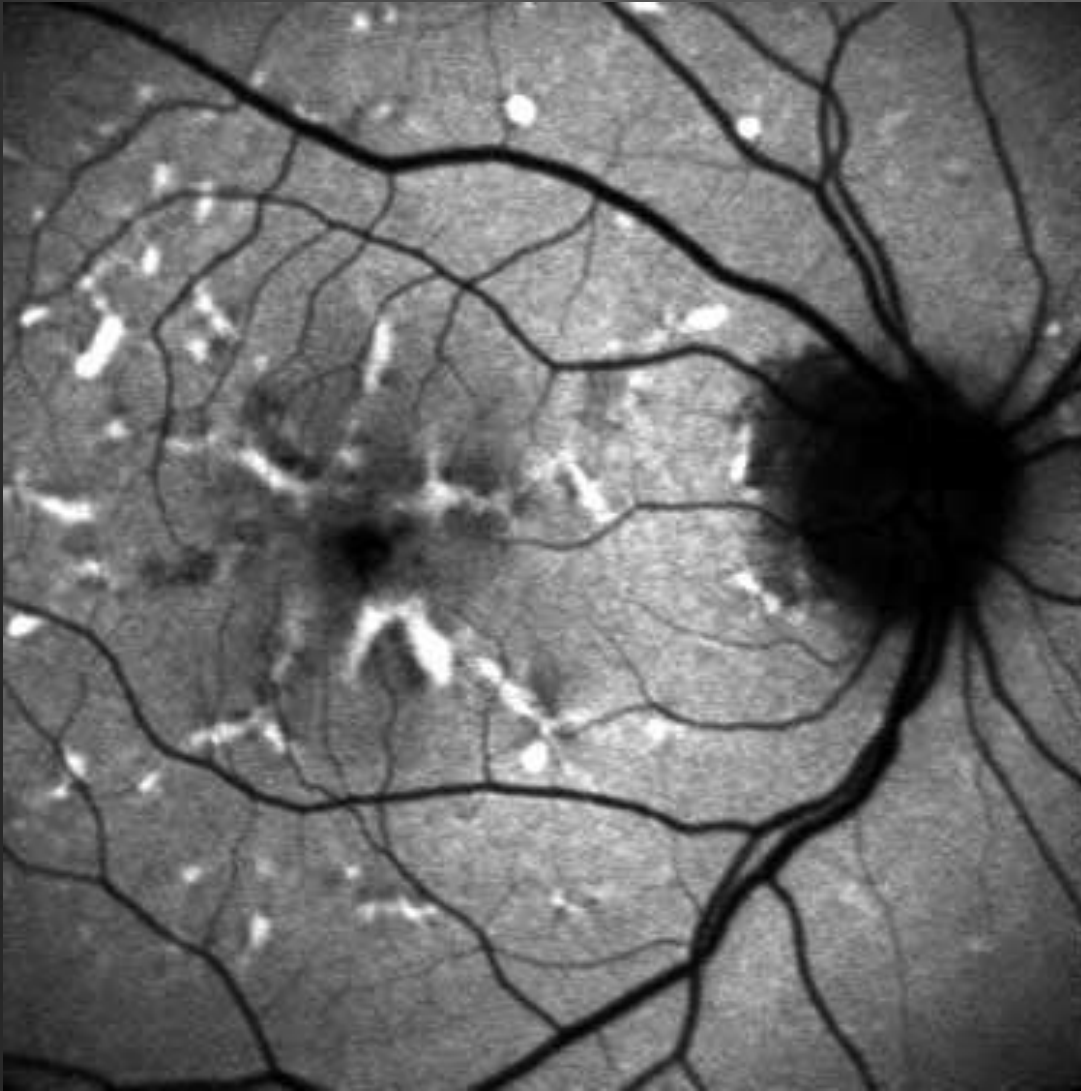
HEREDITARY DISEASES



Stargardt's disease

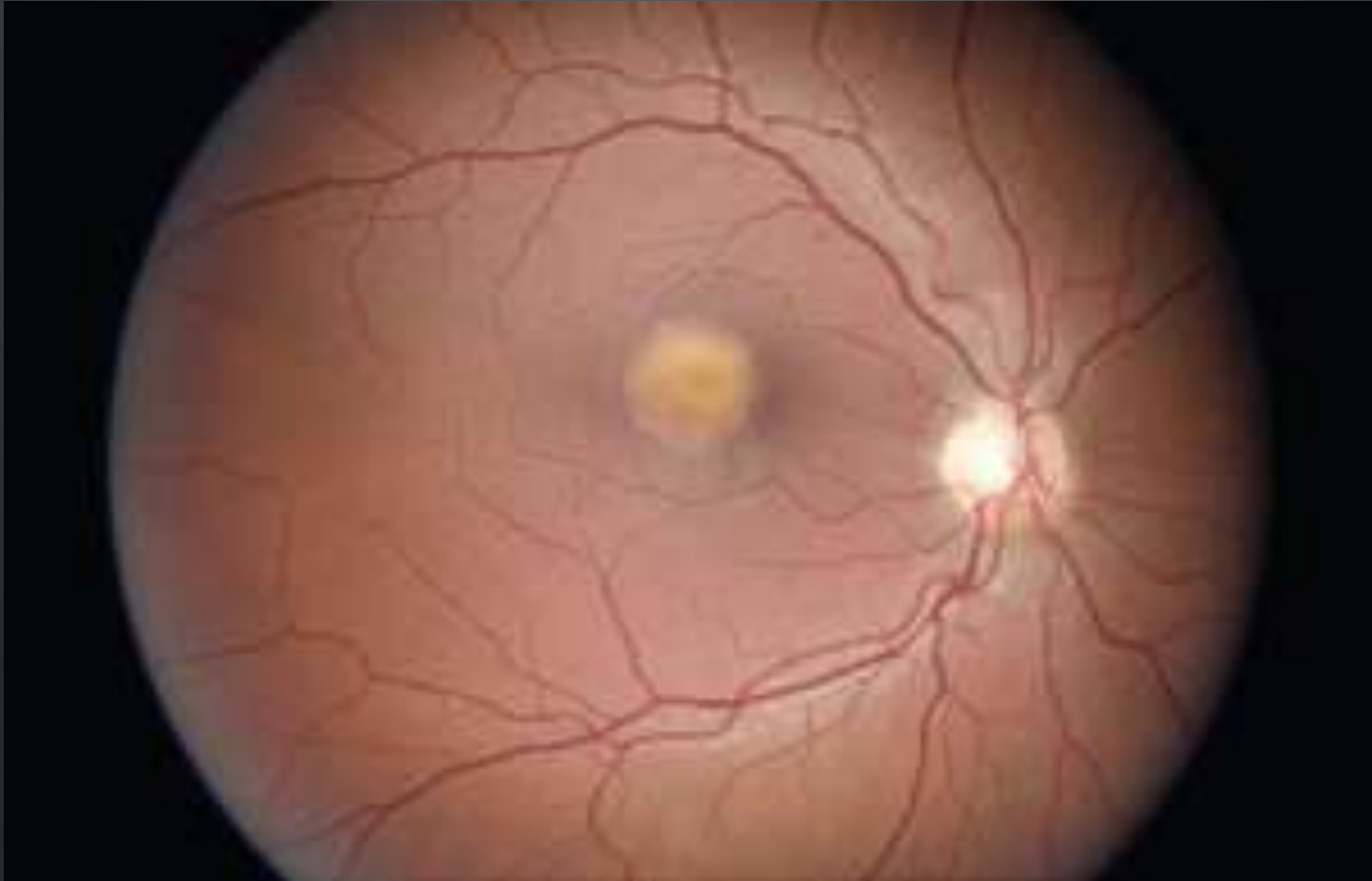


Normal appearing retina in Stargardt's disease



- Diffusely enhanced and focally increased AF seen in normal appearing retina
- Pathologic accumulation of lipofuscin
- AF pattern might also be very heterogeneous (correlations of AF phenotype with genotypic phenotypes)

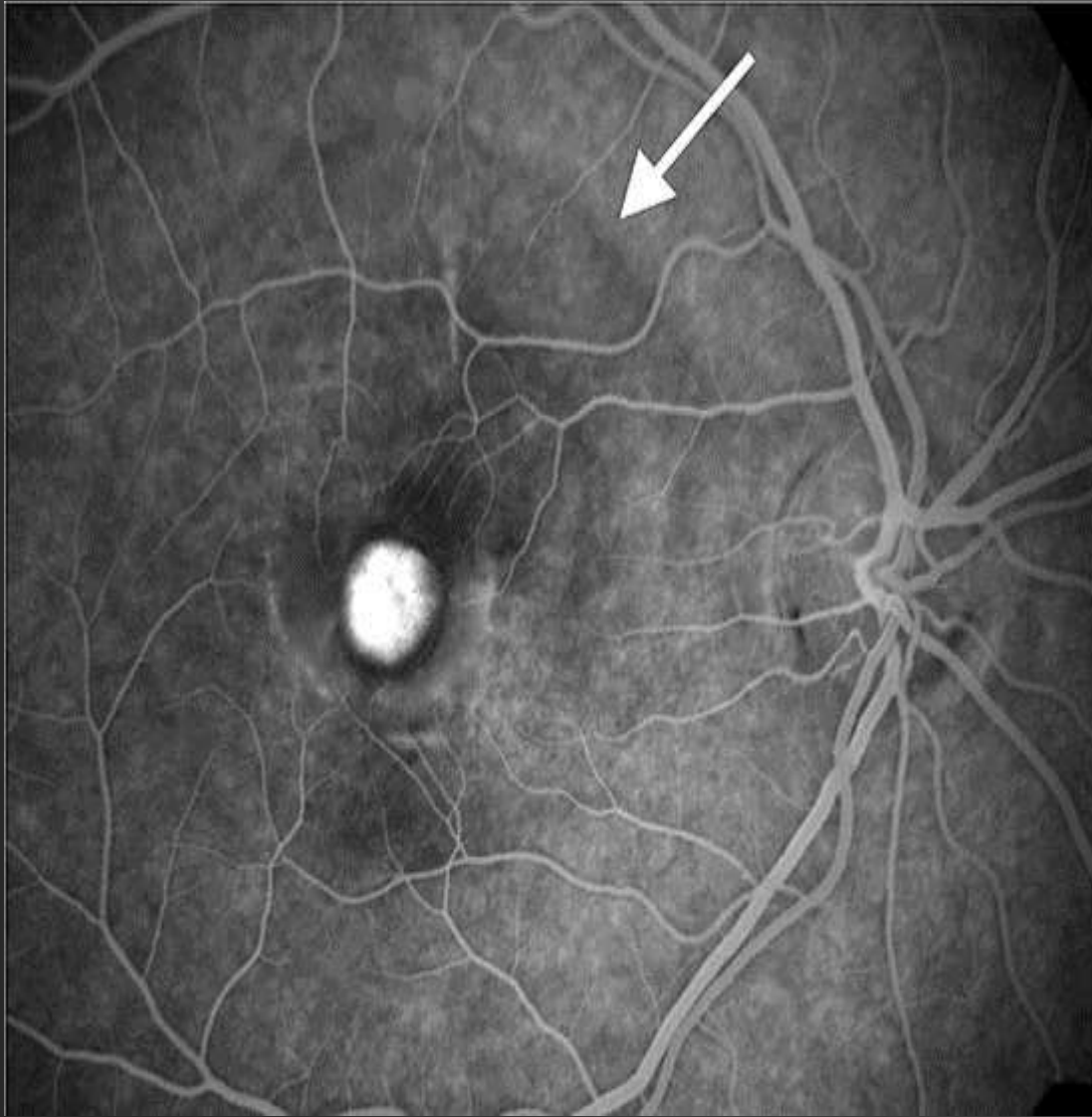
Best Disease



'Egg-yolk' appearance

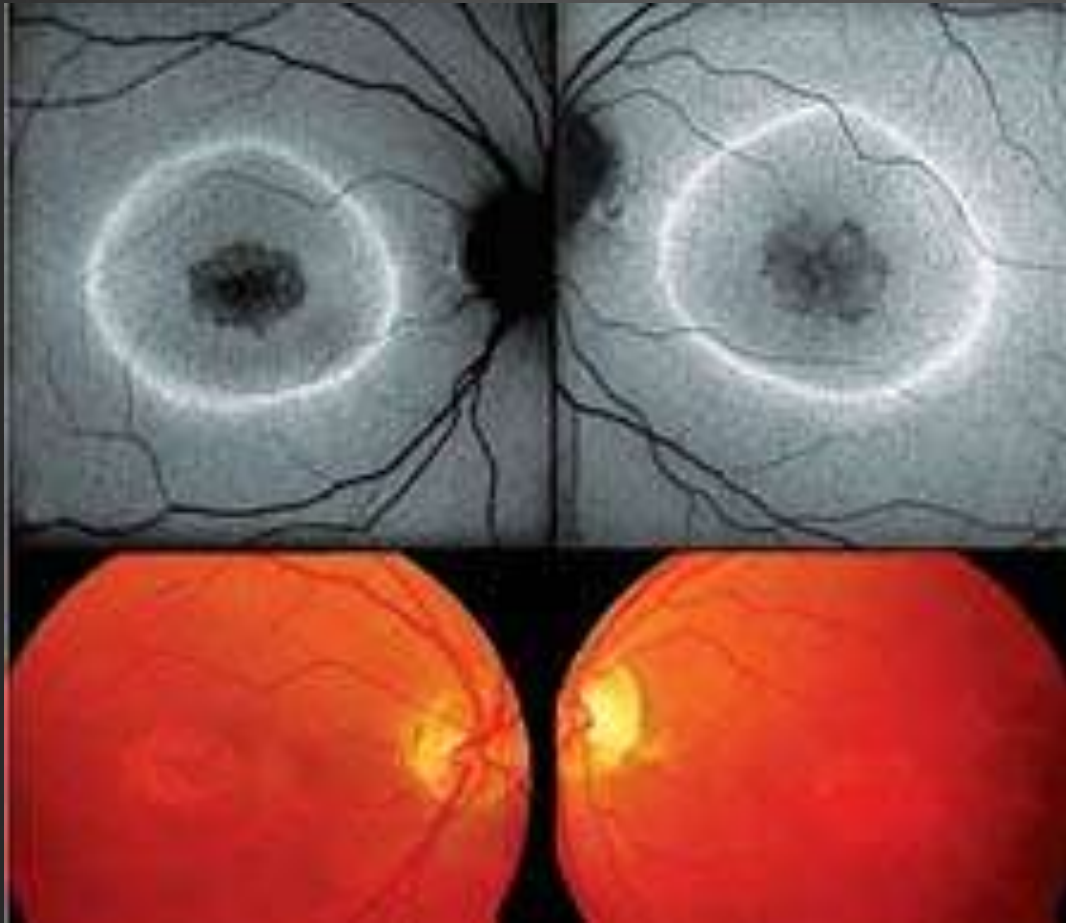


- ⊙ Excessive accumulation of lipofuscin in the central area showing highly increased AF

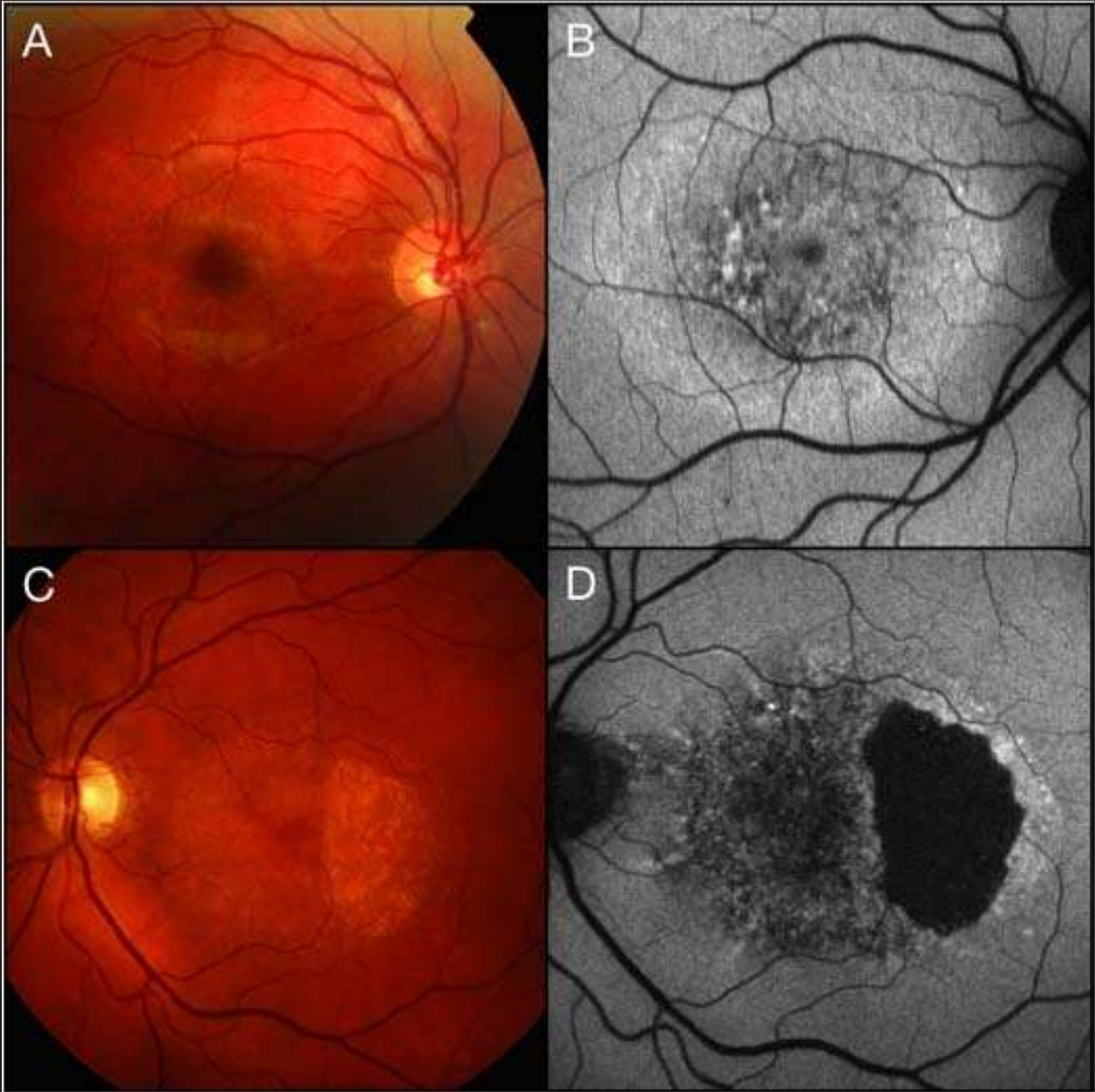


- ⊗ FFA image
- ⊗ BEST disease

MACULAR DYSTROPHY



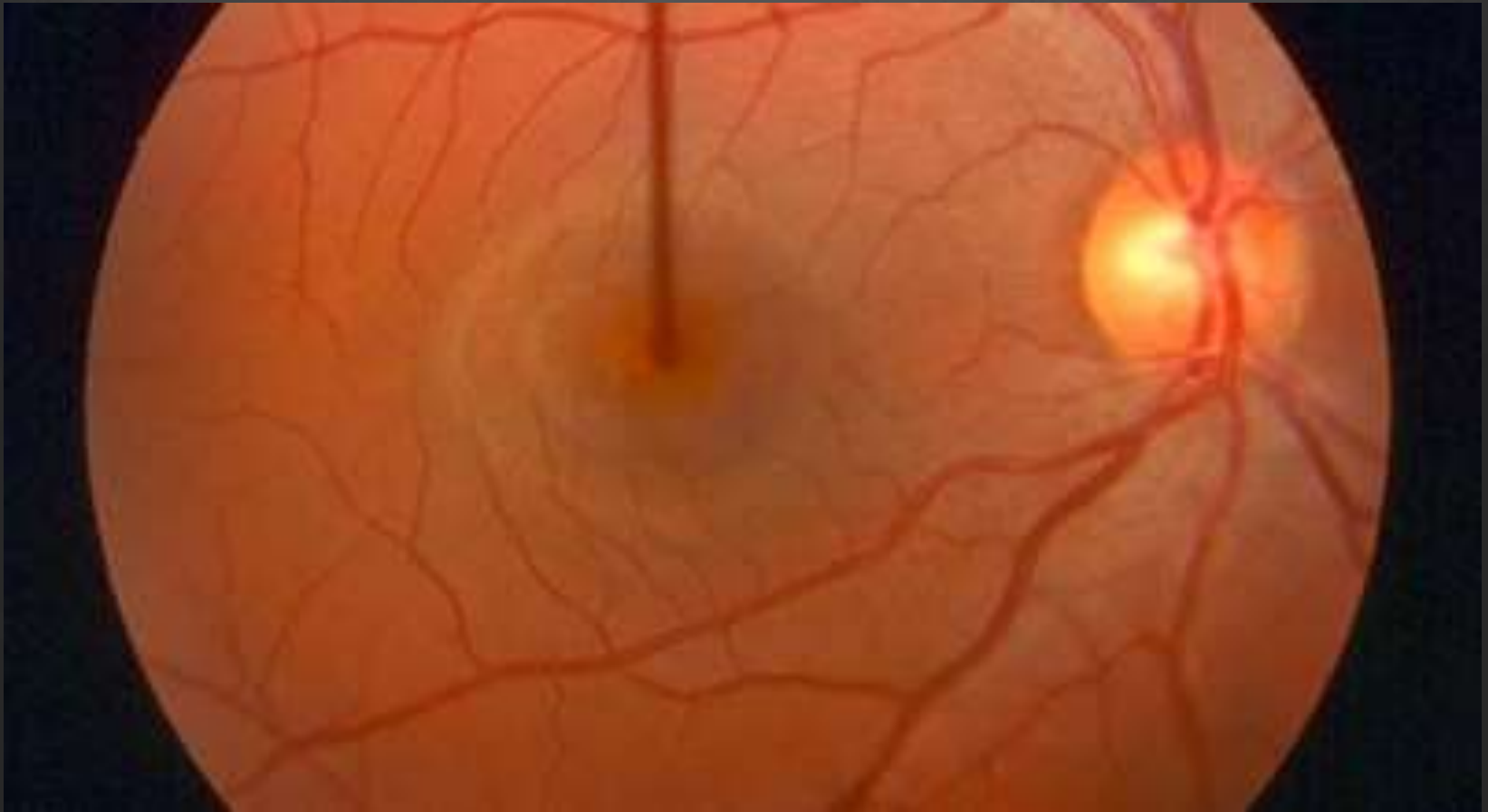
Ring of increased autofluorescence in the parafovea which is not visible on fundus photography. Functional testing reveals that this ring correlates with functional abnormalities and represents a demarcation line between normal and abnormal functional retina.

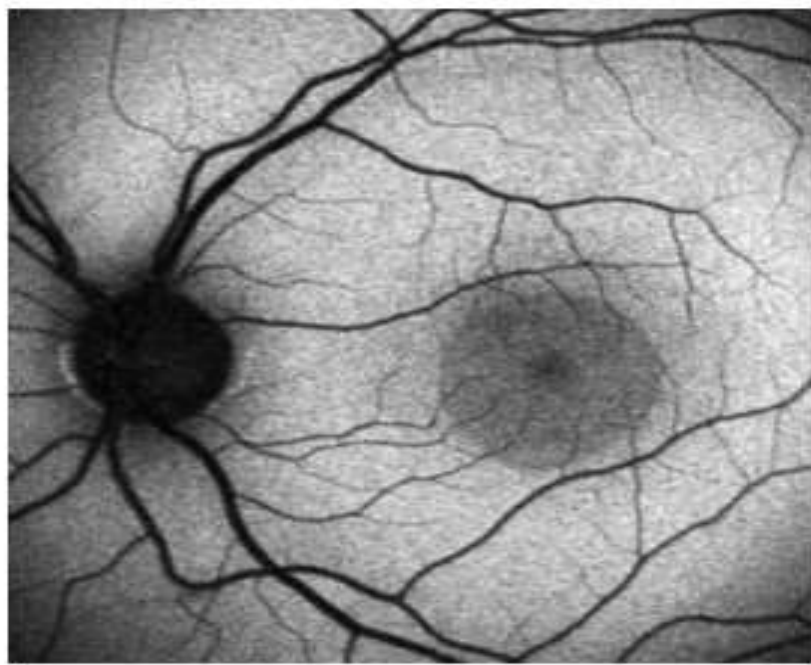


Pattern dystrophy
with corresponding
autofluorescence
images

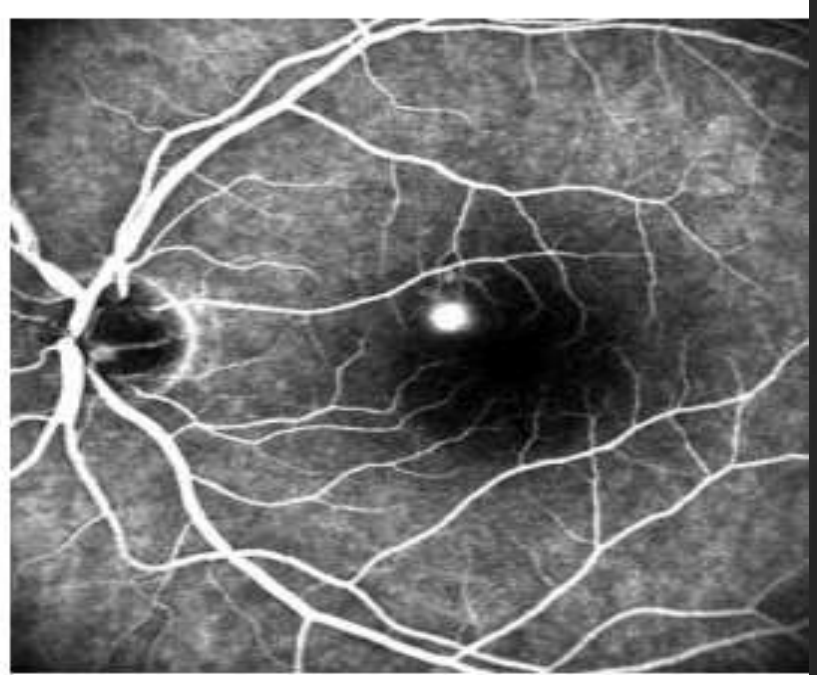
INFLAMMATORY
CONDITIONS
AFFECTING RPE

Central Serous Retinopathy

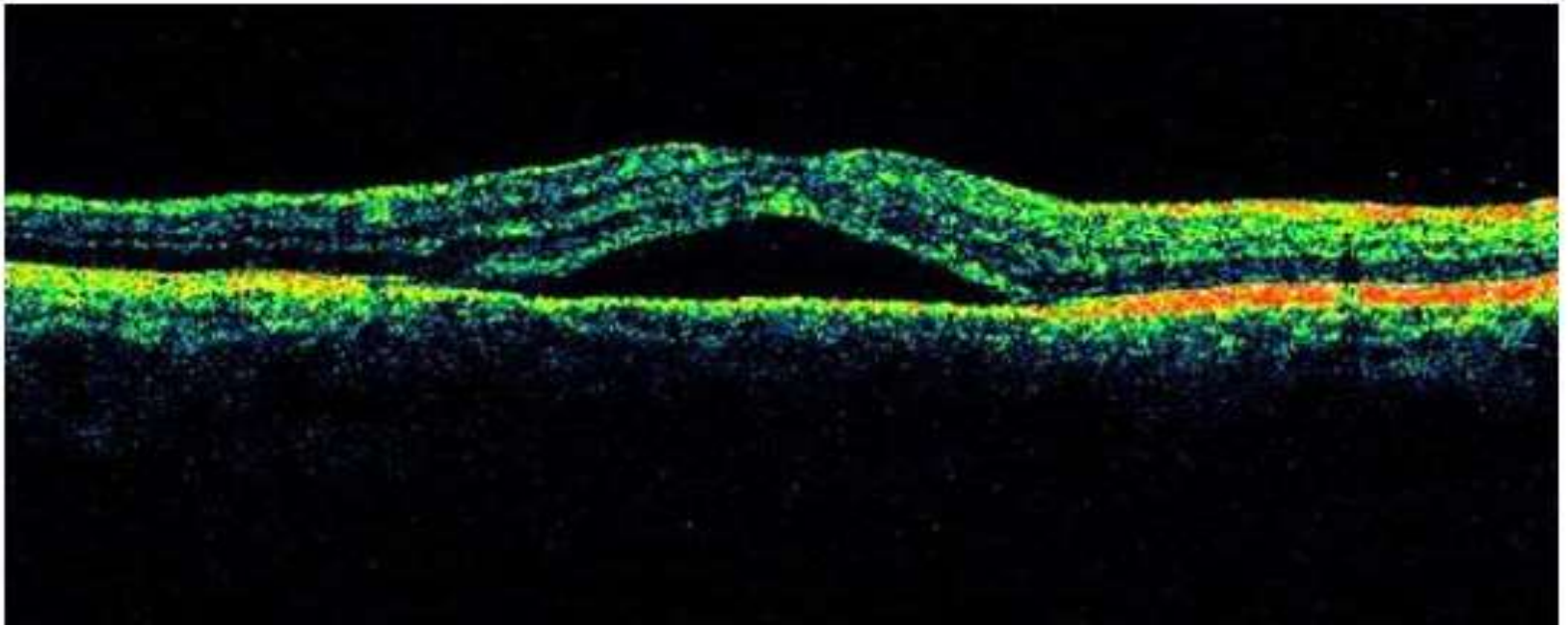




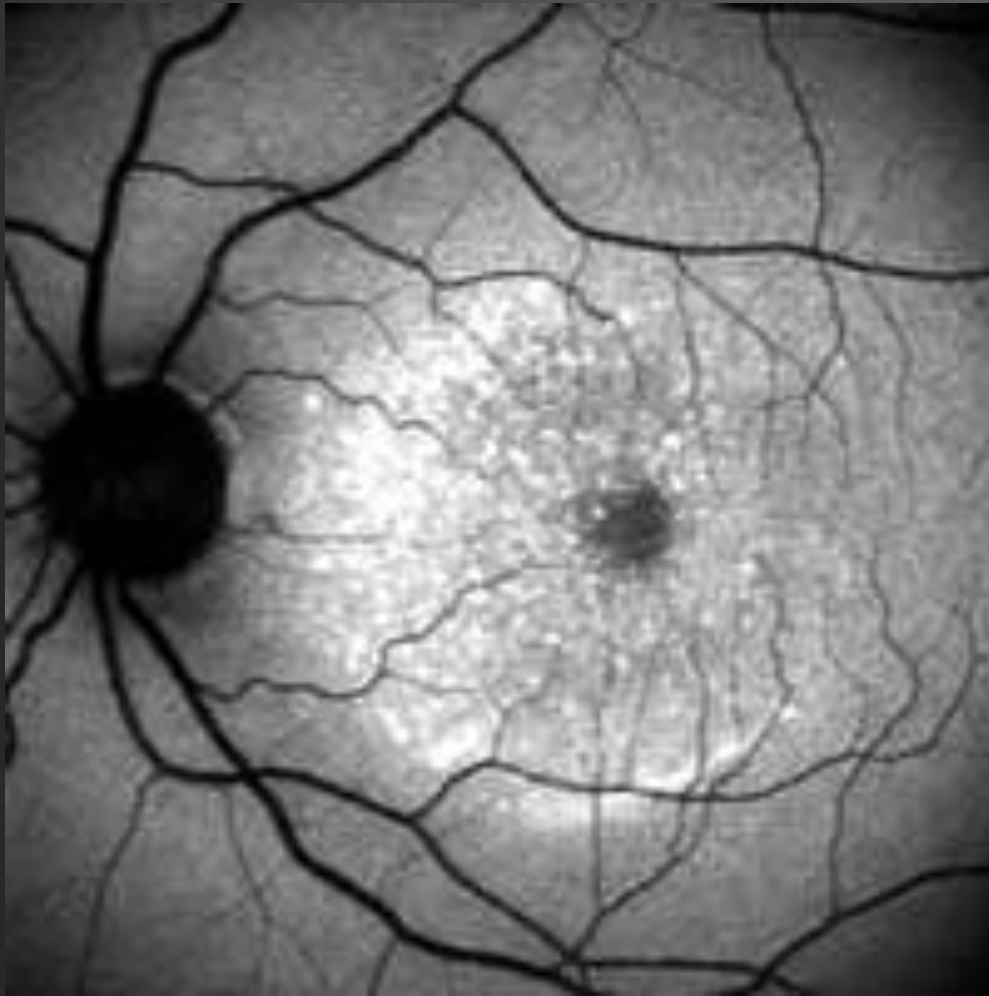
a



b



Resolved CSR



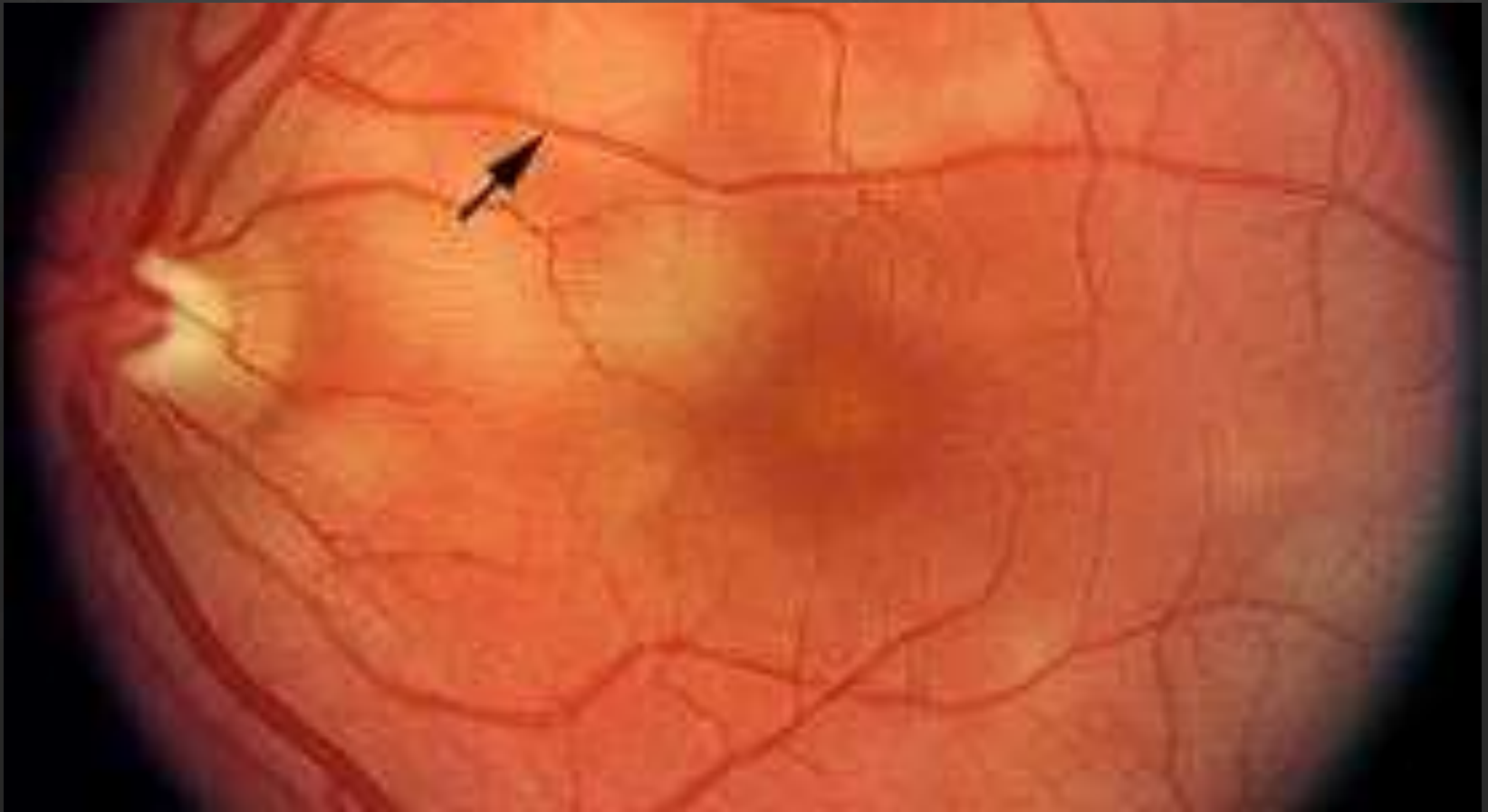
- ⊗ Increased AF within the former neurosensory elevation most likely due to higher metabolism of RPE cells from the protein enriched subretinal fluid



- Extensive AF pattern in patient with chronic CSR
- AF can help differentiate the edge of RPE dysfunction
- There is hyperautofluorescence either due to shed PRC or abnormal accumulation of lipofuscin A2E

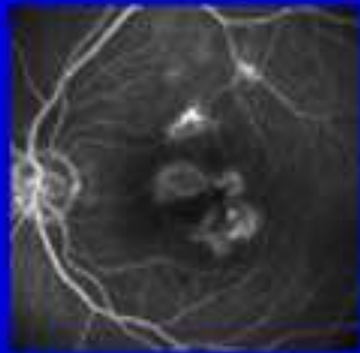
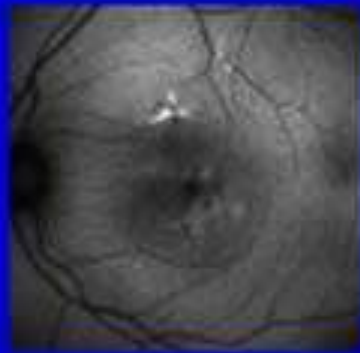
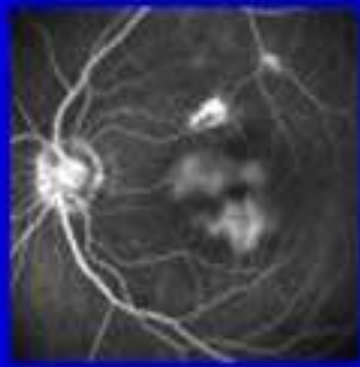
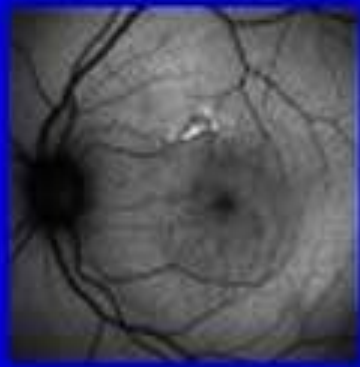


Acute posterior multifocal placoid pigment epitheliopathy (AMPPE)

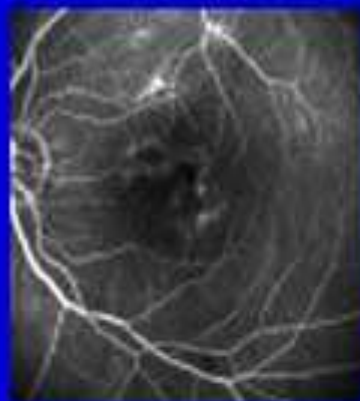
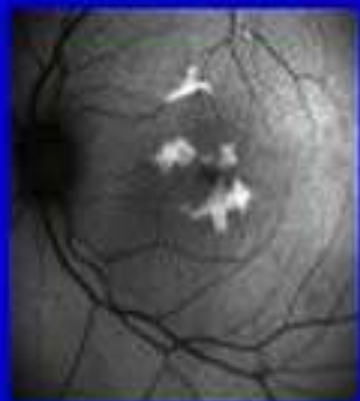


AMPPE

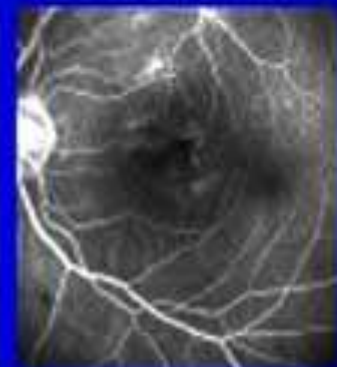
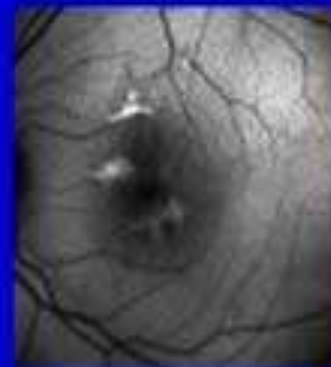
- ⊗ AF sequence of an eye with APMPPPE
 - ⊗ Affected RPE cells demonstrate increased AF in the early phase
 - ⊗ An increase in AF is seen up to 3 weeks
 - ⊗ Gradual fade away after this
 - ⊗ Atrophy occurs after 1 year leading to decrease AF in former lesions



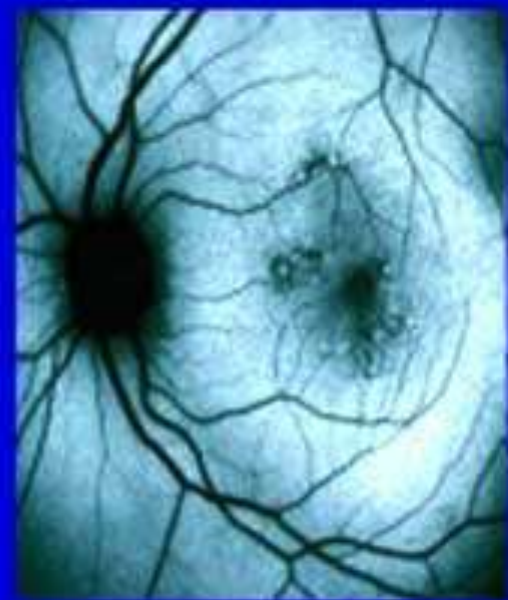
3d



3mo



6wo



12mo

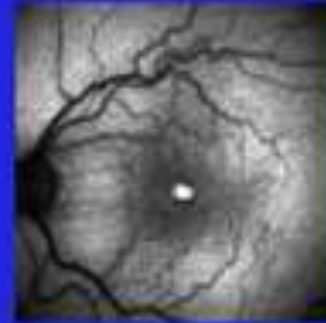
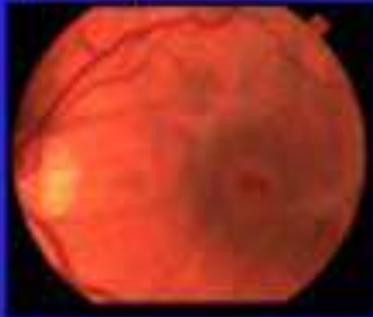
MACULAR HOLE SURGERY



- ❁ Bare RPE cell layer causes increased AF with no blockage from macular pigments

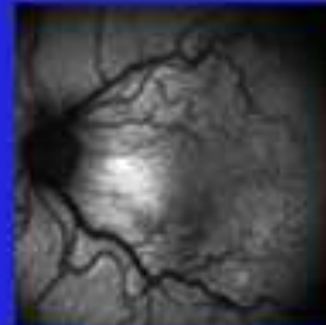
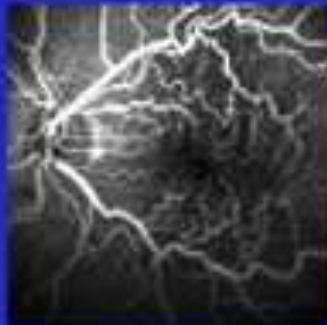
Macular Hole Surgery

preop



Visual acuity 0,1; macular hole and epiretinal gliosis

postop



Visual acuity 0,2 (2 months postop)

- Pre op increase in AF and disappearance after successful closure

SUMMARY

- ⊗ AF imaging is a novel tool of intrinsic fluorescence – RPE layer
- ⊗ It is primarily a result of intracellular accumulation of lipofuscin with age and alterations in different disease states
- ⊗ Improvement in fundus cameras have enhanced imaging from AF
- ⊗ Non-invasive, inexpensive and fast
- ⊗ Can detect and add information for a variety of macular diseases
- ⊗ Monitoring tool after surgery and laser treatment
- ⊗ May contribute as an adjunctive tool for new treatment modalities
- ⊗ Vastly underused diagnostic tool