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EGYPTIAN OPHTHALMOLOGICAL SOCIETY
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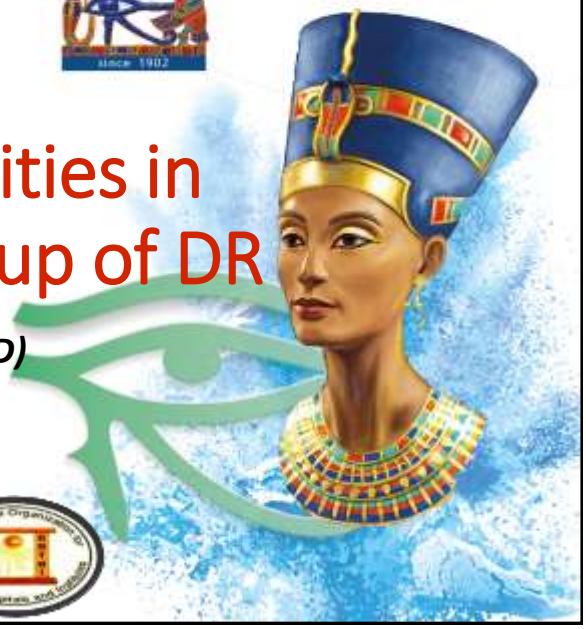

Multi-image modalities in diagnosis and follow up of DR

***Mohammed Shikhoun Ahmed** (MD)*

Assistant professor of ophthalmology at **(GOTHI)**

Head of Ophthalmology department Sohag Teaching Hospital

Vitreo-retinal consultant

While the primary method for diabetic retinopathy diagnosis by clinical examination which considered the basic method, various imaging modalities are of significant utility in the screening, evaluation, diagnosis, and follow up of the different stages of DR.

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Remember

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Multiple images commonly used

1. ***Fundus photography (FF).***
2. ***Fundus fluorescein angiography (FFA)***
3. ***Optical coherence tomography (OCT).***
4. ***Optical coherence tomography with angiography (OCTA)***
5. ***Ultra-wide-field imaging (wide field FAF, wide field FFA)***
6. ***Ultrasonography.***
7. ***Electro-retinogram****(pERG, ffERG, mfERG)* ***, Visual evoked potential*** *(pVEP, flash VEP)*

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- Is it possible not to use any images??
- What is the 1st one you prefer to start with??
- What is the Best one??
- Can we use multiple images together??
- What are we looking fore??

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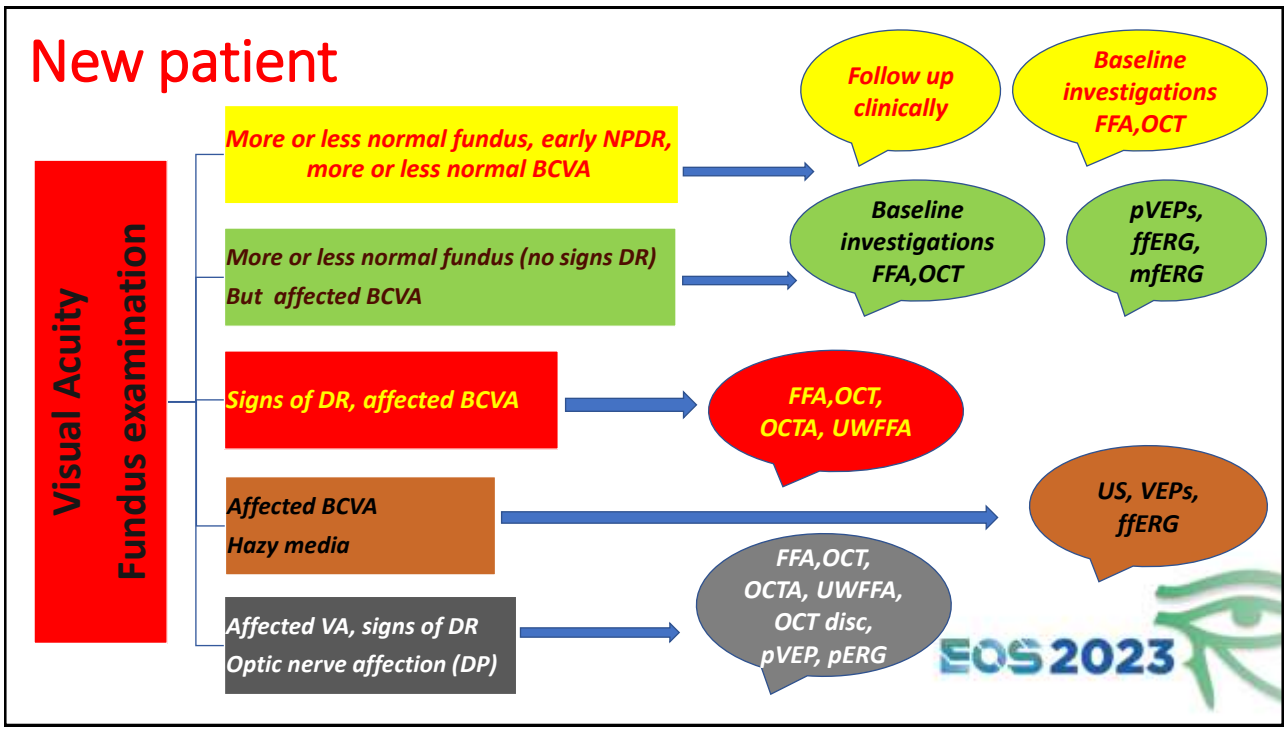


1-Fundus photography

❖**Colour Fundus photography:**

- Documents all signs of DR which seen in binocular microscopy examination.
- Gives a good idea and documents Peripheral retina.

❖**Red free Fundus photography:**

- Taken with the yellow-green barrier filter which blocking red light, so red structures appear black with good contrast, so vasculature and hemorrhages identified easily.
- Visibility of retinal nerve fiber layer defects and other retinal details like cotton wall spots and hard exudates appear more clear.

2- Fundus Fluorescein Angiography

❖**Advantages:**

- Reliable , familial , all findings, staging of DR can be demonstrated.
- Documents colour, red free and fluorescein images, examine wide area, optic disc, retinal periphery
- Gives good idea about vasculature and retinal circulation, leakage, blockage, ischemia, ….

❖**Disadvantages:**

- Invasive, related to time, needs wide pupil, clear media, co-operative patient.
- Can not be used in pregnant, renal , patients with hyper sensitivity, ….
- Systemic complication and side effects are present.
- Not helpful in delineating deep capillary network or choroidal vasculature and gives 2D images in viewing superficial retinal circulation.

3-Optical Coherence Tomography OCT

❖**Advantages:**

- Non invasive, small pupil , cross sectional layers imaging, accurate macular thickness measuring .
- Accurate idea about disc parameters, RNFL ,GCC.
- Better in diagnosis and follow up of DME, CME vitero-macular tractions, macular bucker, ERMs, macular hole, state of post. Vit. Face.

❖**Disadvantages:**

- Cannot examine vasculature, leakage , NVDs, NVEs, ischemic areas,….
- Needs clear media, cooperative patient.
- Examine small area of retina (macula 3mm,6mm).

4- Optical Coherence Tomography with Angiography OCTA

❖**Advantages:**

- 3D visualization of the retinal and choroidal microcirculation without dye injection.
- Non-invasive, relatively fast imaging study.
- Gives a good idea about superficial plexus, deep plexus, chorio capillaries.
- Gives a good idea about disc vasculature and micro-capillaries.
- Ability to visualize and quantify flow in different retinal and choroidal plexuses.

❖**Disadvantages:**

- Needs high patient co-operation.
- Many artifacts are present. Cannot assess leakage or hges .

5- Ultra-wide field imaging

Ultra-wide field *is a new technology using confocal scanning laser ophthalmoscopy to get wide field high resolution images.*

- *Using red (633nm) or green (523nm) laser.*
- *Wide field colour, FAF,FFA .*

Ultra-wide field imaging

❖Advantages:

- **Documents wide field colour, red free and fluorescein images.**
- **Documents wide area up to extreme retinal periphery in one image to give high resolution good retinal overview.**
- **Gives good idea about vasculature and retinal circulation, leakage, blockage, ischemia up to extreme periphery.**
- **Good in studying anterior retina, other vascular and hereditary retinal diseases.**
- **Gives very good idea about peripheral ischemic parts, NVDS, NVEs, so it's useful in planning before laser treatment and good for post laser follow up.**

❖Disadvantages:

- **New, expensive ,not wide ranged, needs more training, and experiences.**
- **Cannot photograph extremely to ora serrata.**
- **Distortion in the peripheral images due to interference of the ellipsoid mirror and the spherical nature of the globe.**

6- Ultrasonography

❖**Advantages:**

- **It is the basic diagnostic imaging modality.**
- **Safe, noninvasive most useful in the presence of opaque ocular media (corneal opacities, anterior chamber opacities, cataract, vitreous hemorrhage, or inflammatory opacities).**
- **Applicable , easy to do , no need for time and patient cooperation, no systemic side effects,….**
- **Mandatory in cases with hazy media.**

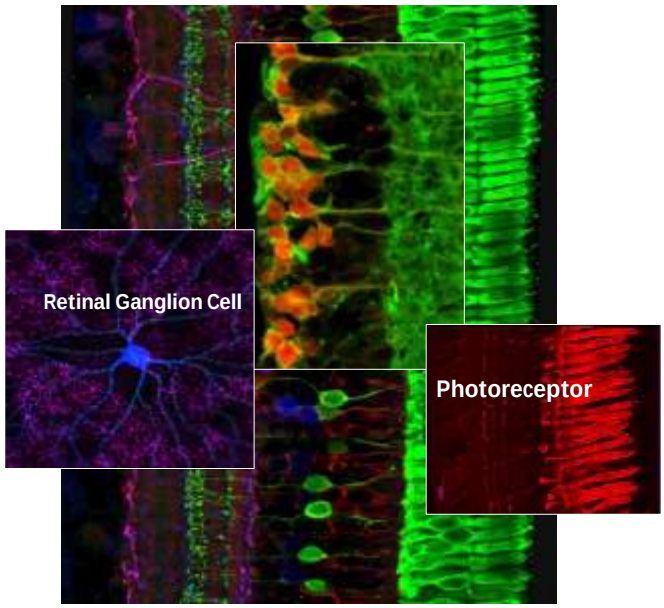
❖**Disadvantages:**

- **Limited use.**
- **Gives little information.**

7- Electro-physiological studies

- ***VEPs :*** ***pVEP, flash VEP***

- ***ERGs:*** ***pERG, ffERG, mfERG***



Retina

- Photoreceptors
- Bipolar cells
- Ganglion cells

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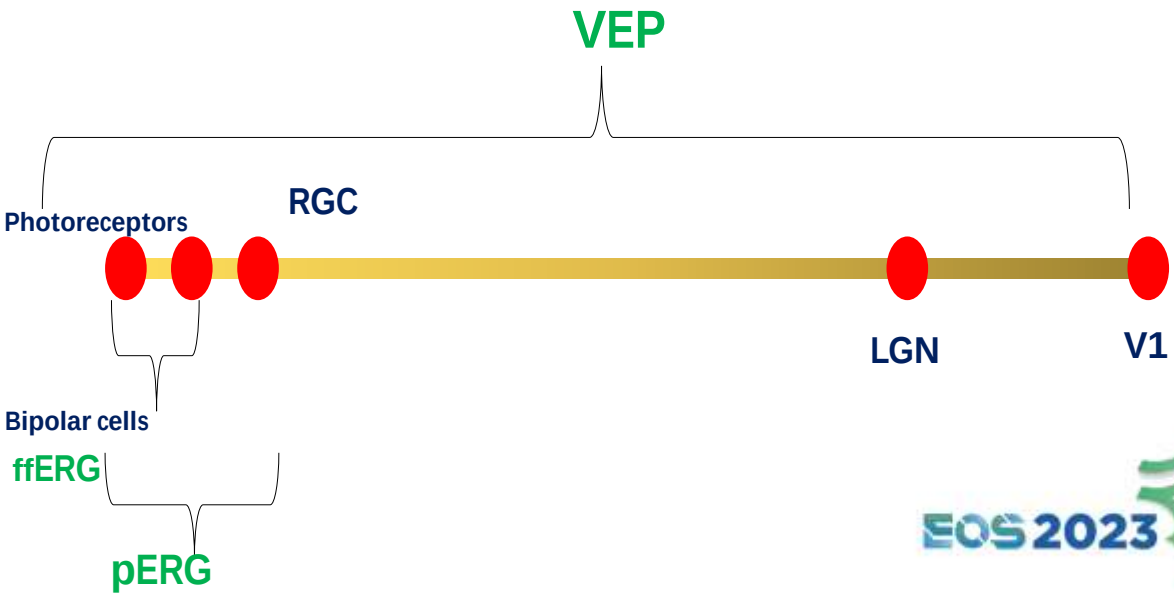
Main neurons of the Visual Pathway



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Review Article

Role of Electrophysiology in the Early Diagnosis and Follow-Up of Diabetic Retinopathy

Nicola Pescosolido,[1] Andrea Barbato,[2] Alessio Stefanucci,[3] and Giuseppe Buomprisco[4]

[1]*Department of Cardiovascular, Respiratory, Nephrologic, Anesthesiologic and Geriatric Sciences, Faculty of Medicine and Dentistry, "Sapienza" University of Rome, Viale del Policlinico 155, 00161 Rome, Italy*
[2]*Center of Ocular Electrophysiology, Department of Sense Organs, Faculty of Medicine and Dentistry, "Sapienza" University of Rome, Viale del Policlinico 155, 00161 Rome, Italy*
[3]*Faculty of Medicine and Dentistry, "Sapienza" University of Rome, Viale del Policlinico 155, 00161 Rome, Italy*
[4]*Department of Sense Organs, Faculty of Medicine and Dentistry, "Sapienza" University of Rome, Viale del Policlinico 155, 00161 Rome, Italy*

Correspondence should be addressed to Andrea Barbato; andrea.barbato@gmx.ch

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Retinopathy is a severe and common complication of diabetes, representing a leading cause of blindness among working-age people in developed countries. It is estimated that the number of people with diabetic retinopathy (DR) will increase from 126·6 million in 2011 to 191 million by 2030. The pathology seems to be characterized not only by the involvement of retinal microvessels but also by a real neuropathy of central nervous system, similar to what happens to the peripheral nerves, particularly affected by diabetes. The neurophysiological techniques help to assess retinal and nervous (optic tract) function. Electroretinography (ERG) and visual evoked potentials (VEP) allow a more detailed study of the visual function and of the possible effects that diabetes can have on the visual function. These techniques have an important role both in the clinic and in research: the central nervous system, in fact, has received much less attention than the peripheral one in the study of the complications of diabetes. These techniques are safe, repeatable, quick, and objective. In addition, both the ERG (especially the oscillatory potentials and the flicker-ERG) and VEP have proved to be successful tools for the early diagnosis of the disease and, potentially, for the ophthalmologic follow-up of diabetic patients.

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The Electroretinogram in Diabetic Retinopathy

R. Tzekov, MD, PhD,[1] and G. B. Arden, MD, PhD, FRCOphth[2]

[1] Retina Foundation of the Southwest, Dallas, Texas, USA, and [2] Center for Applied Vision Research, Department of Optometry and Visual Science, City University, London, United Kingdom

Abstract. Electroretinography (ERG) is an objective method of evaluating retinal function. Since its introduction to clinical practice in the 1940s, it has become a useful and routine diagnostic clinical tool in ophthalmology. This review summarizes the role of ERG as a clinical technique for evaluating the progression of diabetic retinopathy and as a research tool for increasing our understanding of the pathophysiology of diabetic retinopathy. Most studies show unequivocally that the different types of ERG tests detect local abnormalities or widespread pathology, even in very early stages of the disease. It seems plausible that measurements from ERG recordings, particularly the oscillatory potentials, may be useful for predicting progression from nonproliferative to the more sight-threatening stages—preproliferative or proliferative—of diabetic retinopathy. Some recent work implies that the ERG can also be a useful diagnostic method for discriminating between eyes with diabetic retinopathy and those without the condition. (**Surv Ophthalmol 44**:53–60, 1999.

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Diabetic Eye Disease

Disease Stage[2]	Protocol
DM (without evident DR)	PERG / Contrast Sensitivity
NPDR (Mild)	PERG / Contrast Sensitivity
NPDR (Moderate)	PERG / Contrast Sensitivity or ffERG / Multi-Luminance
NPDR (Severe)	ffERG / Multi- or Fixed Luminance
DME	PERG / Contrast Sensitivity or ffERG / Multi- or Fixed Luminance
PDR	ffERG / Multi- or Fixed Luminance
DR (plus cataract)	ffERG / Multi- or Fixed Luminance

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Normal

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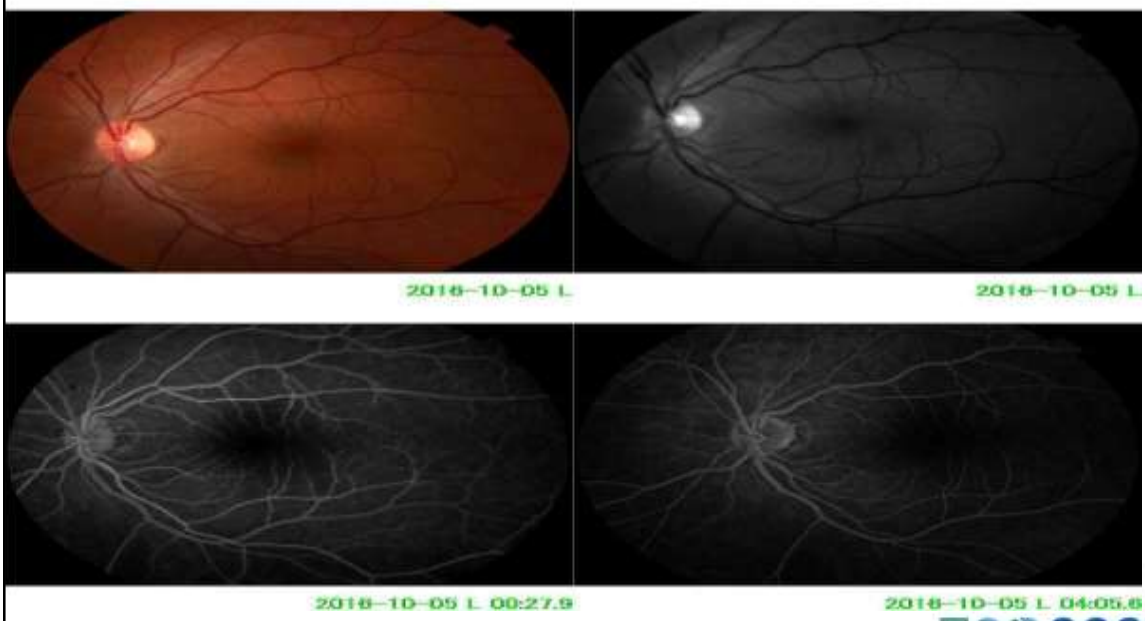

Normal FFA

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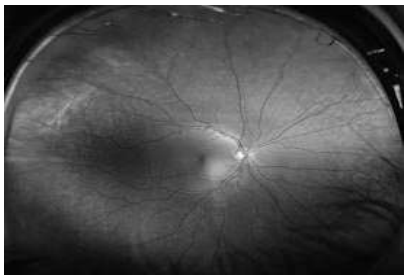
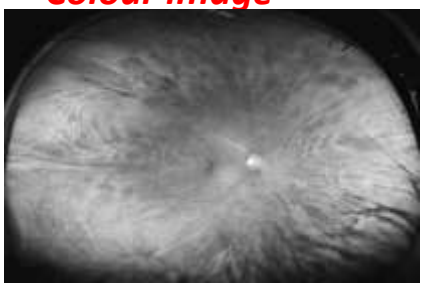
Normal Ultra-wide field imaging



- ***Colour image***

Red free with green laser

(Retinal BVs, ant. Retina are more accentuated)



Red free with red laser

(Choroidal BVs are more accentuated)

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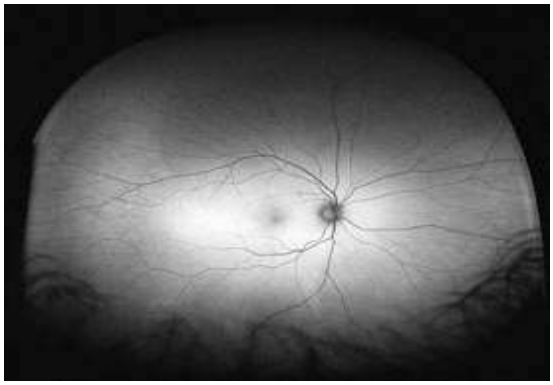
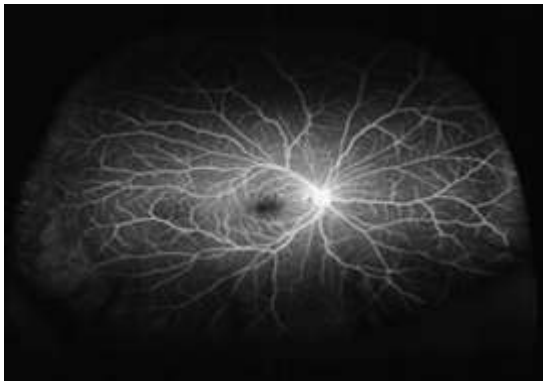
Normal Ultra-wide field imaging





Wide field FAF

Wide field FA

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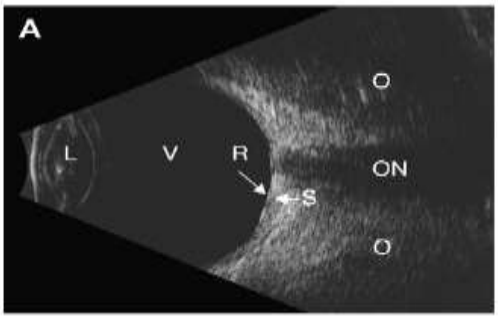
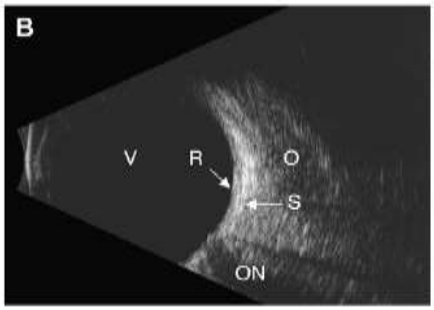
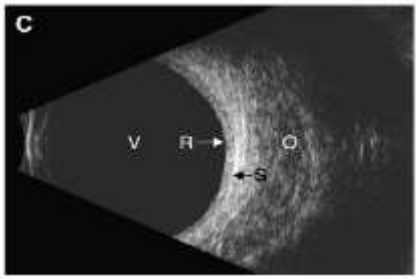
Normal U/S







A- ***Axial scan***

B- ***Longitudinal scan***

C- ***Transverse B-scan***

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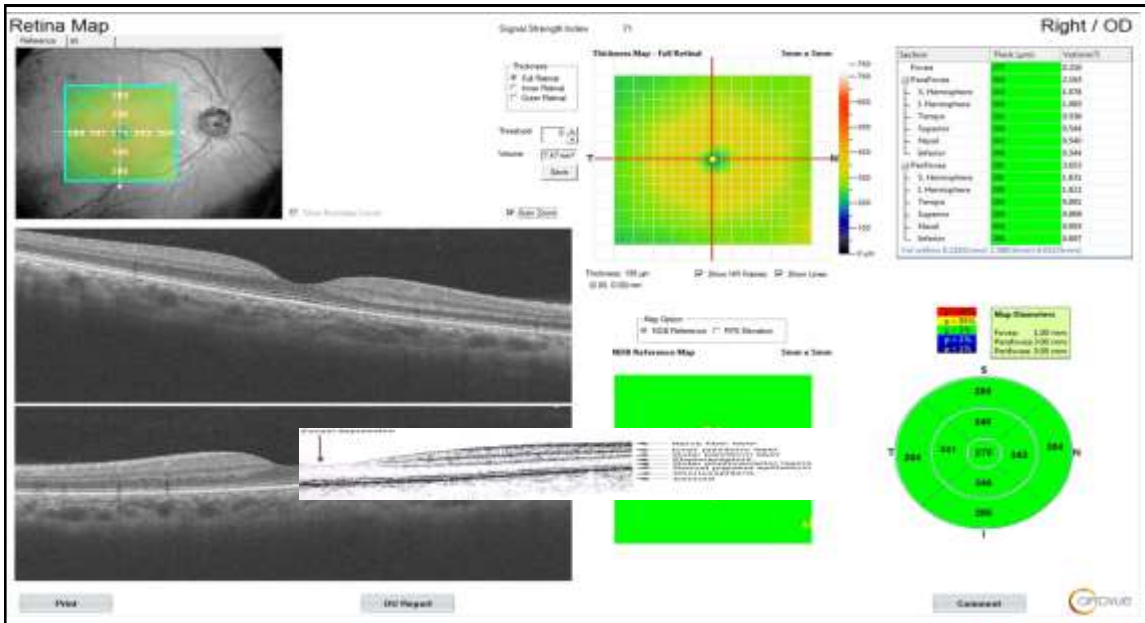

NORMAL OCT

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Normal OCTA

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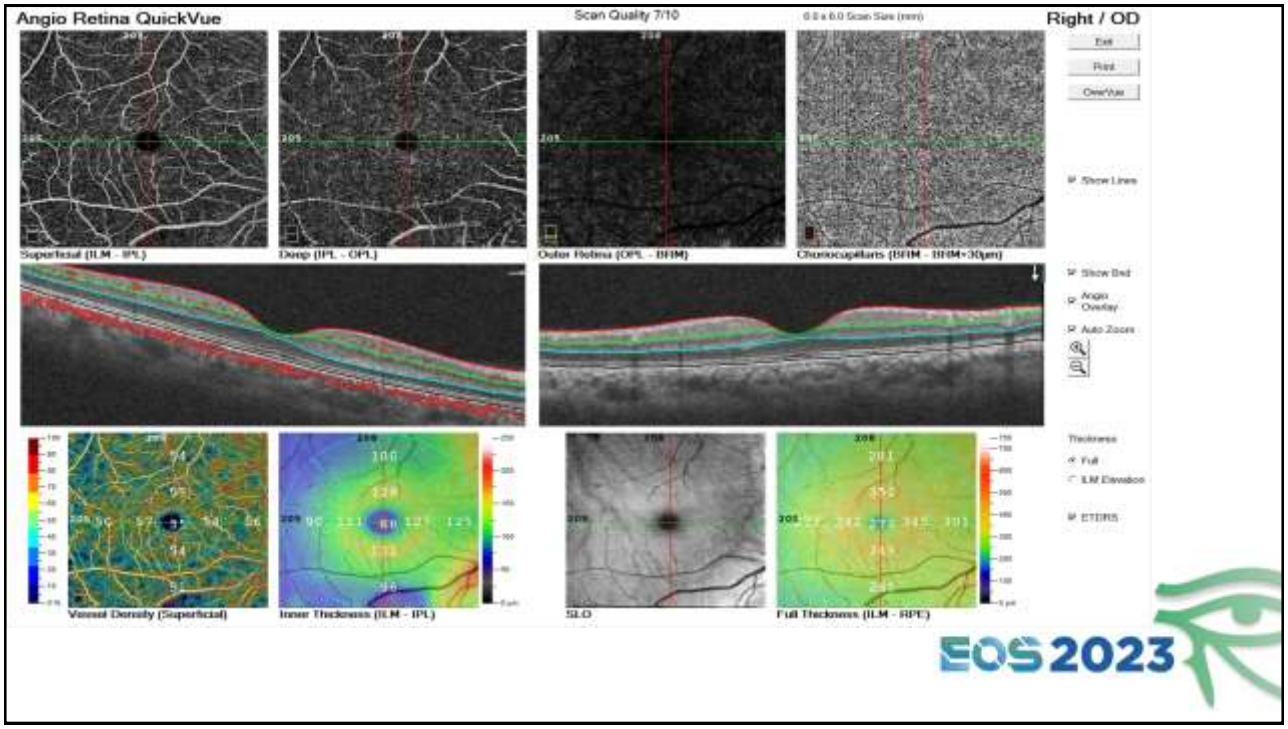
Angio Retina QuickVue
Scan Quality 7/10
Right / OD
Superficial (ILM - IPL)
Deep (IPL - OPL)
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30µm)
Vessel Density (Superficial)
Inner Thickness (ILM - IPL)
SLO
Full Thickness (ILM - RPE)
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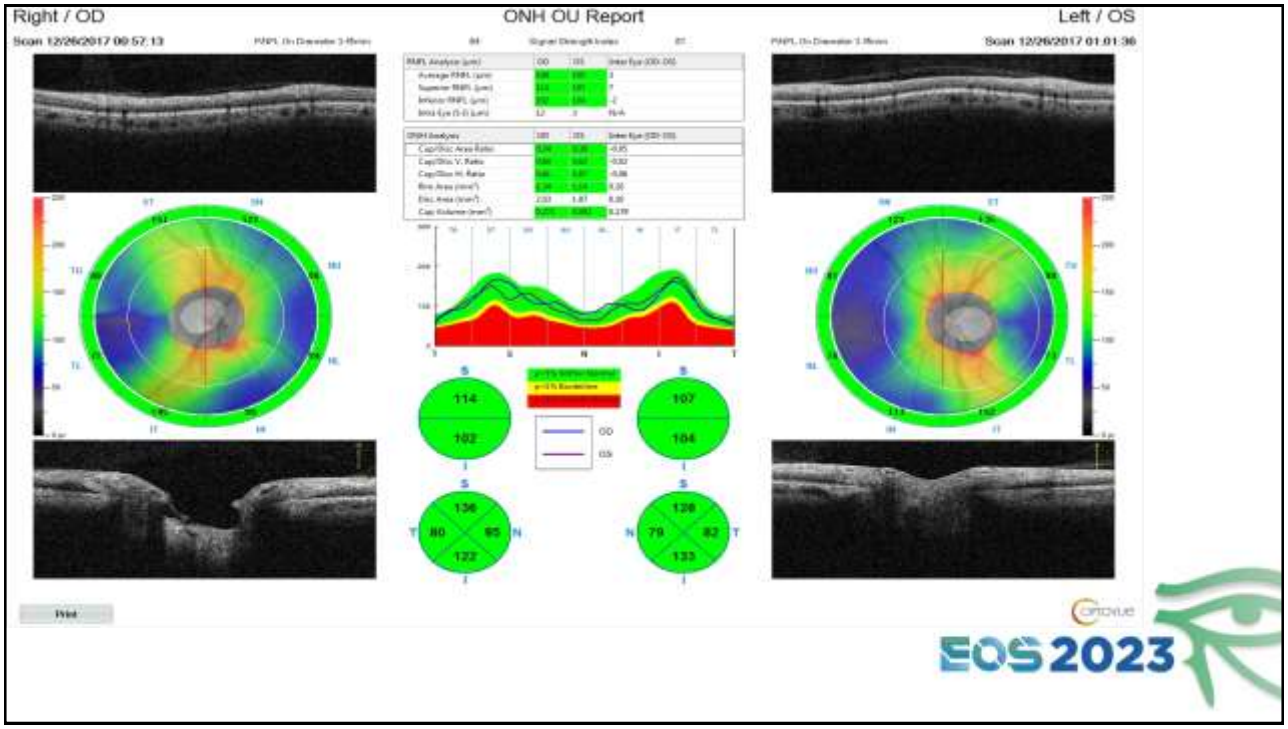
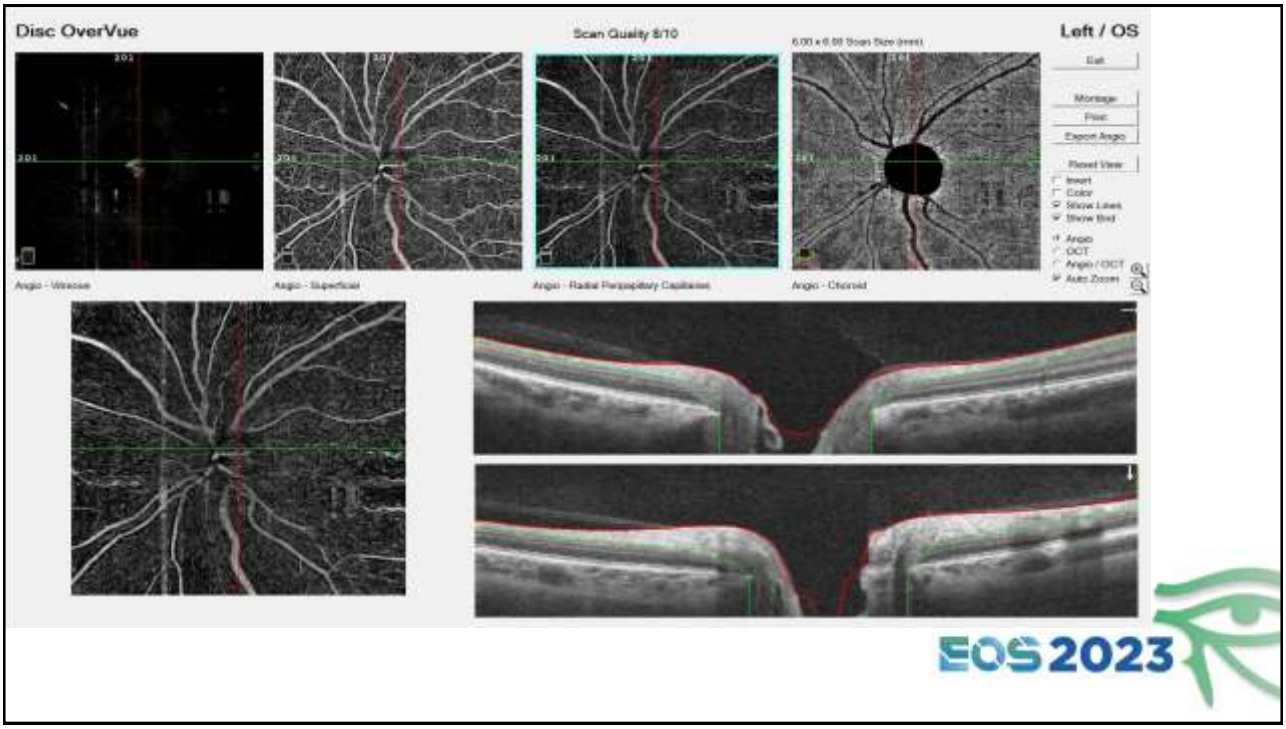

Right / OD
ONH OU Report
Left / OS
Scan 12/26/2017 09:57:13
Scan 12/26/2017 01:01:36
EOS 2023


Disc OverVue
Scan Quality 8/10
Left / OS
Angio - Superficial
Angio - Choroid
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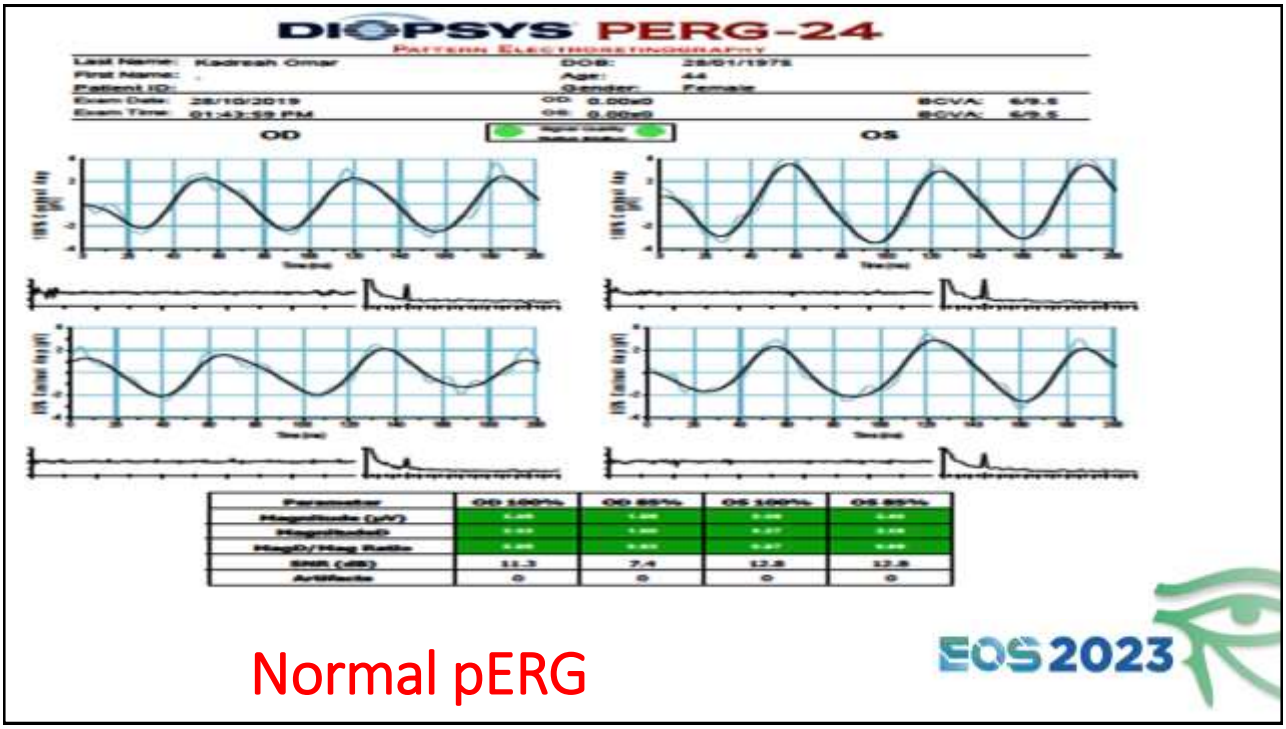
DIOPSYS PERG-24
Pattern Electroretinography
OD
OS
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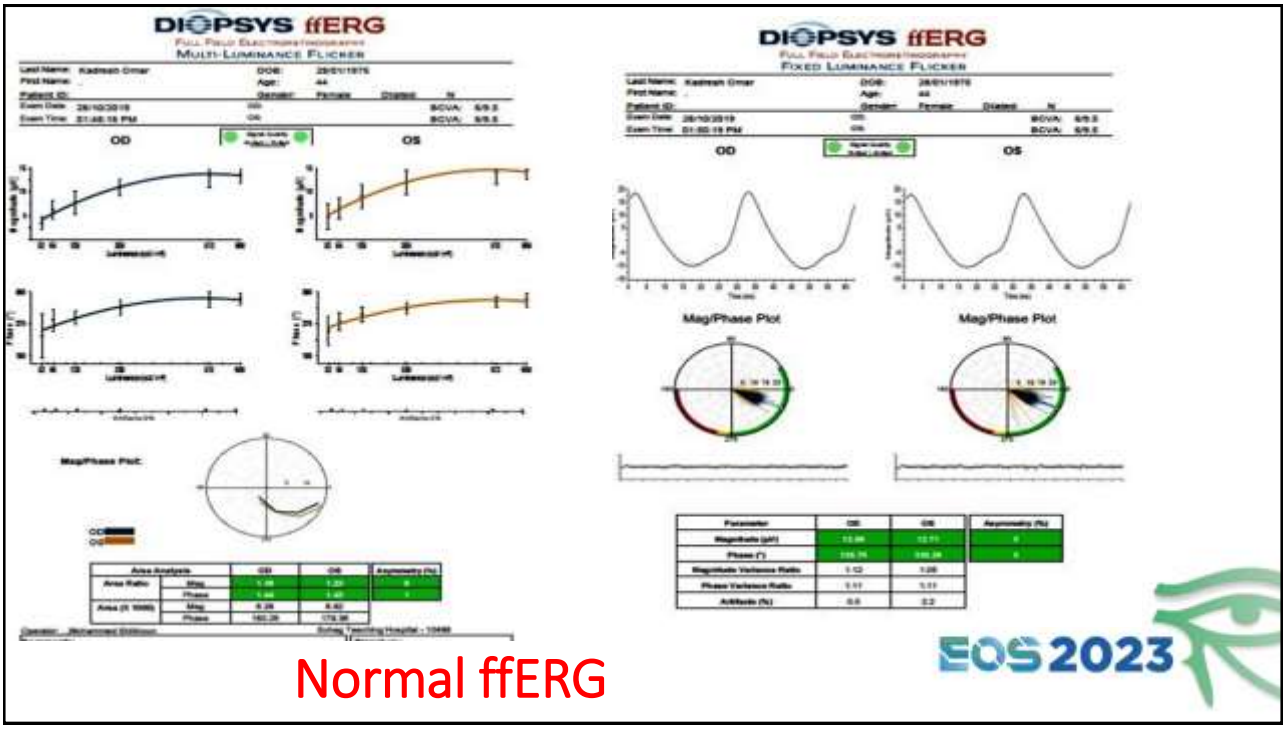
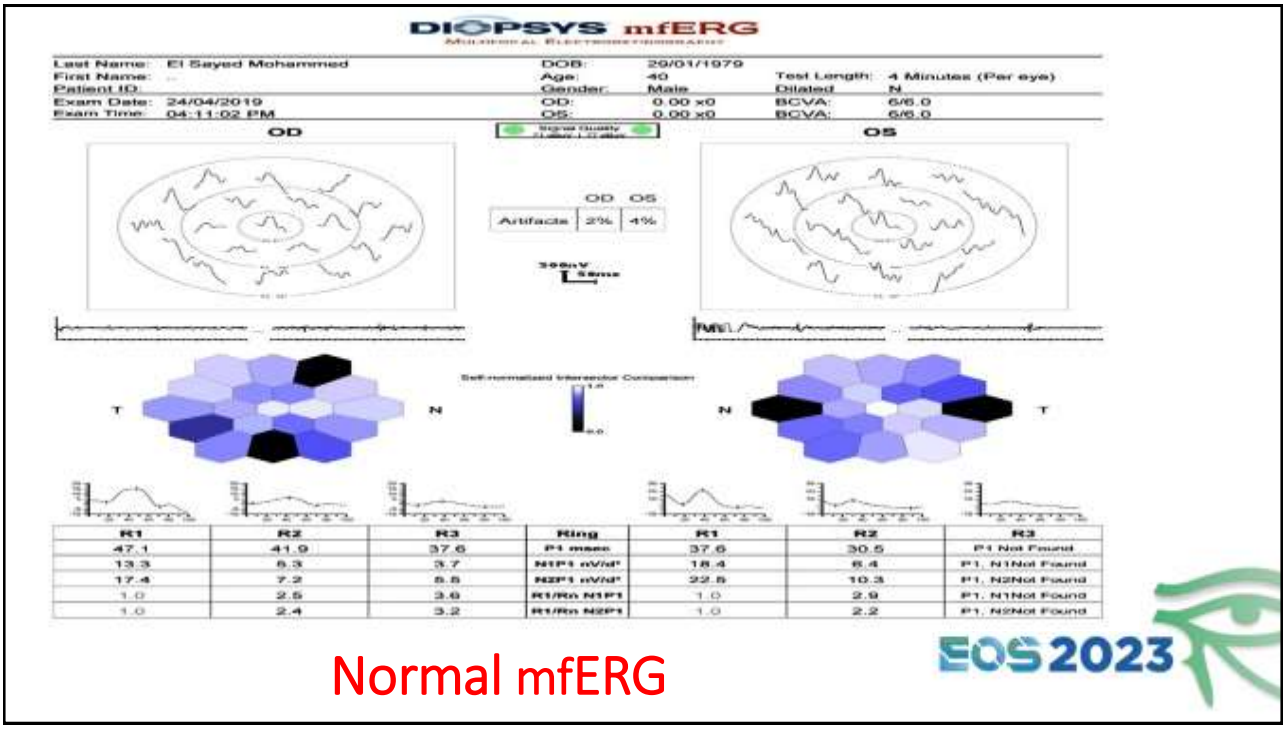
Normal pERG

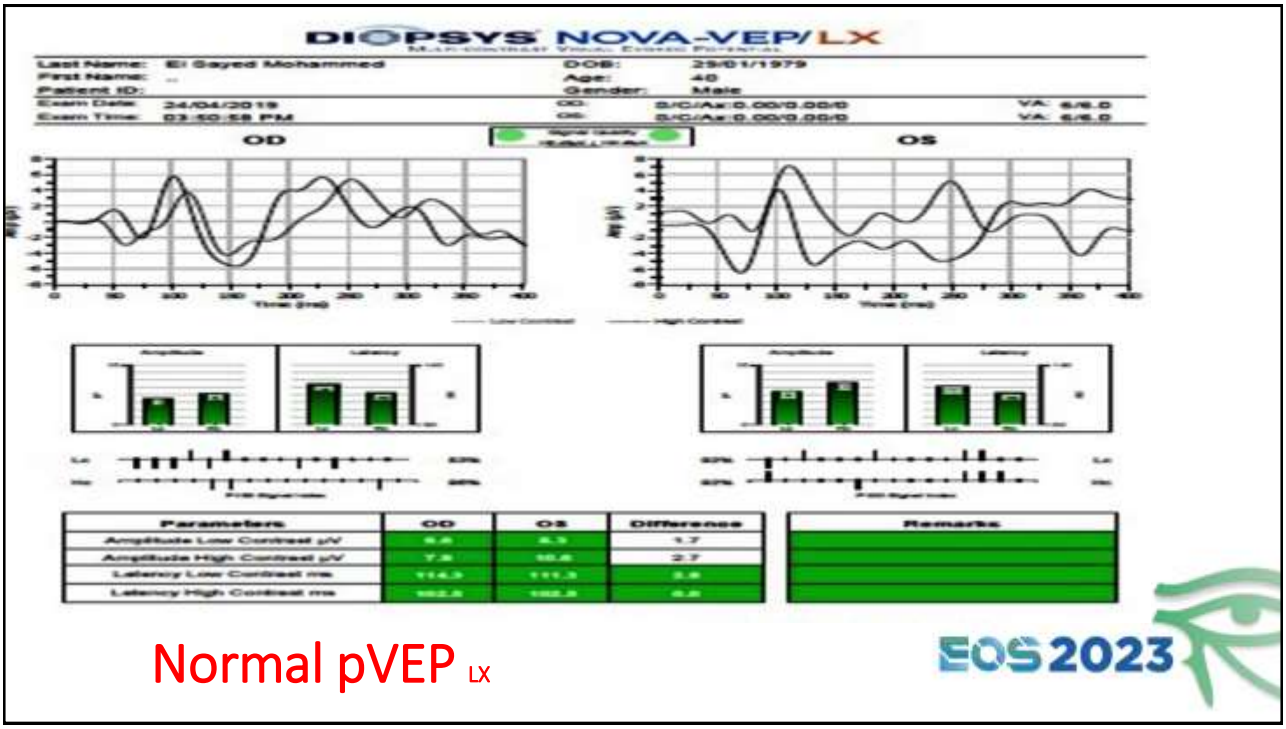


Normal ffERG



R1	R2	R3	Ring	R1	R2	R3
47.1	41.9	37.6	P1 mean	37.6	30.5	P1 Not Found
13.3	8.3	3.7	N1P1 nV/d²	18.4	8.4	P1, N1Not Found
17.4	7.2	5.5	N2P1 nV/d²	22.5	10.3	P1, N2Not Found
1.0	2.5	3.9	R1/Rn N1P1	1.0	2.9	P1, N1Not Found
1.0	2.4	3.2	R1/Rn N2P1	1.0	2.2	P1, N2Not Found

Normal mfERG



Normal pVEP LX

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Multi-images have an important role in diagnosis, grading and follow up of DR in correlation with Clinical Examination and BCVA assesement

Also get proper assessment of Macula (diabetic maculopathy), optic disc affection (Diabetic papillopathy)

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Grading

- Non proliferative DR
- Pre proliferative DR
- Proliferative DR

Diabetic maculopathy

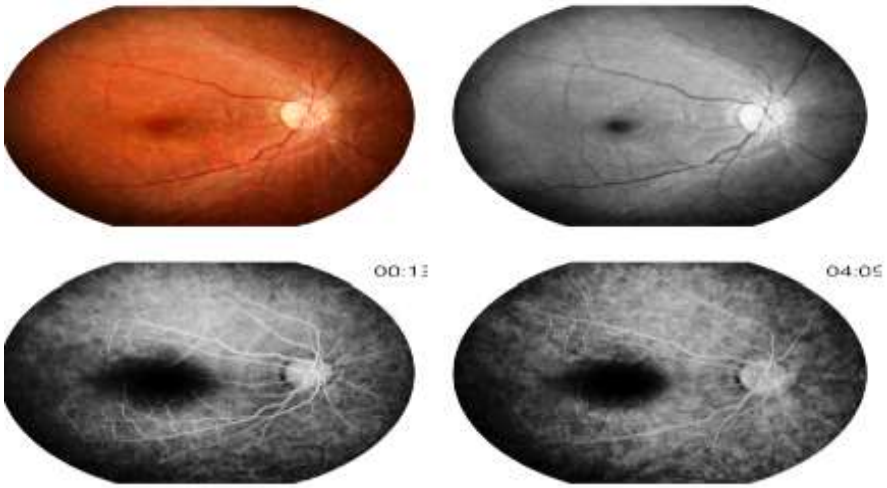
- Wet maculopathy
  (Focal ME, diffuse ME, CME)
- Mixed maculopathy
- Ischemic maculopathy

Diabetic papillopathy

- *Optic disc swelling my be only presentation , associated with any grade of DR.*
- *Can be diagnosed very early by pVEP*
- *If diagnosed early prober ttt*
- *If neglected or missed ends by optic atrophy*

Clinical cases

Sohag Teaching Hospital



Very Early detection by very good correlation of BCVA, clinical Examination, subjective and objective investigations

BCVA is 6/18 in both eyes
Mottled maculae, more or less normal angiogram

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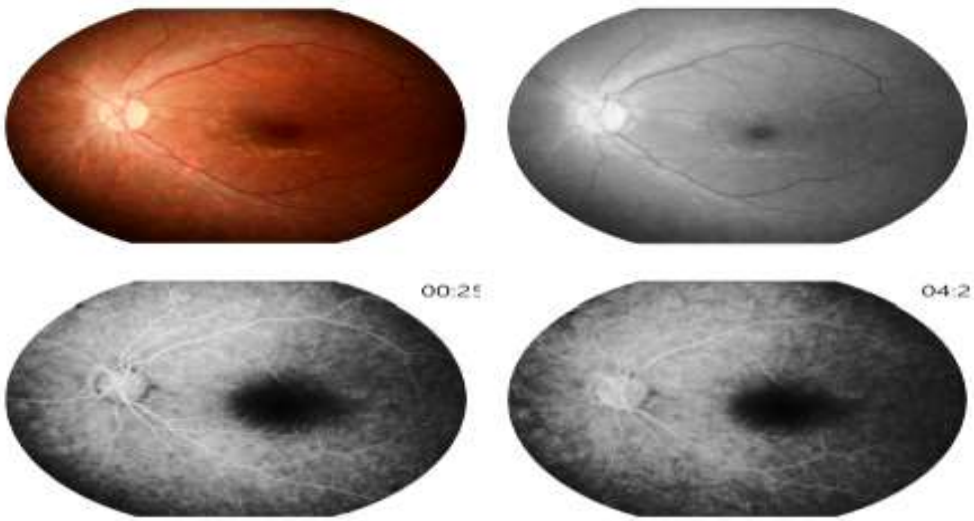
Sohag Teaching Hospital



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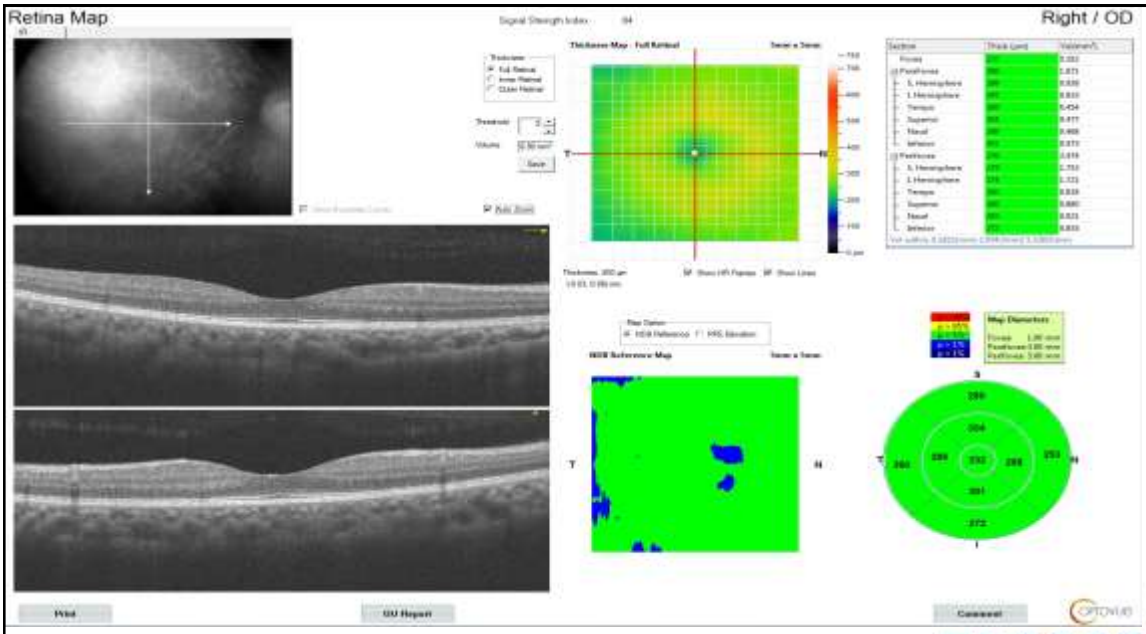
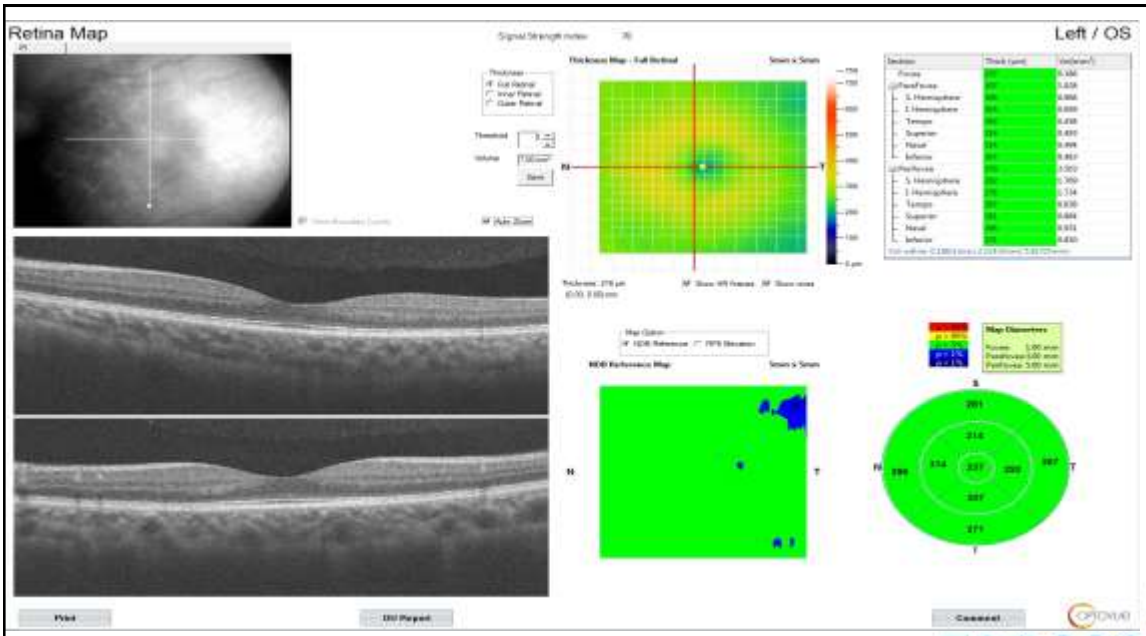
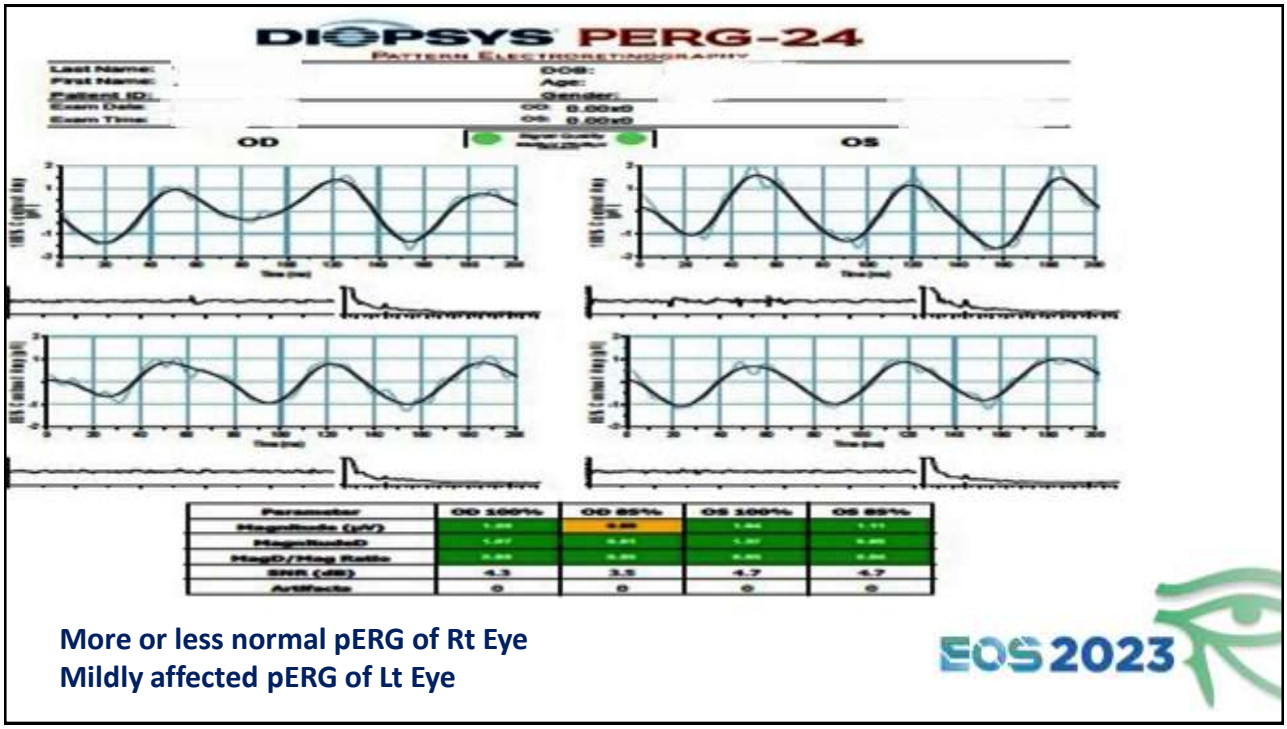


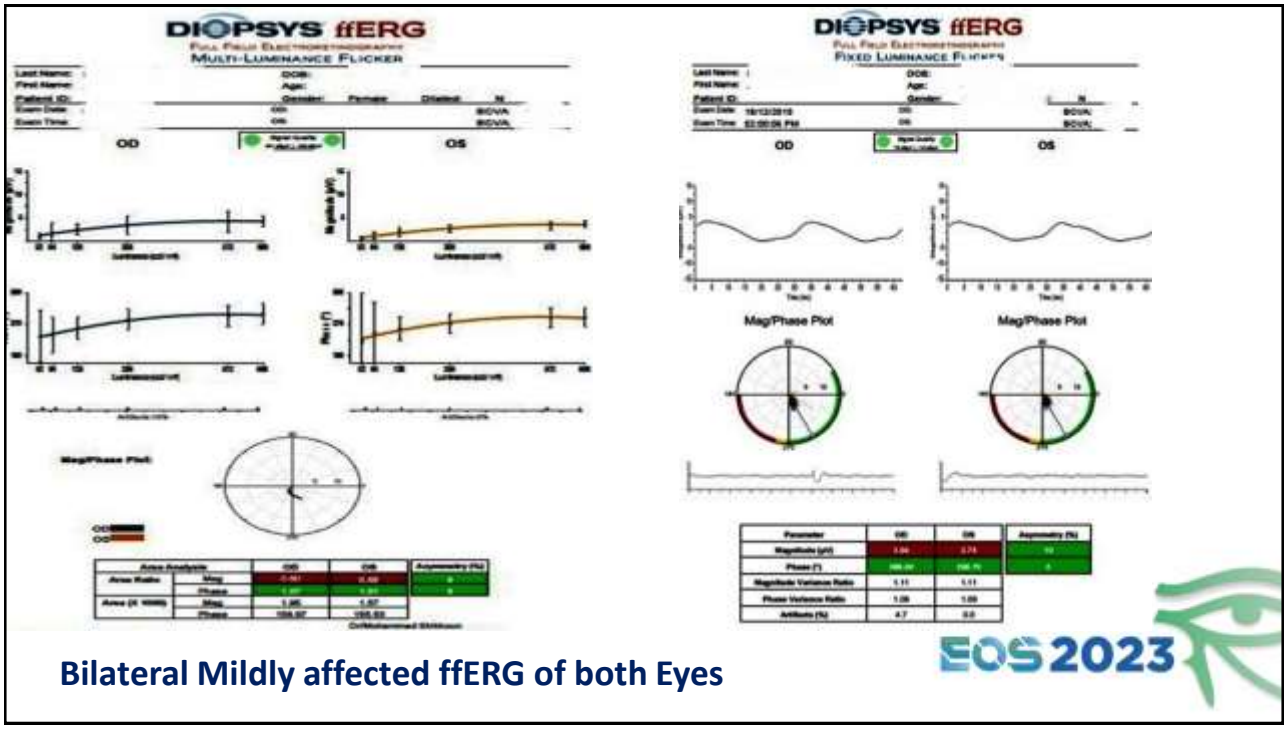
BCVA is 6/18 in both eyes
More or less normal OCT



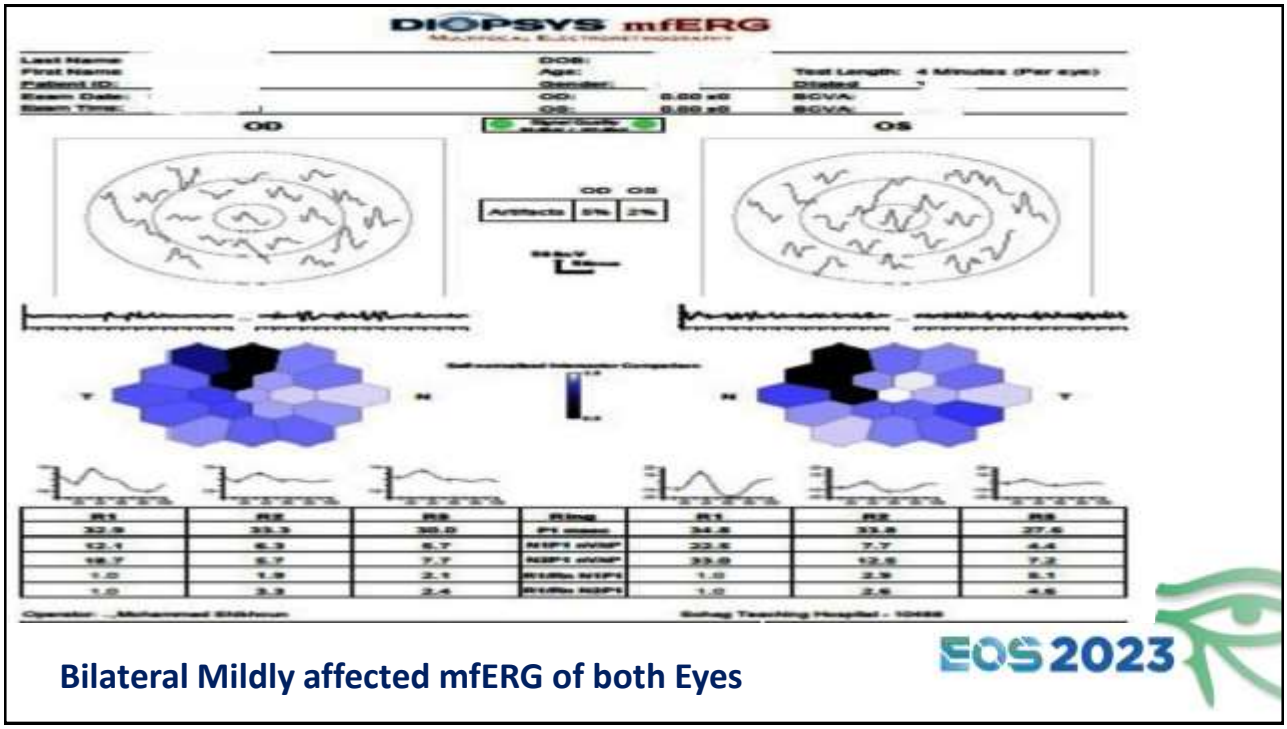
So we should find the cause of diminished VA
So we do Electro physiological studies



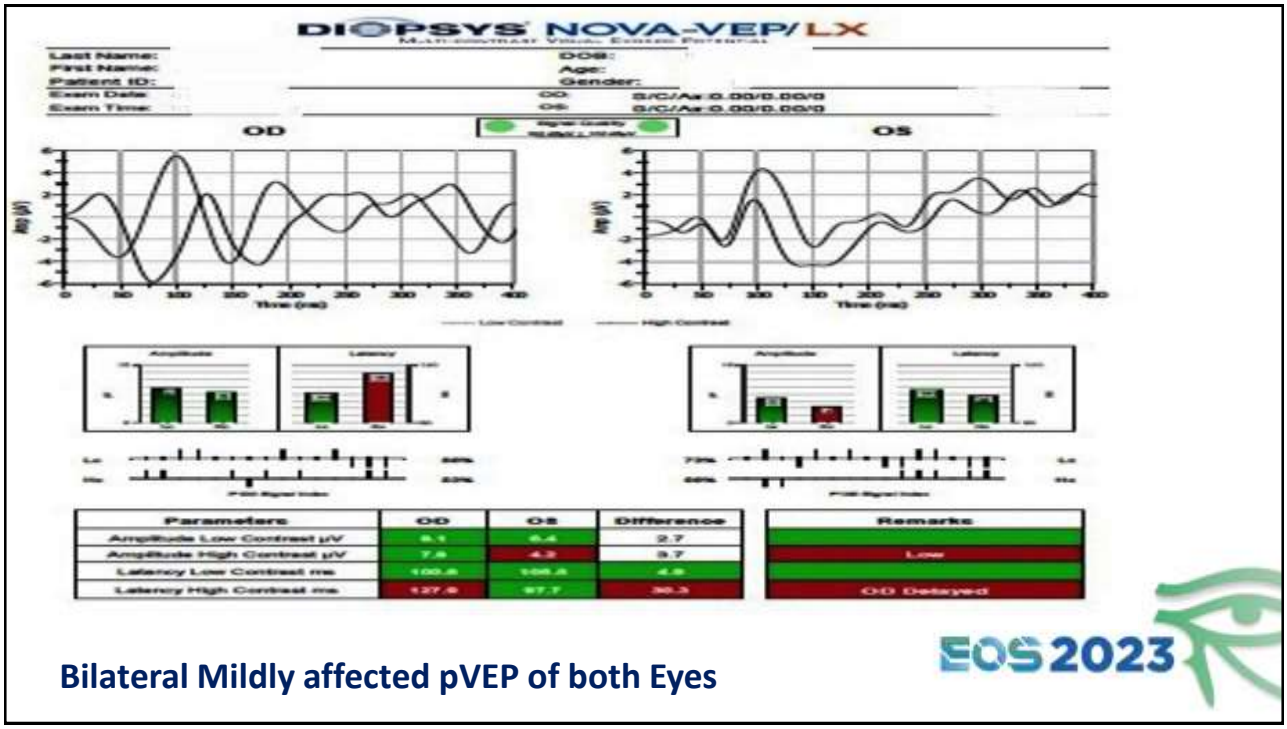
More or less normal pERG of Rt Eye
Mildly affected pERG of Lt Eye



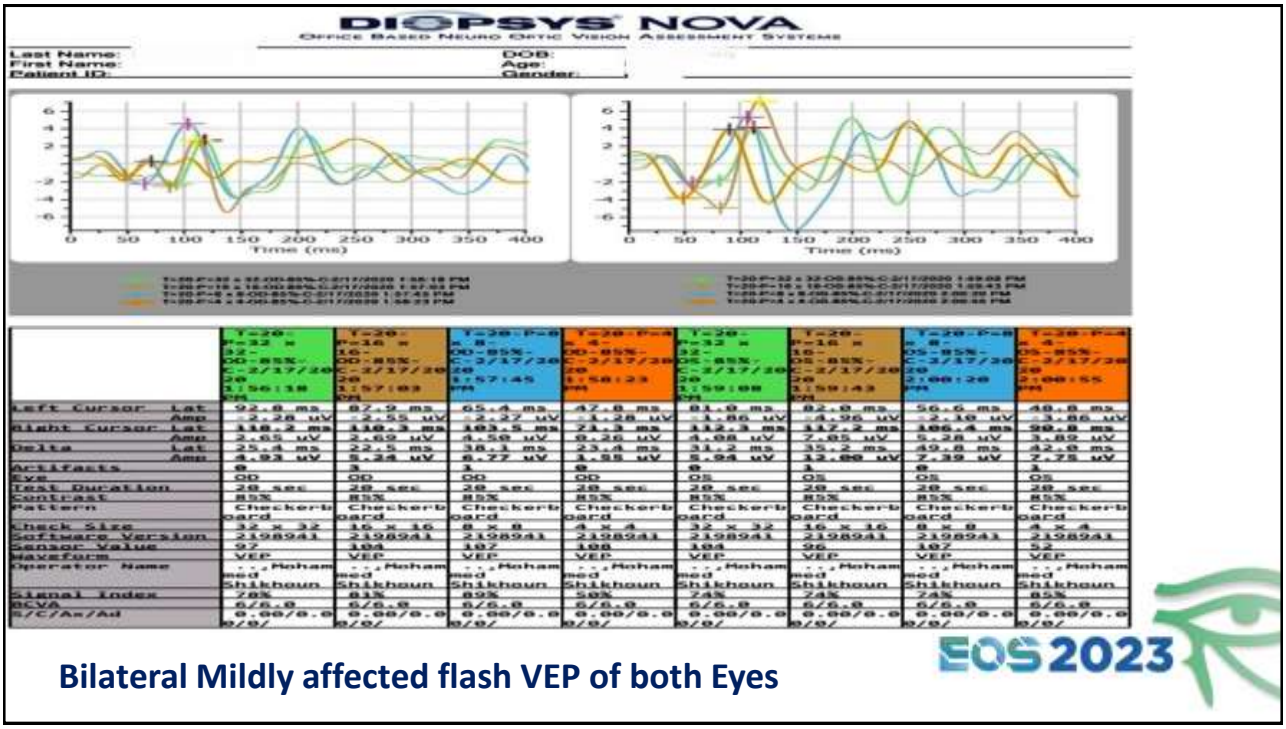
Bilateral Mildly affected ffERG of both Eyes



Bilateral Mildly affected mfERG of both Eyes



Bilateral Mildly affected pVEP of both Eyes



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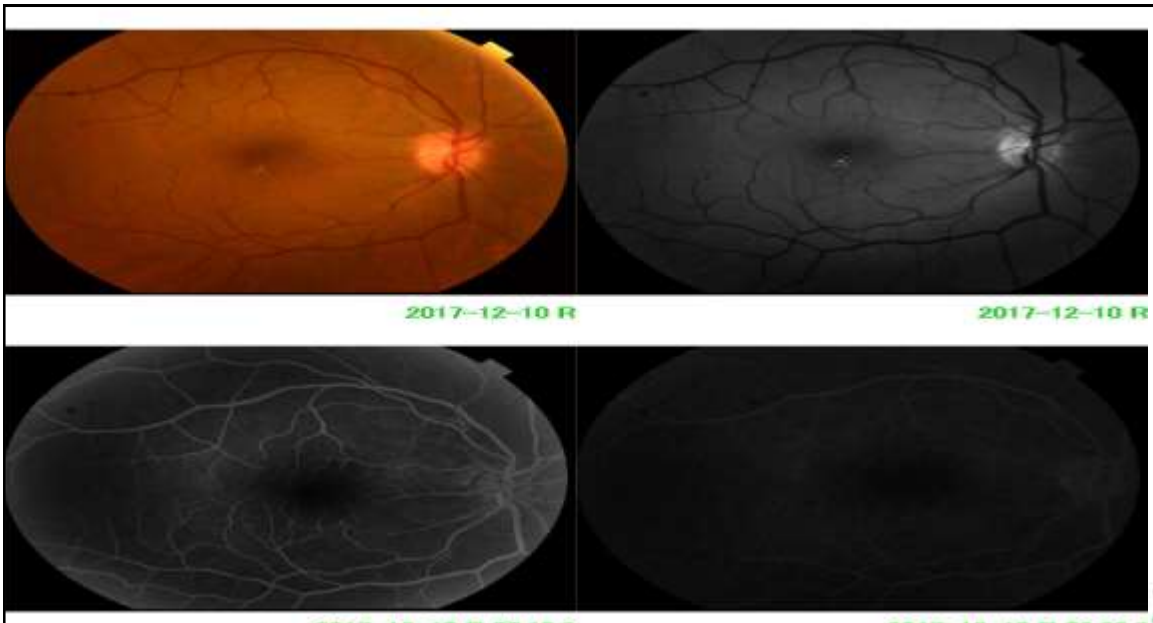
Left Cursor Lat	92.0 ms	87.9 ms	65.4 ms	47.0 ms	81.0 ms	82.0 ms	56.6 ms	40.8 ms
Amp	2.28 uV	2.55 uV	2.27 uV	1.28 uV	1.86 uV	4.96 uV	2.10 uV	3.86 uV
Right Cursor Lat	110.2 ms	110.3 ms	103.5 ms	71.3 ms	112.3 ms	117.2 ms	106.4 ms	90.8 ms
Amp	2.65 uV	2.69 uV	4.50 uV	0.26 uV	4.08 uV	7.05 uV	5.28 uV	3.89 uV
Delta Lat	25.4 ms	22.5 ms	38.1 ms	23.4 ms	31.2 ms	35.2 ms	49.8 ms	42.6 ms
Amp	4.93 uV	5.24 uV	6.77 uV	1.55 uV	5.94 uV	12.00 uV	7.39 uV	7.75 uV
Artifacts	0	1	1	0	0	1	0	1
Eye	OD	OD	OD	OD	OS	OS	OS	OS
Test Duration	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec	20 sec
Contrast	85%	85%	85%	85%	85%	85%	85%	85%
Pattern	Checkerboard	Checkerboard	Checkerboard	Checkerboard	Checkerboard	Checkerboard	Checkerboard	Checkerboard
Check Size	32 x 32	16 x 16	8 x 8	4 x 4	32 x 32	16 x 16	8 x 8	4 x 4
Software Version	2198941	2198941	2198941	2198941	2198941	2198941	2198941	2198941
Sensor Value	92	104	102	108	104	96	102	52
Waveform	VEP	VEP	VEP	VEP	VEP	VEP	VEP	VEP
Operator Name	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun	...,Mohammed Shikhoun
Signal Index	78%	81%	89%	50%	74%	74%	74%	85%
BCVA	6/6.0	6/6.0	6/6.0	6/6.0	6/6.0	6/6.0	6/6.0	6/6.0
S/C/Ax/Ad	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/	0.00/0.0 0/0/

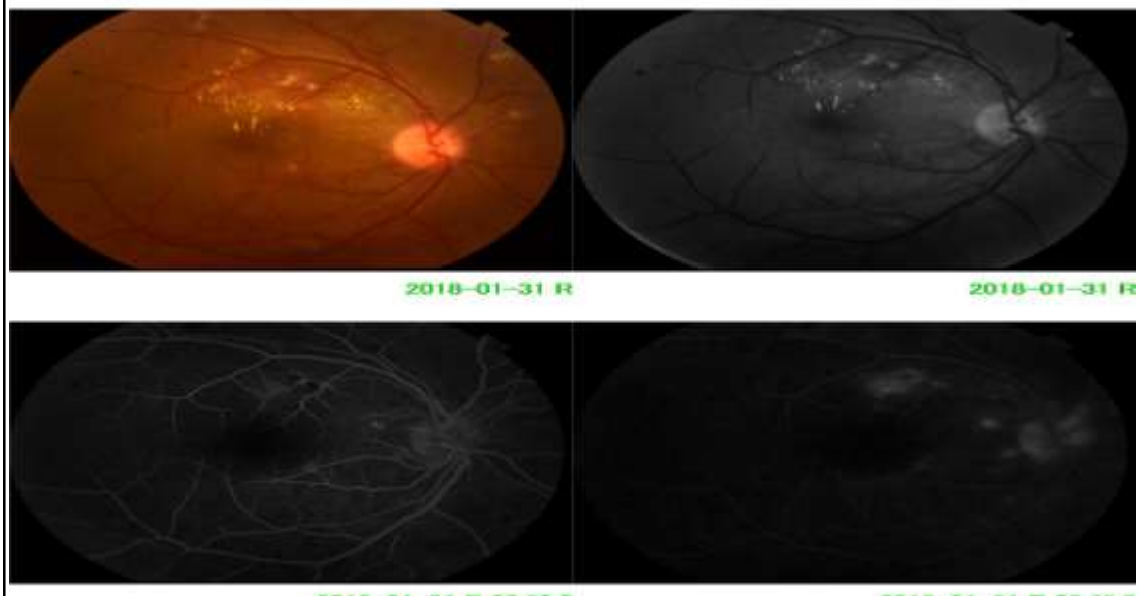
Bilateral Mildly affected flash VEP of both Eyes

EOS 2023



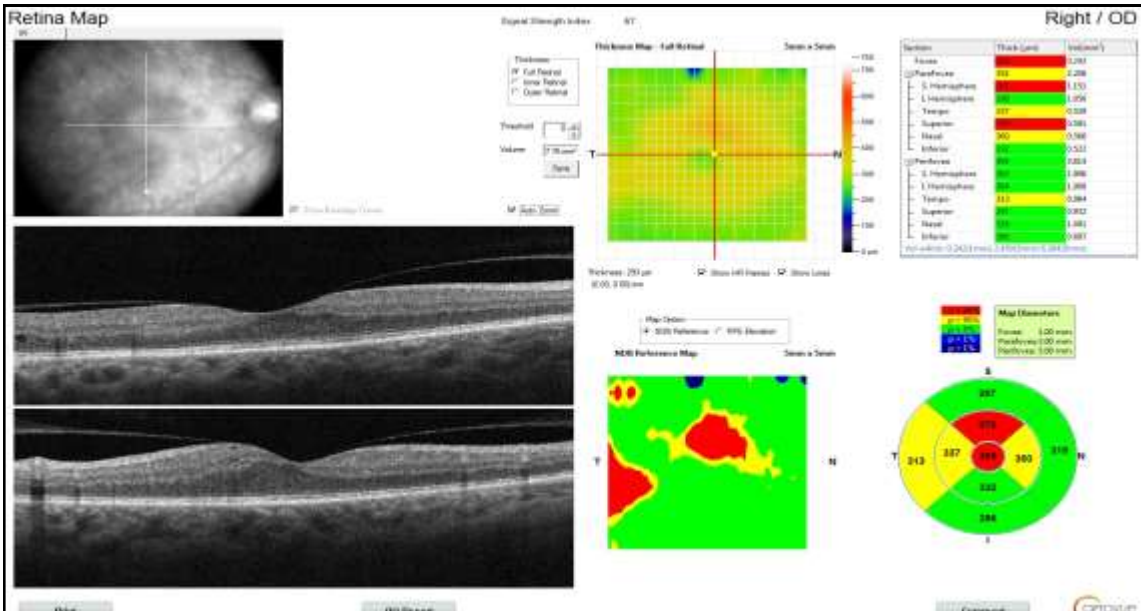
Early NPDR

EOS 2023

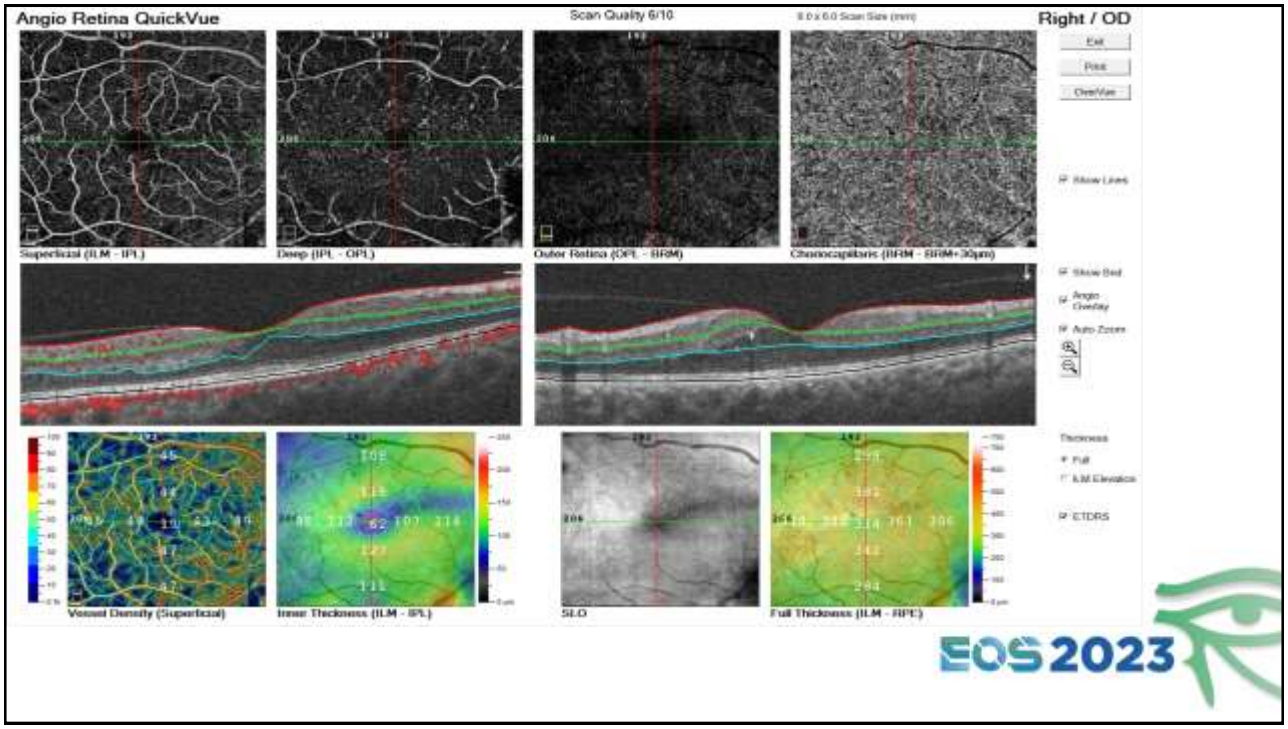


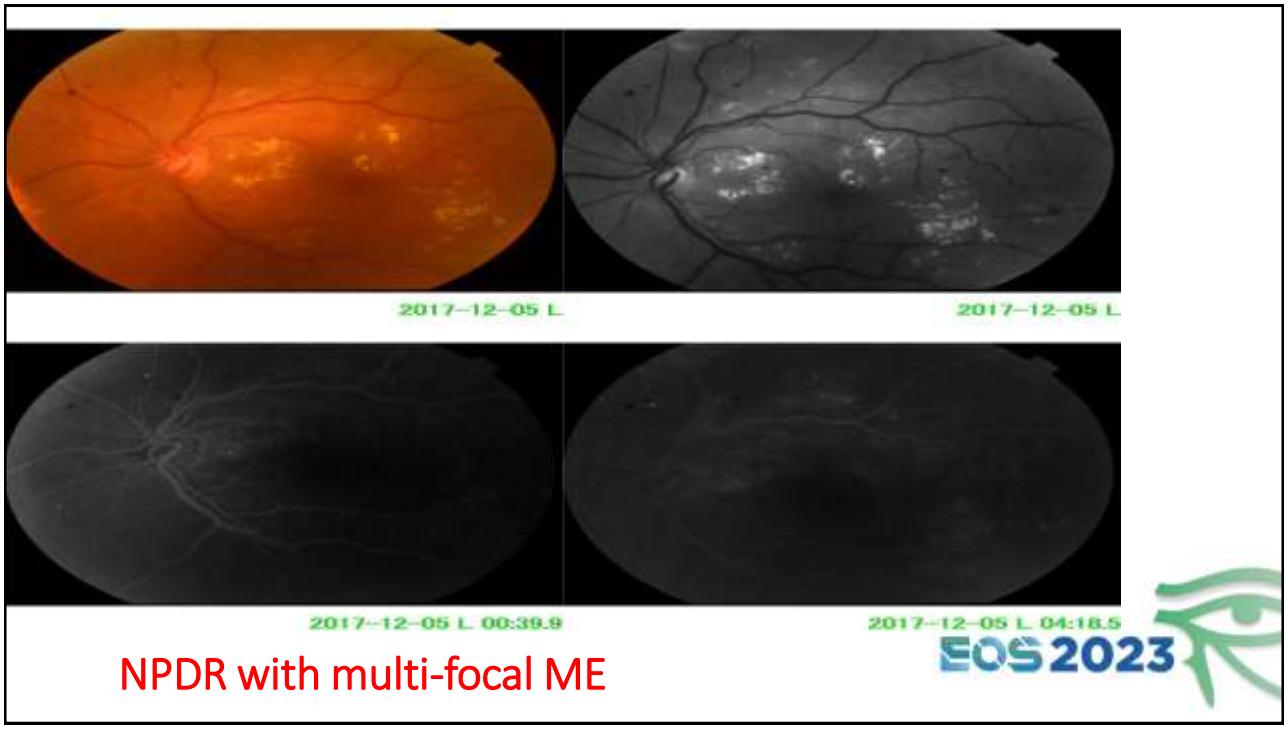
NPDR with Focal ME

EOS 2023

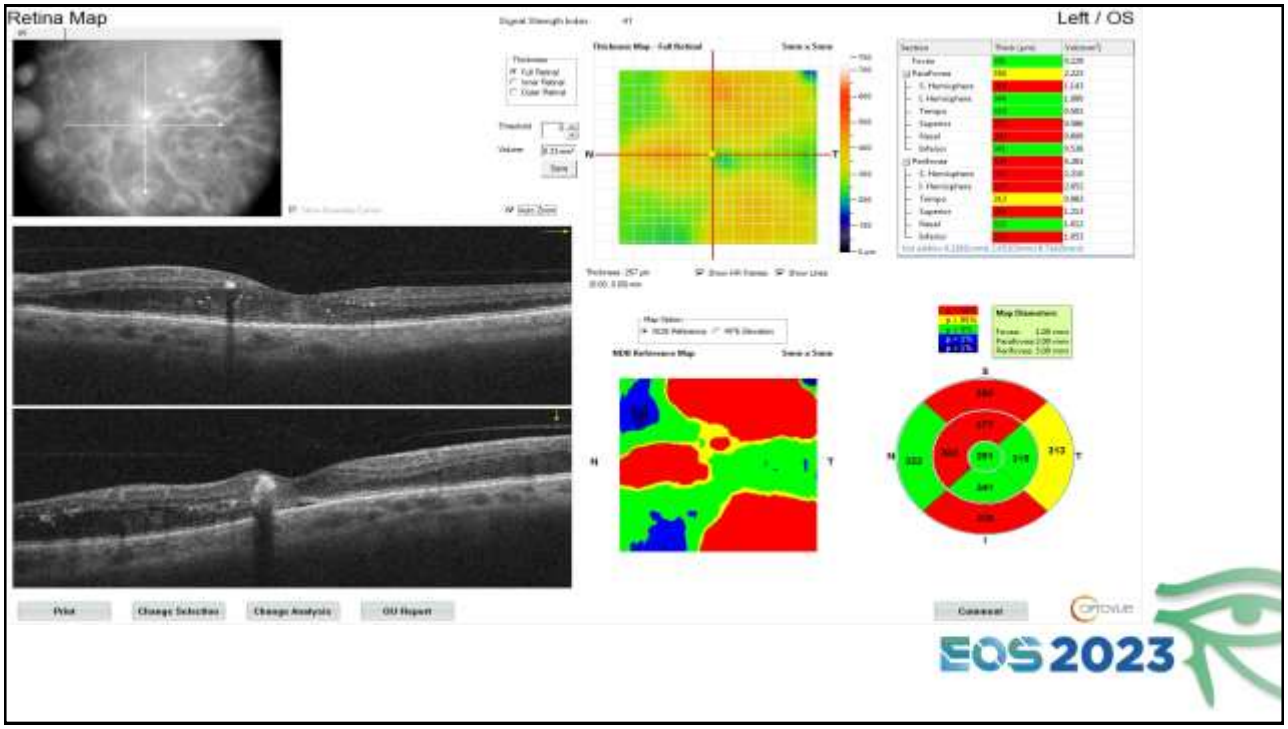


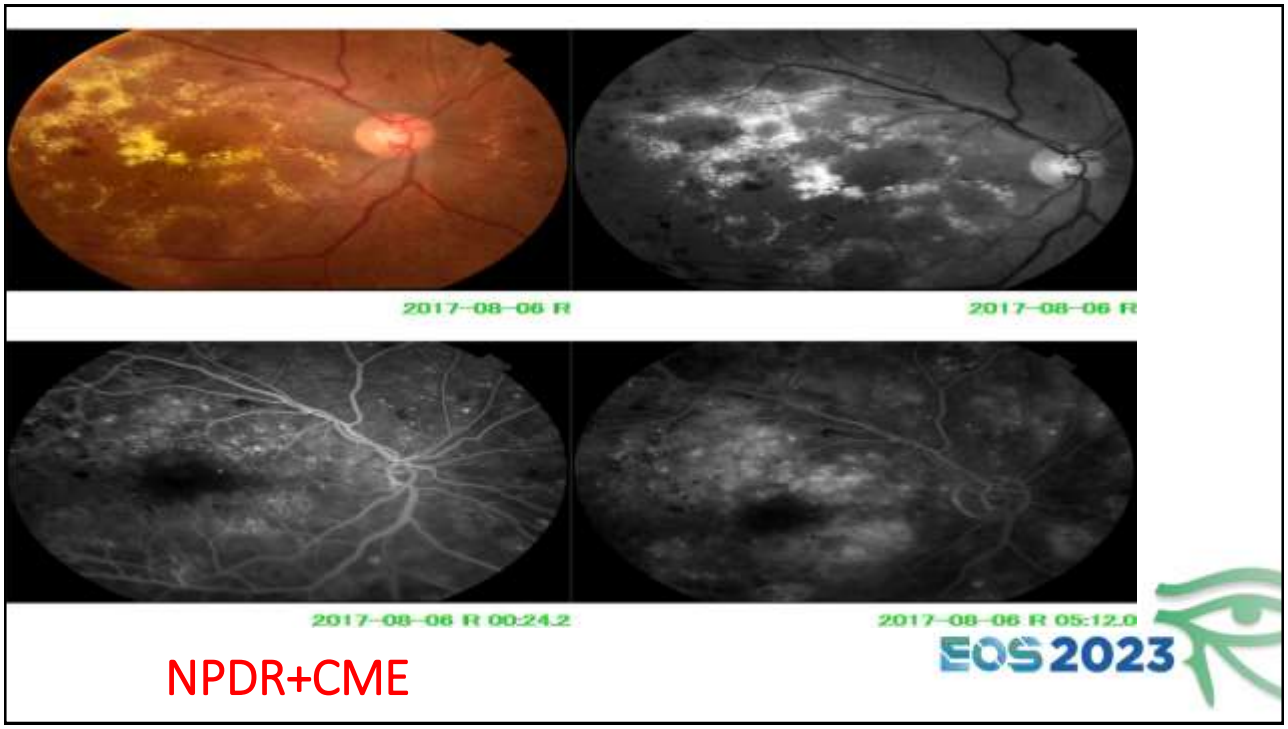
EOS 2023



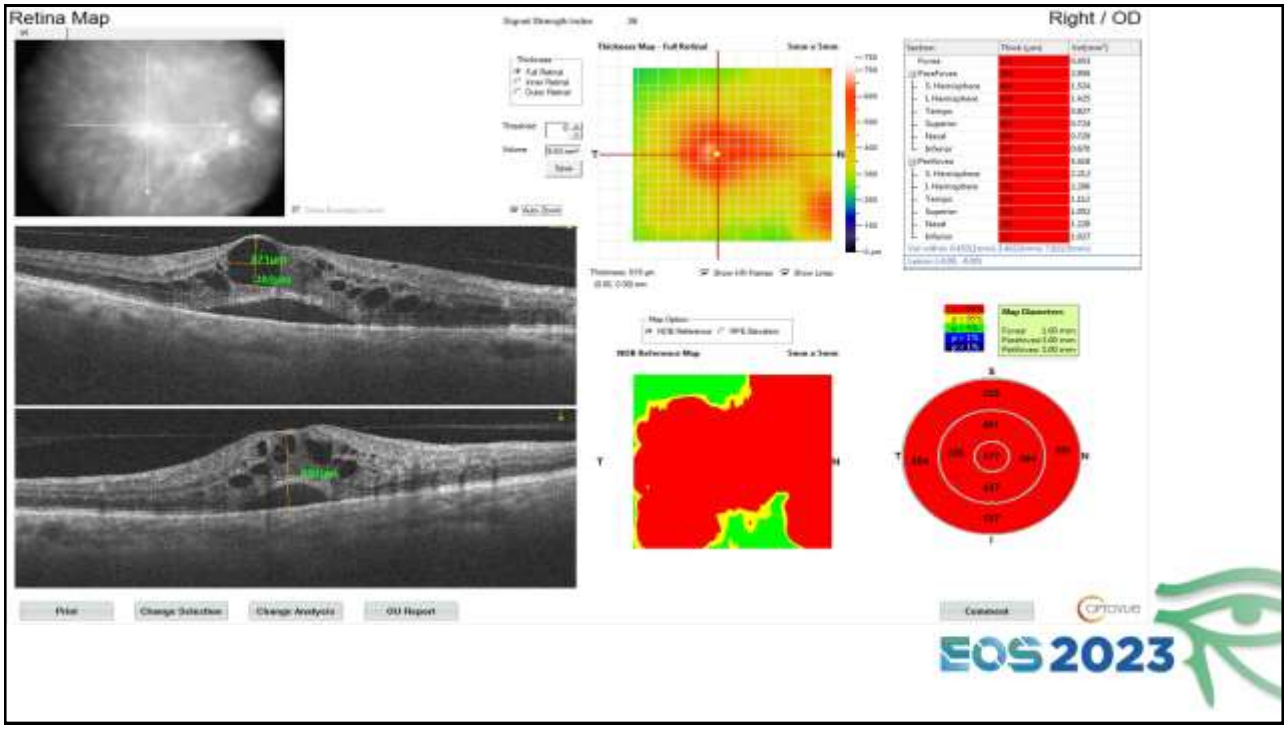


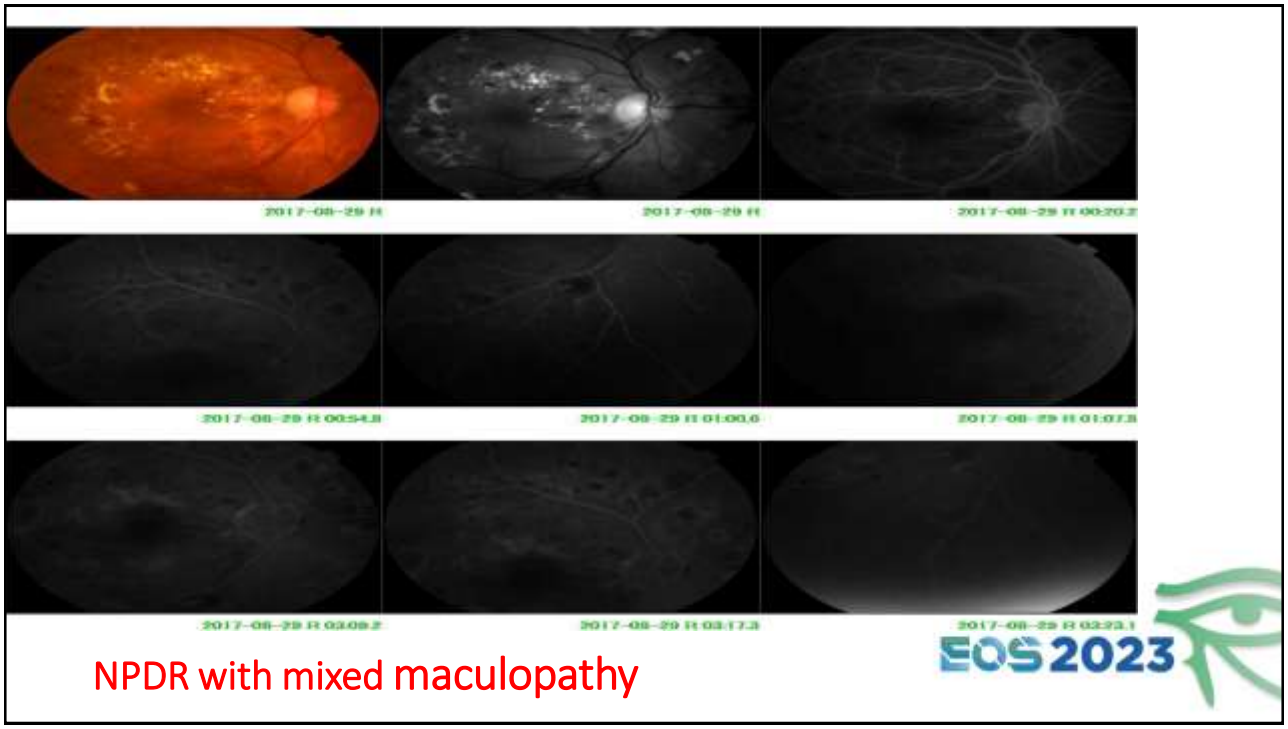
NPDR with multi-focal ME


Retina Map
Left / OS
Print
Change Selection
Change Analysis
OU Report
Cancel
EOS 2023

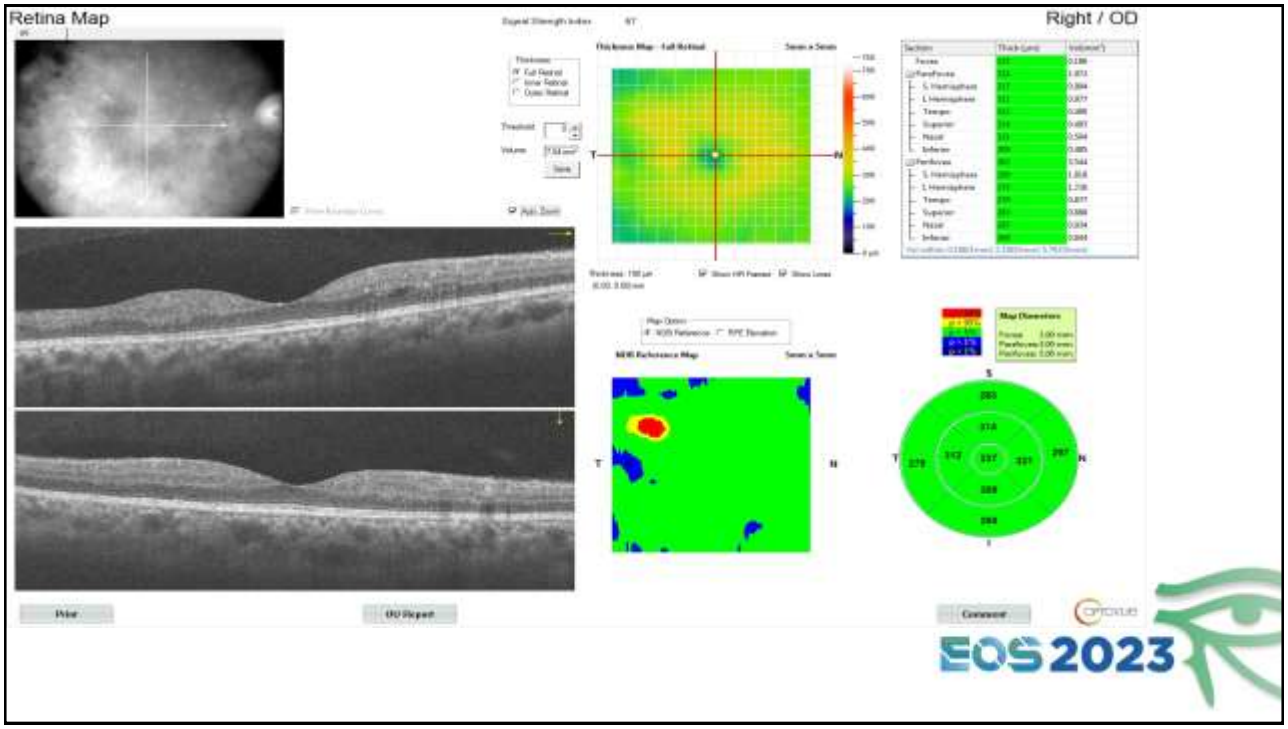

2017-08-06 R
2017-08-06 R
2017-08-06 R 00:24.2
2017-08-06 R 05:12.0
EOS 2023

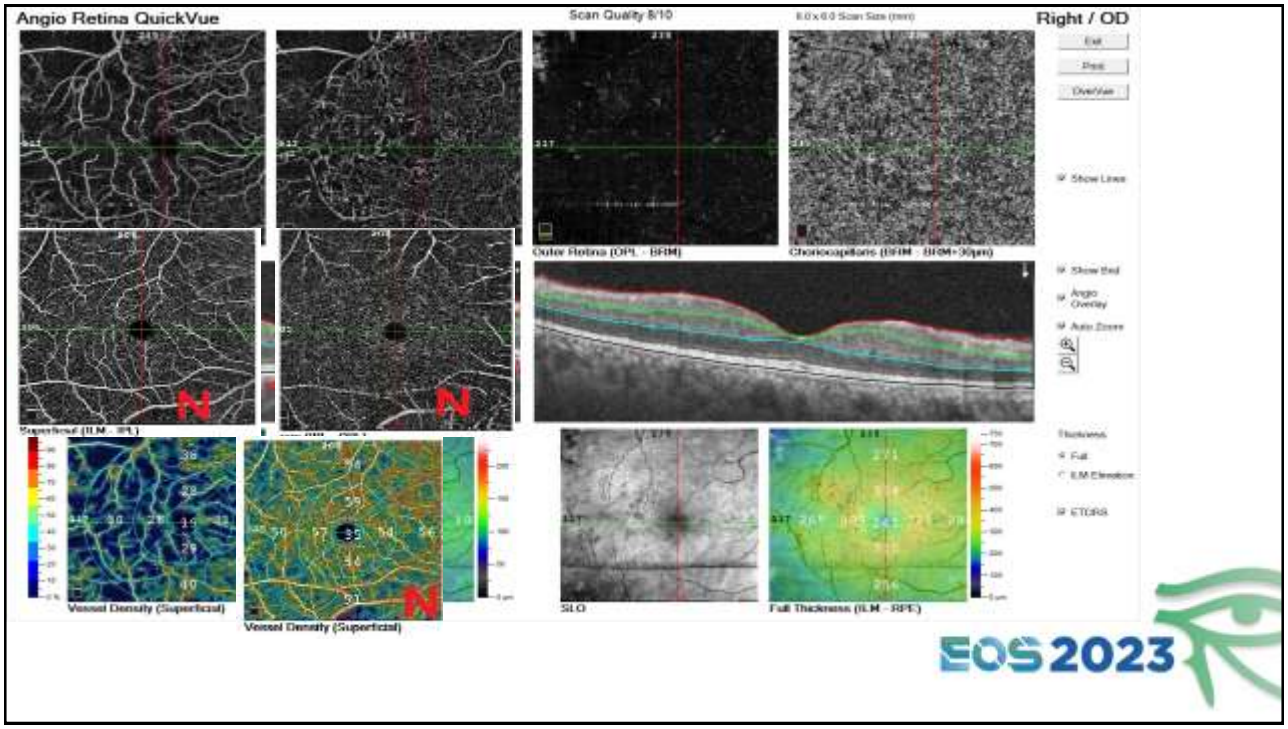
NPDR+CME

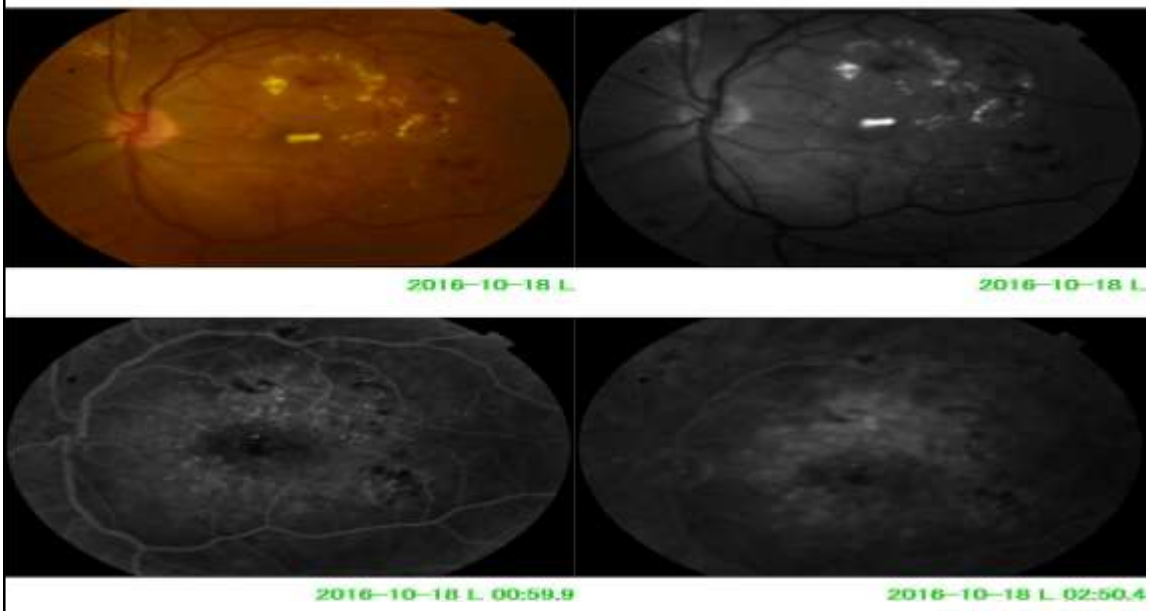




NPDR with mixed maculopathy

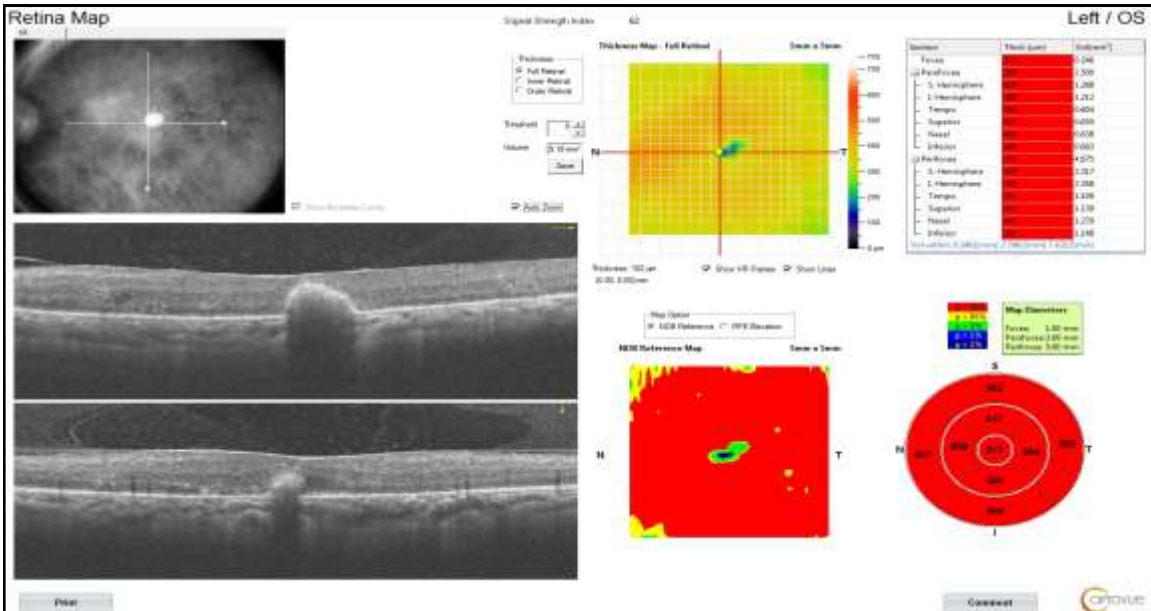

Retina Map
Right / OD
EOS 2023


Angio Retina QuickVue
Scan Quality 8/10
Right / OD
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30µm)
Vessel Density (Superficial)
SLO
Full Thickness (ILM - RPE)
EOS 2023

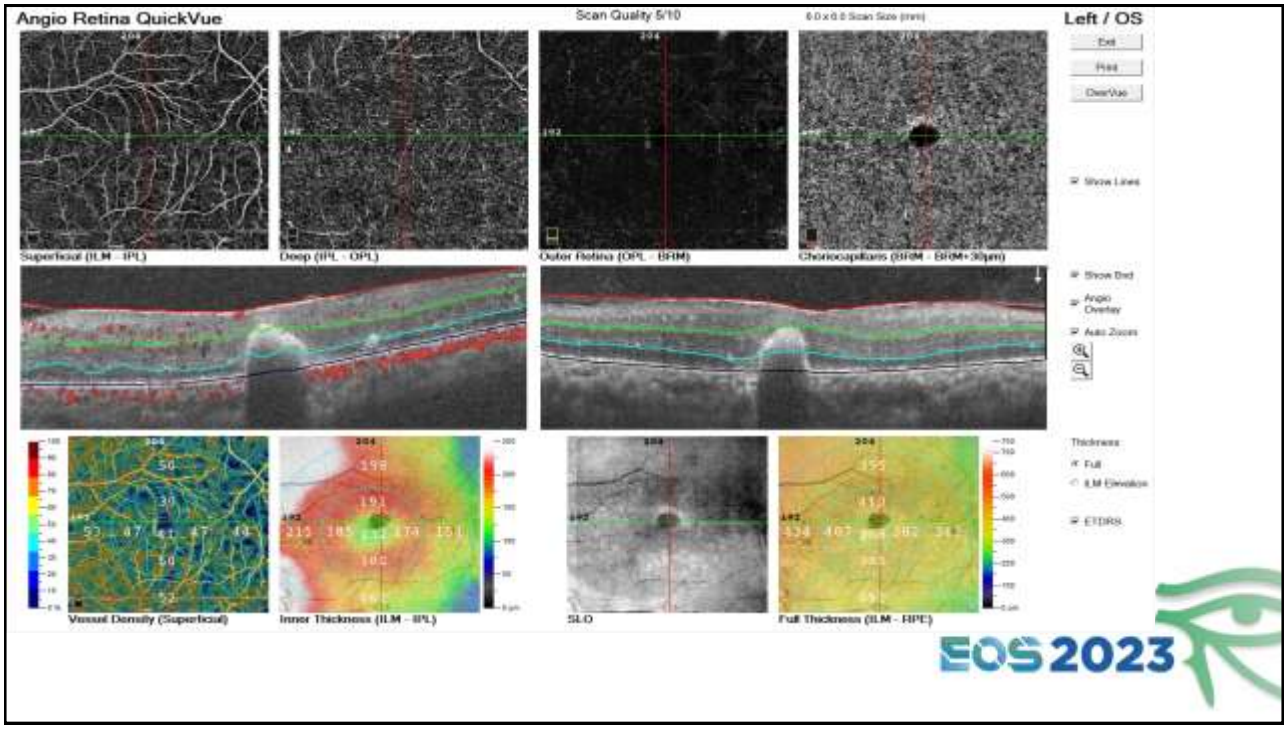


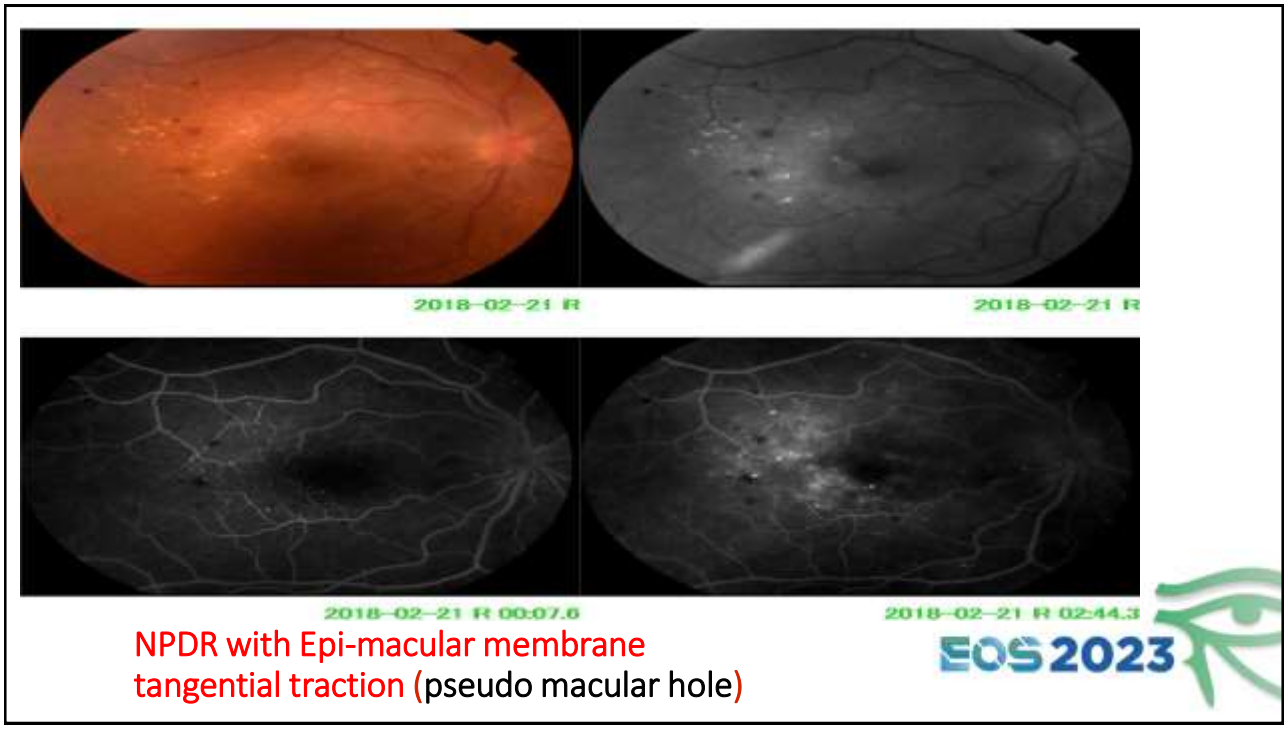
NPDR with macular pucker

EOS 2023

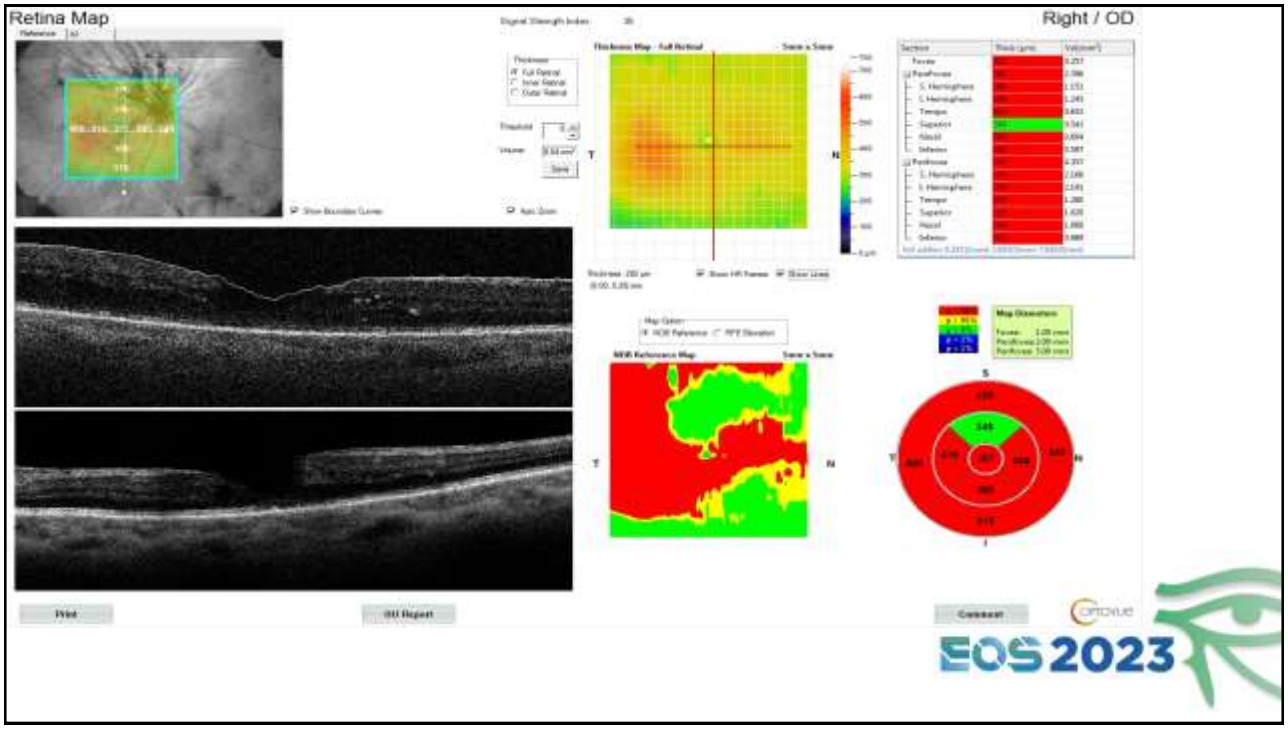


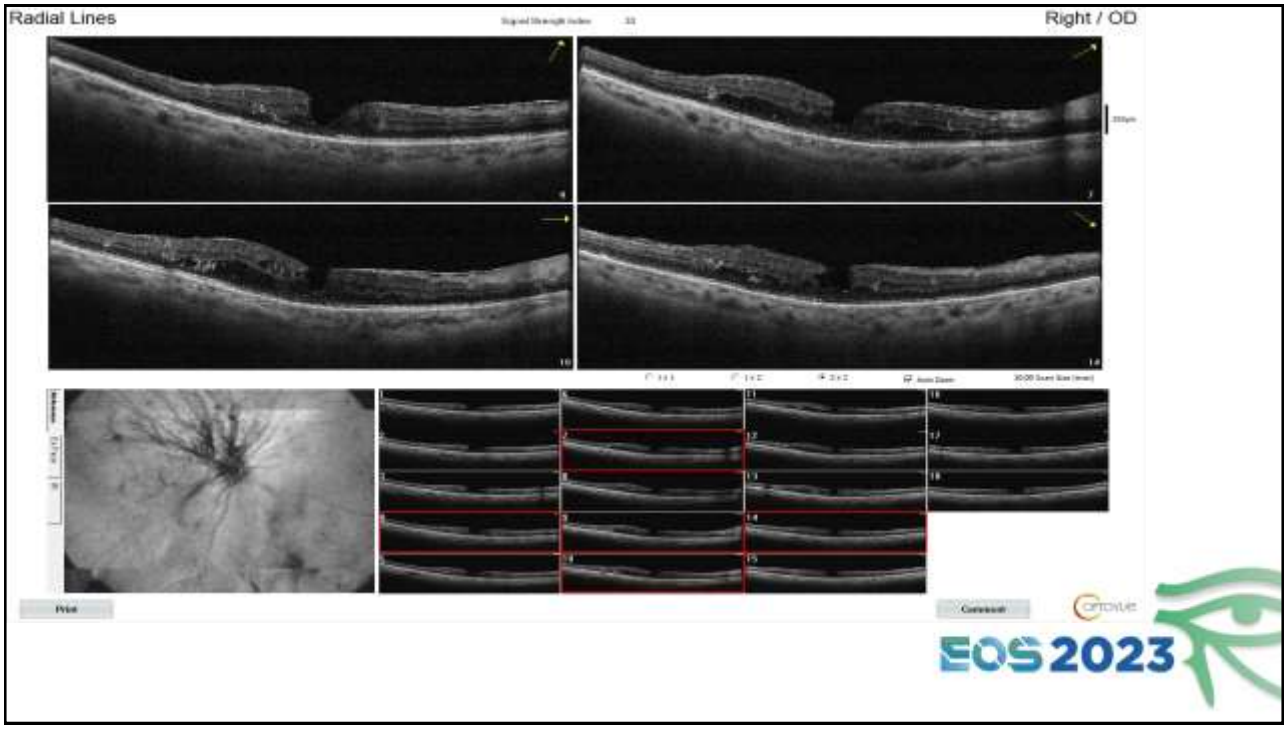
EOS 2023

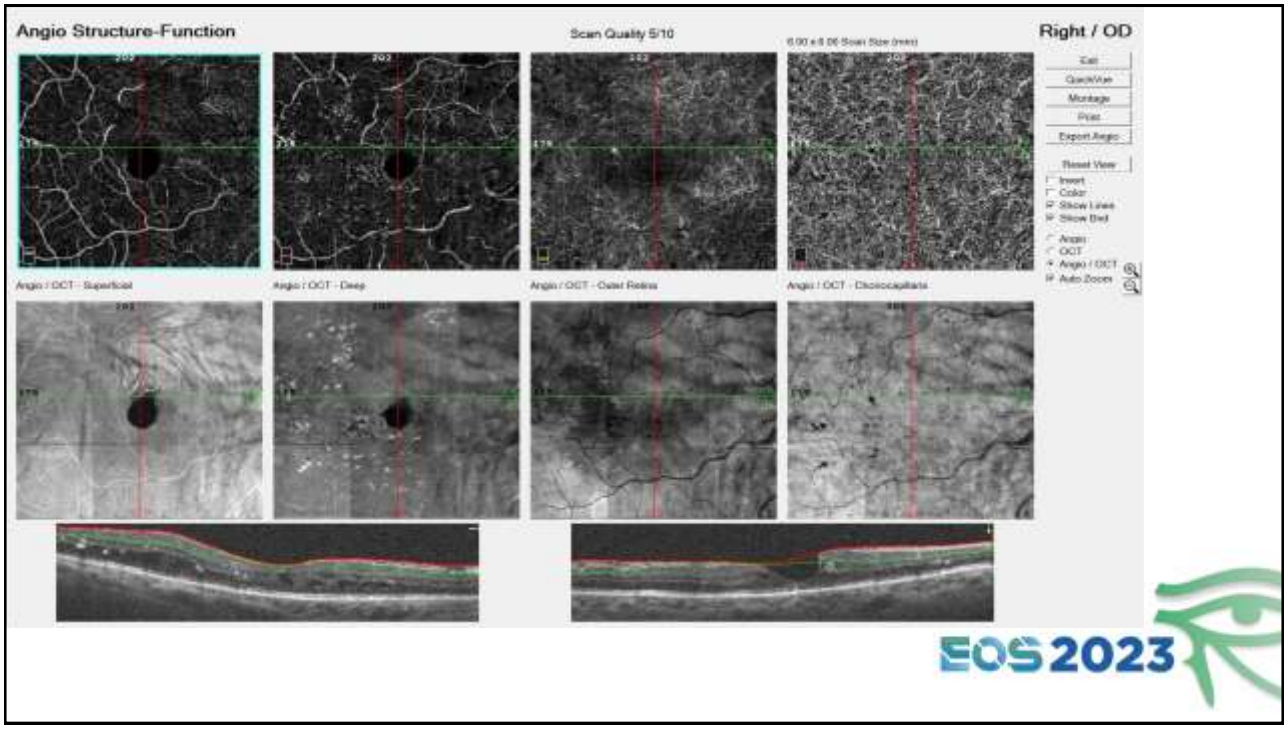


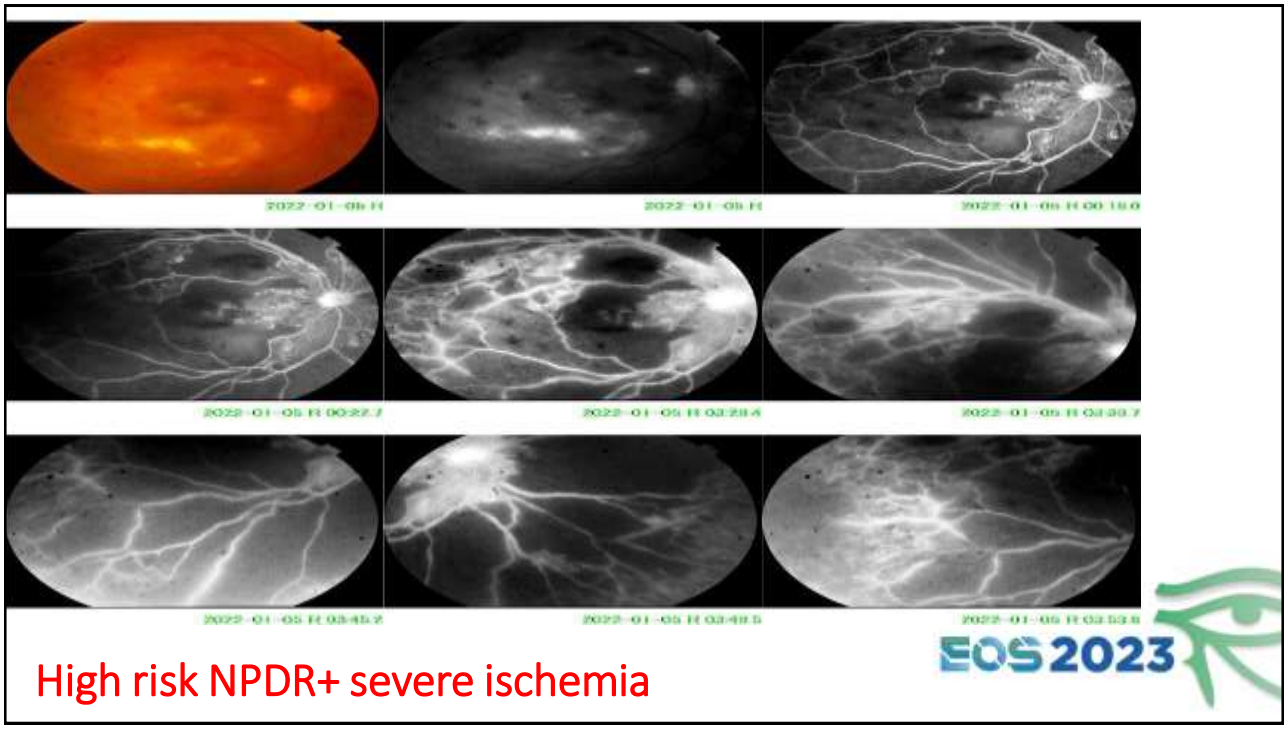


NPDR with Epi-macular membrane tangential traction (pseudo macular hole)

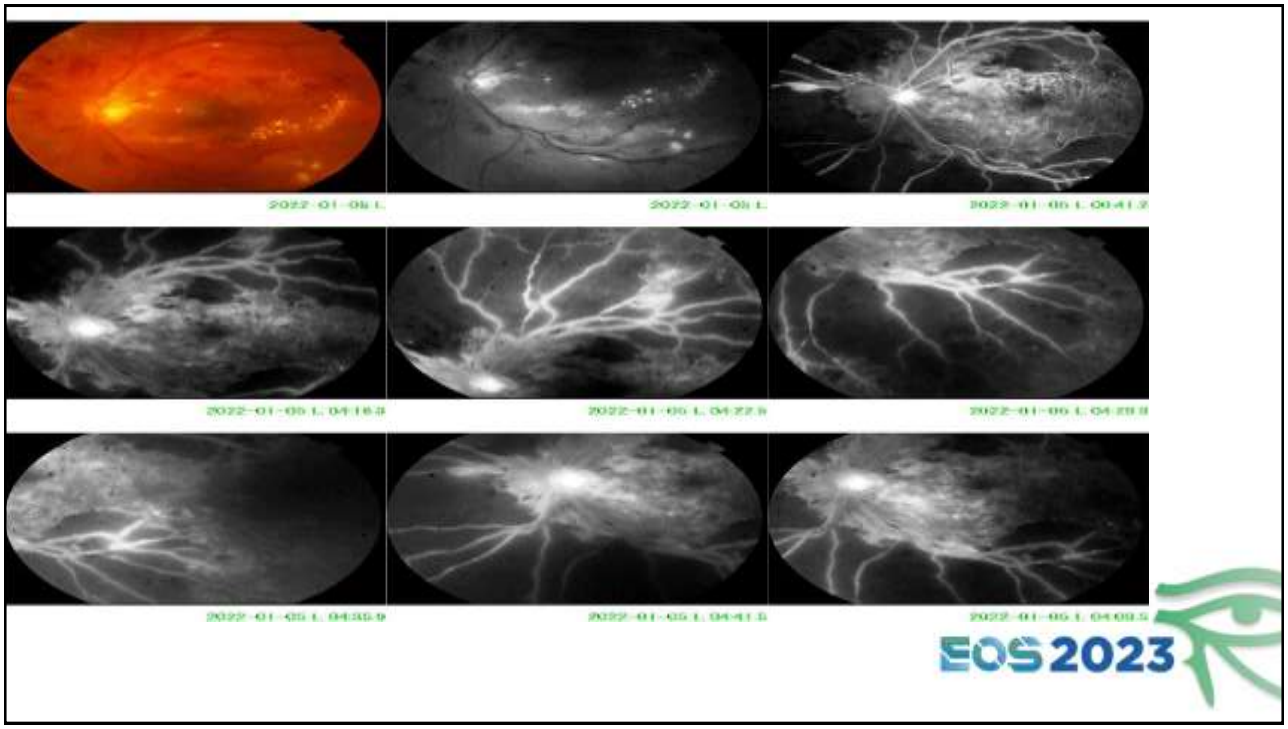

Retina Map
Right / OD
Print
OU Report
Comment
EOS 2023

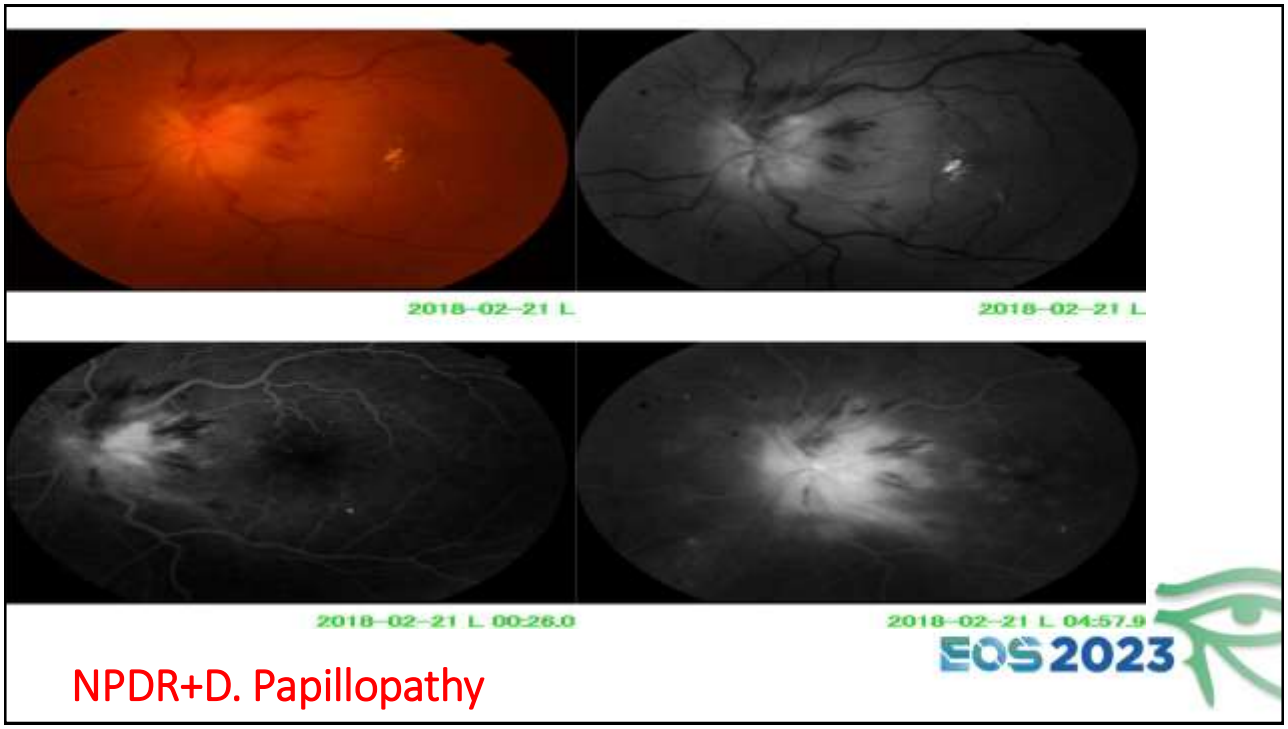

Radial Lines
Right / OD
Print
Comment
EOS 2023



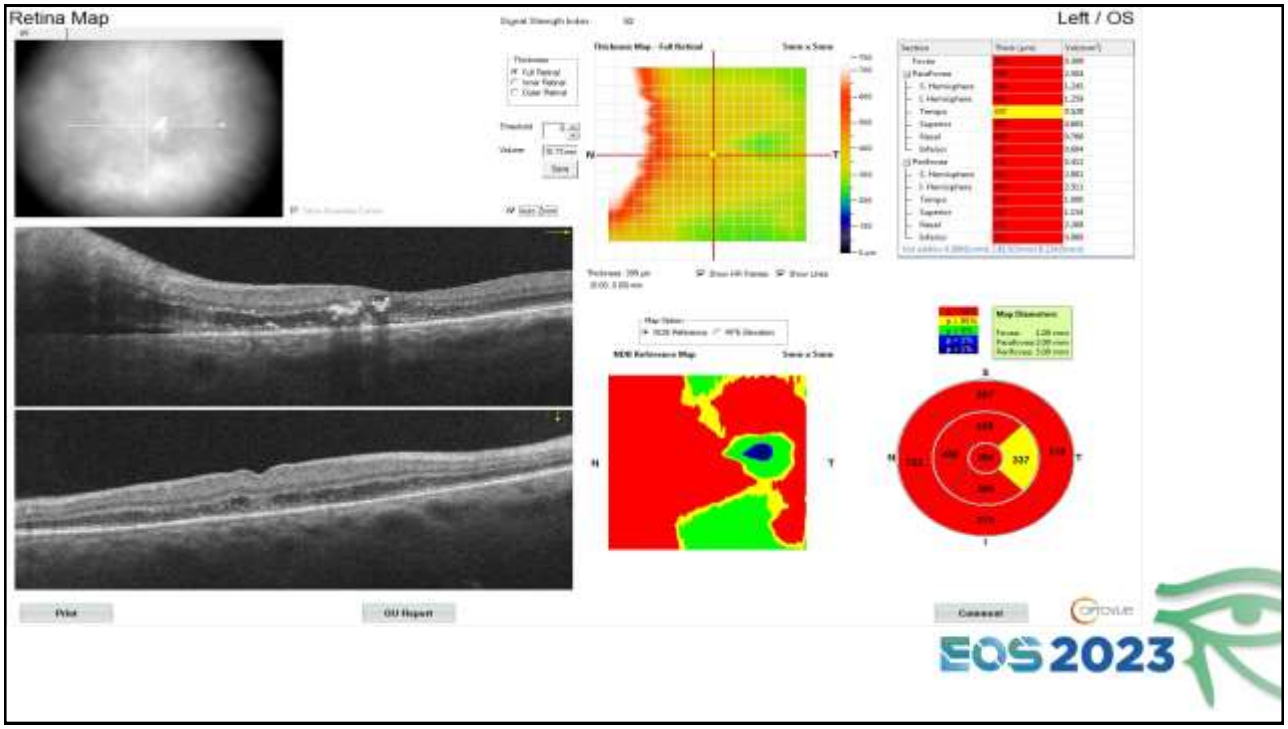


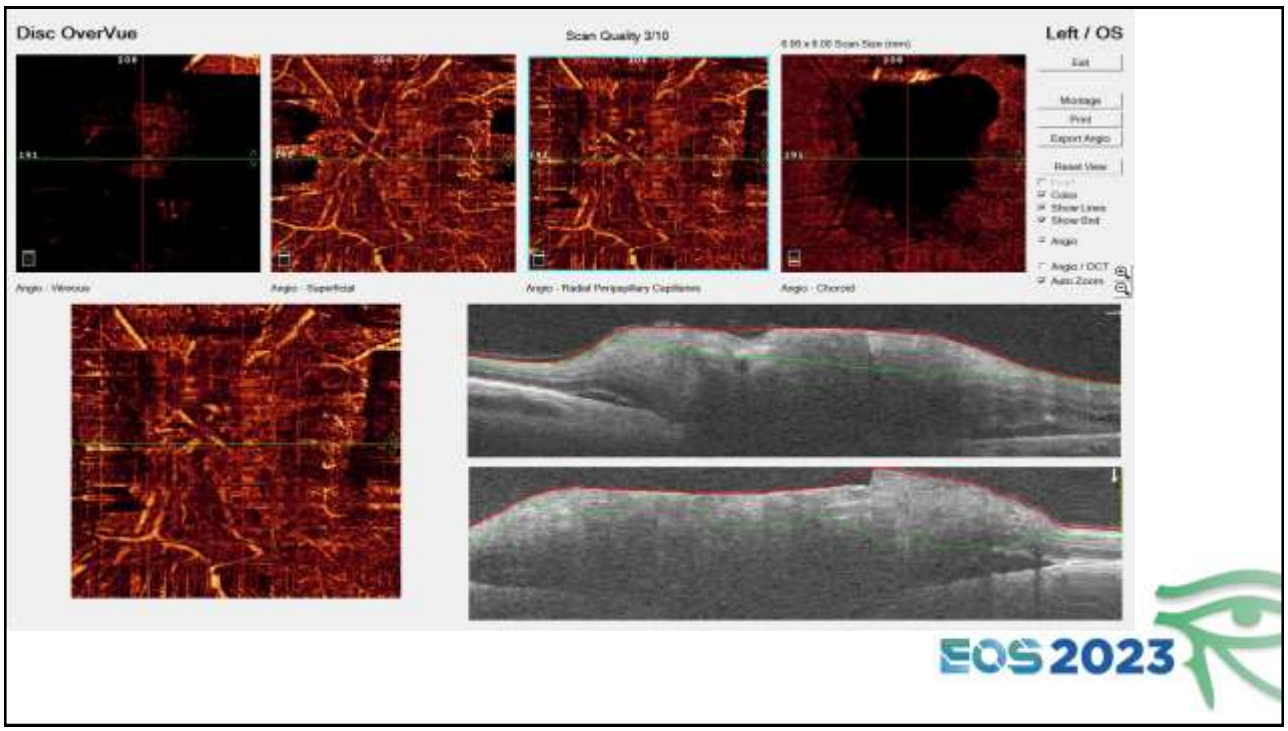
High risk NPDR+ severe ischemia

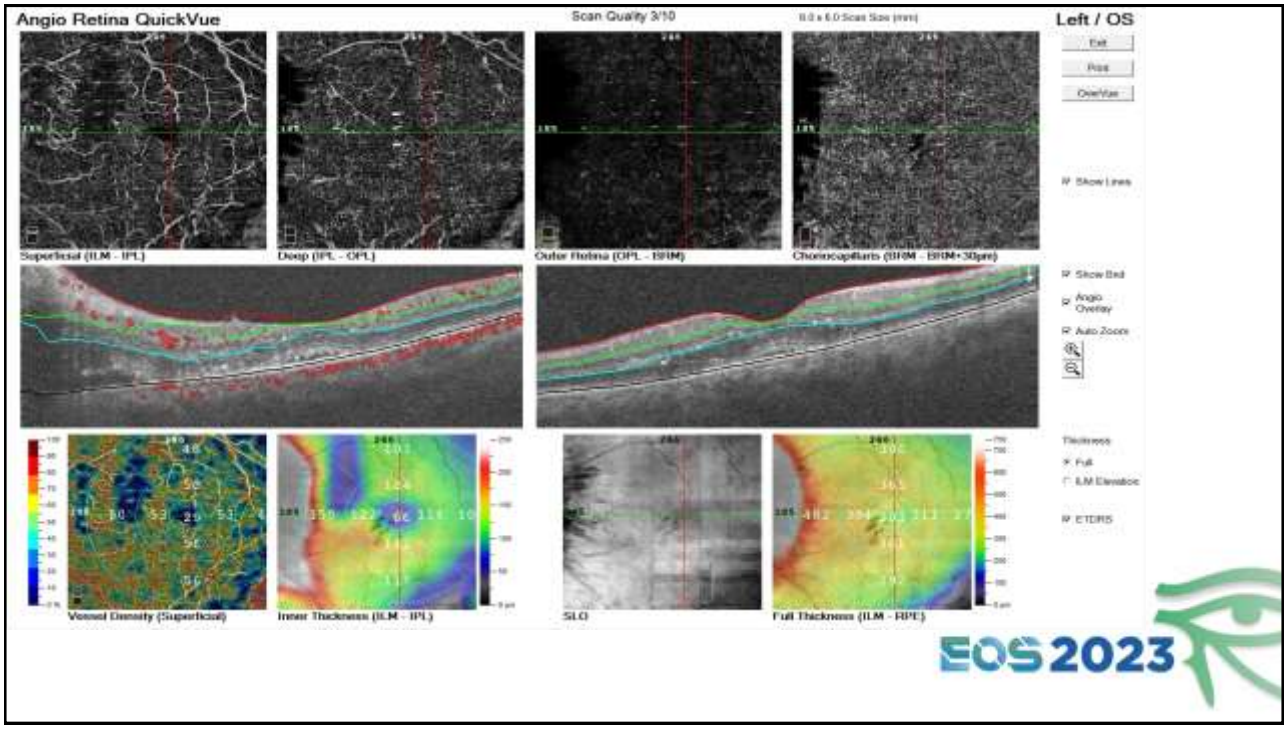


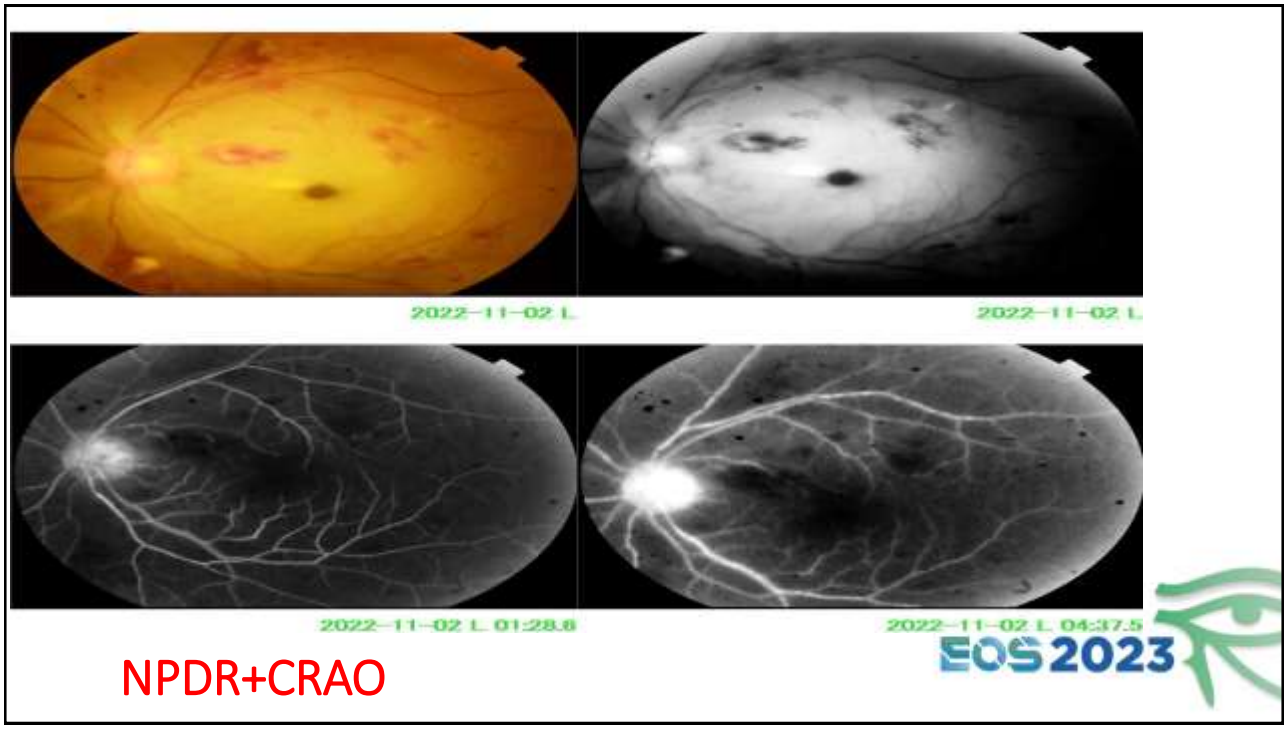


NPDR+D. Papillopathy

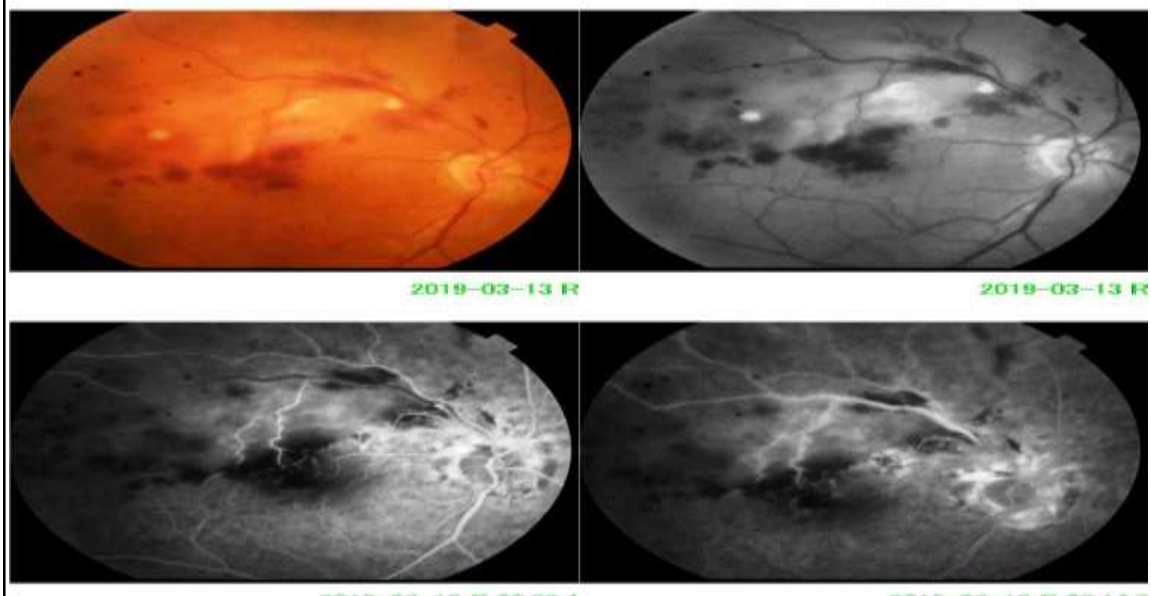

Retina Map
Left / OS
Print
OU Report
Cancel
EOS 2023


Disc OverVue
Scan Quality 3/10
Left / OS
Exit
Montage
Print
Export Angio
Reset View
Angio
Angio - Vitreous
Angio - Superficial
Angio - Radial Peripapillary Capillaries
Angio - Choroid
EOS 2023

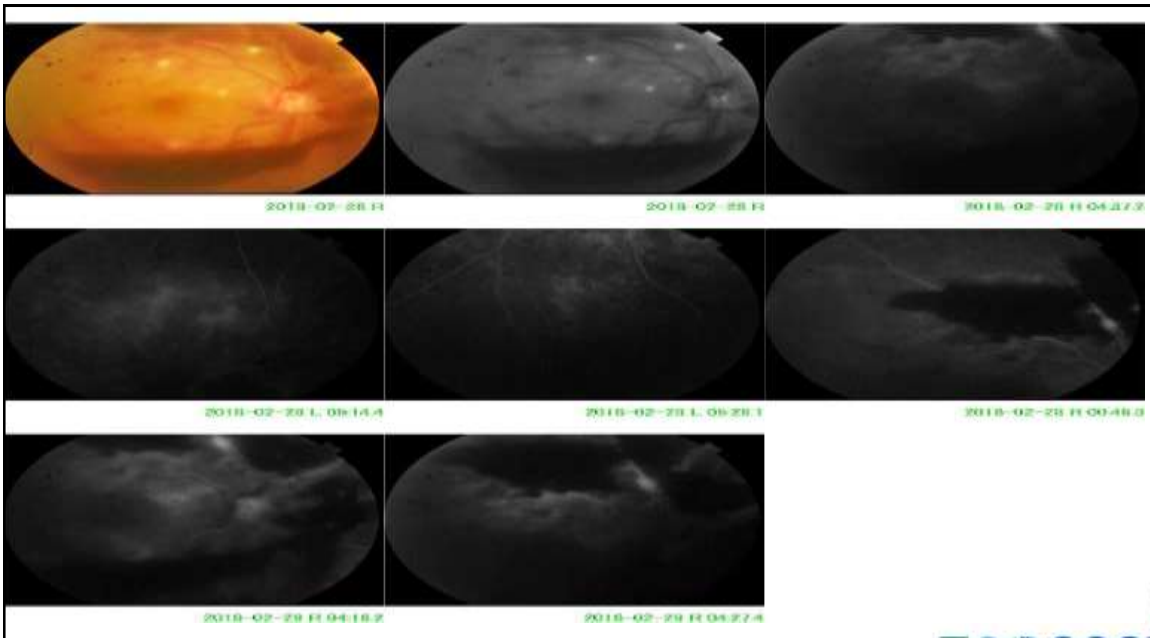

Angio Retina QuickVue
Scan Quality 3/10
Left / OS
Superficial (ILM - IPL)
Deep (IPL - OPL)
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30μm)
Vessel Density (Superficial)
Inner Thickness (ILM - IPL)
SLO
Full Thickness (ILM - RPE)
EOS 2023


2022-11-02 L
2022-11-02 L
2022-11-02 L 01:28.6
2022-11-02 L 04:37.5
EOS 2023

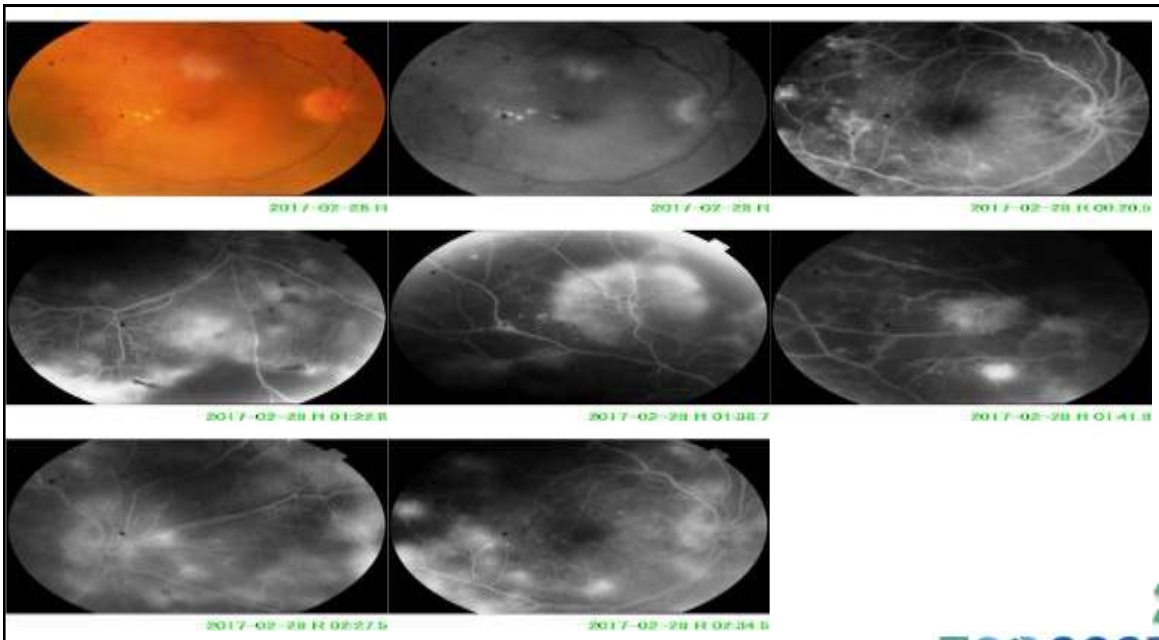
NPDR+CRAO



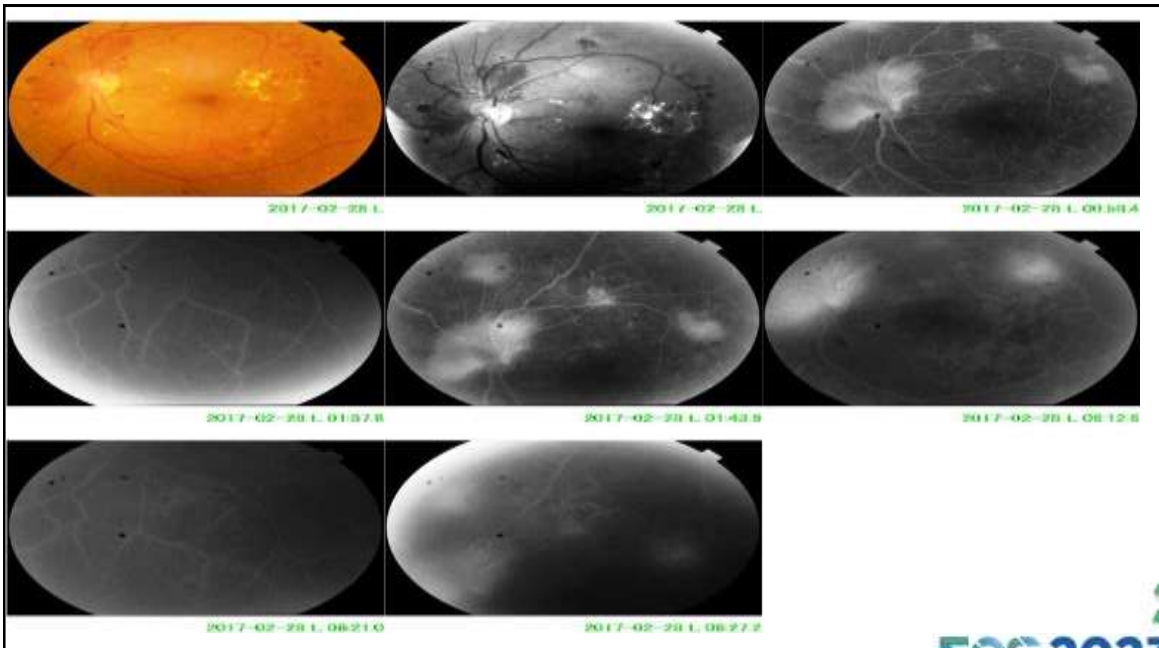
NPDR+BRVO+BRAO



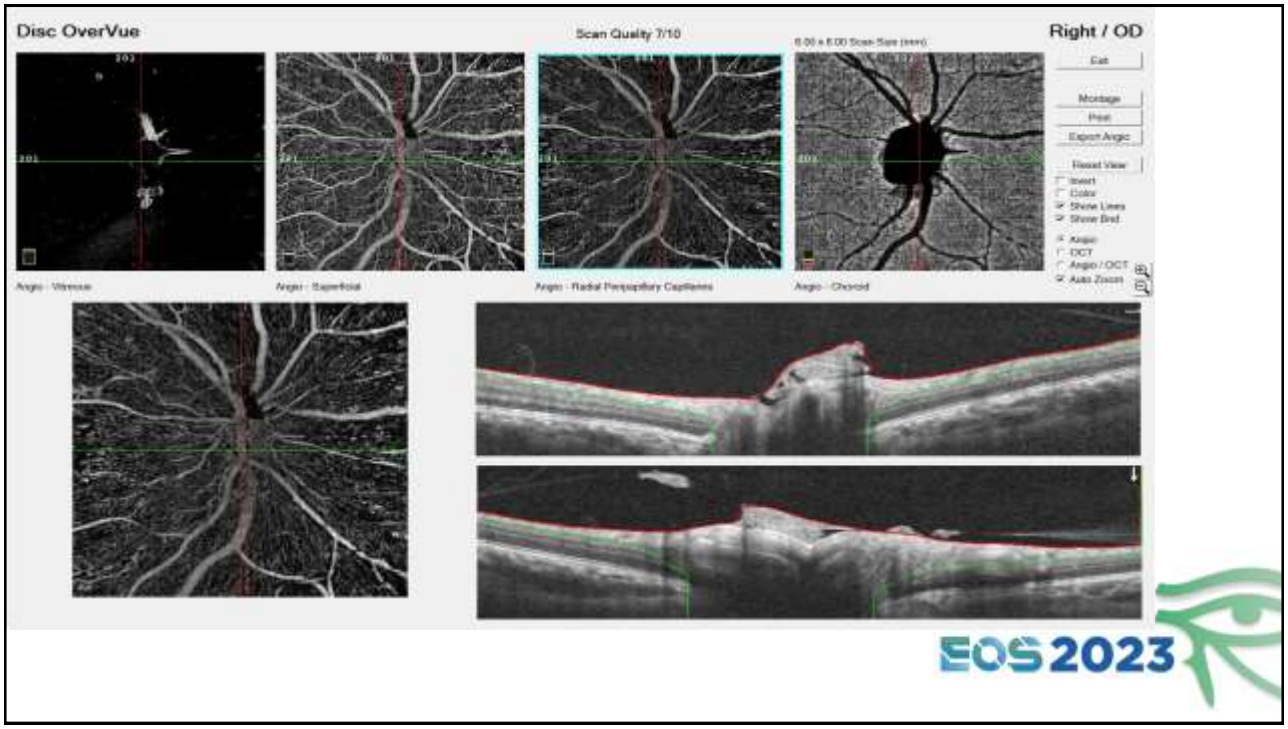
PDR+ pre retinal, vitreal hges

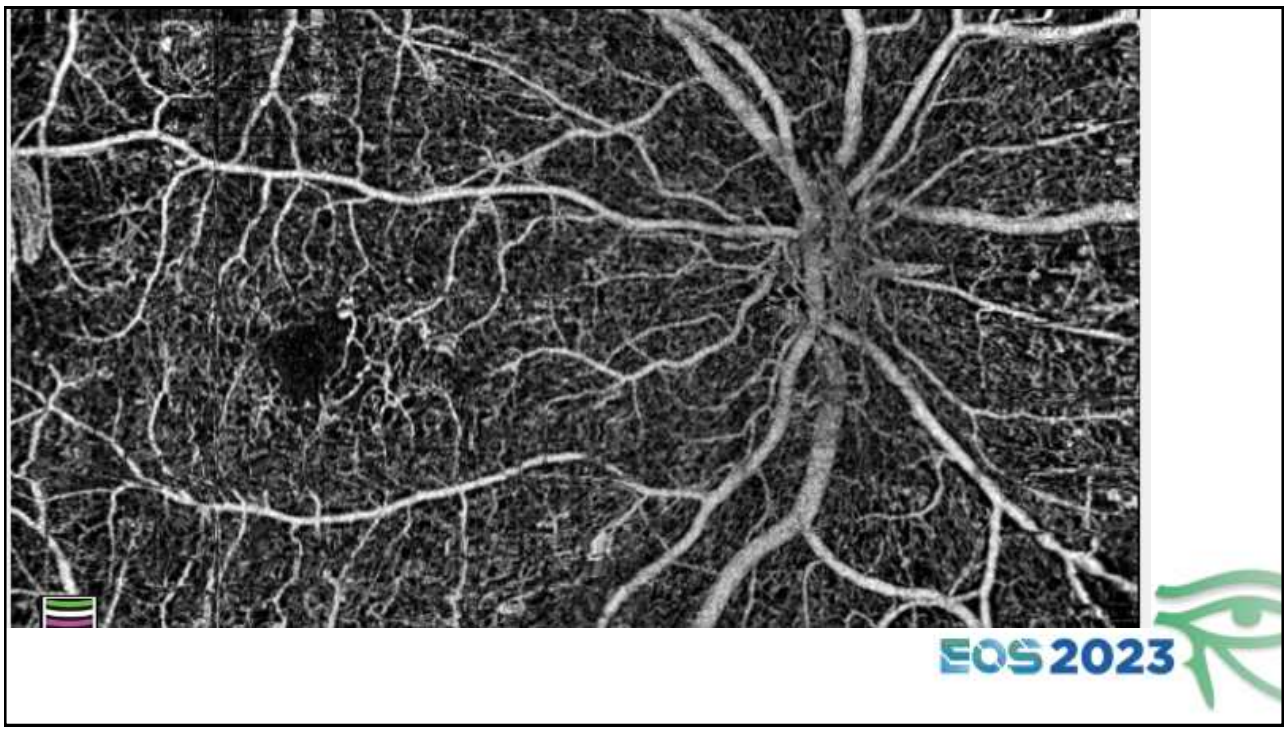


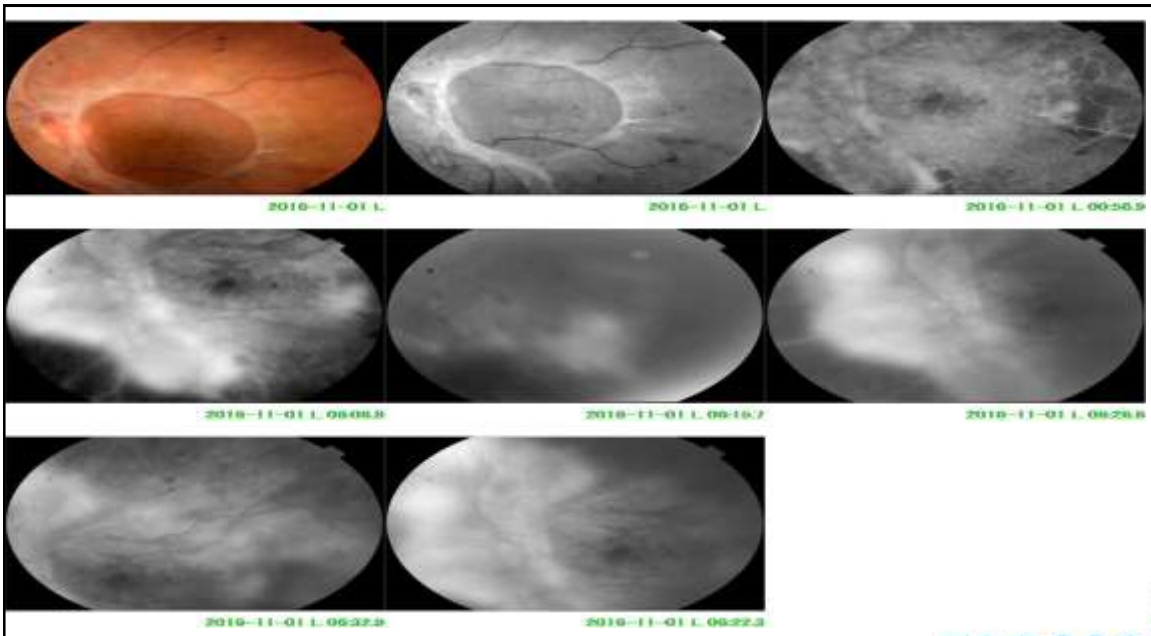
PDR, NVEs, mixed maculopathy



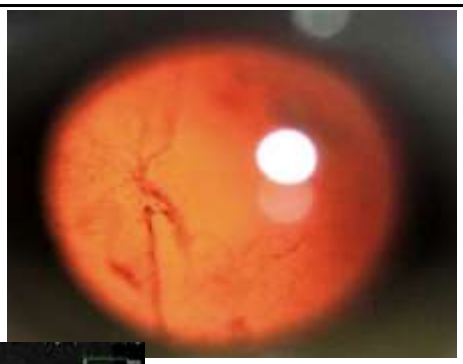
PDR, NVDs , NVEs+ mixed macuolopathy

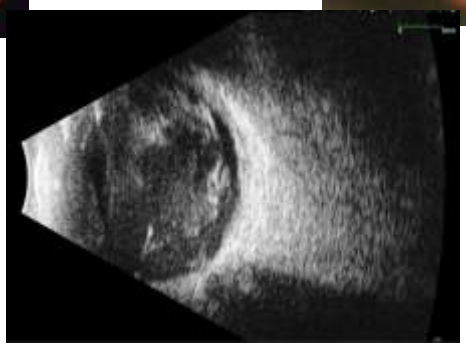

Disc OverVue
Scan Quality 7/10
Right / OD
Angio - Vitreous
Angio - Superficial
Angio - Radial Peripapillary Capillaries
Angio - Choroid
EOS 2023


EOS 2023

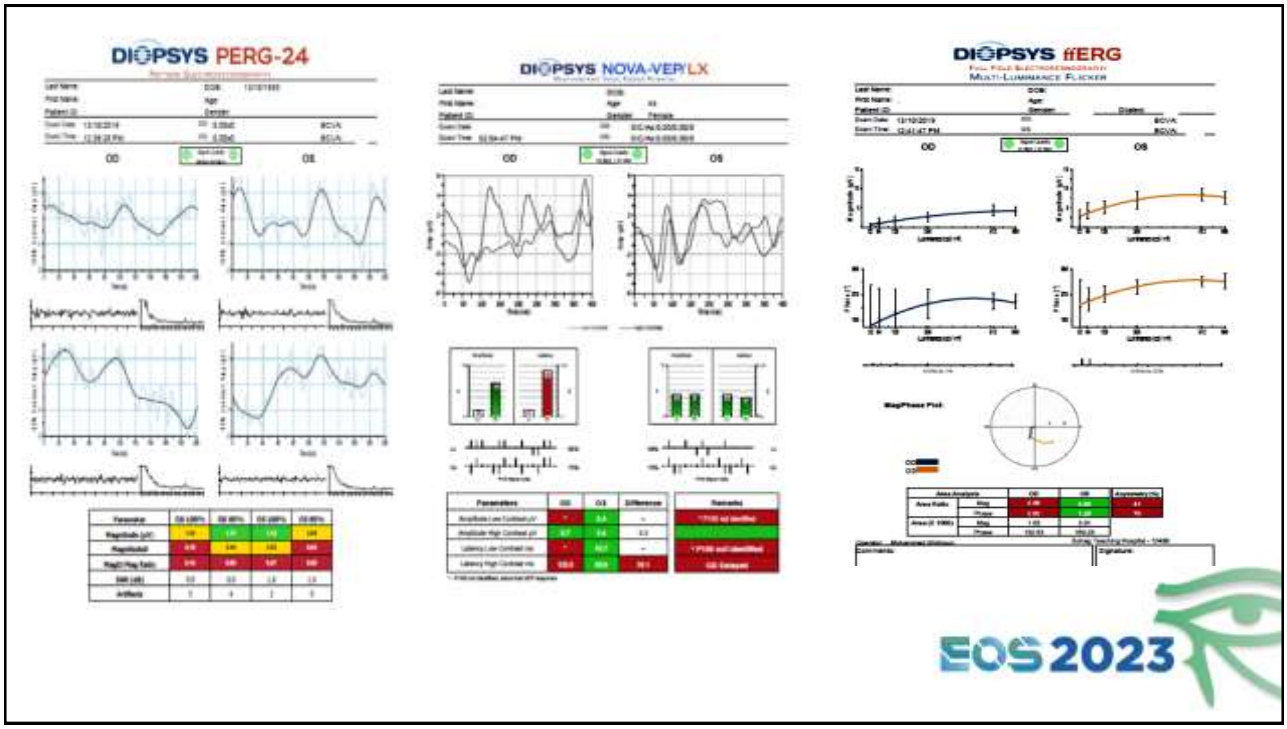


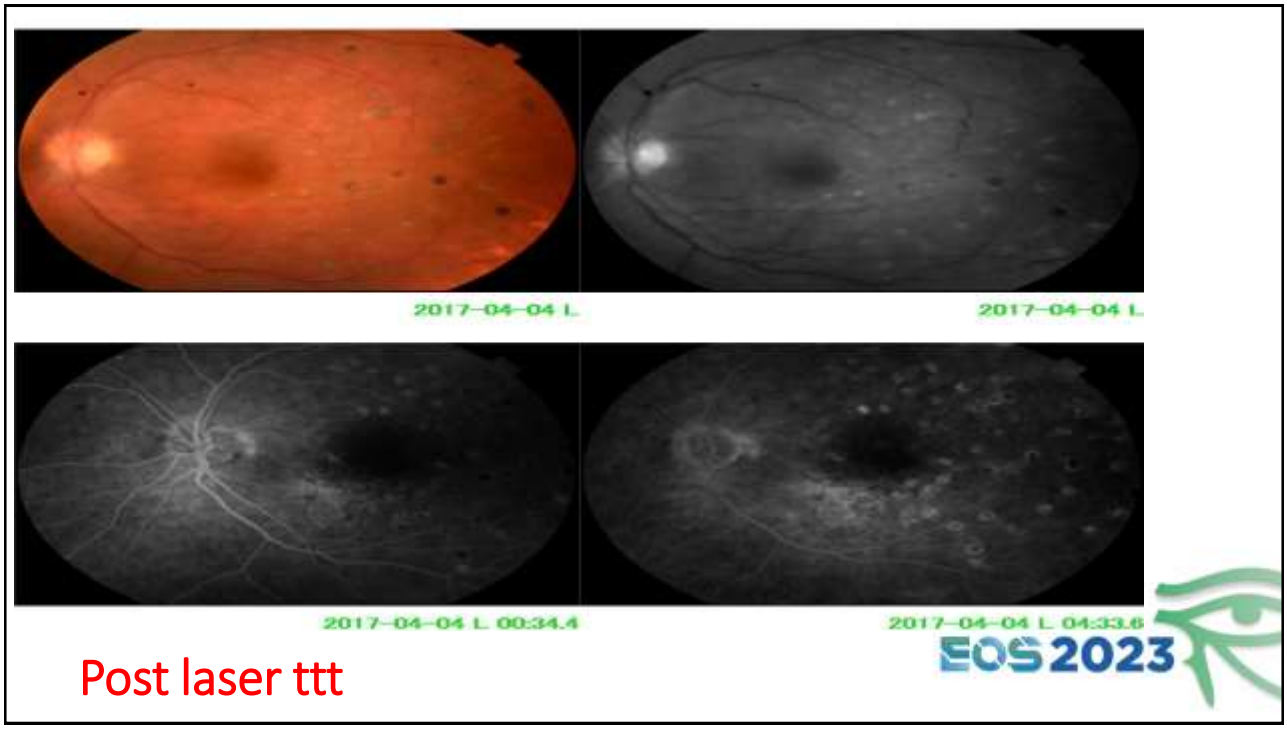
PDR(FVMs ,NVDs , NVEs)



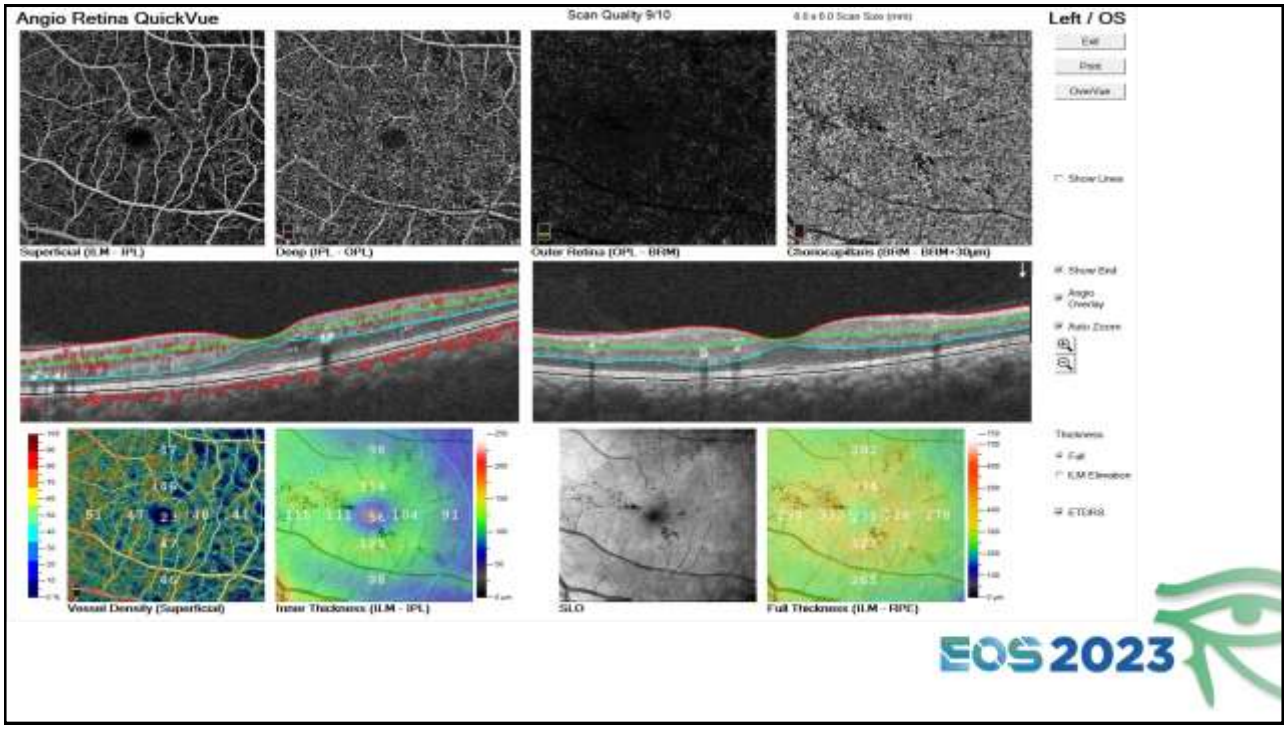


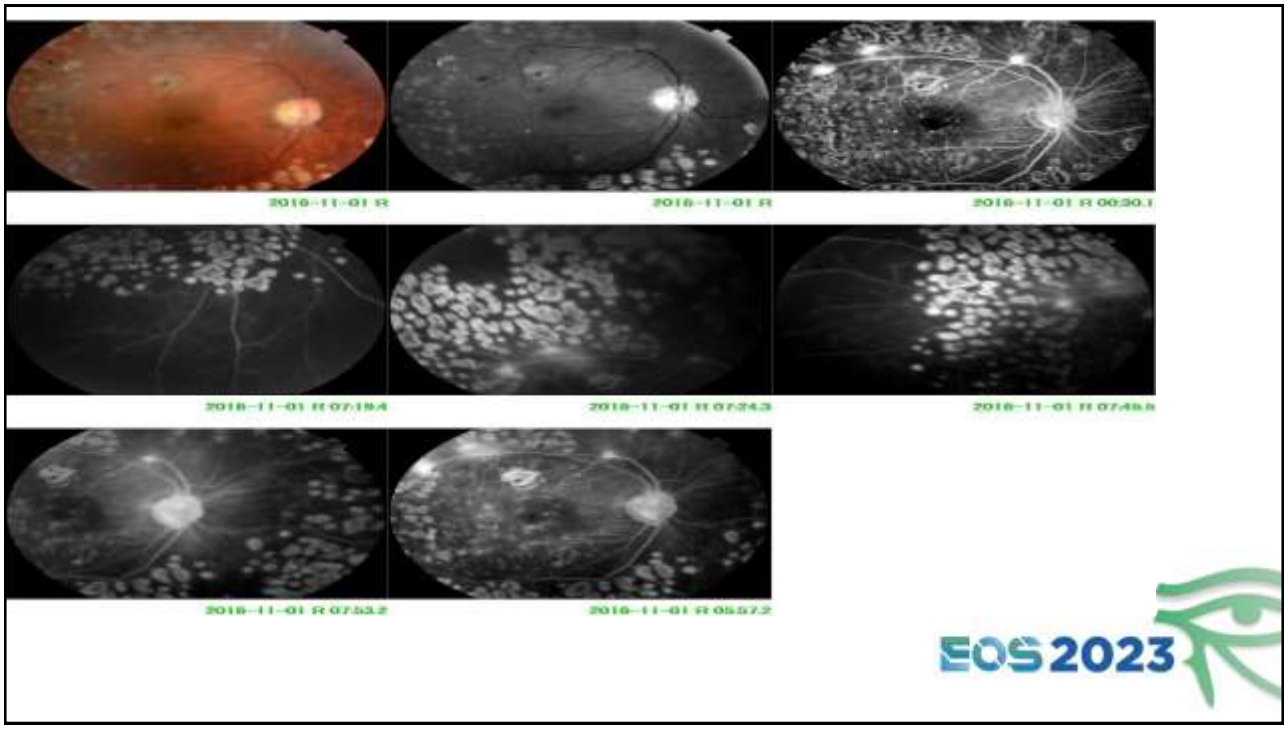
PDR , dense vit. hge

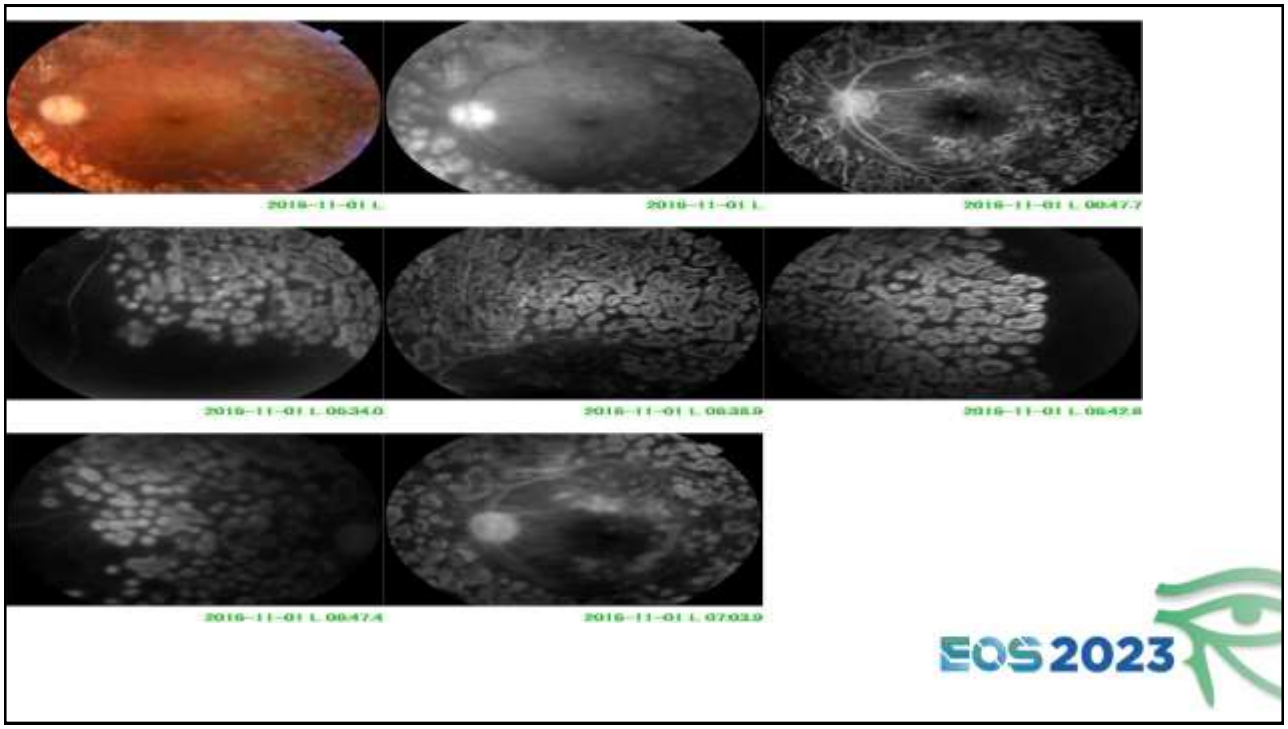


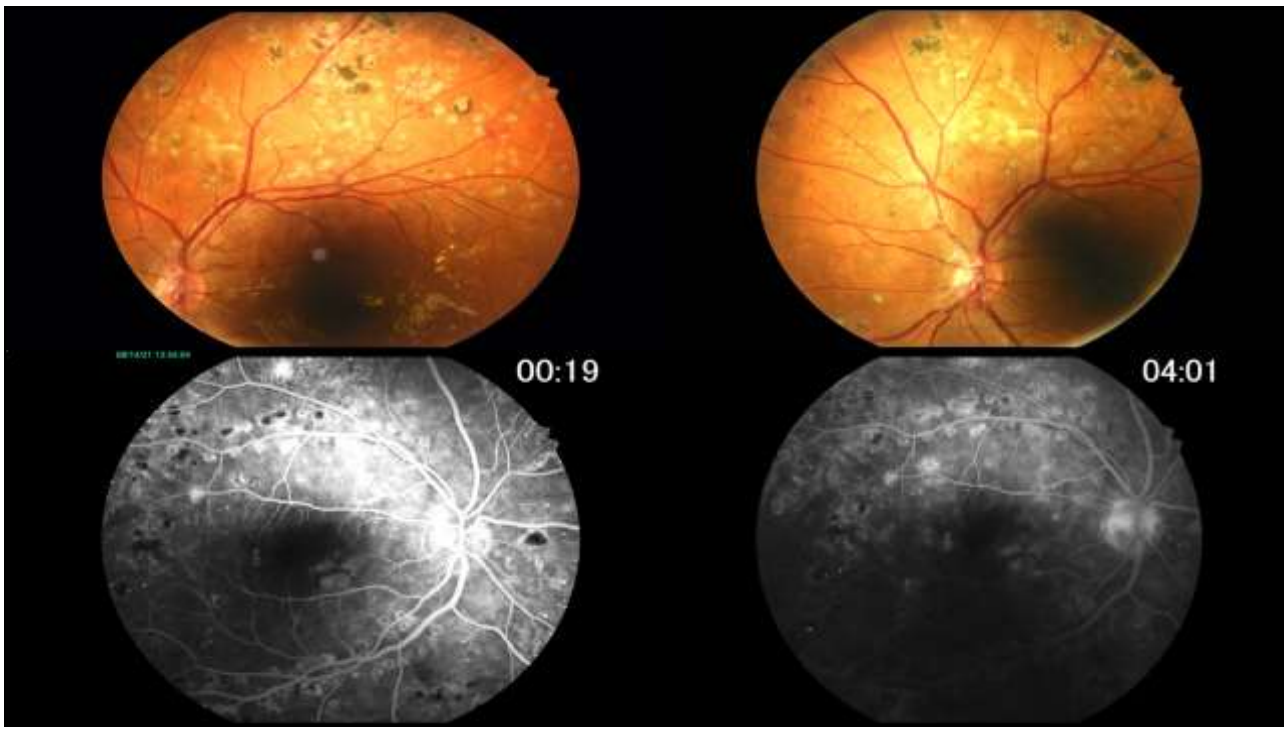


Post laser ttt


Angio Retina QuickVue
Scan Quality 9/10
Left / OS
Superficial (ILM - IPL)
Deep (IPL - OPL)
Outer Retina (OPL - BRM)
Choriocapillaris (BRM - BRM+30µm)
Vessel Density (Superficial)
Inner Thickness (ILM - IPL)
SLO
Full Thickness (ILM - RPE)
EOS 2023


2018-11-01 R
2018-11-01 R
2018-11-01 R 00:30.1
2018-11-01 R 07:19.4
2018-11-01 R 07:24.3
2018-11-01 R 07:46.5
2018-11-01 R 07:53.2
2018-11-01 R 05:57.2
EOS 2023


2016-11-01 L
2016-11-01 L
2016-11-01 L 06:47:7
2016-11-01 L 06:34:0
2016-11-01 L 06:38:9
2016-11-01 L 06:42:8
2016-11-01 L 06:47:4
2016-11-01 L 07:03:9
EOS 2023


00:19
04:01

Home message

- ***Clinical examination is the standard method in diagnosis and follow up.***
- ***Each type with each suitable case or inter-act with each other to draw the best way for diagnosis and follow up.***
- ***All image modalities can be used if needed and if available, with clinical correlation.***

EOS 2023


Thank you