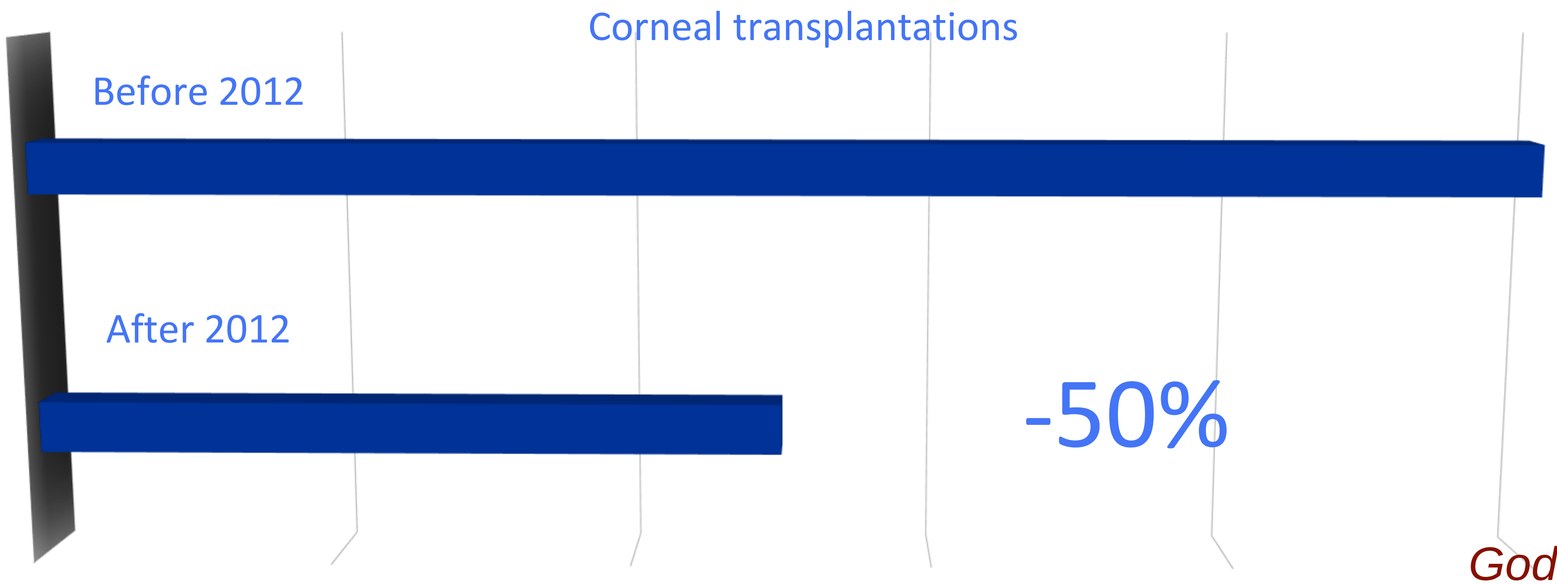
Individualized cross-linking protocols for the treatment of keratoconus

Léonard Kollros, M.Sc. Clin. Opto

CROSS-LINKING (CXL)

- Global standard of care for keratoconus
- Approximately 200’000 procedures per year
- Does not improve topography but stabilizes it



Godefrooj et al., 2016

Sandvik et al., 2015

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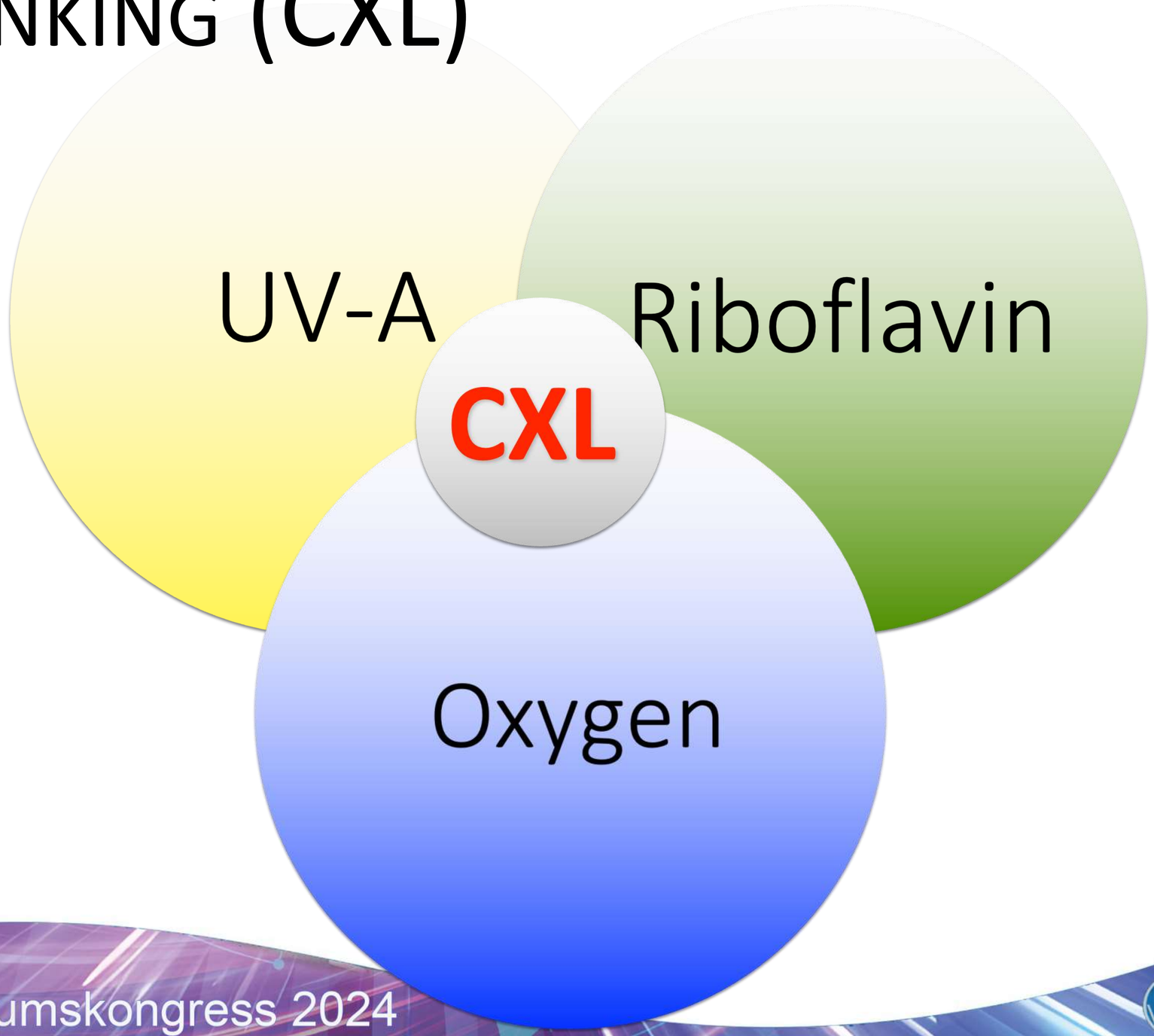
Cross-linking (CXL)



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CROSS-LINKING (CXL)

CXL

PubMed®

cross-linking

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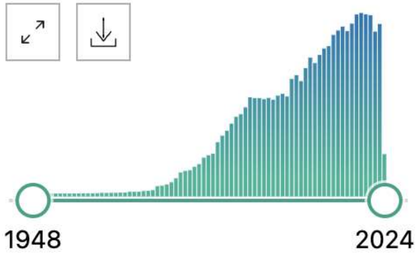
66,698 results

Page 1 of 6,670

RESULTS BY YEAR



1 Cite Share

Cross-linking electrospinning.

Han WH, Wang QY, Kang YY, Shi LR, Long Y, Zhou X, Hao CC.

Nanoscale. 2023 Oct 5;15(38):15513-15551. doi: 10.1039/d3nr03956k.

PMID: 37740390 Review.

However, considering the poor water resistance and mechanical properties of electrospun (e-spun) nanofibers, **cross-linking** is a perfect solution. In this review, we systematically discuss the **cross-linking** e-spinning system for the first time, includin ...

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CROSS-LINKING (CXL)

Protocols

Epi - off

Since 2000

Epi - on

Since 2020

Customized

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CROSS-LINKING (CXL)

Cornea

Corneal Biomechanical Properties at Different Corneal Cross-Linking (CXL) Irradiances

Arthur Hammer,[1] Olivier Richoz,[1] Samuel Arba Mosquera,[2] David Tabibian,[1] Florence Hoogewoud,[1] and Farhad Hafezi[1,3]

30 min @ 3 mW/cm²

=

10 min @ 9 mW/cm²

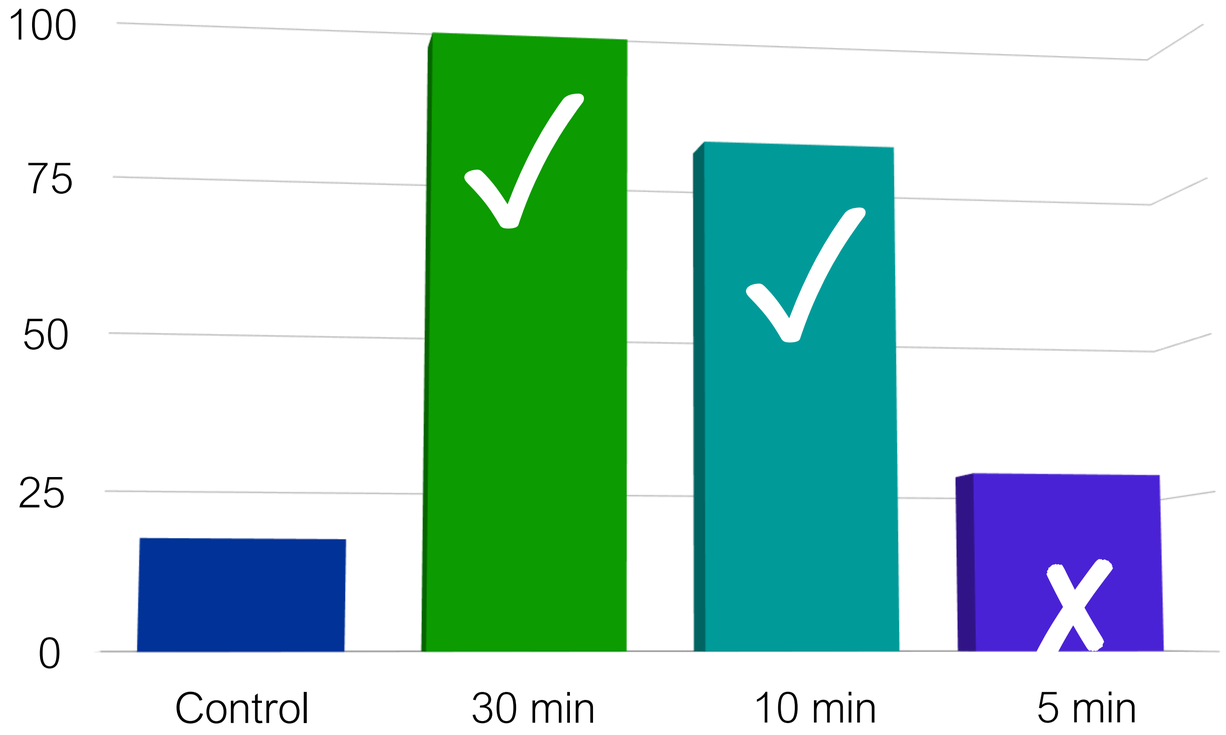
=

5 min @ 18 mW/cm²

=

3 min @ 30 mW/cm²

5.4 J/cm²



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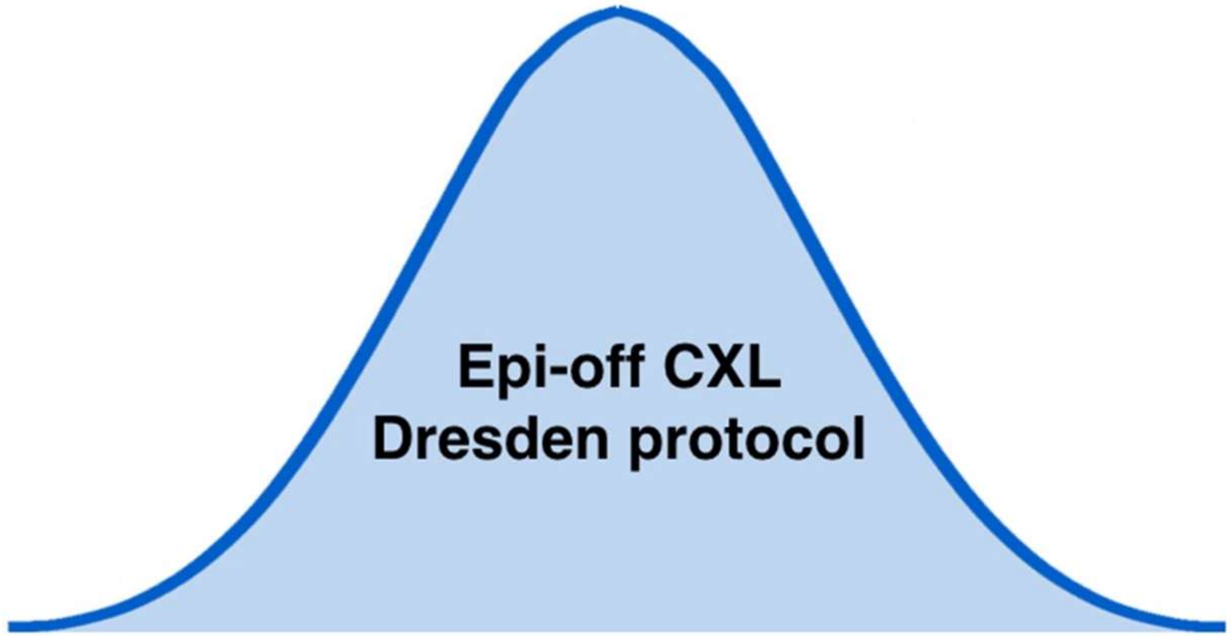
CROSS-LINKING (CXL)



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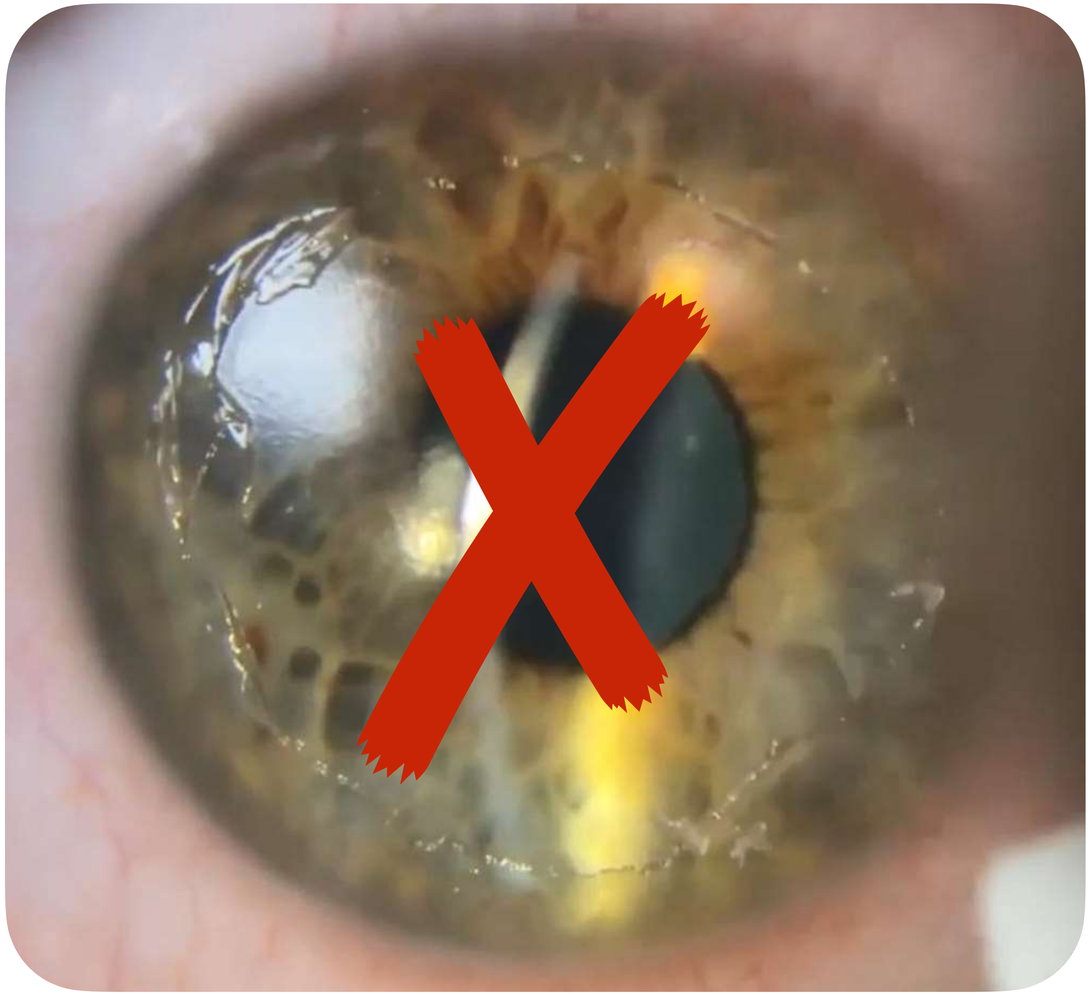
Epi-on cross-linking (CXL)



CXL

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Epi-on cross-linking (CXL)

Supplemental oxygen

(To ensure oxygen saturation)

Iontophoresis

(To ensure riboflavin saturation)

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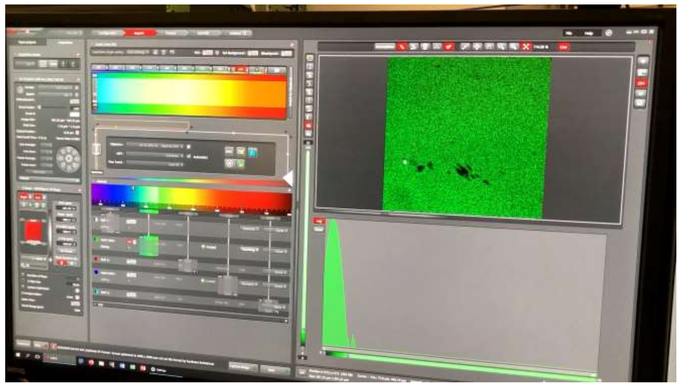
EPI-ON CROSS-LINKING (CXL)



- No additional oxygen, no iontophoresis needed

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Epi-on cross-linking (CXL)

- **Strong epi-on**
- **With special eye drops**
- **No iontophoresis needed**
- **No additional oxygen needed**

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Improve

KC Contact lenses

PRK ICRS

PACE

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P TK A ssisted C ustomized E pi-on

- Strong and immediate flattening
- No tissue removal like in excimer laser ablation, corneal stroma intact

CXL

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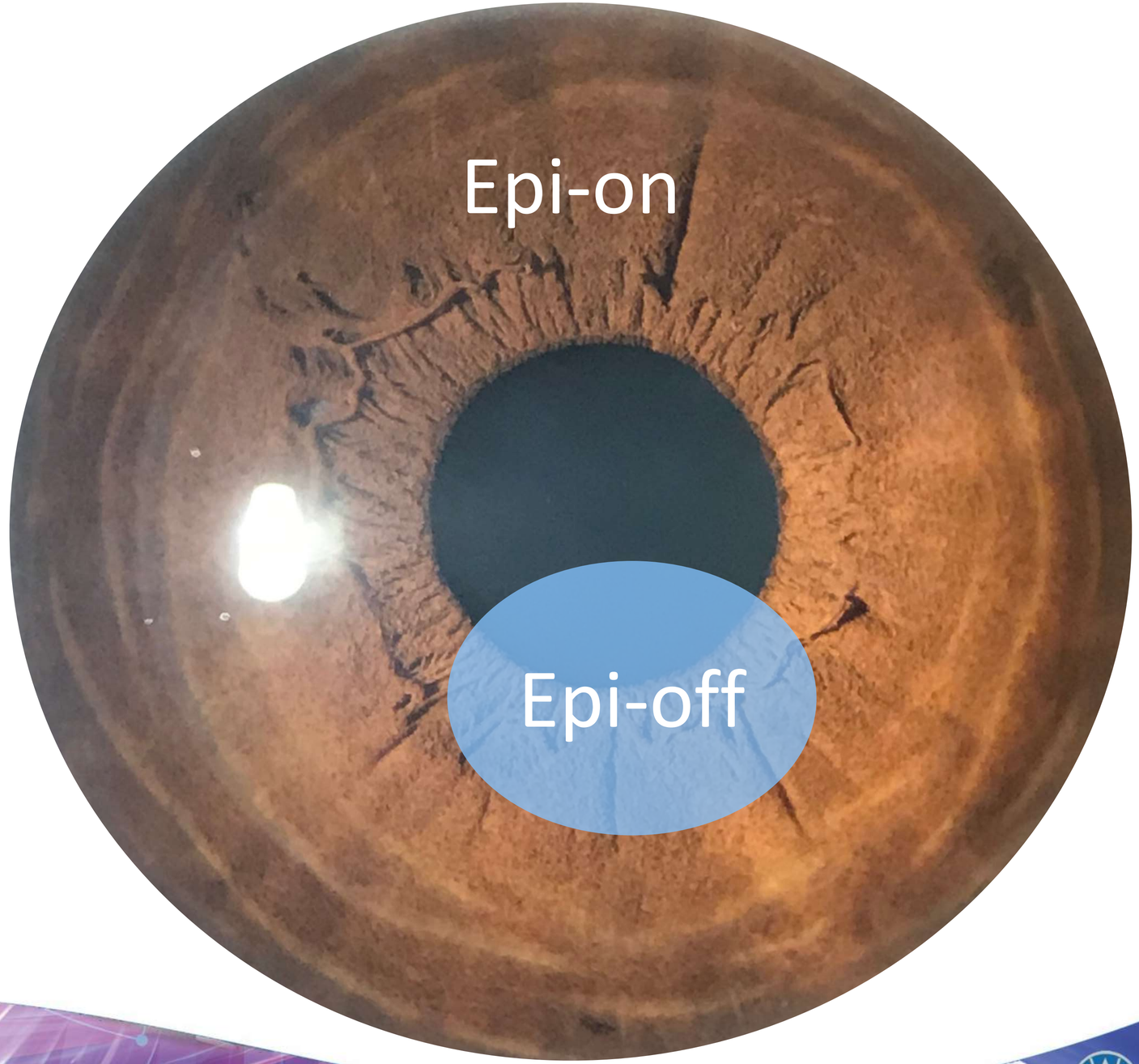
PACE

1. Decentered PTK, Epithelial map-guided

2. Gradient between epi-off and epi-on



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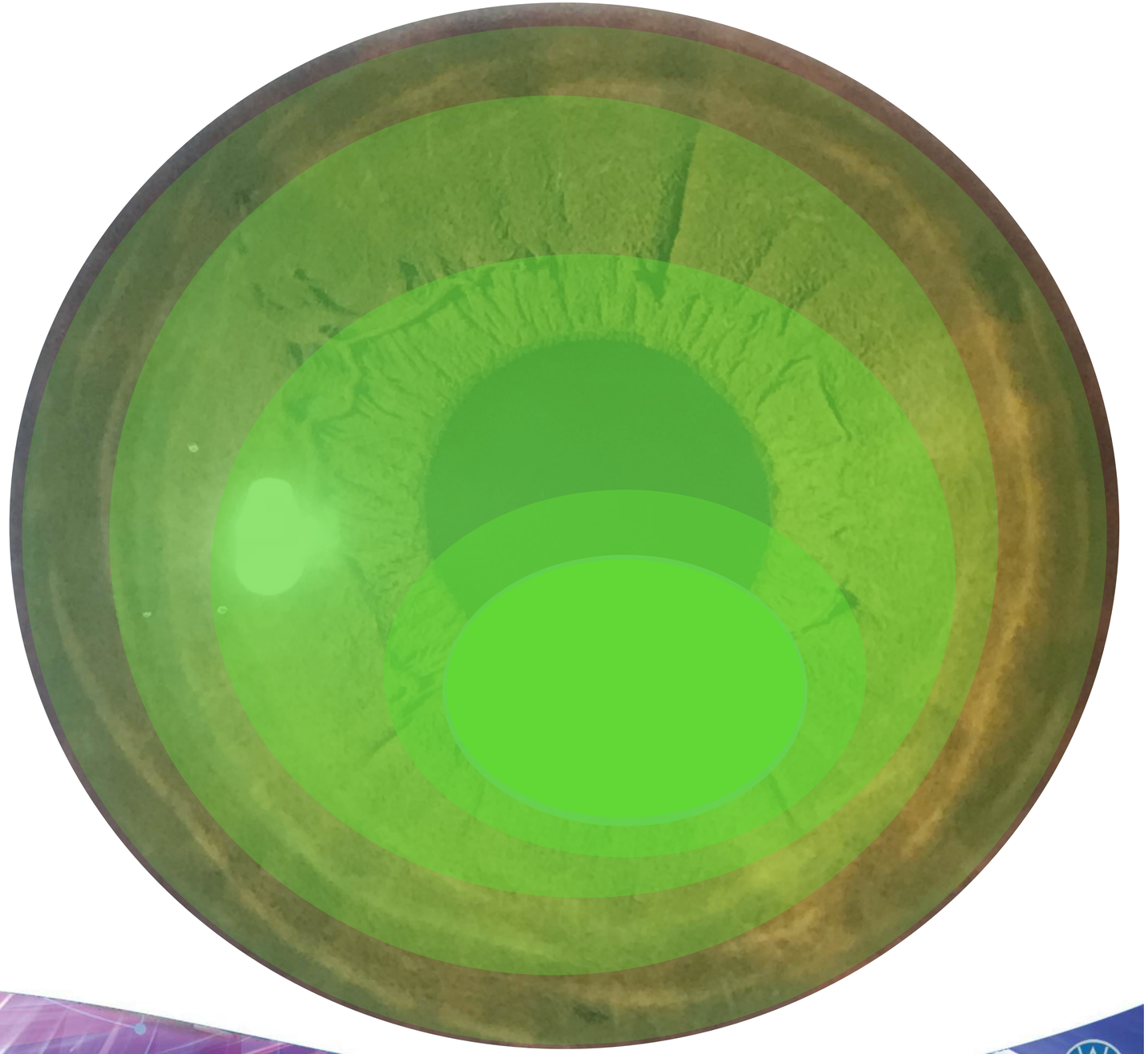
PACE

1. Decentered PTK, Epithelial map-guided
2. Gradient between epi-off and epi-on
3. Gradient of riboflavin saturation



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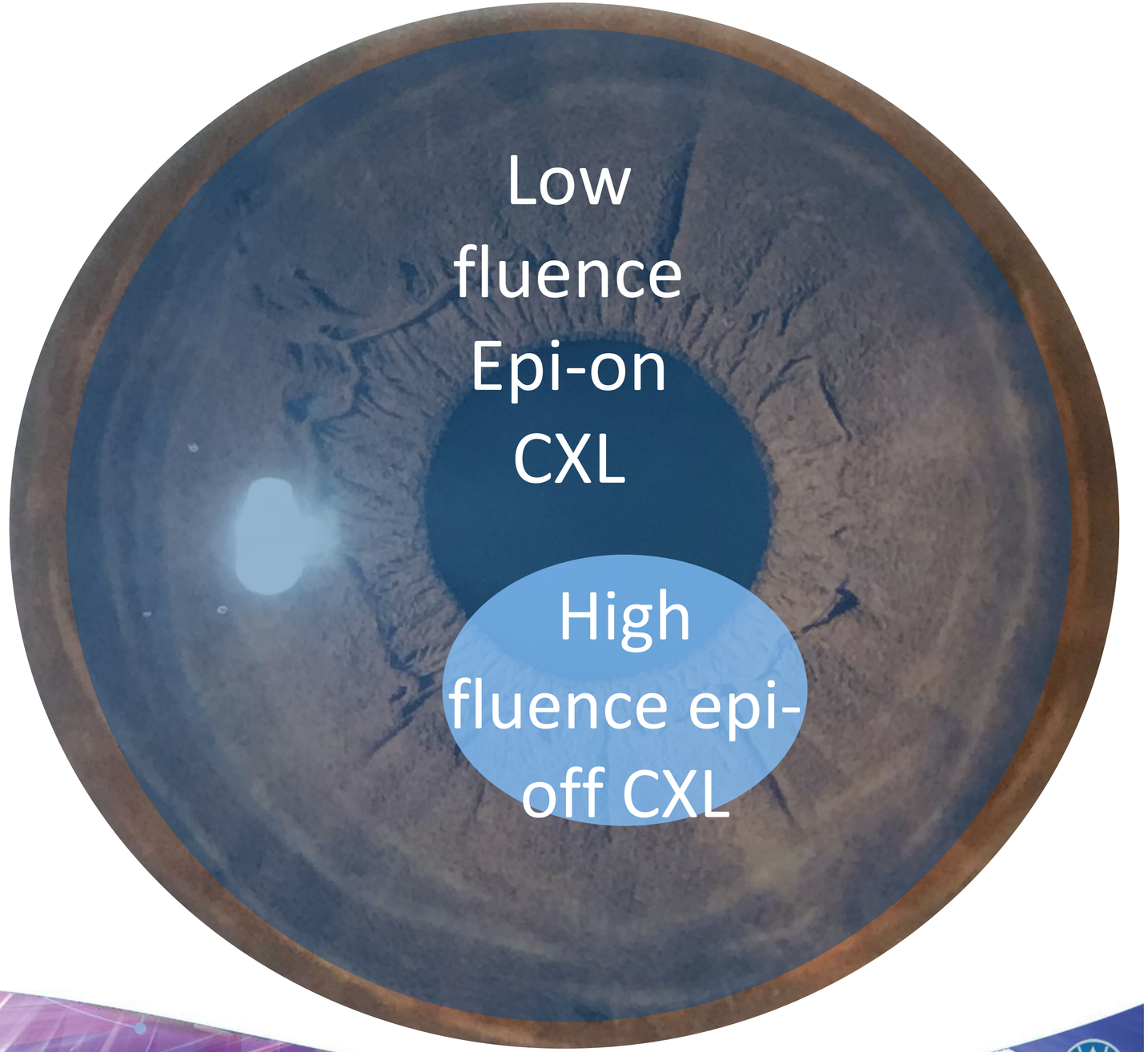
1. Decentered PTK, Epithelial map-guided
2. Gradient between epi-off and epi-on
3. Gradient of riboflavin saturation
4. Gradient between high and low fluence



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OPTIC Lorella & Léonard n|w

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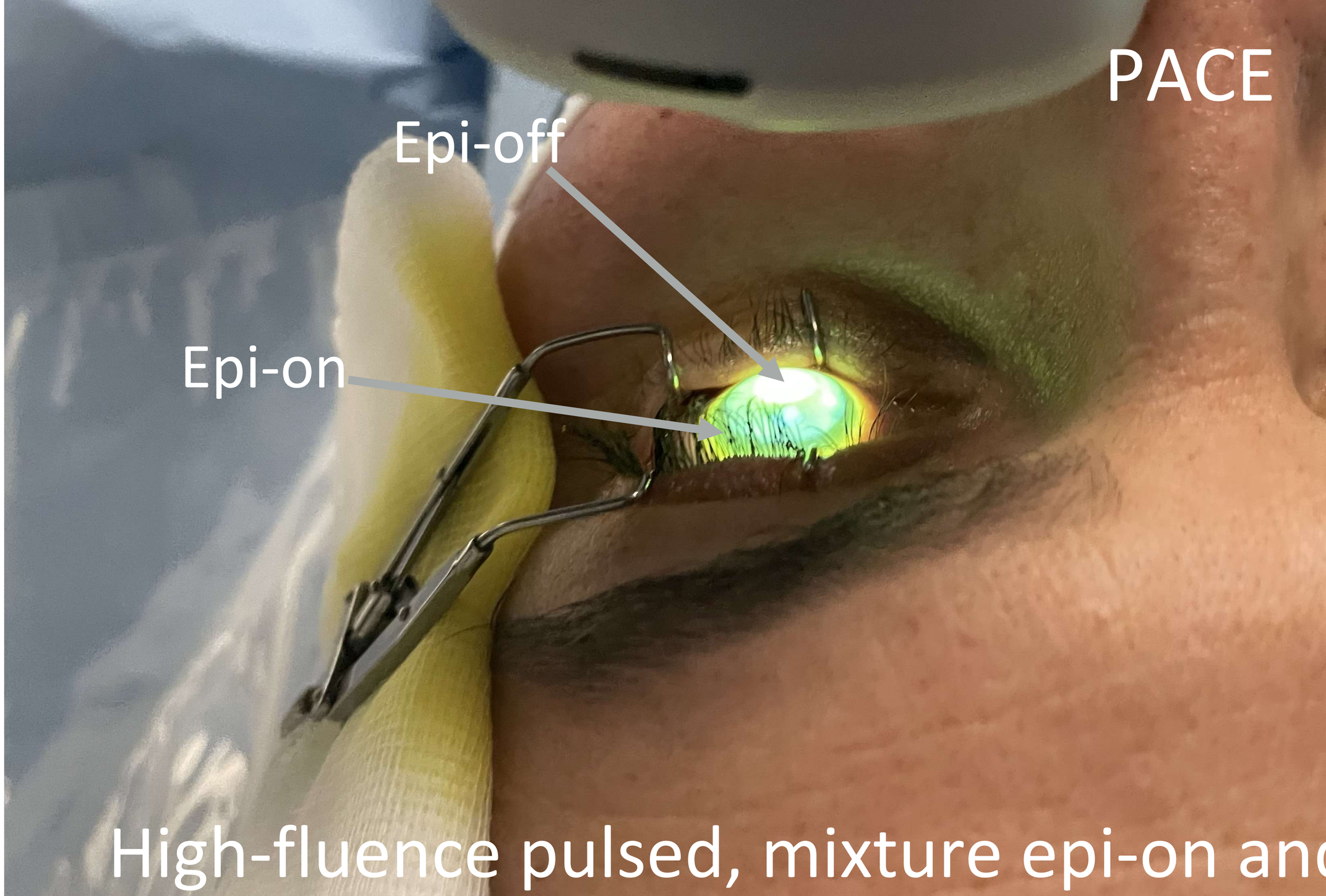

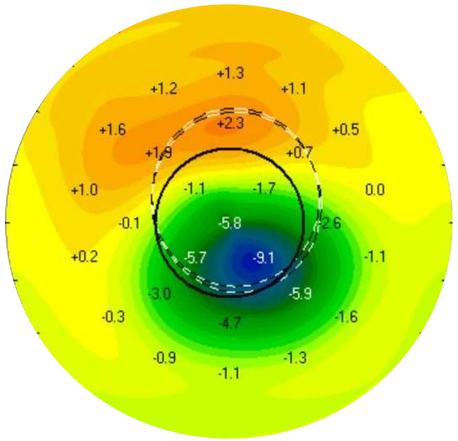

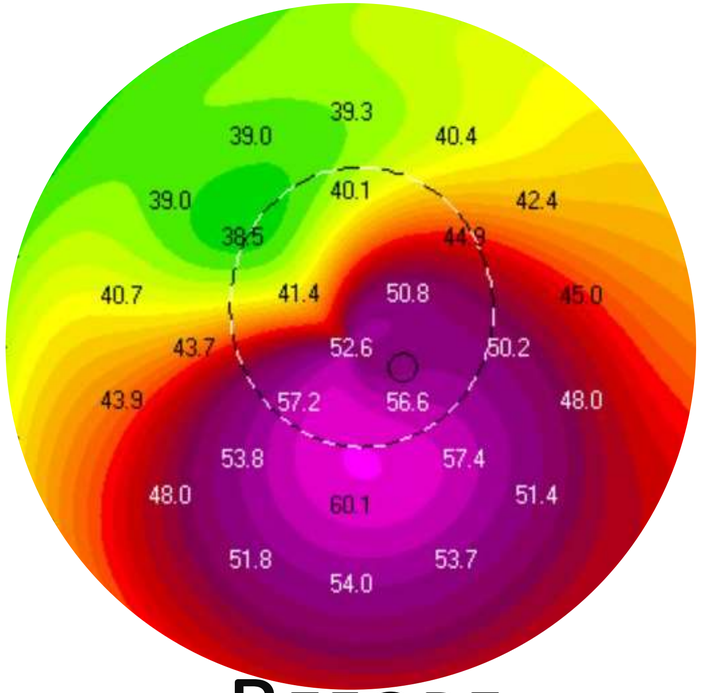

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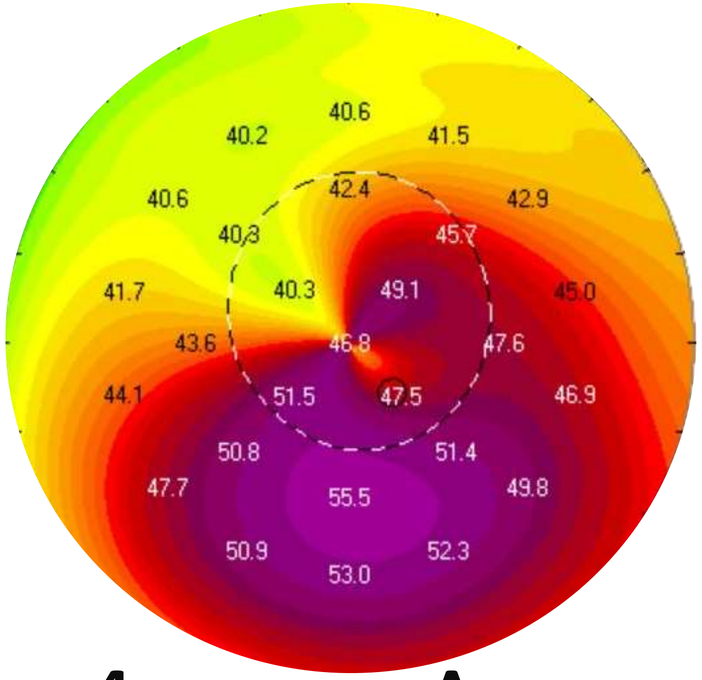

4 WEEKS AFTER PACE

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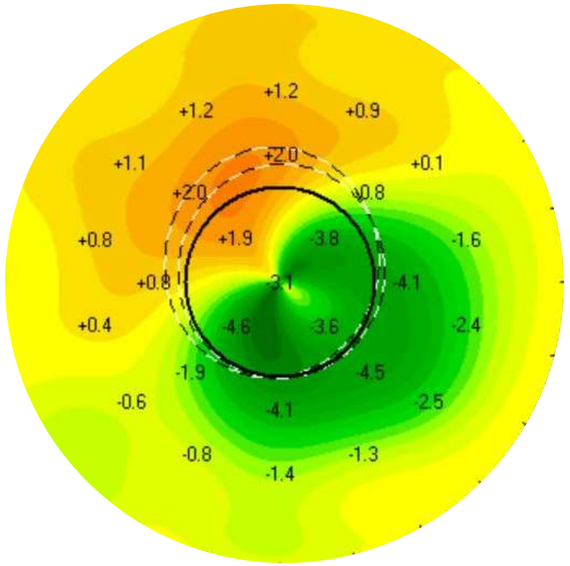

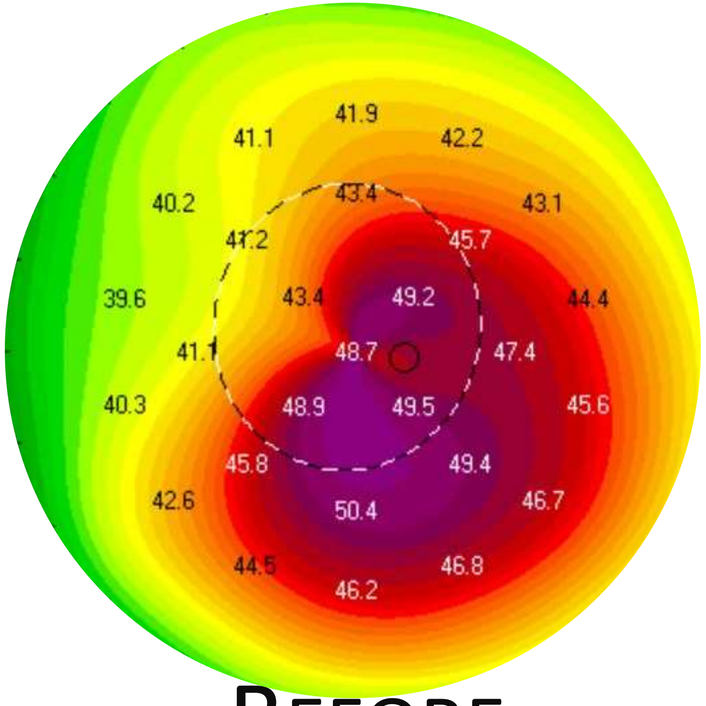

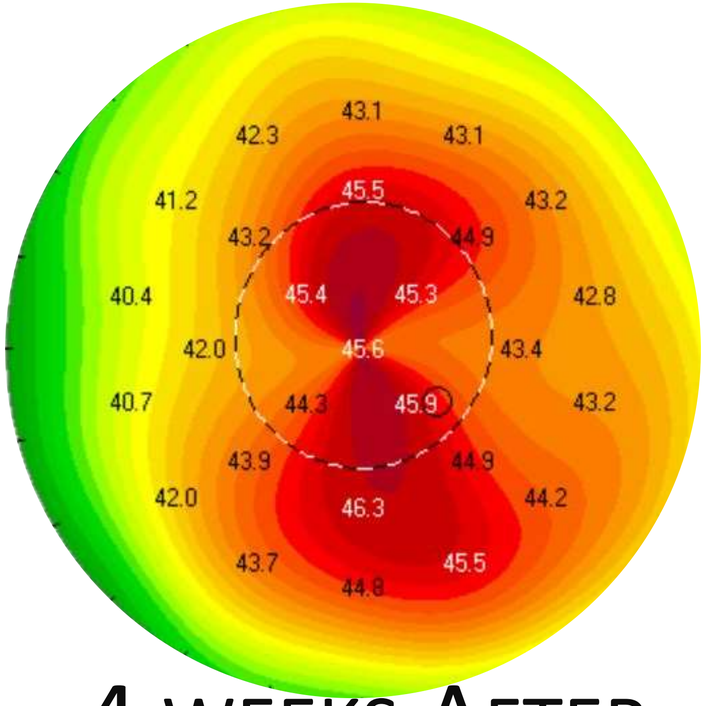

BEFORE PACE

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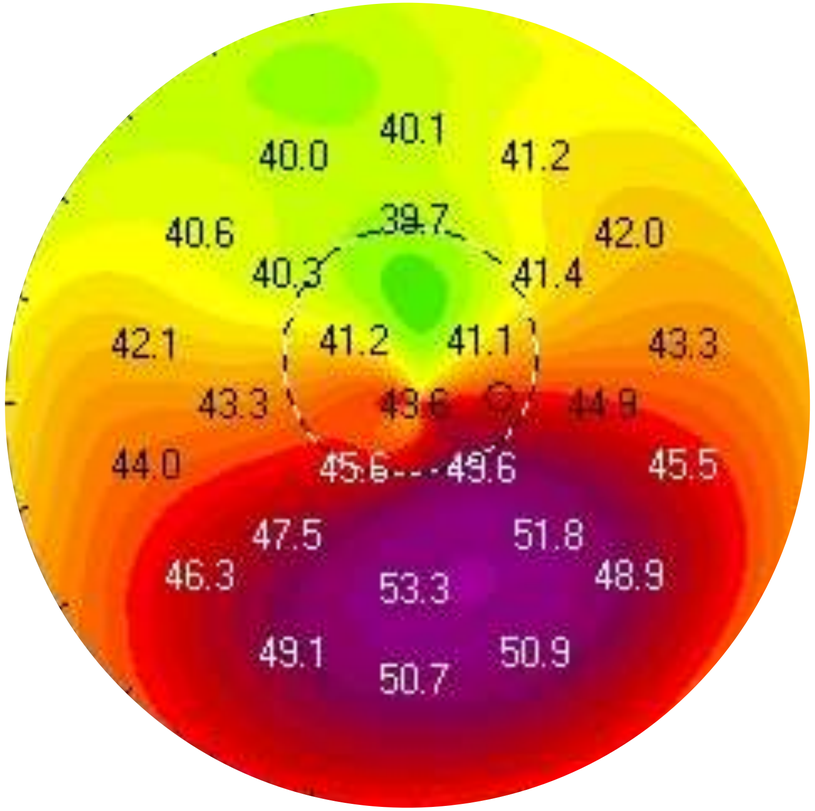

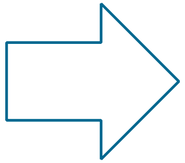

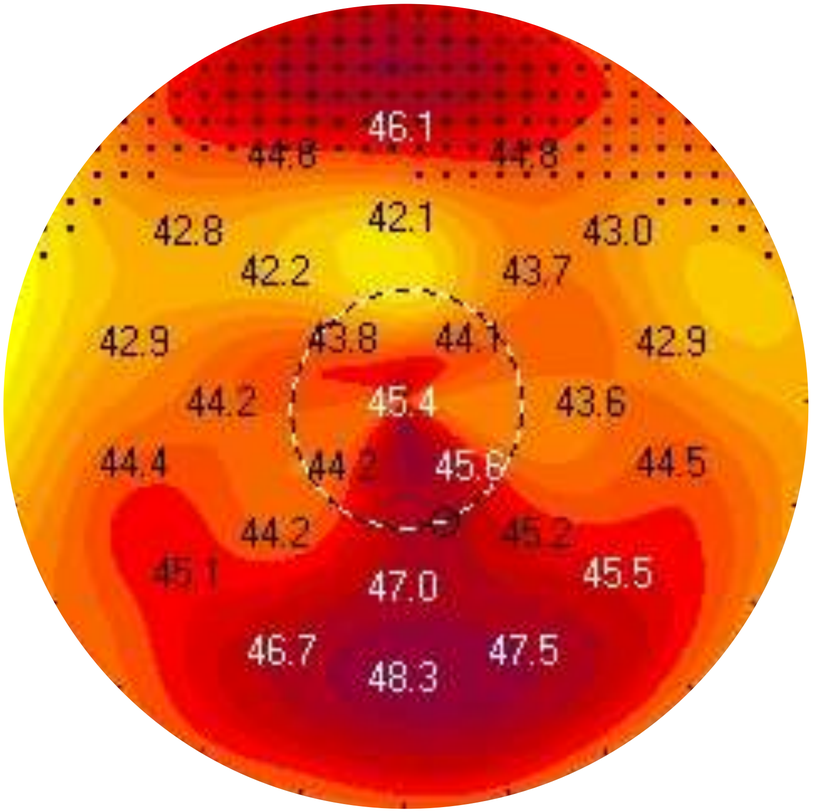

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AFTER 3 MONTHS

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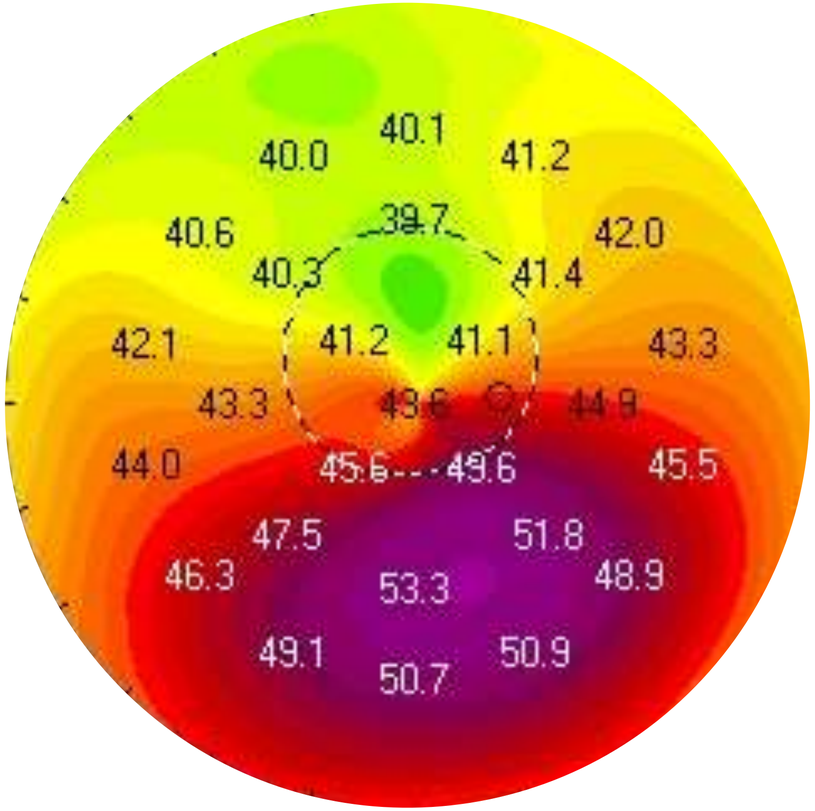

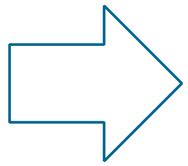

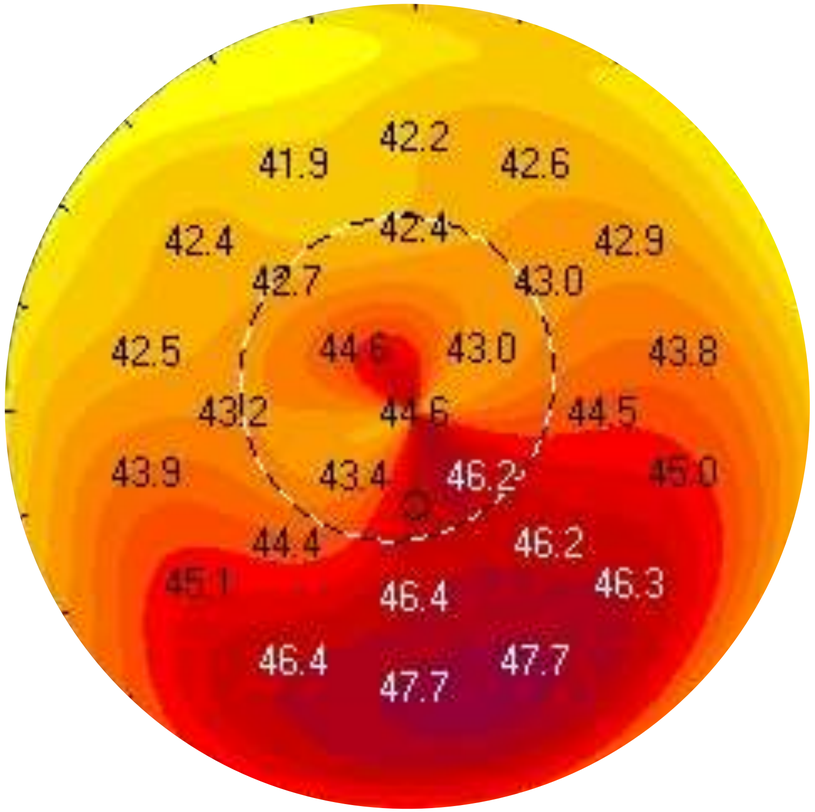

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AFTER 6 MONTHS

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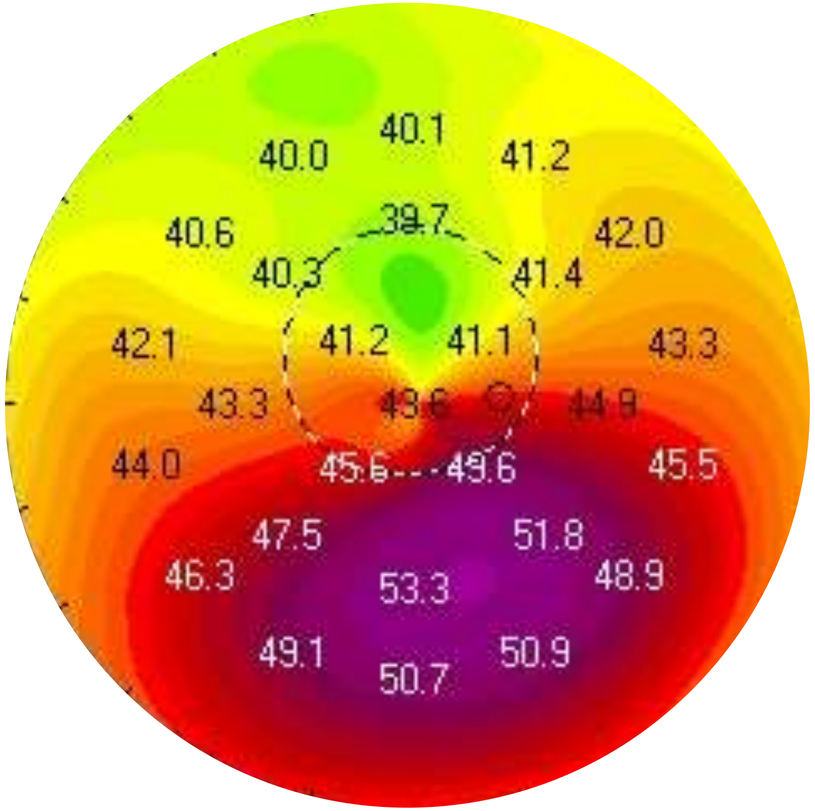

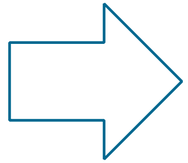

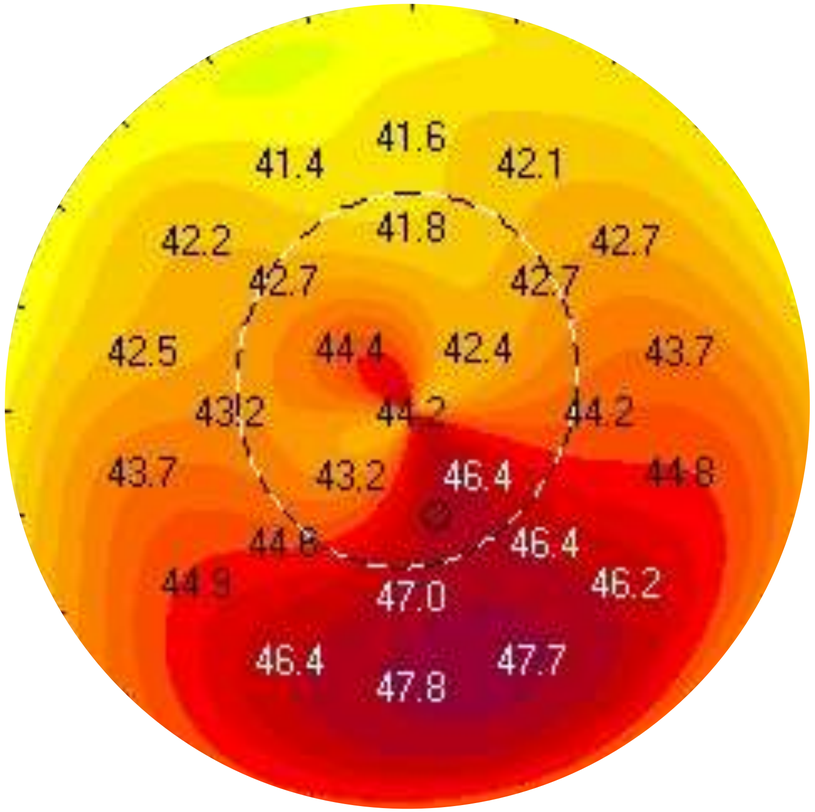

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AFTER 12 MONTHS

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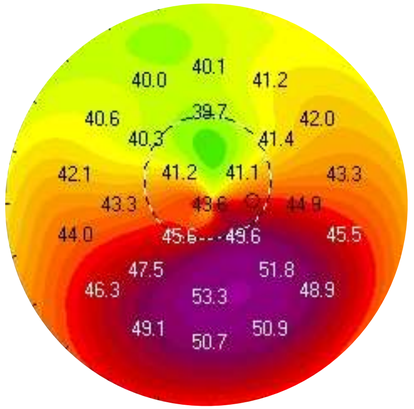

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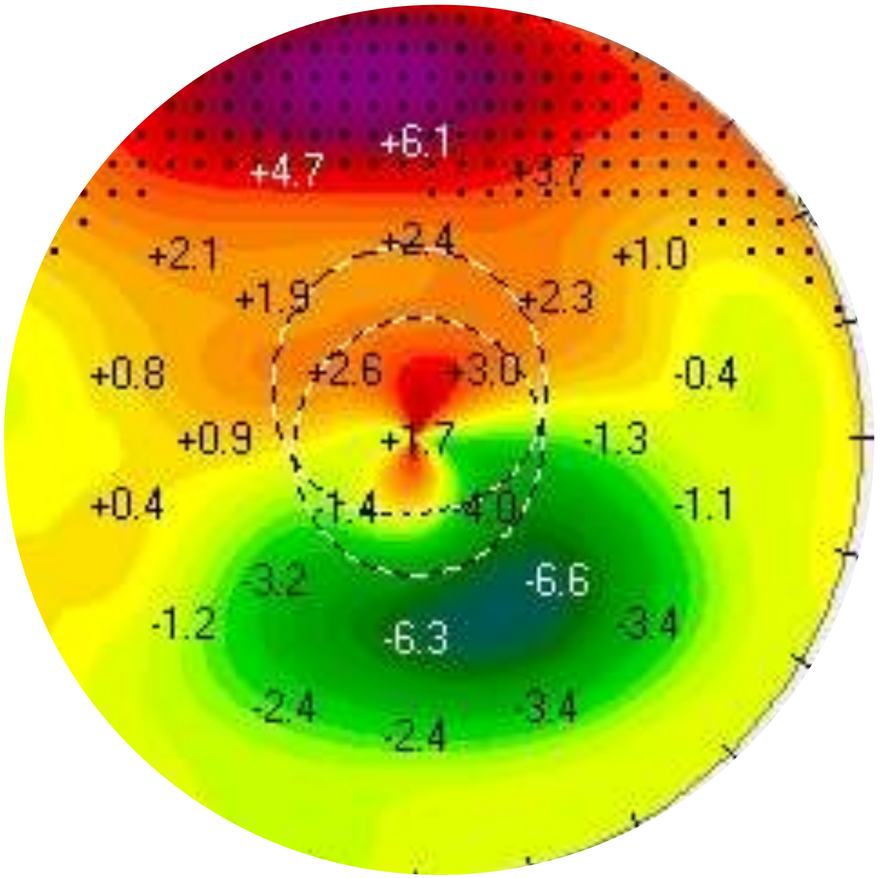

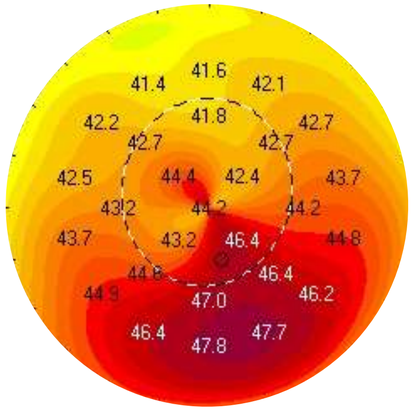

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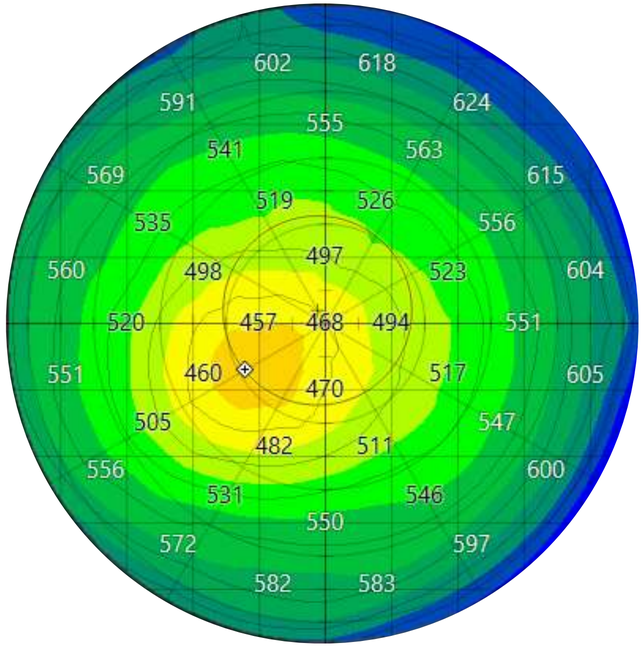
THICKNESS?



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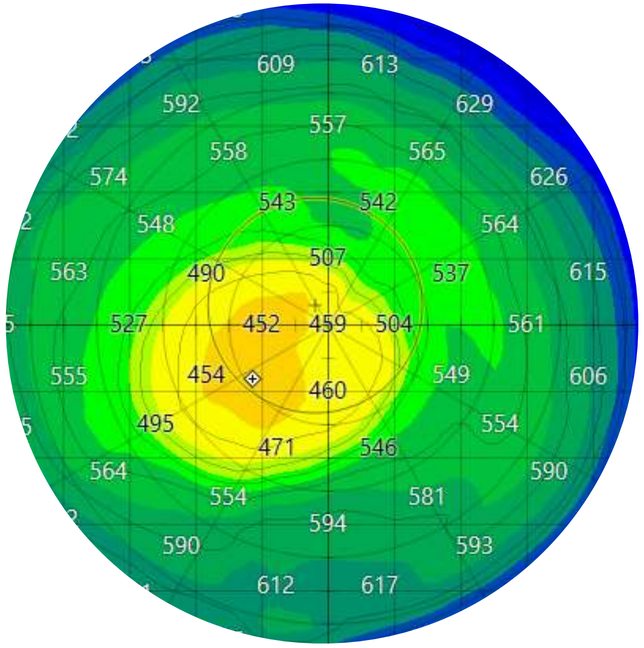

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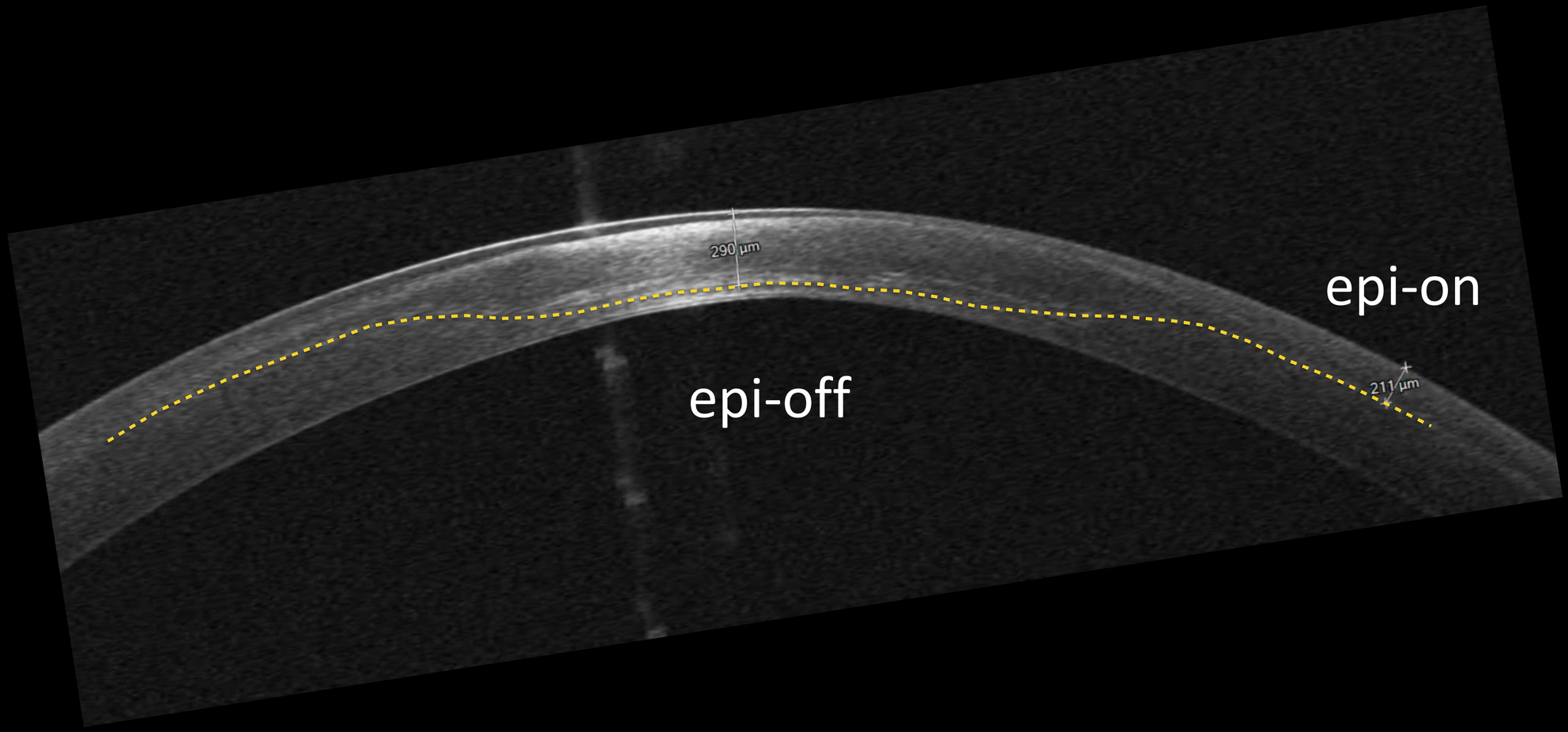
DEMARCATION LINE



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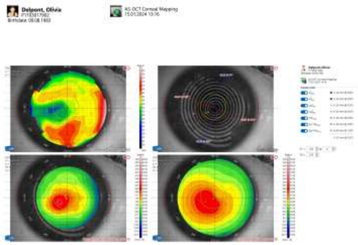
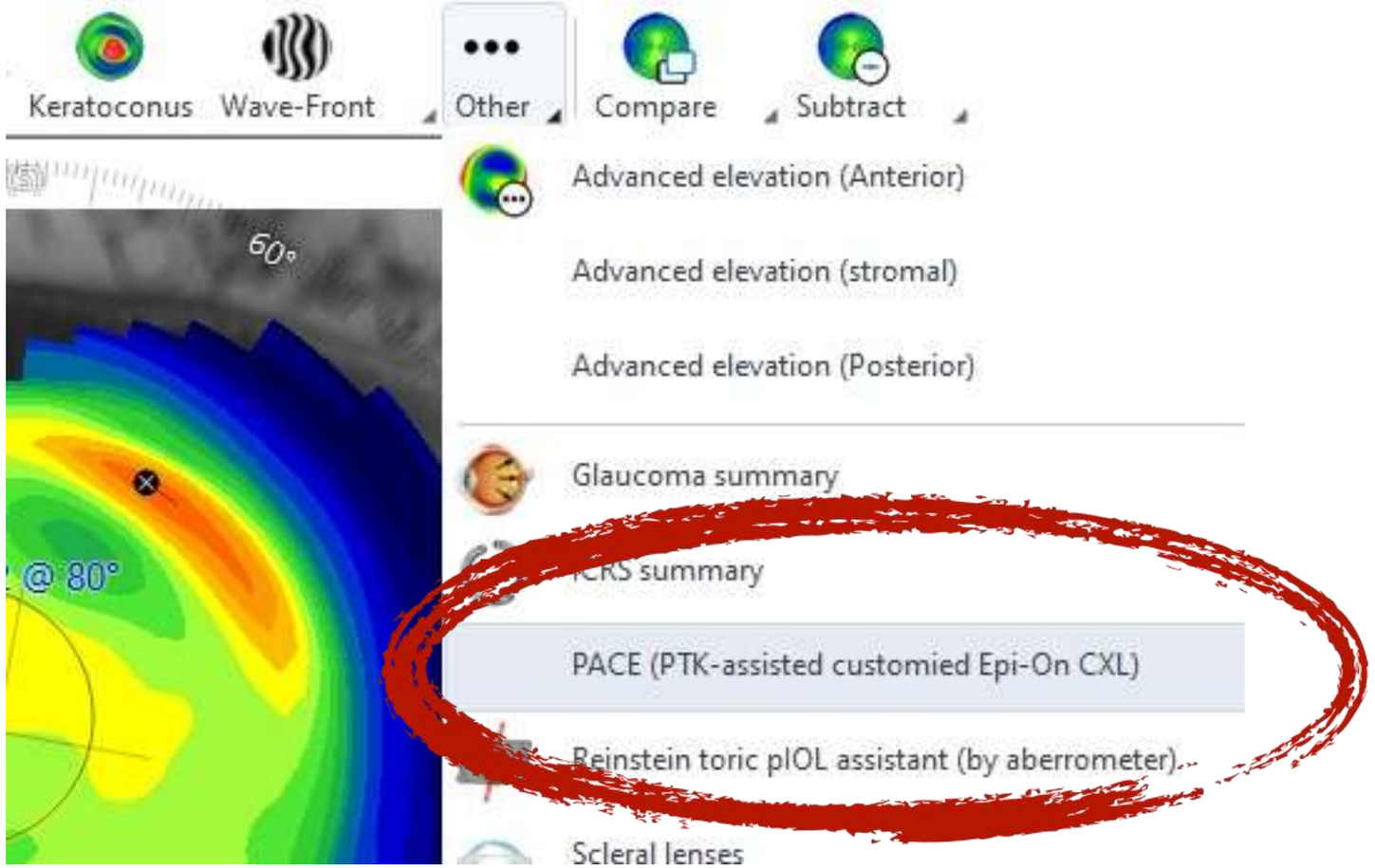
PLANNING THE PTK





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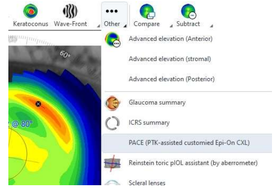
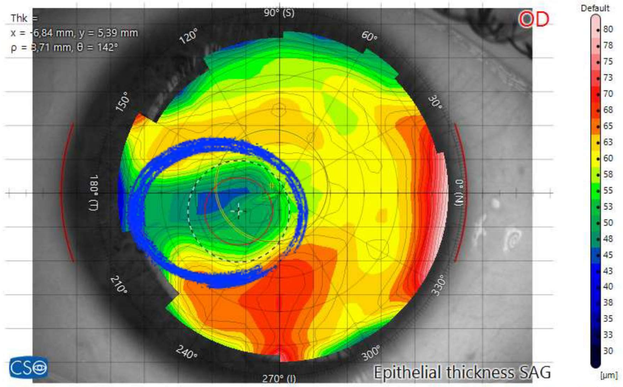
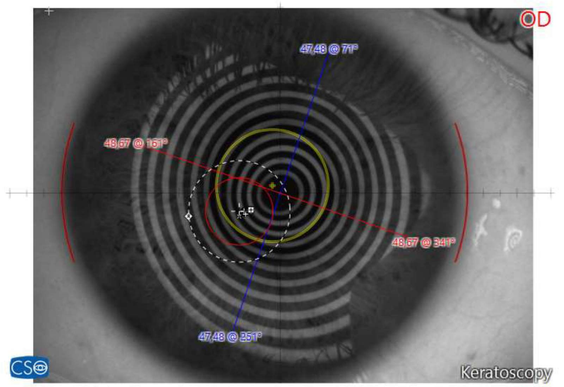
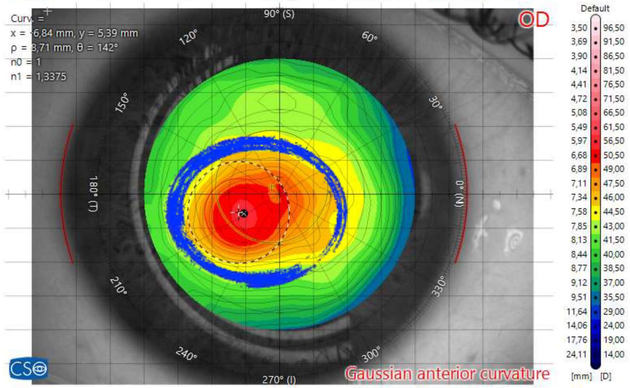


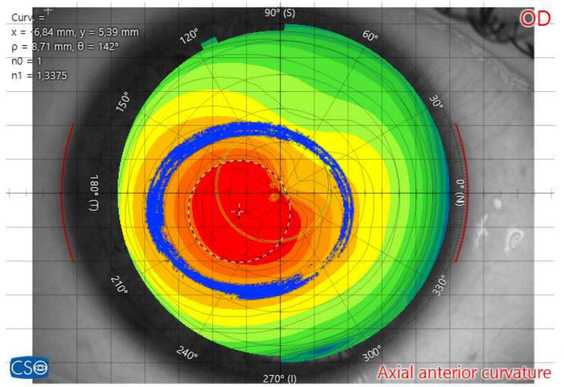
Delpont, Olivia
P1703017902
Birthdate: 09.08.1983

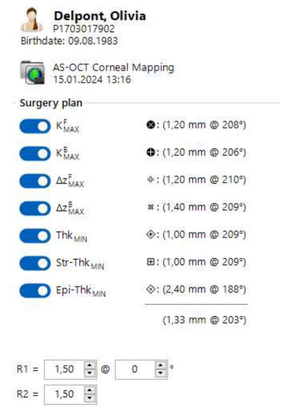
AS-OCT Corneal Mapping
15.01.2024 13:16











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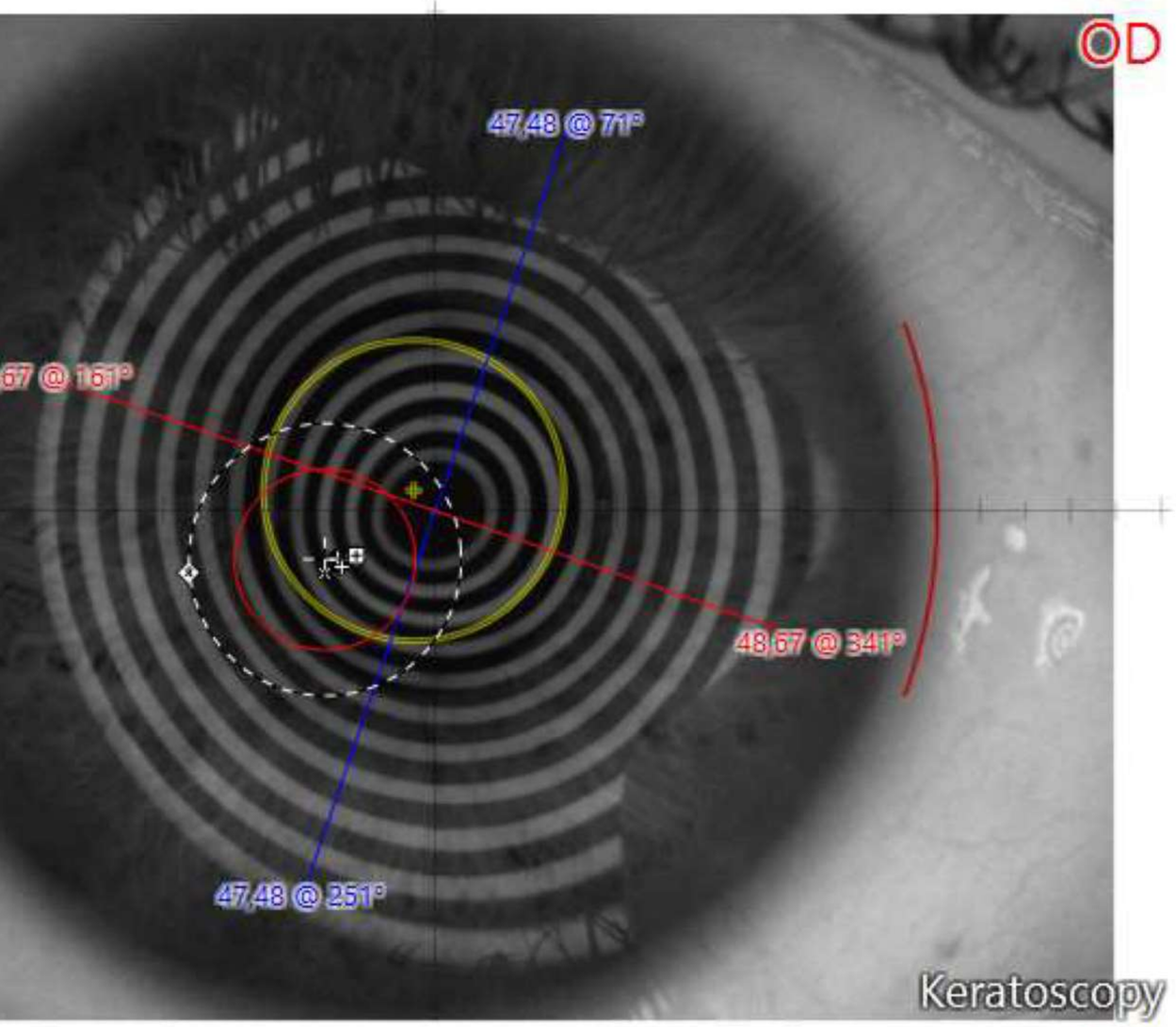
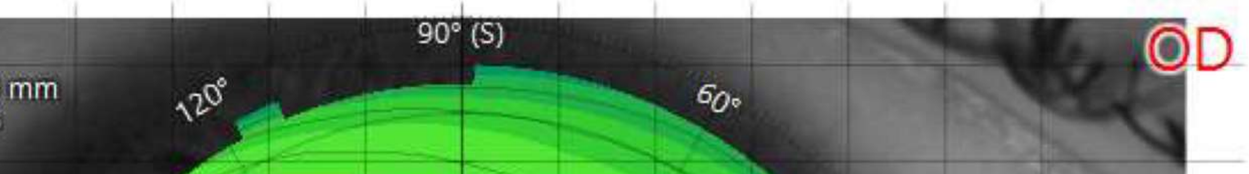
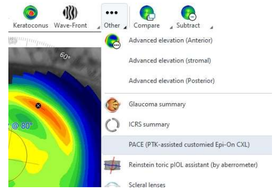
PLANNING THE PTK







Delpont, Olivia
P1703017902
Birthdate: 09.08.1983

AS-OCT Corneal Mapping
15.01.2024 13:16

Surgery plan

K^{F}_{MAX}	: (1,20 mm @ 208°)
K^{B}_{MAX}	: (1,20 mm @ 206°)
Δz^{F}_{MAX}	: (1,20 mm @ 210°)
Δz^{B}_{MAX}	: (1,40 mm @ 209°)
Thk_{MIN}	: (1,00 mm @ 209°)
$Str\text{-}Thk_{MIN}$	: (1,00 mm @ 209°)
$Epi\text{-}Thk_{MIN}$	: (2,40 mm @ 188°)

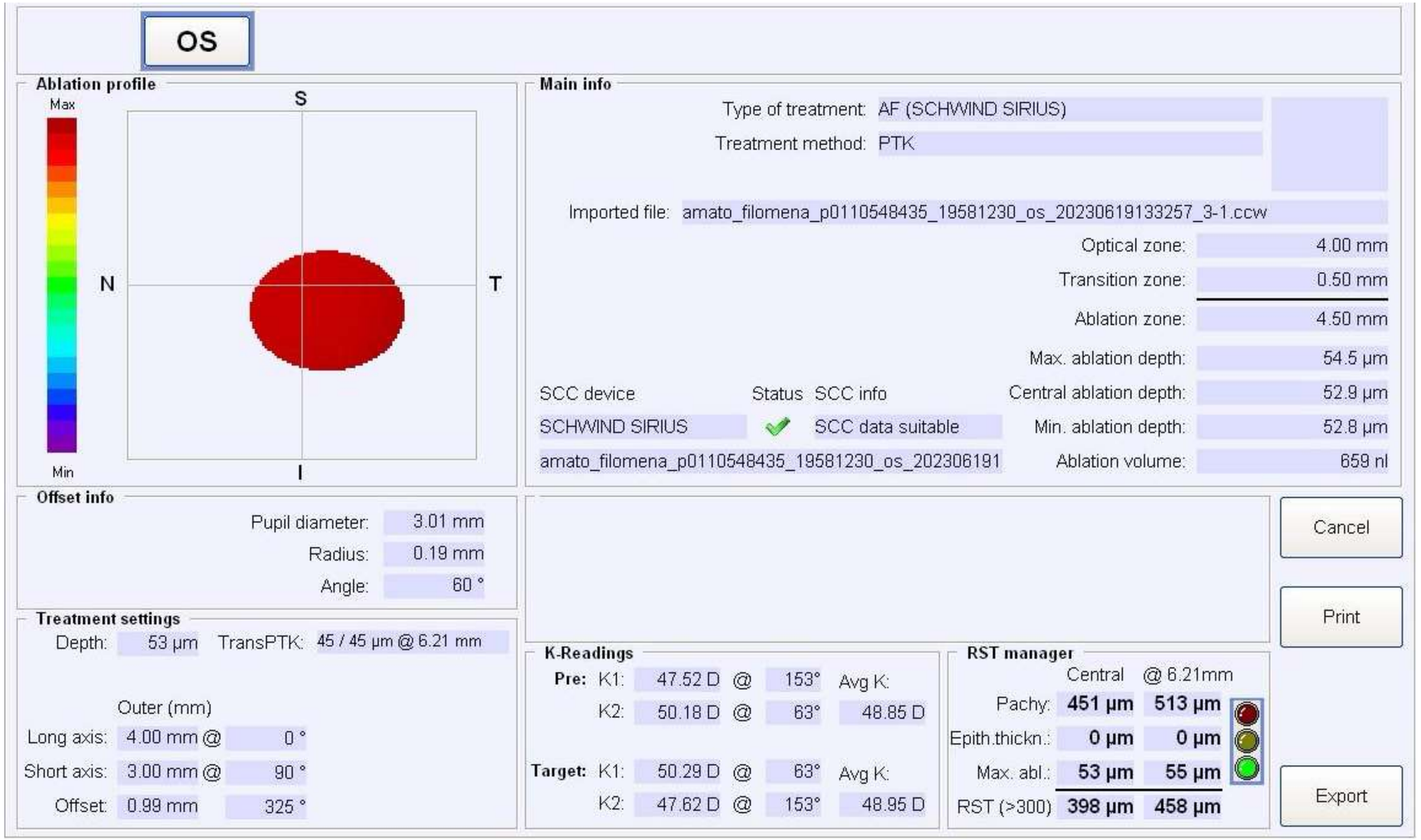
(1,33 mm @ 203°) OFFSET

Default
3,50 • 96,50
3,69 • 91,50
3,90 • 86,50

R1 = 1,50 @ 0 °
R2 = 1,50

SHAPE

PLANNING THE PTK



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Difference to current PRK/CXL proto

PACE

Athens Protocol

Cretan Protocol

Stare-X

Trek

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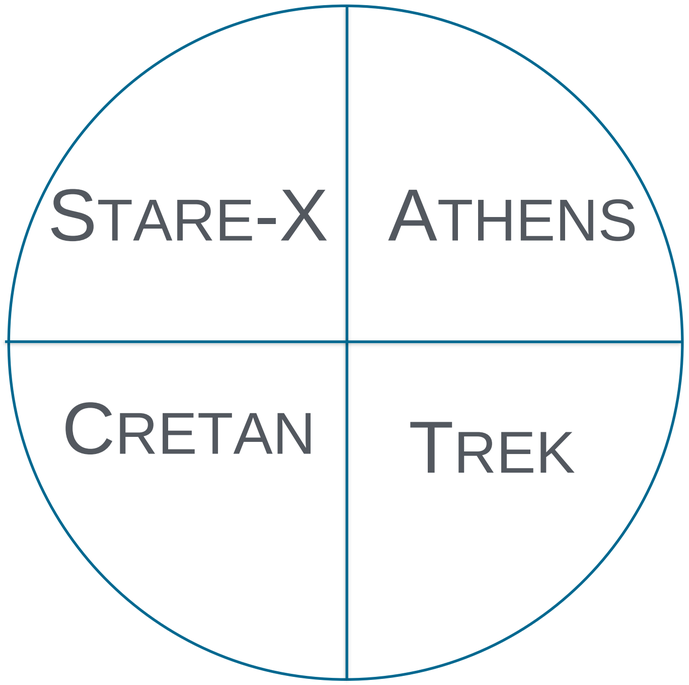

STROMA IS REMOVED

Excimer laser

Cross-Linking

PACE

Excimer laser

Cross-Linking

STROMA UNCHANGED

ADDITIONAL COUPLING EFFECT

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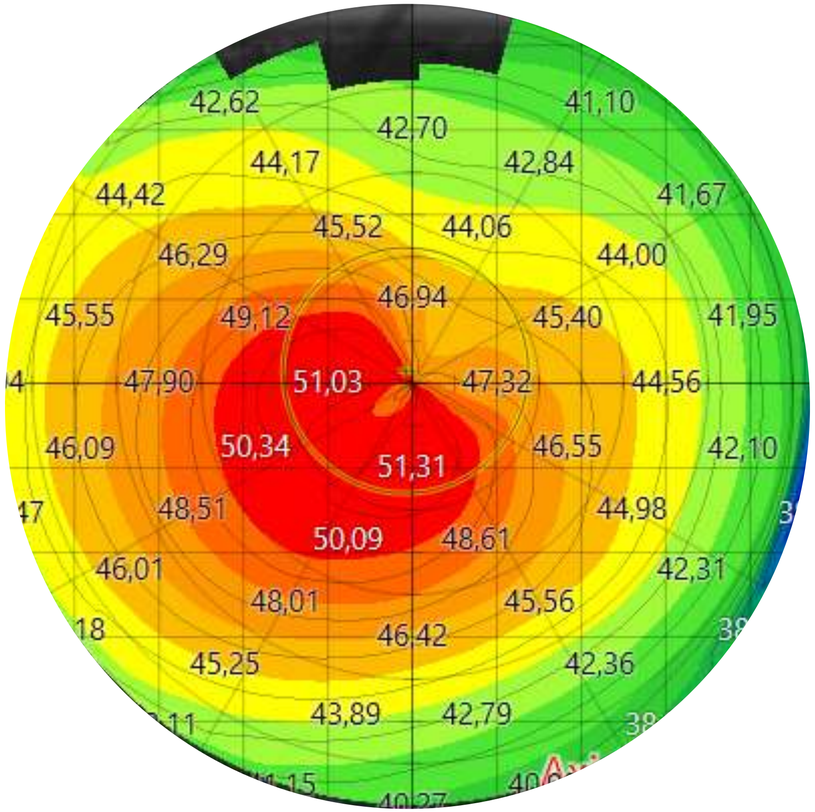
5 MINUTES AFTER PACE



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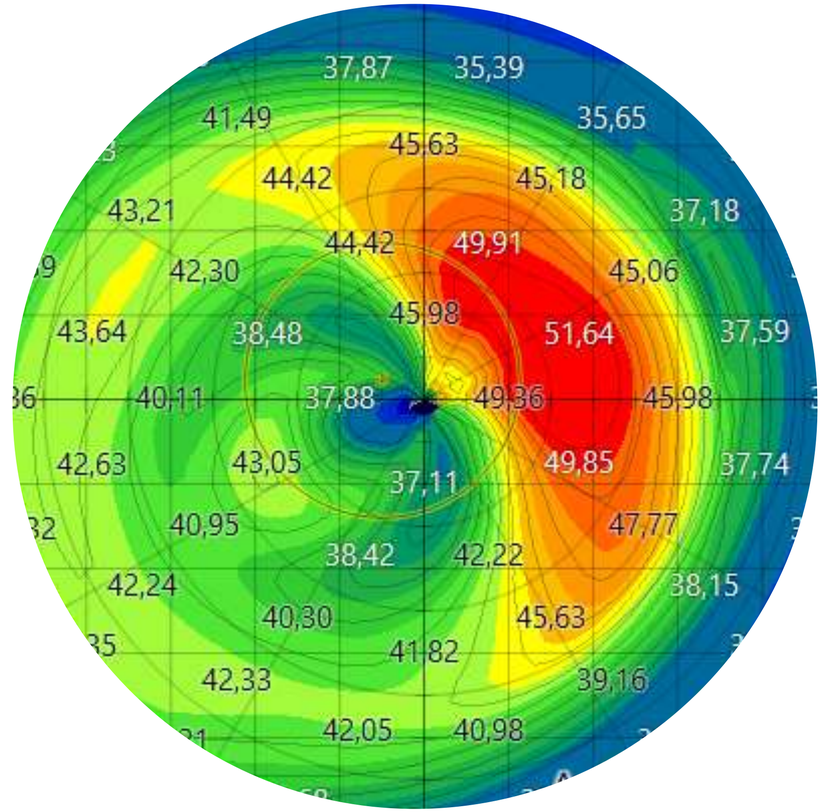

5 MINUTES AFTER PACE

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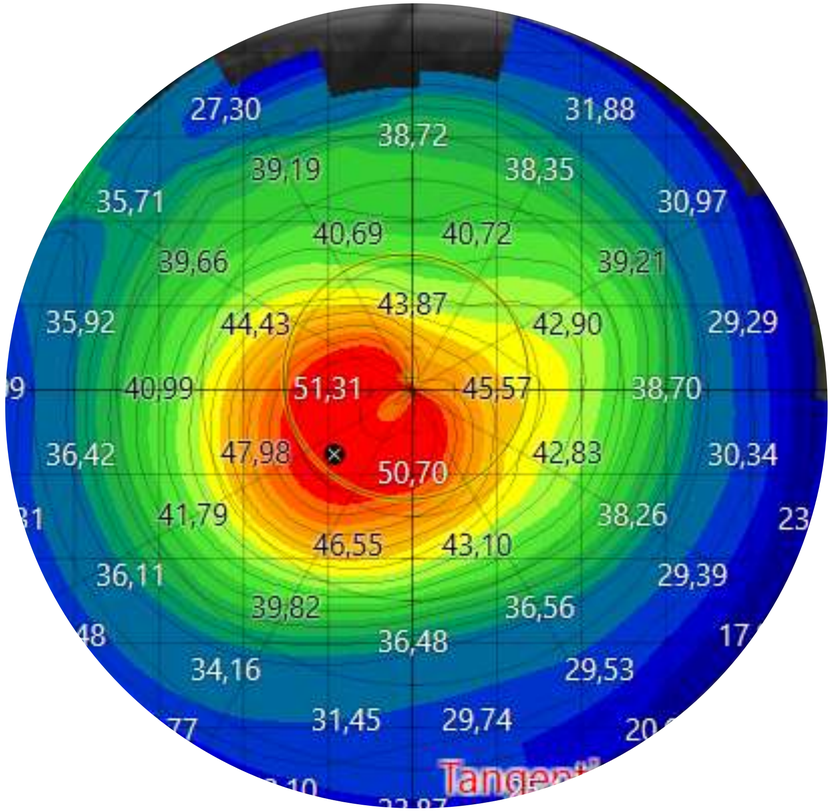
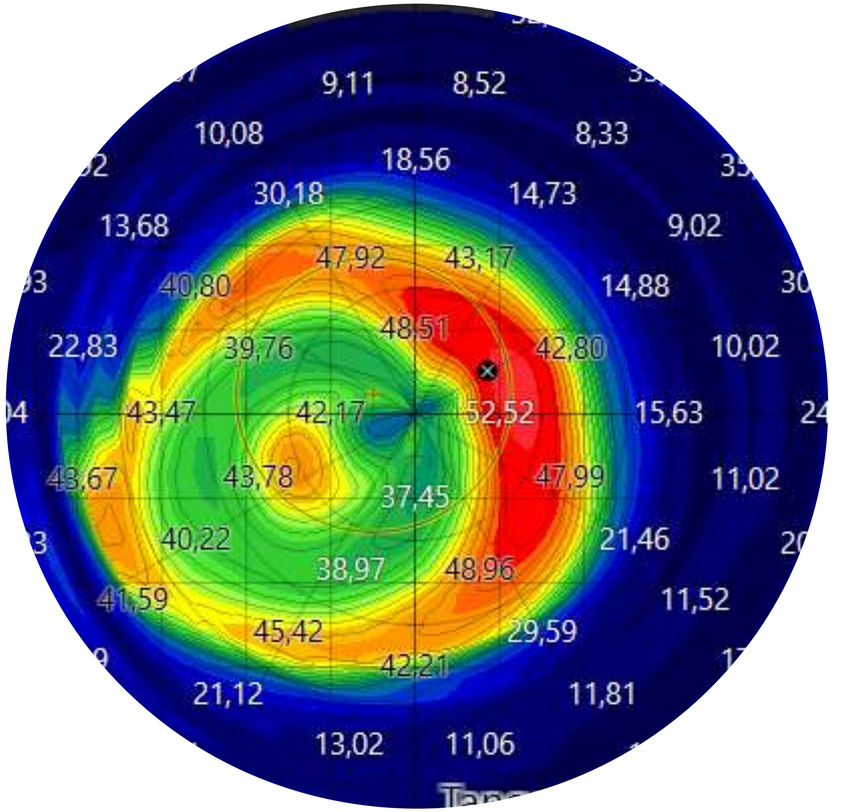


BEFORE PACE



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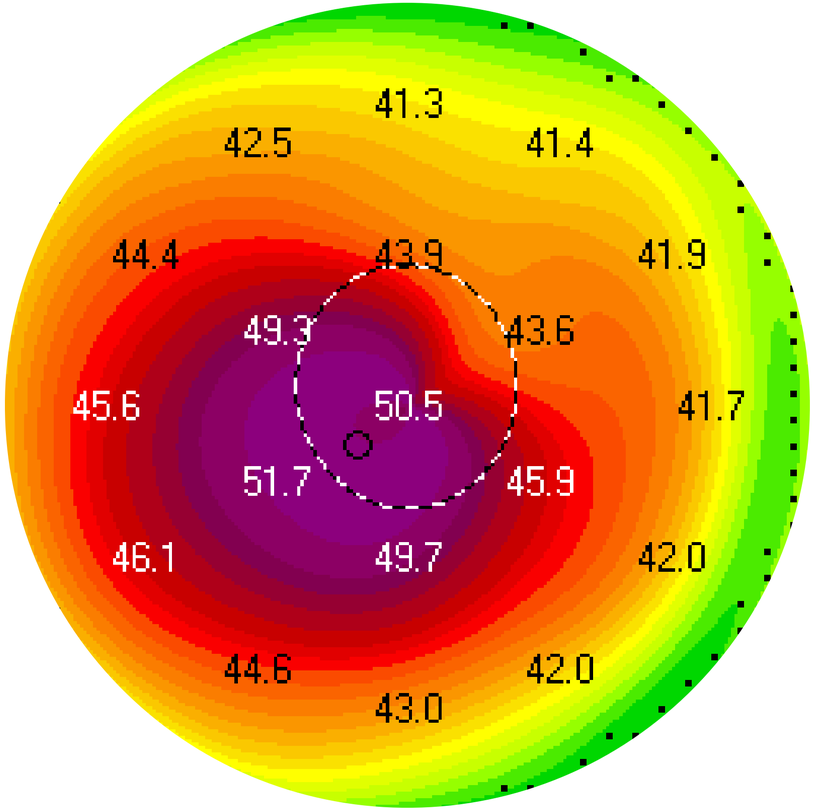

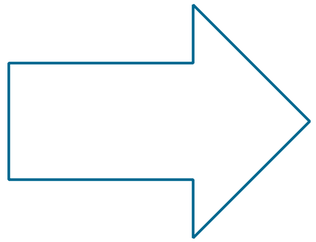

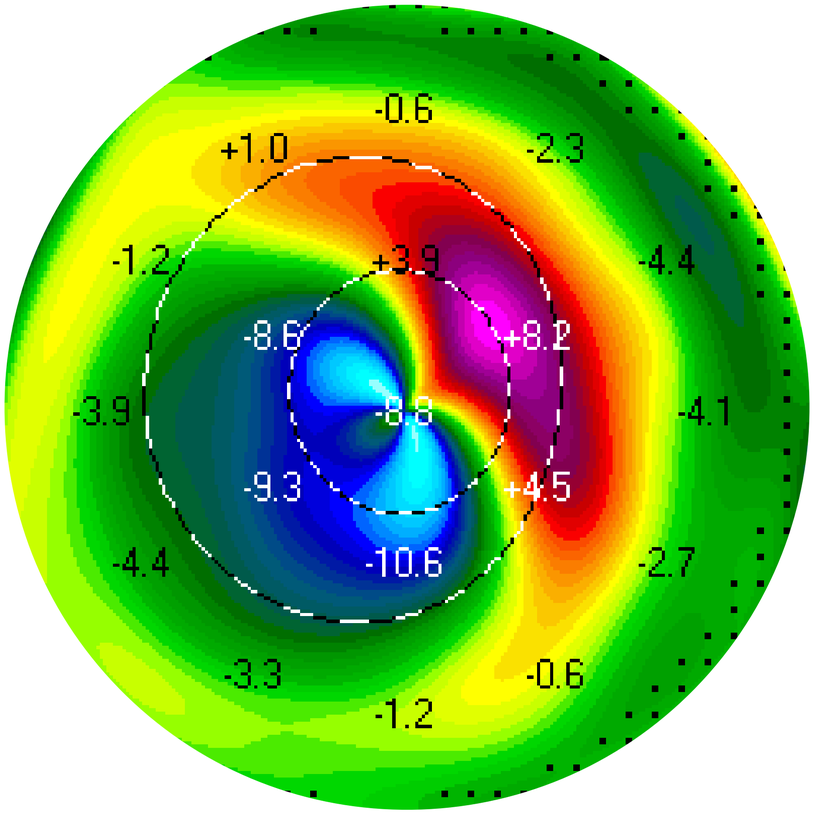

BEFORE PACE

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Conclusion PACE

(1) Regularization of up to 12 D

(2) Improves CDVA

(3) Later, wavefront-guided PRK is possible

(4) Can be used in stable keratoconus

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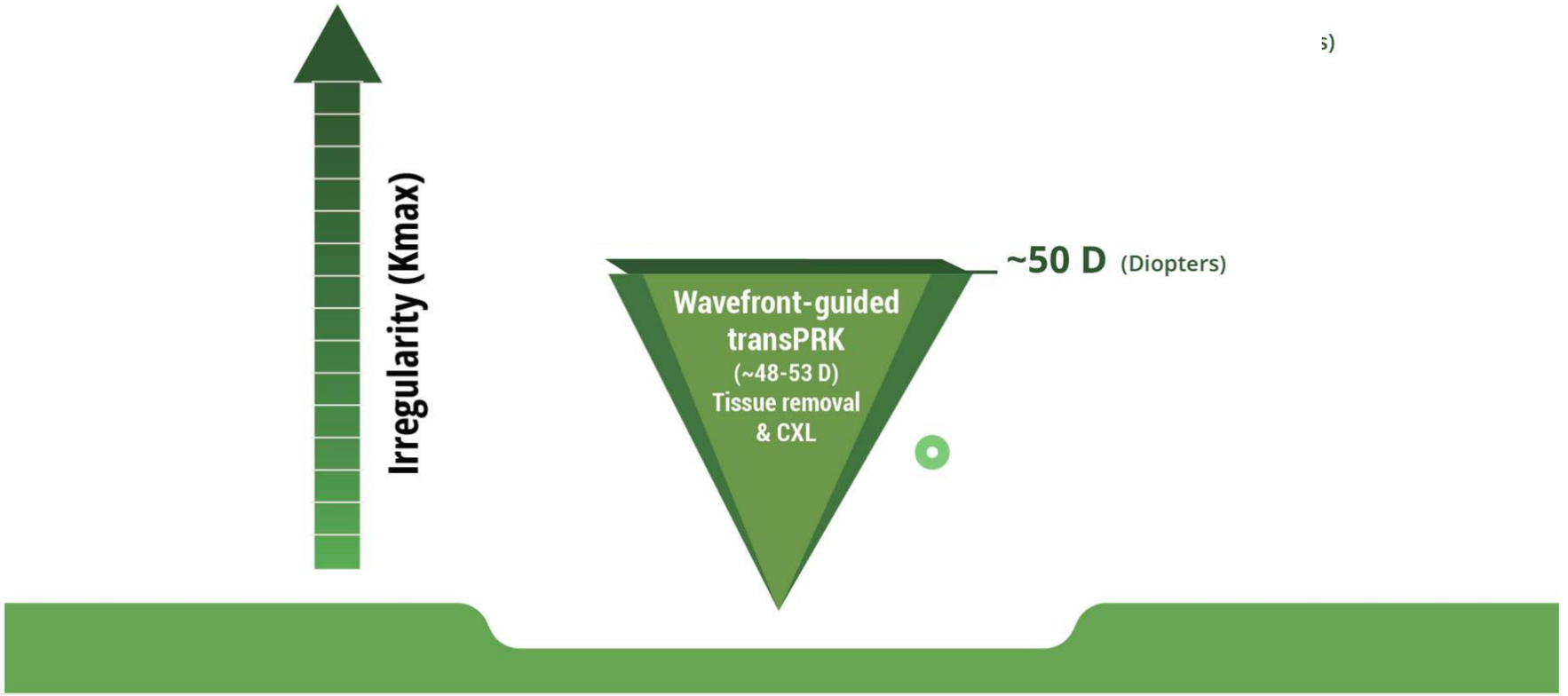
ELZA'S APPROACH TO IMPROVE VISION IN KERATOCONUS



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