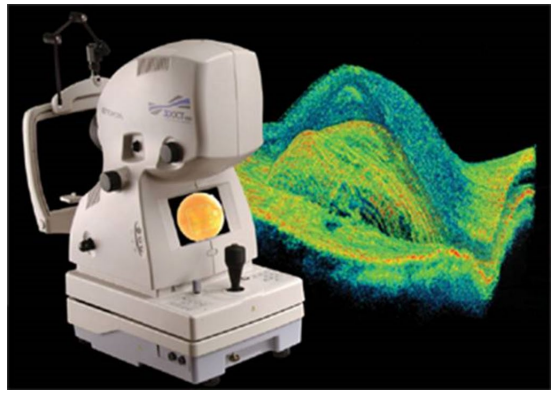
Optical Coherence Tomography in DESP



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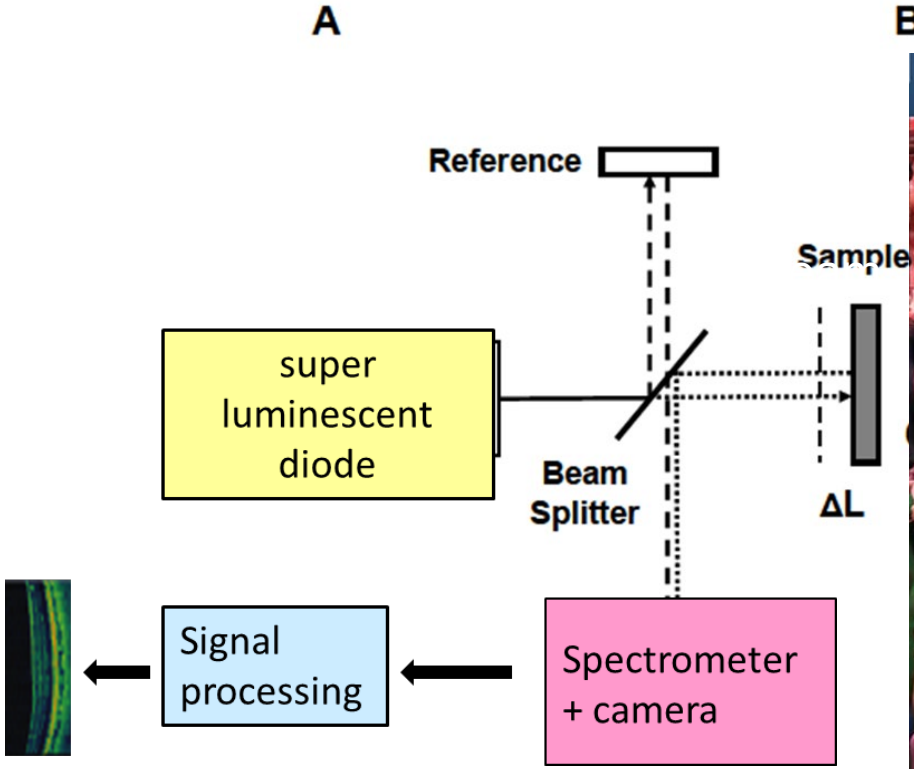
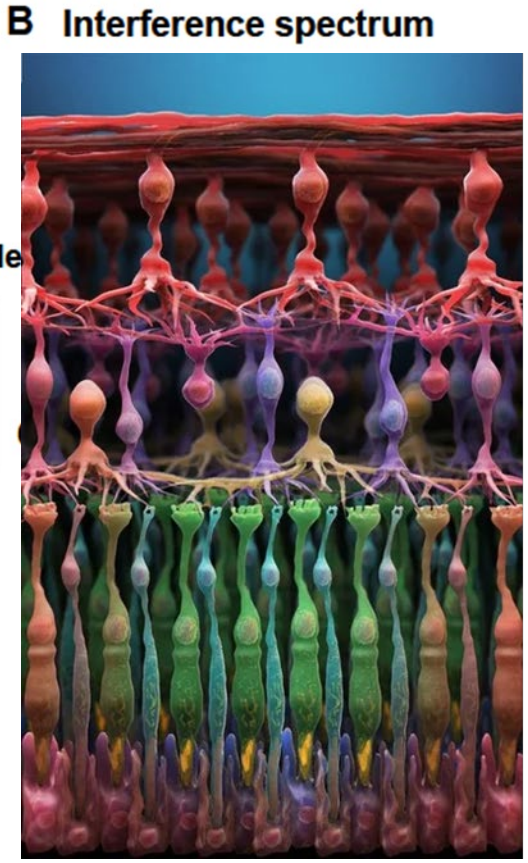
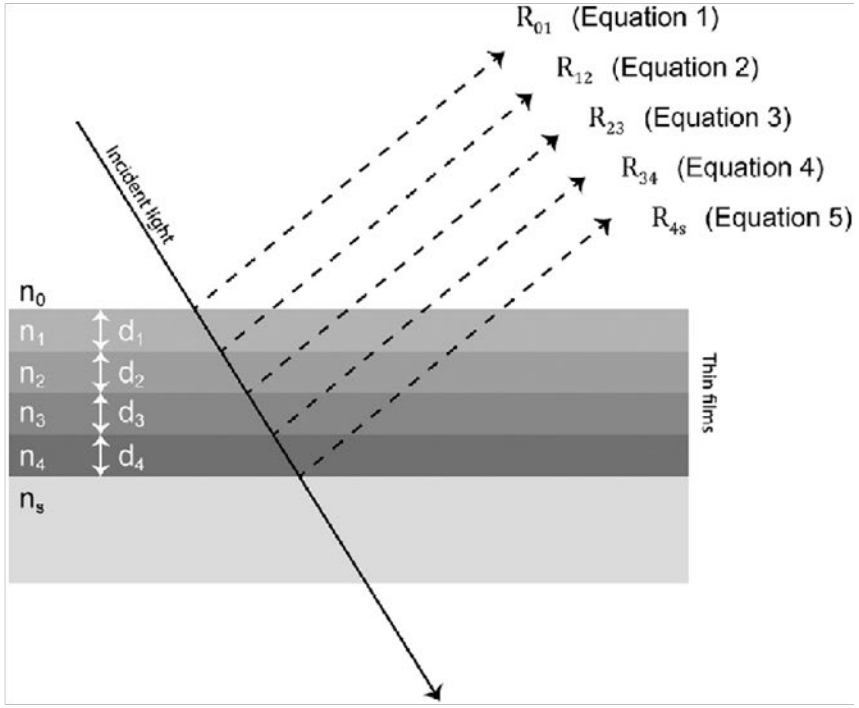
Content

- What is OCT?
- OCT features in Diabetes
- OCT capture & grading in Diabetes
- NON DR OCT examples
- Quiz

Optical Coherence Tomography (OCT) of the Retina

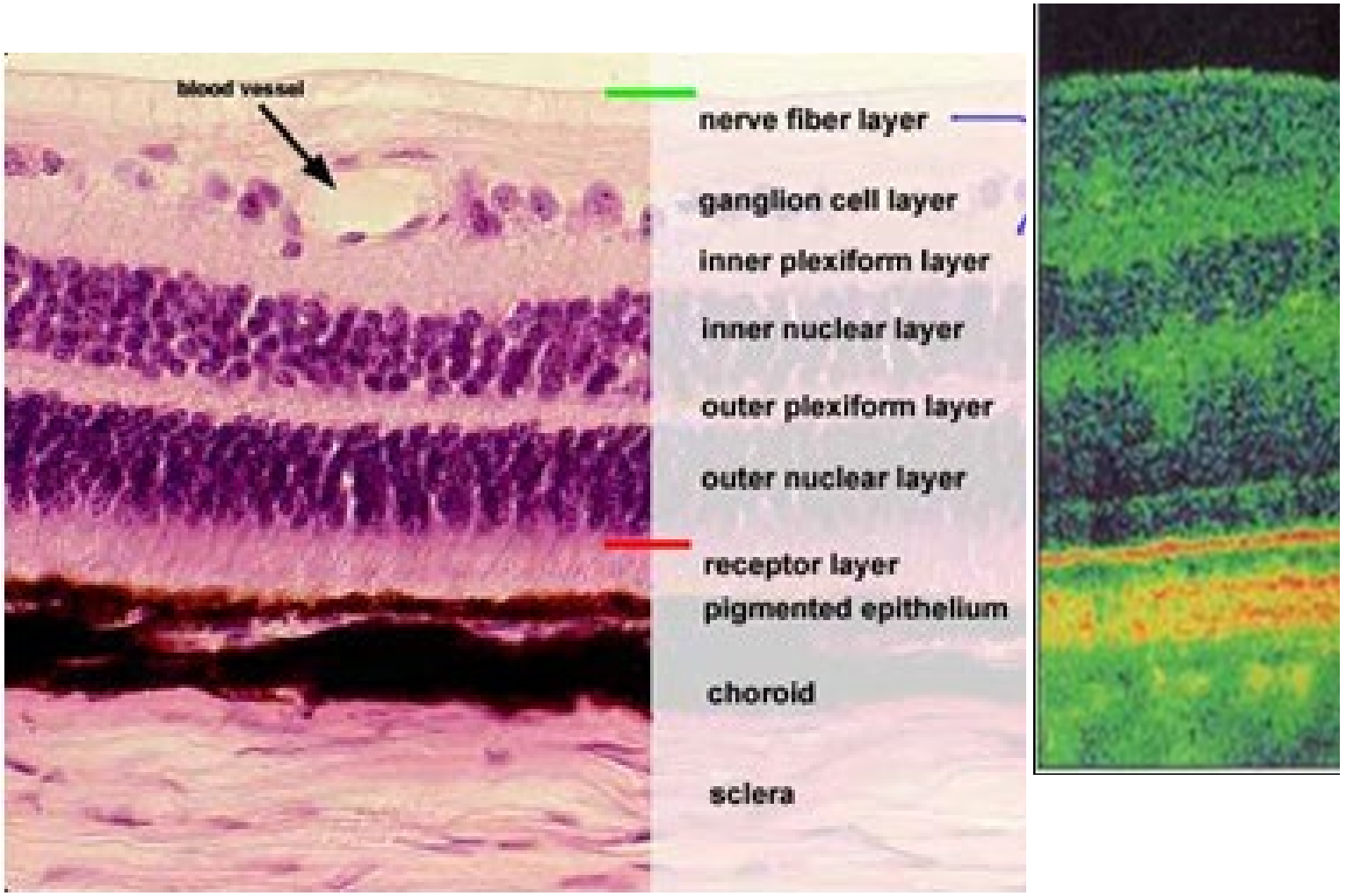




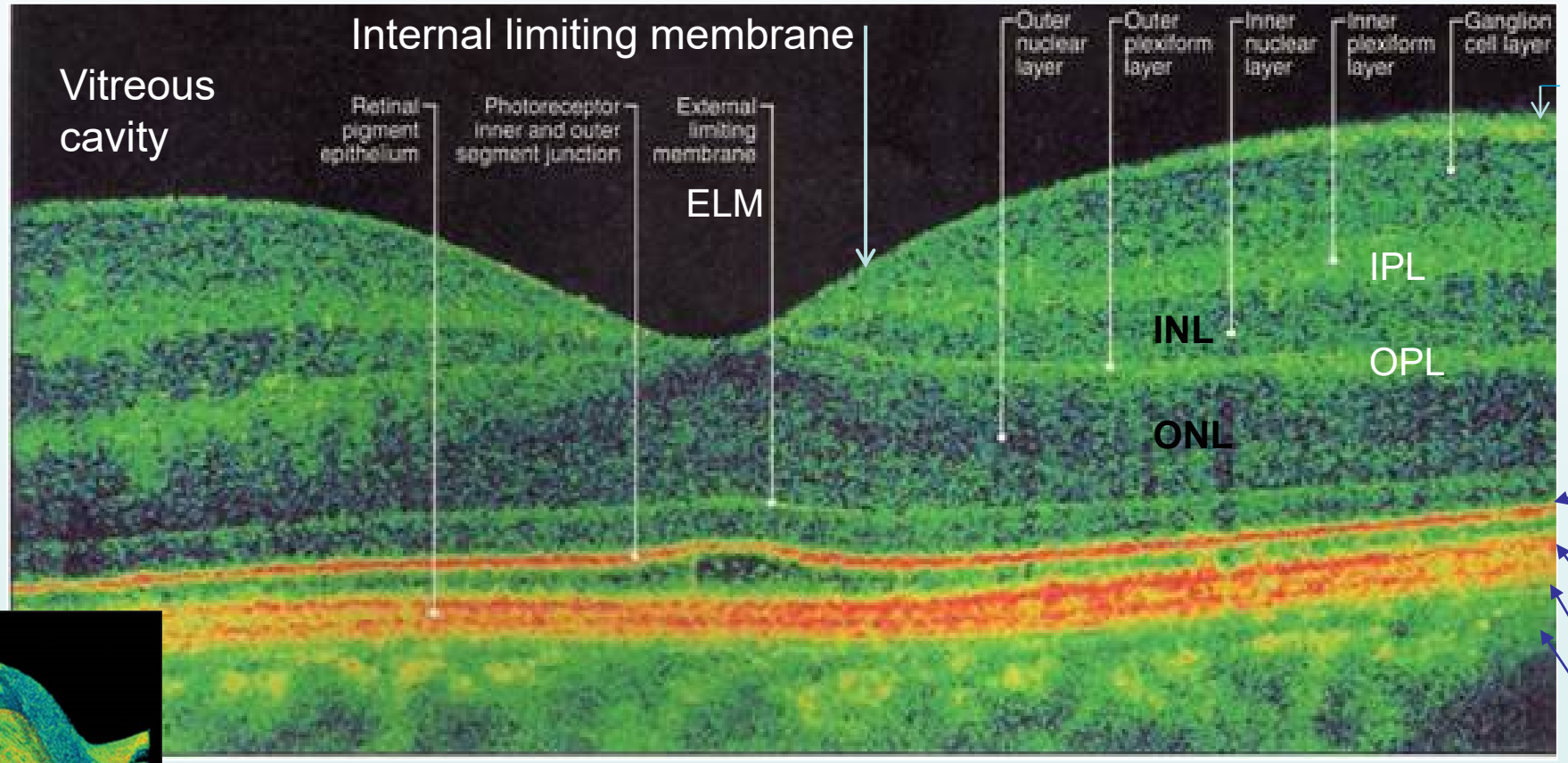


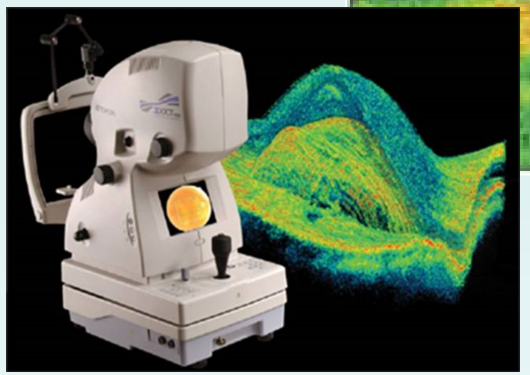
OCT technology utilises low-coherence interferometry, where a low-coherence light beam is directed to the target tissue and the scattered back-reflected light is combined with a second beam (reference), which was split off from the original light beam. Software analysis of the resulting exiting spectra creates a cross-sectional map of the retina - a tomographic scan (multiple A-scans are combined into B-scans, multiple B-scans create a volumetric map)

Retinal Structure / OCT layers



Normal Retinal OCT layers/ Topcon



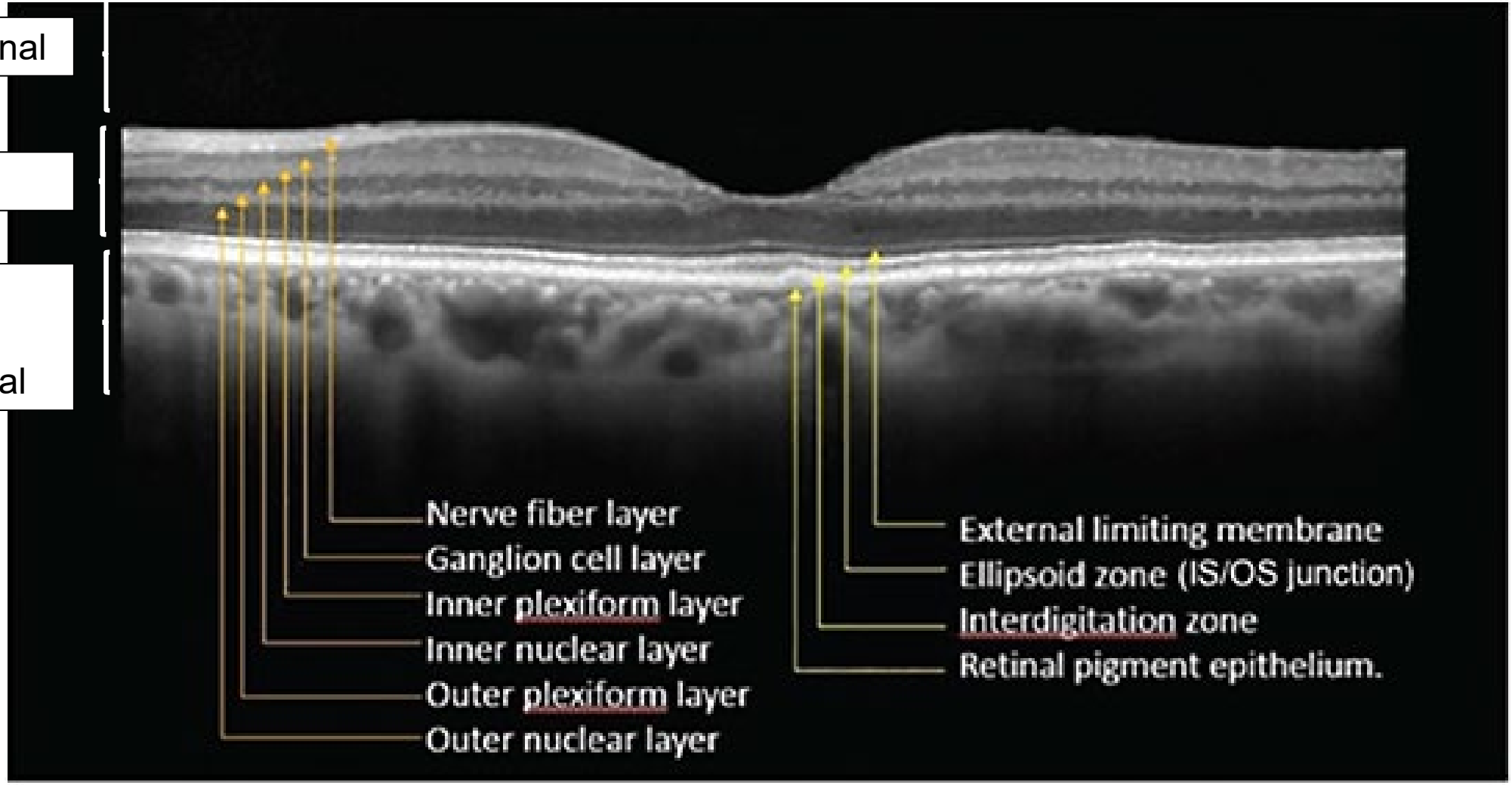


Retinal Layers/ Heidelberg OCT

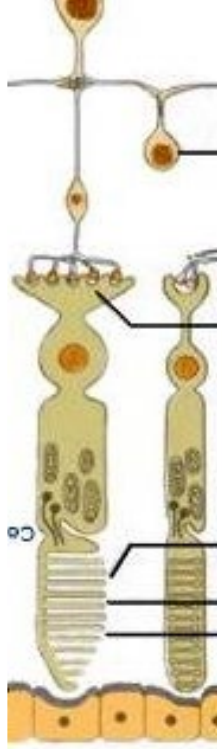
Pre-retinal

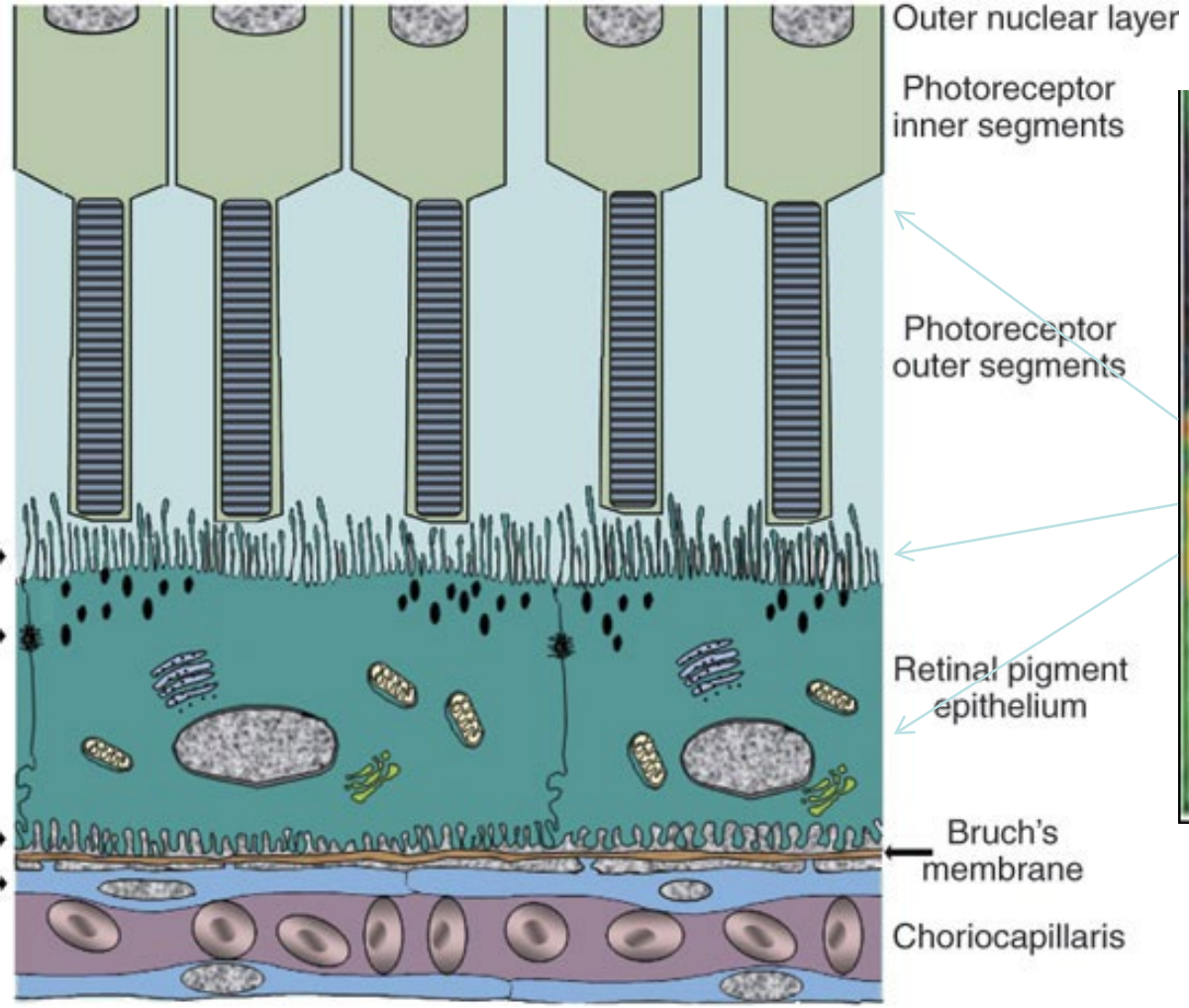
Retinal

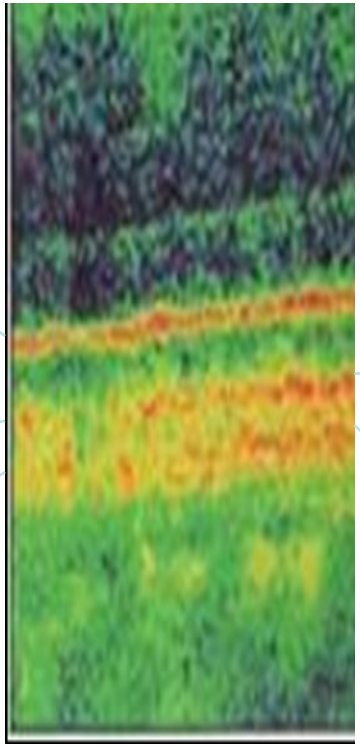
Sub-retinal/ choroidal



‘Trilaminar band’







IS/OS junction

Interdigitation zone

RPE

Relative OCT Signal "Reflectivity"

SIGNAL	STRUCTURES
High (white) Hyper-reflective	RPE, IS/OS junction, exudates, ERM
Moderately Highly reflective	NFL, Scar Tissue, CNV, blood, microaneurysms, vitreo-retinal interface
Moderately (grey) reflective	Retina, Choroid, Vitreous bands
Moderately Low reflectivity	Vitreous debris, Posterior hyaloid, Outer retina, noise
Low (black) Hypo-reflective	Vitreous, Silicone oil, Cysts, "Shadowing" behind blood vessels and behind exudates

OCT CAPTURE

PATIENT PREPARATION

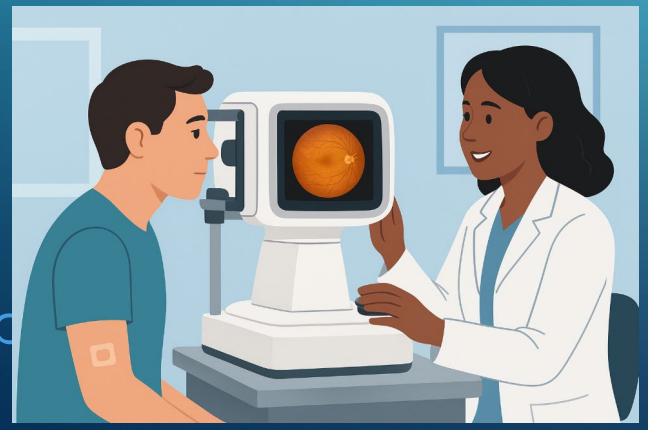
- **Explain** the procedure
- **Patient comfort** – chin on chinrest, head against band and eyes aligned with canthus mark
- **Correct Fixation**

SCAN POSITION

- **Fovea-centred**
- Covers DESP definition of **macula**
- Full retinal layers **within frame**

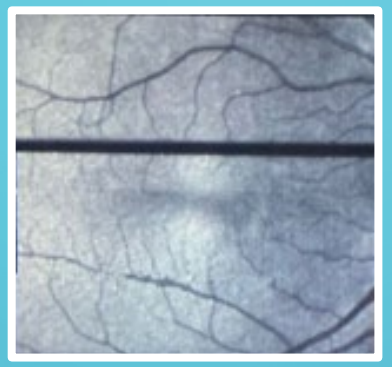
SCAN QUALITY

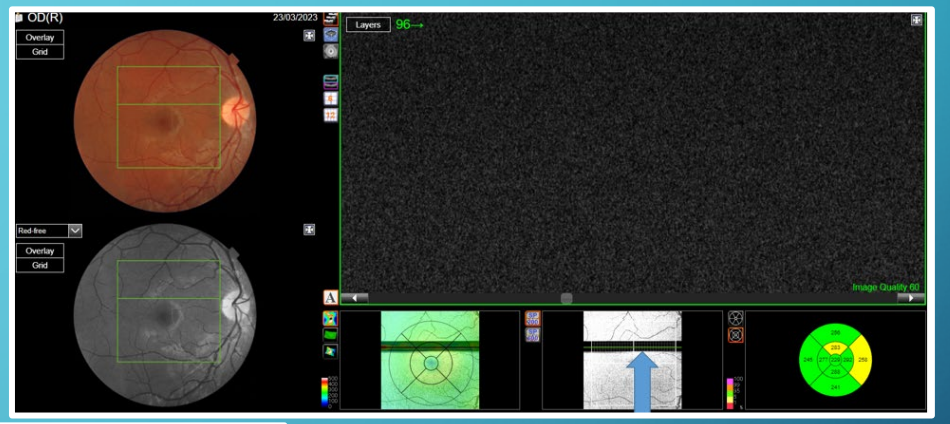
- Clear, **visible layers**
- 'Look' around **opacities**
- **Optimise** scan
- **Reduce** artefacts



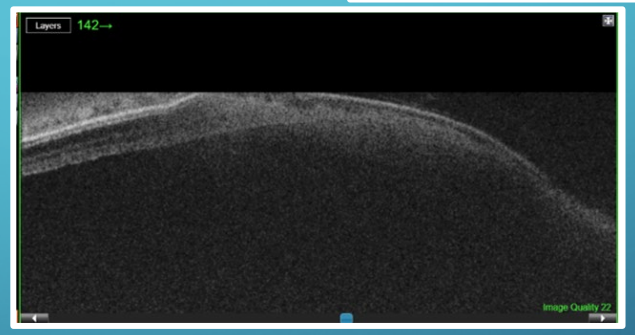
COMMON OCT ARTEFACTS

Blink

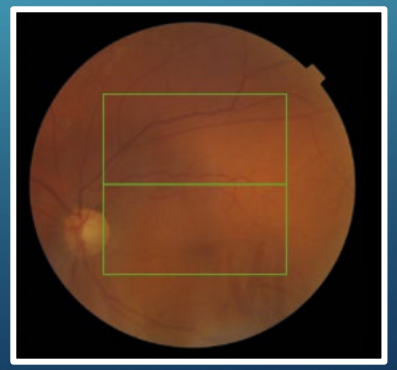




Mirror/ inverted (e.g. high myopes, retinal detachment)

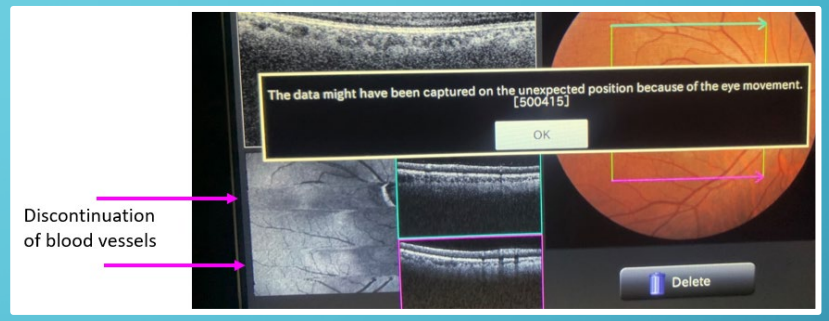


Off centre (e.g. poor fixation, poor attention, AMD)

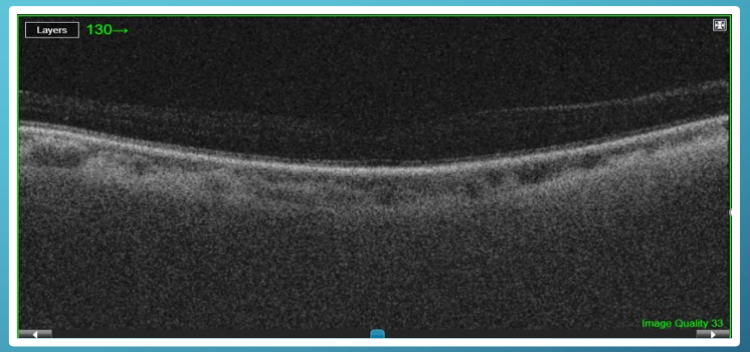


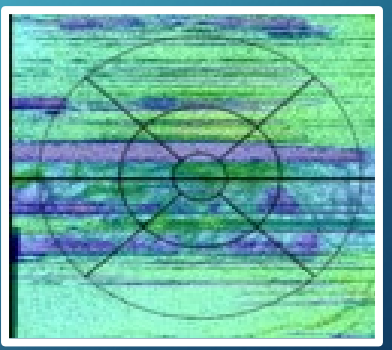
COMMON OCT ARTEFACTS

Motion

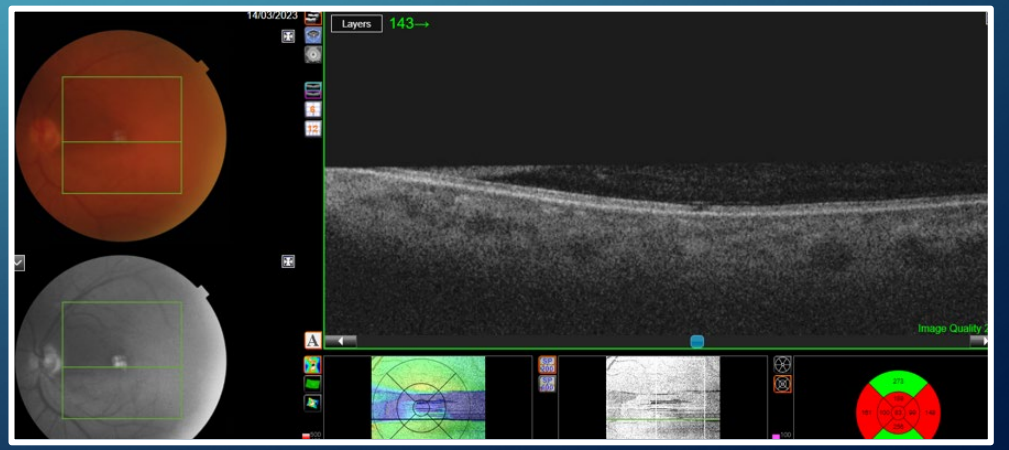


Poor signal strength (e.g. dense cataract, vitreous haemorrhage)



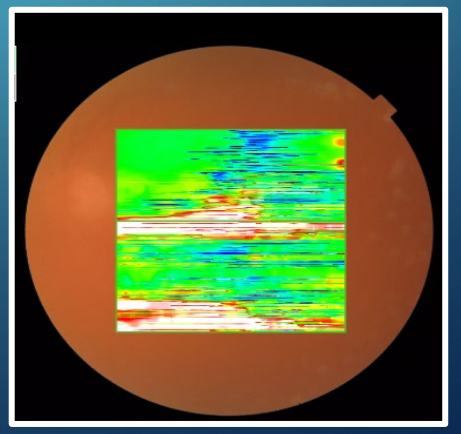


Out of register (scan shifted superiorly or inferiorly)



WHY ARE ARTEFACTS SIGNIFICANT?

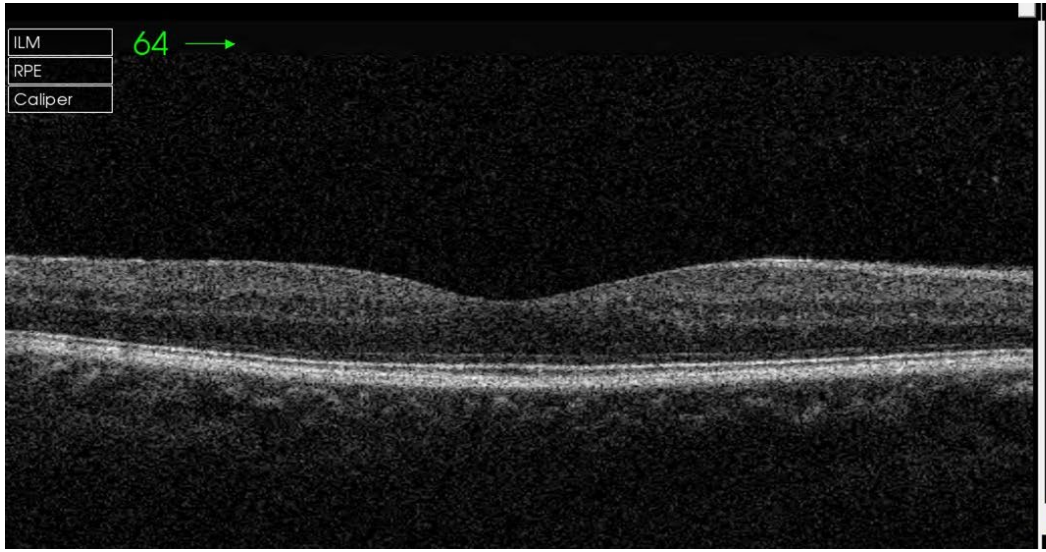
- Can produce **incorrect retinal thickness** measurements as machine cannot correctly identify the ILM or outer retinal layers (segmentation error)
- **Incorrect referral** or monitoring
- **Missed pathology**
- Repeated visits – **cost and inconvenience** for patient

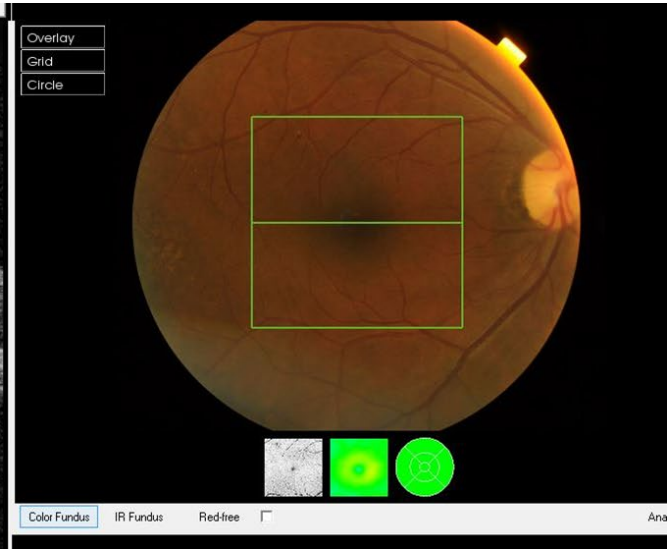


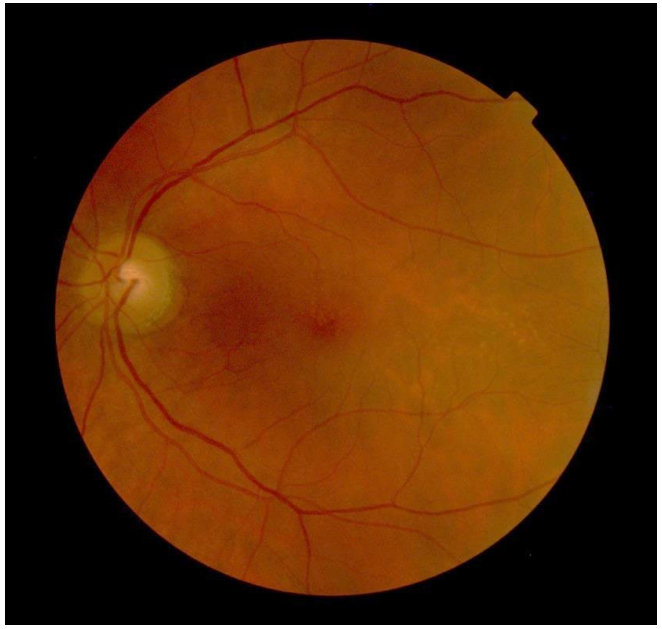
DIABETIC FEATURES ON OCT

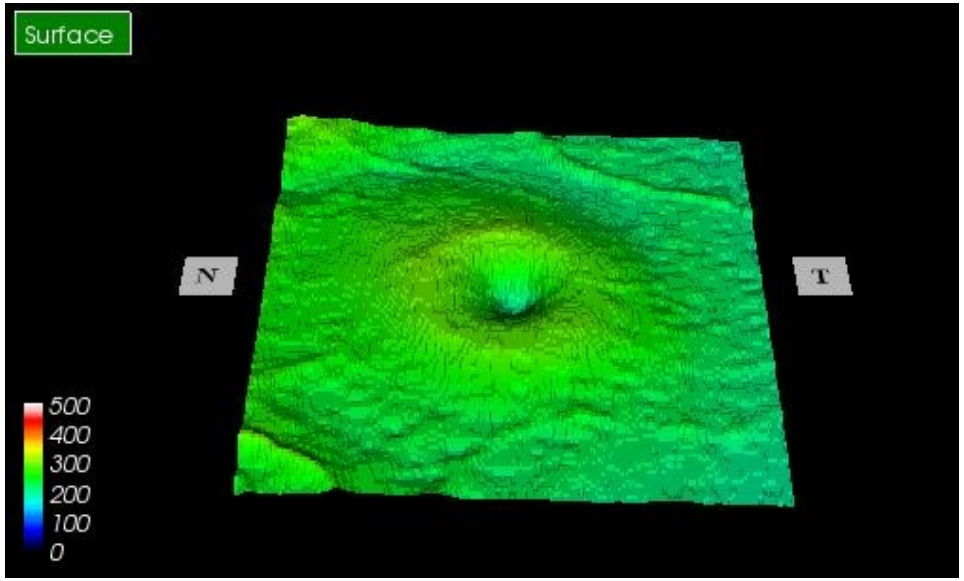
	Diabetes features	Non DR patholoy
Vitreous/ VR interface	**Vitreous haemorrhage**	Vitreous haemorrhage (secondary to PVD/retinal tear)
	Tractional Retinal detachment	Vitreo-macular traction/ Epi-retinal membrane
Posterior hyaloid	**Pre-retinal haemorrhage**	Valsalva haemorrhage
	NVD/NVE	
Retinal	**Microaneurysms/ exudates/ DRIL/Hyper-reflective foci**	Lamellar hole/ macular hole/ Cystoid macular Oedema/ BRVO/ CRVO/ Mactel/ Paracentral Acute Middle Maculopathy
	Cotton wool spot (NFL)	CRAO
	Intra-retinal cysts/ DMO	Cystoid macular oedema secondary to RVO/post op
Sub-Retinal	**Subretinal fluid (occasionally related to DMO)**	Central serous retinopathy/ AMD/ Retinal detachment
Outer retina/ photo-receptors/ RPE/ Choroidal/ Bruchs	**Laser scars/ Diabetic changes to ELM/EZ layer**	PED/ CNV/ wet AMD/ IPCV/ drusen/ Geographic atrophy/ HCQ toxicity/ Retinitis Pigmentosa

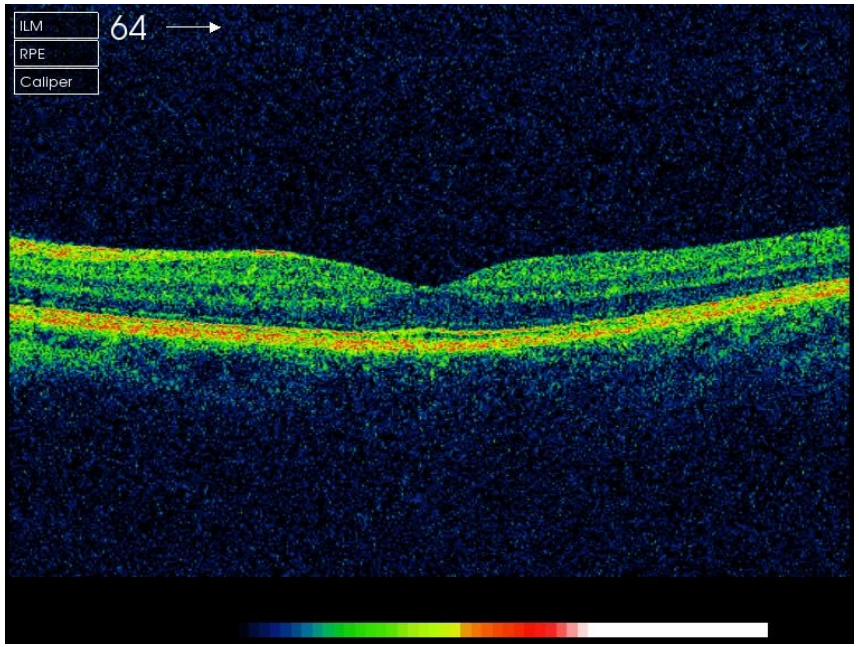
Healthy Retina on OCT





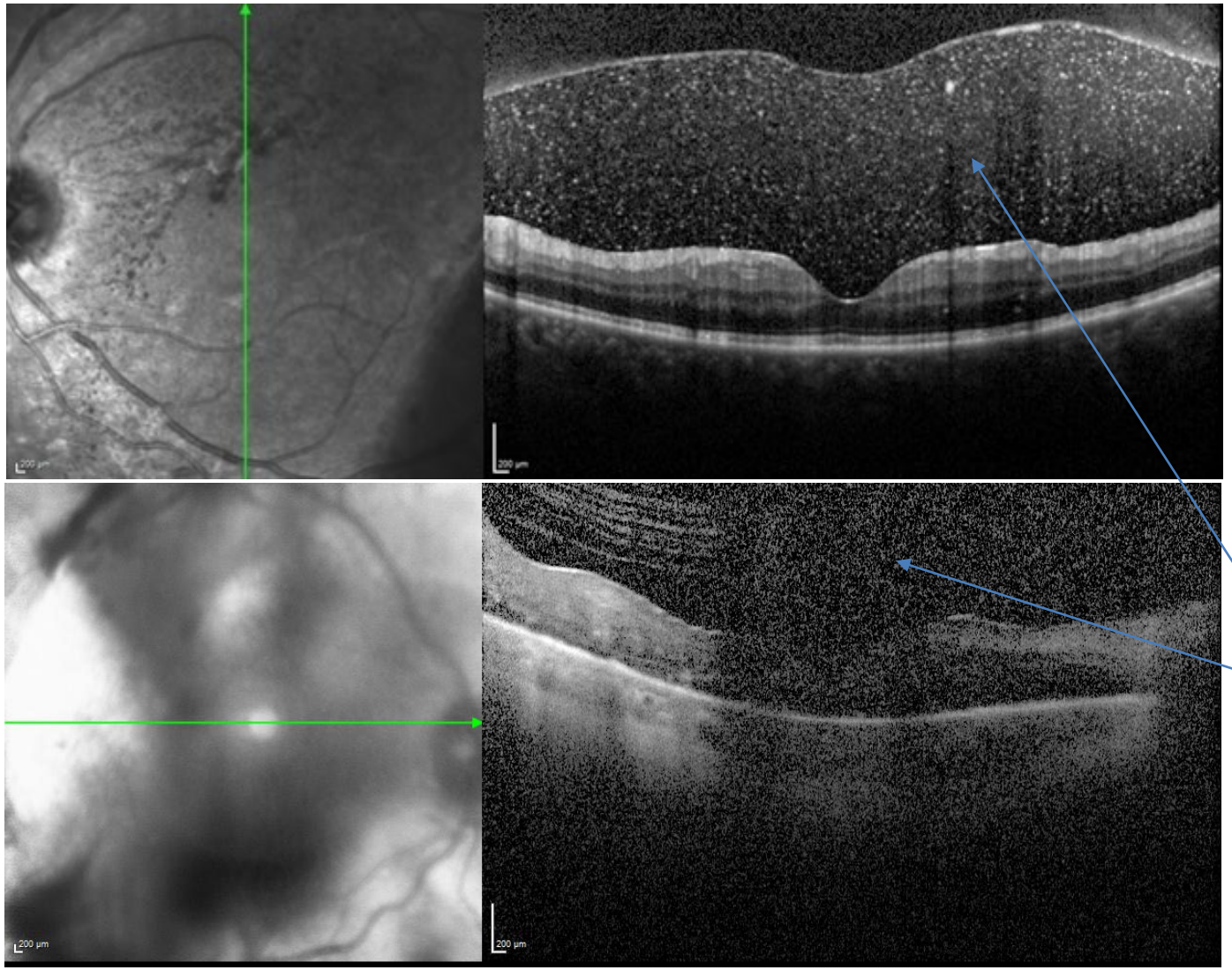




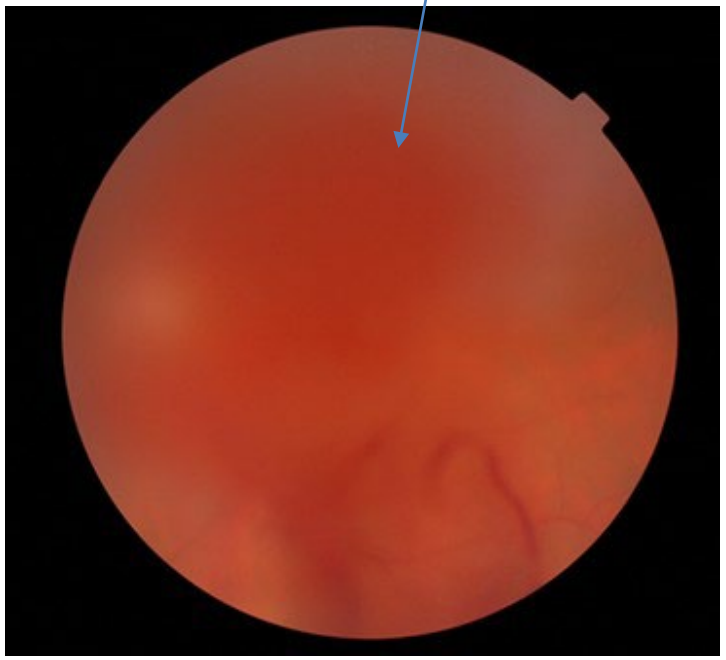


Vitreous Haemorrhage

Heidelberg OCT scans

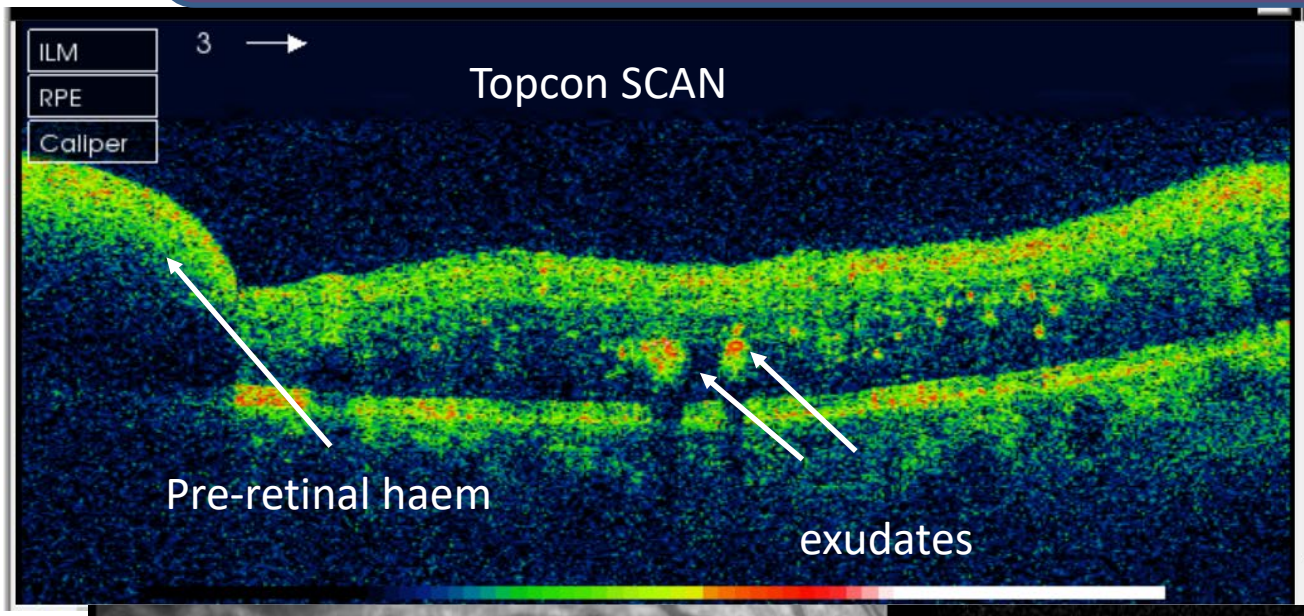


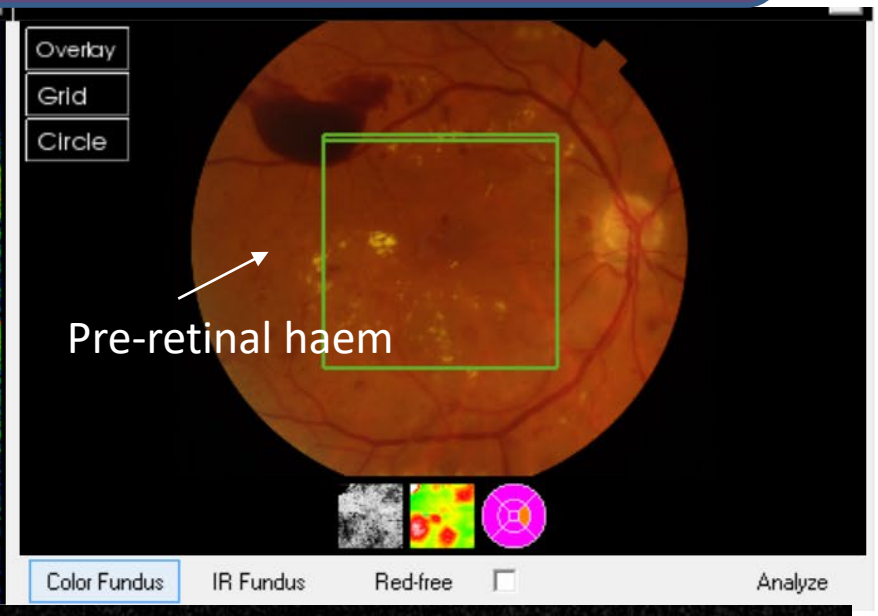
Blurred image due to vitreous haemorrhage obscuring the view

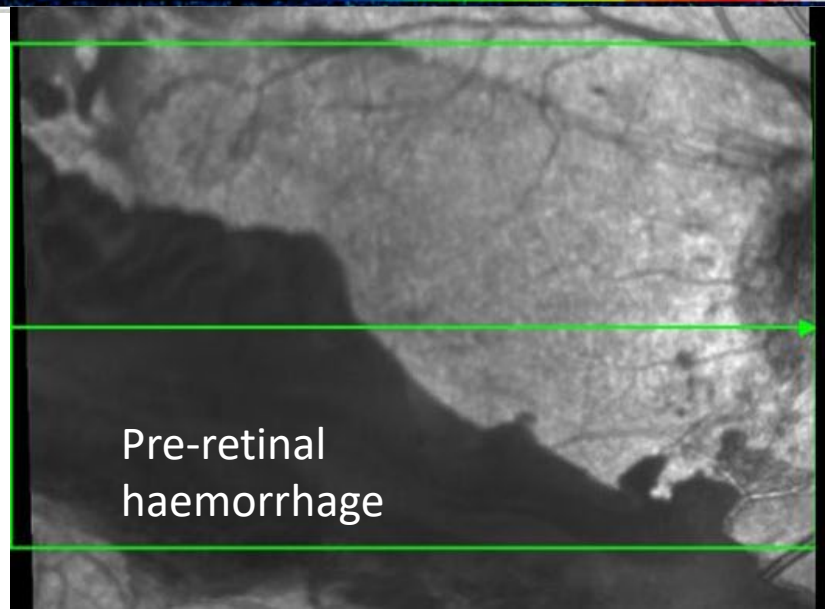


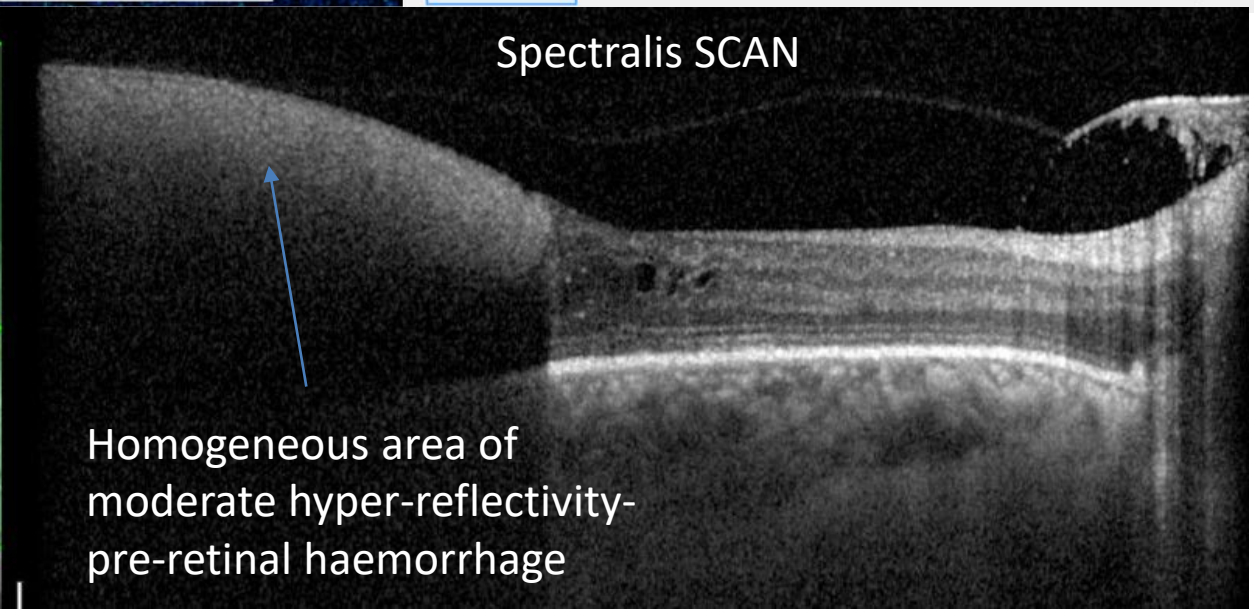
Moderately reflective spots in the vitreous gel. Often reduced signal from the retina underneath and reduced quality of image depending on density of haemorrhage.

Pre-retinal Haemorrhage

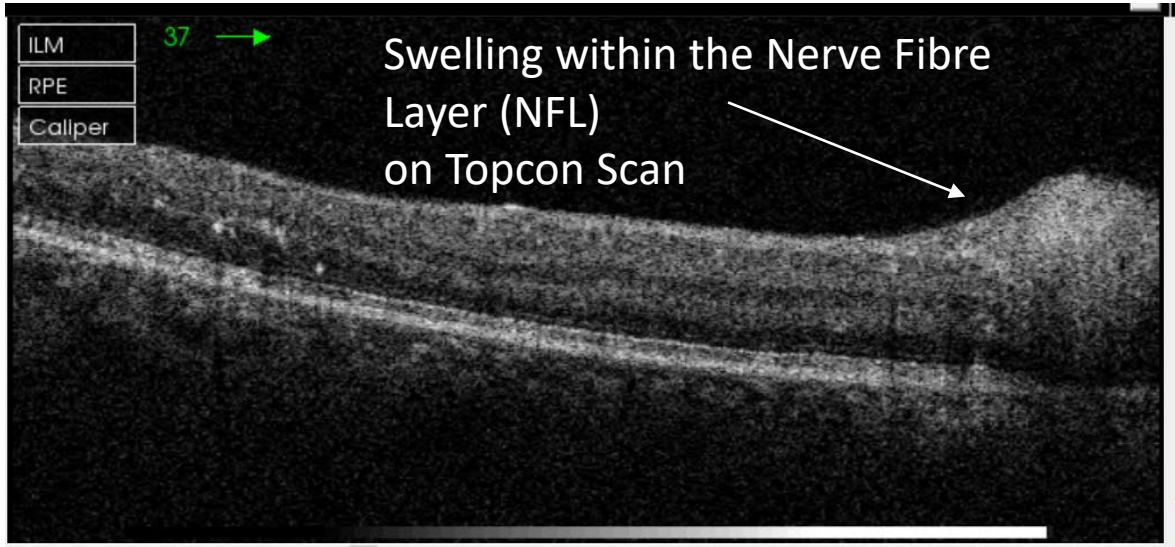


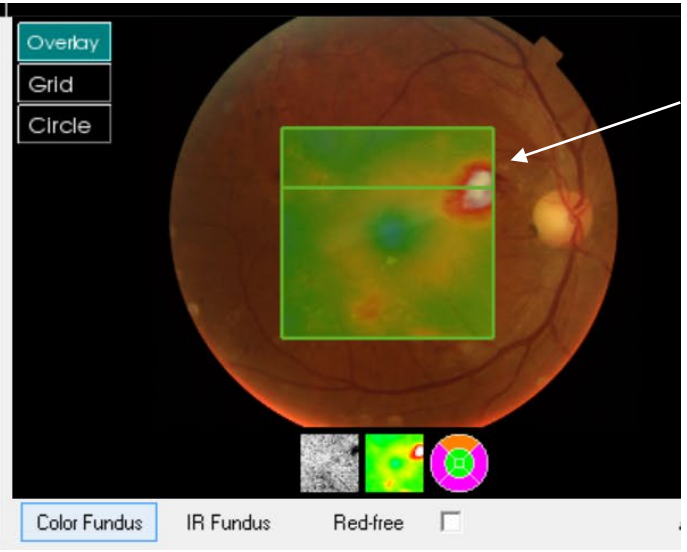




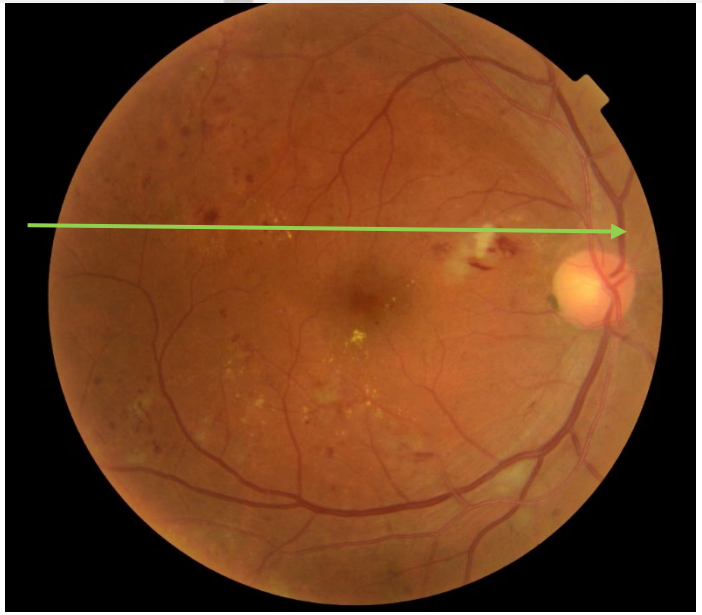


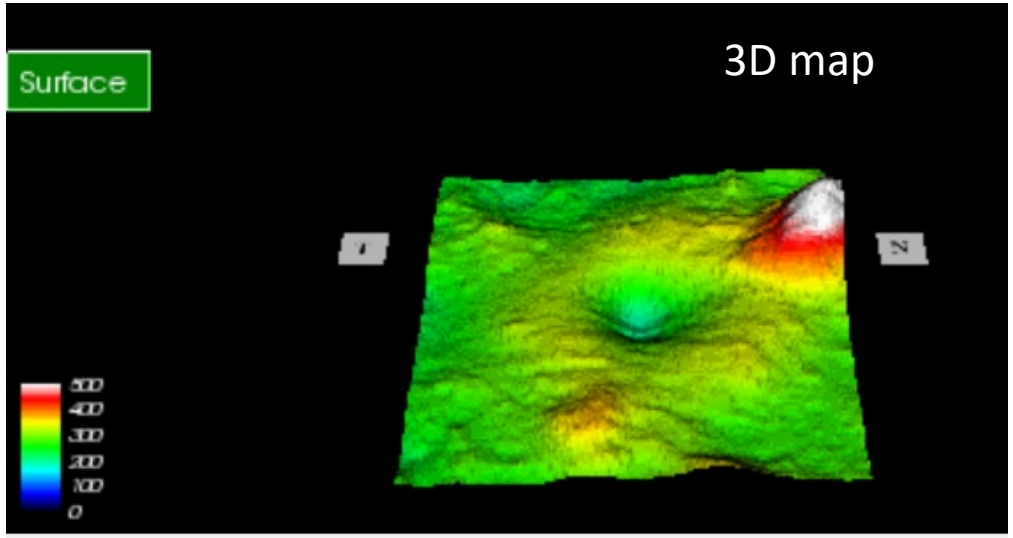
Cotton Wool Spots



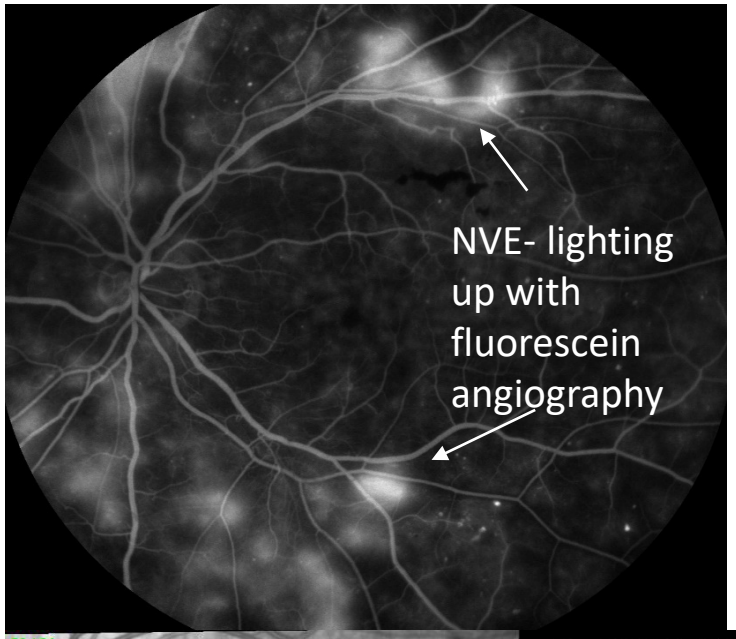


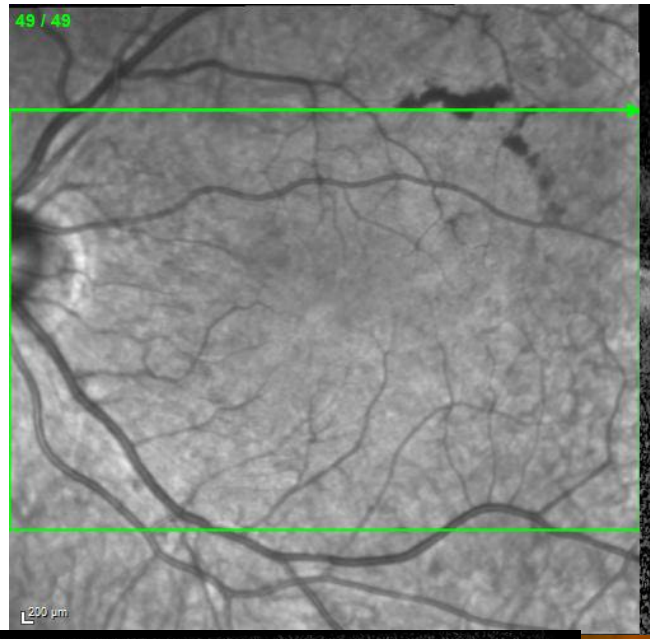
Thickening from CWS but not due to maculopathy

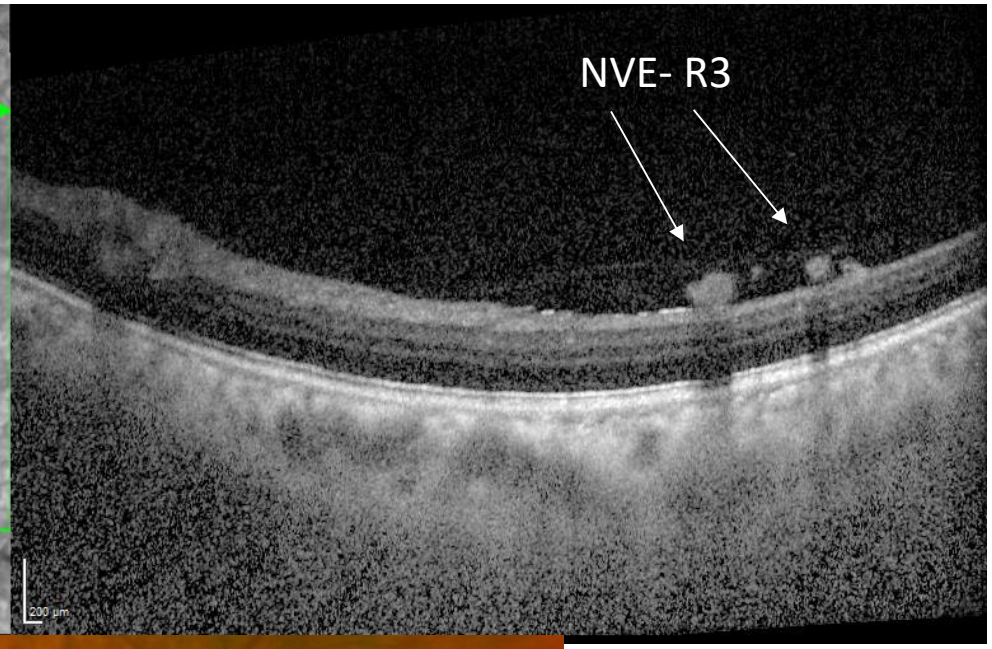


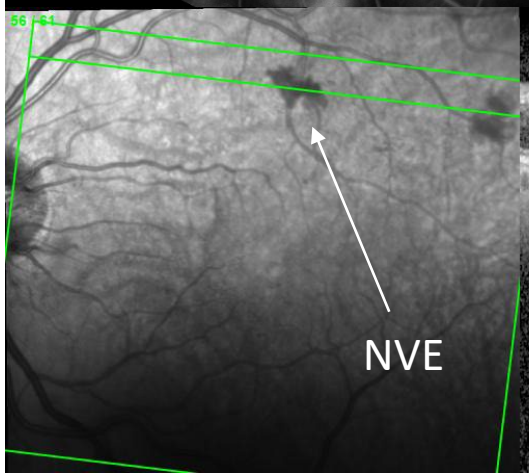


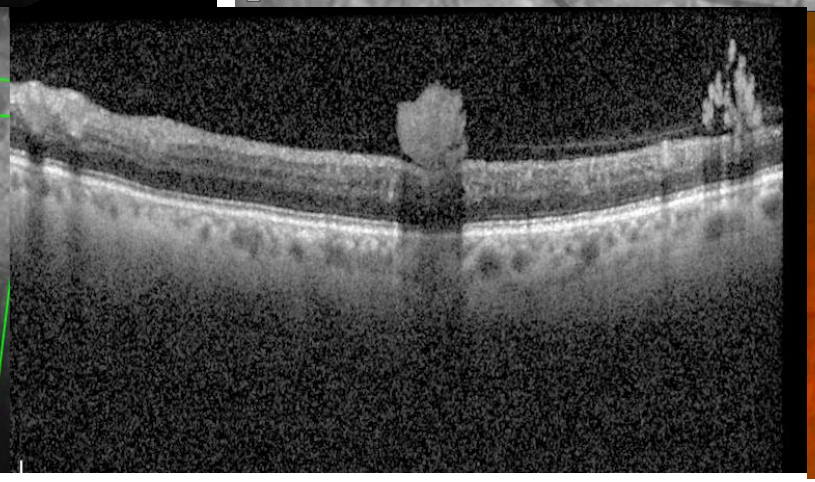
New Vessels Elsewhere (NVE)

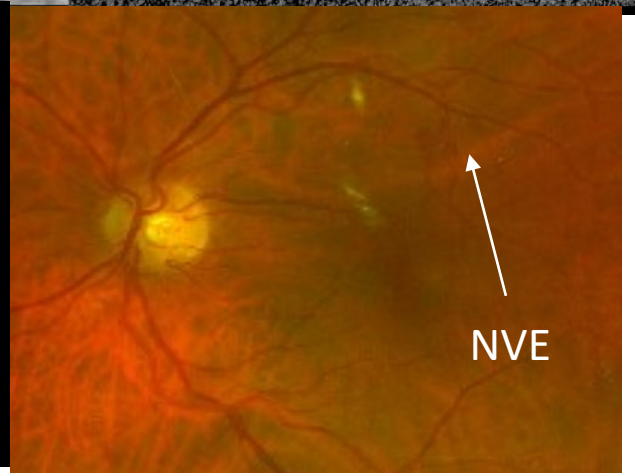






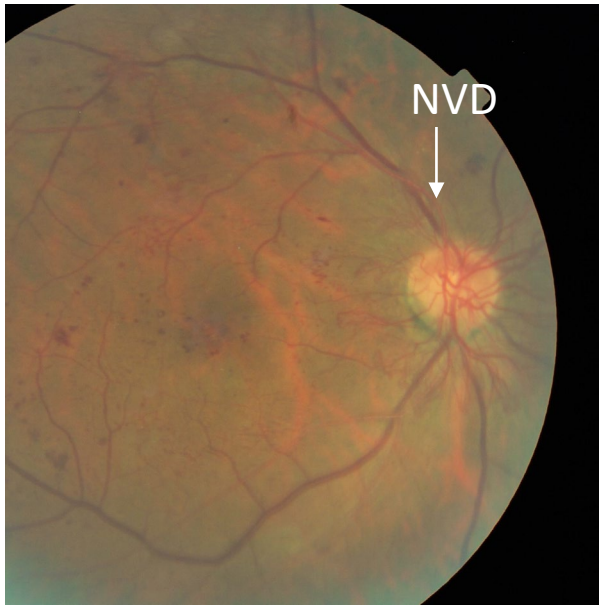


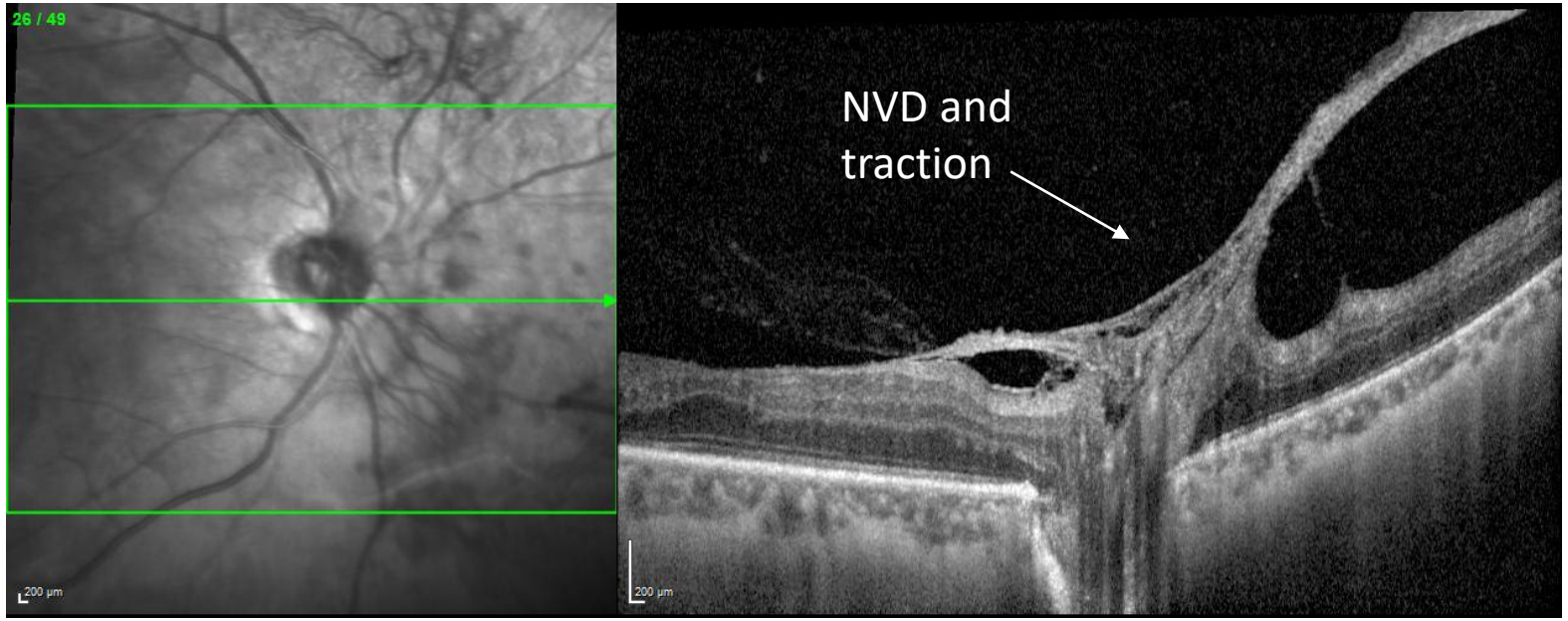


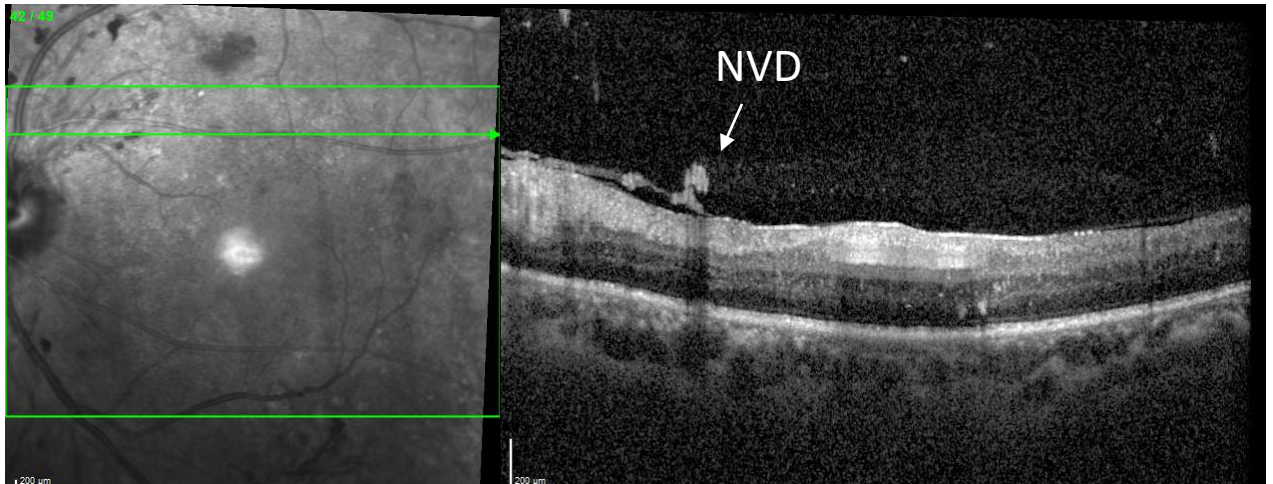


Heidelberg OCT scans showing New Vessels Elsewhere (NVE)

New Vessels at Disc (NVD)



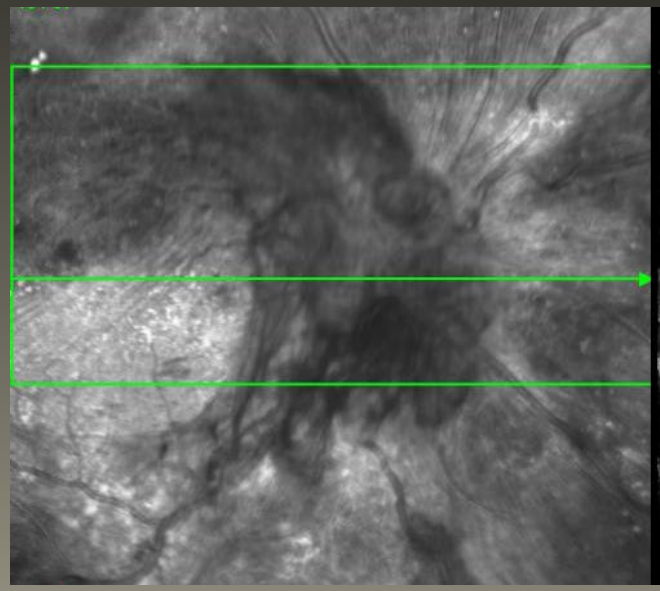


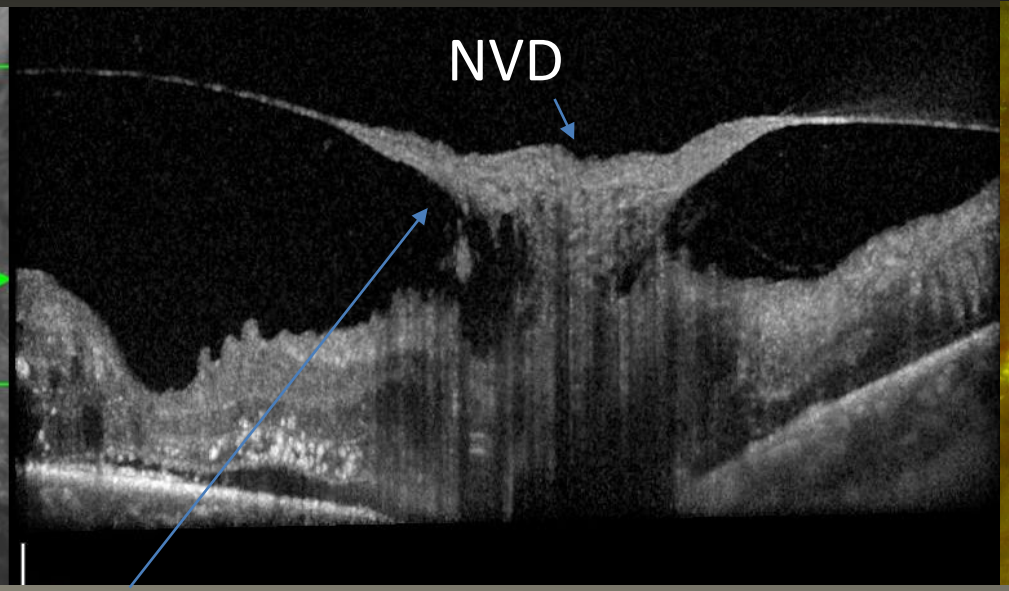


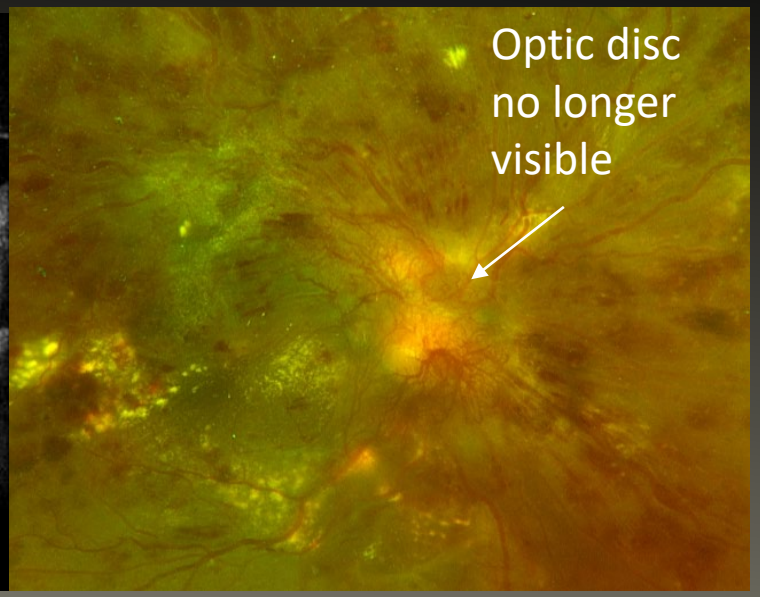
Heidelberg OCT scans

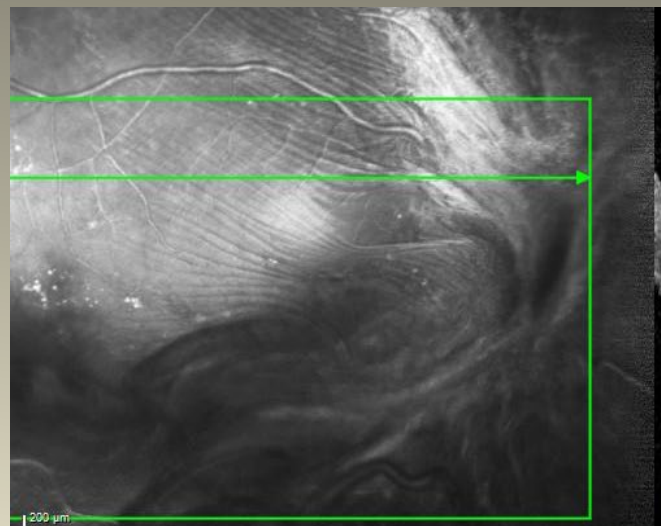
Tractional Retinal Detachment

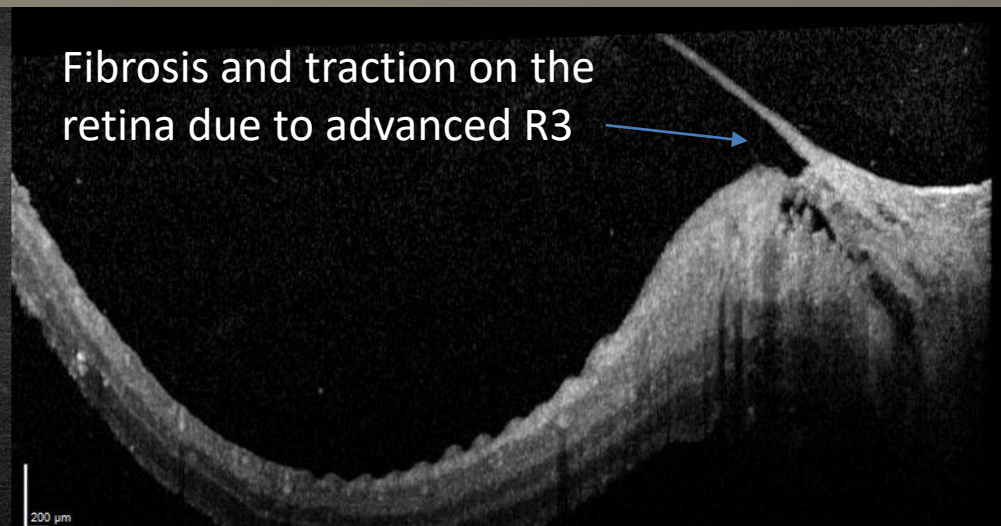
Heidelberg OCT scans

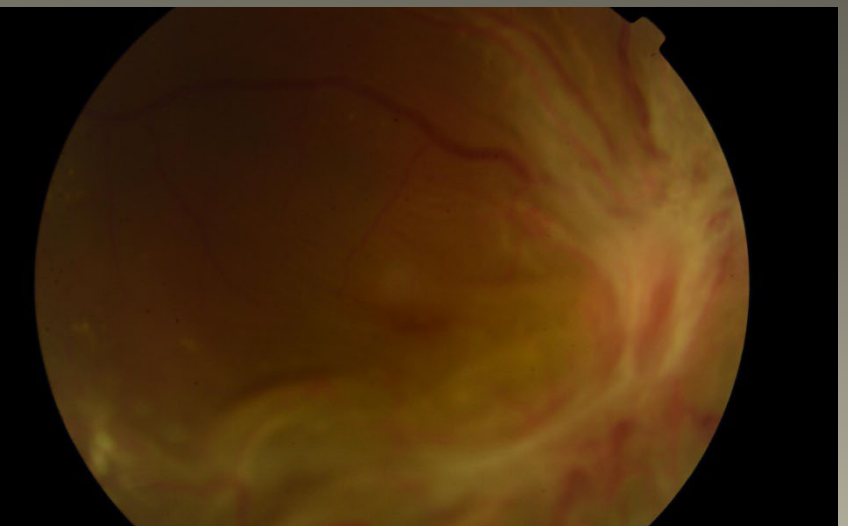




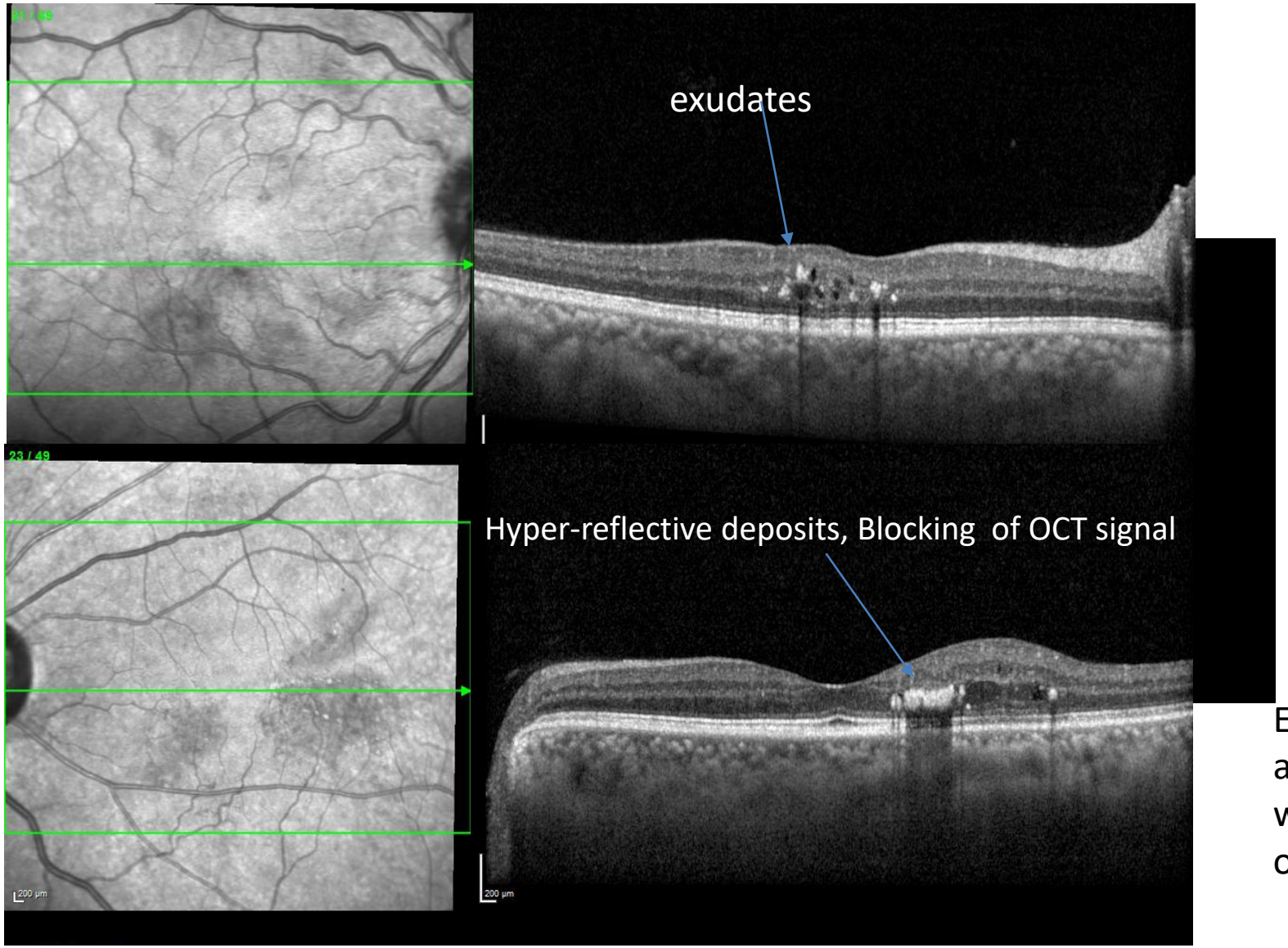








Exudates

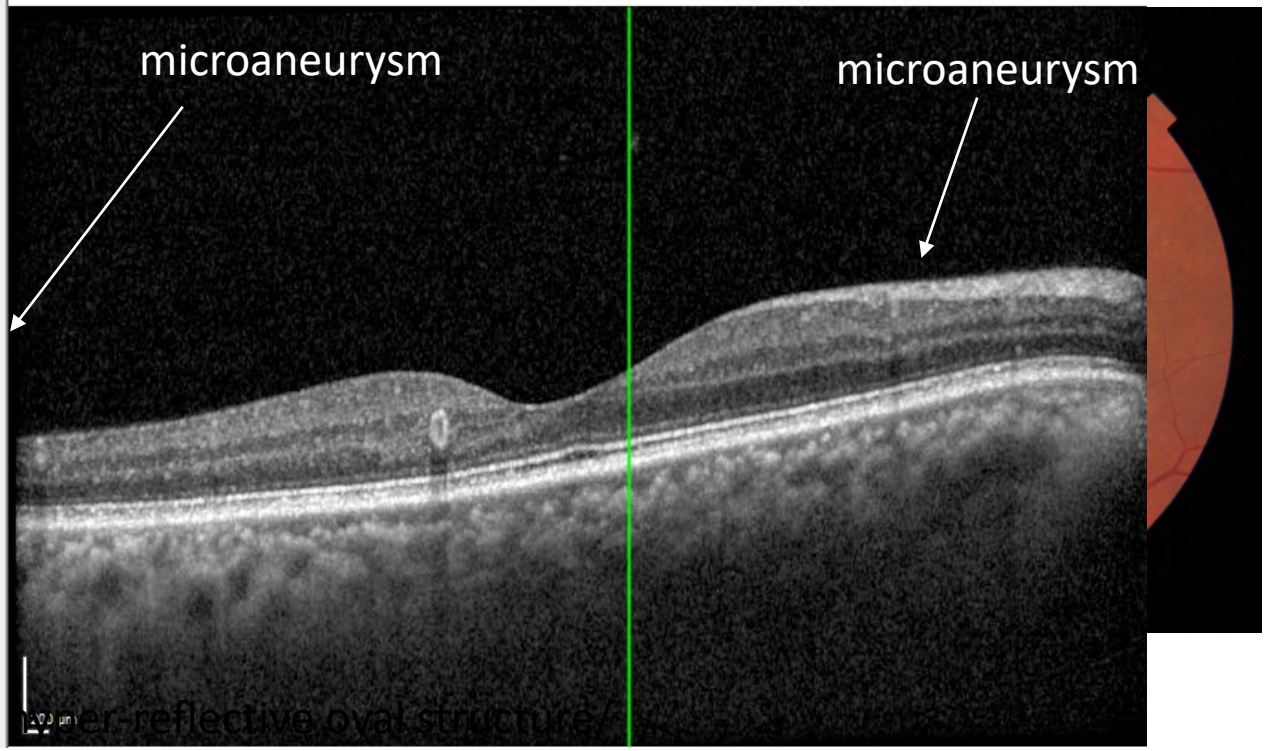


Exudates

Exudates which are depicted as hyper-reflective areas with shadowing behind them on the OCT scan

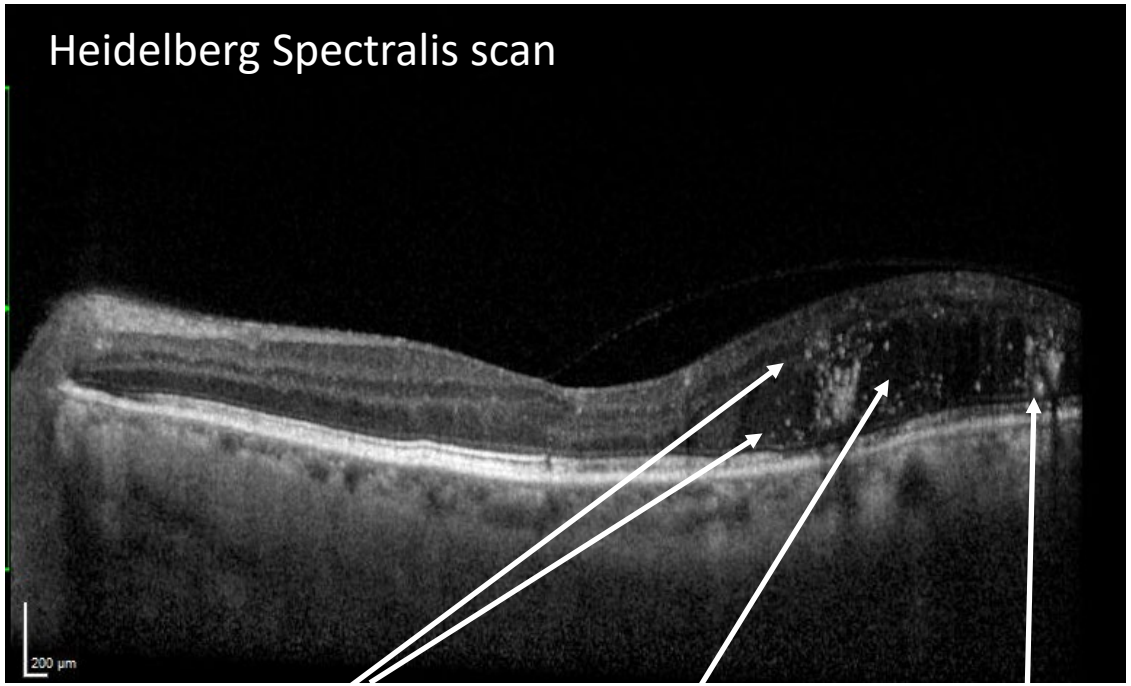
Microaneurysms

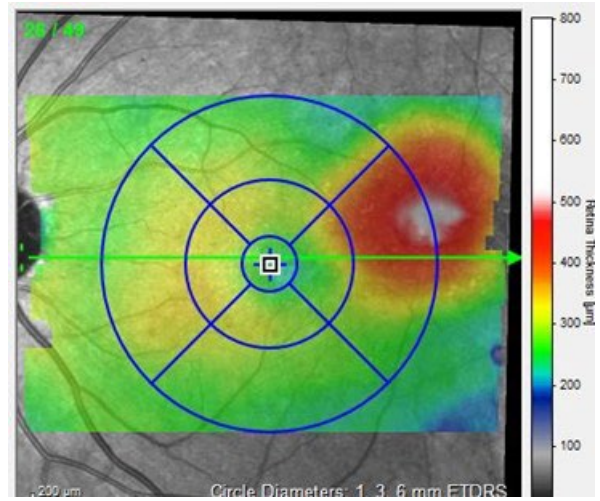
Topcon & Heidelberg OCT scans- showing an **OCT negative scans** for diabetic maculopathy

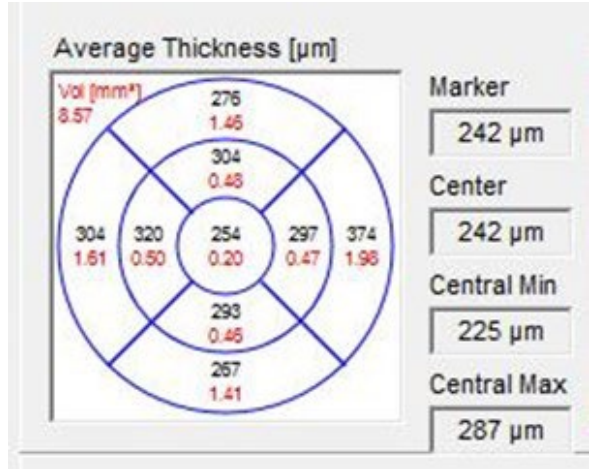


A micro-aneurysm which is depicted as a hyper-reflective oval structure / lumen with some mild shadowing behind it. Grade as OCT negative

Diabetic Macular Odema (CSME)/ Non-centre-involving







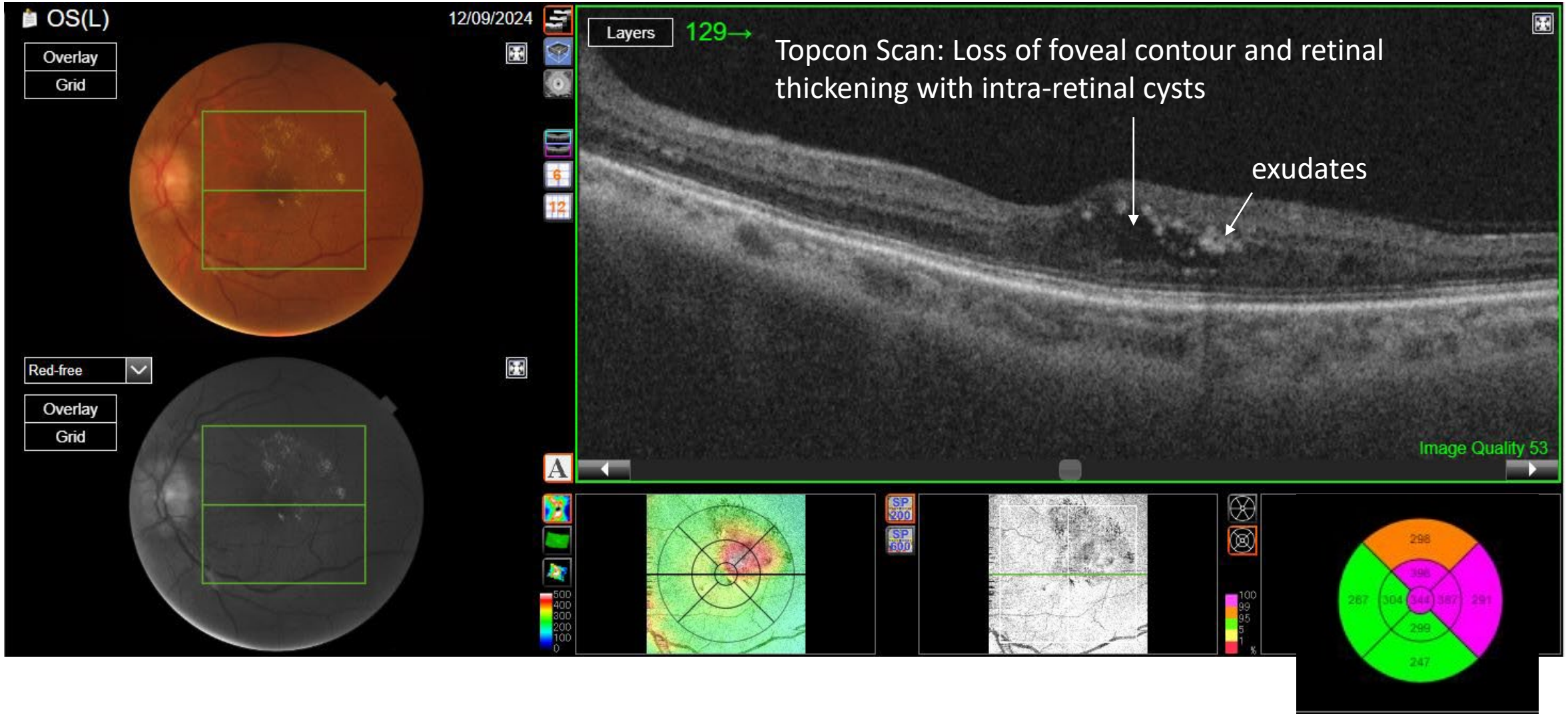
Area of thickening away from the central fovea secondary to diabetic maculopathy. Area > 1 disc area (DA). This would benefit from laser treatment.

Hyper-reflective dots

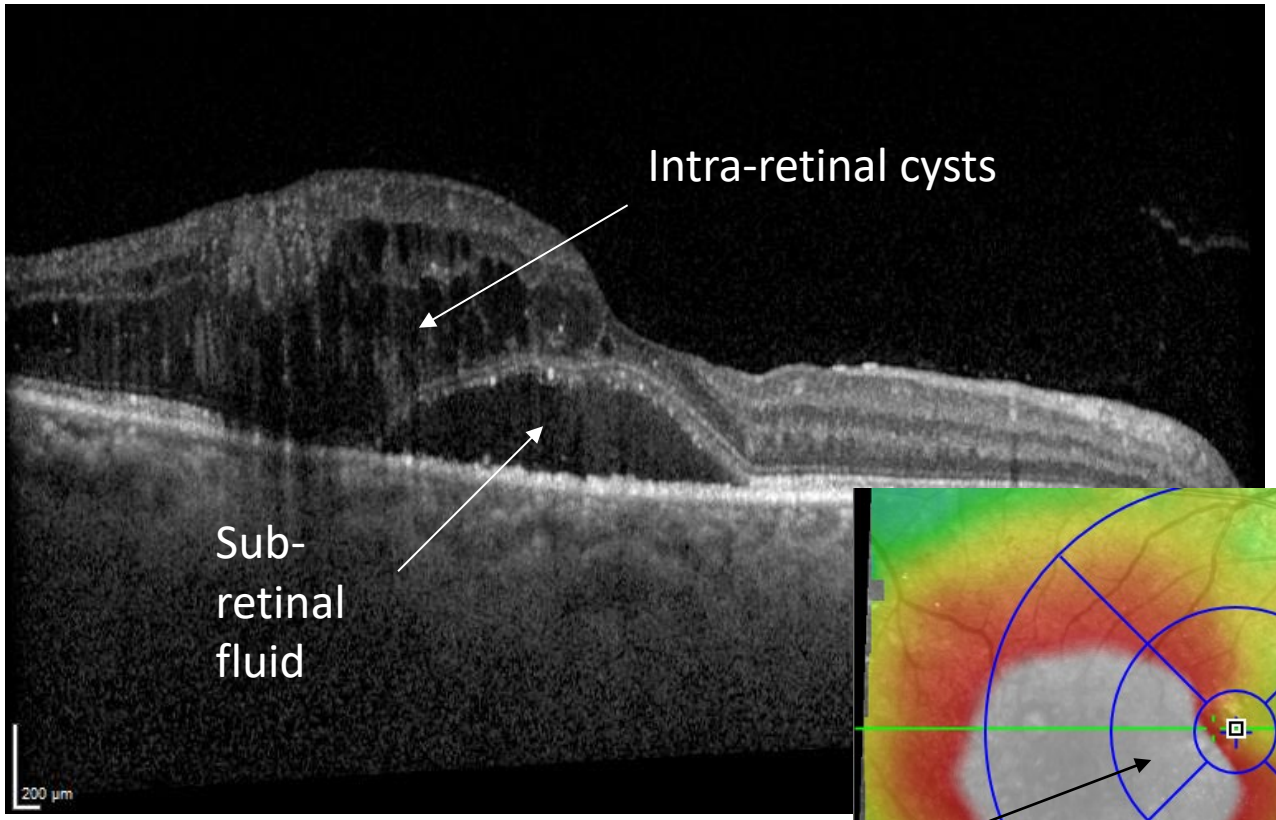
Intra-retinal cysts

Exudates

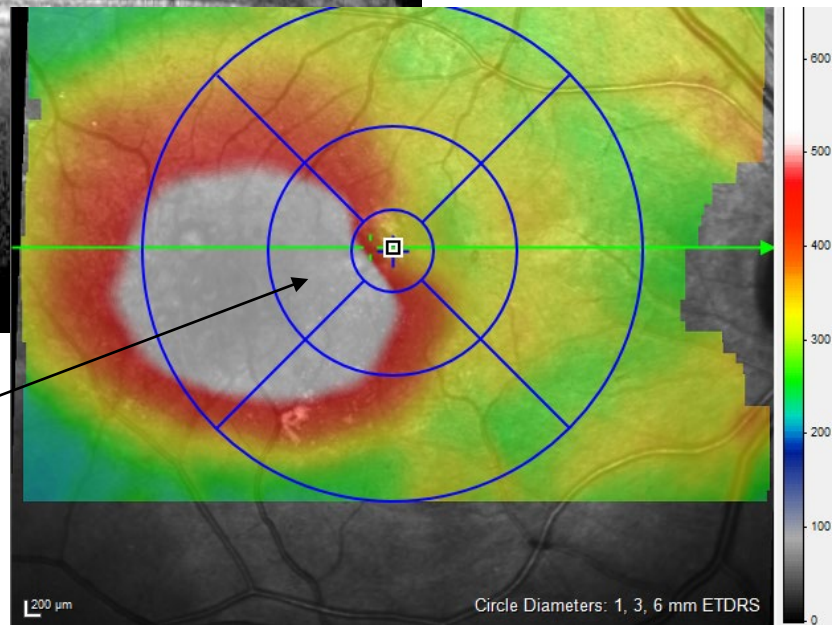
Diabetic Macular Odema (DMO)/loss of contour



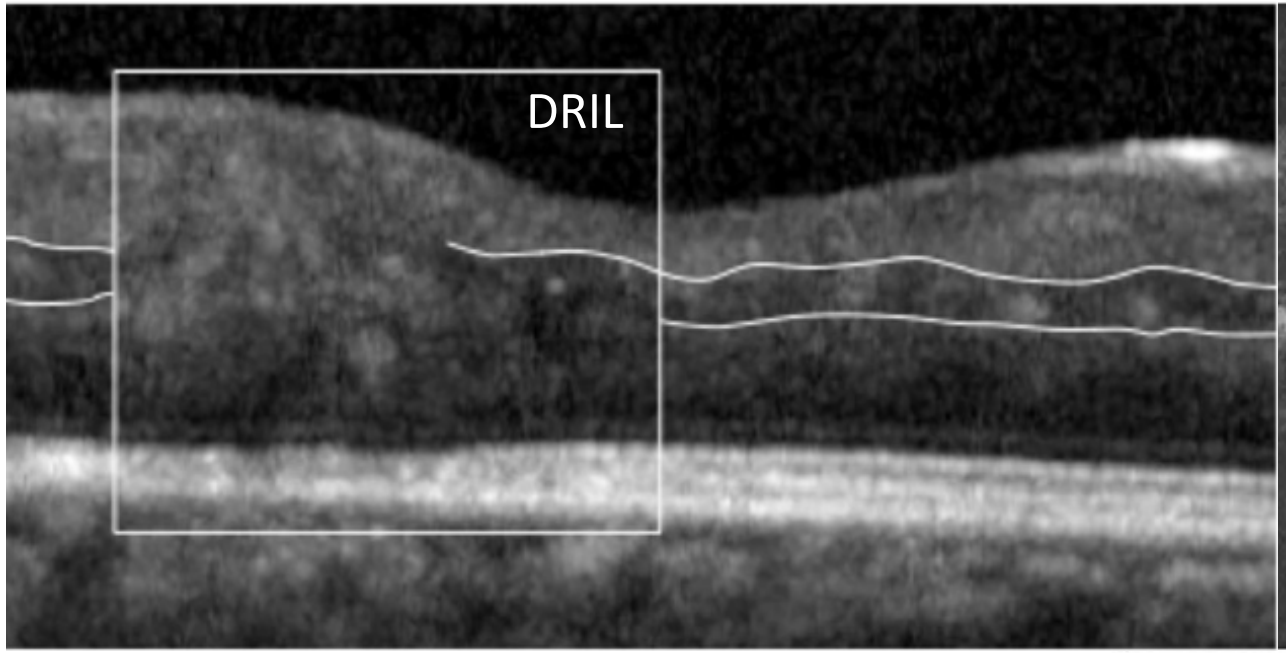
Advanced Diabetic Macular Odema (DMO) > 400 µm

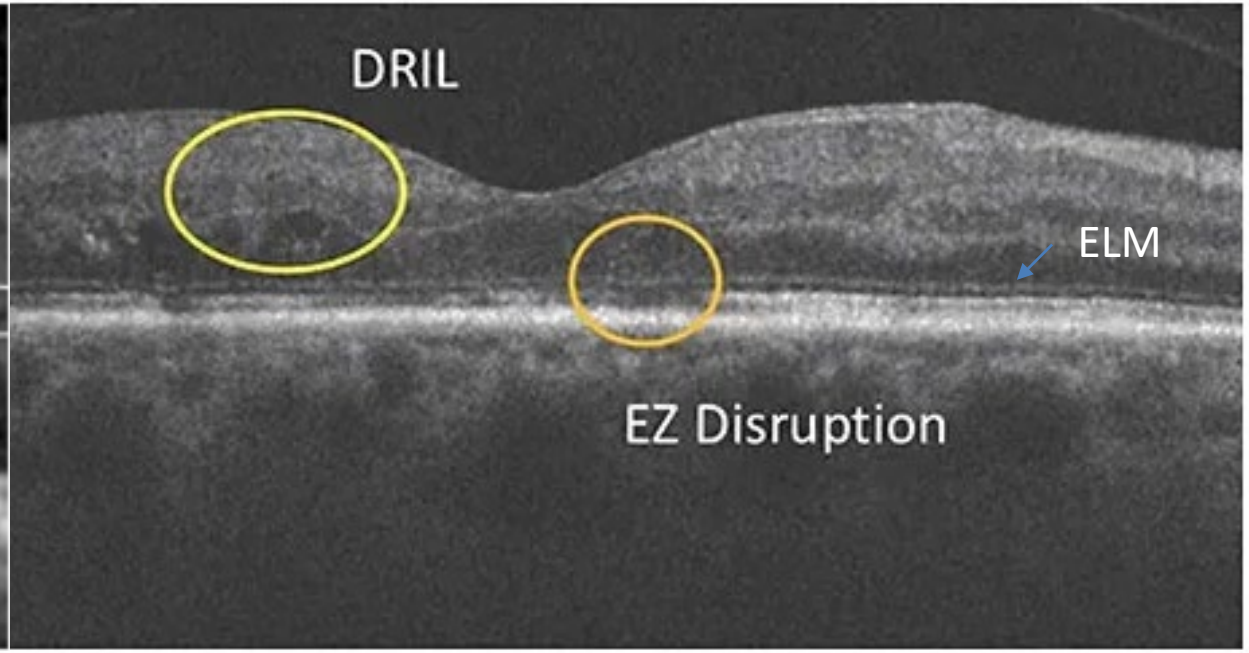


Extensive thickening of retina- requiring Anti-VEGF injections (refer within 4 weeks)



DRIL- Disorganisation of the Retinal Inner Layers

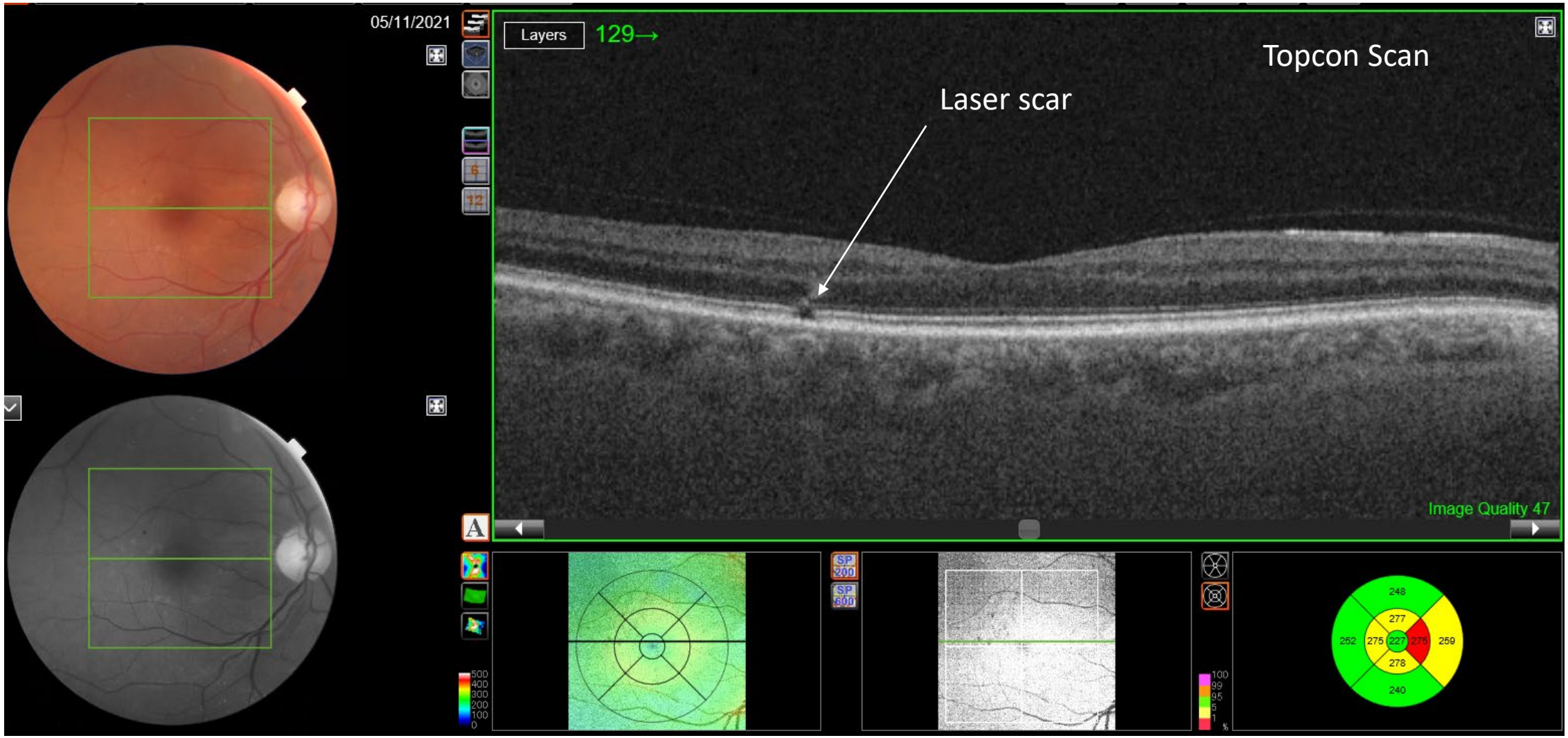




The integrity of the external limiting membrane (ELM) and the ellipsoid zone (EZ)/outer retinal layer, and disorganization of the retinal inner layers (DRIL) have all been linked to visual acuity prognosis.

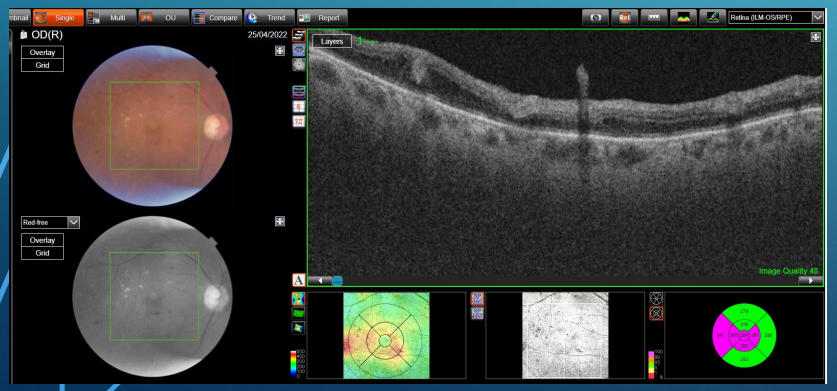
[Inflammation and DME roundtable discussion | Retinal Physician]

Scars from previous laser treatment



M1 / SURVEILLANCE OCT CLINICS

All M1 → OCT clinic Images graded by Senior graders



- OCT negative → Back to RDS under DESP
- OCT borderline → Stay in surveillance
- OCT Positive (no treatment) → Stay in surveillance
- OCT Positive (close to/ requiring treatment) → HES
- Non-DR pathology (AMD/CRVO/ VMT etc) → HES

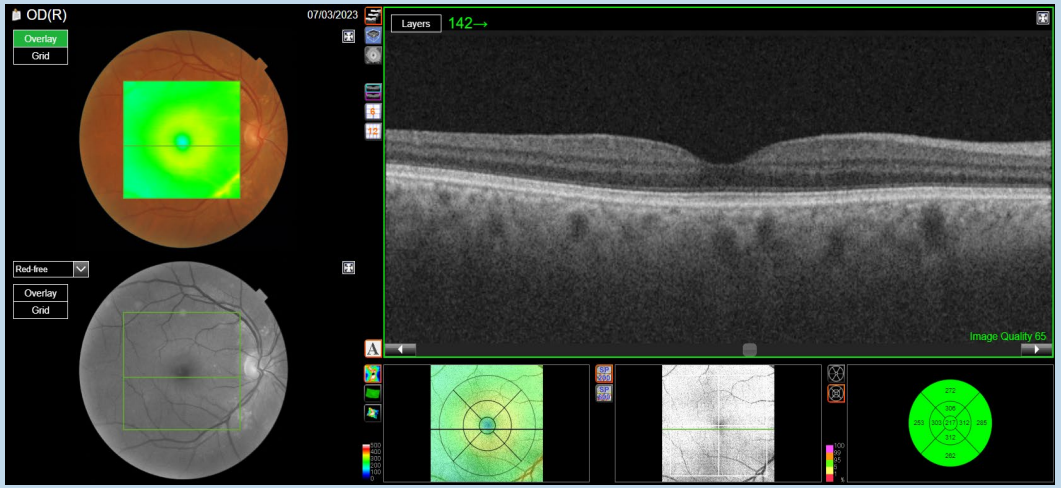
OCT GRADING

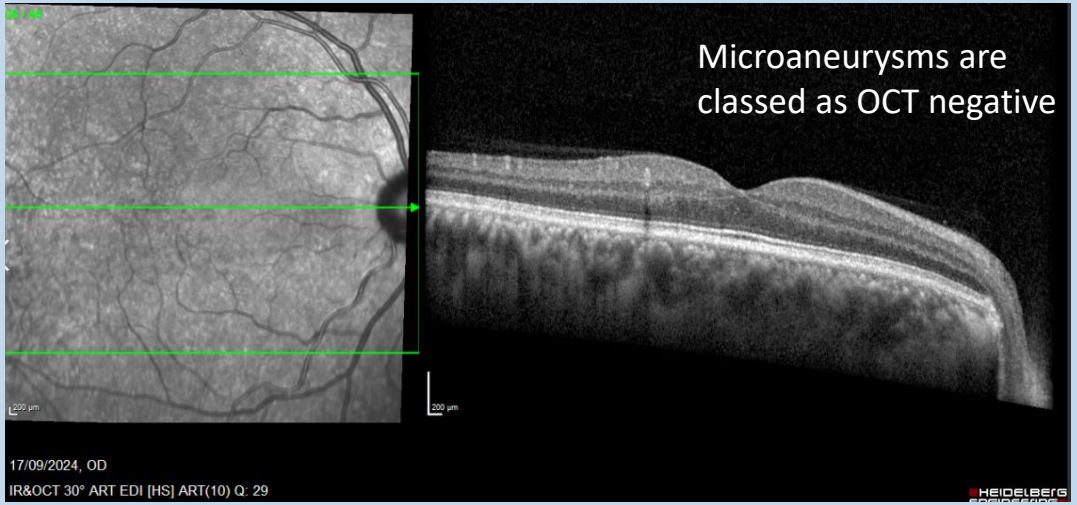
OCT Features - DR Related

OCT negative	**OCT negative**
☐ *No intraretinal cystoid space(s) or thickening in macula and no abnormality of ILM contour*	☐
OCT borderline	**OCT borderline**
☐ *Intraretinal cysts with no change in foveal contour [M1]*	☐
☐ *An area of retinal thickening less than 1-disc area within the macula [M1]*	☐
OCT positive	**OCT positive**
☐ *Intraretinal cysts and a change in the foveal contour [M1]*	☐
☐ *Intraretinal cysts and an area of retinal thickening >= 1/2 disc area within 1DD of fovea [M1]*	☐
☐ *Intraretinal cysts and an area of retinal thickening >= 1 disc area within the macula area [M1]*	☐

OCT NEGATIVE

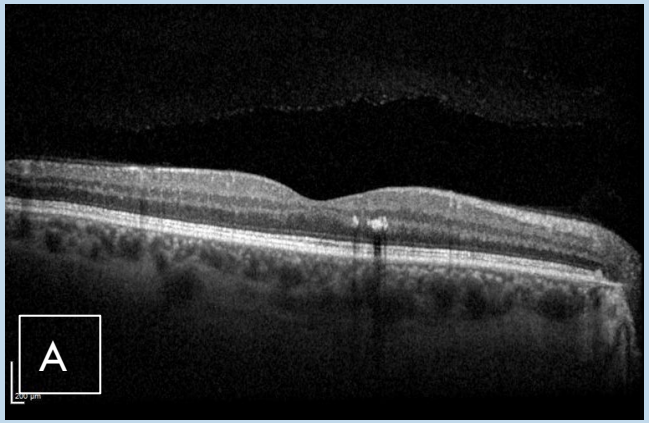
OCT negative is defined as the absence of features required to meet the OCT positive or borderline criteria

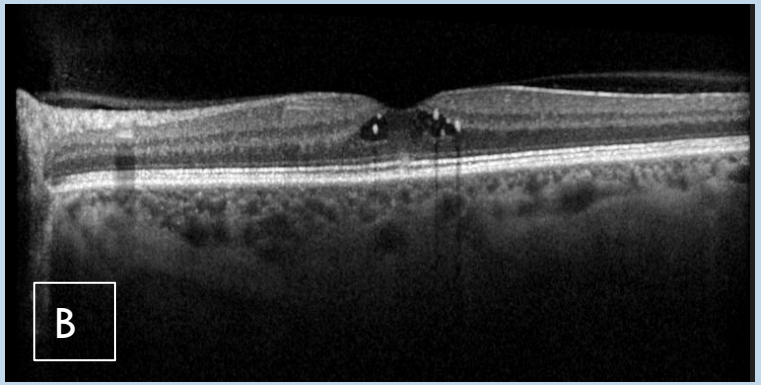


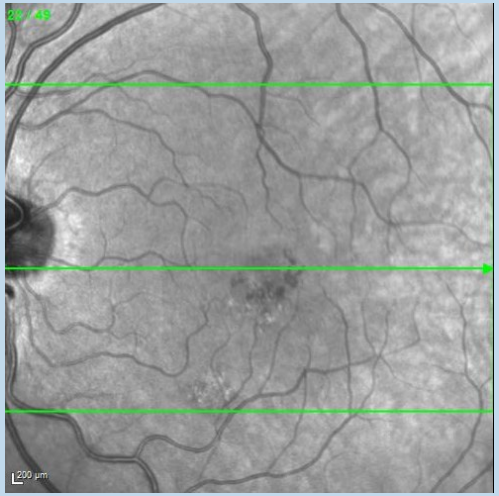


OCT borderline

Intra-retinal single lesions / cystic space or spaces on a single scan with no change in the ILM contour (examples A or B)

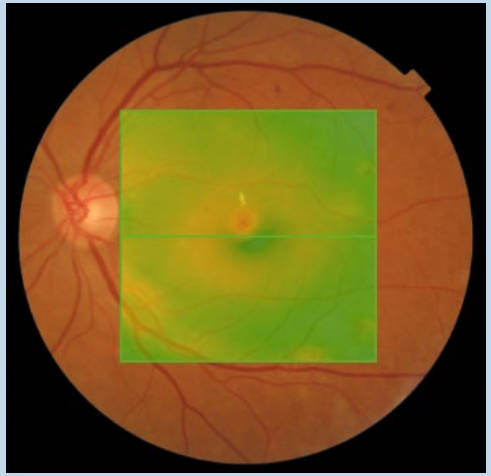


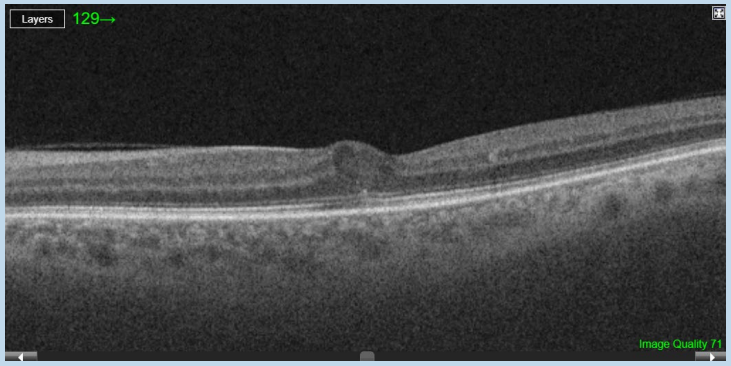




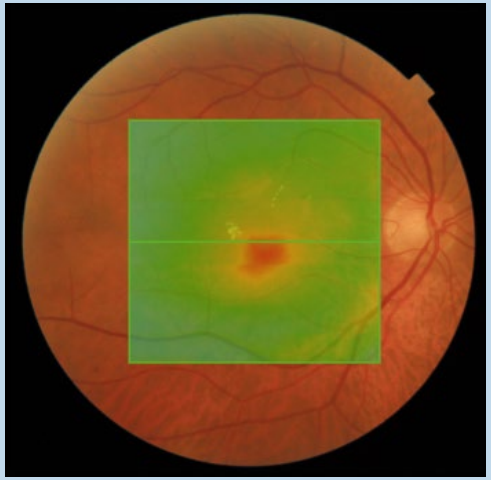
OCT POSITIVE -3 DEFINITIONS

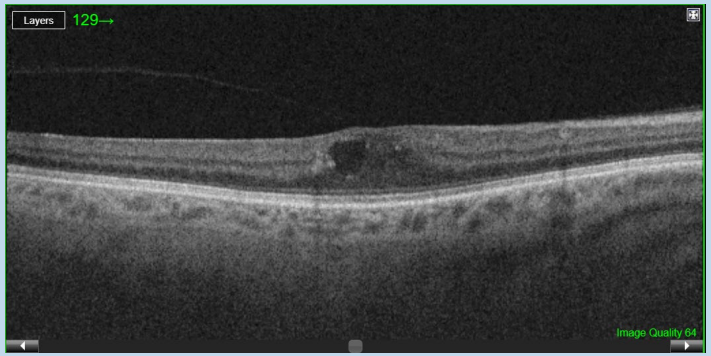
(1) Any cystic change in the retina from diabetes resulting in a change of the foveal ILM contour (will include centre-involving DMO)



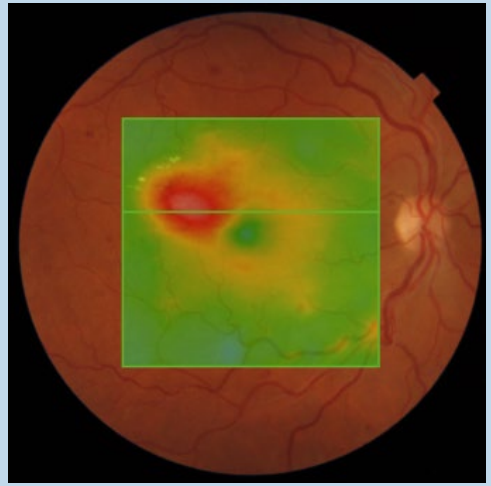


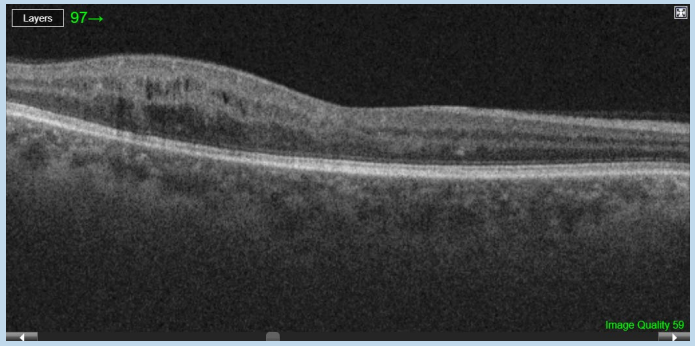
(2) An area of parafoveal retinal thickening of greater than ½ disc area within 1 disc diameter of the central fovea





(3) An area of retinal thickening greater than 1 disc area within the NHS DESP definition of the macula

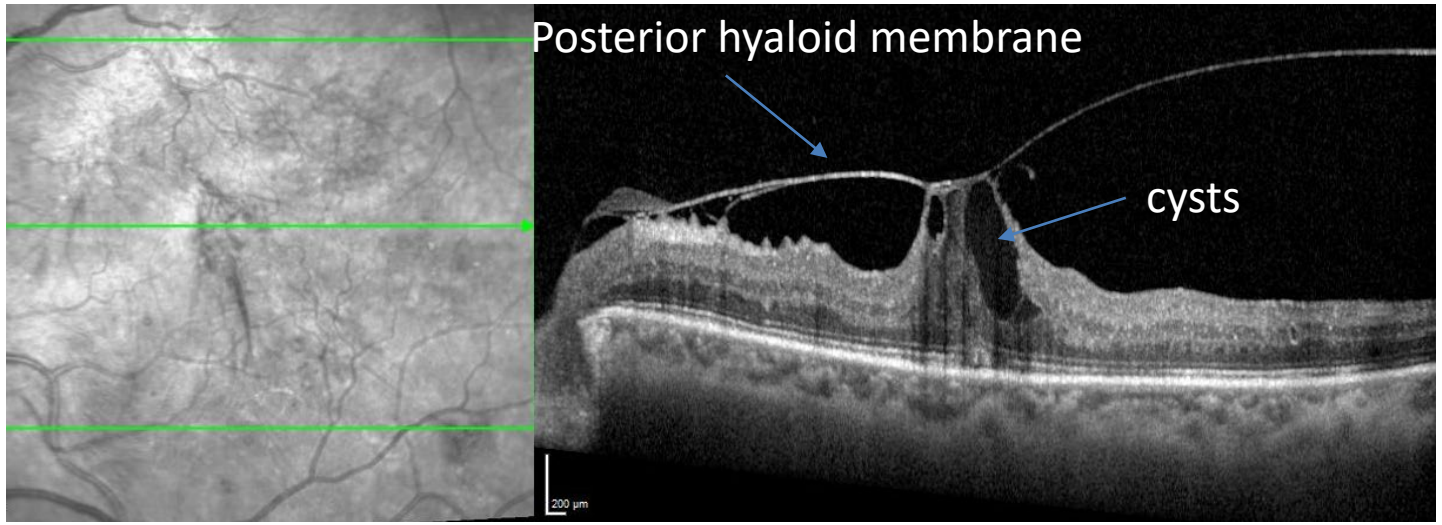


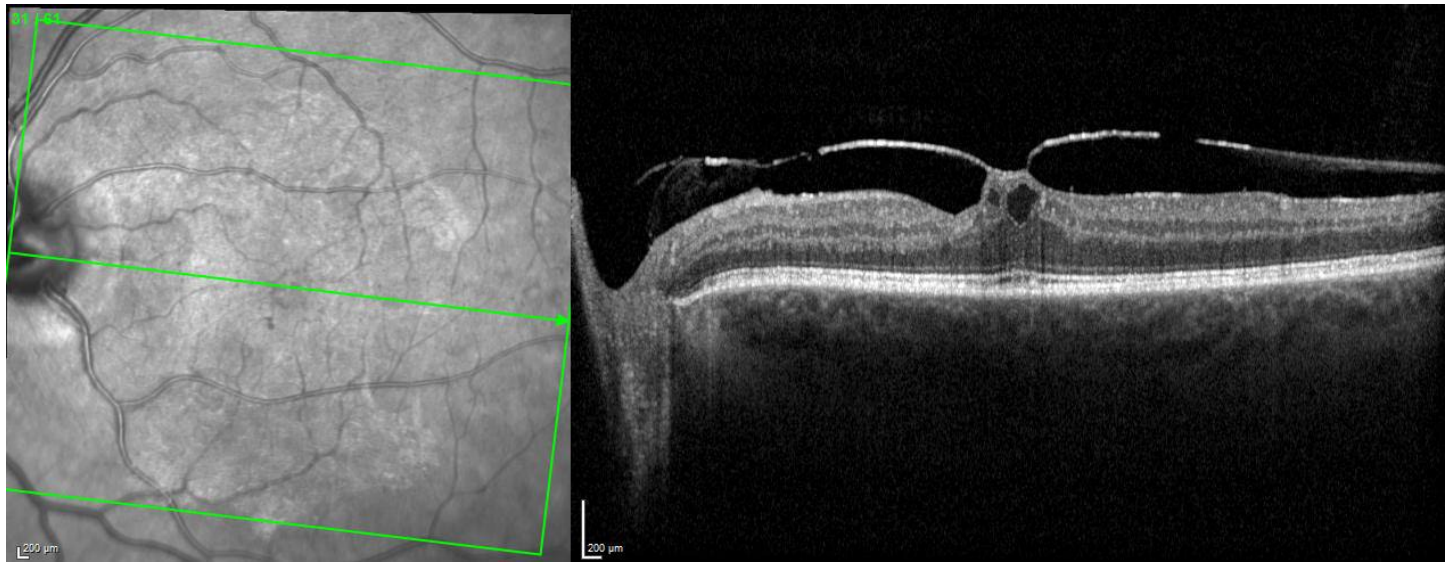


OCT workshop

NON-DR CASES

Vitreomacular traction



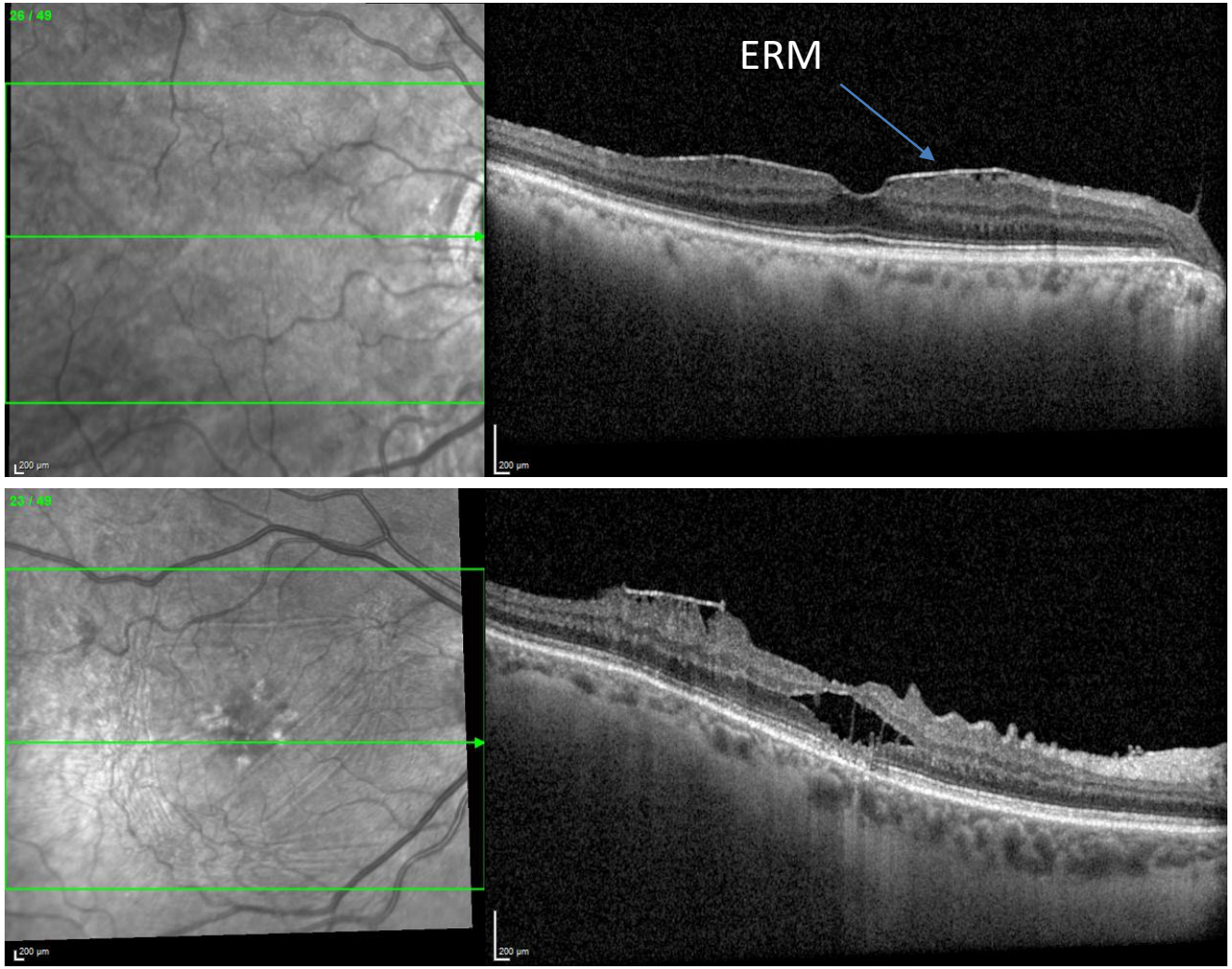


Caused by traction from the vitreous during a posterior vitreous detachment.

Can cause distortion of vision

Occasionally requires referral for surgical intervention

Epiretinal Membrane



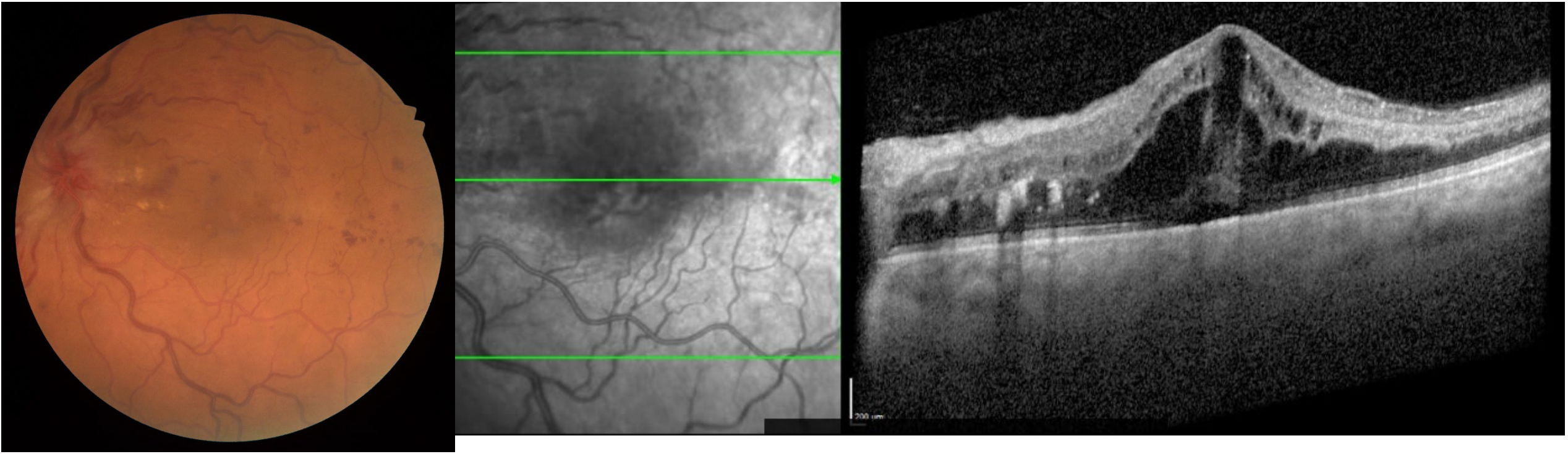
Also known as ‘macular pucker’
Caused by traction from the vitreous following a posterior vitreous detachment (PVD)

Can be associated with a vein occlusion or any surgical procedure in the eye. More common in diabetes or inflammation in the eye.

Can cause distortion of vision

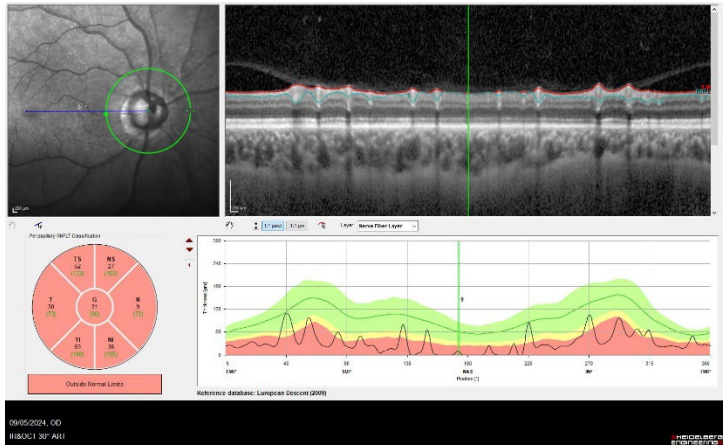
Occasionally requires surgical intervention

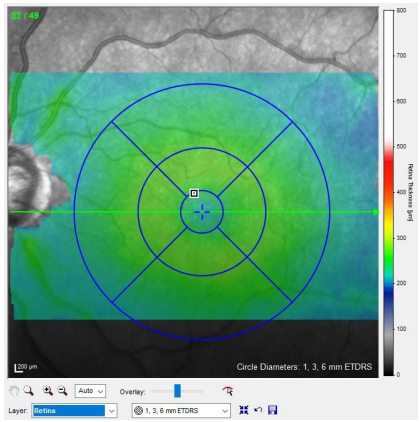
Hemi-Vein Occlusion/ CRVO/ CMO

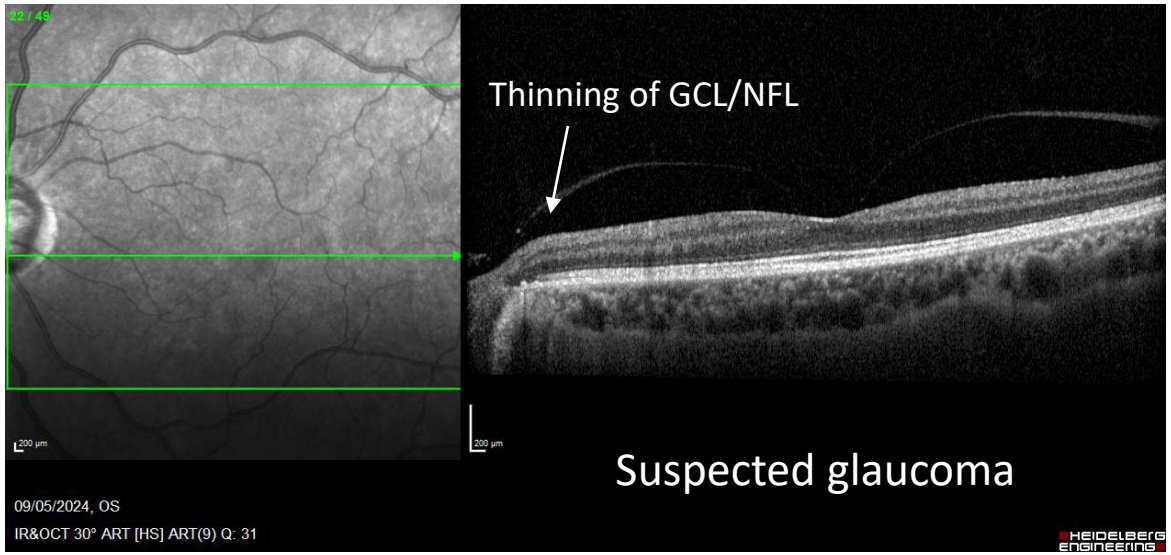


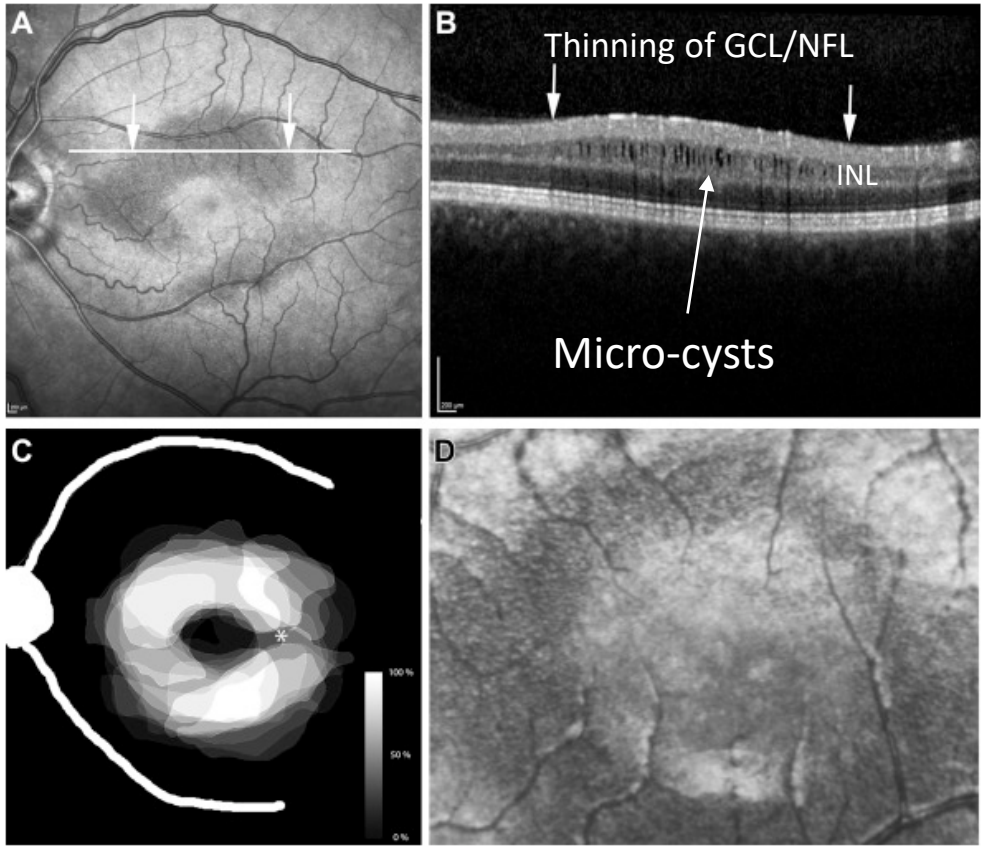
Most retinal layers involved with multiple cysts and sub-retinal fluid (SRF). Also occurs in CRVO and BRVO

Glaucoma/ NFL thinning/ Optic neuropathy





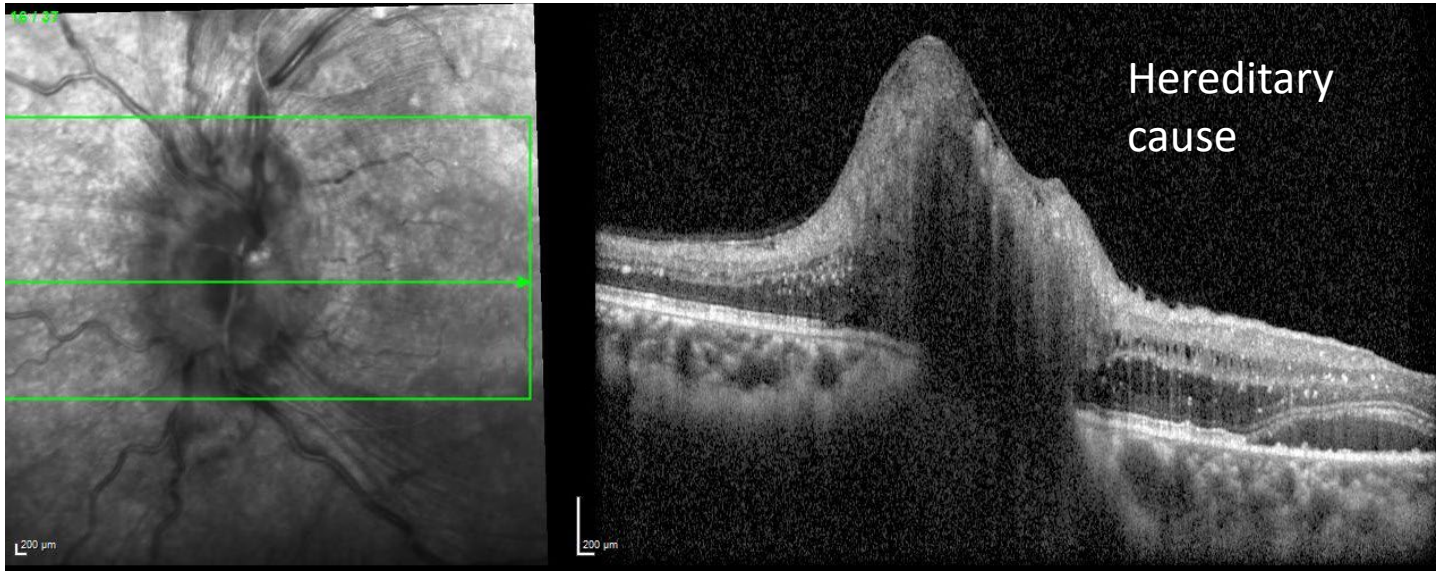


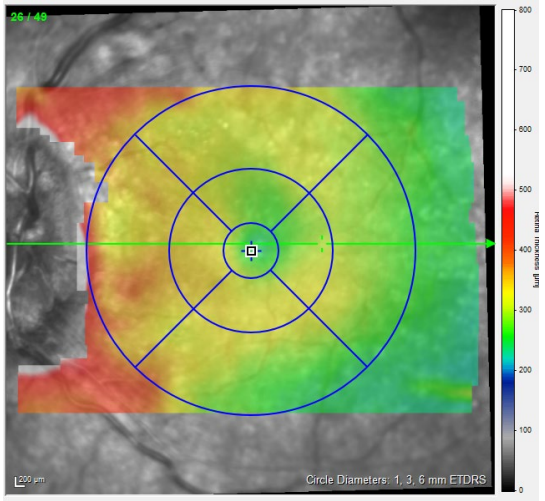


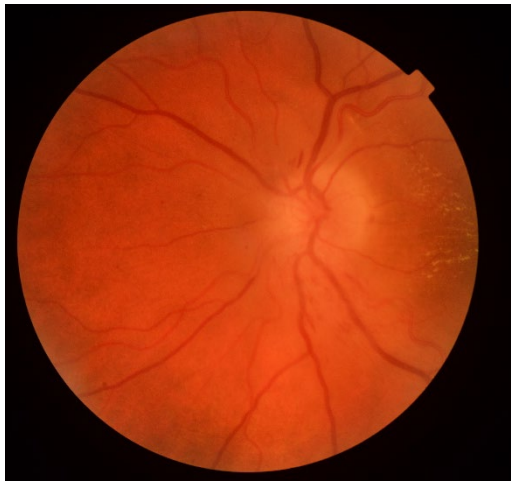
Suspected optic neuropathy

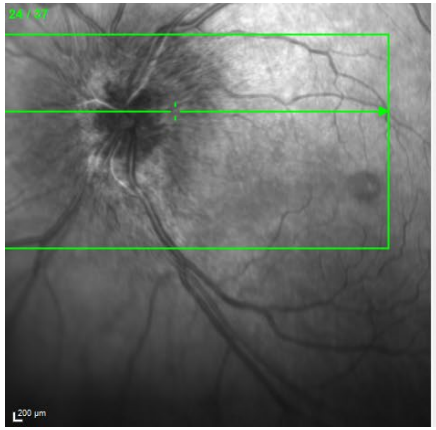
Microcystic Macular Edema. Abegg, Mathias et al. Ophthalmology, Volume 121, Issue 1, 142 - 149

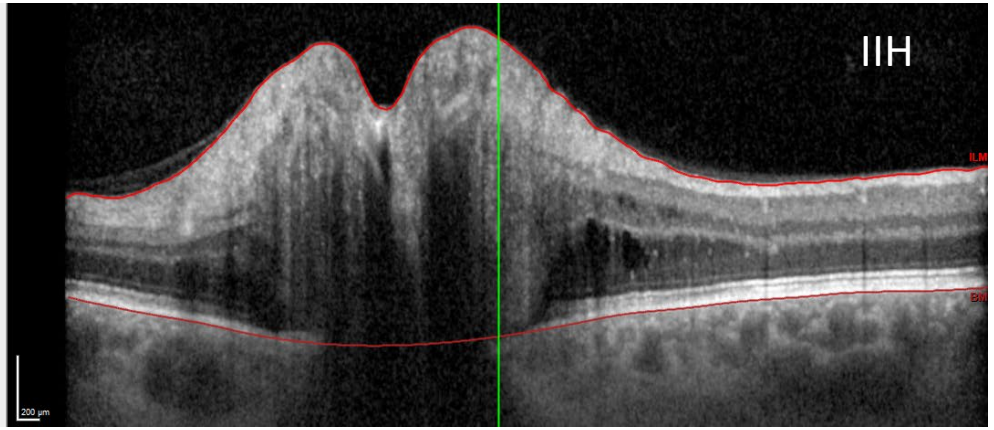
Swollen Optic Disc

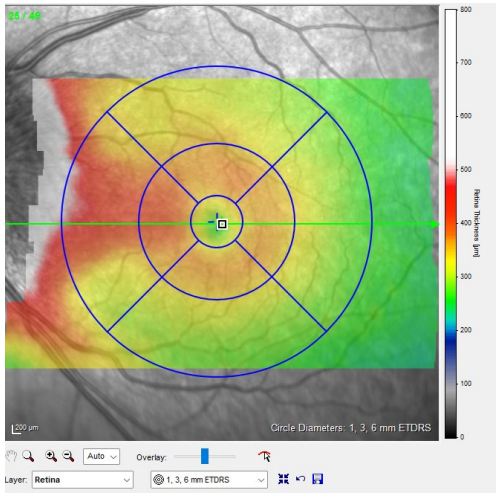




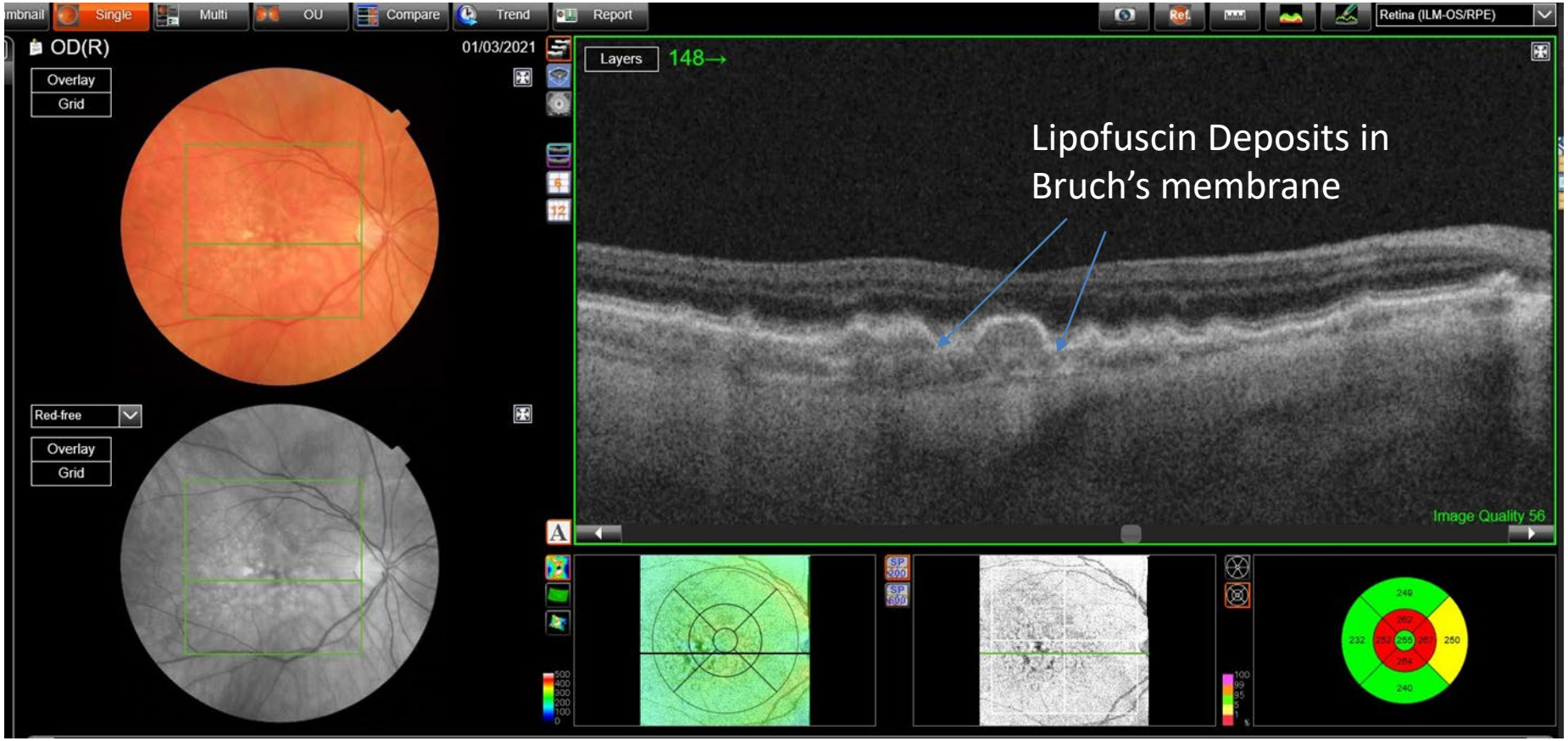




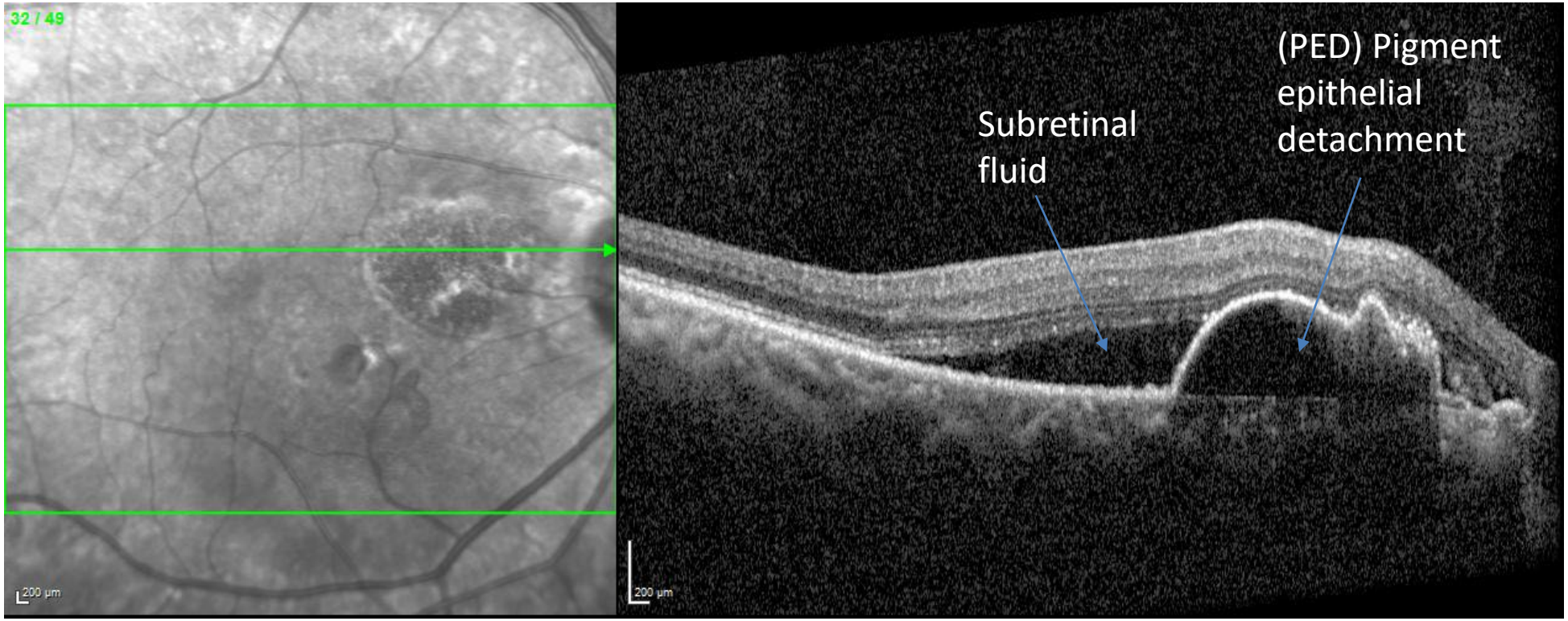




Drusen Deposits

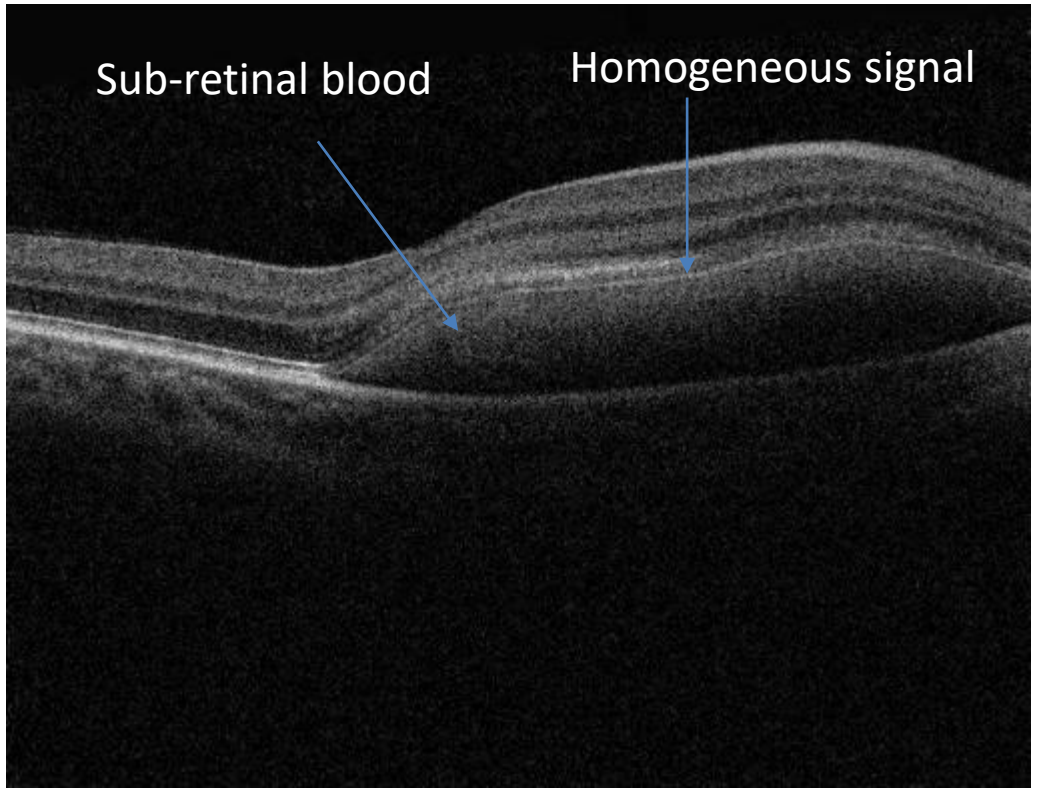


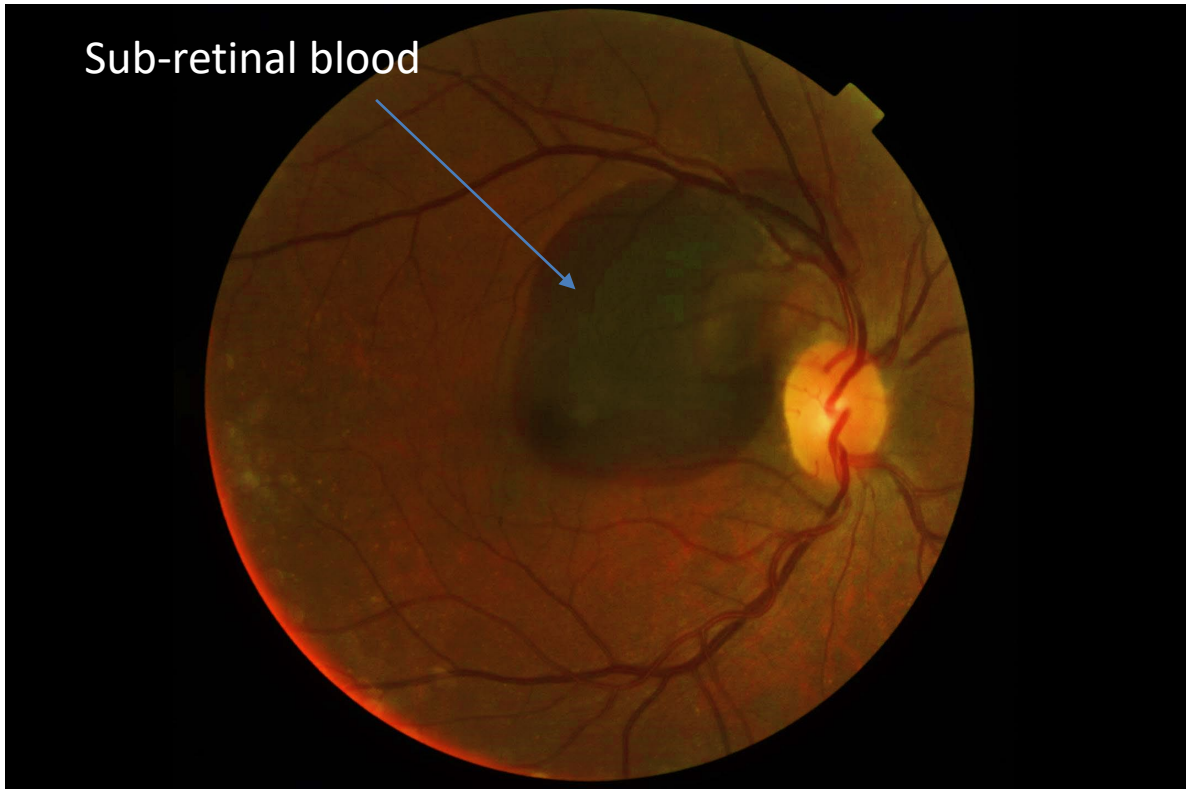
Sub-retinal leakage/ PED- Wet AMD



Not due to Diabetes/ Refer urgently for anti-VEGF treatment within 2 weeks

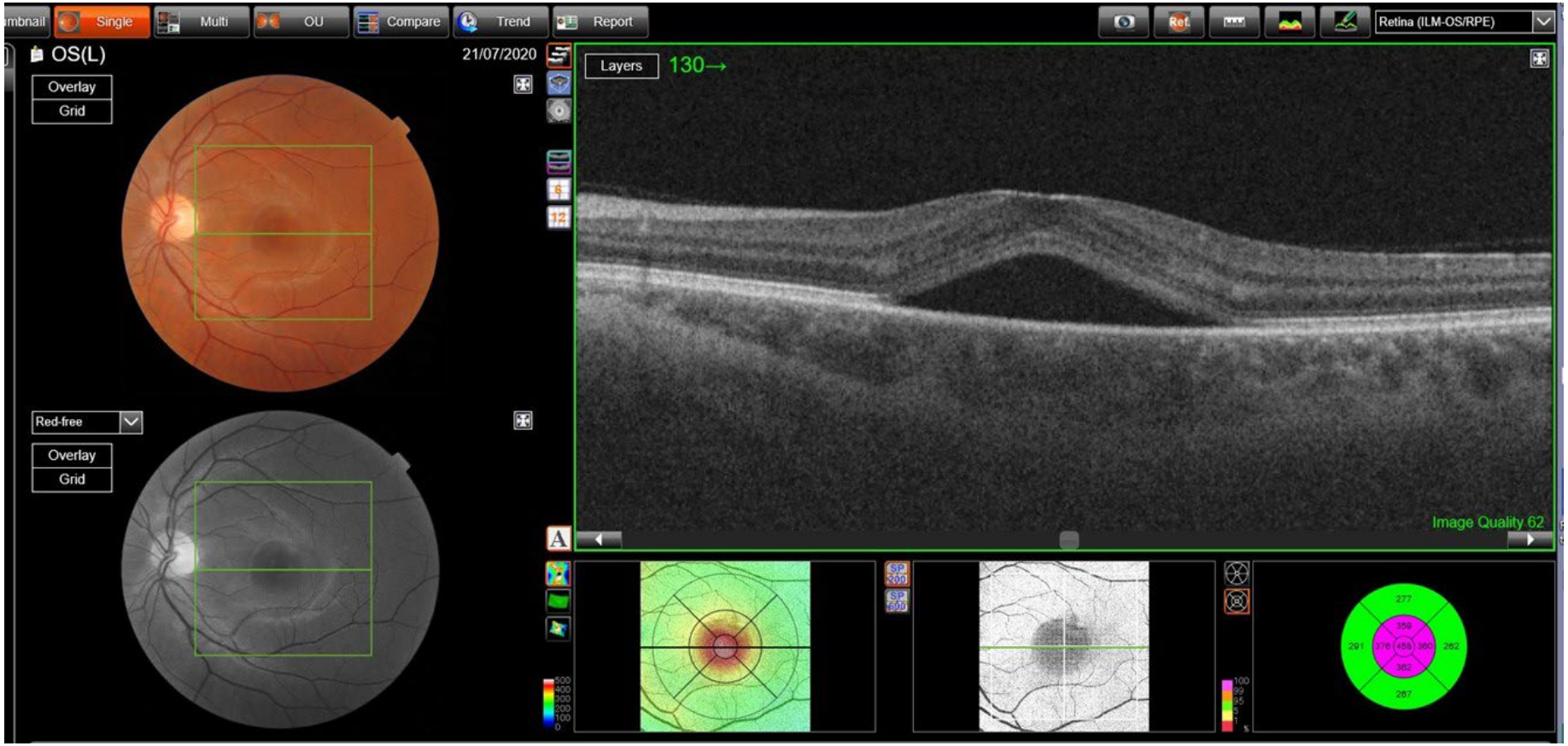
Subretinal haemorrhage-Never due to Diabetes! IPCV





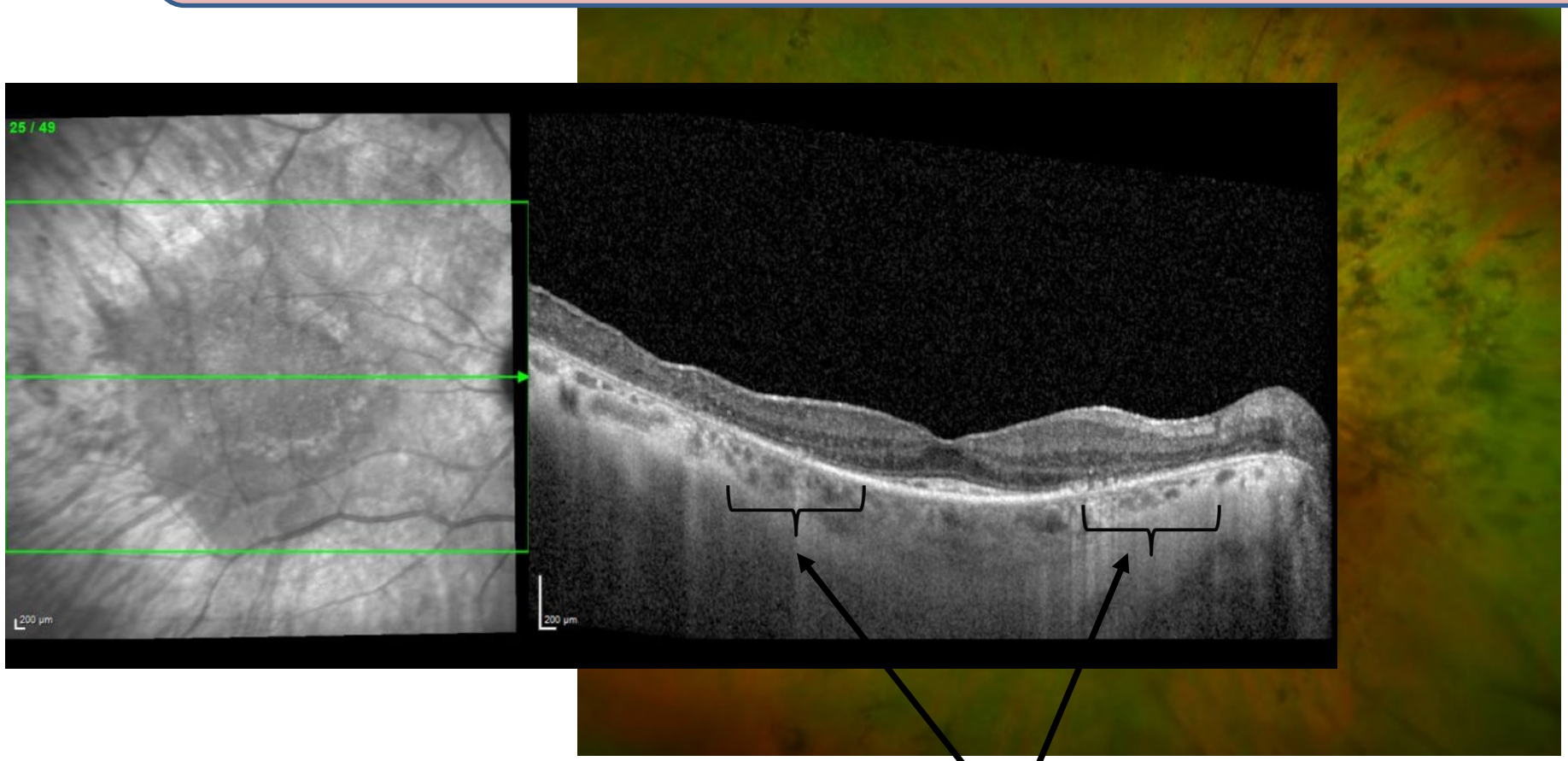
Caused by a variant of AMD, Idiopathic Polypoidal choroidal vasculopathy (IPCV)- refer Urgently

Central Serous Retinopathy (SRF)



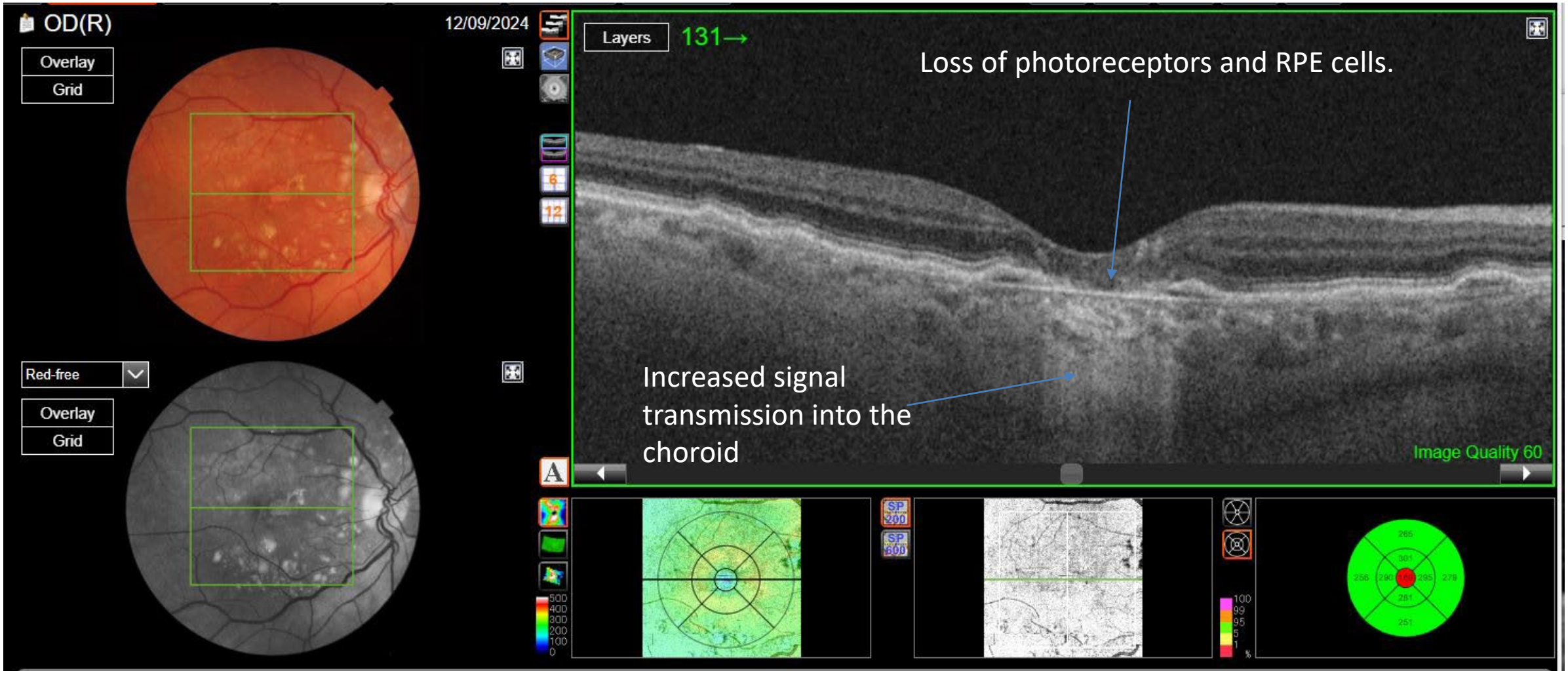
Occurs more common in younger males/ Can resolve spontaneously/ may require referral if chronic

Retinitis Pigmentosa

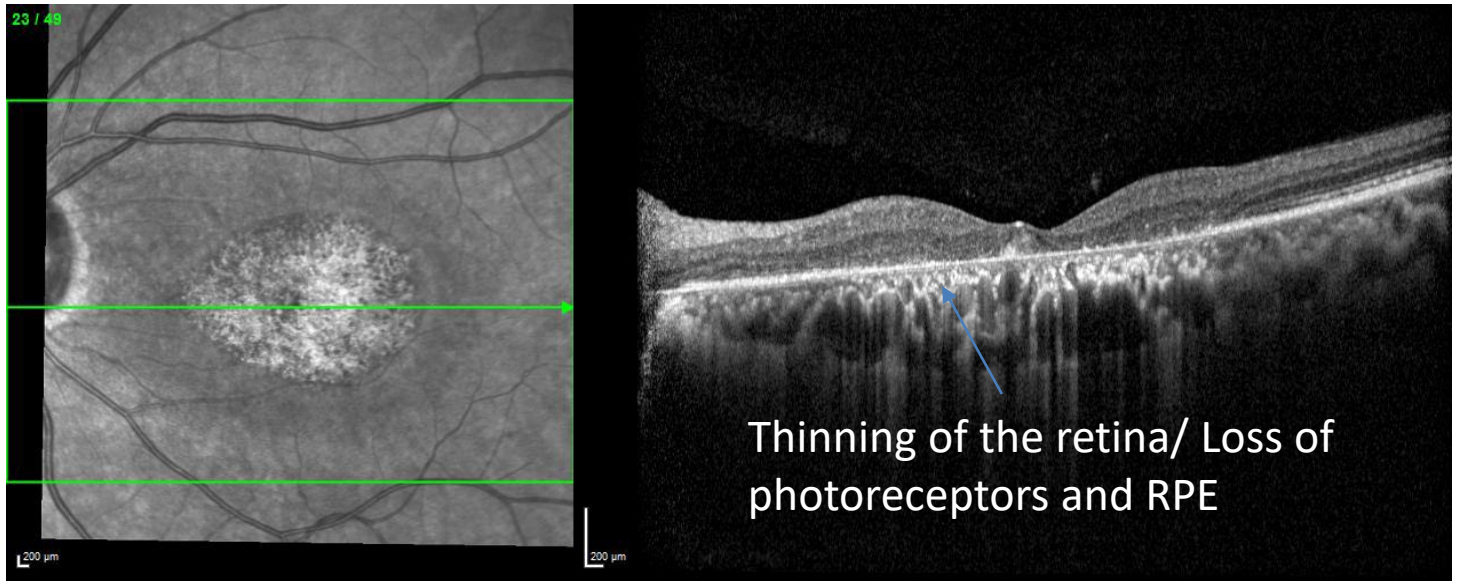


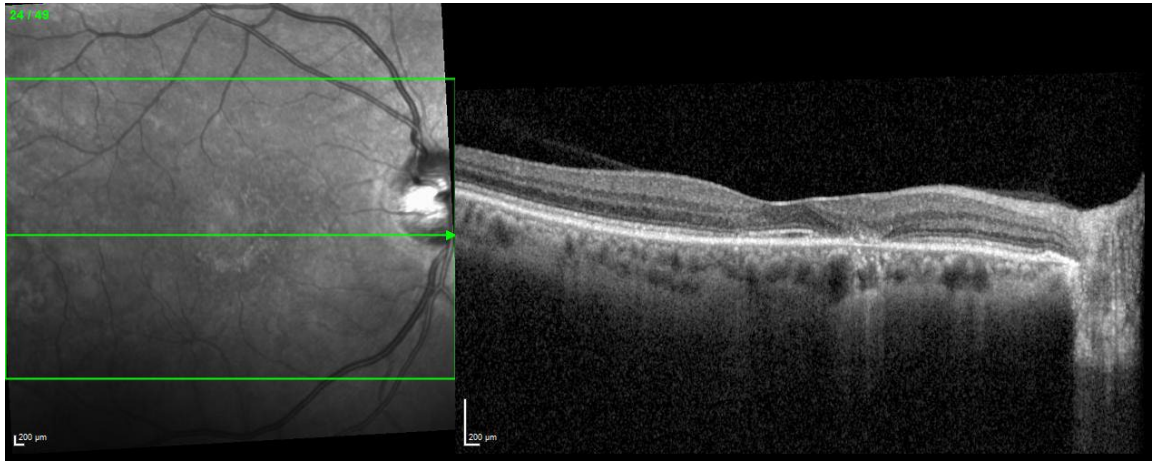
Loss of Outer Retina and Photoreceptors- thinning of retina

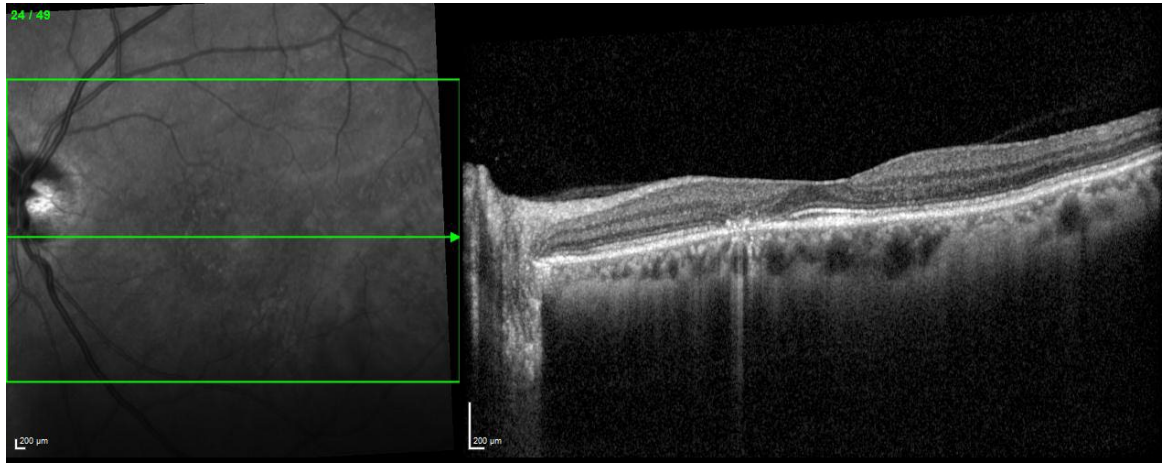
Dry/ Atrophic AMD



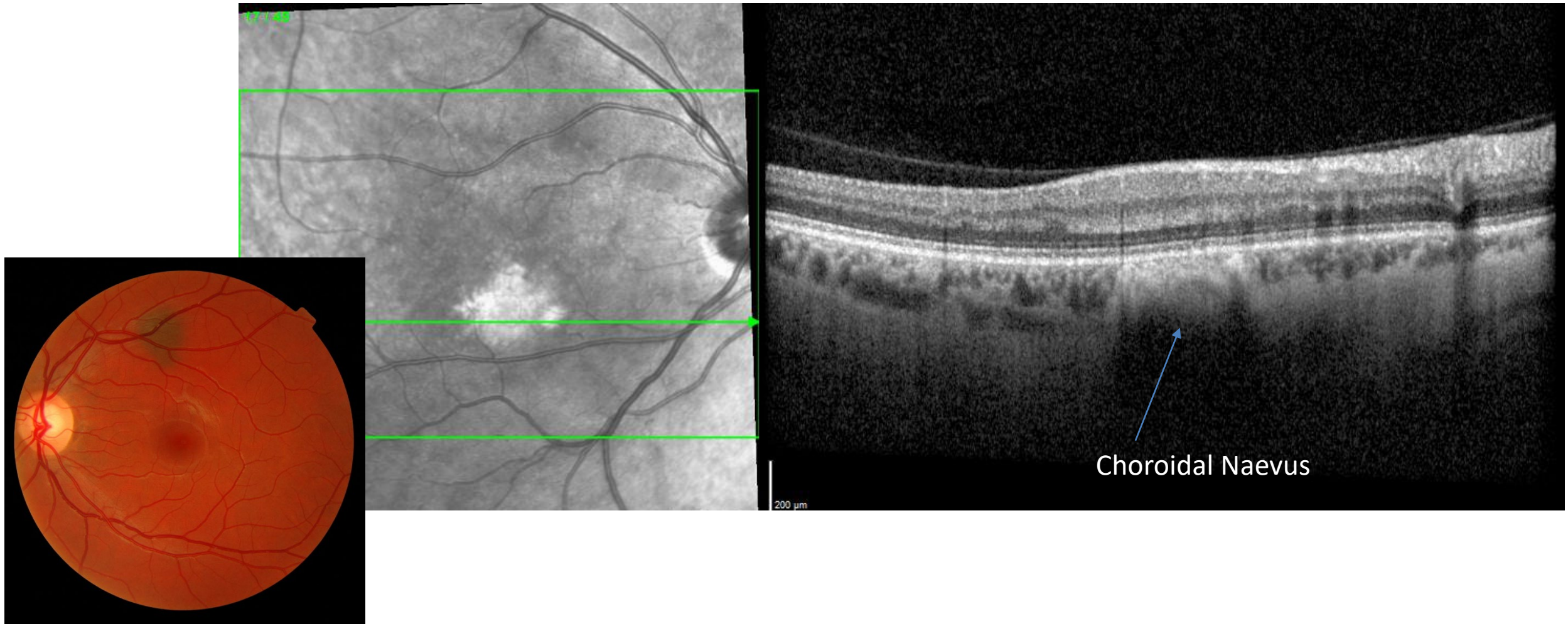
Hydroxychloroquine toxicity/ Bulls eye maculopathy



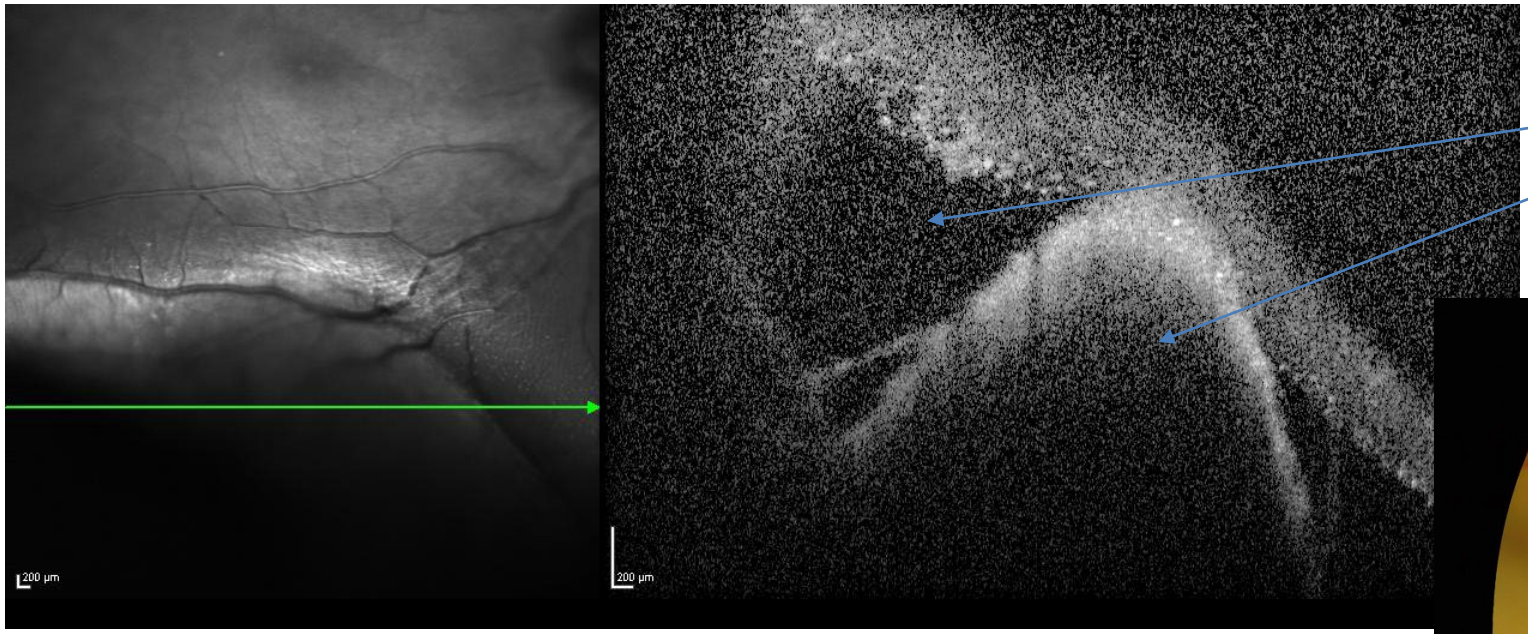




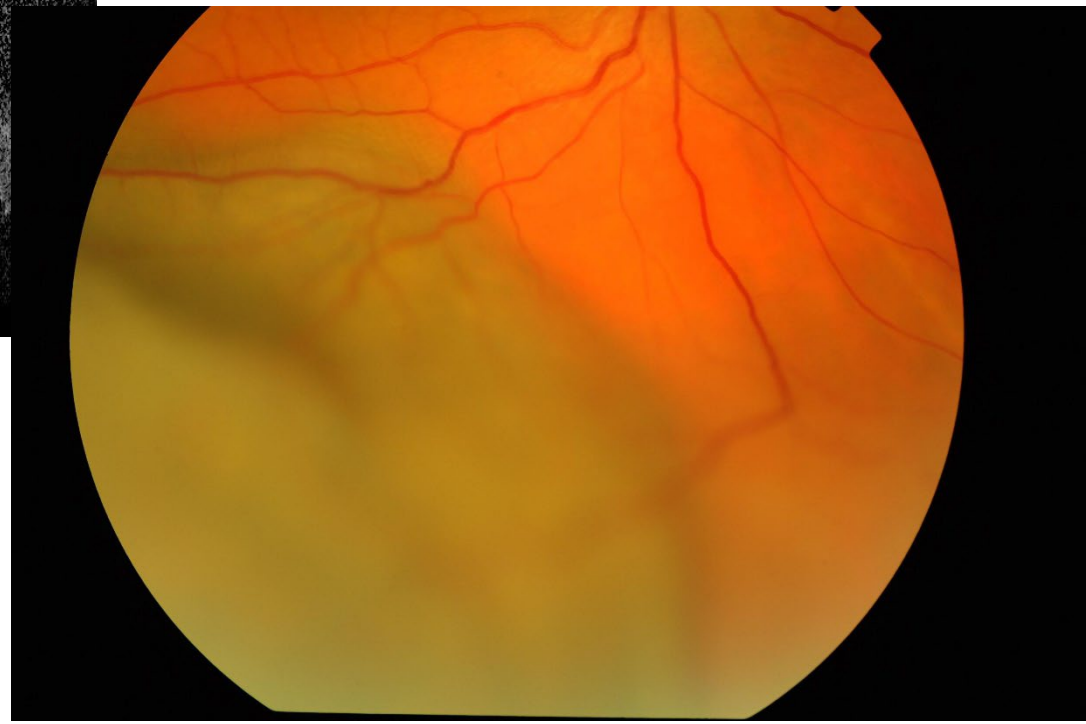
Choroidal Naevus



Choroidal Melanoma



Elevated tumour with sub-retinal fluid (SRF)



QUIZ TIME