Micropulse Laser in Diabetic Macula Oedema

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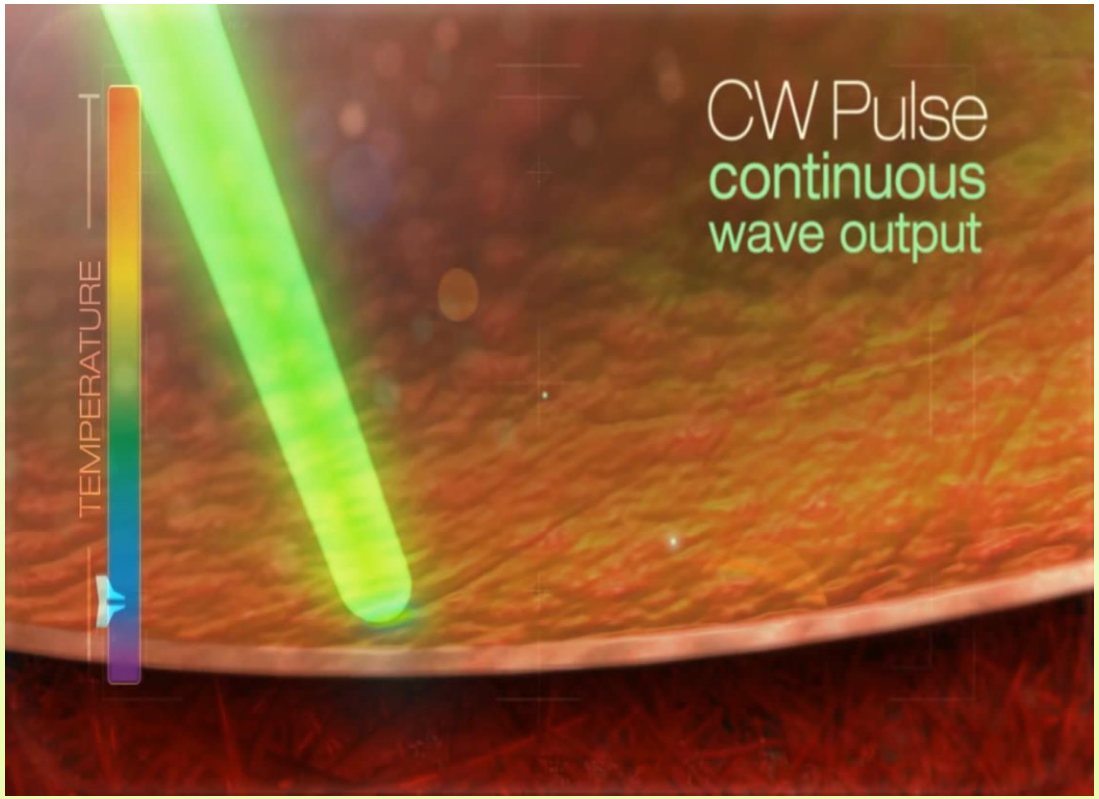
HISTORY OF LASERS IN DIABETIC RETINOPATHY

- 1917 - Einstein developed the concepts of laser
- 1940's- Meryer-Schwickerath xenon arc photocoagulator in the later years
- 1960 - Theodor Maiman: Ruby crystal medium
- 1968 - L'Esperance - The argon blue-green laser (488-514nm)
- 1972 - krypton laser (647um)
- Subsequently yellow (577um) , green and diode (810um)
- Navigated laser system
- Pattern scanning laser
- Short-pulse duration - sub threshold - Micropulse

LASERS IN DIABETIC RETINOPATHY

- 2 pivotal large, prospective, multicenter, randomized studies –
- **Diabetes Retinopathy Study (DRS)**
- **Early Treatment Diabetes Retinopathy Study (ETDRS)**

- Mechanism for the focal laser treatment is also not clear, may involve:
  - RPE stimulation
  - Closure of leaking microaneurysm
  - Induction of endothelial cell proliferation
  - Alteration in the biochemical environment in RPE (cytokines & growth factors)

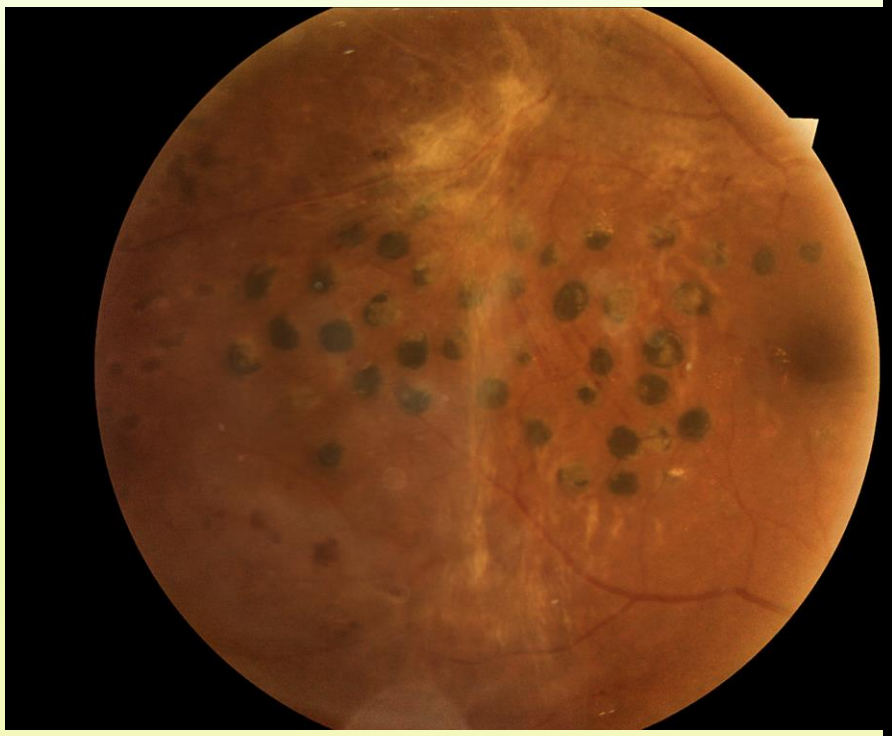


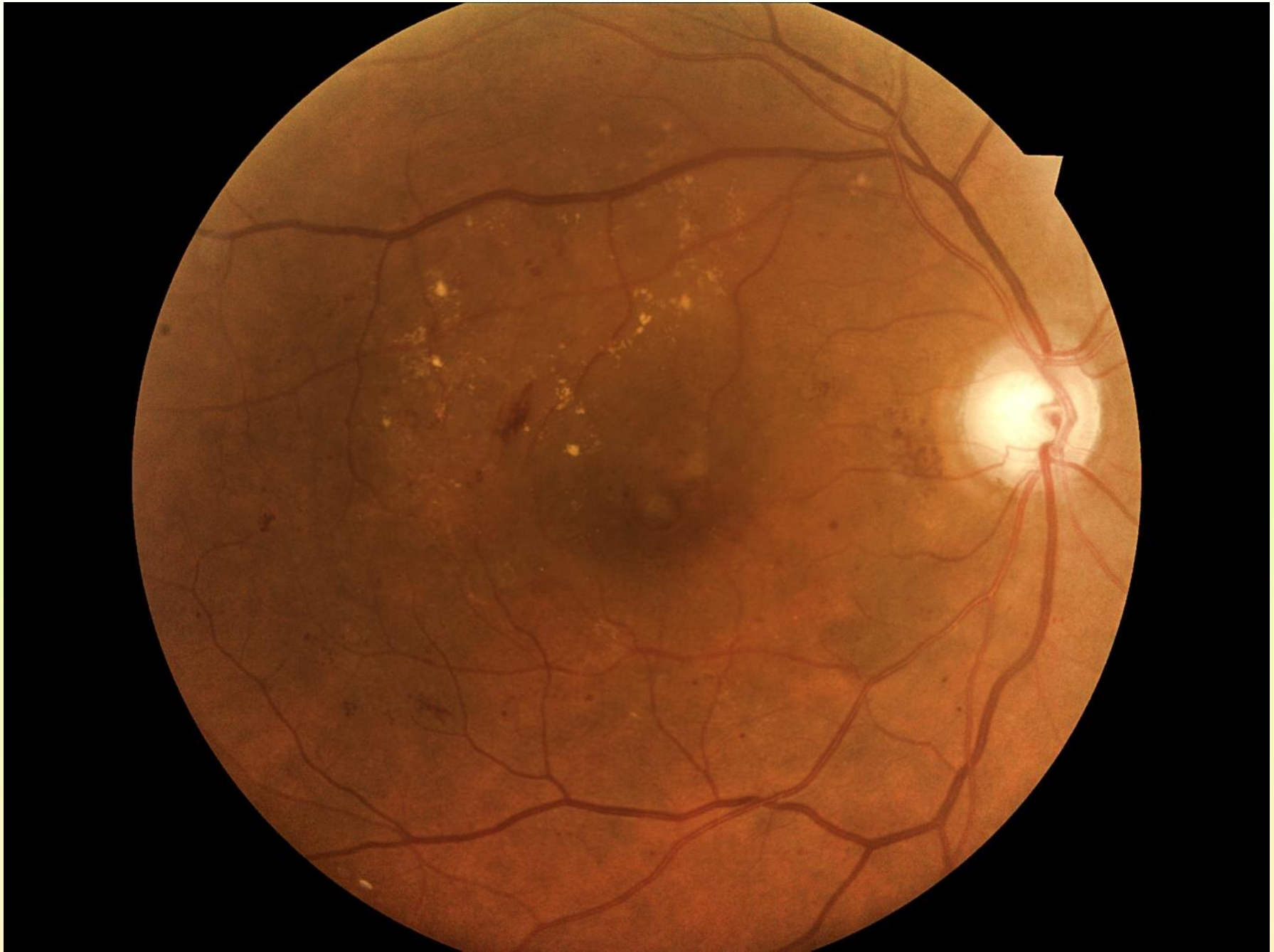
Conventional

- Laser energy is absorbed in the RPE
- Heat spreads to the neurosensory retina
- Thermally damaged retina blanches

Micropulse

- Energy in a train of on/off pulses
- Allows for thermal relaxation
- Avoids thermal damage



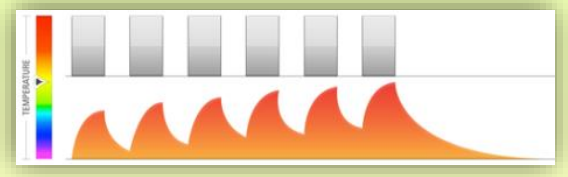


MICROPULSE LASER

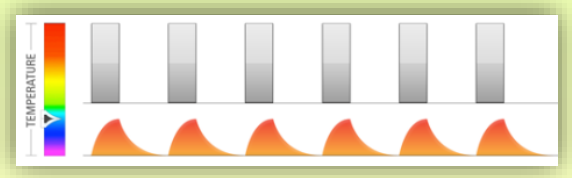
Repetitive short pulses permit tissue to cool between pulses and reduce thermal buildup.

CW Laser Exposure

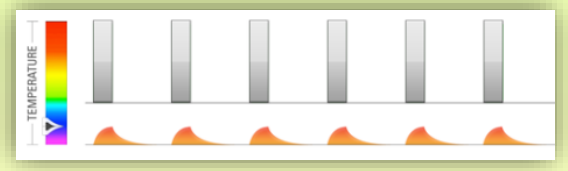
100% Duty Cycle (DC)



MicroPulse High DC (15%)



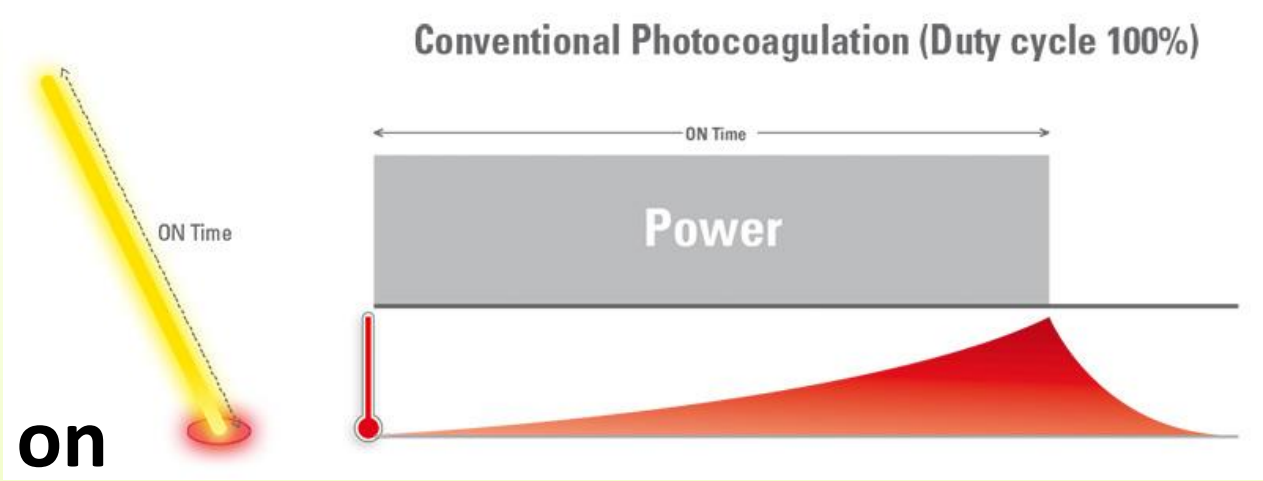
MicroPulse Medium DC (10%)



MicroPulse Low DC (5%)

DUTY CYCLE

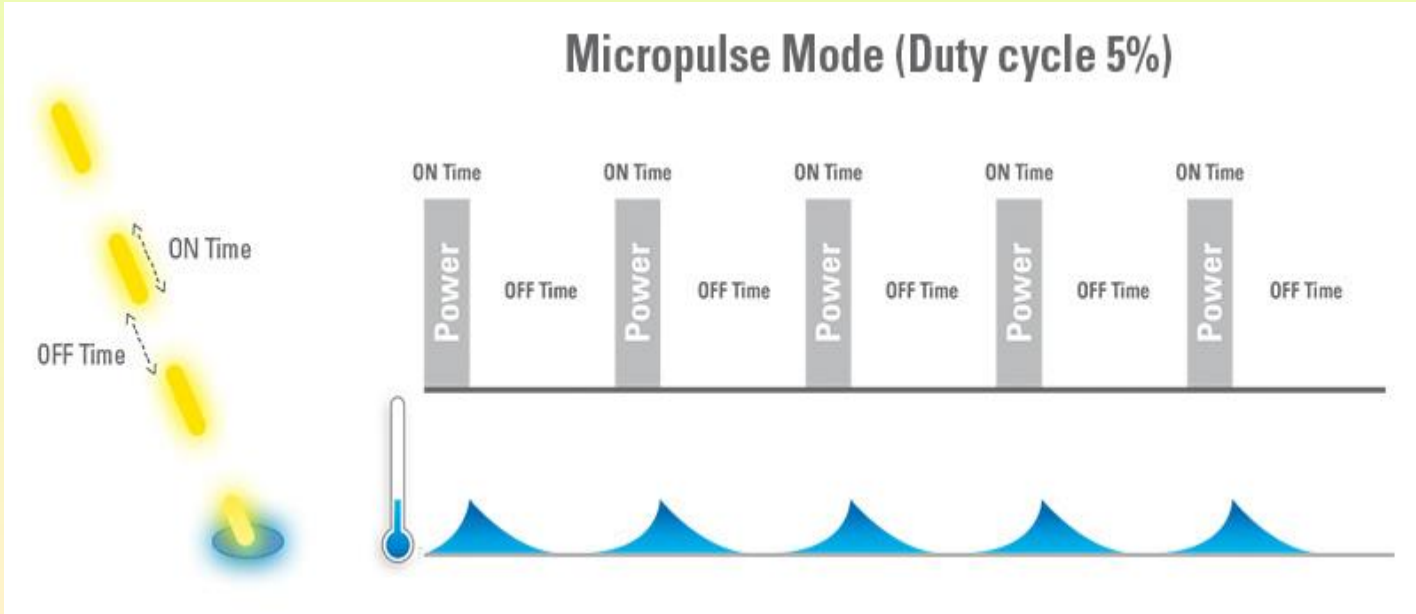
Percentage of time that the laser is on



ON TIME: Duration of each micropulse
OFF TIME: Interval between micropulse

Period (T) = ON + OFF TIME

DUTY CYCLE(%)
= ON TIME/ T x 100



Laser-Tissue Interaction & Absorption

3 principal chorioretinal light-absorbing chromophores:

Melanin

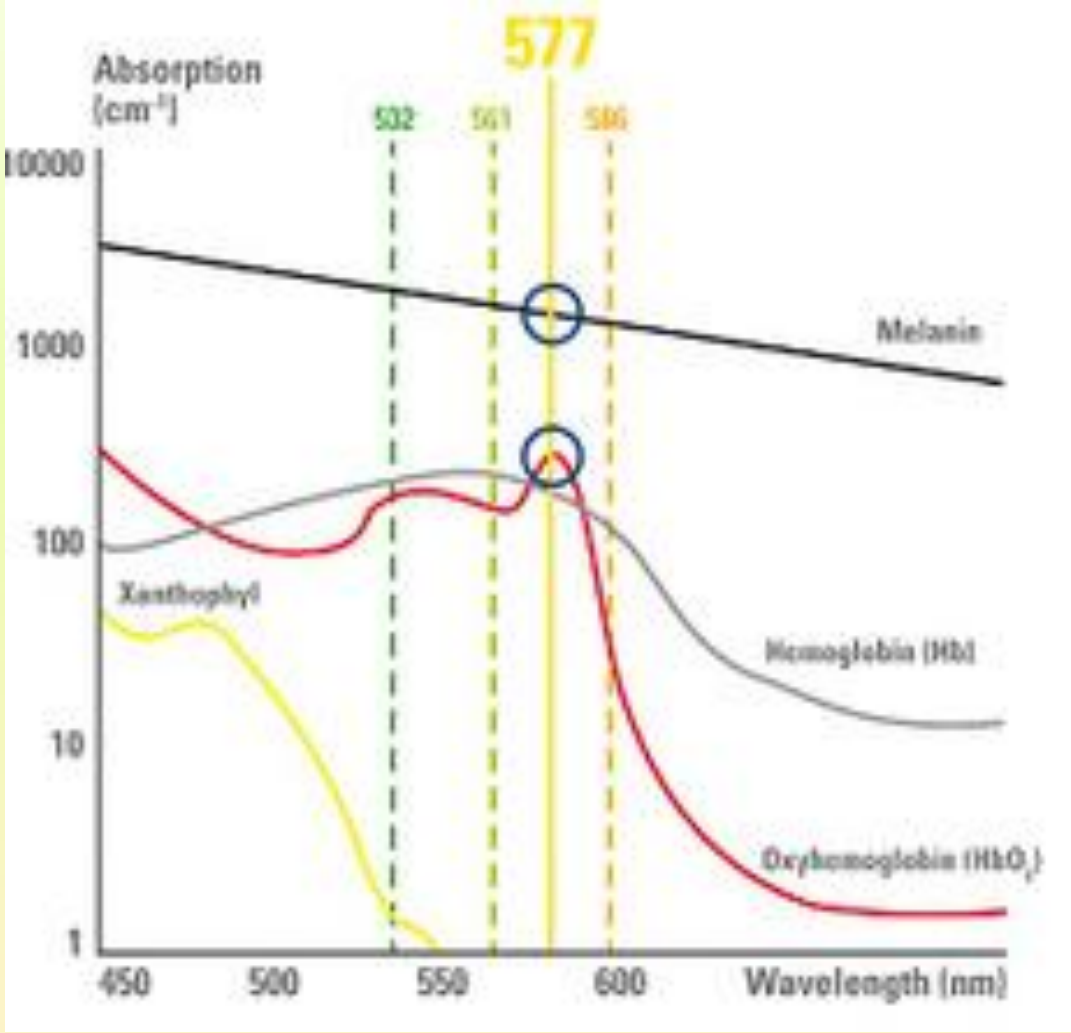
- Light absorption reduced with increasing λ

Hemoglobin

- HbO absorption spectrum peaks 577 nm yellow
- High choriocapillaris Hb absorption - uniform laser

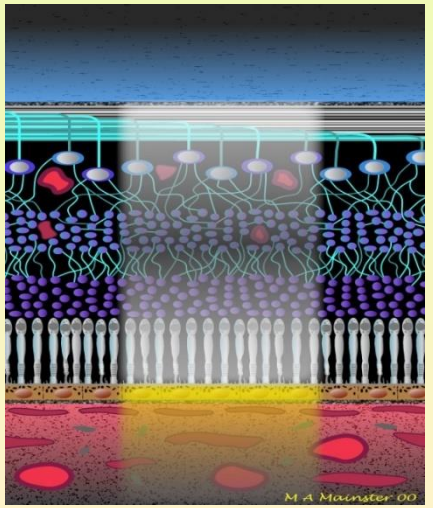
Xanthophyll – (inner and outer plexiform layer)

- 577 nm neglibile absorption by xanthophyll
- Fovea friendly



Benefit of 577 um YELLOW LASER

- High transmission through dense ocular media
- Consistent tissue uptake with reduced thermal effects
- Early visability of very light tissue reactions at the RPE level
- Low power required for increased patient comfort
- Fovea friendly – negligible absorption by xanthophyll
- Micropulse has tissue sparing capability



Pattern Scanning

CONVENTIONAL PRP

USED FOR

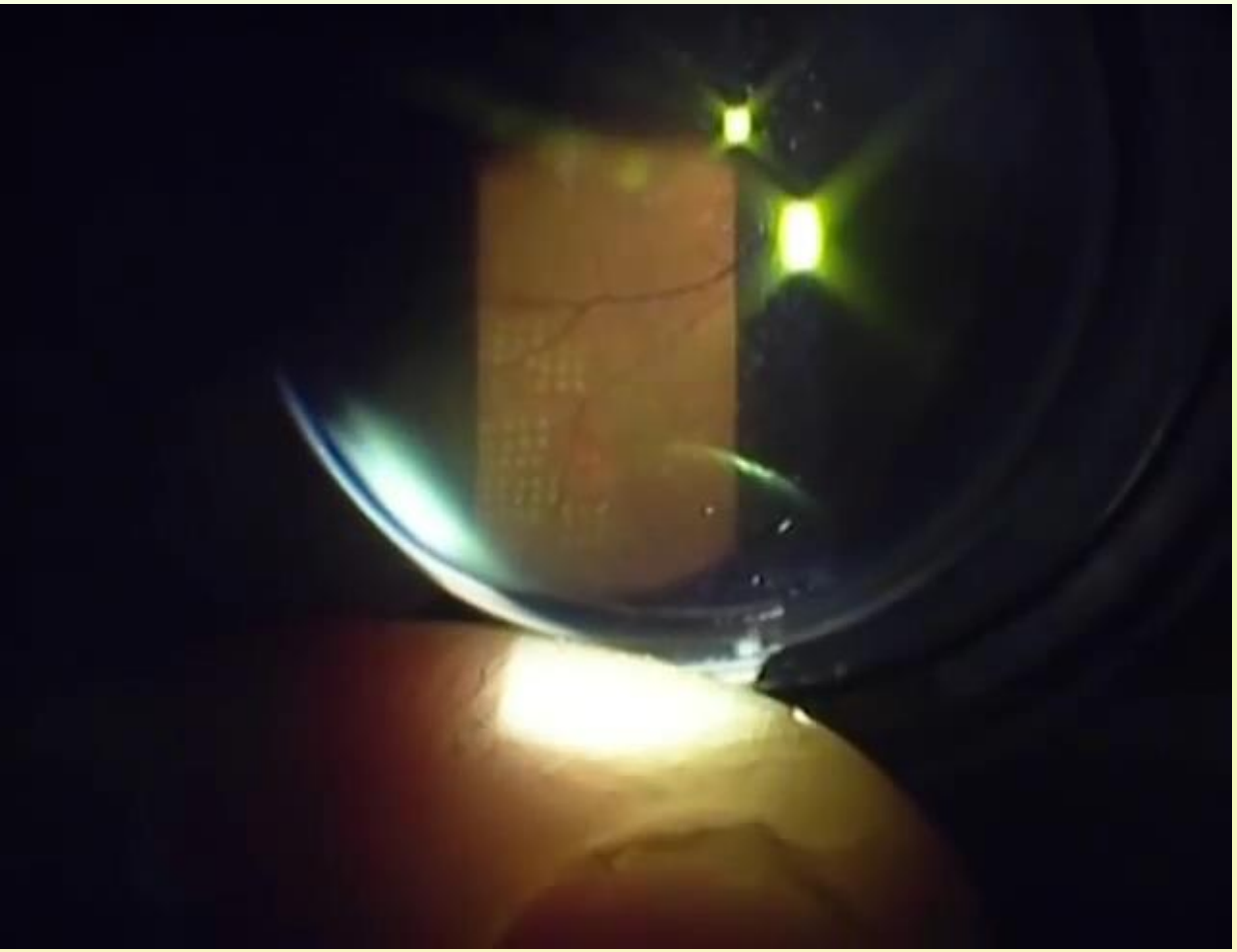
Conventional laser

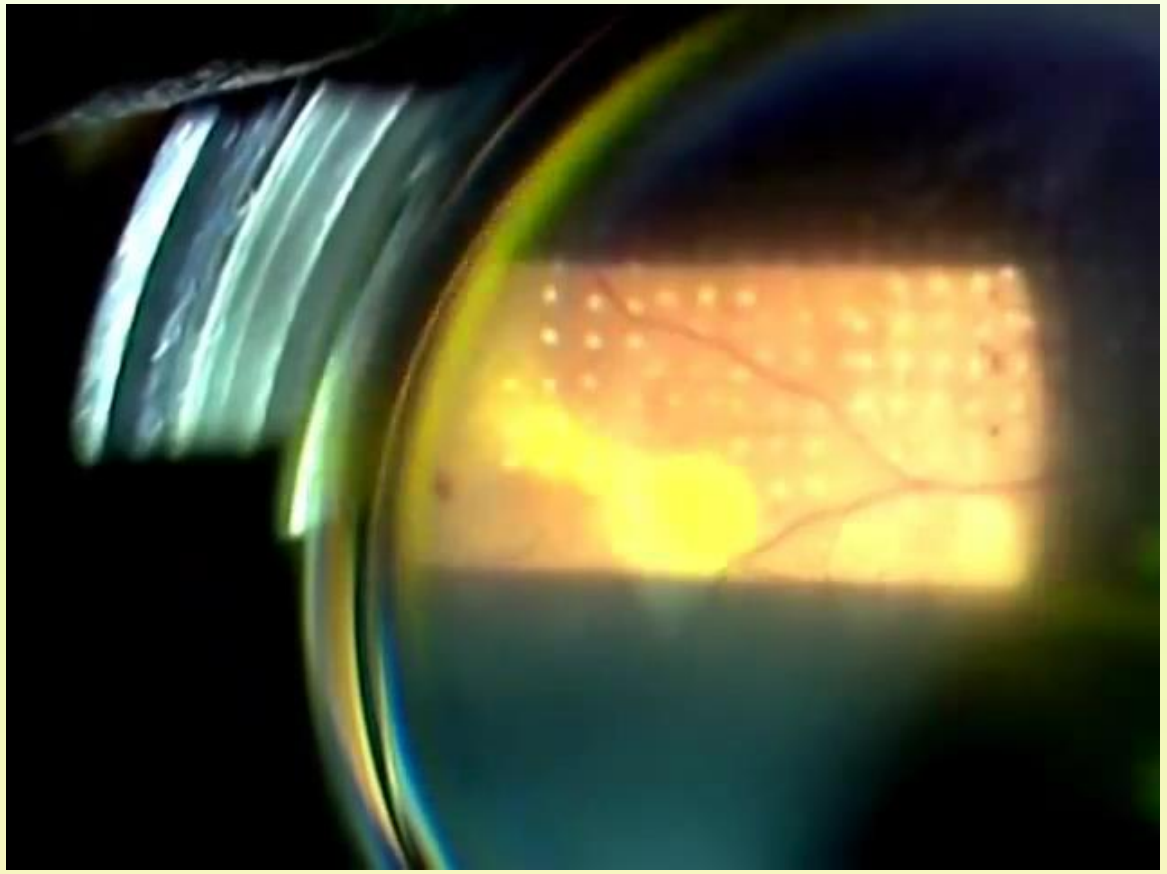
- PRP
- Retinal Holes/ Tears

Micropulse laser

- Maculopathy

CONVENTIONAL LASER: Pattern Scanning





Micropulse laser is foveal friendly

- Must be 5% duty cycle
- Low intensity/high density

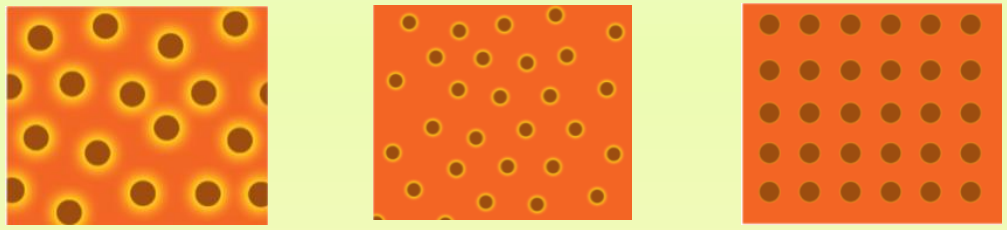
Caution

- Heavily pigmented patients
- Critical to always perform the test spot routine
- 0.2% - can result in pigmentary changes at the foveal center

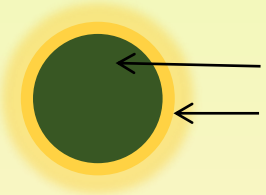
MicroPulse Low Intensity/High Density Application

Low-intensity MicroPulse exposures avoid thermal retinal injury. Therefore, **high-density** (confluent) coverage of the diseased retina is needed to maximize clinical effectiveness

Continuous-wave Laser



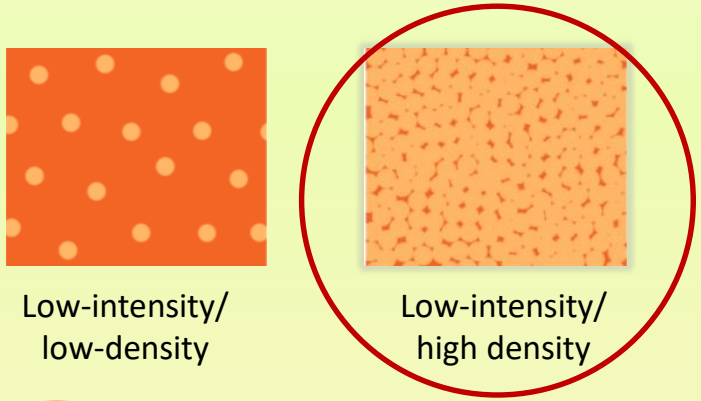
High-intensity argon | Low-intensity argon | Pattern Scanning



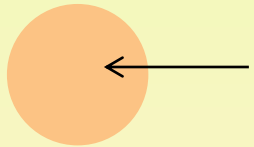
Area of retina damaged by laser

Area of retina affected by laser but not destroyed; able to contribute to the therapeutic effects of laser treatment

MicroPulse Laser



Low-intensity/ low-density | Low-intensity/ high density



Area of retina affected by laser but not destroyed; able to contribute to the therapeutic effects of laser treatment

Retinal Micropulse laser : How does it work

- **Stimulation of a biological response that restores the RPE cell function**
- **Highly selective for the RPE cells**
- **577 nm yellow laser is ideal for diseases with RPE pathology**

How to determine Micropulse laser power

- Main challenge at present is fine-tuning the treatment dosimetry
- Settings are evolving
- 1st time do a TEST SPOT BURN FIRST
- Use conventional laser to get a power setting for gentle burn (duration 0.1s)
- Switch
  - 200um spot size
  - Duration to 200ms
  - 5% duty cycle
  - increase laser power by x 2-4

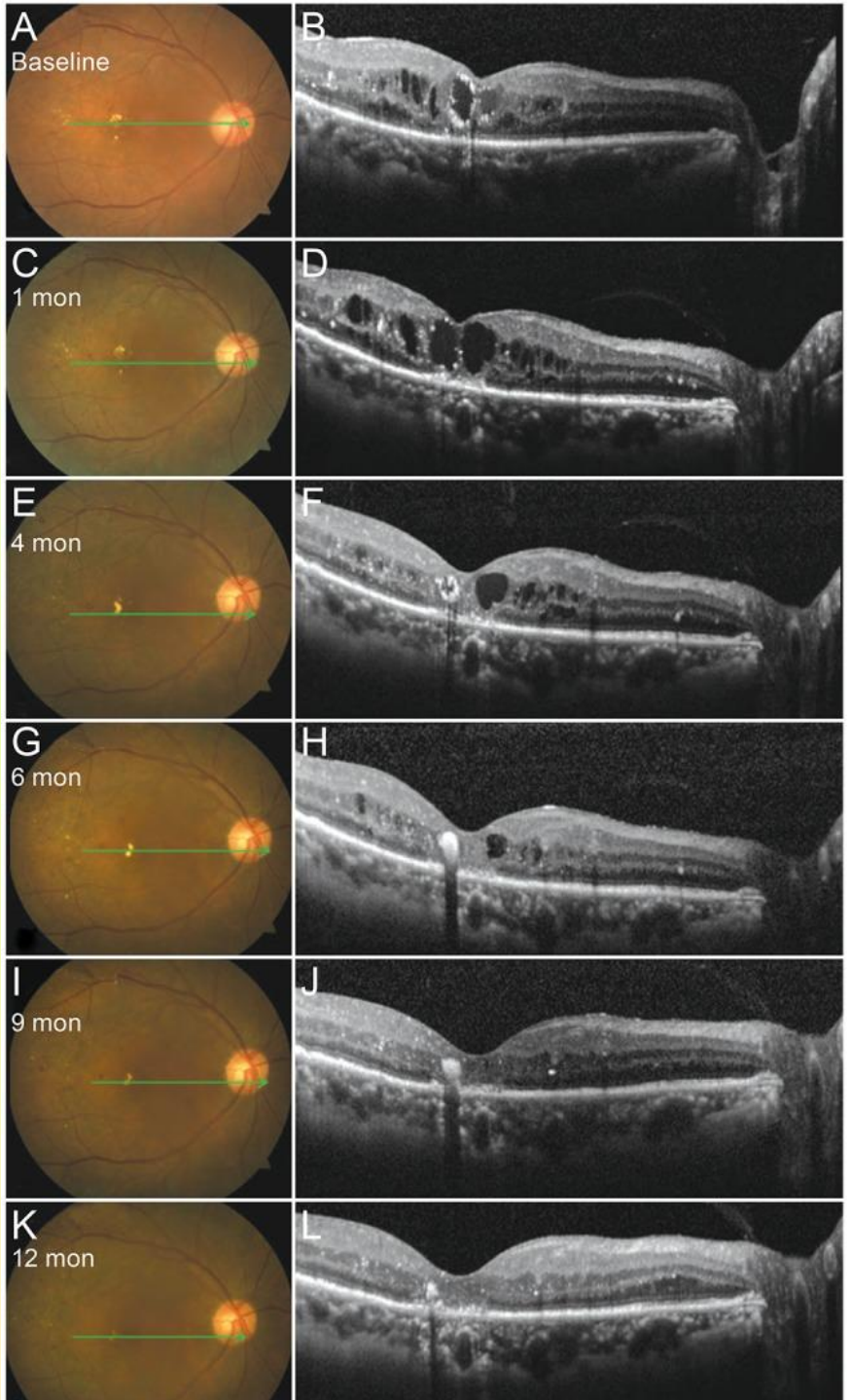
MicroPulse Laser settings

Micropulse laser is of low intensity
So to get a clinical response – need a confluent high density laser

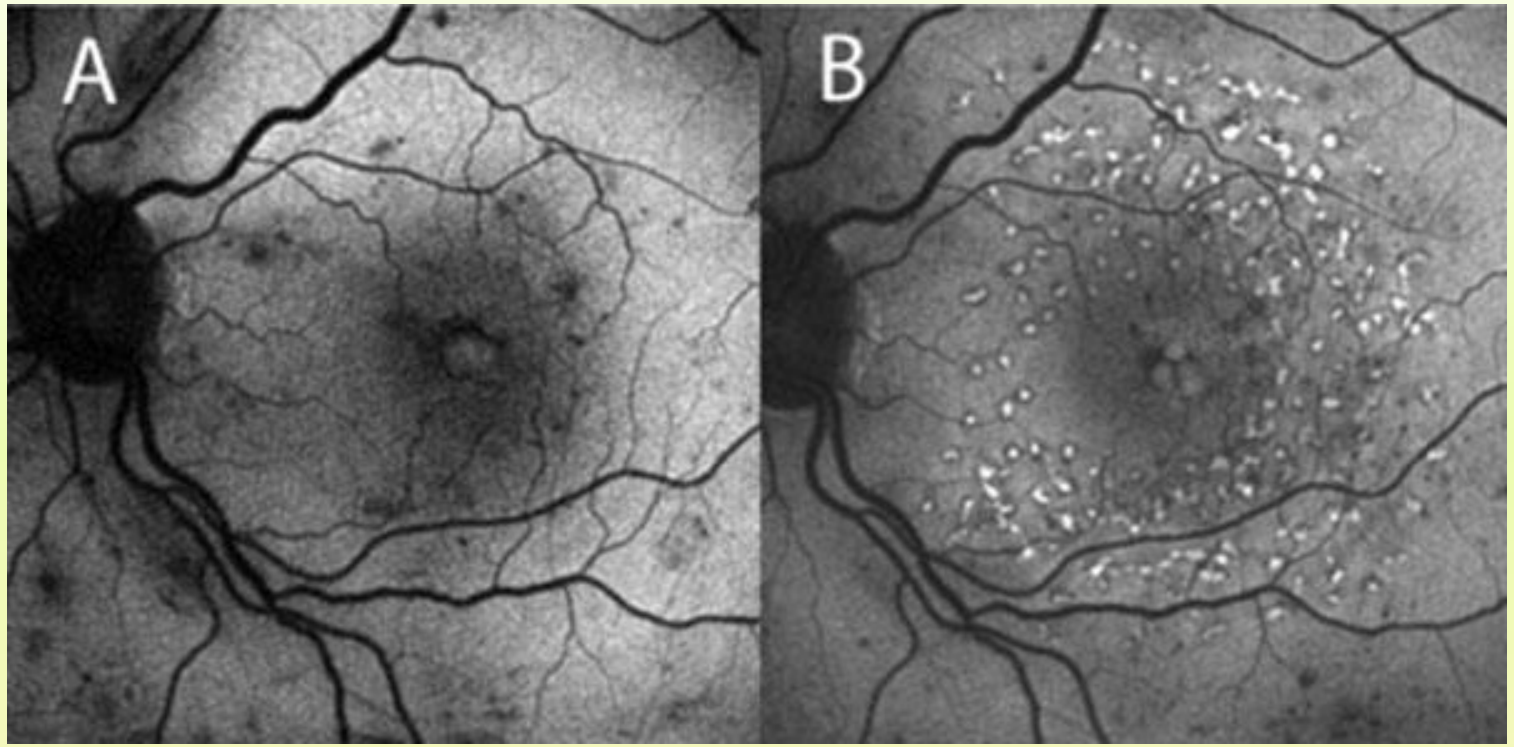
- 200um spot size
- 200ms duration
- 400mW
- 5% duty cycle
- 7x7 confluent grid

DIABETIC MACULA OEDEMA

- Micropulse as effective as conventional argon laser for DME
- Micropulse is as effective as subthreshold diode laser in reducing CRT.



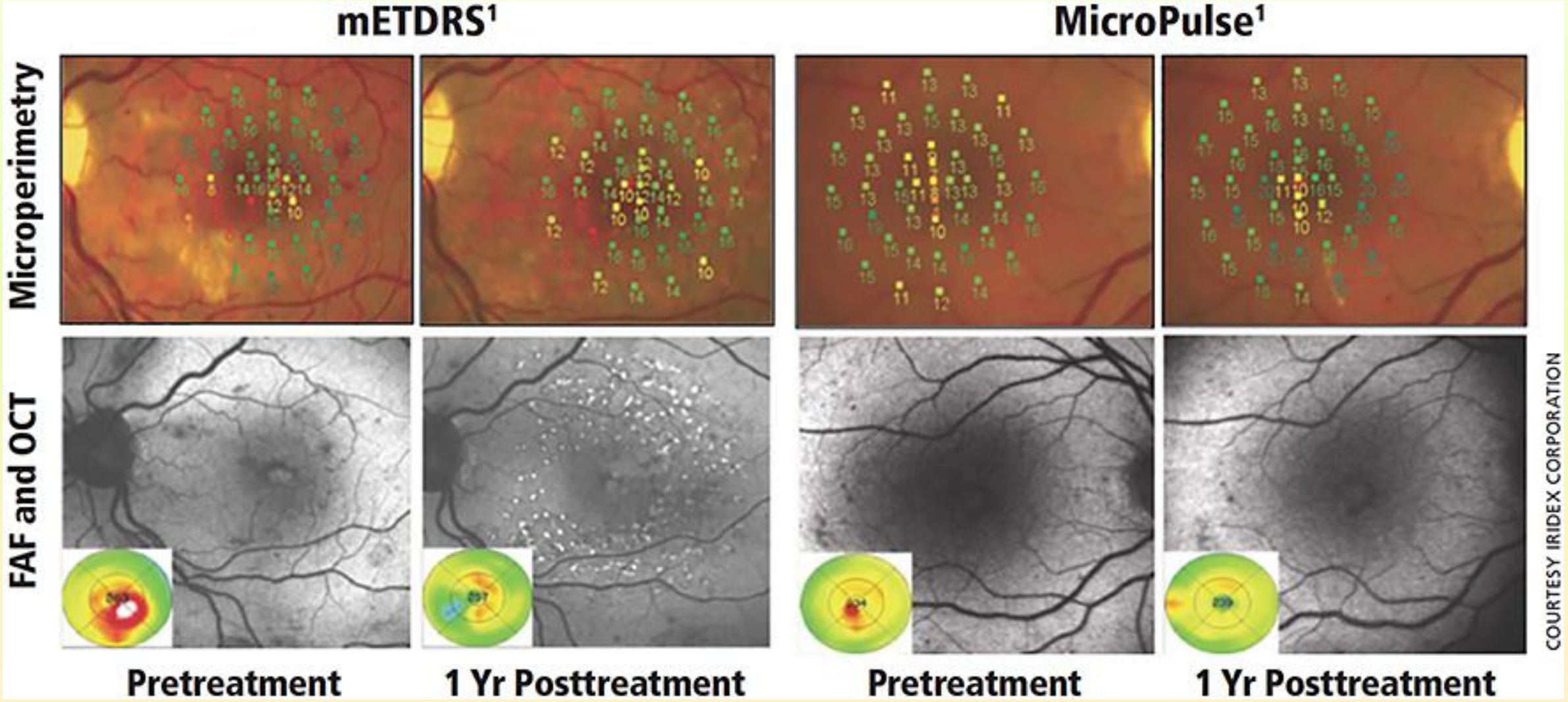
Conventional laser



Tissue sparing micropulse laser has the benifical effects of conventional laser while minimizing the negative effects of laser

Changes in macular sensitivity

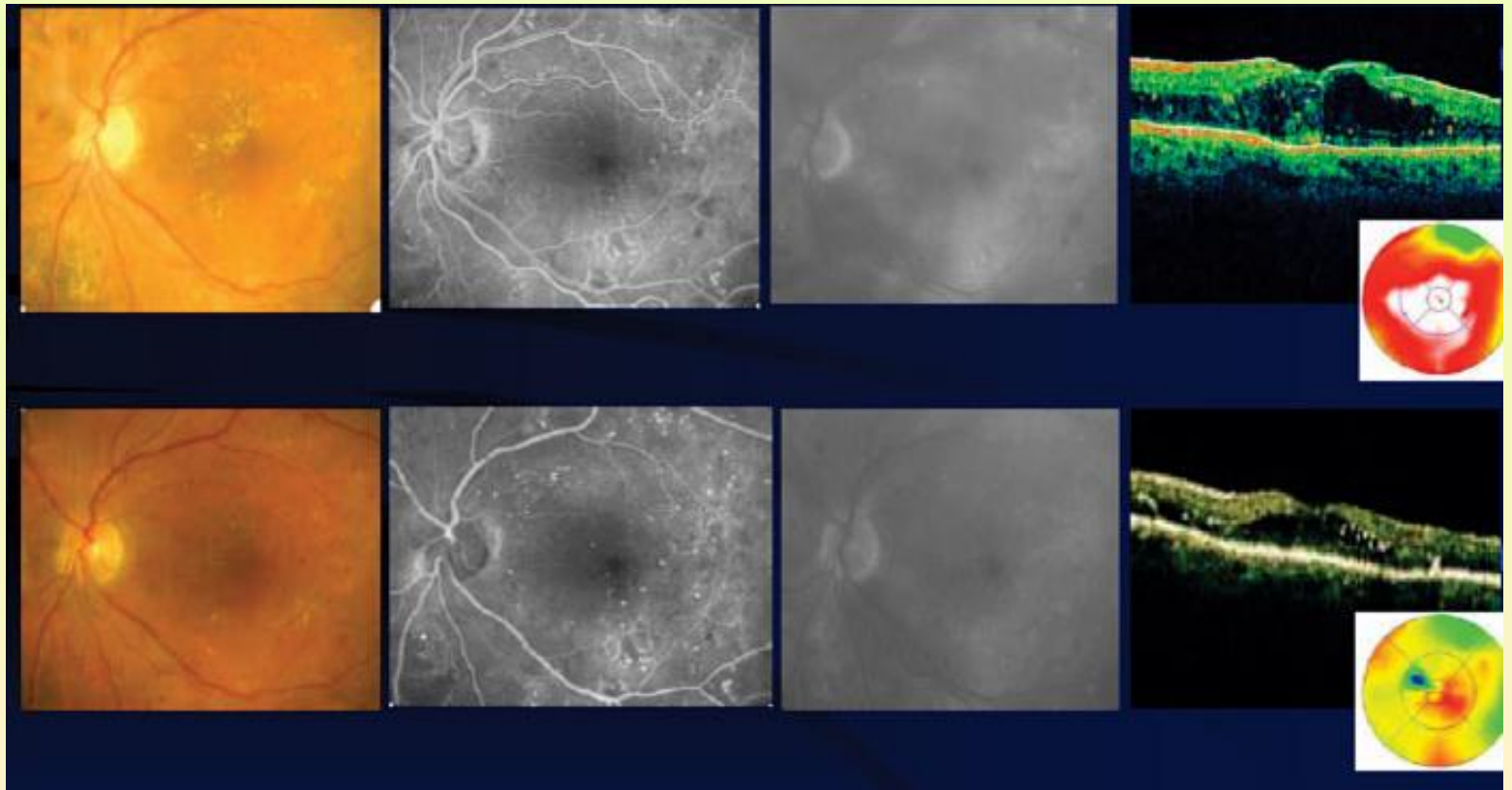
- Improved microperimetry as early as 1/12 after micropulse laser before significant OCT changes are seen



- Micropulse laser is as effective as conventional laser
- Acts slowly
- Not recommended for macular edema >400 µm
- Intravitreal Avastin/ triamcinolone 2/52 before micropulse
  - More rapid resolution & longer lasting effect

Optical Coherence Tomogram is important

- Treatment is guided by OCT
- Macula oedema is most responsive to treatment if <400um
- Retreatment is guided by OCT



OCT PRE AND POST TREATMENT

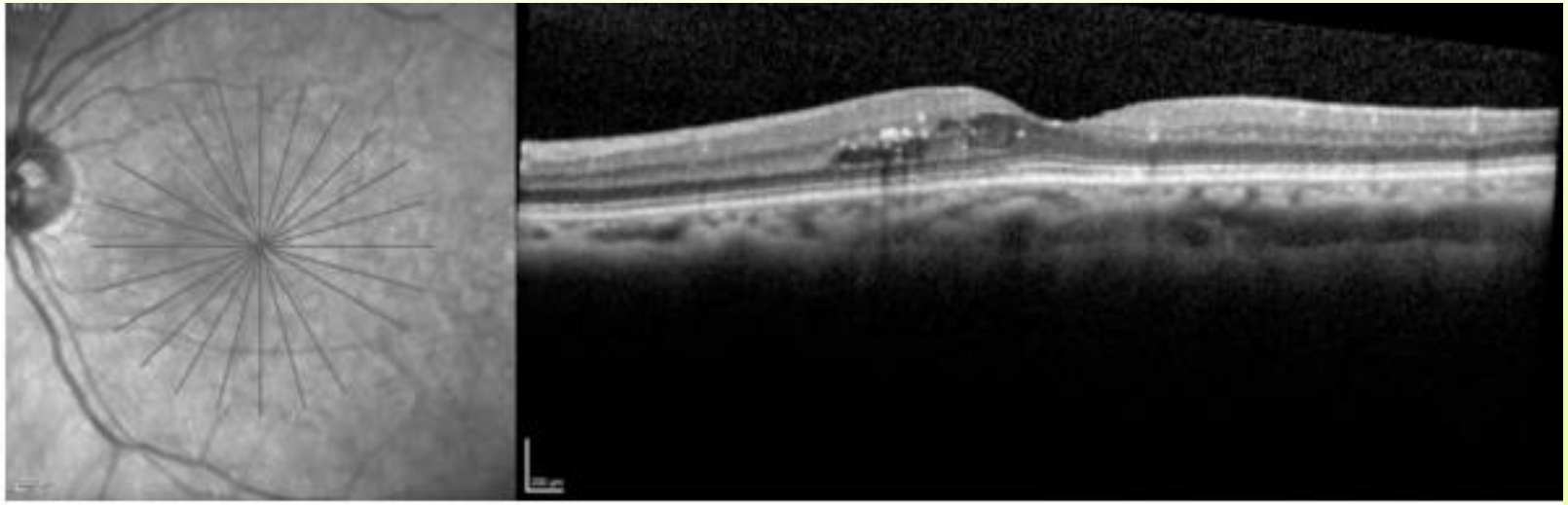
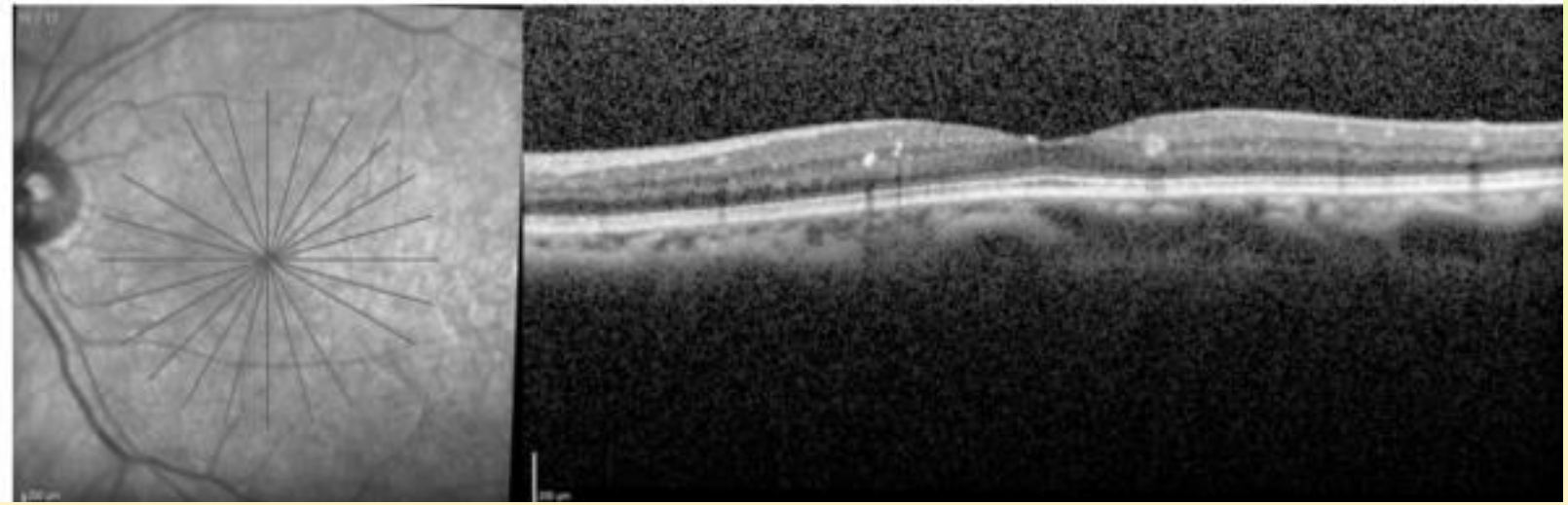
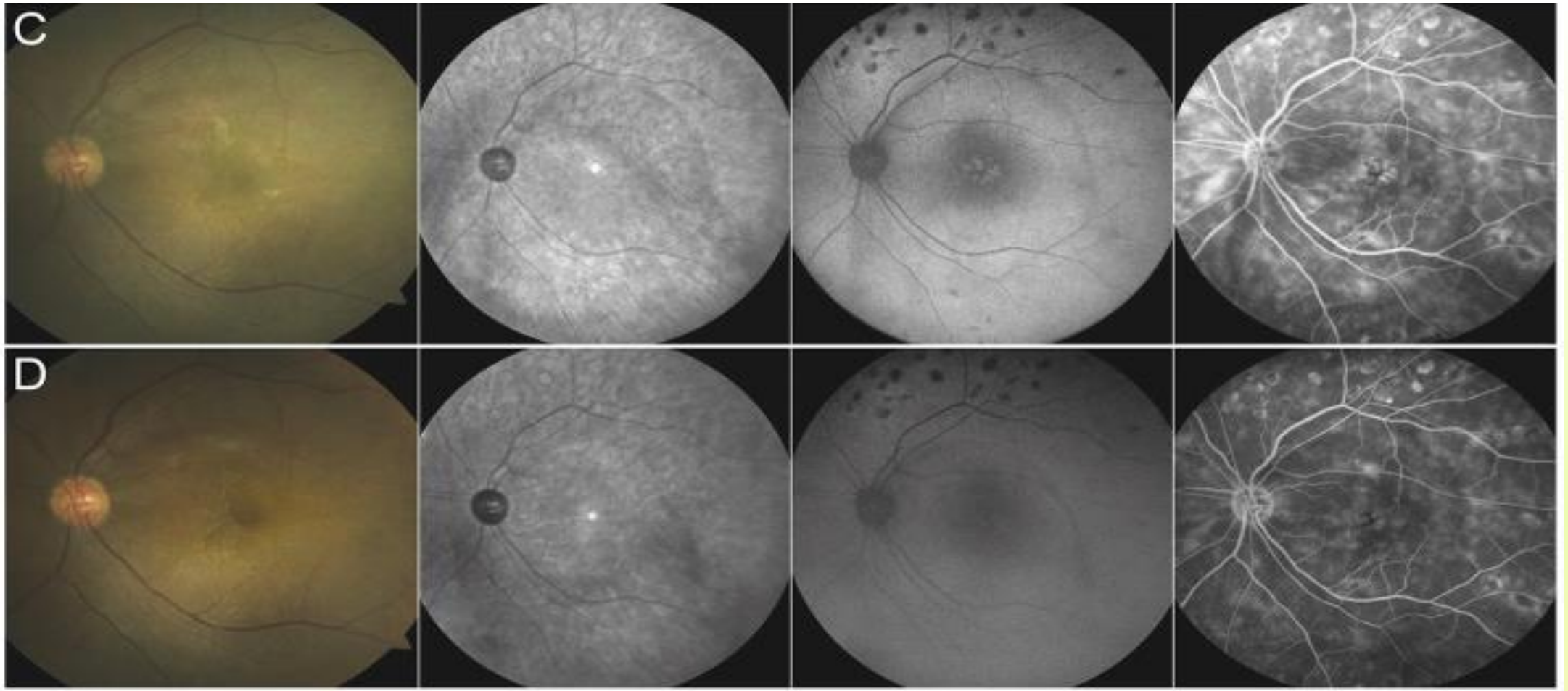


Figure 1 J.



Pre Tx

6 months
Post Tx



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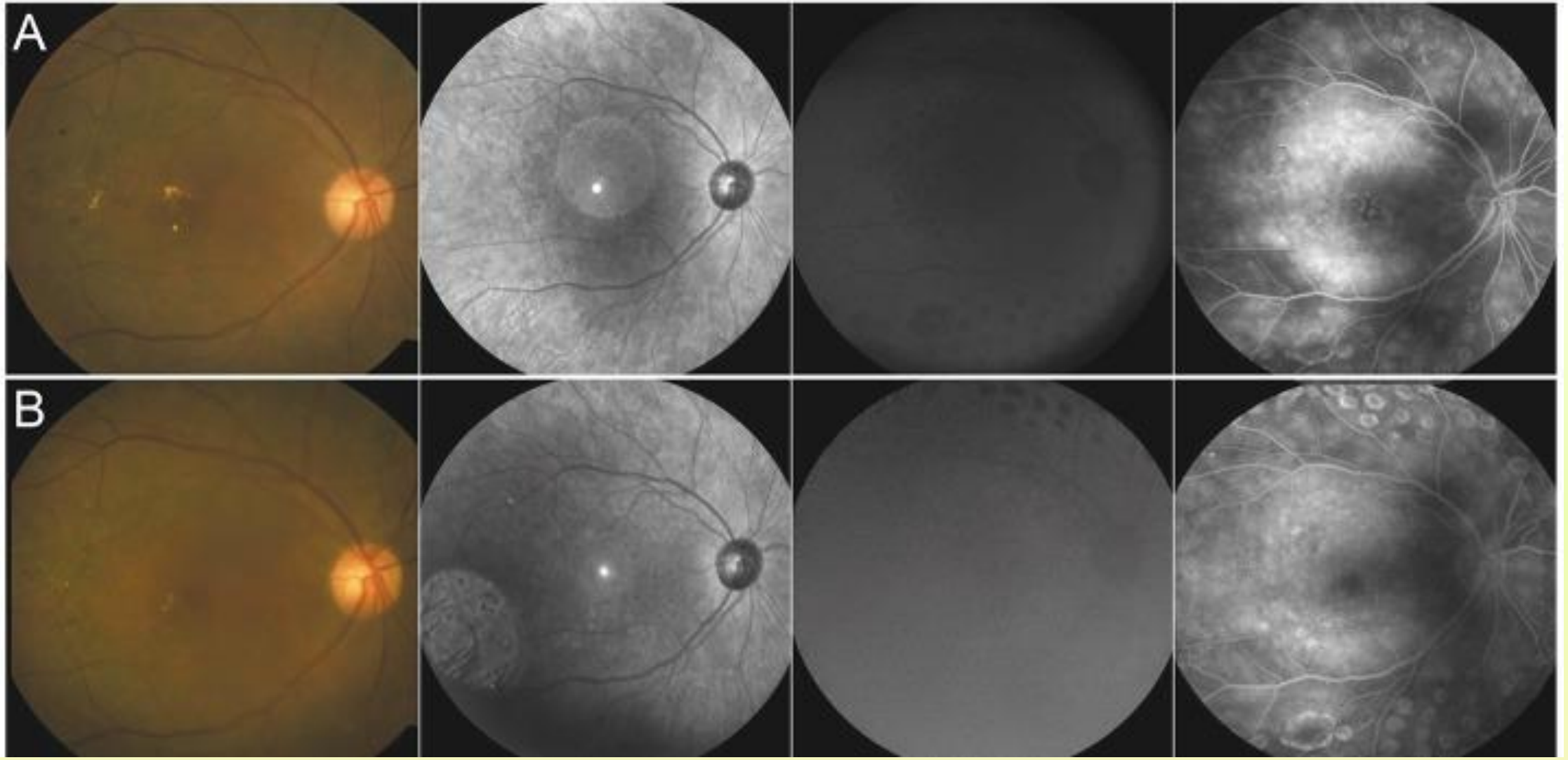
Kwon YH, et al The short-term efficacy of subthreshold Micropulse yellow (577-nm) laser photocoagulation for diabetic macular edema. Korean J Ophthalmol. 2014 Oct;28(5):379-85

Pre Tx

14 months Post Tx



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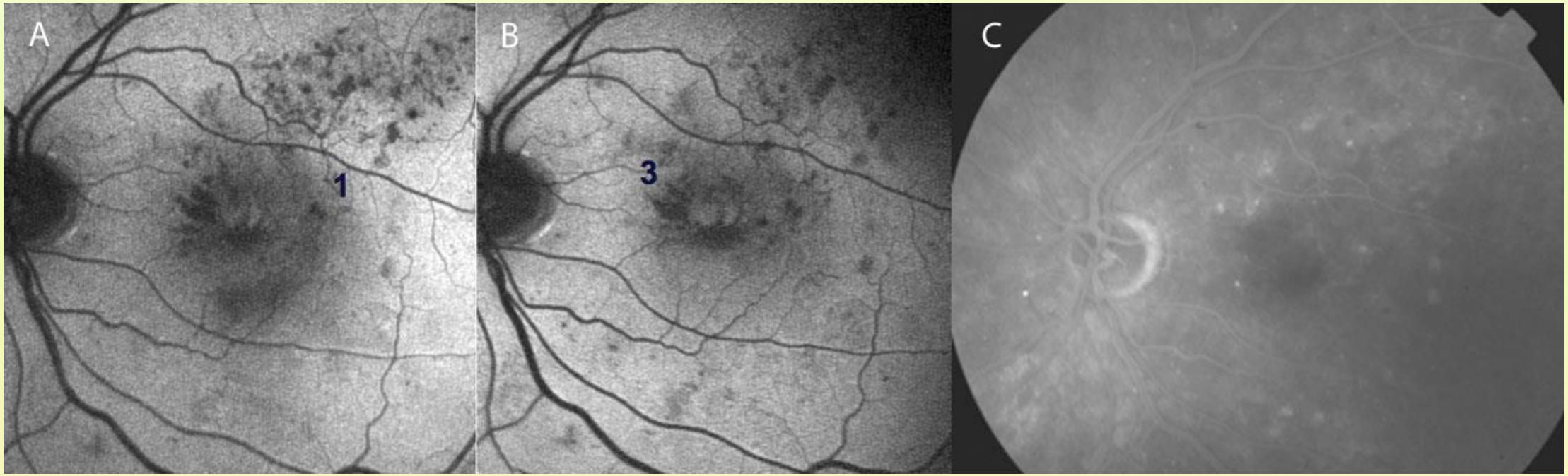
Kwon YH, et al The short-term efficacy of subthreshold Micropulse yellow (577-nm) laser photocoagulation for diabetic macular edema. Korean J Ophthalmol. 2014 Oct;28(5):379-85

Pre & post-subthreshold micropulse diode laser



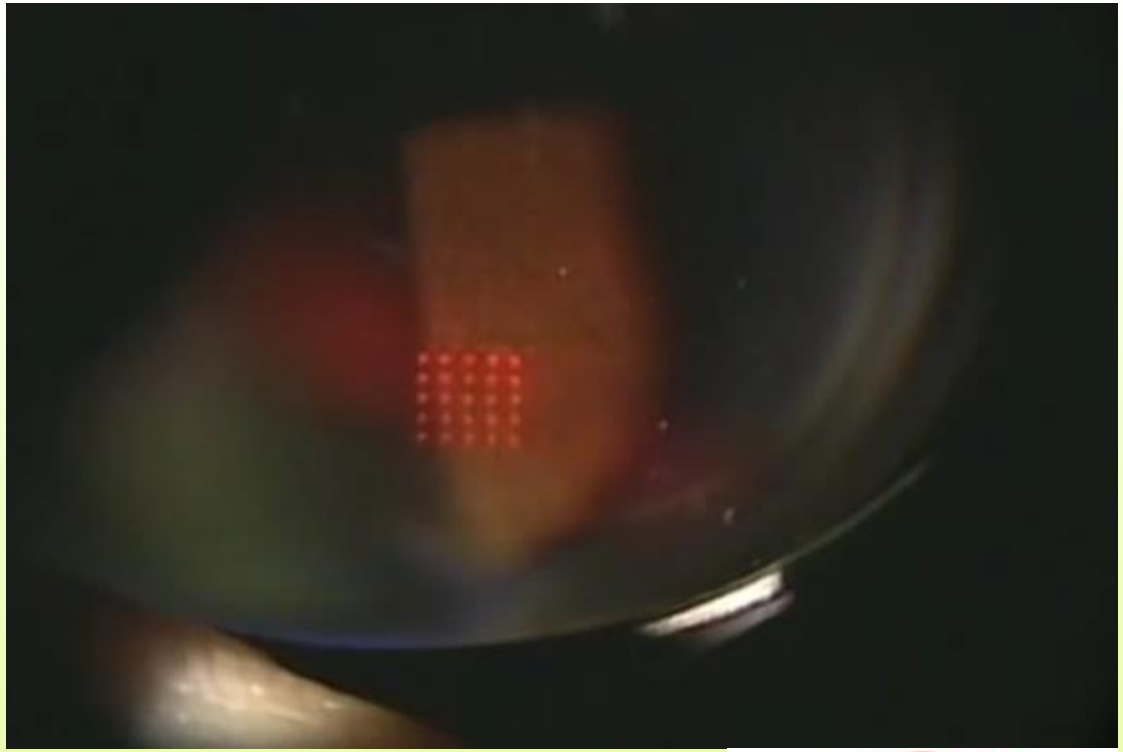
Important to manage patient expectations

- The response to subthreshold laser is typically slower than pharmacotherapy
- May take 3-4 months for noticeable results-
- Results are longer lasting.
- OCT images and vision may stabilize but not necessarily improve
- Like injections, patients may require more than one treatment
- Anti-VEGF treatments can be continued and may reduce in frequency but not always eliminated.

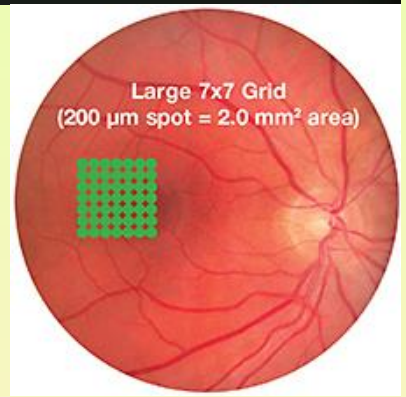
Benefits of Micropulse

- Non invasive
- Painless
- No/low risk
- Can be used on CENTER INVOLVING FOVEAL OEDEMA
- Option of first line treatment
- Option of an adjunct to intravitreal pharmacoptherapy
- Can reduce the number of anti VEGF injections

MICROPULSE LASER



- Alternative treatment
- Foveal centered macula oedema
- Patients refractory to anti VEGF



- 577um laser (5% duty cycle) is very fovea friendly
- Studies show better visual acuity/colour vision and microperimetry after micropulse laser than conventional laser


Thank
you