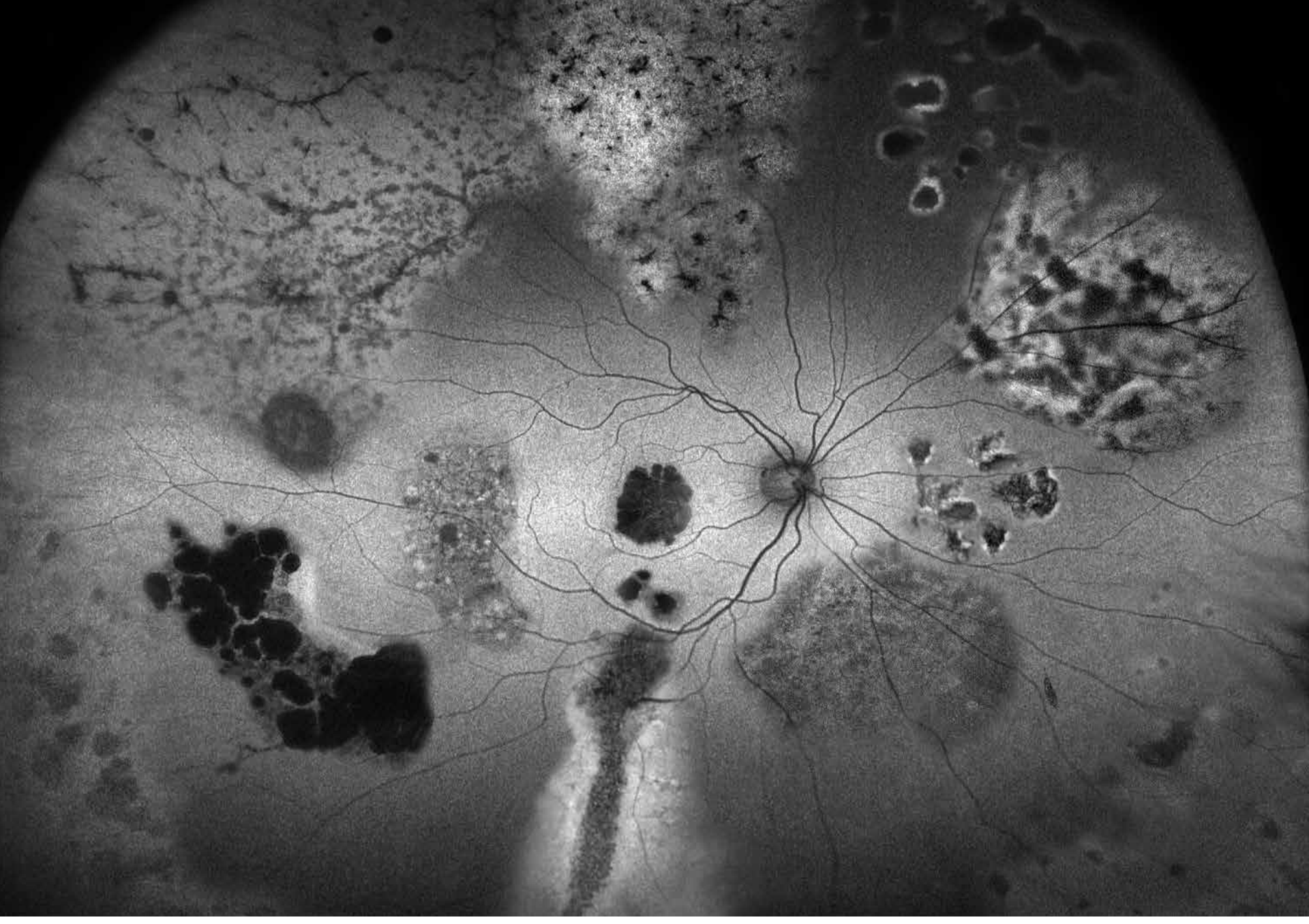


optomap® *af* Diagnostic Atlas

A Retinal Reference Guide

optos®

Building *The* Retina Company

Optos' core devices produce ultra-widefield (UWF™), high resolution digital images (**opto**map®) of approximately 82% and 200° of the retina, something no other device is capable of doing in any single image.

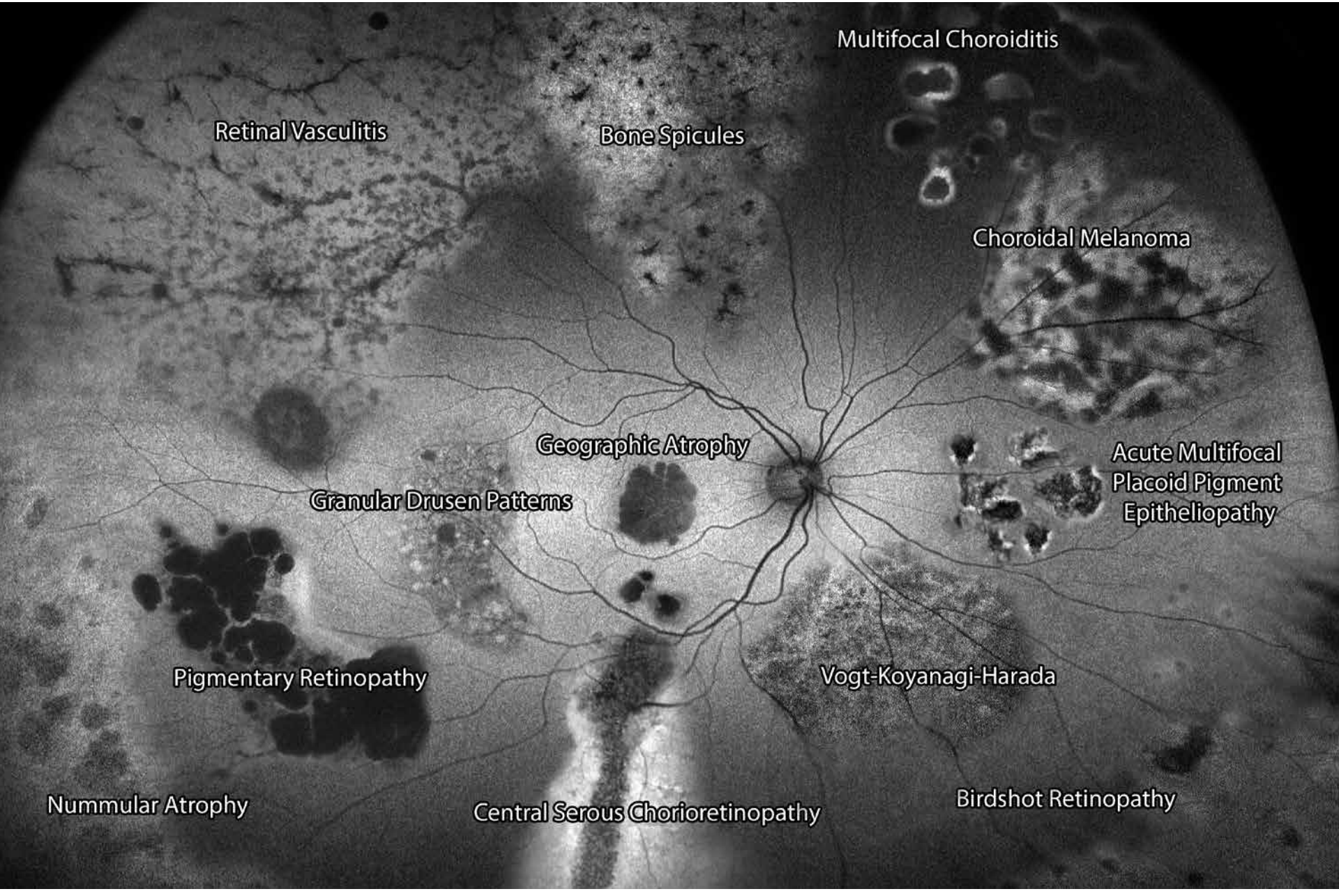
An **opto**map image provides more clinical information which facilitates the early detection, management and effective treatment of disorders and diseases in the retina. Retinal imaging can also indicate evidence of non-eye or systemic diseases such as hypertension and certain cancers.

optomap color images consist of two channels of information, a red channel (633-635nm) which visualizes the choroidal layer and a green channel (532nm) which visualizes the retinal pigment epithelium (RPE). **opto**map *af* (autofluorescence) images are captured using a green wavelength (532nm) to visualize the function of the RPE.

The **opto**map *af* Diagnostic Atlas: A Retinal Reference Guide is designed to illustrate how different pathologies are visualized in autofluorescence.

Reference for Definitions

Dictionary of Eye Terminology. Sixth Edition. 2012.
Barbara Cassin and Melvin L. Rubin, MD.
Triad Communications, Inc.


Multifocal Choroiditis
Retinal Vasculitis
Bone Spicules
Choroidal Melanoma
Geographic Atrophy
Acute Multifocal Placoid Pigment Epitheliopathy
Granular Drusen Patterns
Pigmentary Retinopathy
Vogt-Koyanagi-Harada
Nummular Atrophy
Central Serous Chorioretinopathy
Birdshot Retinopathy

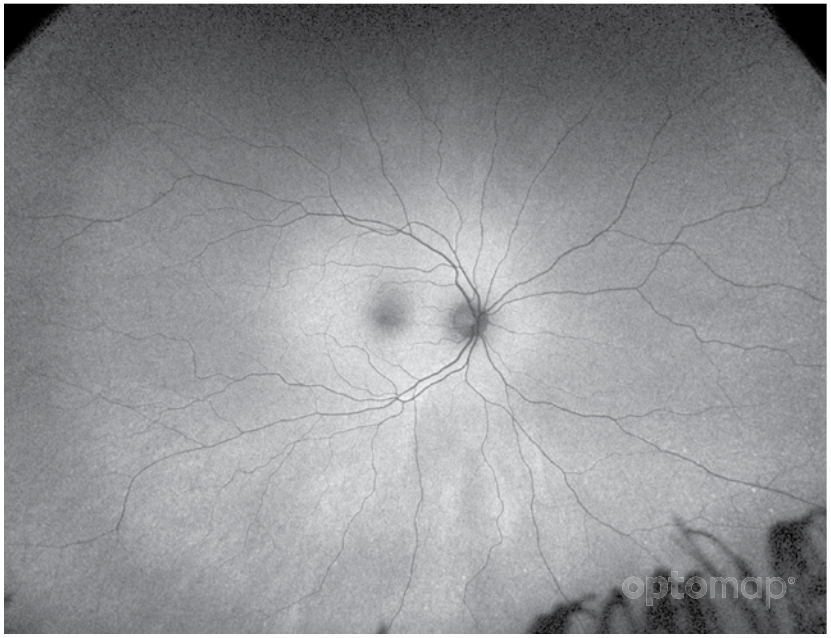
optomap *af* (autofluorescence) is a non-invasive, in-vivo imaging modality used to provide information on the health and function of the retinal pigment epithelium (RPE). Over time, the retinal photoreceptors naturally age and produce a metabolic waste known as lipofuscin. Lipofuscin is the fatty substance found in the retinal pigment epithelium. Excessive amounts can be caused by the aging retina, certain retinal diseases and/or the progression of diseases.[1] It has been thought that excessive levels of lipofuscin could affect essential RPE functions that contribute to the progression of age-related macular degeneration (AMD).[2] These findings have also been shown to have prognostic value and help to predict which eyes are at greater risk of progression to advanced disease.[3]

Typically, autofluorescence imaging has clinical applications in age-related macular degeneration, central serous retinopathy, choroidal tumors and nevi, inflammatory diseases, inherited disease, optic nerve head drusen, pattern dystrophies, retinal toxicity and retinal detachments.

Autofluorescence excitation wavelength is between 480-510 nm, with an emission wavelength from 480-800 nm.[1] **opto**map *af* uses a wavelength of 532nm to capture an image.

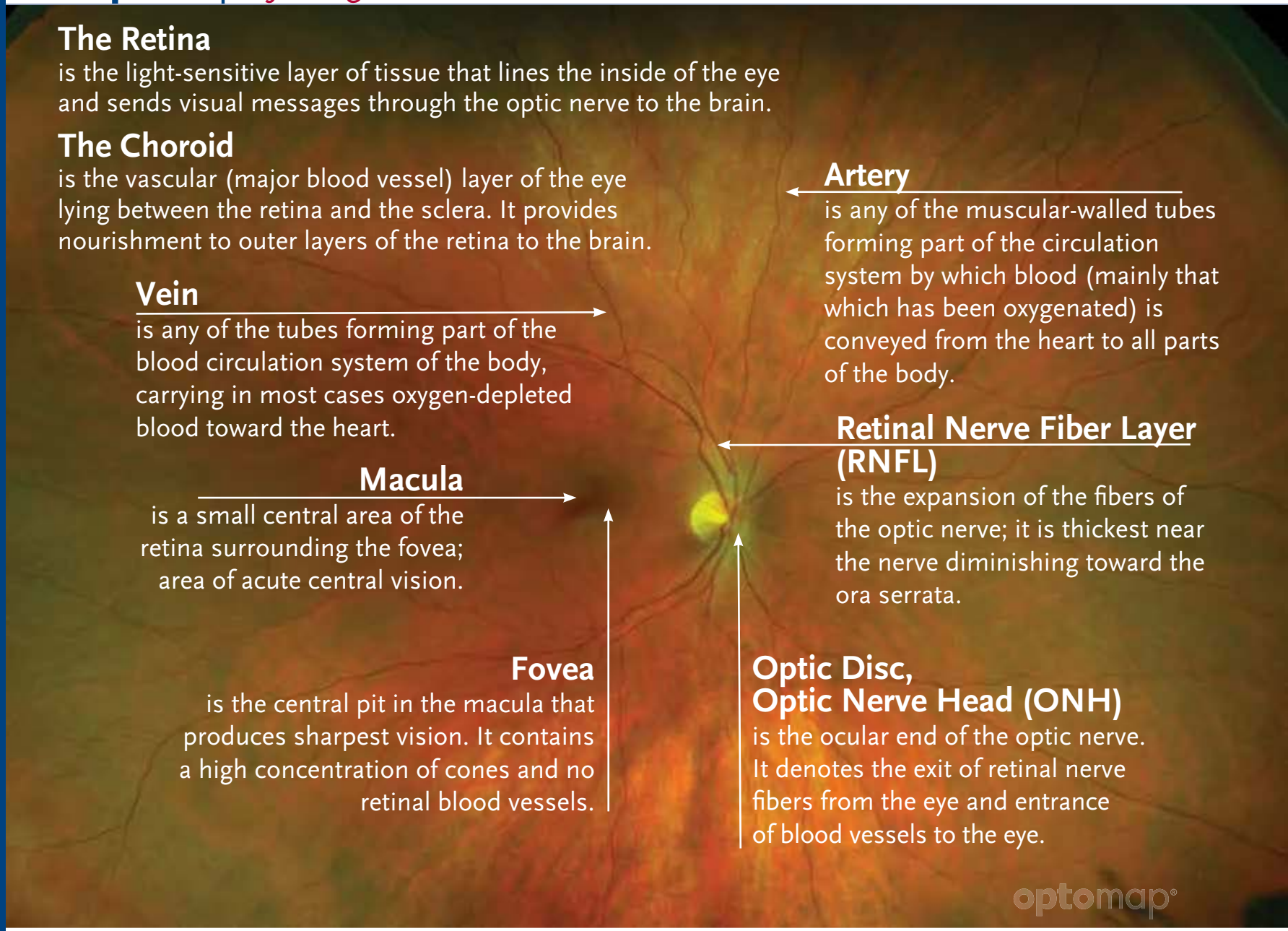
1. Holz, F. S.-V. (2010). Atlas of Fundus Autofluorescence Imaging. Heidelberg, Germany: Springer-Verlag.
2. Delori, F. G. (2001). Age-Related Accumulation and Spatial Distribution of Lipofuscin in RPE of Normal Subjects. IVOS, 42(8), 1855-1866.
3. Sadda, S. (October 2013). Evaluating Age-Related Macular Degeneration With Ultra-widefield Fundus autofluorescence. Retina Today.

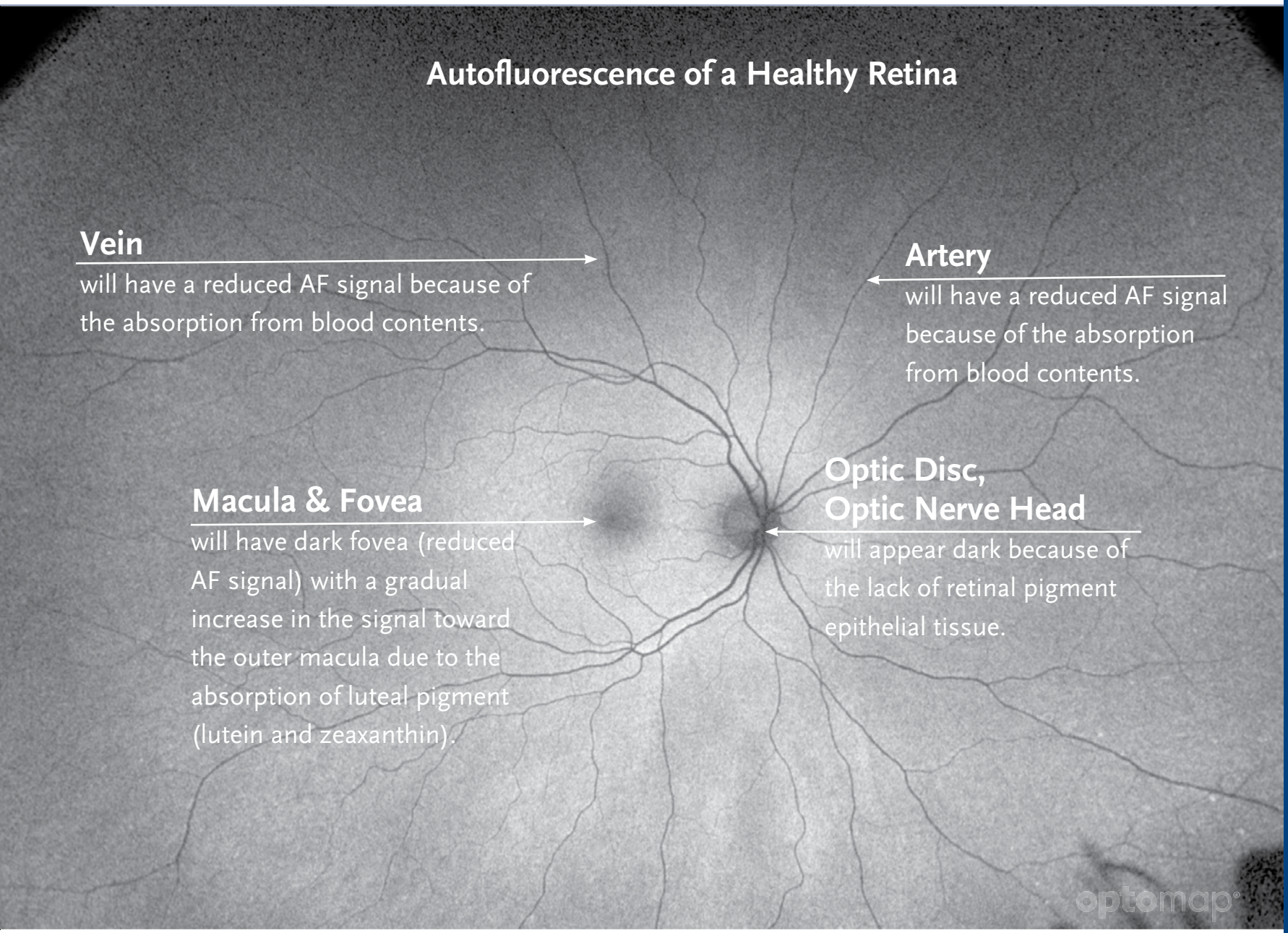
optomap color images provide a structural image of the retina. **opto**map images consist of two channels of information, a red channel (633-635nm) which visualizes the choroidal layer and a green channel (532nm) which visualizes the retinal pigment epithelium (RPE).



optomap *af* images are captured using the green wavelength (532nm) and visualize the health and function of the RPE.

Autofluorescence can be used to see subtle structural changes, as well as metabolic changes within the RPE, which can be invisible on fundus images or on exam.

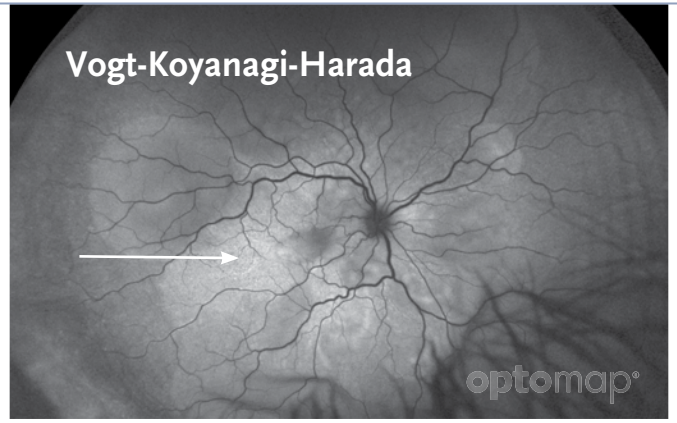

The Retina
is the light-sensitive layer of tissue that lines the inside of the eye and sends visual messages through the optic nerve to the brain.
The Choroid
is the vascular (major blood vessel) layer of the eye lying between the retina and the sclera. It provides nourishment to outer layers of the retina to the brain.
Vein
is any of the tubes forming part of the blood circulation system of the body, carrying in most cases oxygen-depleted blood toward the heart.
Macula
is a small central area of the retina surrounding the fovea; area of acute central vision.
Fovea
is the central pit in the macula that produces sharpest vision. It contains a high concentration of cones and no retinal blood vessels.
Artery
is any of the muscular-walled tubes forming part of the circulation system by which blood (mainly that which has been oxygenated) is conveyed from the heart to all parts of the body.
Retinal Nerve Fiber Layer (RNFL)
is the expansion of the fibers of the optic nerve; it is thickest near the nerve diminishing toward the ora serrata.
Optic Disc, Optic Nerve Head (ONH)
is the ocular end of the optic nerve. It denotes the exit of retinal nerve fibers from the eye and entrance of blood vessels to the eye.
optomap®

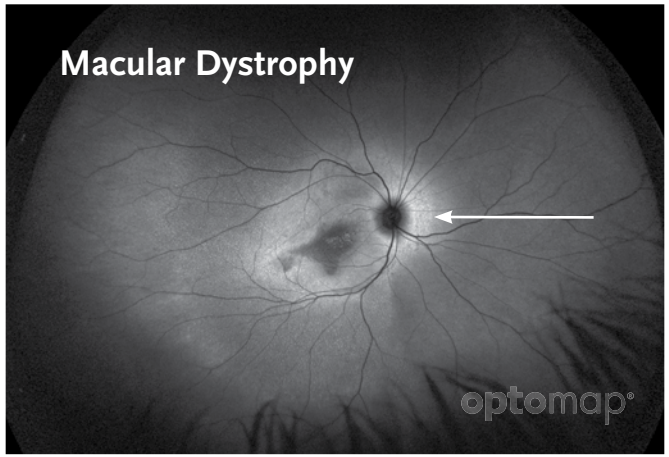

Autofluorescence of a Healthy Retina
Vein
will have a reduced AF signal because of the absorption from blood contents.
Artery
will have a reduced AF signal because of the absorption from blood contents.
Macula & Fovea
will have dark fovea (reduced AF signal) with a gradual increase in the signal toward the outer macula due to the absorption of luteal pigment (lutein and zeaxanthin).
Optic Disc, Optic Nerve Head
will appear dark because of the lack of retinal pigment epithelial tissue.
optomap®

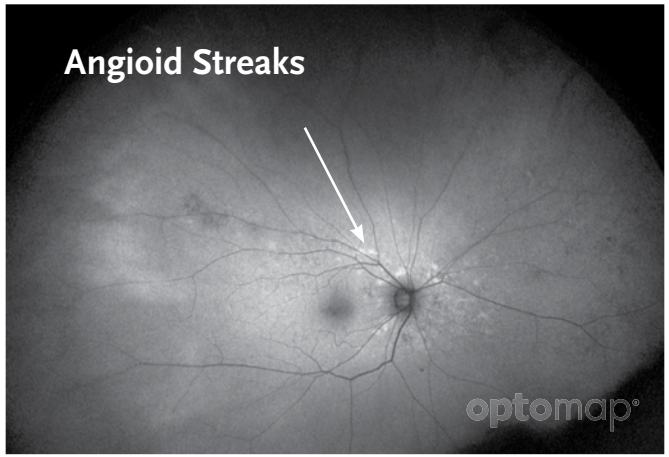
Hyperautofluorescence

is an increased AF signal which will appear white on the image. Many disease states can cause the accumulation of lipofuscin and a hyperautofluorescence signal[1]:

- Stargardts disease
- Best disease
- Adult vitelliform macular dystrophy
- Age-related macular degeneration
- Intraretinal fluid (e.g., macular edema)
- Subretinal fluid
- Choroidal tumors and melanomas
- Drusen
- Older Intraretinal and subretinal hemorrhages
- Choroidal vessels in the presence of RPE and choriocapillaris atrophy (e.g., the center of laser scars or within patches of RPE atrophy)
- Idiopathic macular telangiectasia
- Cystoid macular edema
- Optic Nerve Head Drusen





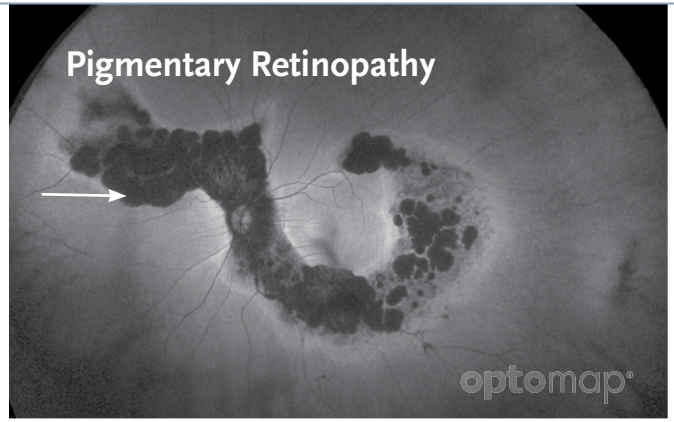


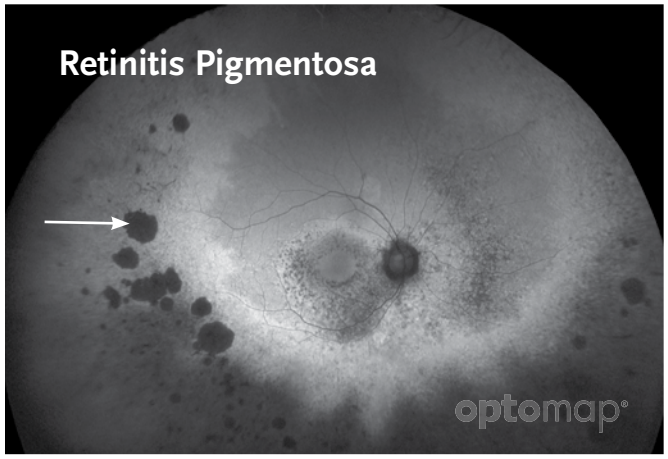
1. Schmitz-Valckenberg, S. H. (2008). Fundus Autofluorescence Imaging. Retina, The Journal of Retinal and Vitreous Diseases, 28(3), 385-409.

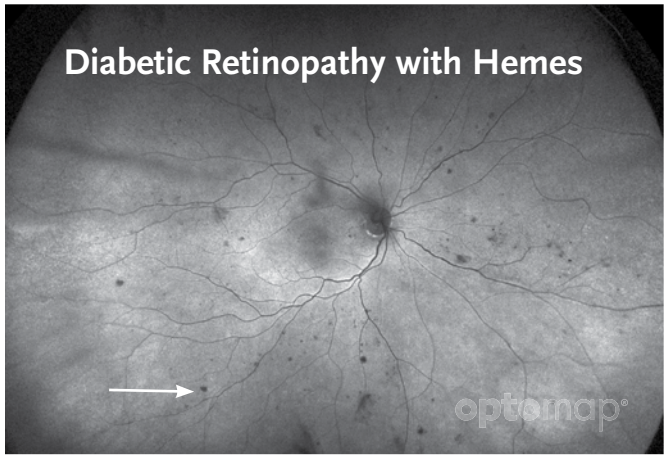
Hypoautofluorescence

is a decreased AF signal which will appear black on the image. Many disease states can cause this retinal damage and a hypoautofluorescence signal[1]:

- Geographic atrophy
- Hereditary retinal dystrophies
- RPE hypertrophy
- Intraretinal fluid (e.g., macular edema)
- Intraretinal and subretinal lipid
- Fresh intra- and subretinal hemorrhages
- Fibrosis, scar tissue, or borders of laser scars
- Retinal Vessels
- Luteal pigment (lutein and zeaxanthin)
- Media opacities (vitreous, lens, anterior chamber, or cornea)





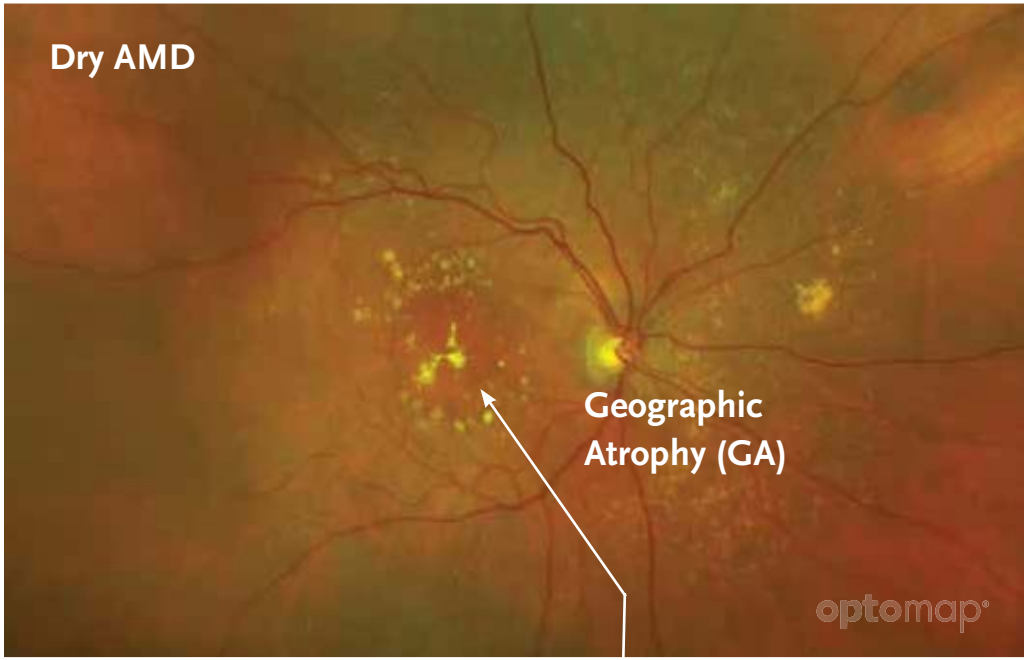


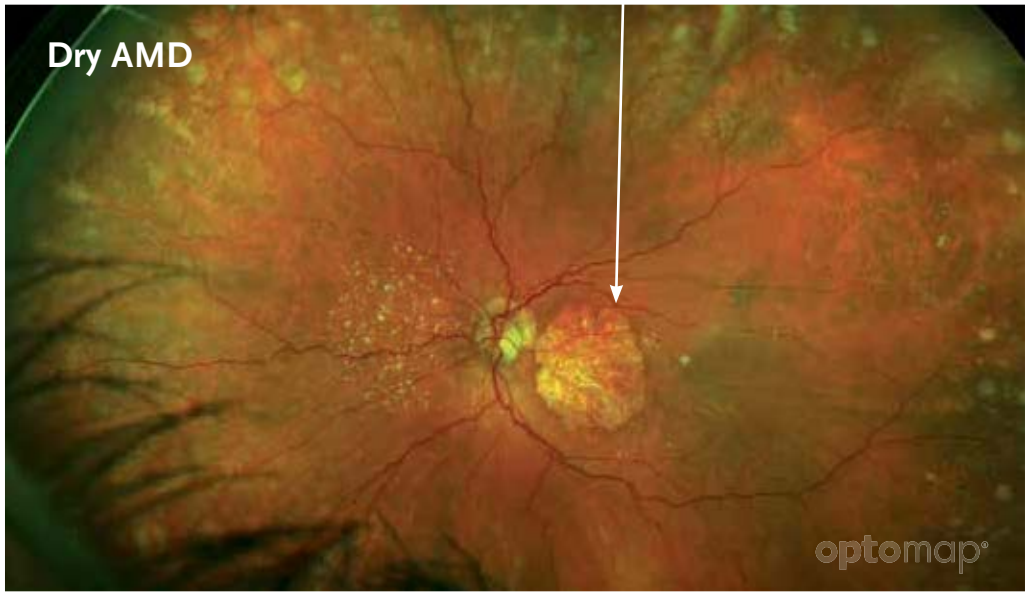
Age-Related Macular Degeneration (AMD, ARMD)

is a group of conditions that include deterioration of the macula, resulting in loss of sharp central vision. Two general types: dry and wet.

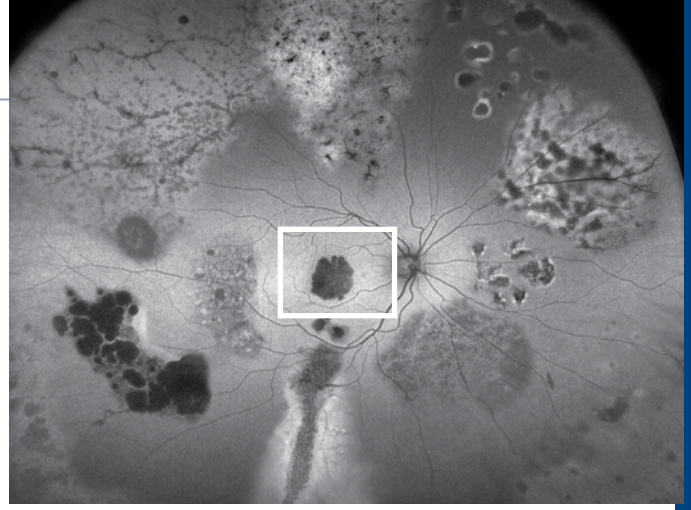
Dry AMD is usually evident as a disturbance of macular pigmentation and deposits of yellowish material under the pigment epithelial layer in the central retinal zone.

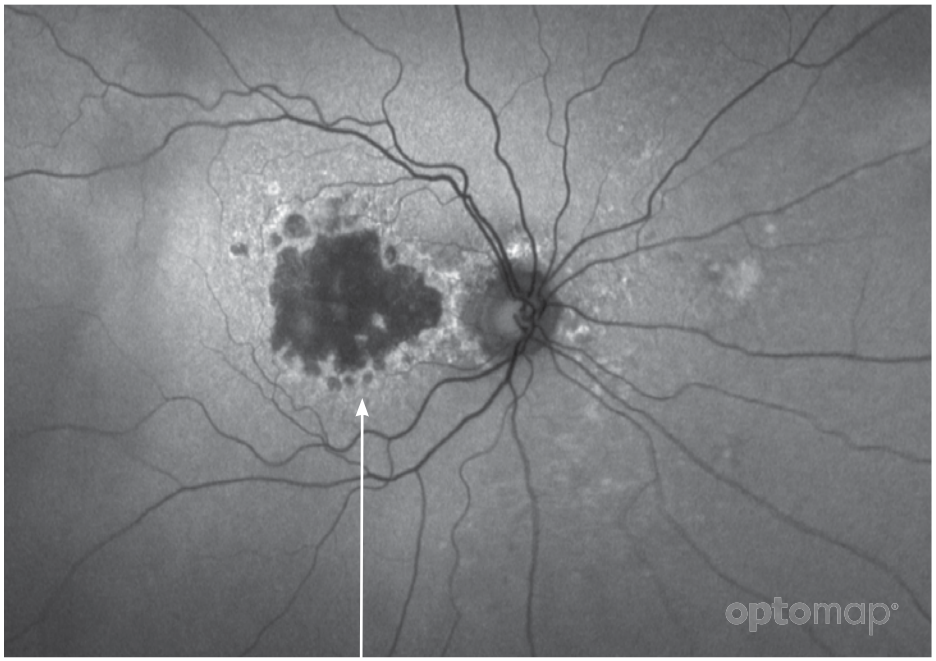
In AMD, AF has been an indicator for disease progression. In a recent study about 69% of AMD patients had peripheral autofluorescent findings.[1]

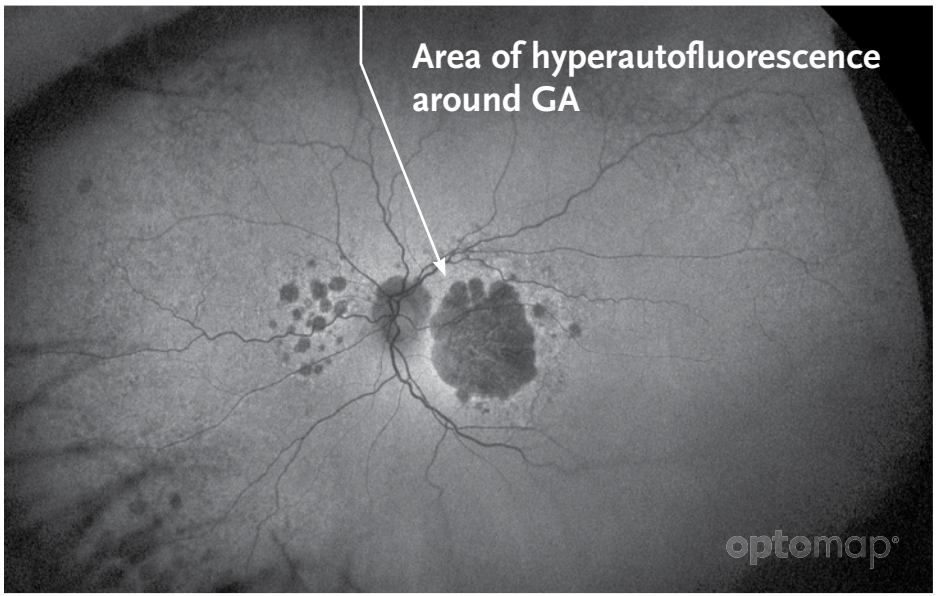




1.Sadda, S. (October 2013). Evaluating Age-Related Macular Degeneration With Ultra-widefield Fundus autofluorescence. Retina Today.







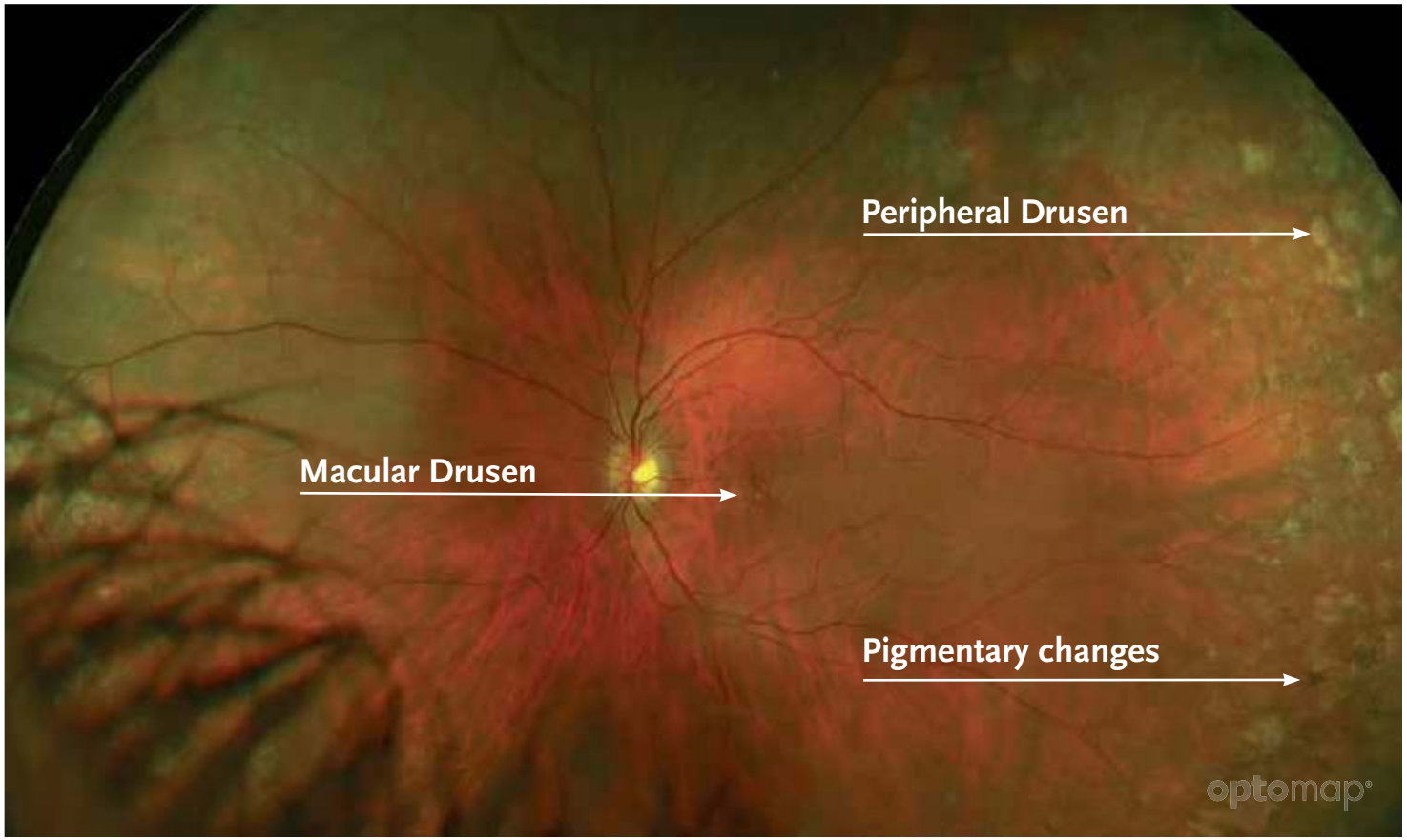
Geographic Atrophy (GA)

is associated with dry AMD and is any sharply delineated round area of hypopigmentation or apparent absence of the retinal pigment epithelium (RPE) on color images. Choroidal vessels are more visible than in surrounding areas and must be at least 175 µm in diameter.

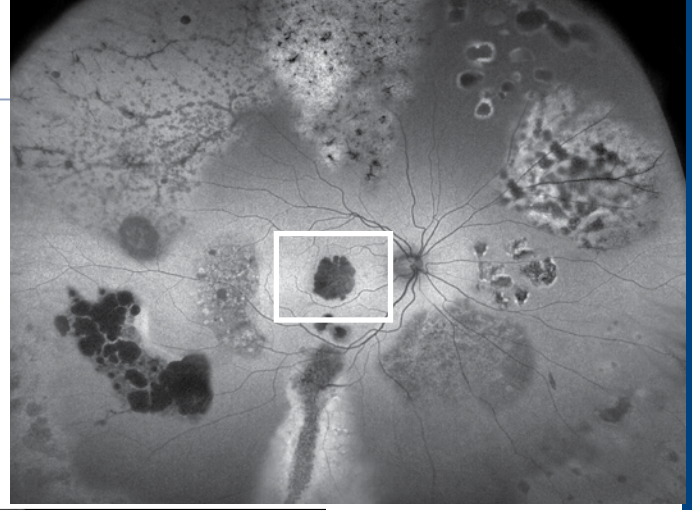
optomap *af* shows hyperautofluorescence around the geographic atrophy that indicates progression of disease.

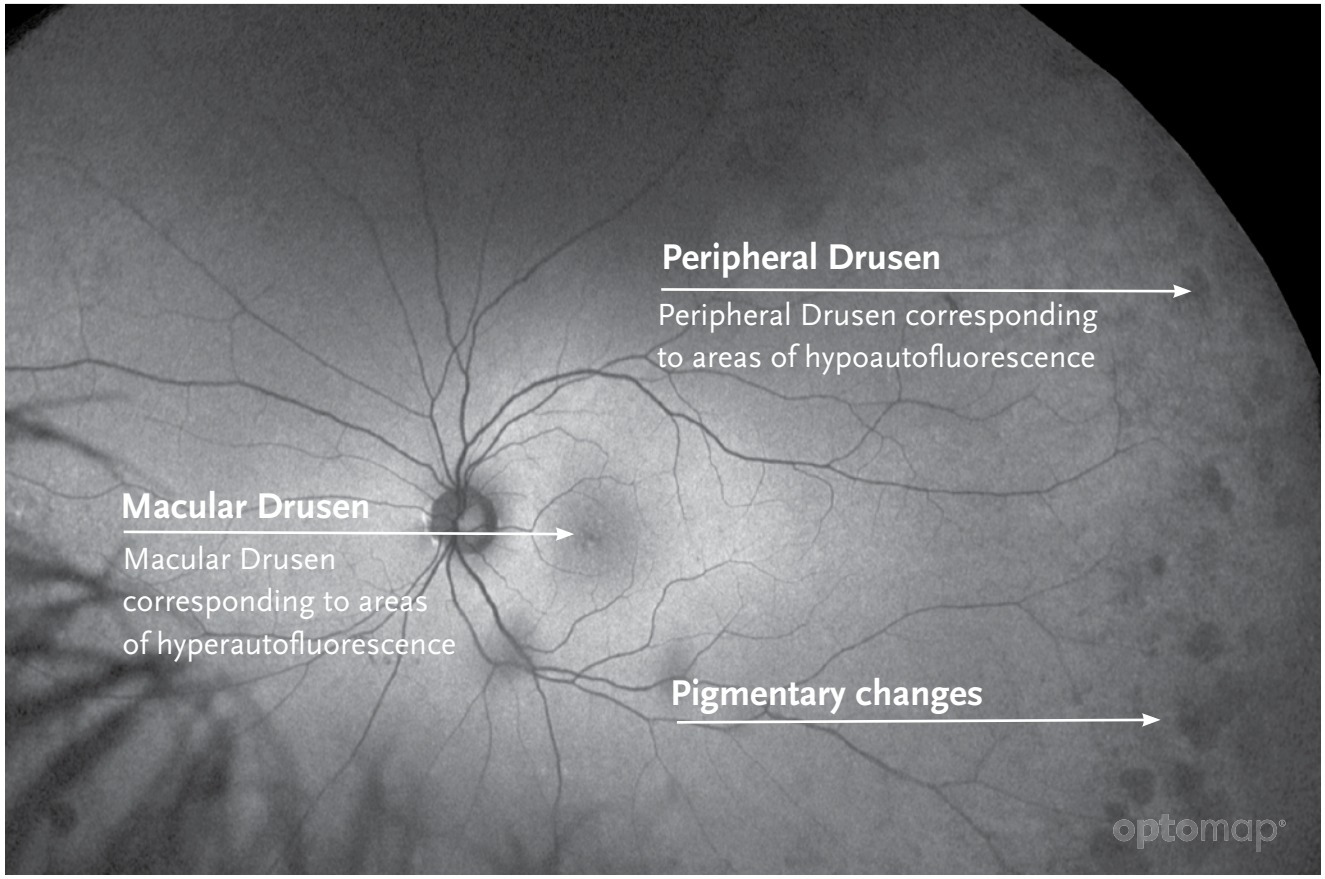
Age-Related Macular Degeneration (AMD, ARMD)

Drusen are tiny hyaline deposits on Bruch's membrane (of the retinal pigment epithelium). Drusen can appear as hypo or hyper-autofluorescent. Peripheral drusen and especially pigmentary changes can suggest a poor prognosis.



AF provides contrast to detect subtle structural changes. Abnormalities on AF demonstrate the function of RPE cells which can be indicative of disease.[1]

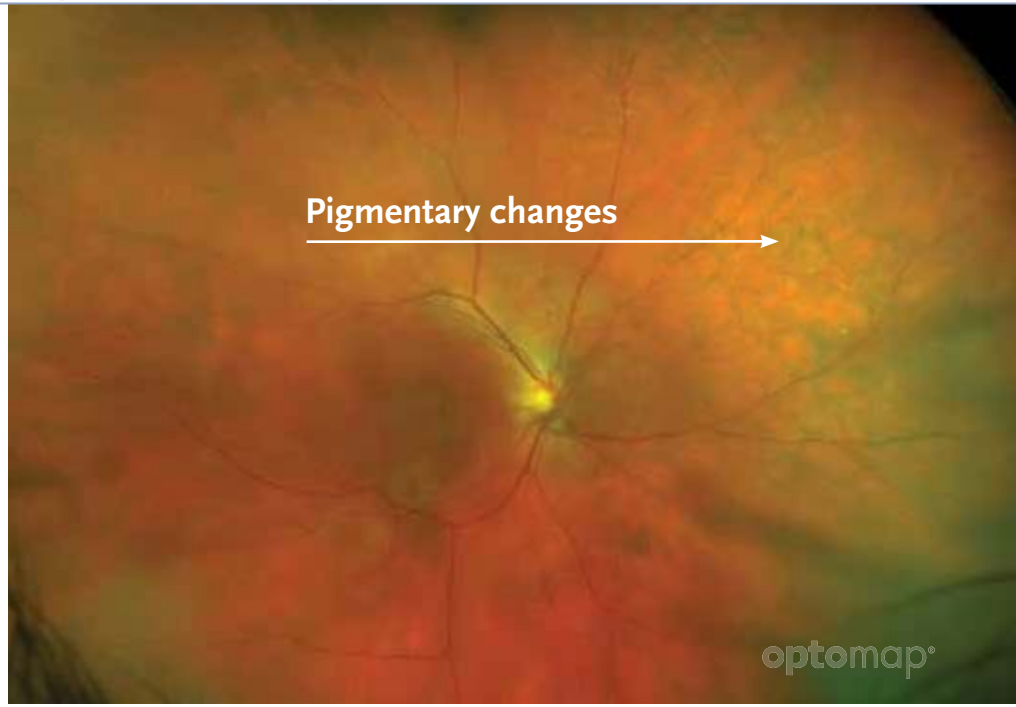




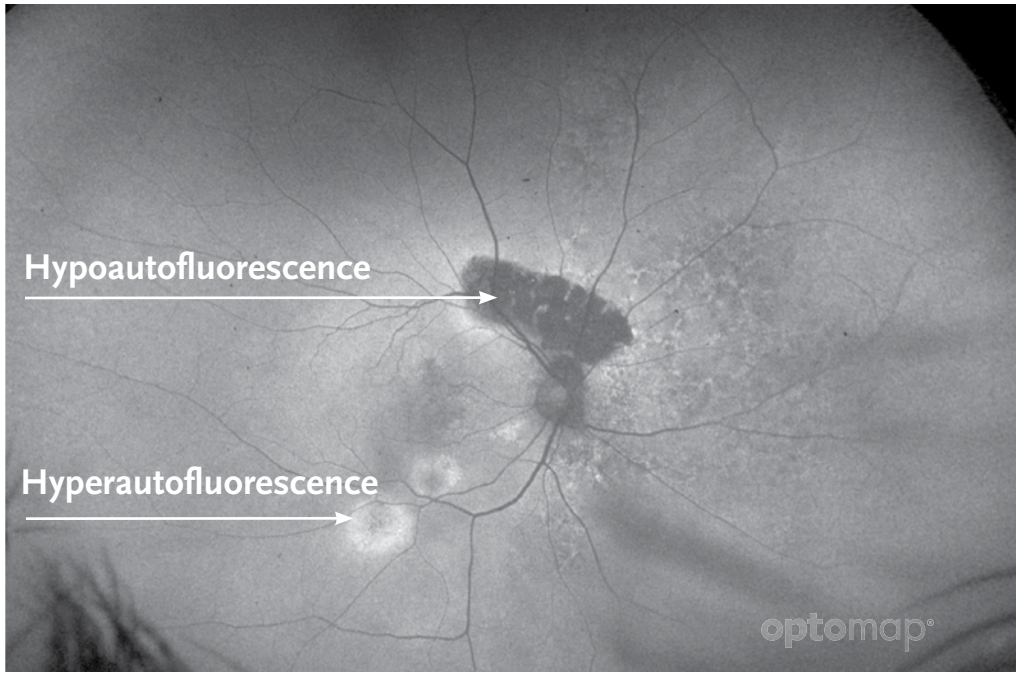
1. Sadda. S. (October 2013). Evaluating Age-Related Macular Degeneration With Ultra-widefield Fundus autofluorescence. Retina Today.

Age-Related Macular Degeneration (AMD, ARMD)

optomap color demonstrates some central atrophy of this atypical macular degeneration, but gives no indication of prognosis or progression.

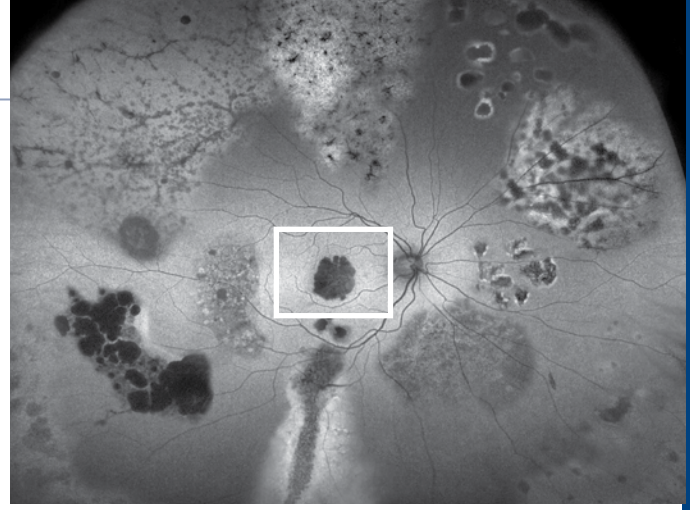


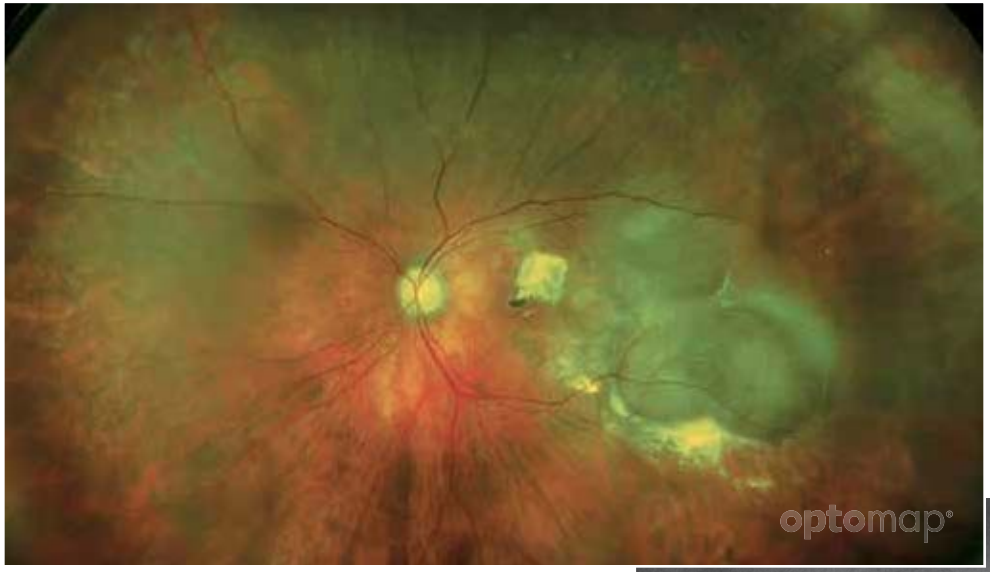
optomap *af* image of the same patient illustrates two levels of damage. Hypoautofluorescence, a decreased signal, indicates a complete loss of function. Hyperautofluorescence, an increased signal, shows areas of dysfunction, but not loss. The wide-spread extent of RPE damage can be tracked over time.



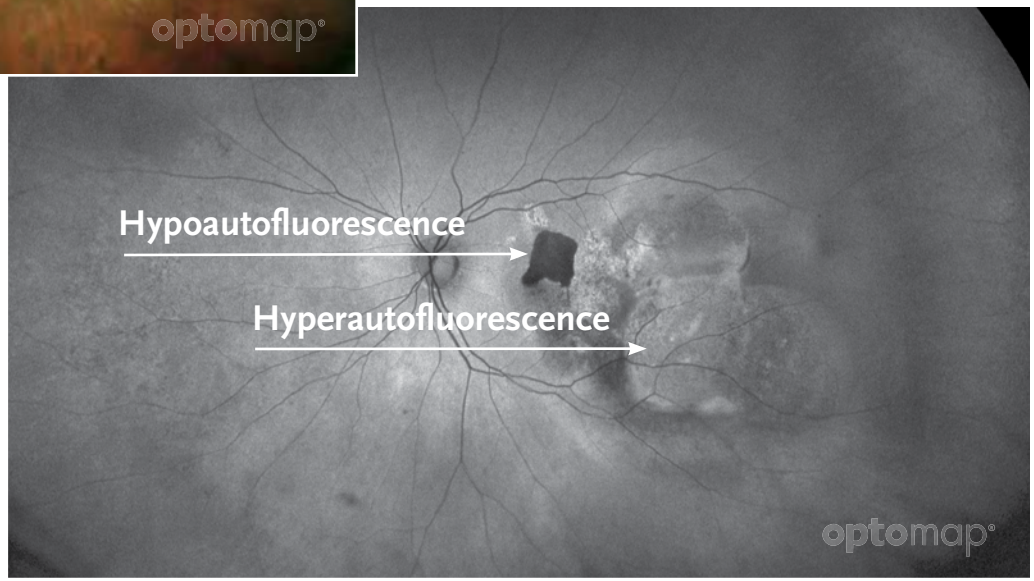
Wet AMD

is abnormal new blood vessel growth under the retina which leaks fluid and blood, further disturbing macular function.



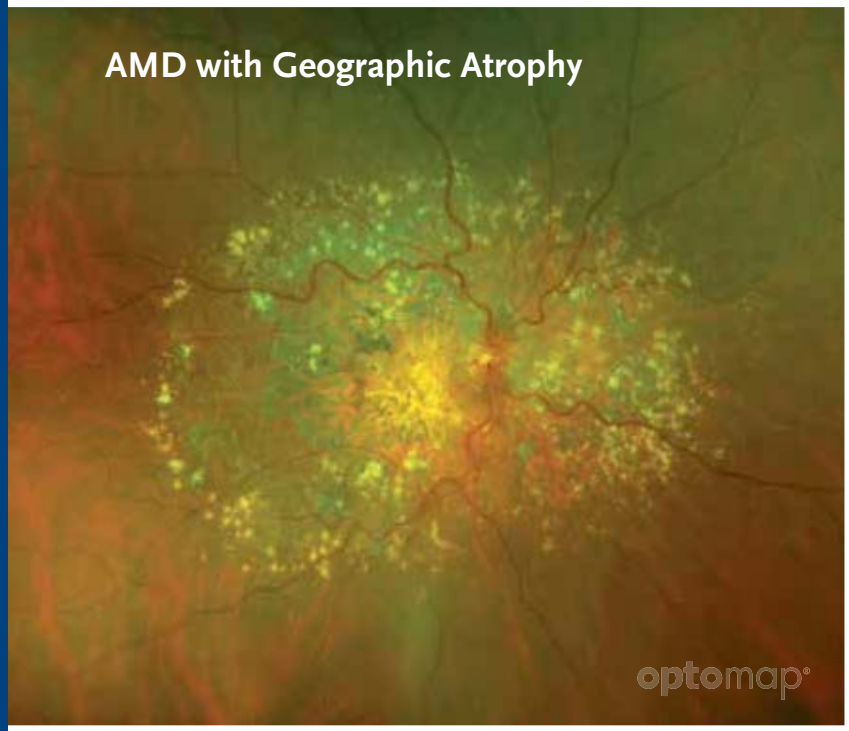


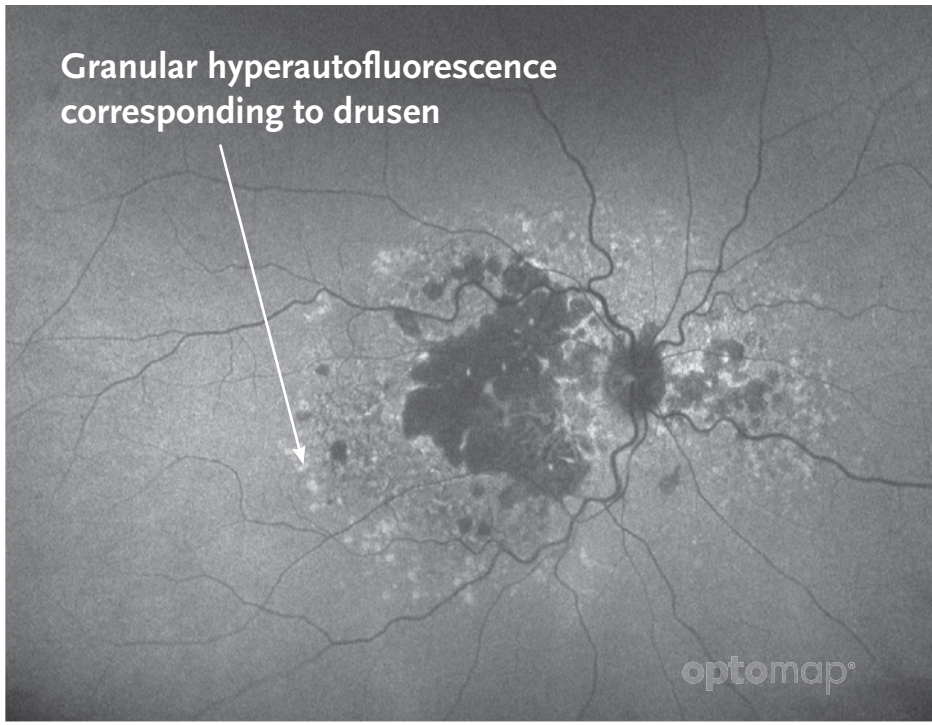
optomap *af* showing a large pigment epithelial detachment (hyperautofluorescence) and an area of atrophy (hypoautofluorescence).



Patterns of Peripheral AF in AMD

In AMD, patterns of AF abnormalities have been shown to be of prognostic importance.[1] These patterns have been classified as granular, mottled, and nummular.



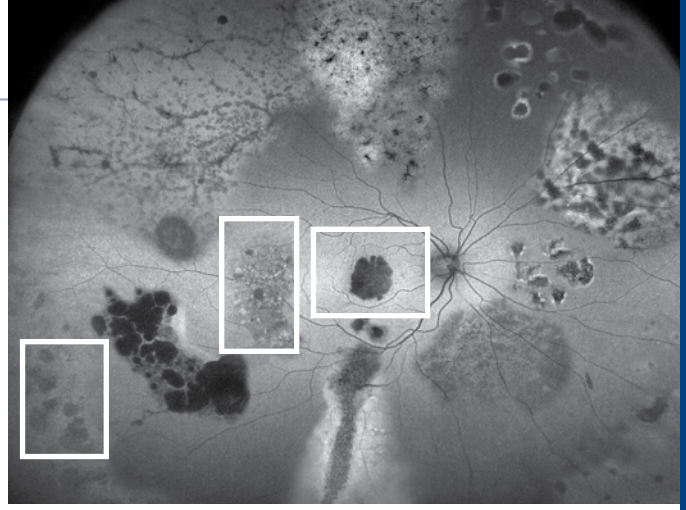


Granular Pattern of retinal degeneration looks like spots of increased AF (hyperautofluorescence) which correspond primarily to drusen.

1. Sadda. S. (October 2013). Evaluating Age-Related Macular Degeneration With Ultra-widefield Fundus autofluorescence. Retina Today.

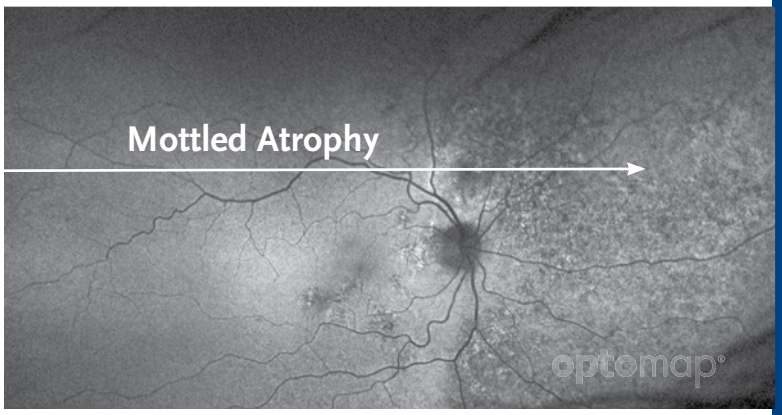
Mottled Atrophy

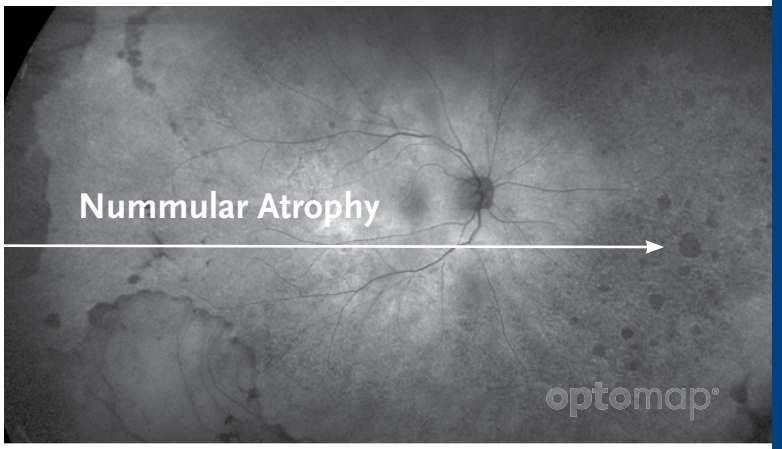
is characterized by patchy, poor demarcated areas of hypoautofluorescence. These areas correspond to pigmentary changes in color that may indicate a poorer prognosis.



Nummular Atrophy

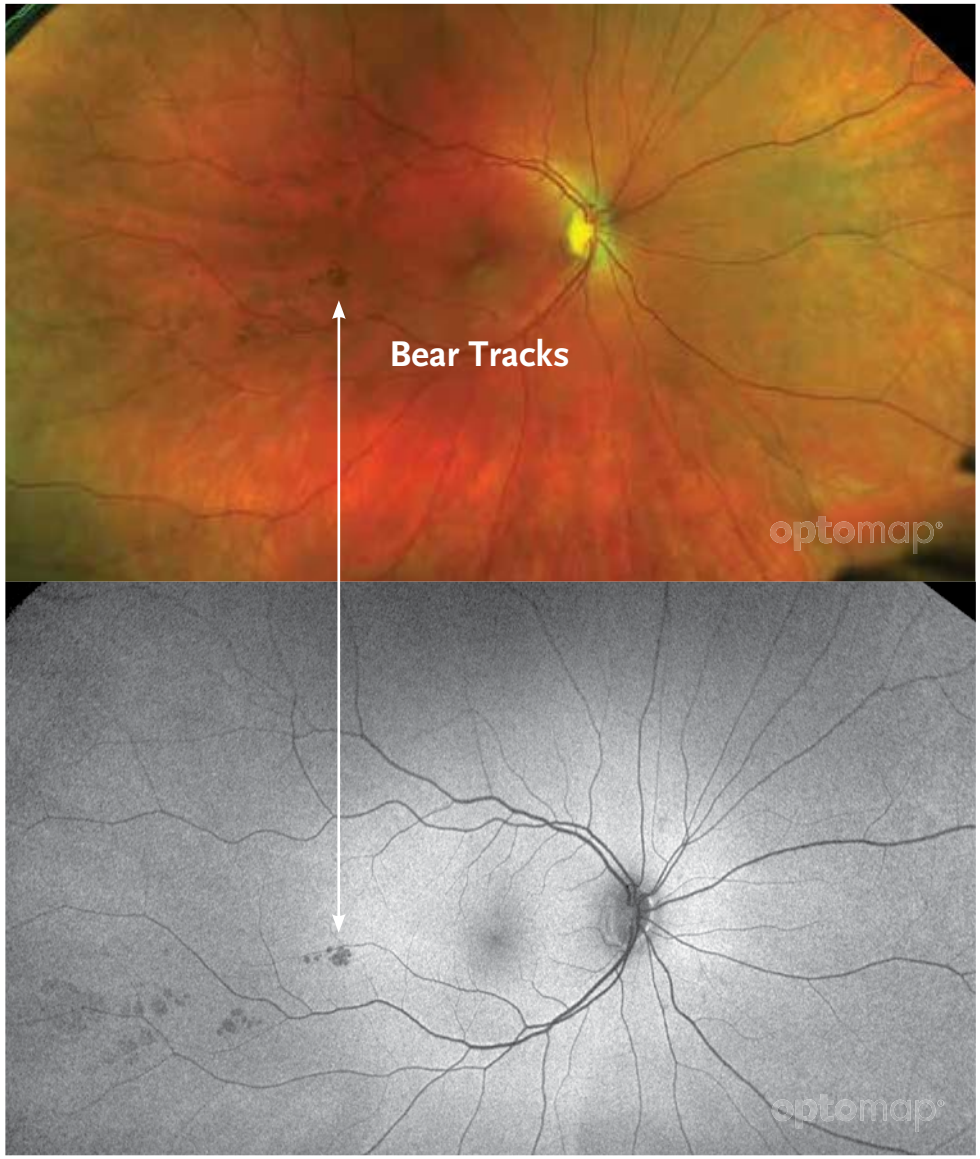
are well-demarcated areas of atrophy which correspond to the cobblestone-like appearance in the color image. These areas will hypoautofluoresce on **opto**map *af* .





Bear Tracks

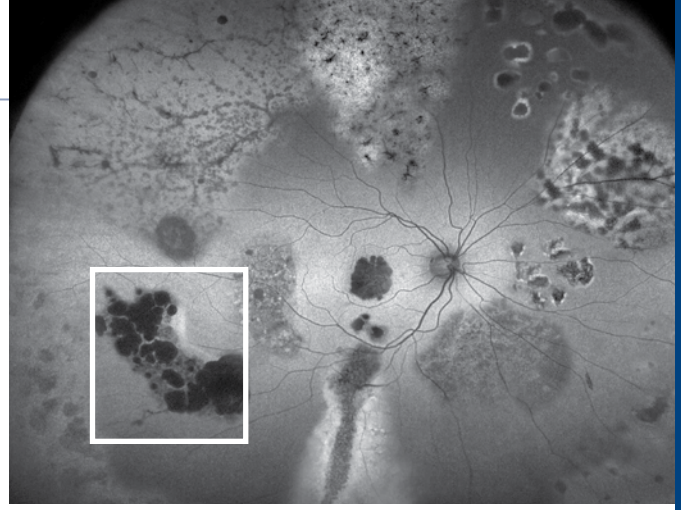
are an area of excessively pigmented retinal pigment epithelium that resemble paw prints. They are congenital.

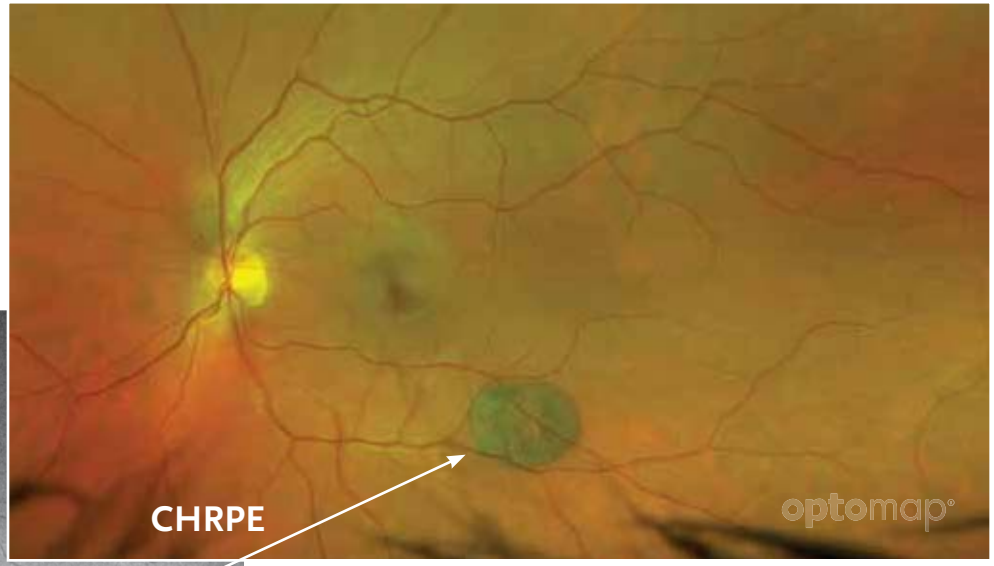


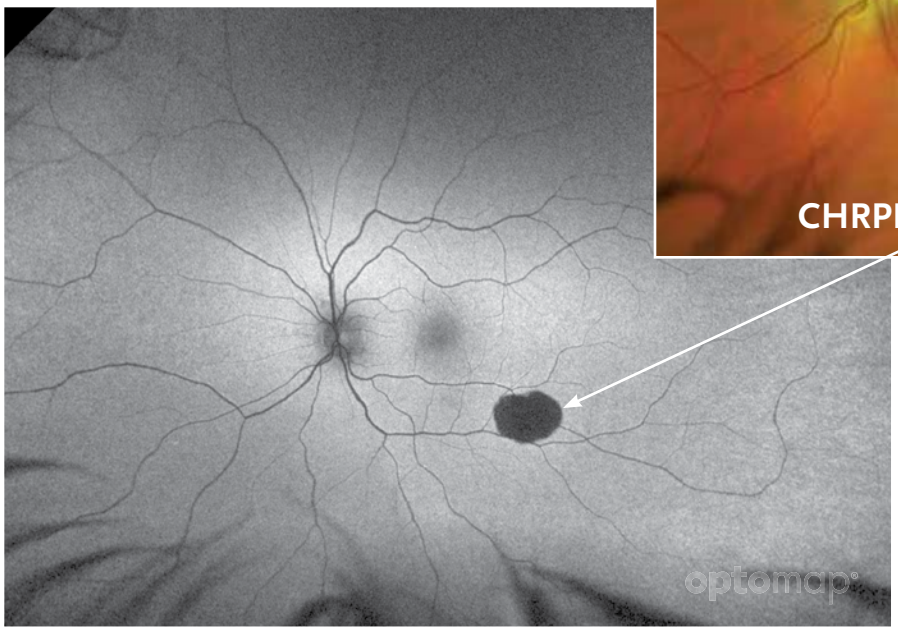
optomap *af* shows more contrast to allow better visualization of pigmentation patterns. Pigmentation in color image corresponds to areas of hypoautofluorescence.

Congenital Hypertrophy of the Retinal Pigment Epithelium (CHRPE)

is an area of enlarged pigment epithelial cells that contain increased pigment. Clinically, they appear as flat, round pigmented lesions, occasionally with depigmented zones, or as small grouped patches known as bear tracks.





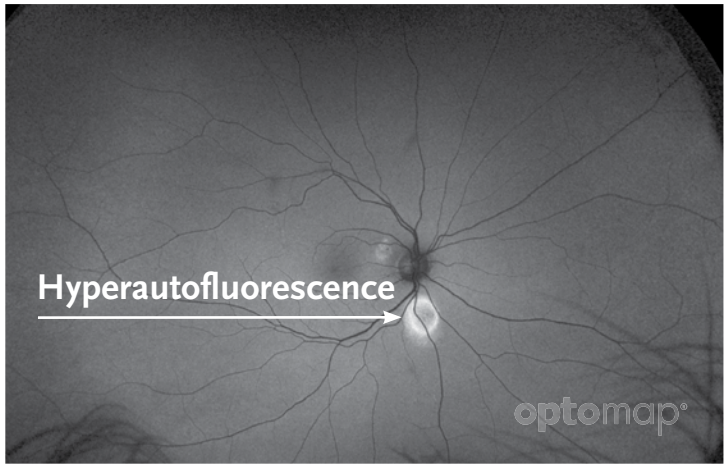


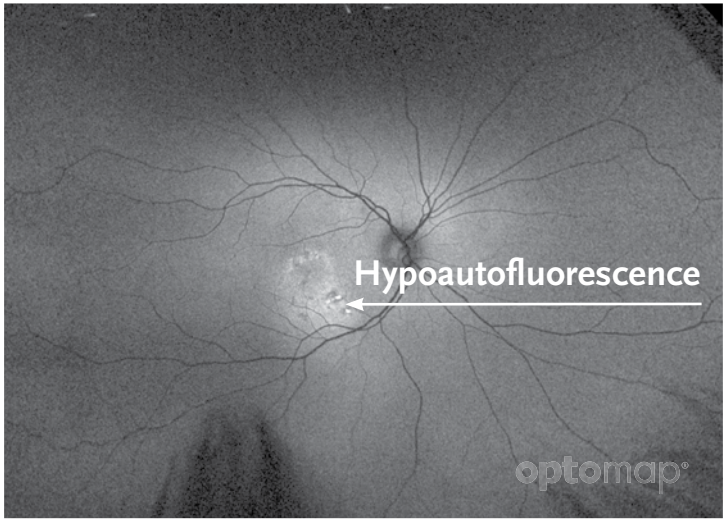
CHRPE appears dark (hypoautofluorescence) on **opto**map *af* image because photoreceptors are absent in this area. RPE cells lose source of lipofuscin and thus it appears dark.

Central Serous Retinopathy, Serous Chorioretinopathy (CSR)

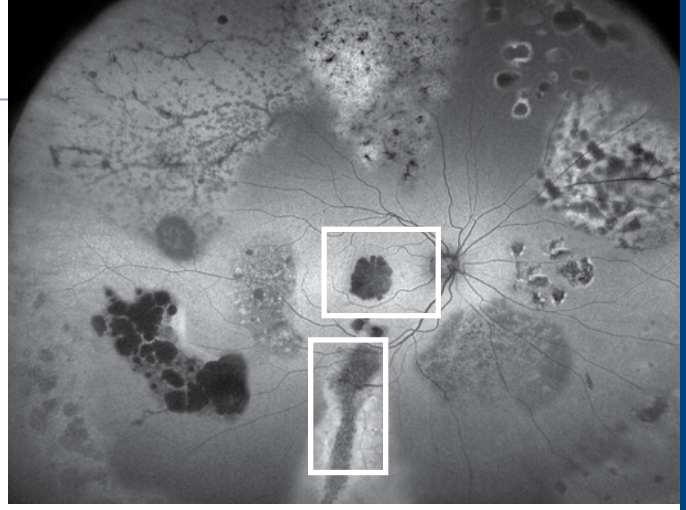
is a blister-like elevation of sensory retina in the macula (area of central vision), with a localized detachment from the pigment epithelium. This results in reduction and/or distortion of vision that usually recovers within a few months.

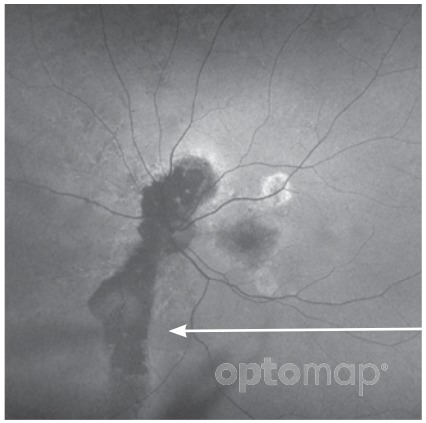
optomap color images show subtle fluid build-up and macular changes. Corresponding **opto**map *af* images demonstrate hyperautofluorescent fluid accumulation and retinal damage. The granular dark areas correspond to the source of the fluid leak.



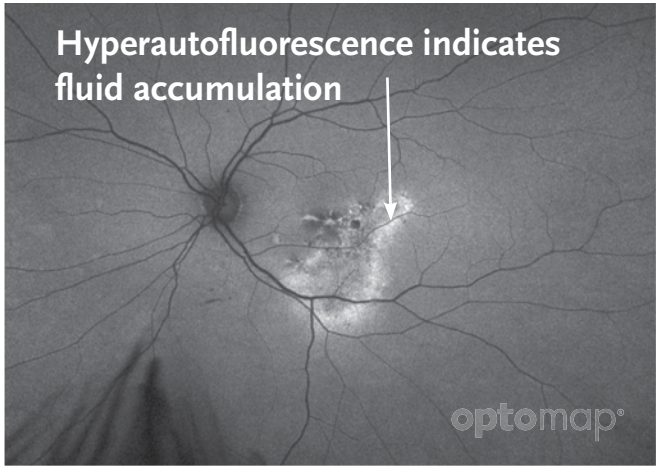


The gutter-like appearances extending to the mid-to-far periphery are characteristic of chronic central serous retinopathy.





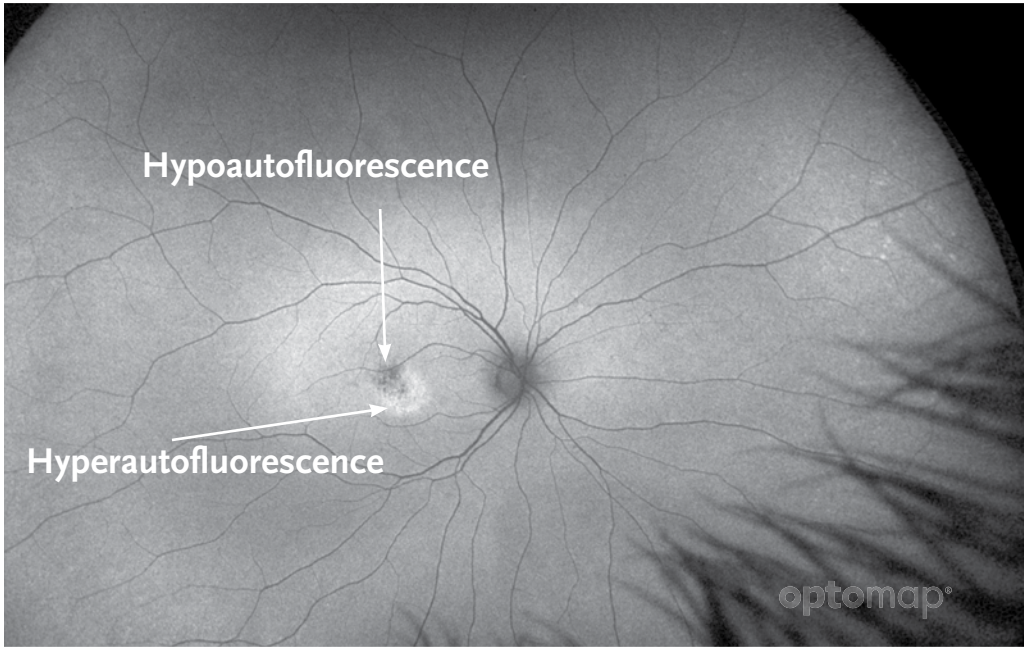
optomap *af* shows a hypoautofluorescence gutter-like appearance which corresponds to the loss of photoreceptors.



Central Serous Retinopathy, Serous Chorioretinopathy (CSR)

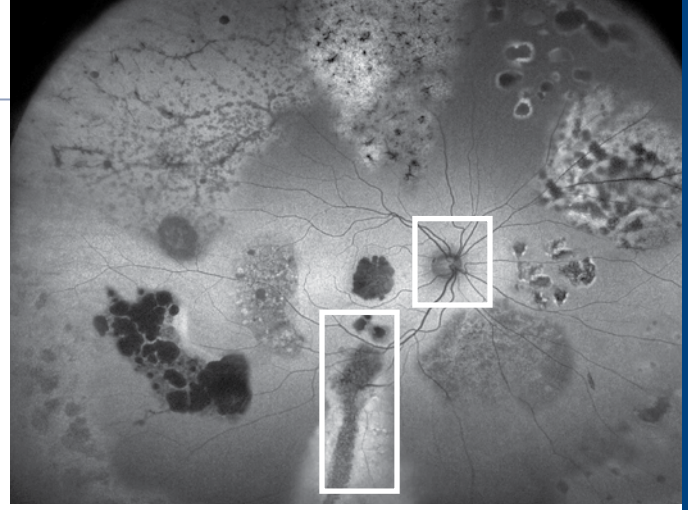
optomap color image shows structural retinal damage while corresponding **opto**map *af* image demonstrates disease activity and potential areas for additional vision loss.

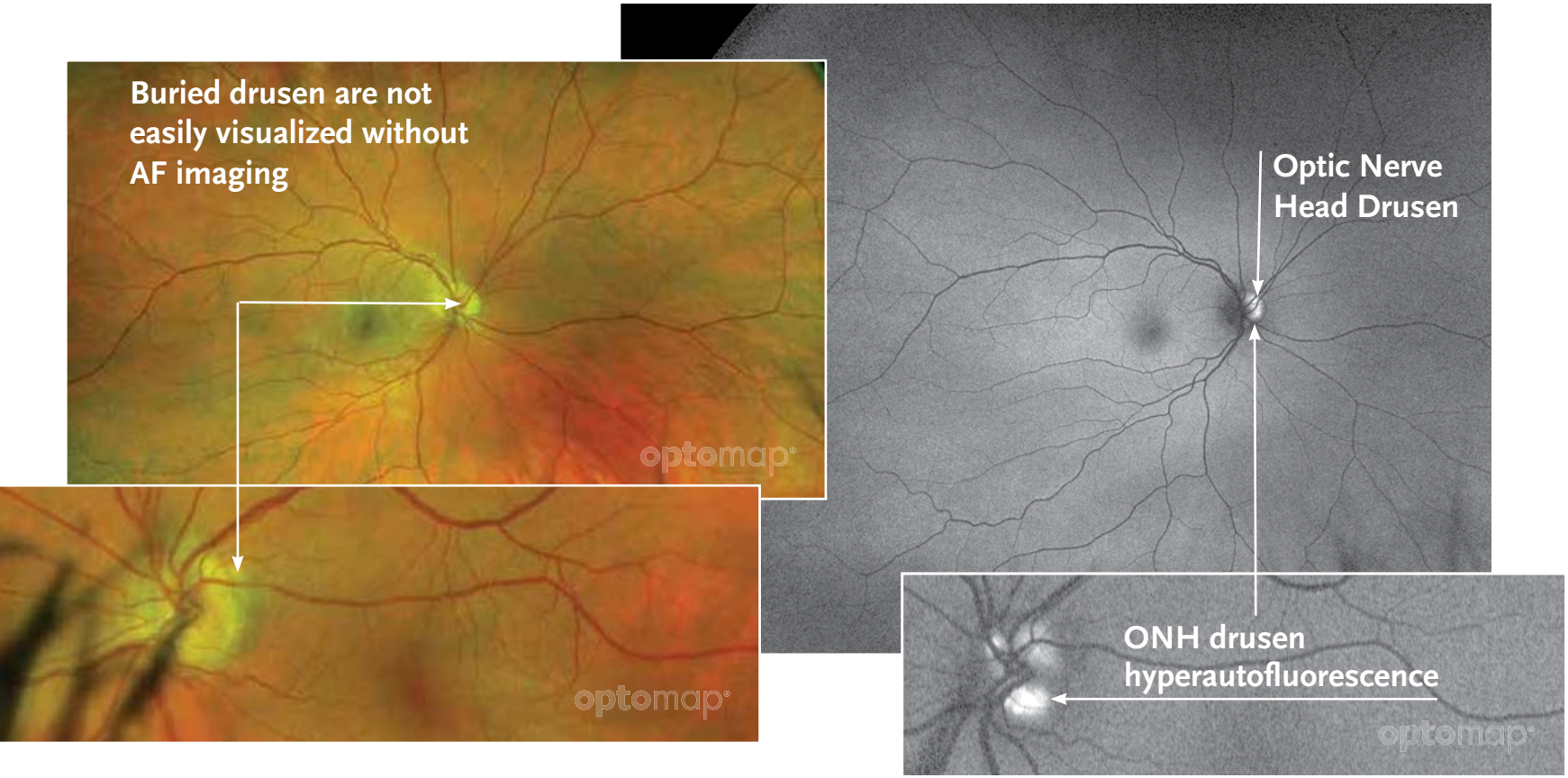
The dark granular areas on **opto**map *af* indicate where the serous leak occurs. The hyperautofluorescent area shows where the neurosensory detachment is located.



Optic Nerve Head Drusen (ONH Drusen)

are hyaline masses or nodules within the optic nerve head. Surface drusen may be seen on clinical exam while deeper drusen may be difficult to appreciate. **opto**map *af* helps to differentiate ONH drusen from AION (Anterior Ischemic Optic Neuropathy) and field defects.

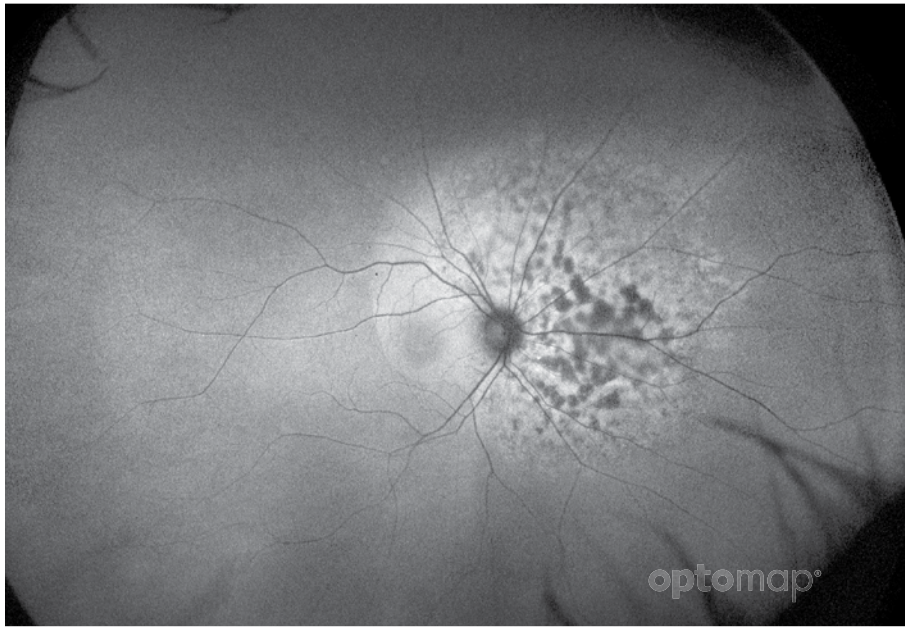




Choroidal Melanoma

is a malignant tumor derived from pigment cells initiated in the choroid.

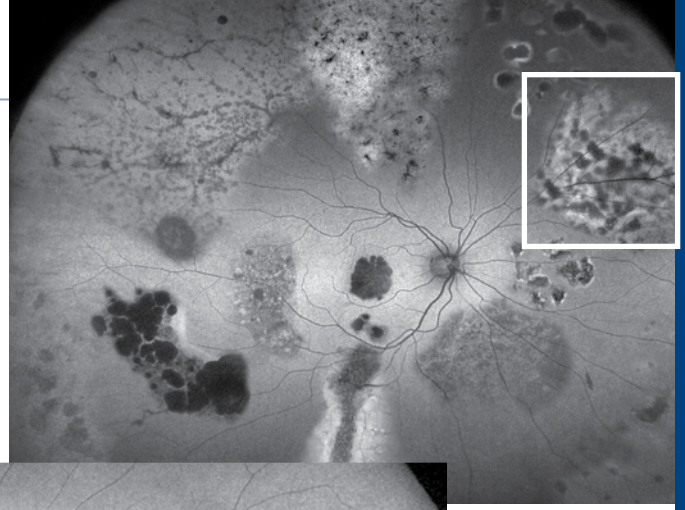
optomap color image shows a large choroidal mass.

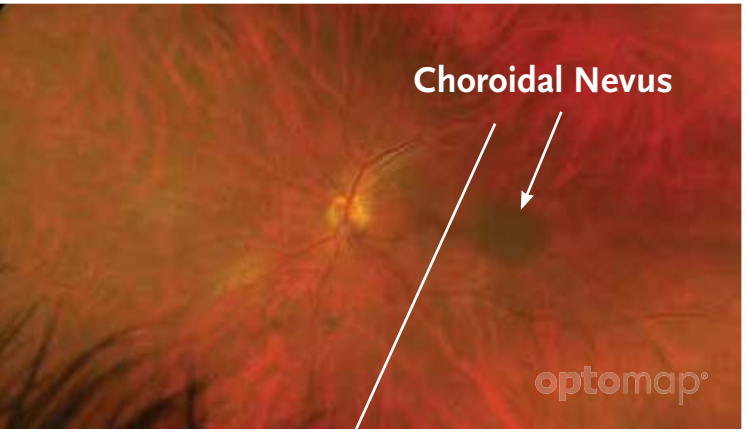


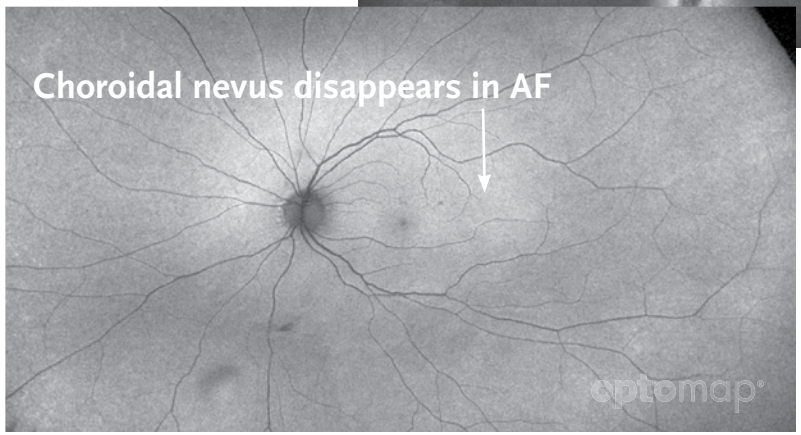
optomap *af* image demonstrates hyperautofluorescent lipofuscin accumulation which corresponds to the orange pigment seen in the exam, which is a high risk feature for melanoma. Hypoautofluorescence shows that the tumor has been growing for some time and permanent retinal damage has occurred.

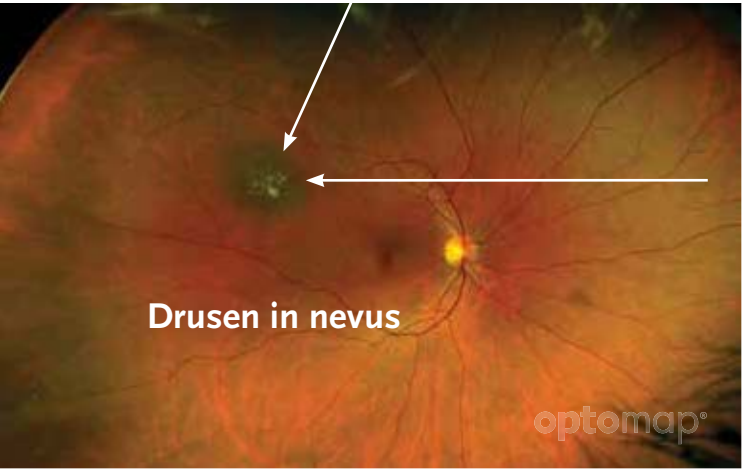
Choroidal Nevus

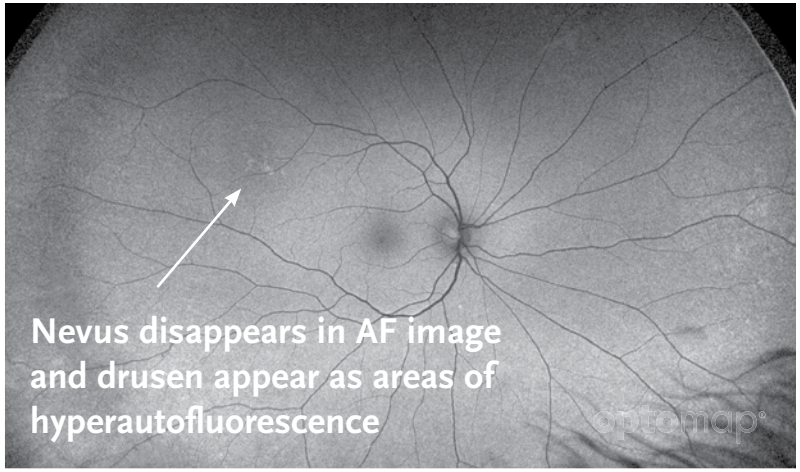
is a benign pigmented or nonpigmented lesion (freckle) in the choroid.





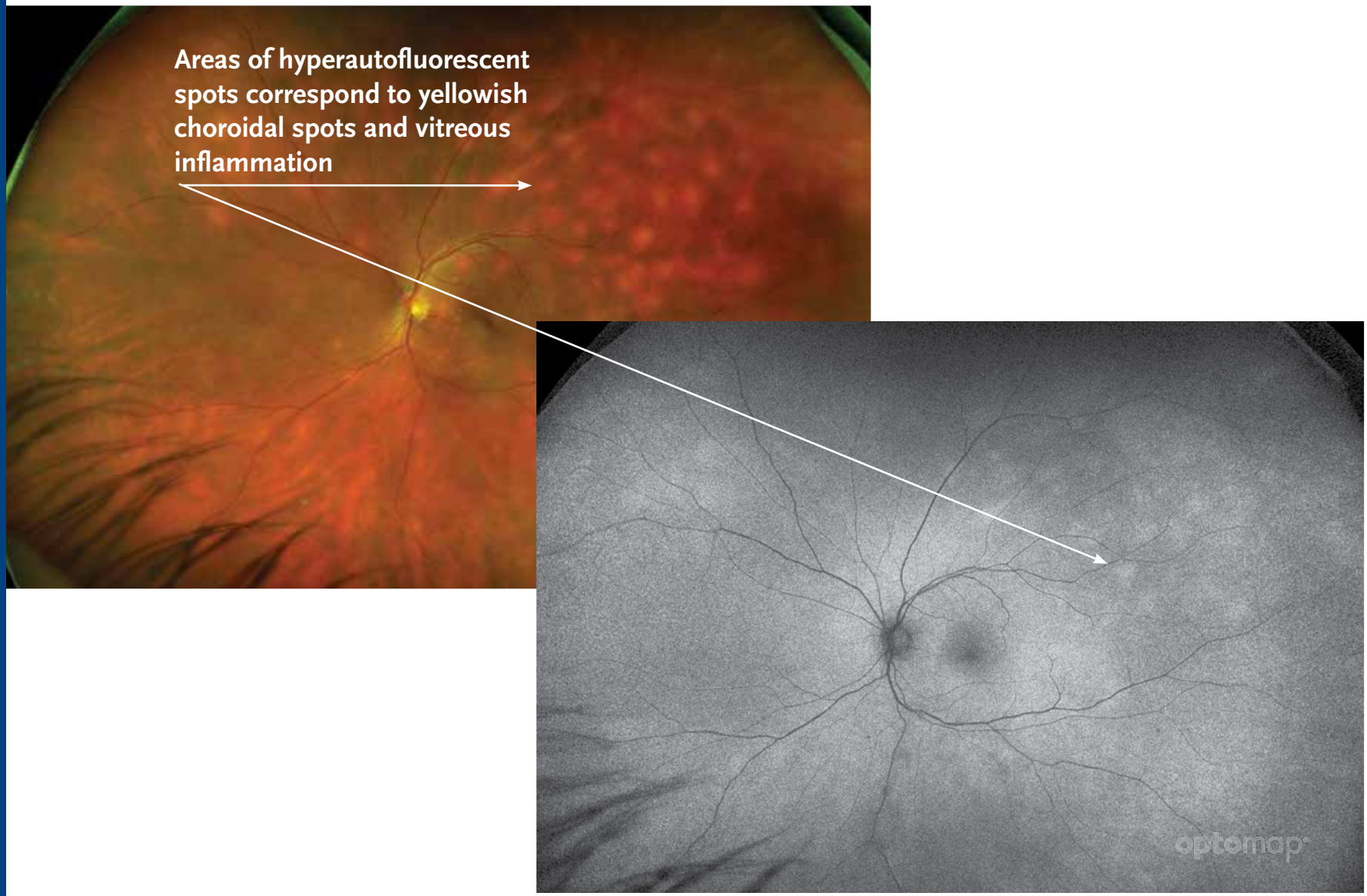






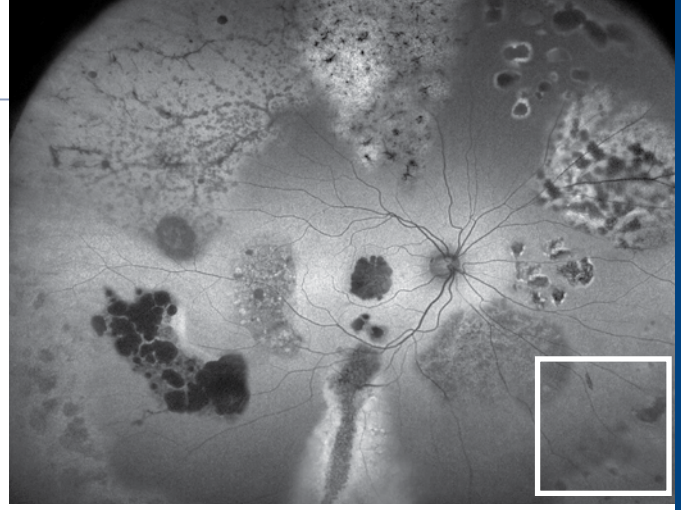
Birdshot Choroiditis

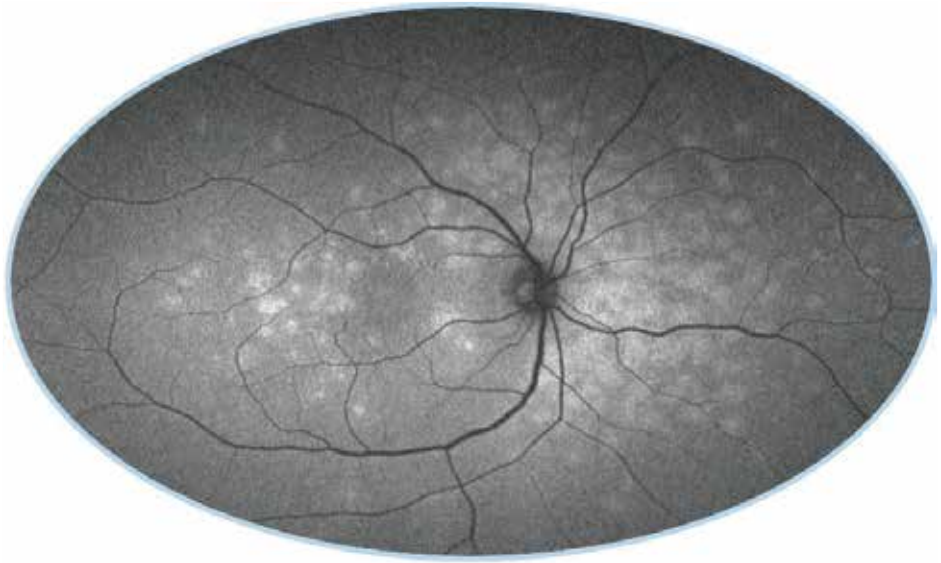
is an inflammatory disease of the choroid. Characterized by small, yellowish choroidal spots and vitreous inflammation.



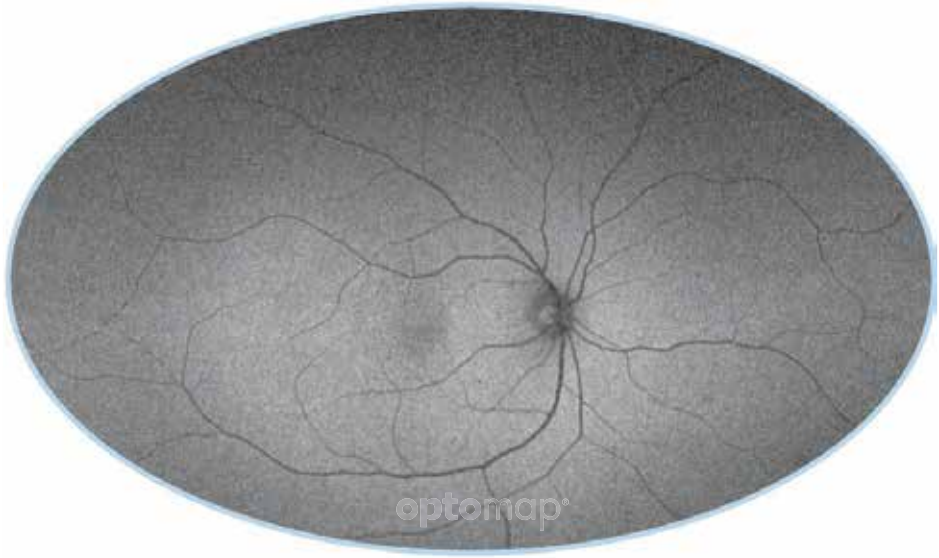
Multifocal Evanescent White Dot Syndrome (MEWDS)

are white dots that appear in the deep layers of the retina caused by inflammation.





Pre-Treatment
optomap *af* image showing hyperautofluorescent dots in the central and peripheral retina before treatment.

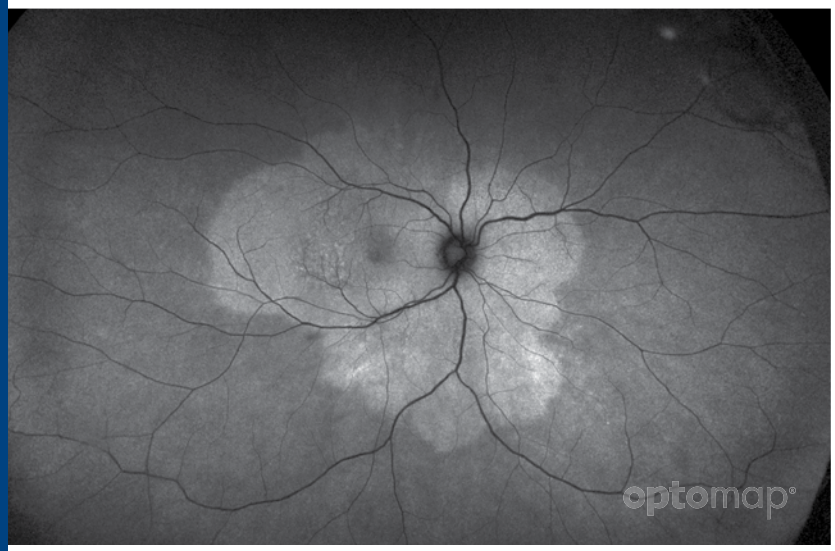


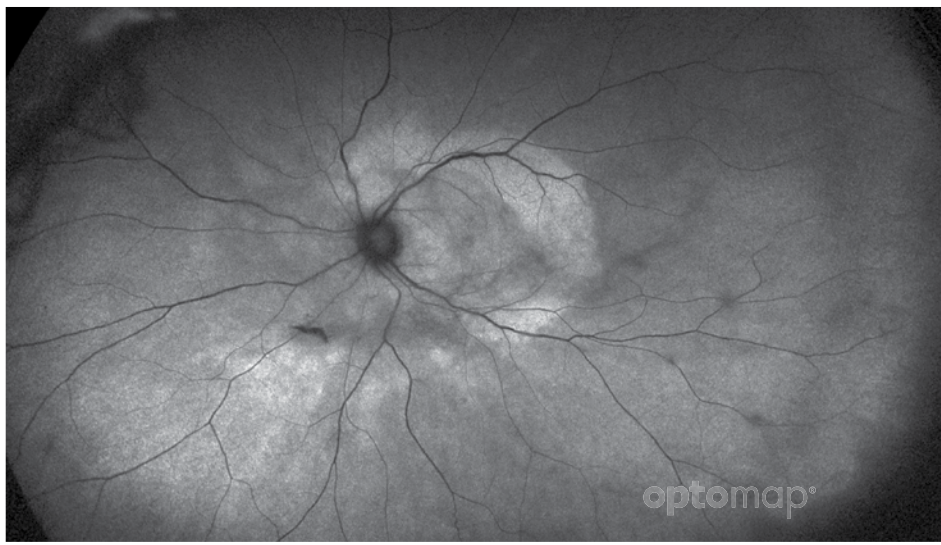
Post-Treatment
optomap *af* image showing a healthy retina after treatment.

Images published in International Journal of Retina and Vitreous

Uveitis

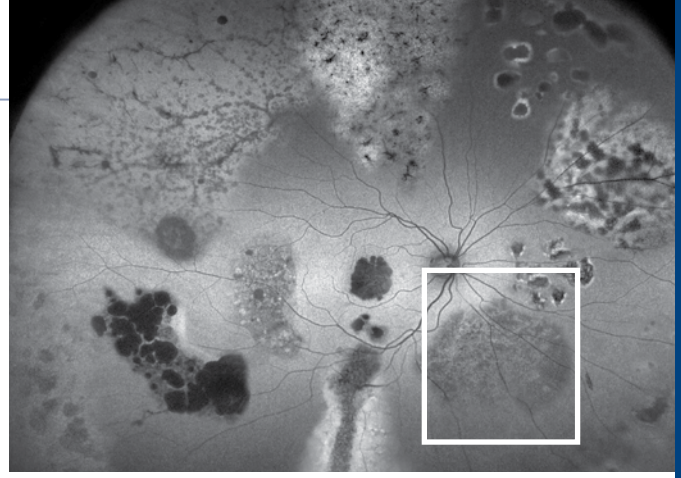
is an inflammation of any of the structures of the uvea: iris, ciliary body, or choroid. Types of uveitis are: anterior, chronic, endogenous, heterochromic, lens-induced, posterior, phaco-anaphylactic and recurrent. In uveitis, both hypo- and hyper-autofluorescence can be seen.

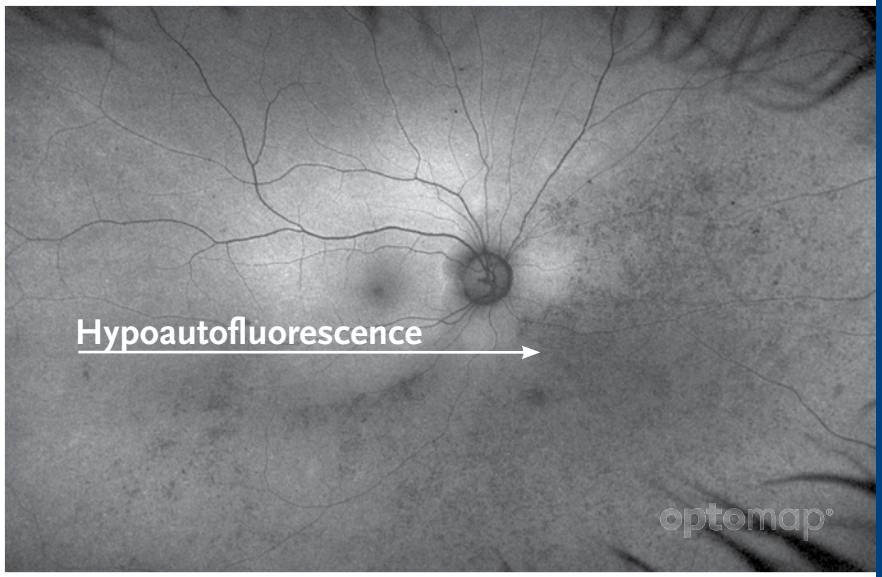




Retinal Degeneration

is deterioration of the retina. Autofluorescence can show pathology not easily visualized in the color images.

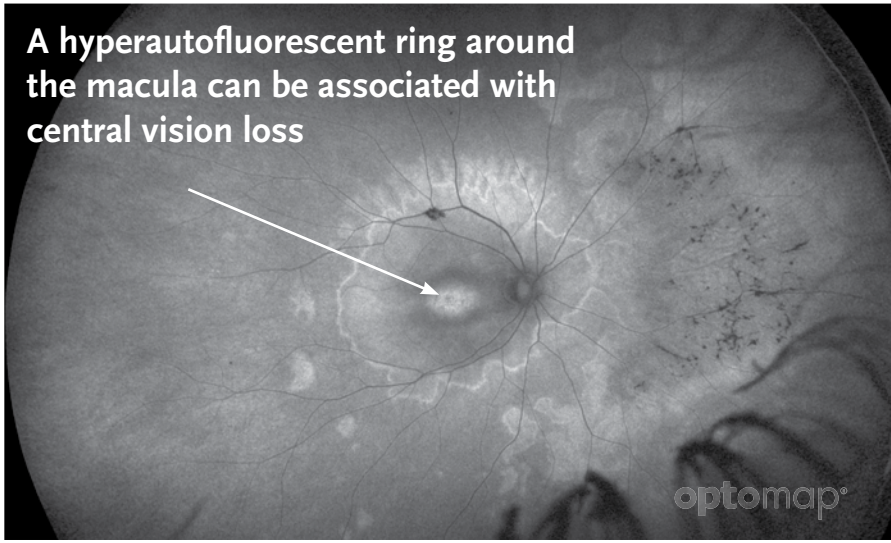


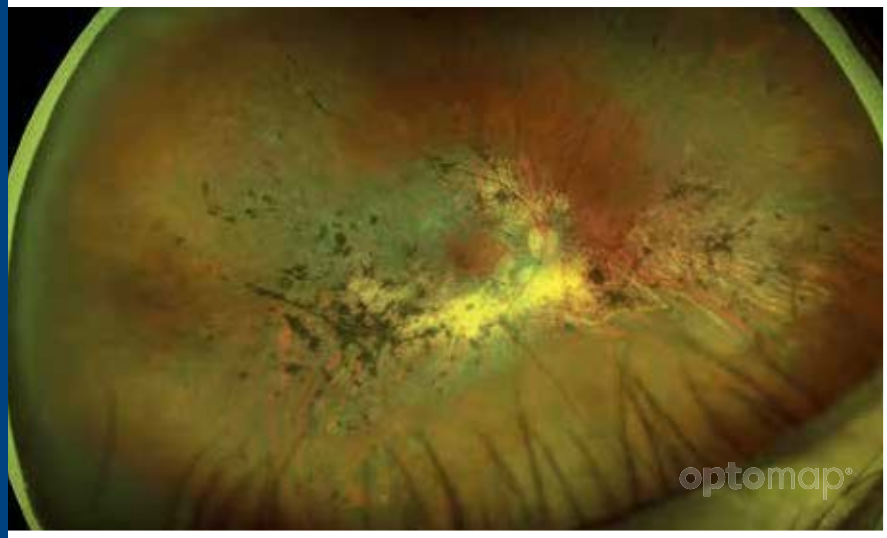


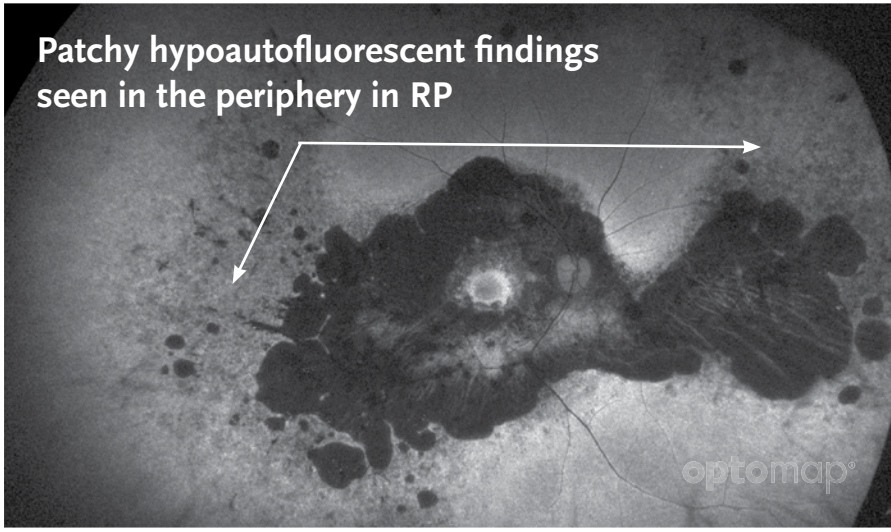
optomap *af* shows areas of hypoautofluorescence corresponding to superior vision loss not seen on color images or exam.

Retinitis Pigmentosa (RP)

is a hereditary, progressive retinal degeneration in both eyes. Night blindness, usually in childhood, is followed by loss of peripheral vision (initially as ring-shaped defect). It progresses over many years to tunnel vision and then blindness.

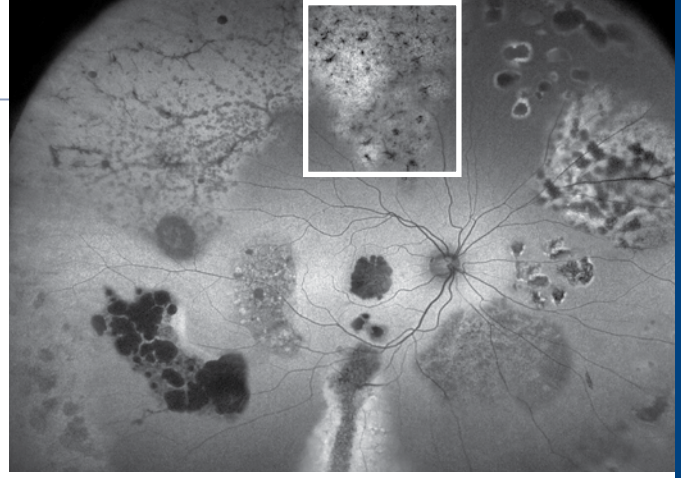


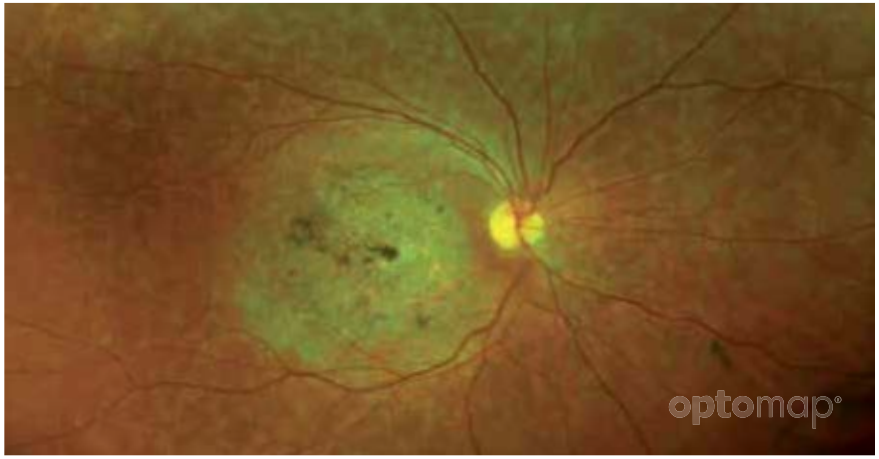


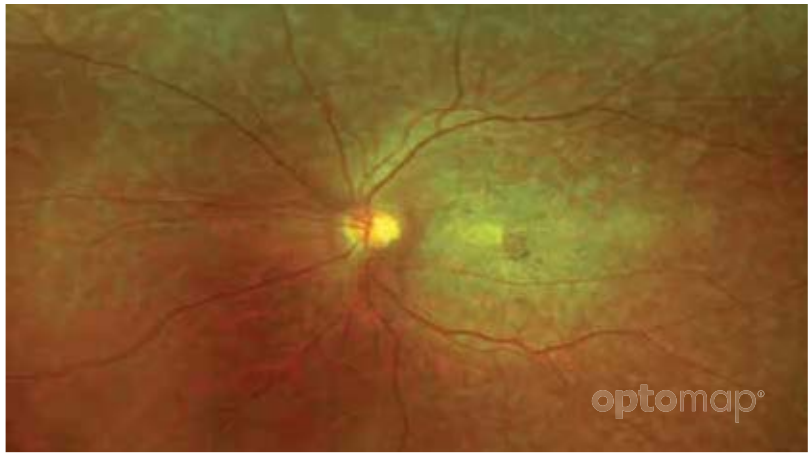


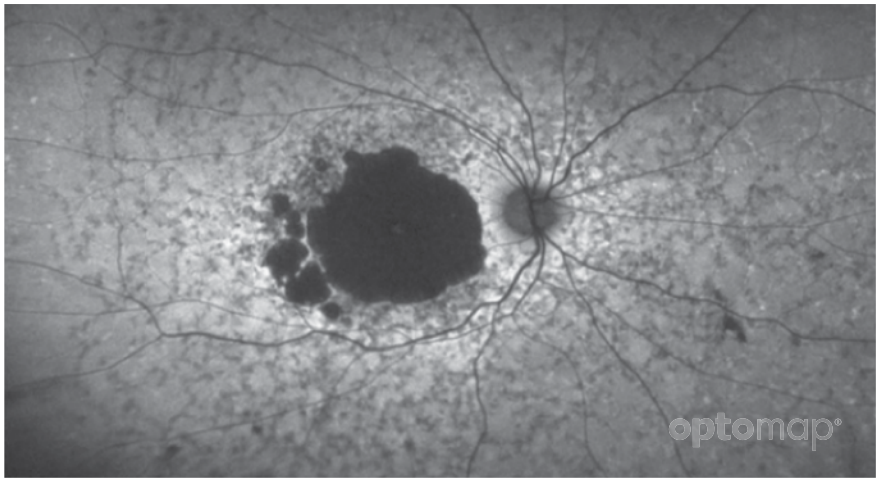
Stargardt's Disease

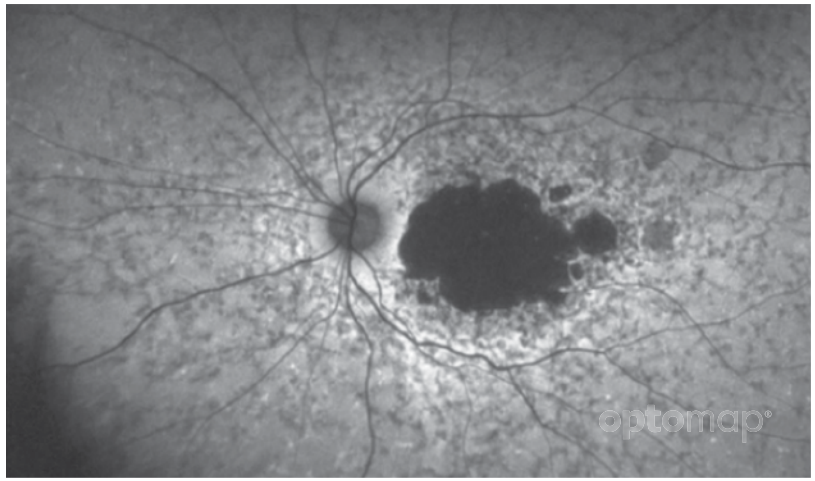
is a hereditary condition of degeneration in the macula characterized by central vision loss with minimal changes visible with an ophthamoscope. In advanced disease, the macula may show pigment clumping surrounded by a hammered-metal appearance. It is often associated with fundus flavimaculatus.





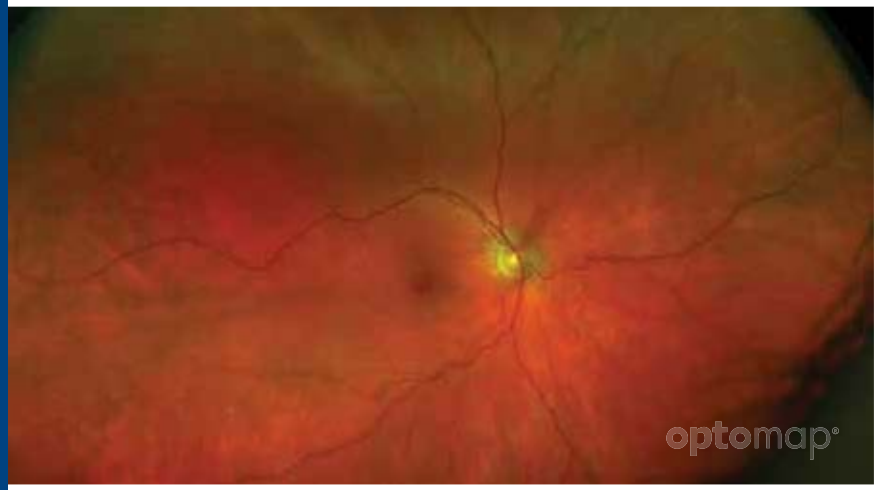


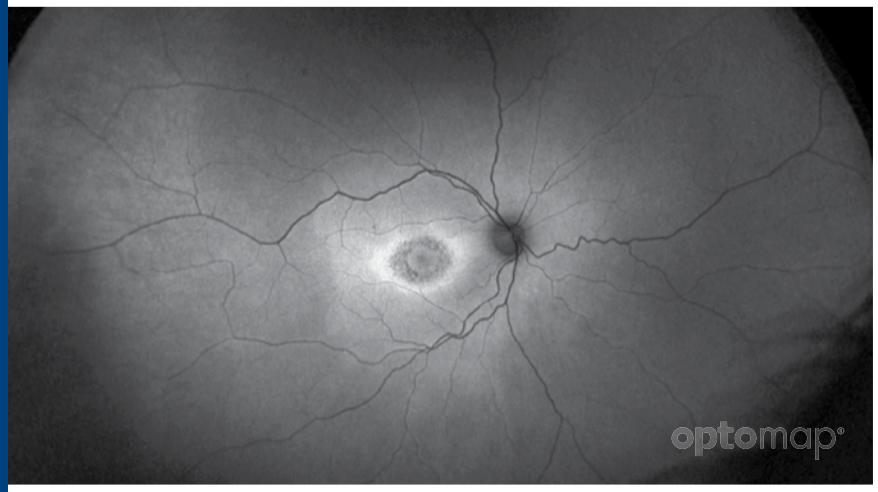


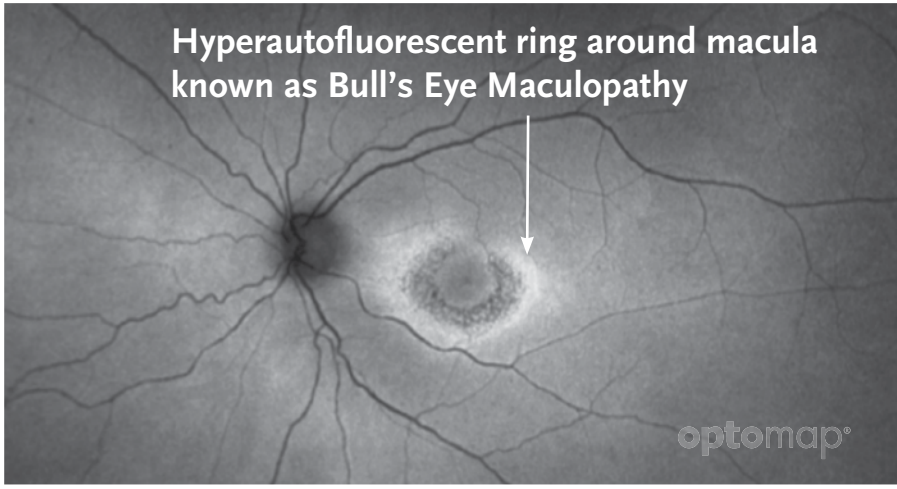


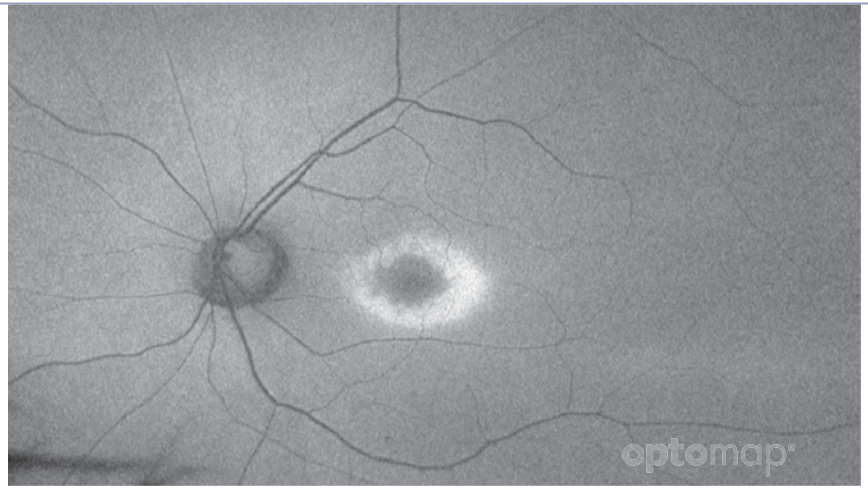
Retinal Toxicity

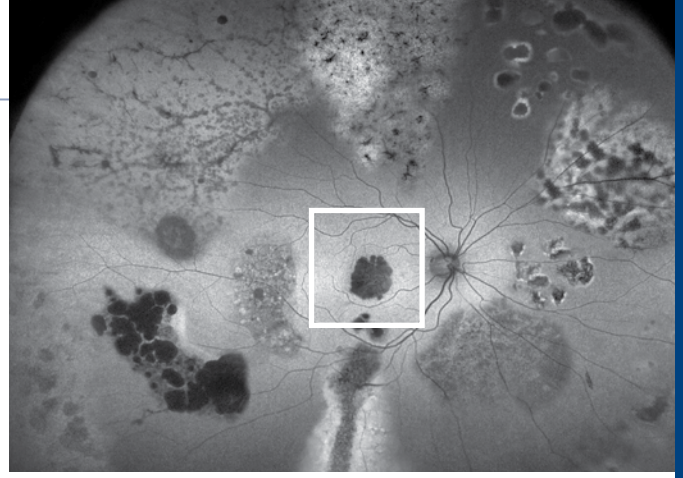
can occur due to systemic exposure to many different drugs including: hydroxychloroquine (anti-malarial and rheumatoid arthritis drug), didanosine (HIV drug) and thioridazine (schizophrenia drugs). Typically, this is apparent due to a hyperautofluorescent ring that occurs around the macula on autofluorescent images. However, in Asian patients toxicity may appear diffuse.



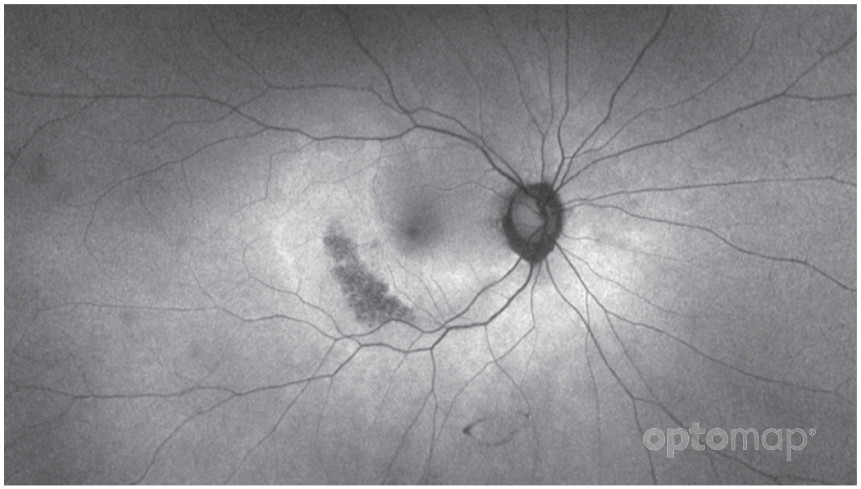


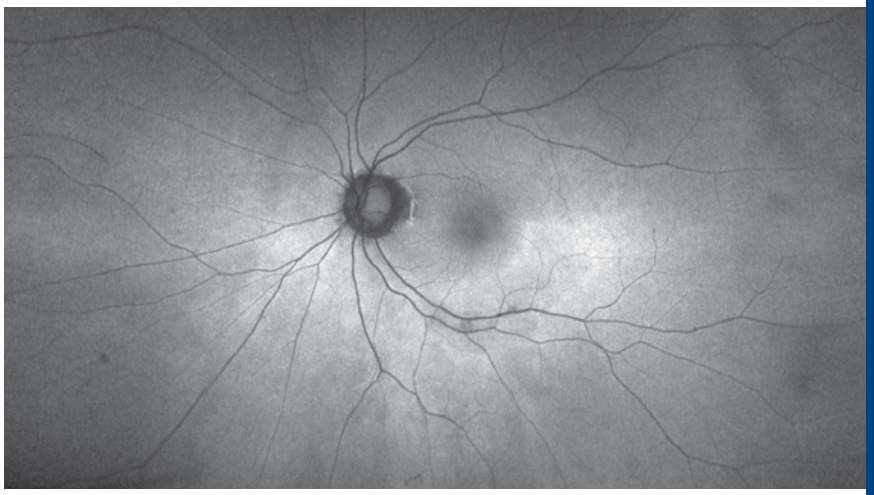






optomap *af* showing areas of central loss and a hyperautofluorescent ring around macula known as Bull's Eye Maculopathy. These changes are not visualized in the color images.

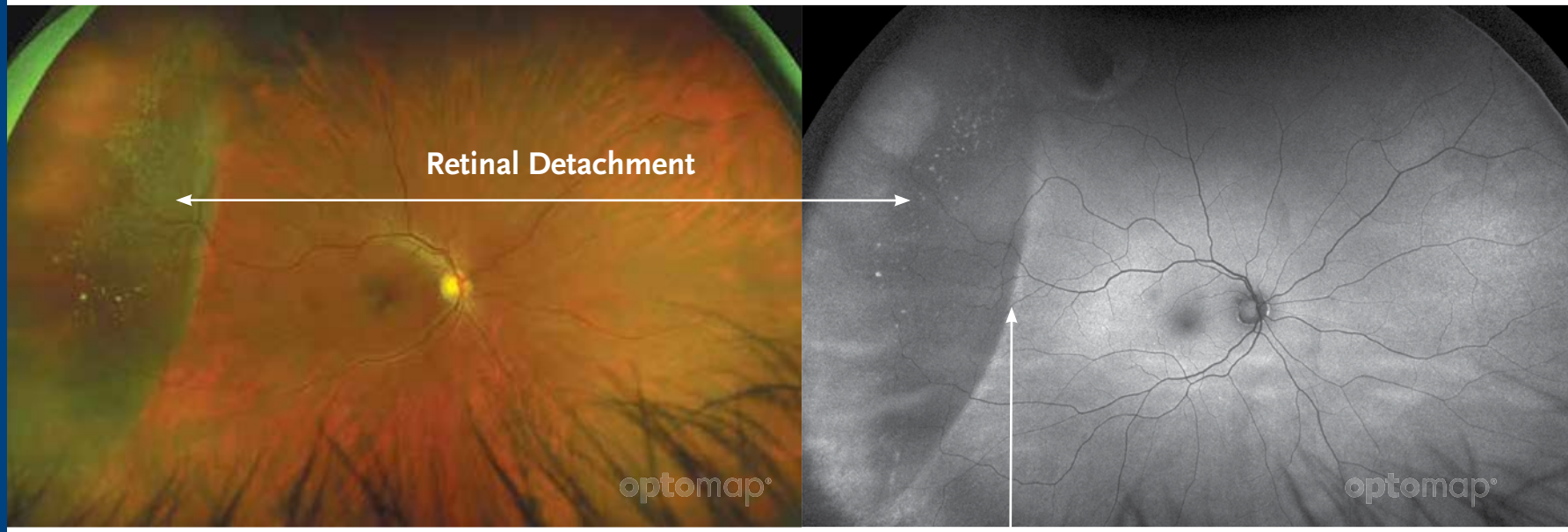




optomap *af* showing characteristic paracentral hypoautofluorescent lesions seen in Asian patients with hydroxychloroquine toxicity.

Retinal Detachment (RD)

is the separation of the retina from the underlying pigment epithelium. It disrupts the visual cell structure and thus markedly disturbs vision. It is almost always caused by a retinal tear and often requires immediate surgical repair.



Area of hyperautofluorescence on the leading edge of the retinal detachment indicating an area of shallow neurosensory detachment which indicates a better outcome after reattachment.[1]

1. MT Witmer et al. 2012. Ultra-wide-field autofluorescence imaging in non-traumatic rhegmatogenous retinal detachment. Autofluorescence imaging of regmatogenous retinal detachment. Eye.

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Contact clinical@optos.com for any additional educational questions.

Optos has more than 20 years of ultra-widefield imaging experience with an extensive library of clinical studies. An ultra-widefield view of the retina helps eyecare professionals provide the best care for their patients.

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