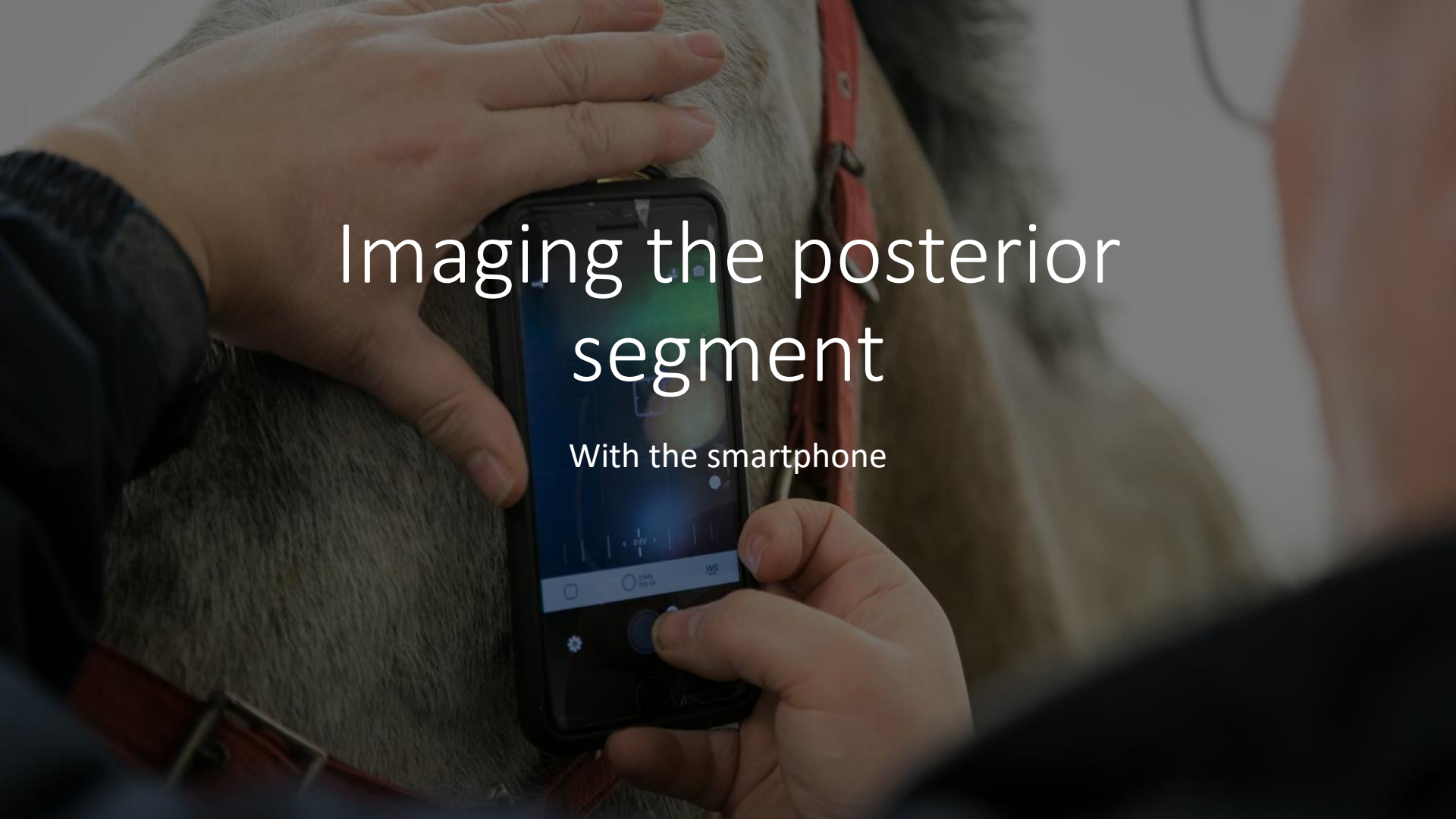


Imaging the posterior segment

With the smartphone

Imaging the posterior segment

Approach – “tell a story of the image’s journey”

Understand pros and cons of direct vs indirect ophthalmoscopy

Techniques To master:

- Continuous light- know how to use and how to alter intensity
- Getting close
- Use the LED location on the phone to help you

How to image the:

- Optic nerve head
- Tapetal fundus
- NTF

The visual axis

Visual axis

Document using distant direct.

Remember to document all 5 angles:

Nasal

Temporal

Superior

Inferior

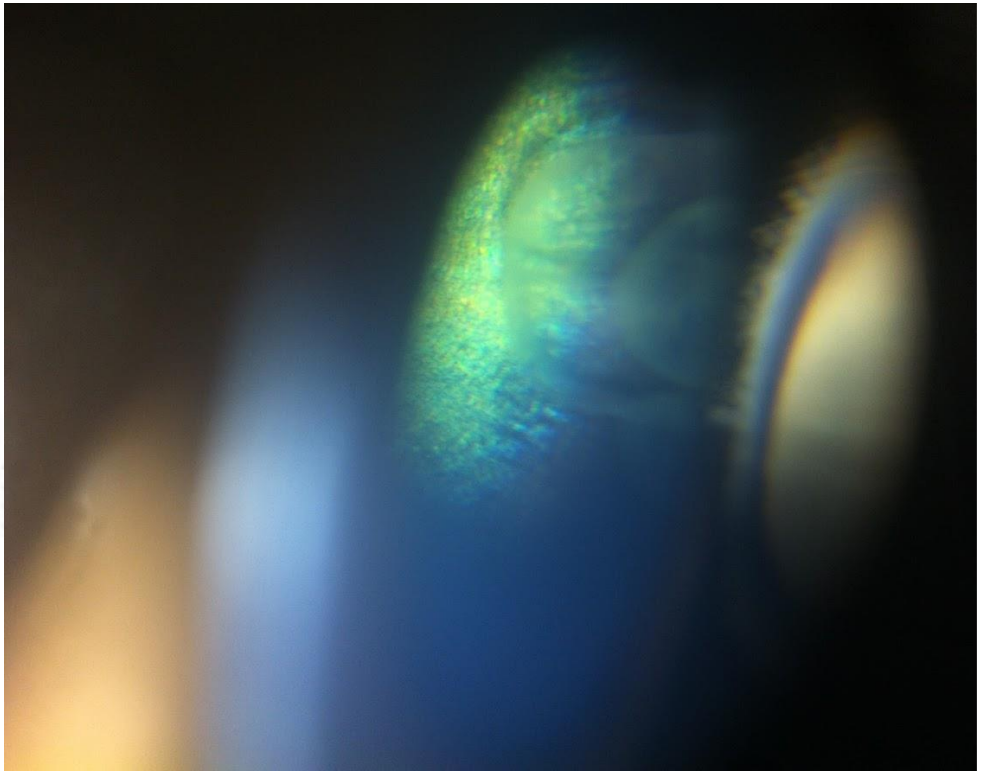
Axial

Imaging the vitreous

Vitreous

Start at vitreal base, 4 angles

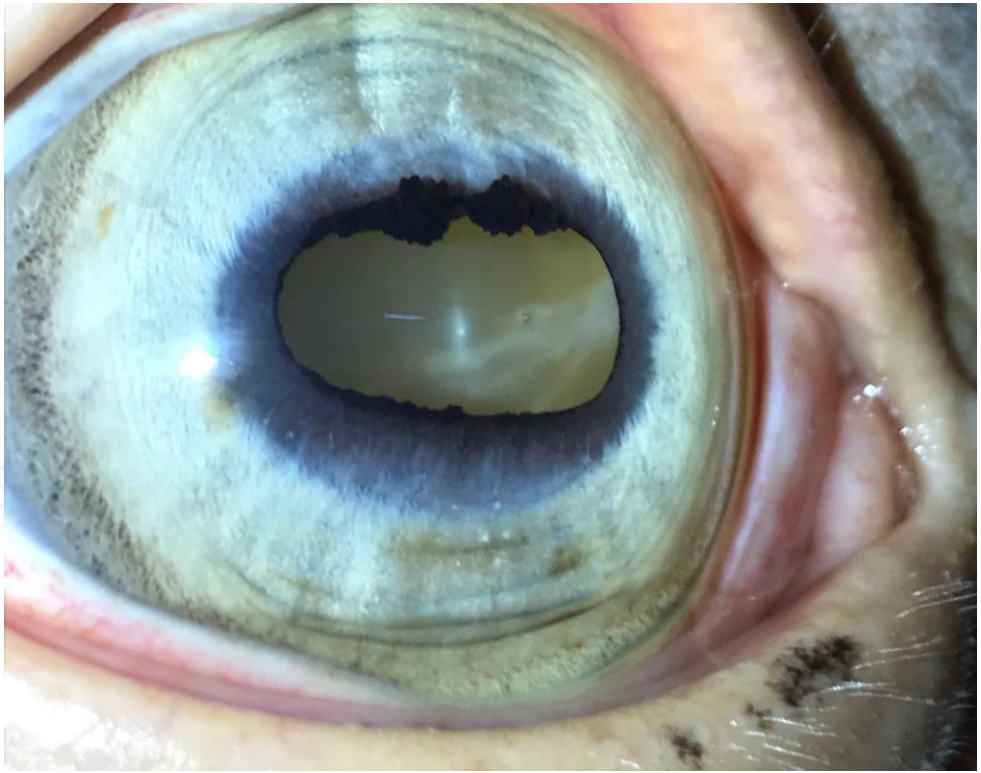
Video often helpful to document opacities



Vitreous

Start at vitreal base, 4 angles

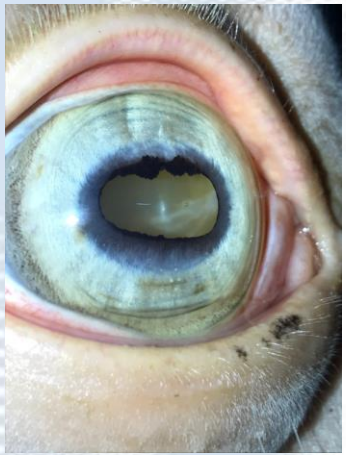
Video often helpful to document opacities

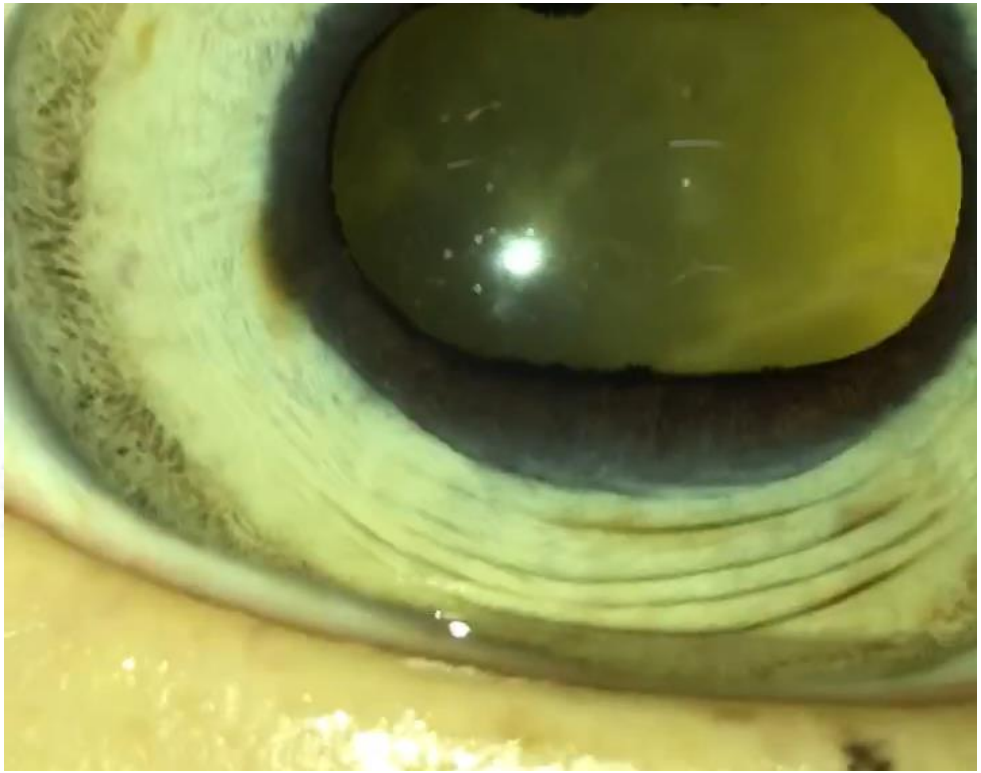


Vitreous

Start at vitreal base, 4 angles

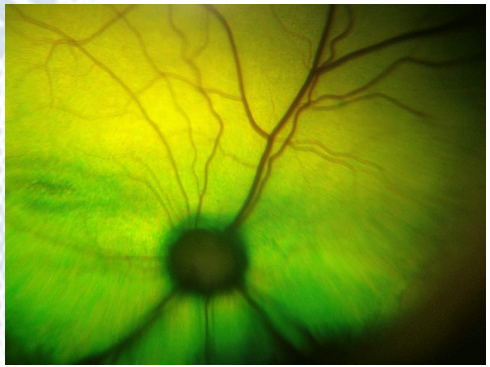
Video often helpful to document opacities

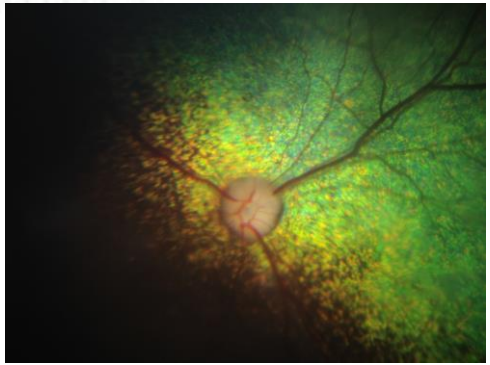


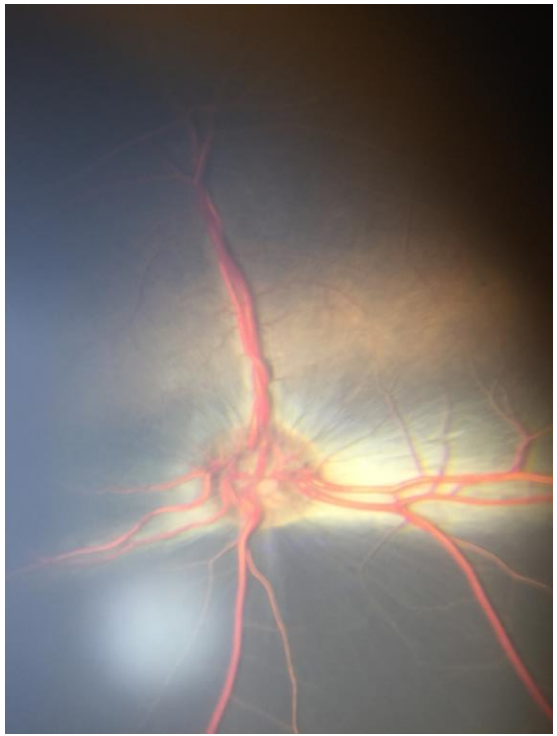


The smart phone for: *imaging the retina*

www.TheEyePhone.com







November 12, 1704; Jean Méry presents to the French Royal Academy of Sciences

Jean Méry had reported to the Academy the observation that, by ***submerging the head of a living cat in water****, one provoked dilatation of the pupils, which could not be reduced by light.* ***In this way, the elements of the fundus oculi are rendered visible.*** *That occurs, according to Méry, by flattening the irregularities of the surface of the cornea by contact with water. Méry's memoir is without question the* ***first publication****, not only of the* ***visualization of the elements of the fundus oculi,*** *but also of the neutralization of corneal dioptric power of a living eye in a liquid, which is an essential part of optical contact systems*

The solution?

CANADA

MEDICAL JOURNAL

AND

Monthly Record

OF

MEDICAL AND SURGICAL SCIENCE.

EDITED BY

GEORGE E. FENWICK, M.D.,

PHYSICIAN TO THE MONTREAL GENERAL HOSPITAL; PHYSICIAN TO THE MONTREAL DISPENSARY AND INFIRMARY FOR DISEASES OF WOMEN AND CHILDREN; DEMONSTRATOR OF ANATOMY MCGILL UNIVERSITY;

AND

FRANCIS WAYLAND CAMPBELL, M.D.,

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VOL. I.

MONTREAL:

DAWSON BROTHERS No. 23 GREAT ST. JAMES STREET;

BAILLIERE BROTHERS, LONDON, PARIS, AND NEW YORK.

1865.

JOHN LOVELL, PRINTER.

A new Ophthalmoscope for photographing the posterior internal surface of the living eye. By A. M. ROSEBRUGH, M.D., Toronto.

CONSTRUCTION:—THE TUBES.

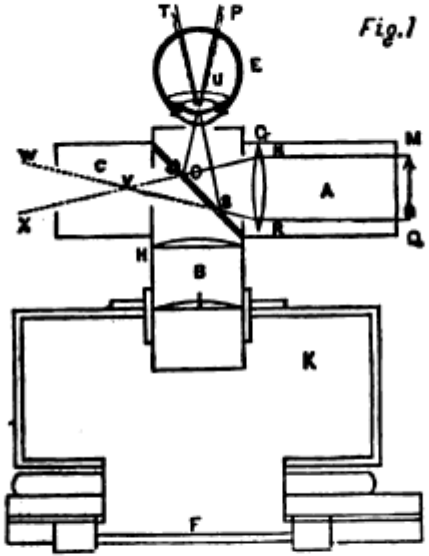

FIG. 1.

This instrument consists of a small photographic camera, to which are adapted two brass tubes (A and B) which meet each other at right angles (fig. 1), 1½ inch in diameter, being respectively 4 and 2½ inches in length. The longer tube B moves freely in the aperture of the camera, and the shorter tube A is turned towards the source of light.

A tube of the same width C, 1½ inch in length, is joined to the side

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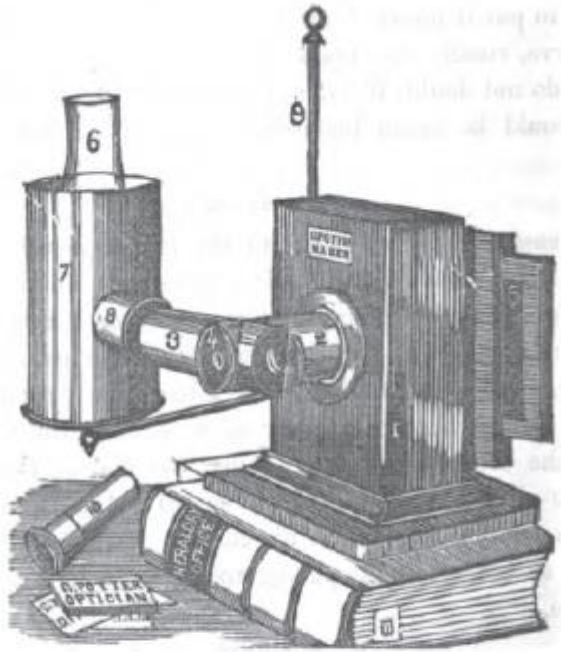
AS AN OPHTHALMOSCOPE.



The position of the instrument when the light is supplied by a lamp:—1, the camera; 2, camera tube; 3, illuminating tube; 4, diaphragm with central aperture; 5, slide with ground glass, 6, glass chimney of lamp; 7, brass tube four inches in diameter, which acts as a shade, and from which projects 8, a brass collar opposite the flame of the lamp, and to which is adapted 3, the illuminating tube of the instrument; 9, upright of the lamp stand; 10, eye-piece containing a camera lens of three inch focus to be adapted to the free extremity of the camera tube: when the eye-piece is used the camera is dispensed with.

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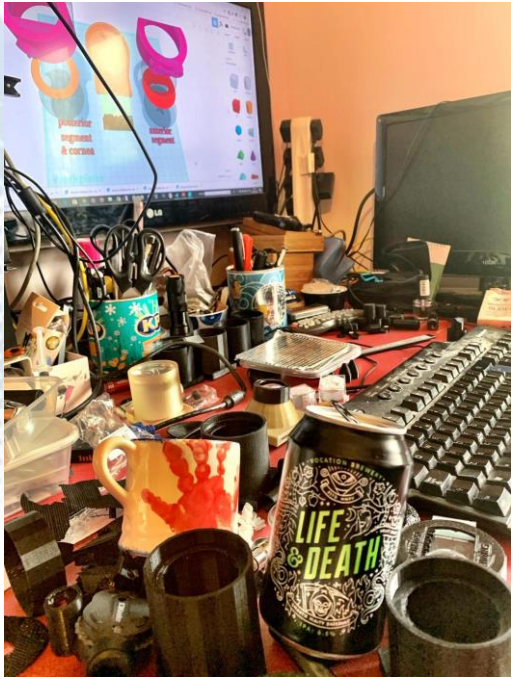
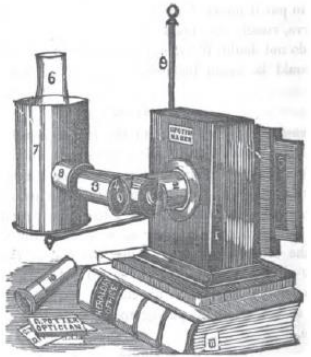


AS AN OPHTHALMOSCOPE.



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Direct vs indirect ophthalmoscopy

Direct fundoscopy

Small FOV = greater detail

Doesn't like opacities in the visual axis

Need to be close to the cornea

Indirect fundoscopy

Modality of choice in small animals – less widely used in equine

Wide FOV = less detail

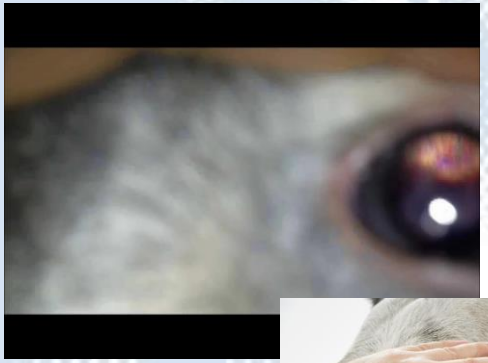
Copes well with opacities in the visual axis

A distant technique

The smart phone for: *imaging the retina*

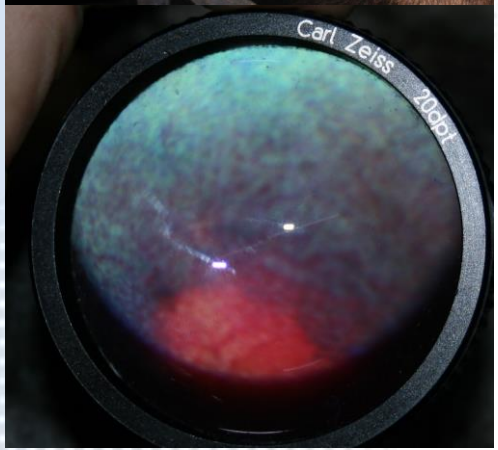
www.TheEyePhone.com

Direct fundoscopy

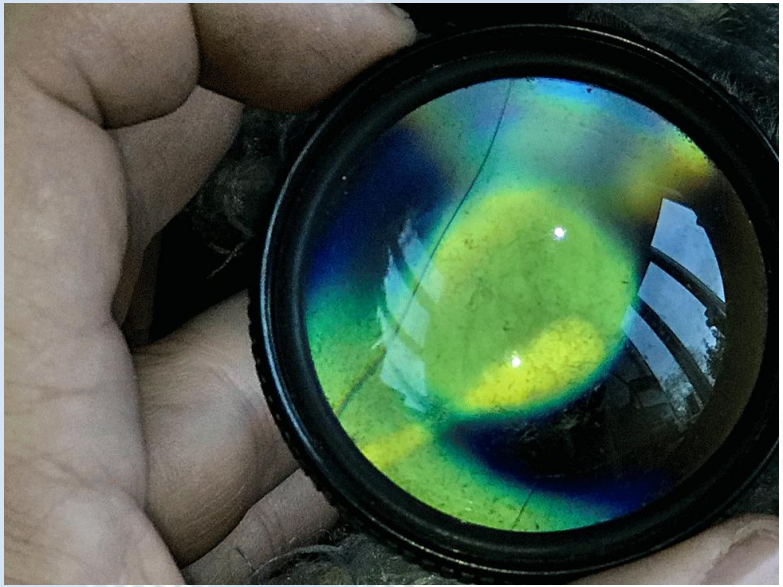


Indirect fundoscopy

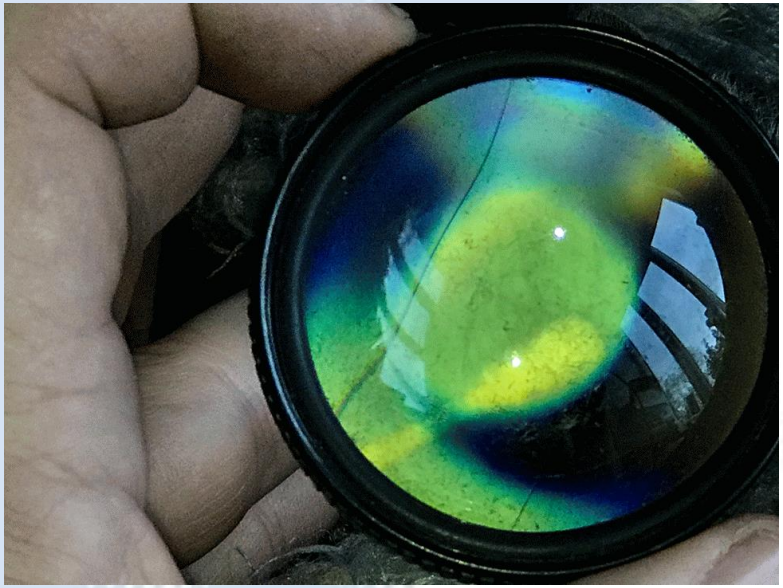
Indirect



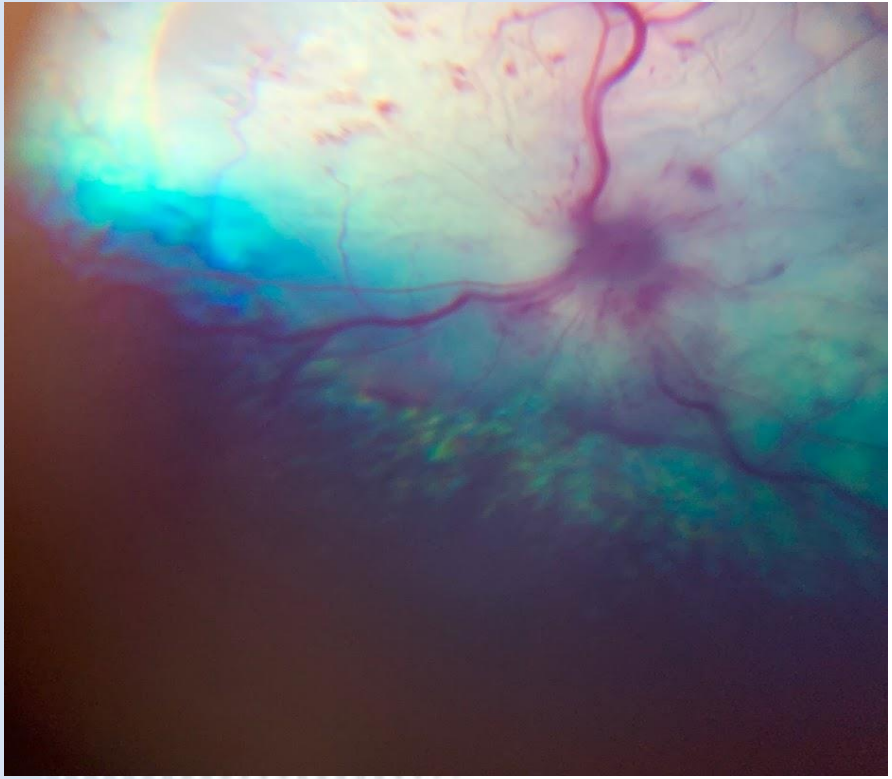
Guess the species



Guess the species



Field of view: determined by camera

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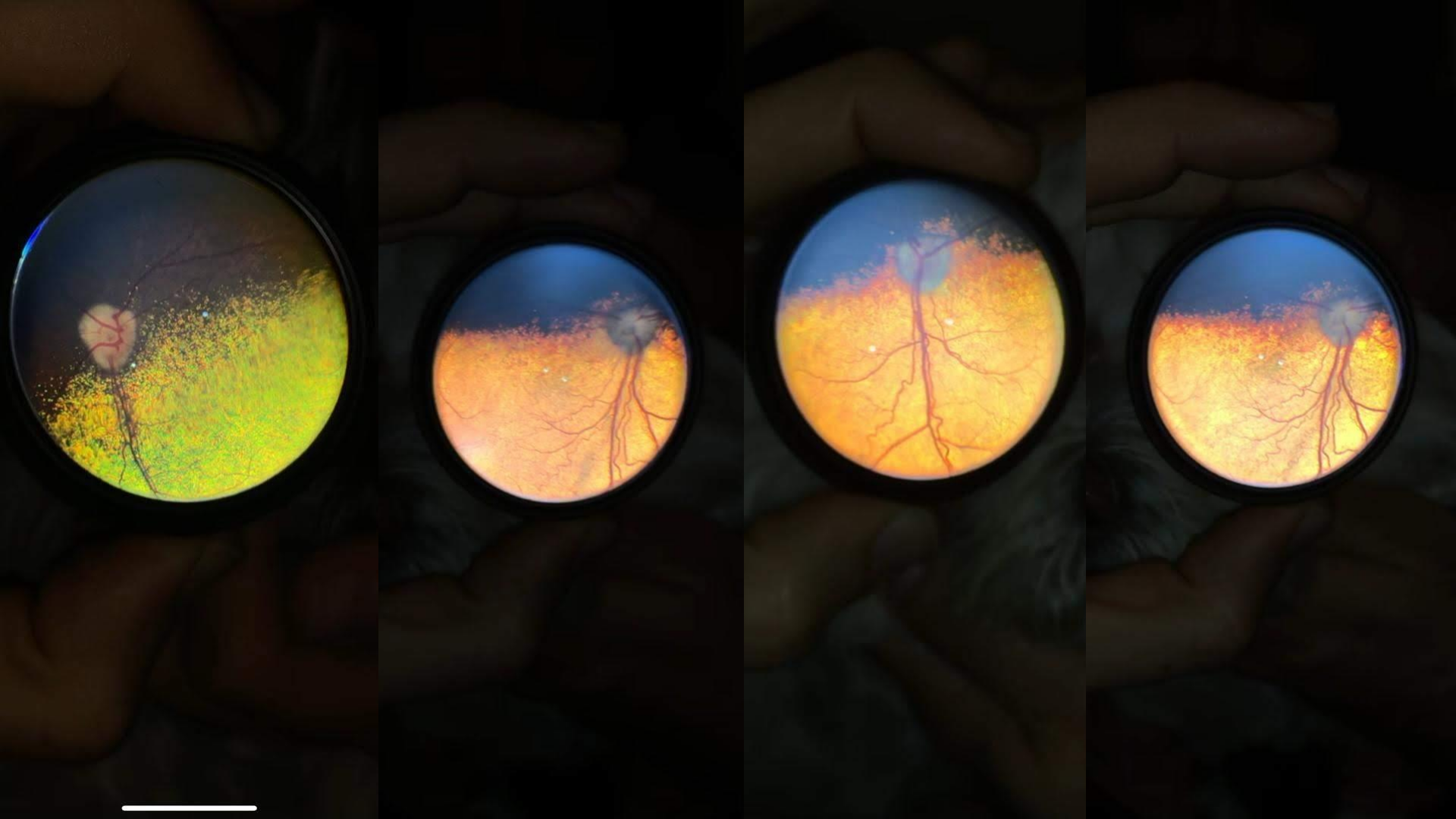



Dr Houman

Indirect ophthalmoscopy

Technique

Indirect “phoneoscopy” Technique

- This technique is much more challenging to learn than direct phoneoscopy. Similar to the monocular indirect ophthalmoscopy technique the phone light is used to produce a tapetal reflection and the diagnostic lens is then positioned to focus the indirect image in front of the lens. This projected image is recorded on the phone camera. *I rarely use this technique in large animals* but is usually the first technique I will attempt in small animals.

Indirect “phoneoscopy” Technique

pros

- The light to lens distance has little effect in this technique ***making it suitable for nearly all phone cameras***.
- Fundic image less affected by opacities in the visual axis e.g. corneal lesions and cataracts.
- Can use through a small pupil
- lens to light distance less critical than in direct fundic imaging
- can use a separate light source if needed

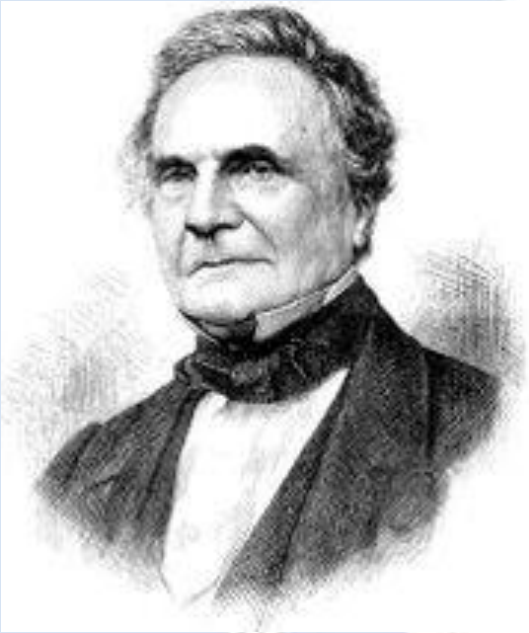
cons

- technically more difficult
- requires diagnostic lens
- requires digital zoom to obtain screen filling image with overall reduction in image resolution

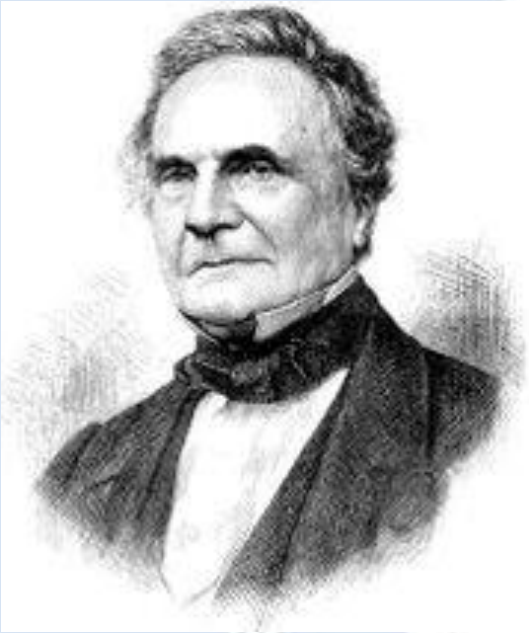
Indirect “phoneoscopy” Technique – step by step

- Mydriasis is helpful but not always essential - a dark room and reducing the LED intensity is usually sufficient to image the retina.
- Work out your camera’s minimum focal distance before you start – this will help you get the best image possible later.
- Open camera app
- Turn the LED on continuously – if you do not have a suitable app installed use your embedded video app and turn the light on.
- If necessary, reduce the LED illumination – if this cannot be done within the app then apply multiple (3-6) layers of micropore tape or similar to the LED.
- Hold diagnostic lens between thumb and forefinger, rest your little finger on the lateral orbital rim and hold the lens away from the eye.
- Image the tapetal reflection from arm’s length
- Once the tapetal reflection is imaged move the diagnostic lens in front of the eye in the same manner as you would with indirect ophthalmoscopy – a retinal image should be visible focused 50mm in front of the lens (assuming a 20Dioptre lens is used).
- Move the camera towards the image until the camera is positioned with its minimum focal distance positioned 50mm in front of the lens.
- Zoom in until the retinal image fills your screen.

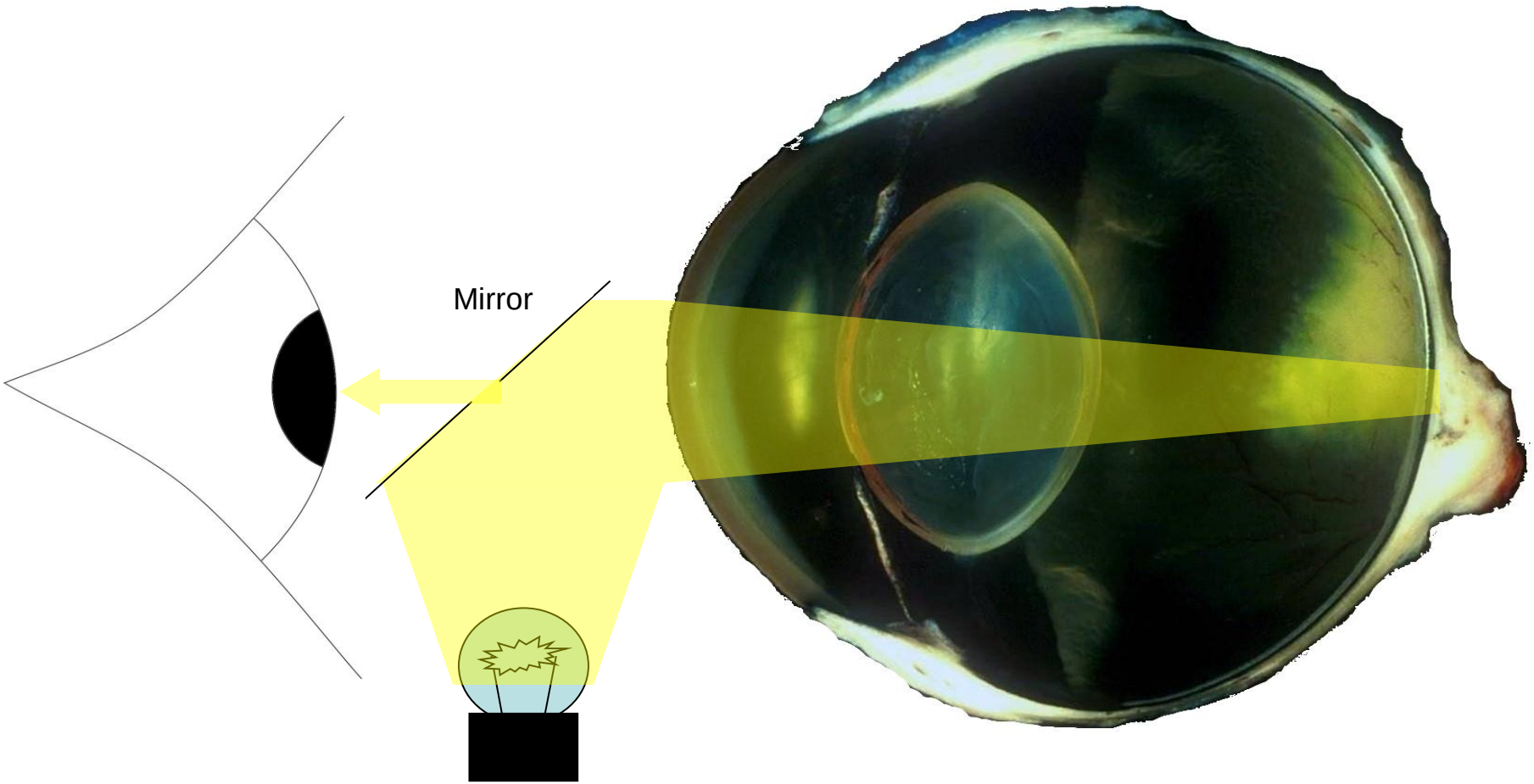
Close direct “phoneoscopy”



Close direct fundoscopy



Close direct fundoscopy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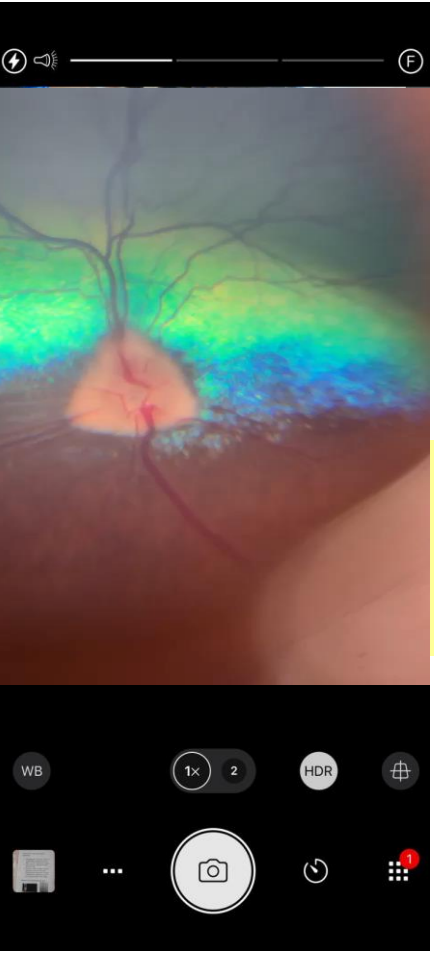
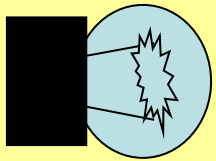
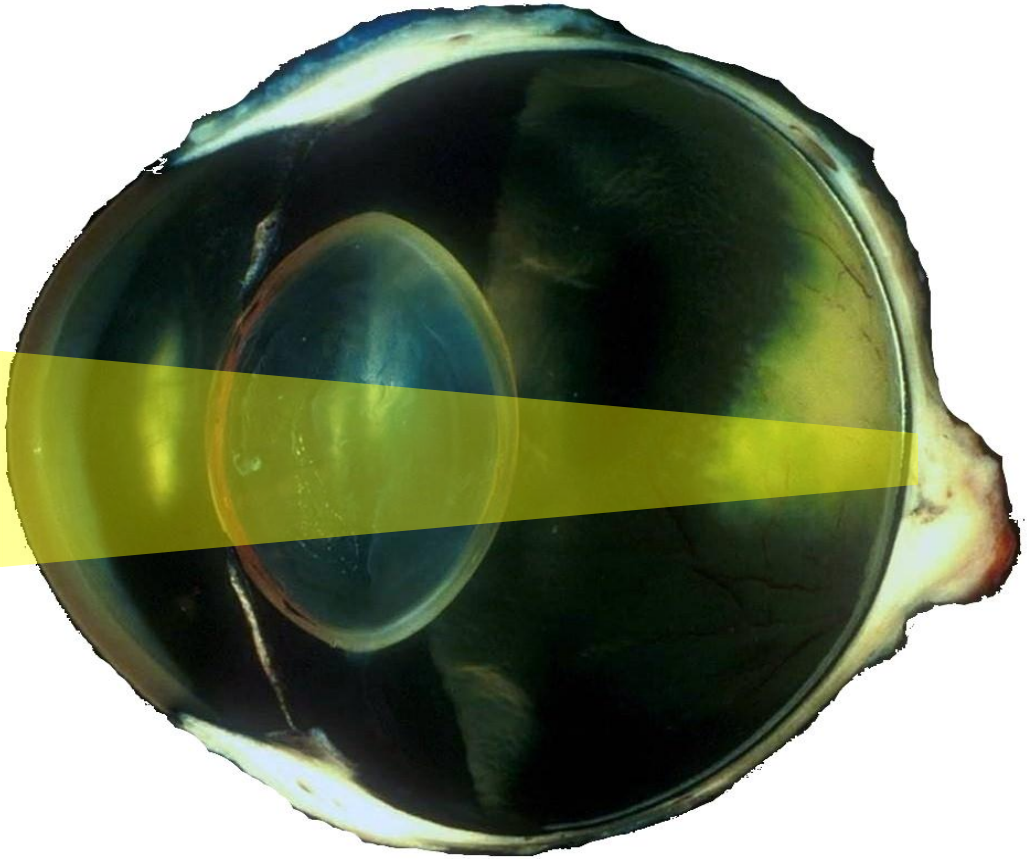
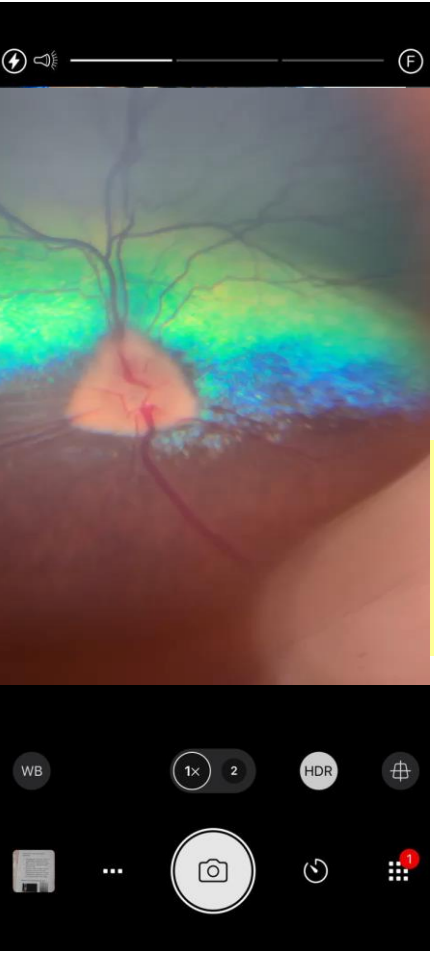

WB
1×
2
HDR






WB
1×
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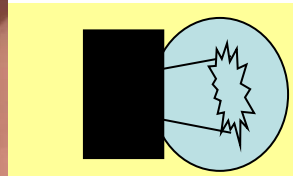
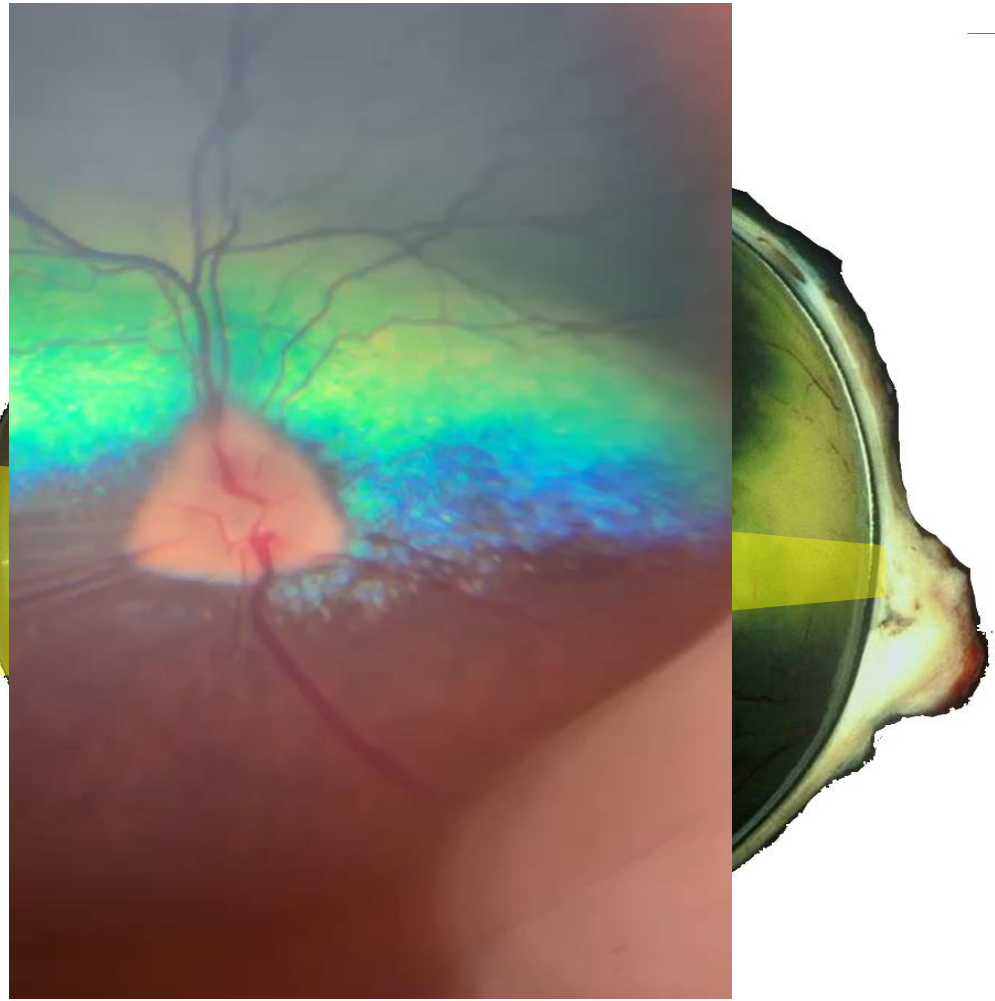
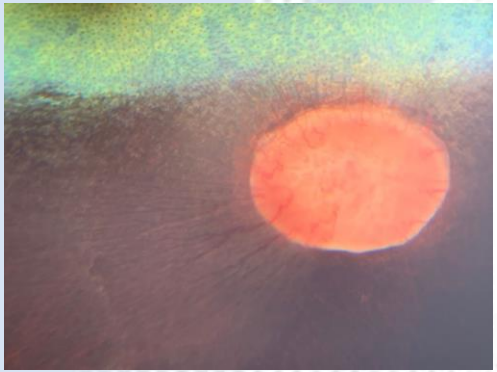
HDR





Tell a story



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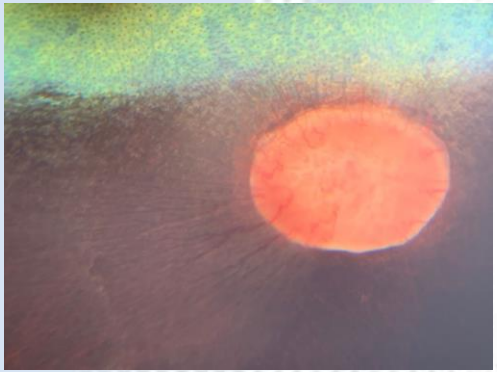
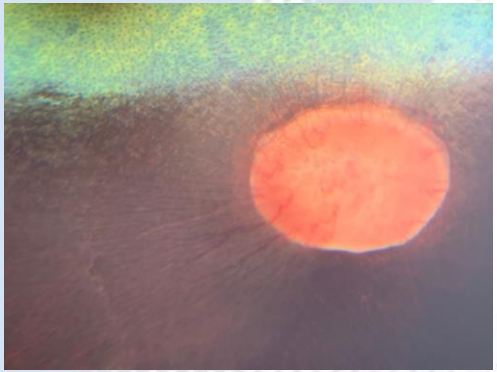
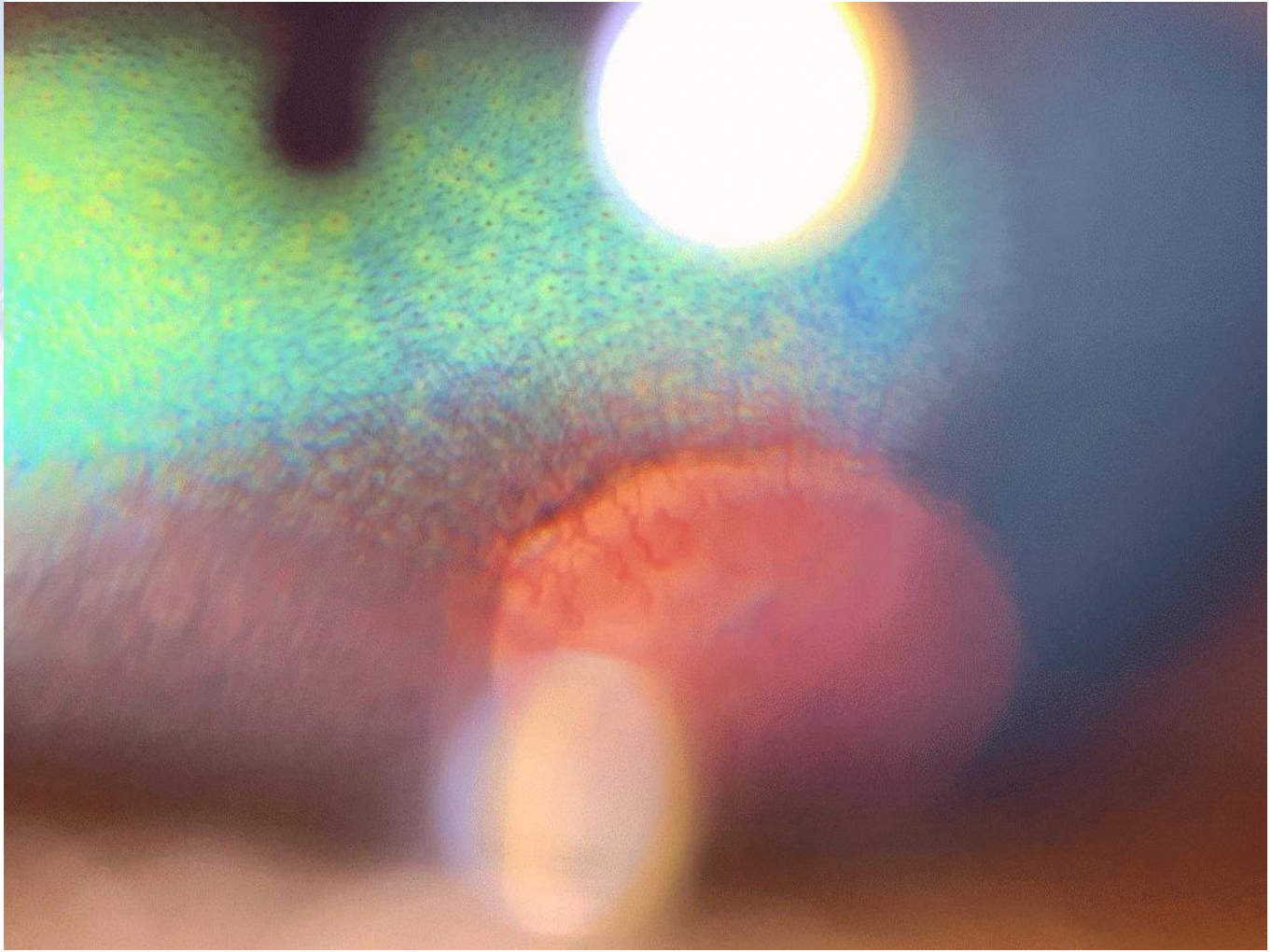
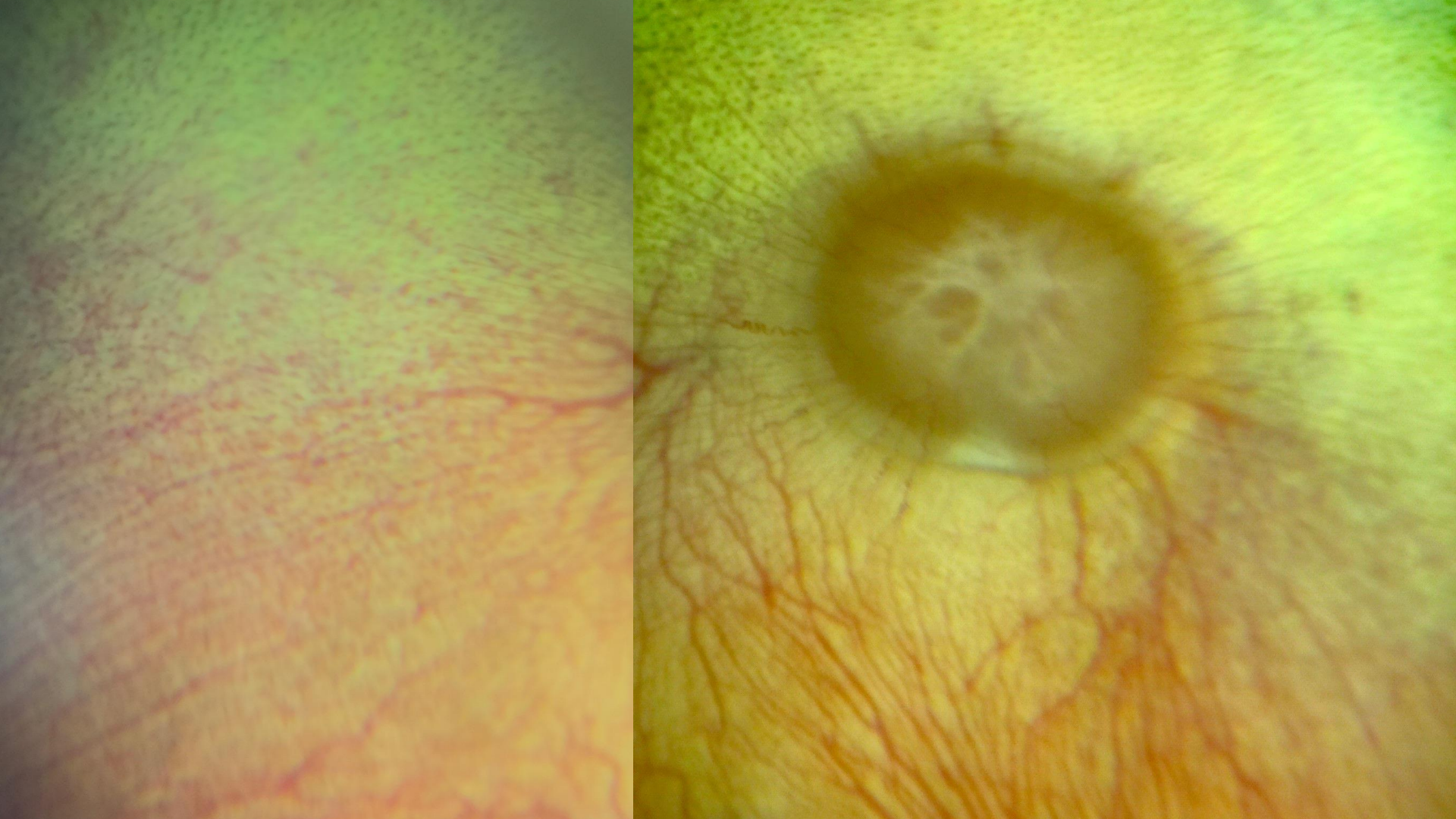


Tell a story







Close direct “phonescopy”

Technique

Close direct – step by step guide

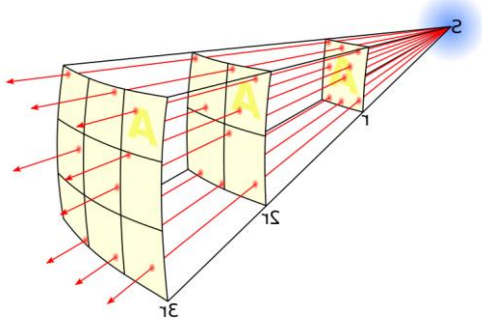
- Mydriasis is helpful but not always essential especially if using a phone with a short Light to lens distance and reduced LED illumination.
- Open camera app – see the “Which App” section at www.TheEyePhone.com if you don’t already have a suitable app installed
- Turn the LED on continuously – if you do not have a suitable app installed use your embedded video app and turn the light on.
- Reduce the LED illumination – if this cannot be done within the app then apply multiple (3-6) layers of micropore tape, medicine labels or similar over the LED.
- Image the tapetal reflection from arm’s length- the distant direct ophthalmoscopy technique can be mimicked in this fashion. Zoom in until the tapetal reflection fills the screen.
- Zoom out again prior to imaging the retina.
- Move the camera towards the eye – when the eye is closer than the camera’s minimum focal distance the retina will start to be imaged.

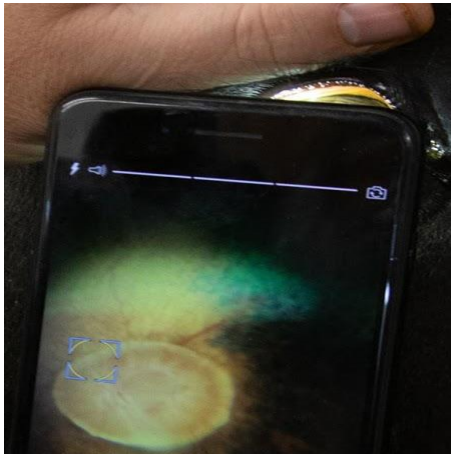
Close direct – step by step guide continued.

- Locking the focus at infinity will stop the autofocus hunting.
- Position the camera close to the cornea (2-5mm) in the same was you would position a direct ophthalmoscope when performing close direct ophthalmoscopy. Removing your camera case will make this easier.
- Tap the screen to focus on the optic nerve head.
- Focus and exposure can be split by moving the focus and the exposure reticle independently. This is very useful for hyper-reflective fundiIf your app allows separate focus and exposure (e.g. Open Camera, Procamera, Camera +) then tap the tapetal fundus to avoid overexposure due to the reflective tapetum.
- Reposition the exposure reticle on the non-tapetal fundus to image.
- Move camera to image the peripheral fundus in 4 quadrants. You may need to rotate your phone through 180 degrees to image the superior fundus.


MEDICAL ENGINEERING
ROYAL LIVERPOOL UNIVERSITY HOSPITAL

Diffuser, app &/or physics to dim the light

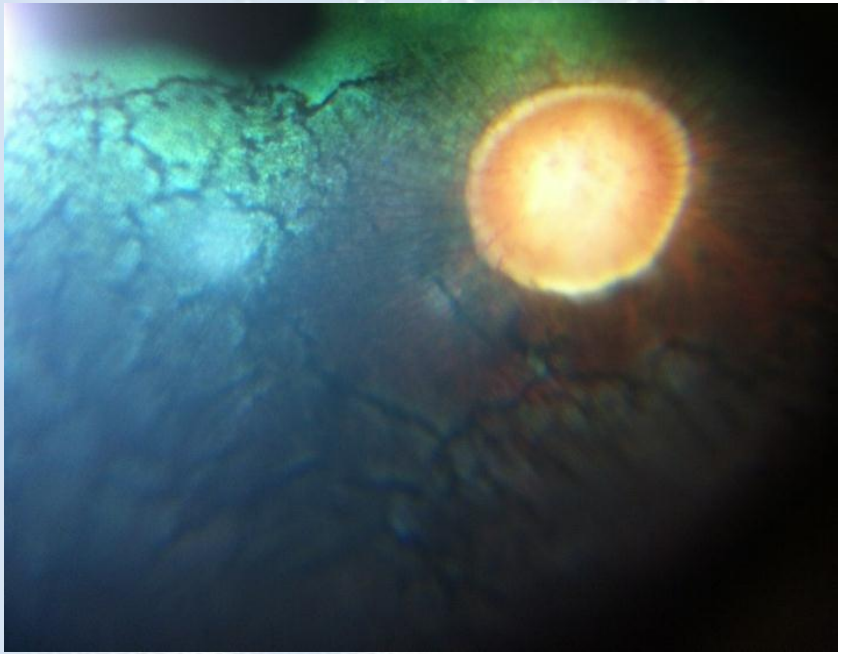




The visual axis

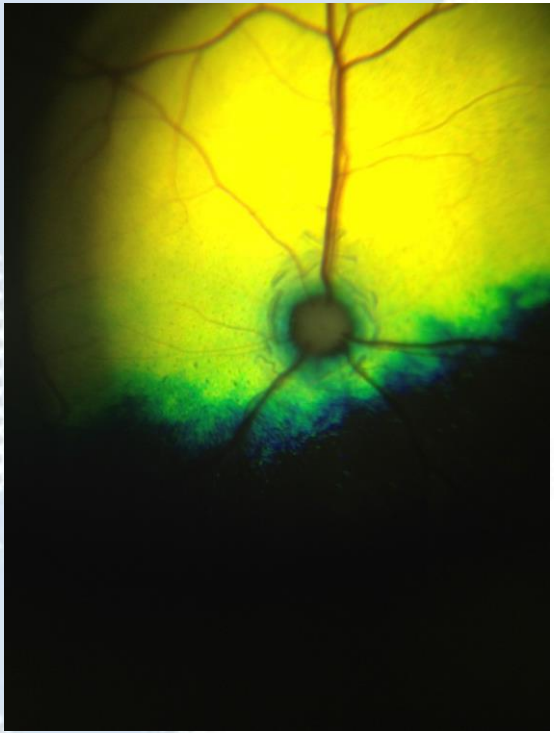
The fundus

Equine



Sideways & point down

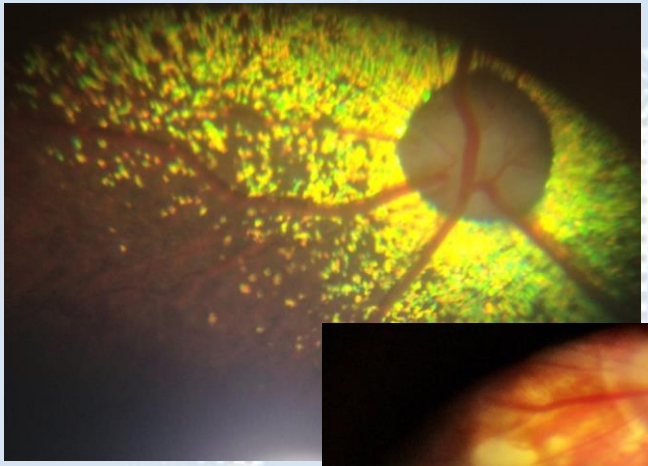
Feline



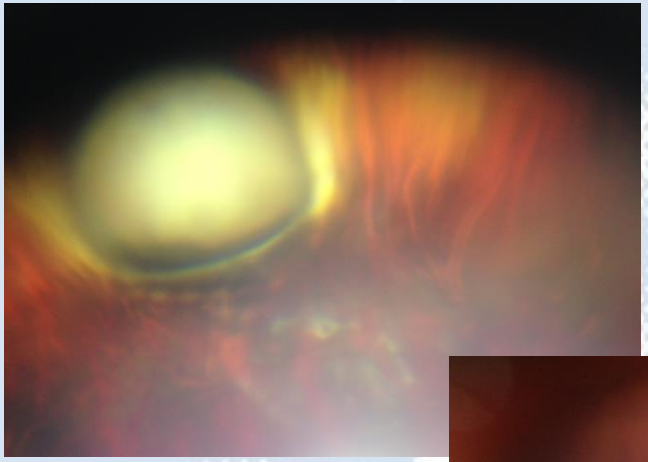
Rob Lowe: Optic neuritis

Vertical

Dogs

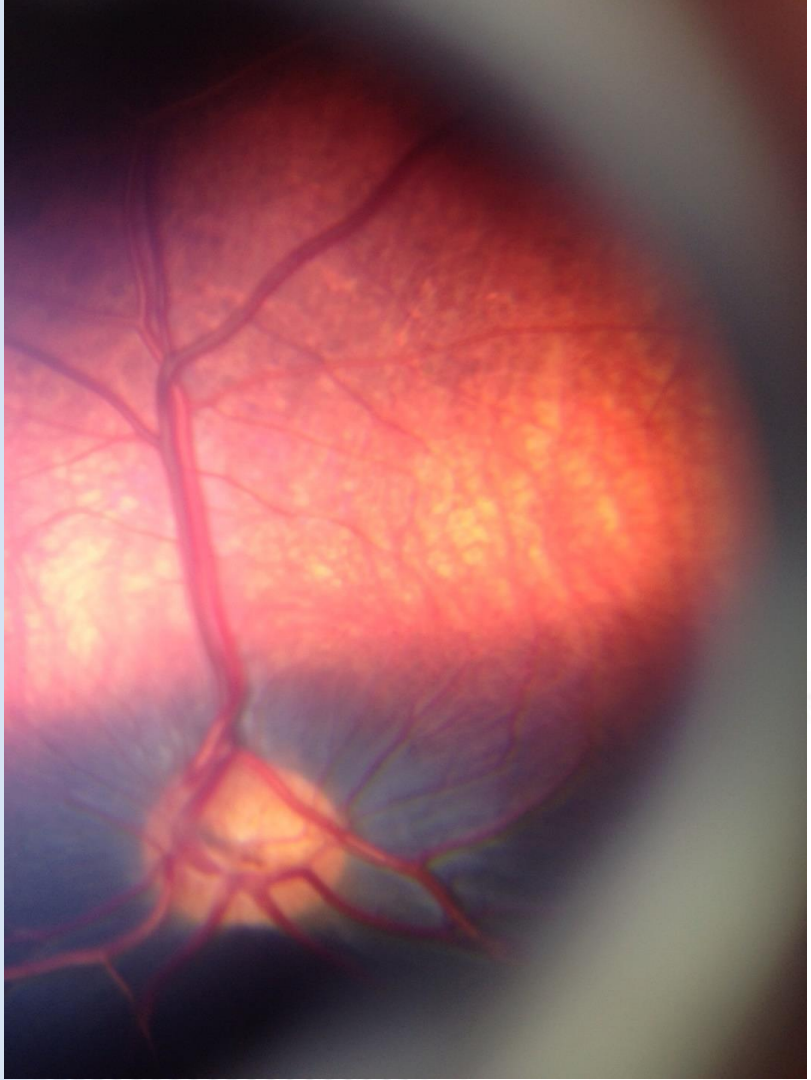


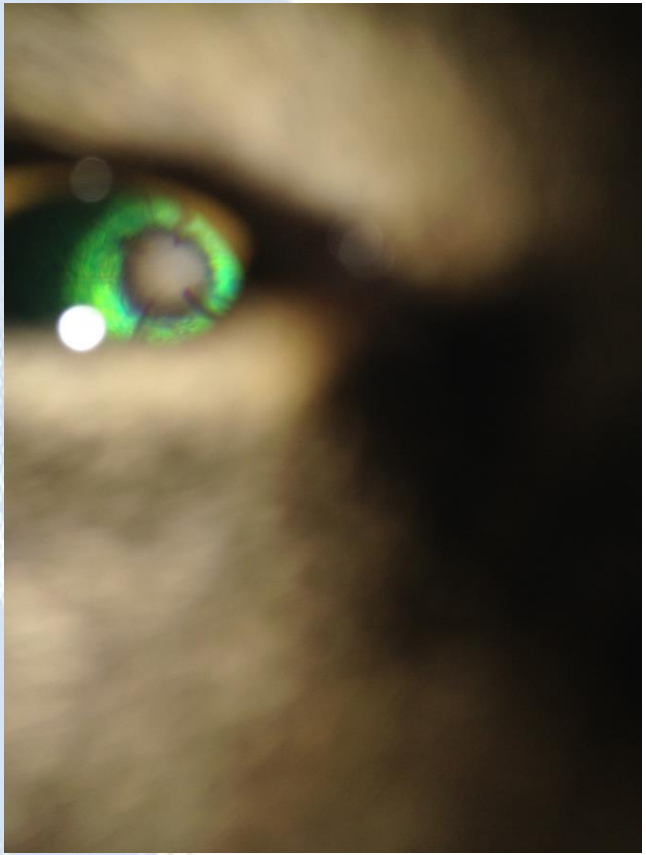
Rabbits

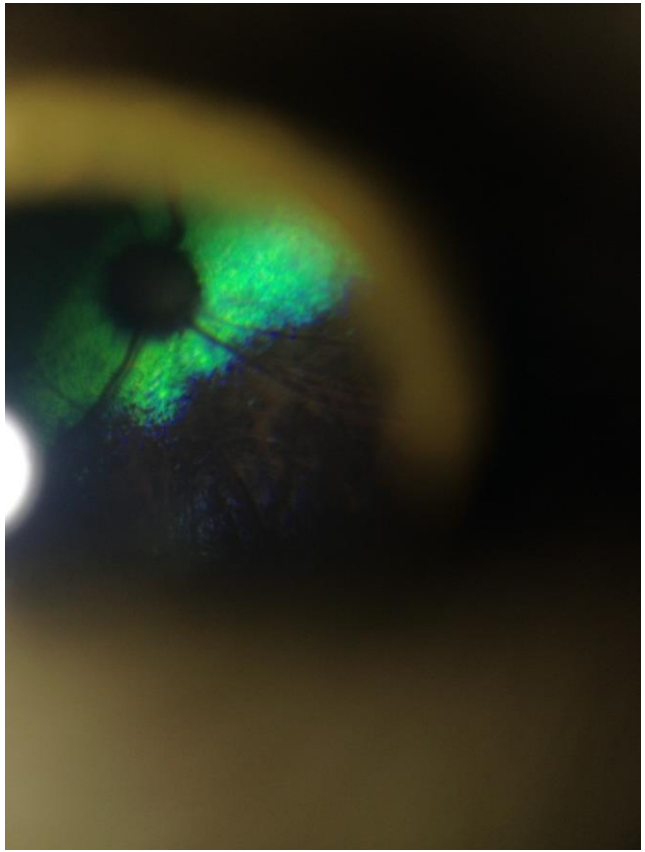


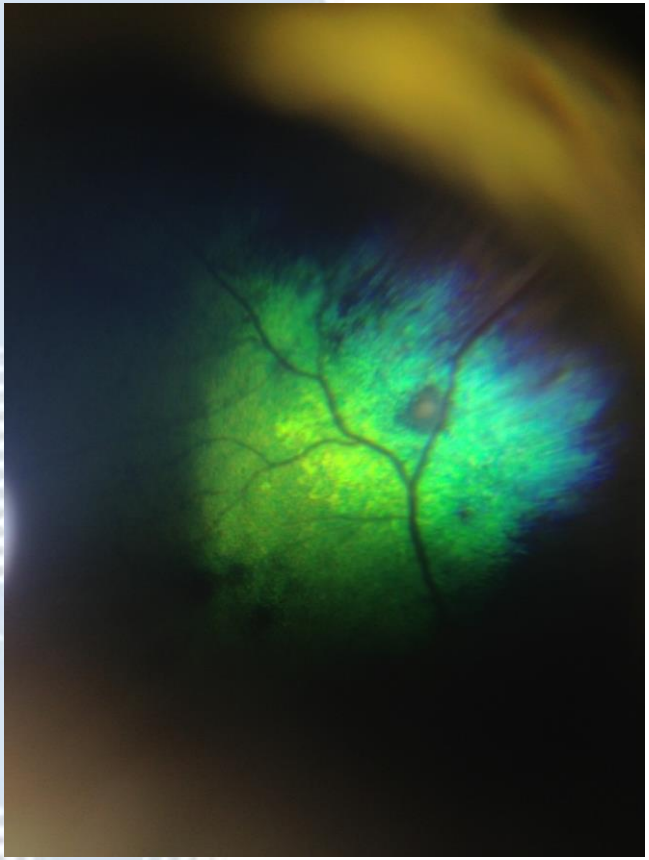
Upside down and pointing up

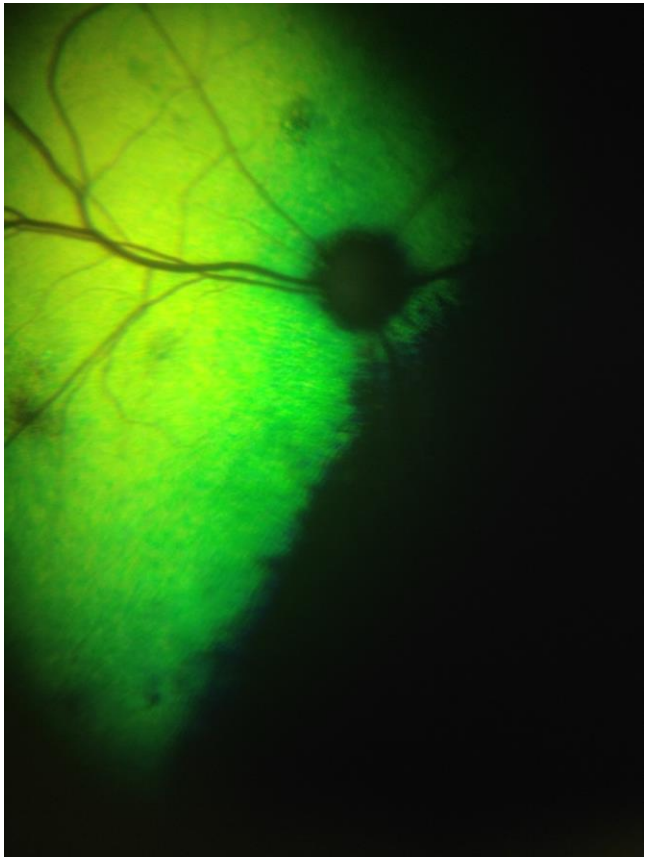

Equine
Eye Clinic

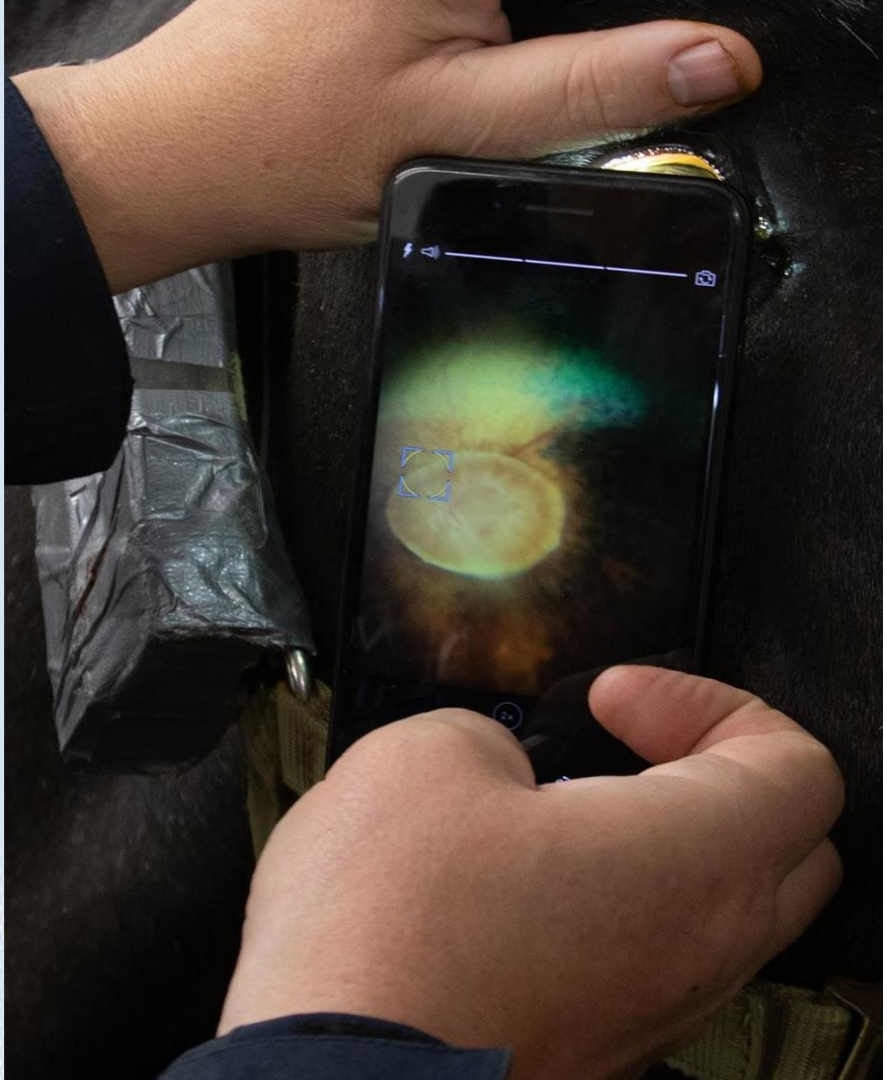


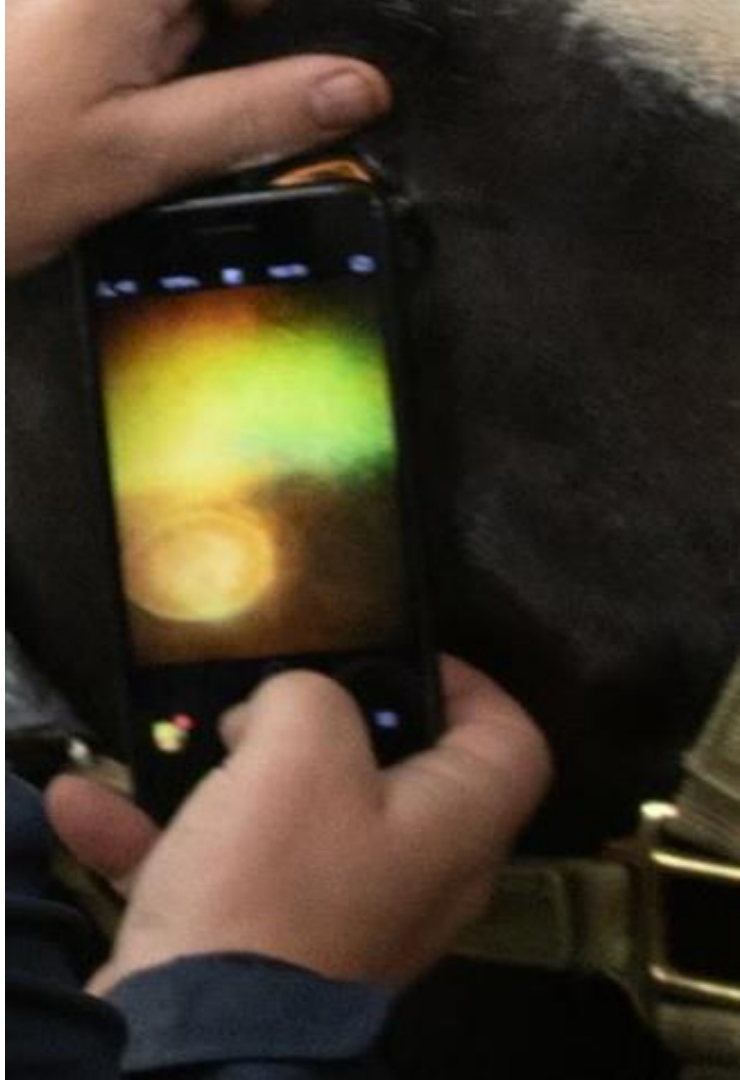




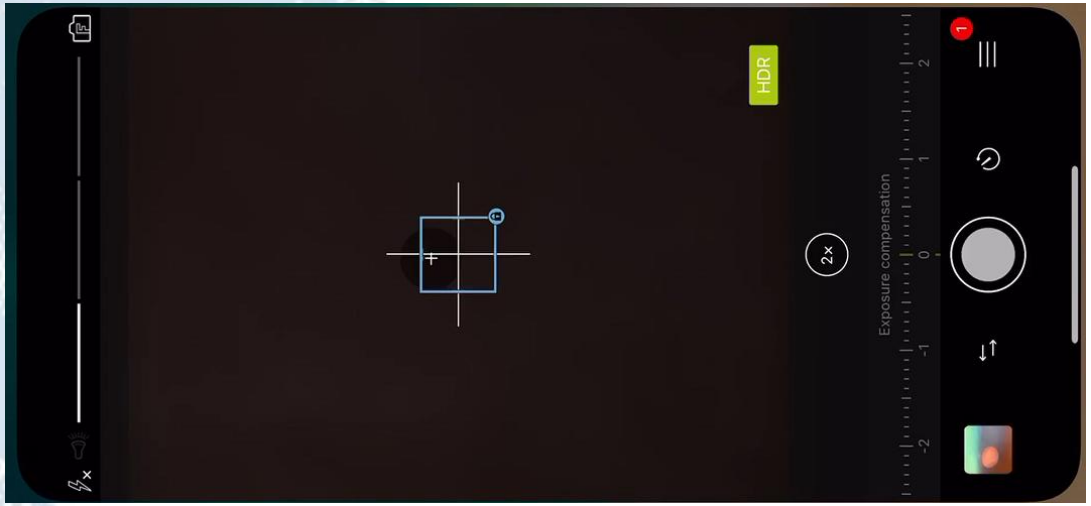






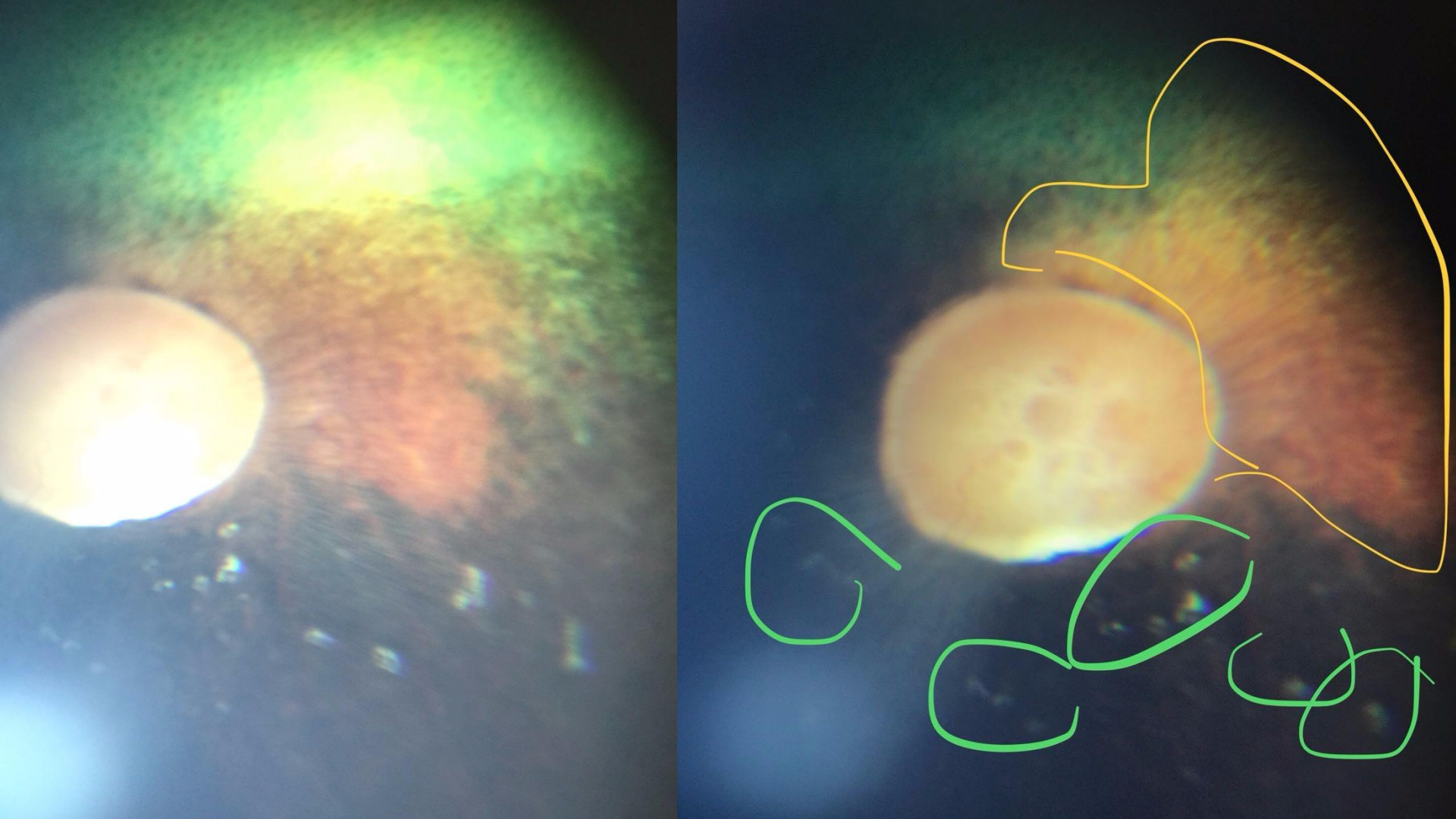


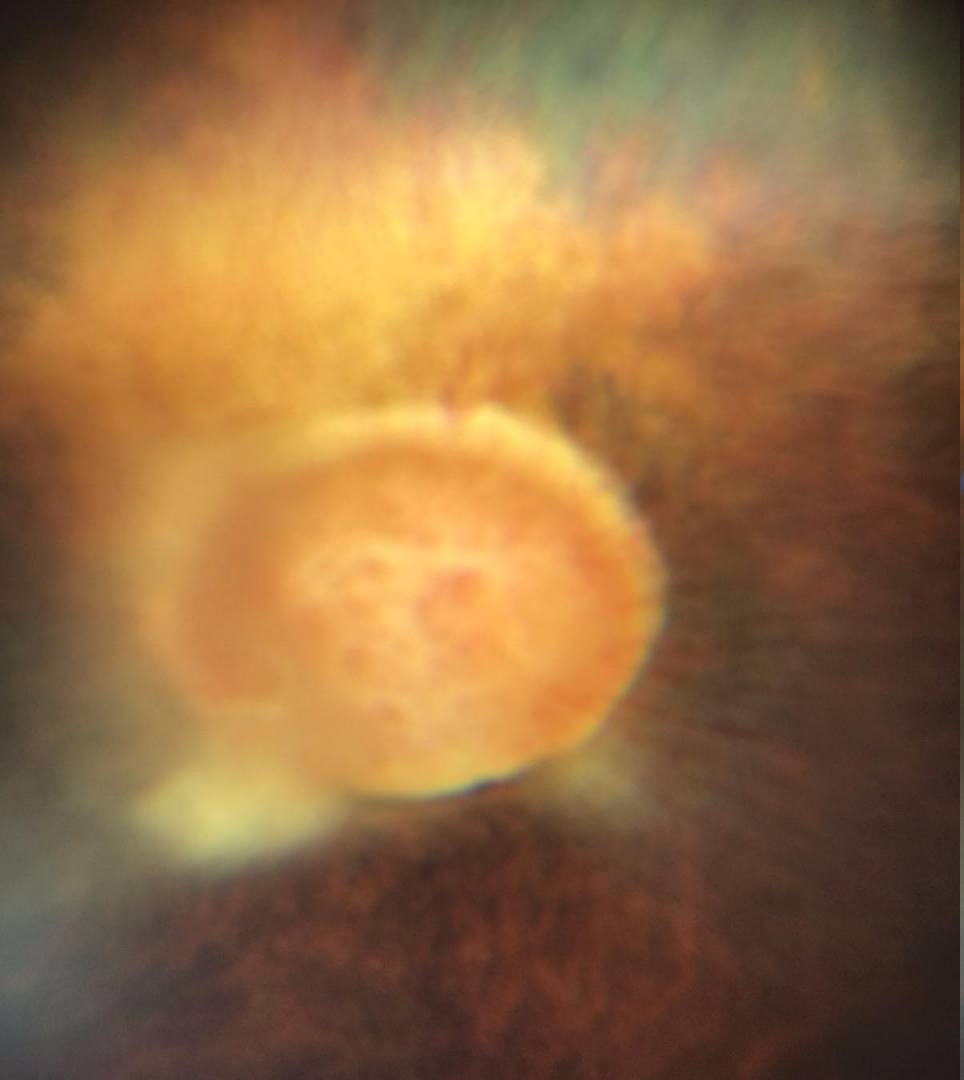

1/50 s
ISO 25
2x

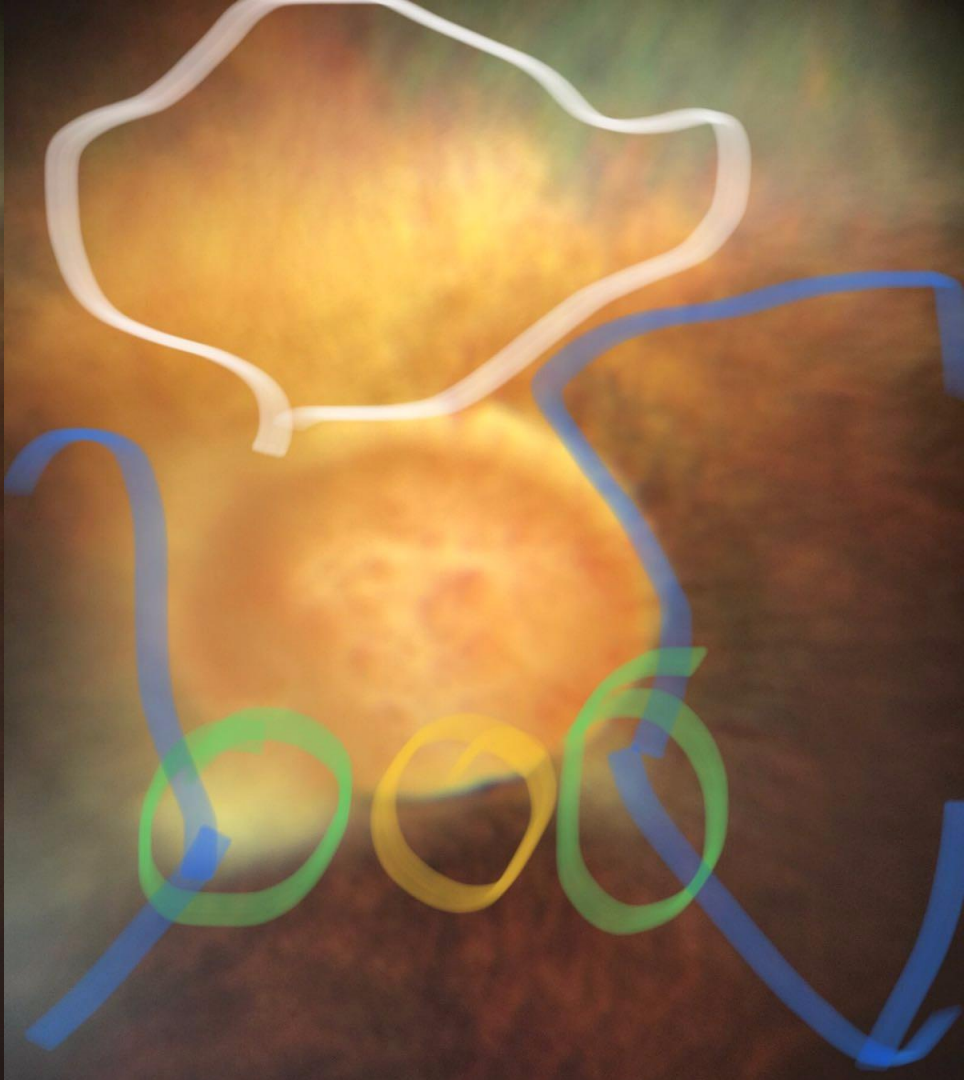


Manual focus & telephoto lens (iPhone Xsmax)

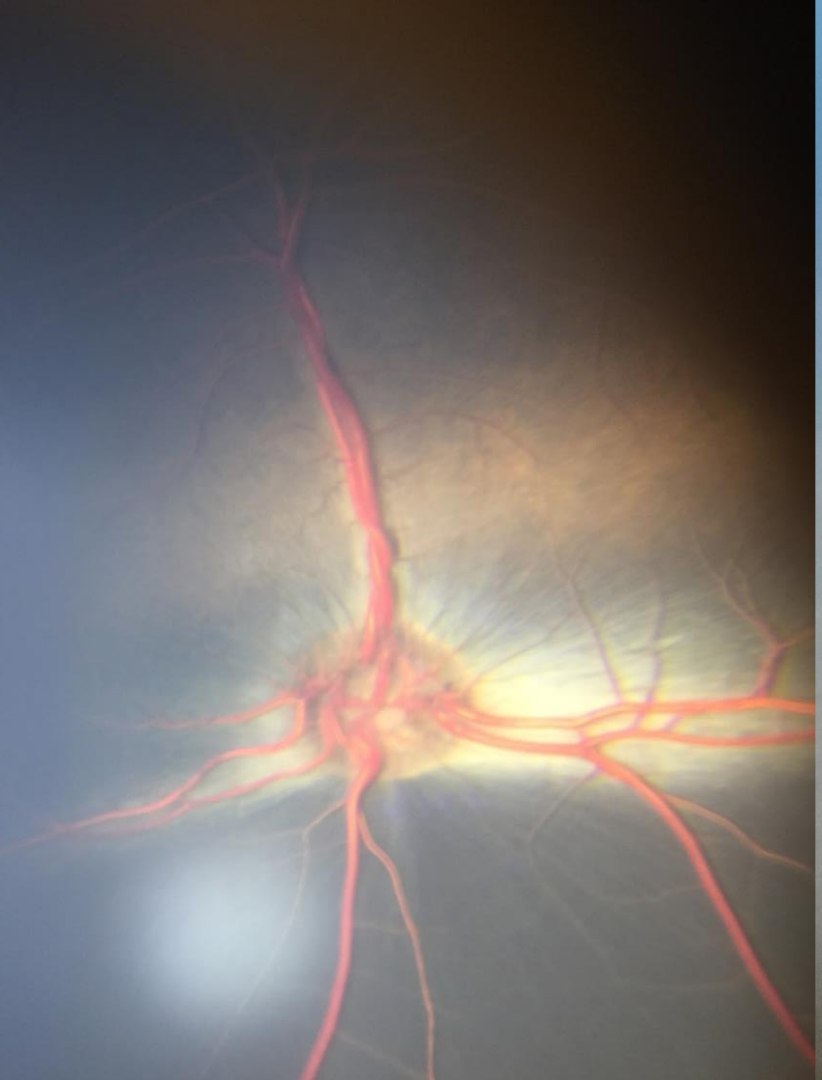
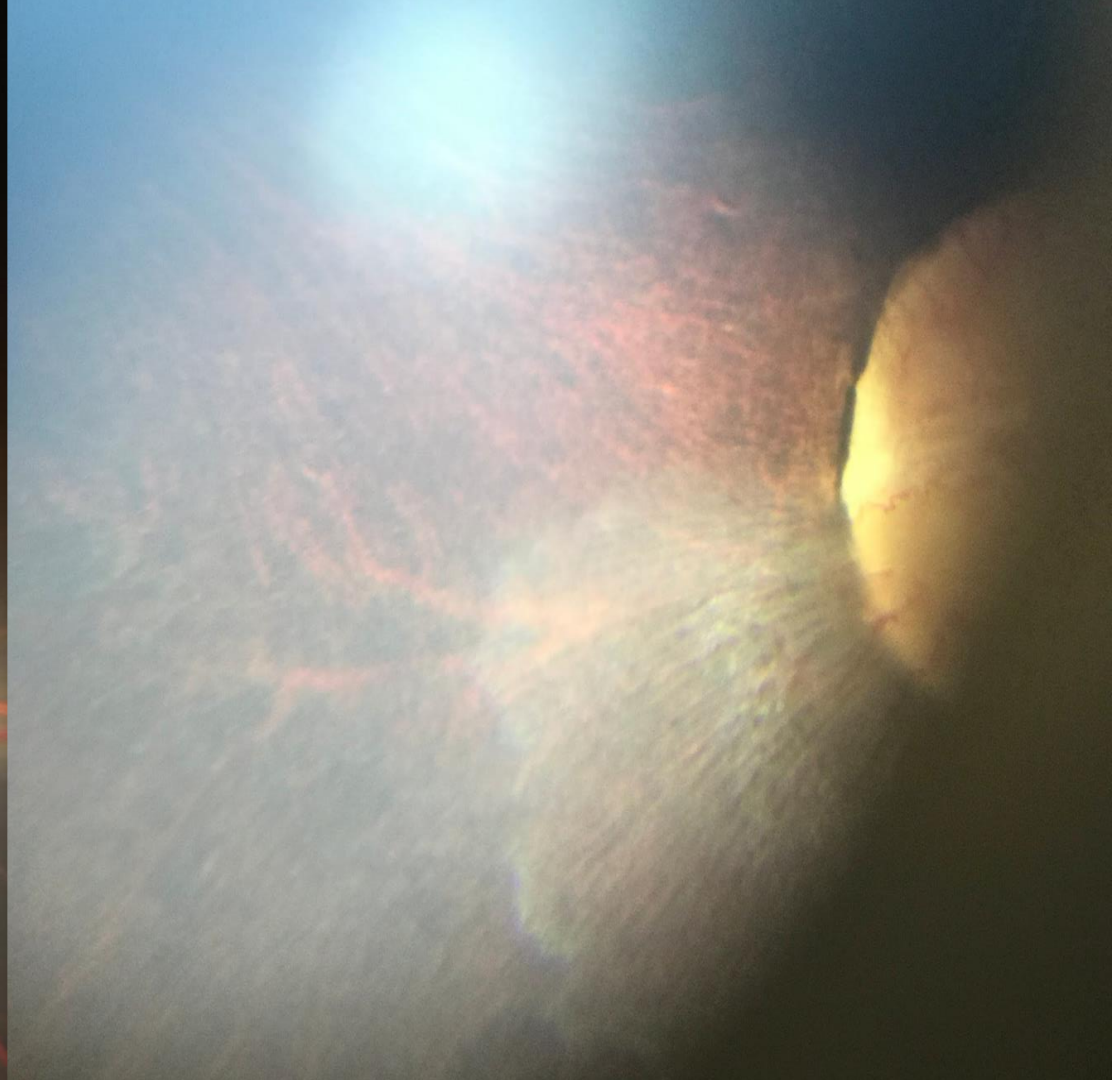
Optic nerve head

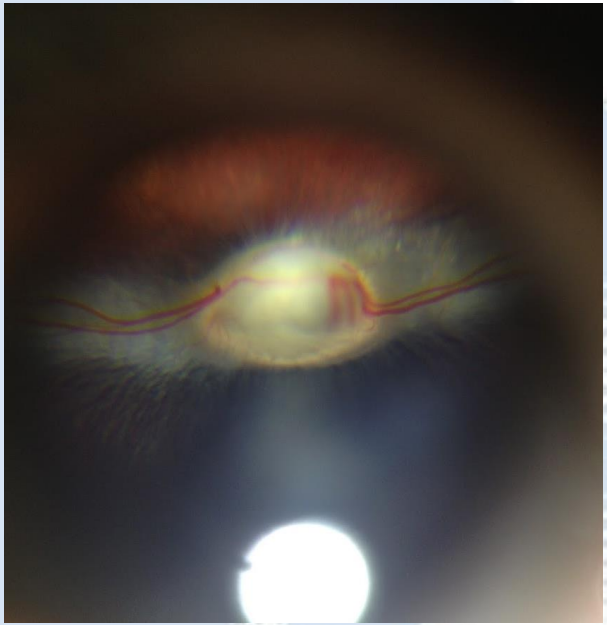
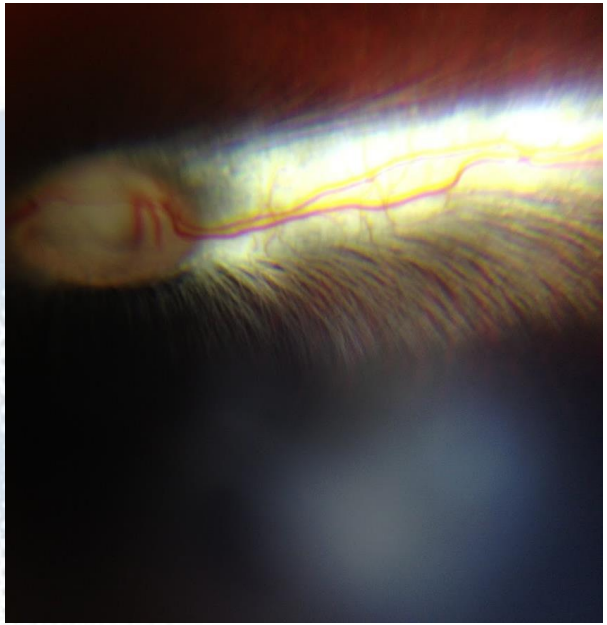
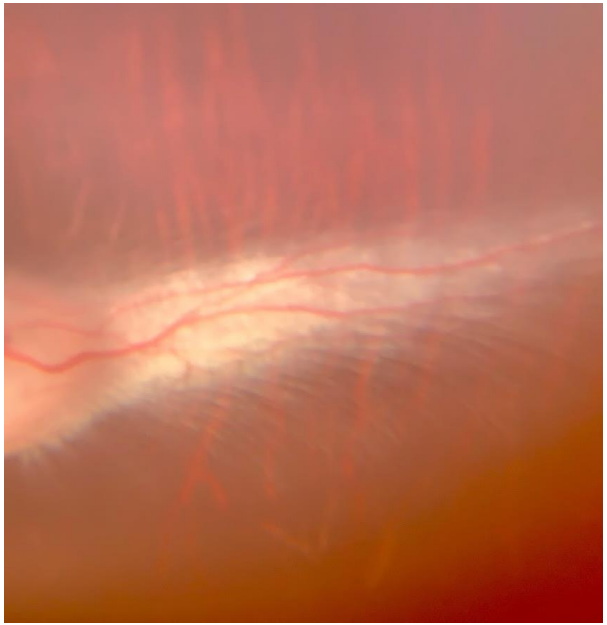






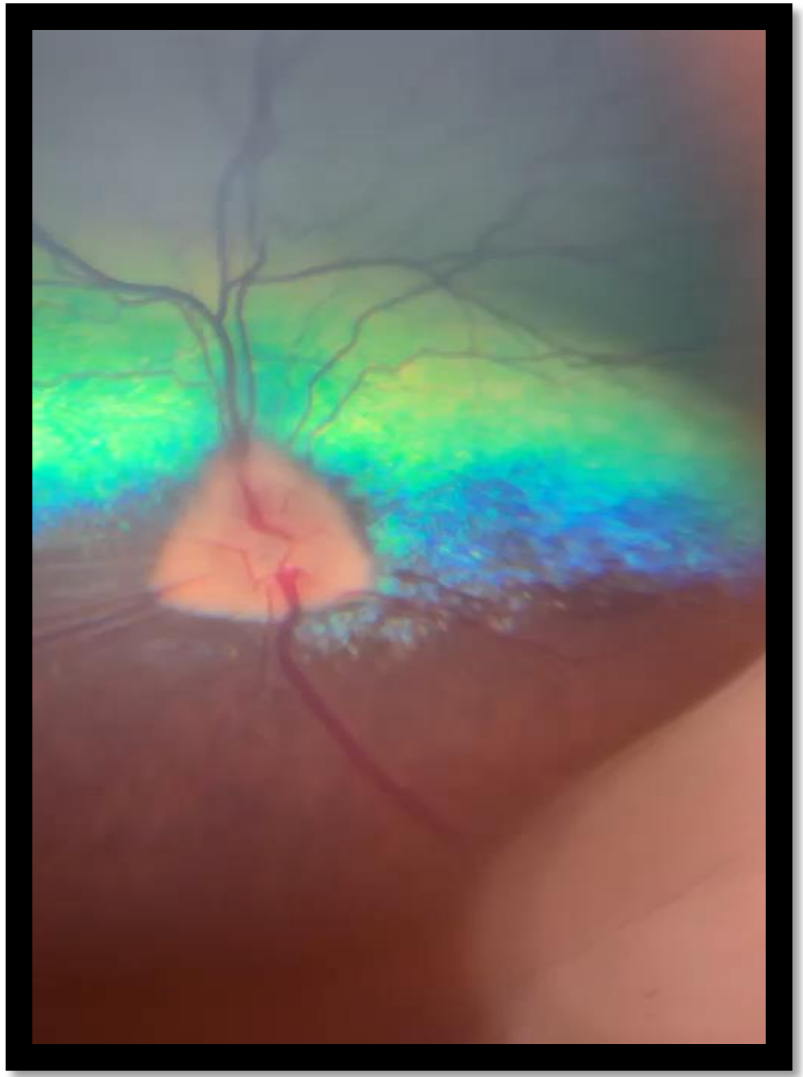
Nerve fibre layer

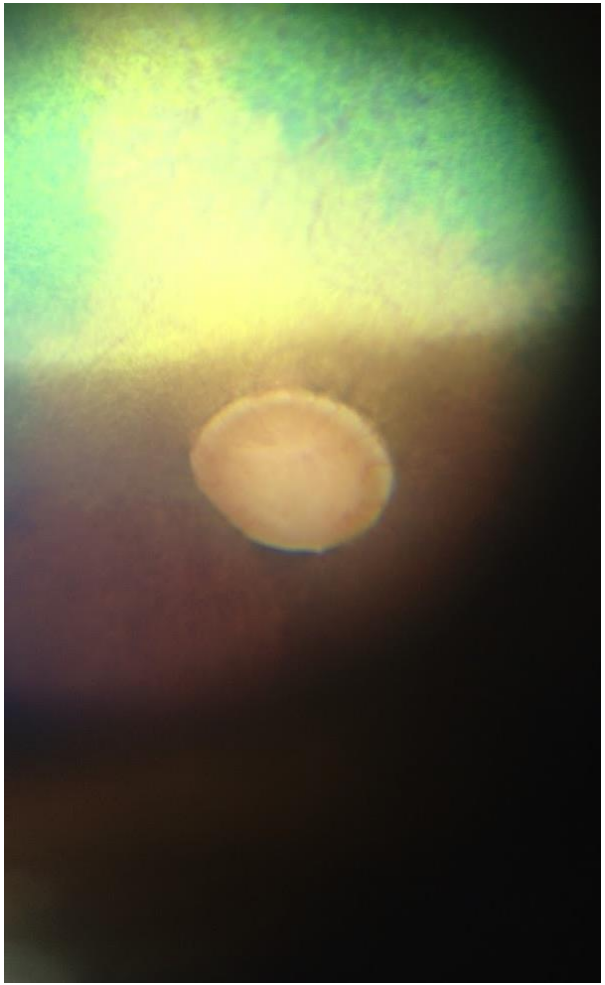
Rabbit

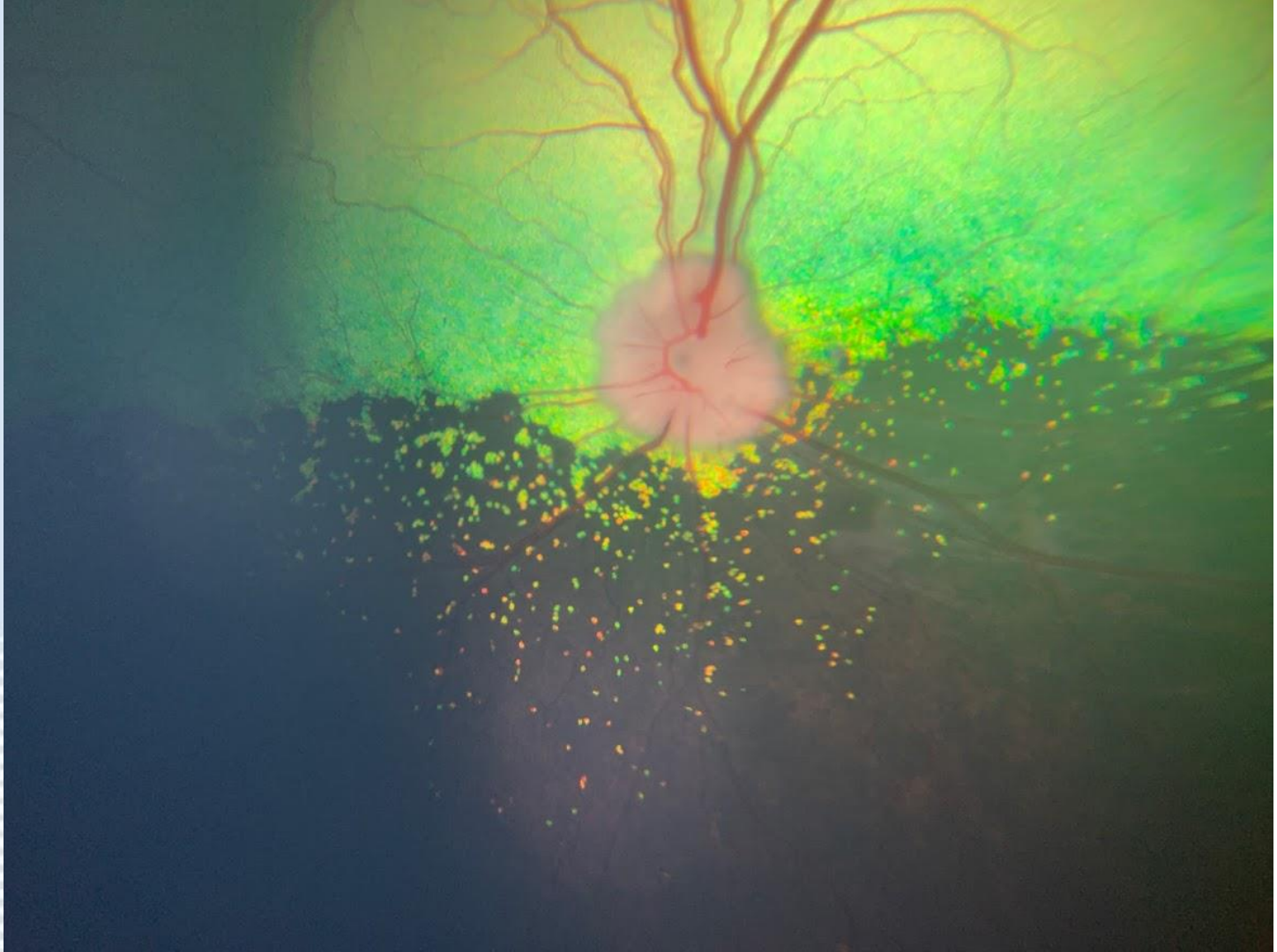
Dynamic assessment of retinal vasculature



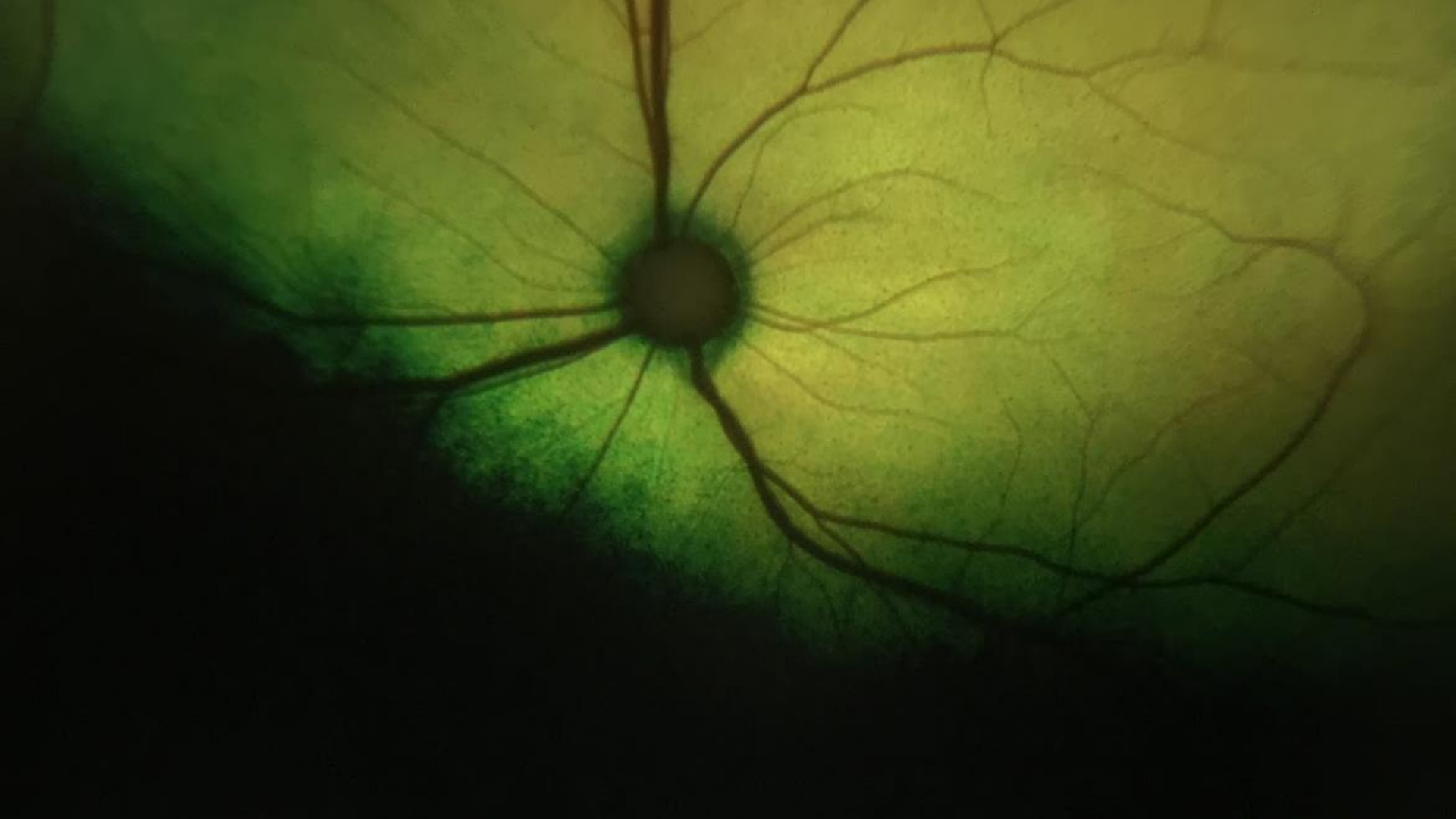
Non tapetal fundus

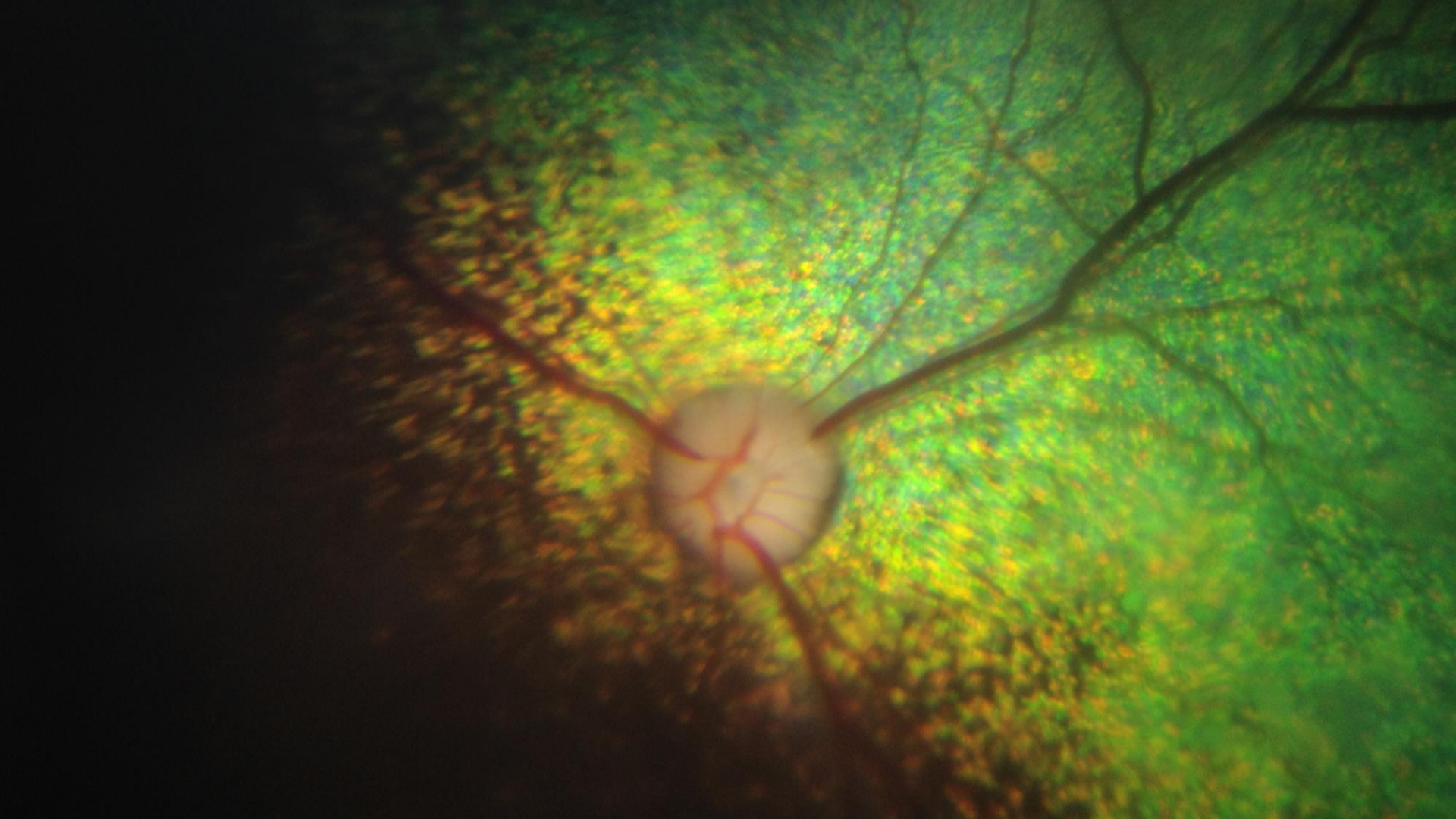




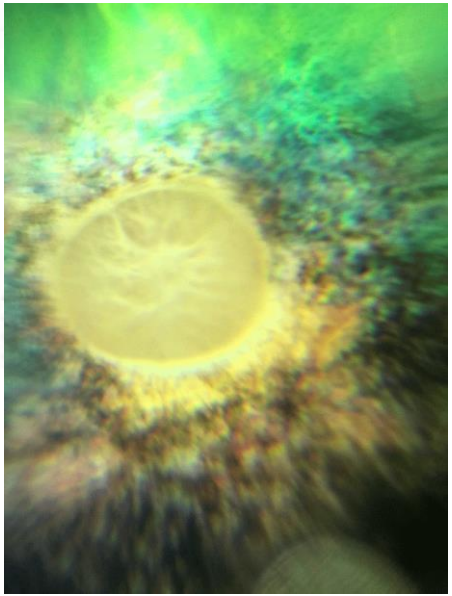


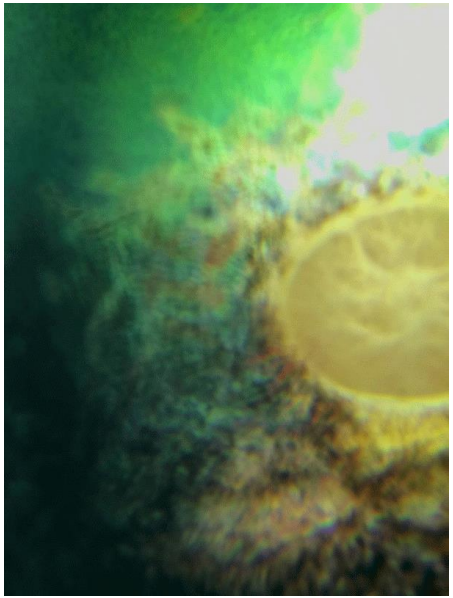
Tapetal fundus



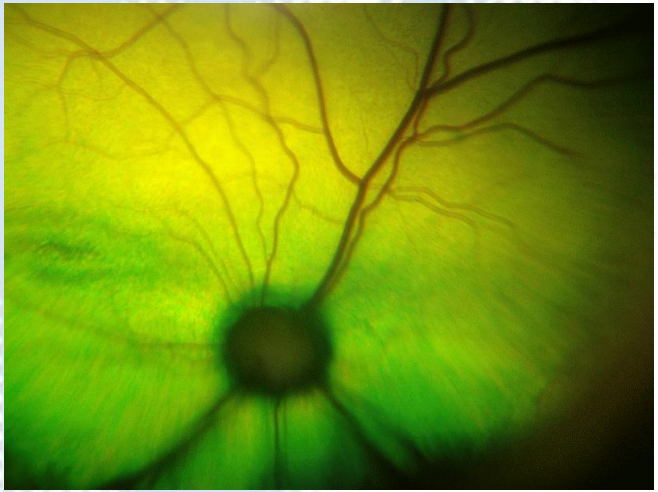


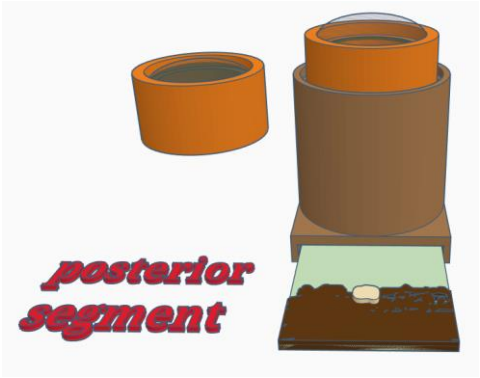
Tapetal hyperflectivity



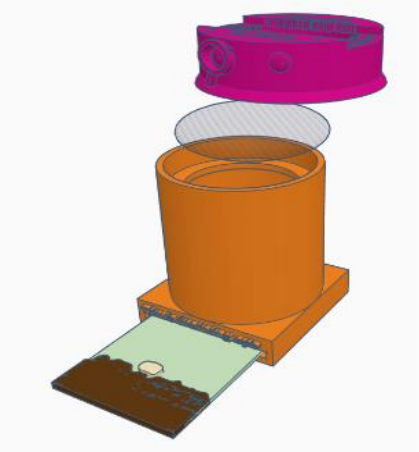


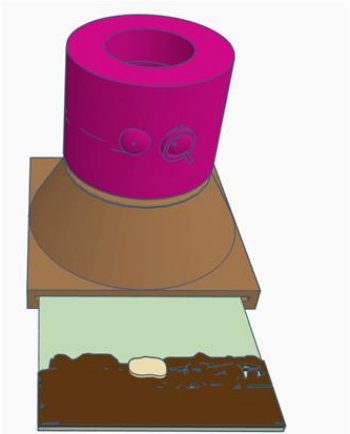
Tapetal hyperflectivity

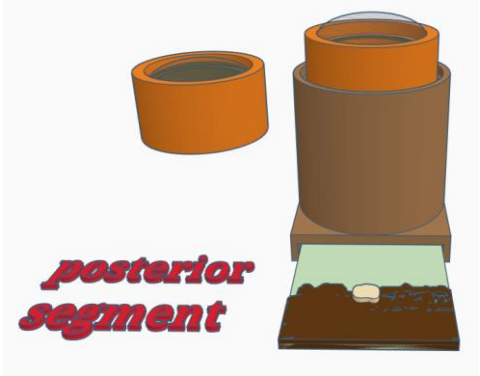




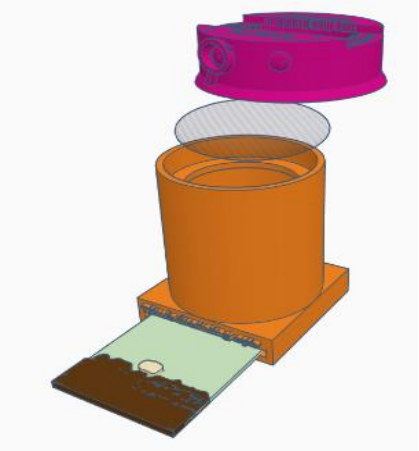
Practical session 3: imaging the posterior segment

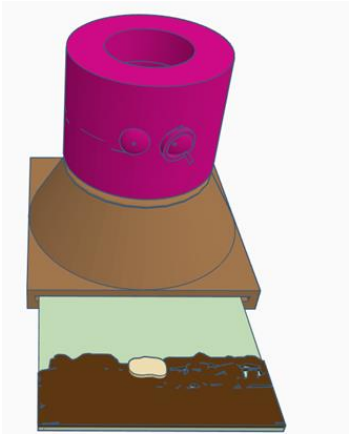






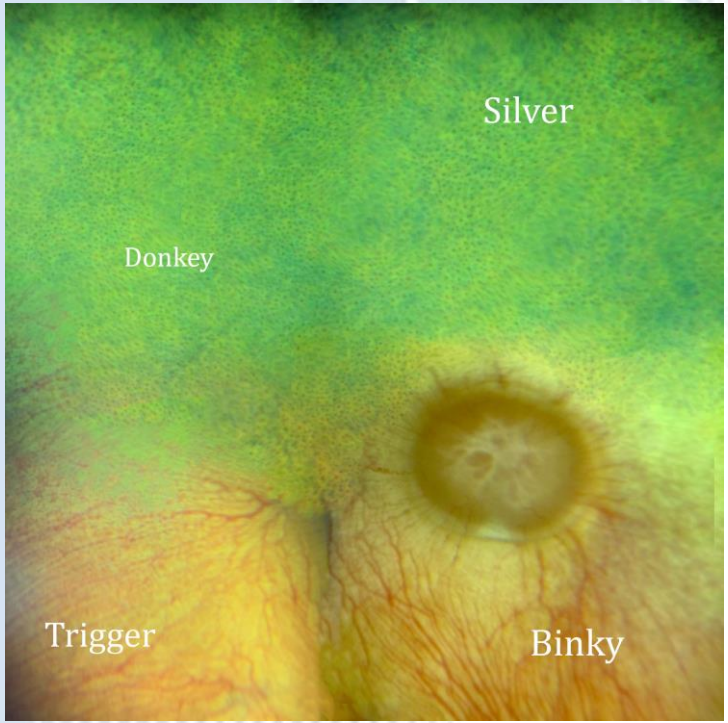
teaching eye in “posterior segment” mode

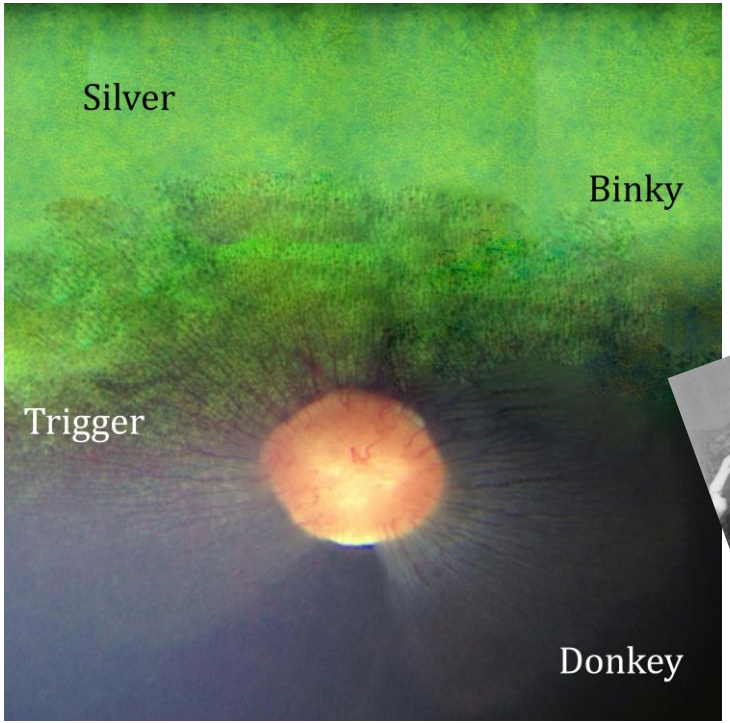




Task 1: Use Distant direct to identify anterior vitreal or peripheral retinal abnormalities using eye model

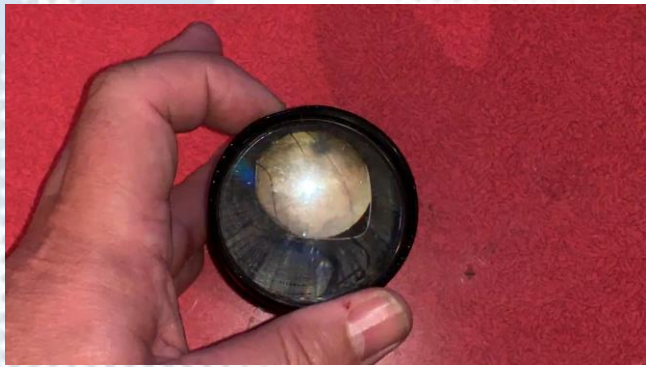
Task 2: Use close direct phoneoscopy to directly image the fundus





Task 3: Use indirect fundoscopy to image the fundus

Task 3: Use indirect fundoscopy to image the fundus



Task 3: Use indirect fundoscopy to image the fundus