

Designing and Fitting Scleral Lenses With High Resolution Optical Coherence Tomography

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Leaving the cornea is sometimes necessary



Why Sclerals?

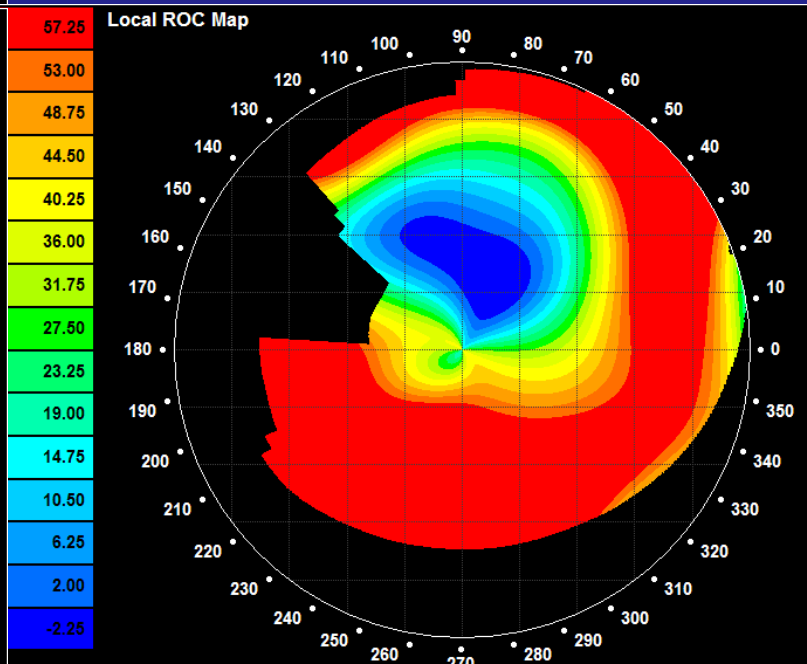
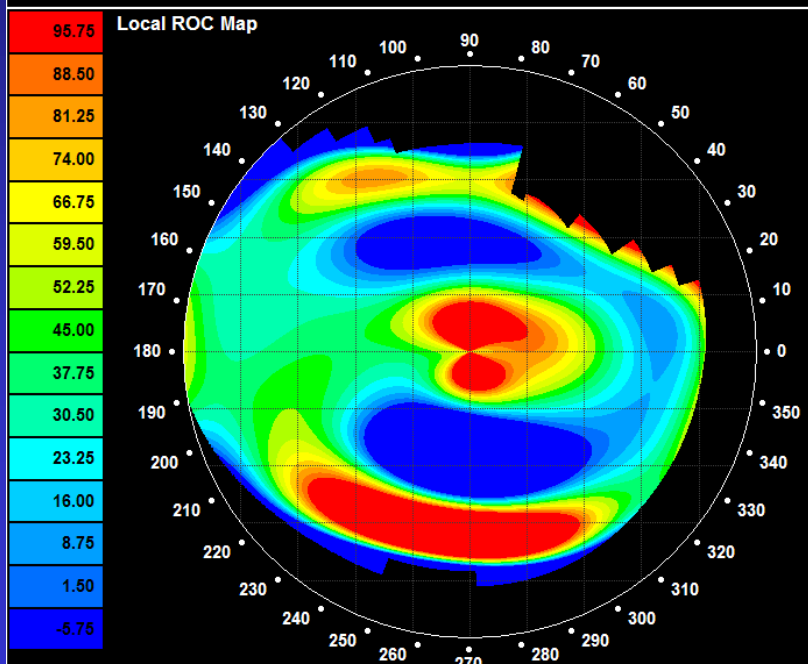
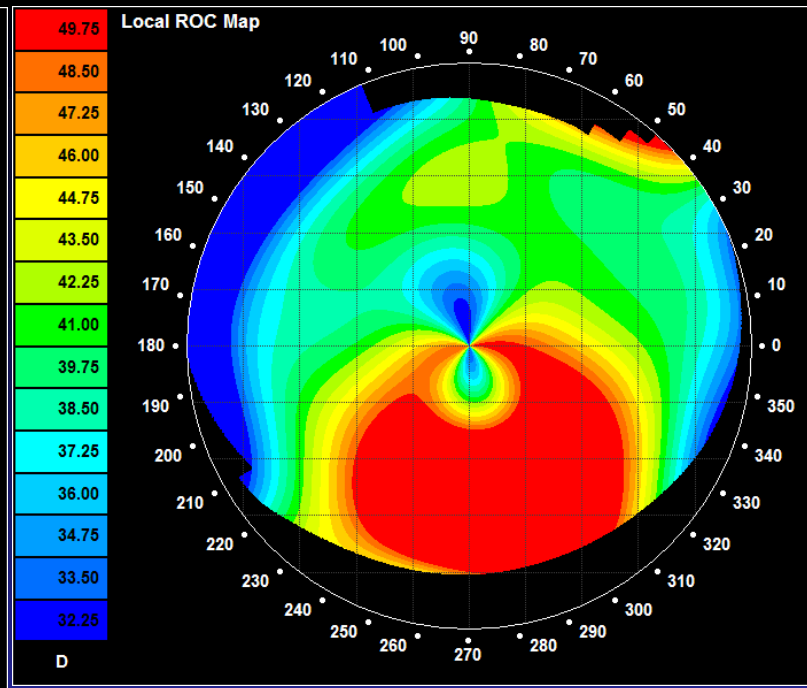
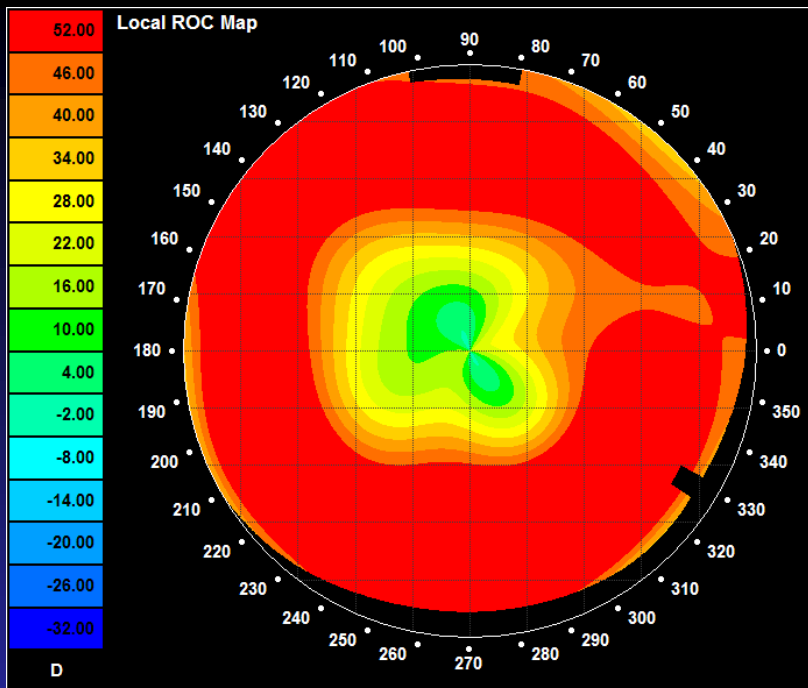
- Scleral lenses are comfortable.
- Scleral lenses can be adapted for a wide range of conditions
 - Dry eye
 - High astigmatism
 - Scarred and diseased corneas
 - Keratoconus
 - Post-surgical

Why Sclerals?

- They don't translate.
- They stay centered
 - Ideal vehicle for complex optical corrections such as wavefront optics.
 - Bifocal corrections
- They are ~~easy~~ to fit.

What do we know about the sclera?





Trial Lenses

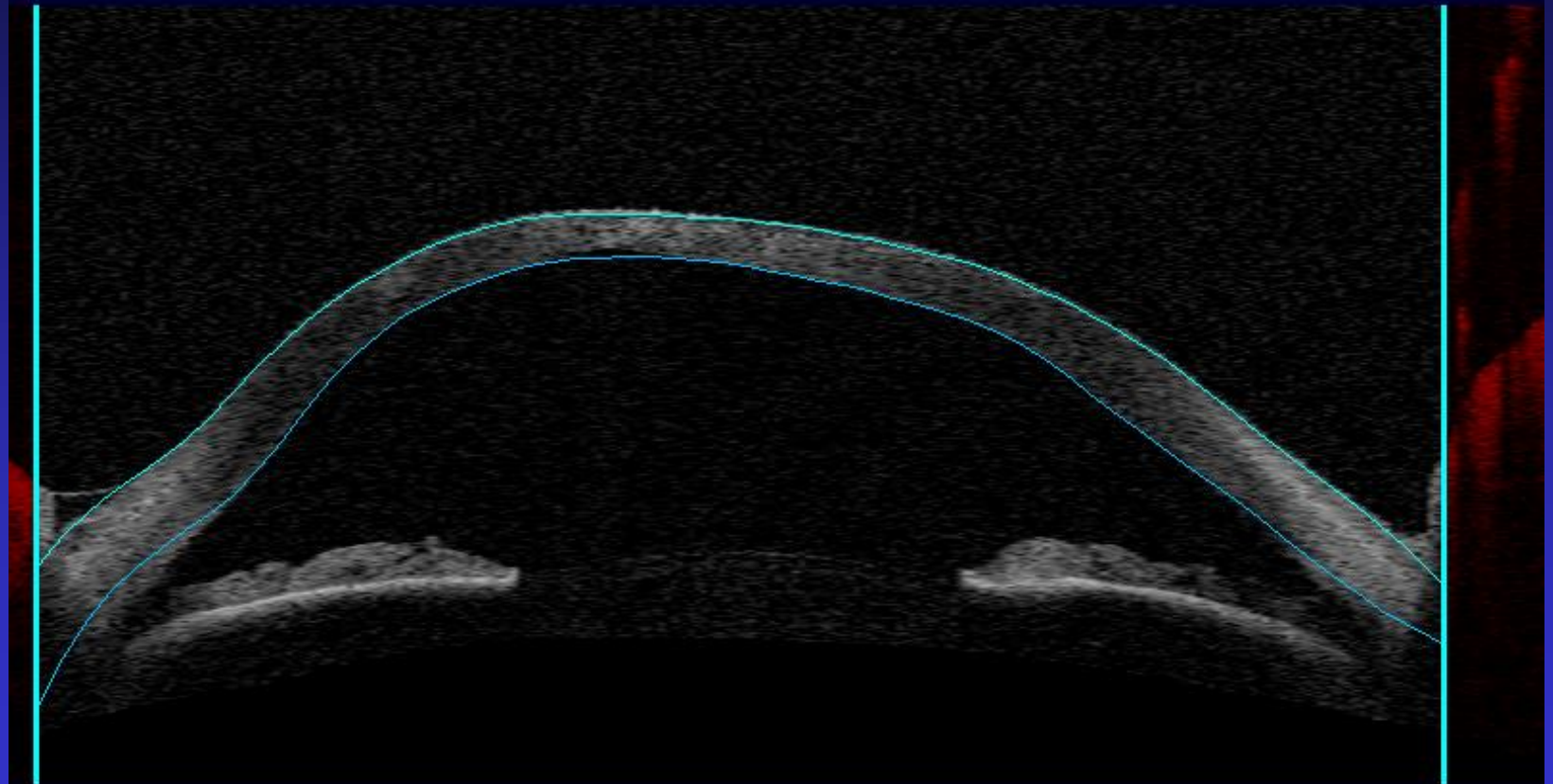


Anterior Segment Single



70°

90°



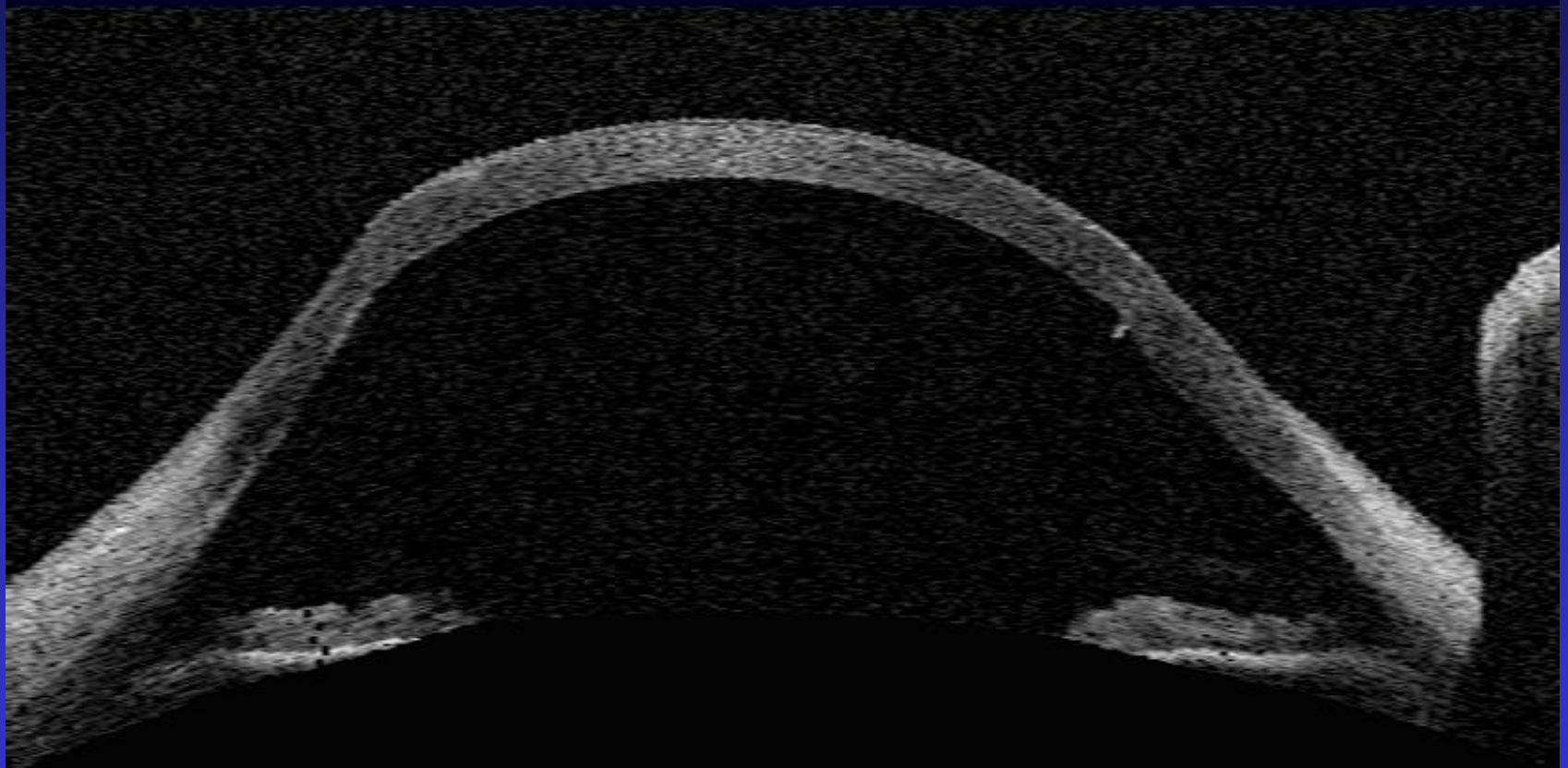
SW Version: 2.0.1.88 Patient ID: Gender: Female Age: 34

Anterior Segment Single



260°

80°



Visante OCT



A novel method of fitting scleral lenses using high resolution optical coherence tomography.
Gemoules G. Eye & Contact Lens. 2008
Mar;34(2):80-3

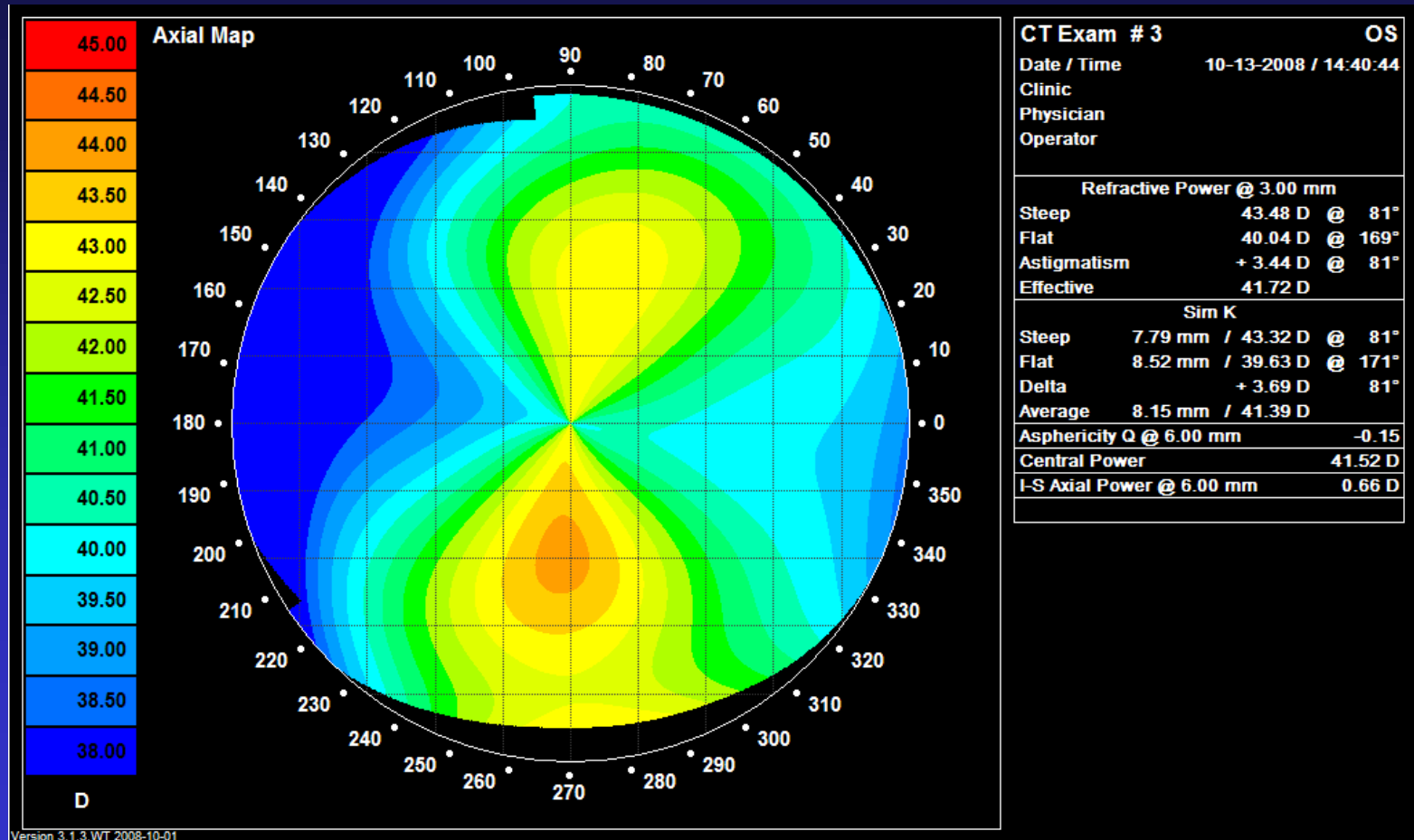
- 9 patients
- Average of 1.7 lenses/eye
- Fewer lenses than trial lens method

Advantages of OCT

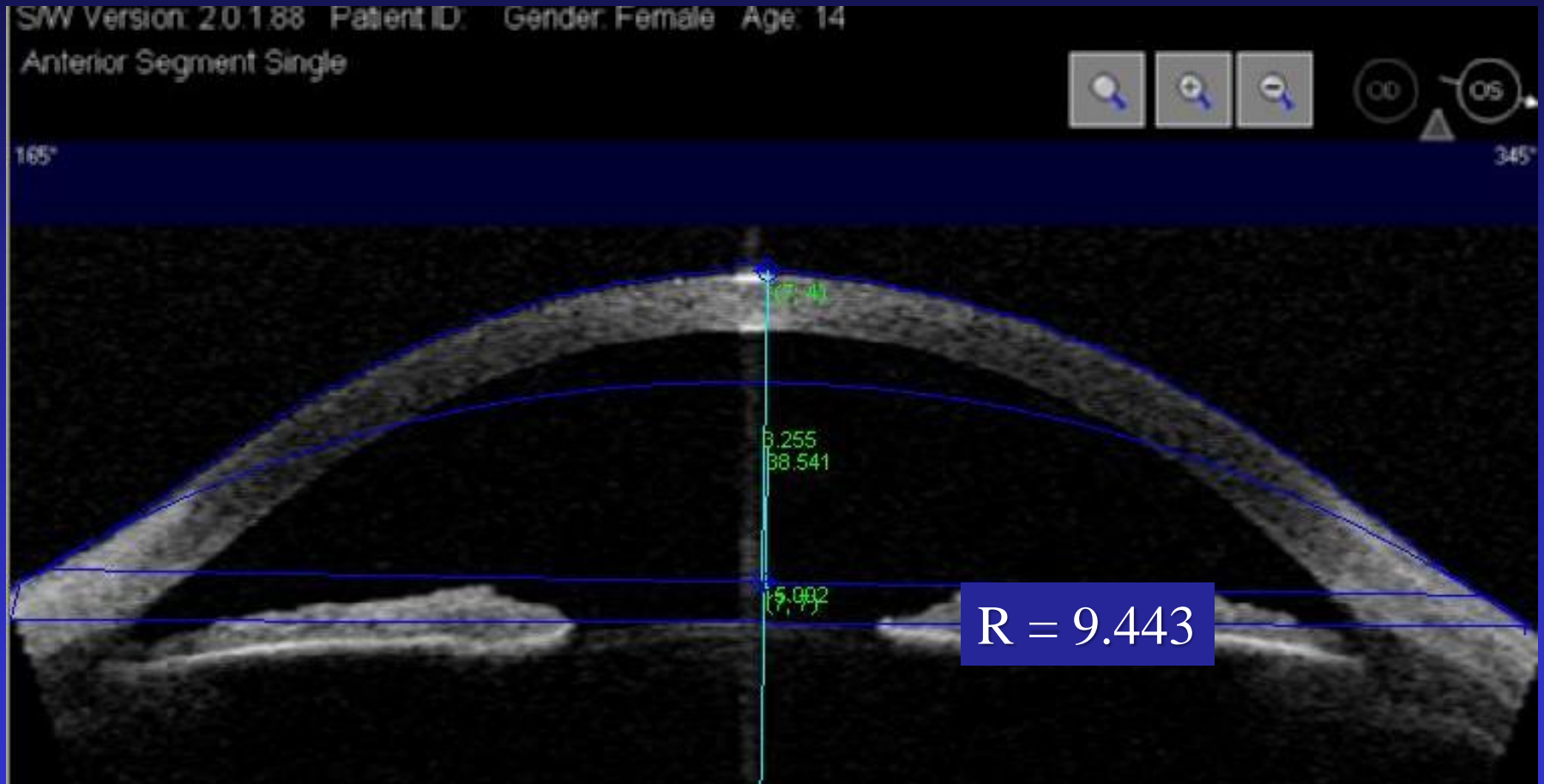
- OCT images are intuitive.
- True elevation data from any reference plane.
- Diagnostic capability
 - Lens/cornea relationship
 - Lens/sclera relationship
- Can actually measure the sclera
- Assists in determining proper lens diameter and shape based upon the individual eye.

Getting Started

Topography as a guide



Cornea scanned at 165 deg.



Cornea scanned at 75 deg.



Data And Design

Sags, Chords, and Conoids

$$r = (y^2 + px^2)/2x$$

r = radius of curvature

y = chord/2

p = eccentricity

x = sagitta

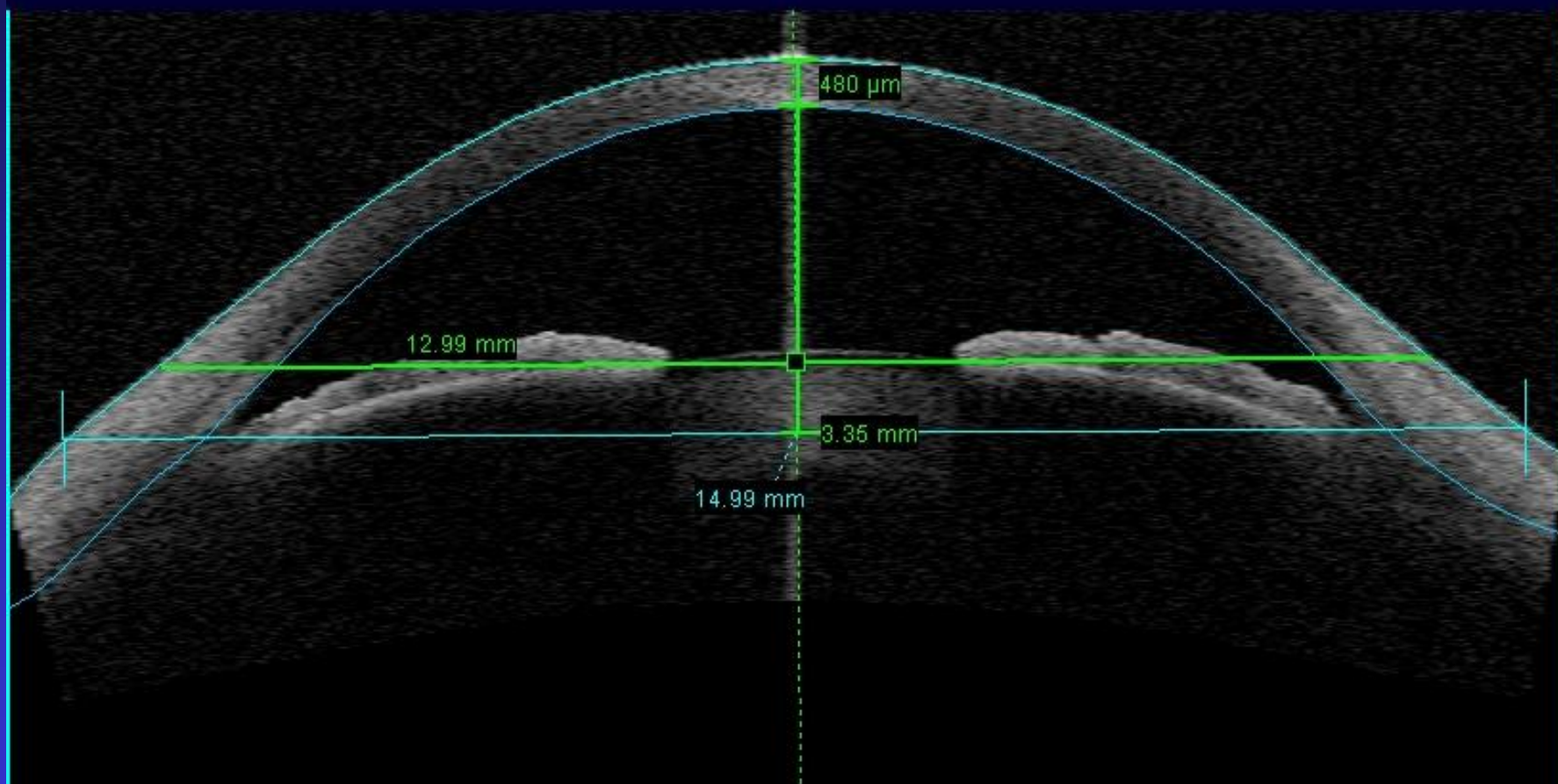
SW Version: 2.0.1.88 Patient ID: Gender: Female Age: 56

Anterior Segment Single



180°

0°



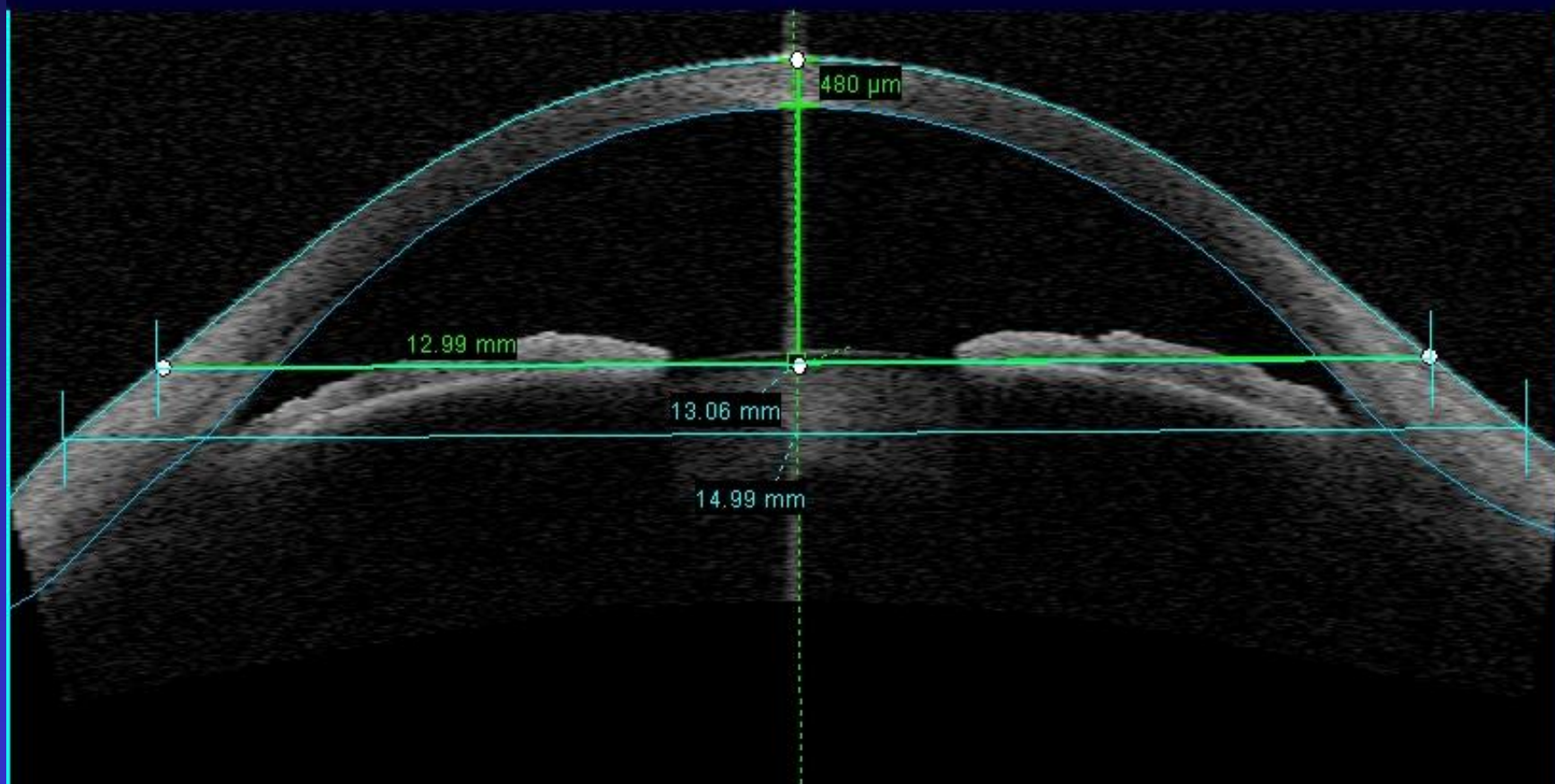
SW Version: 2.0.1.88 Patient ID: Gender: Female Age: 56

Anterior Segment Single



180°

0°



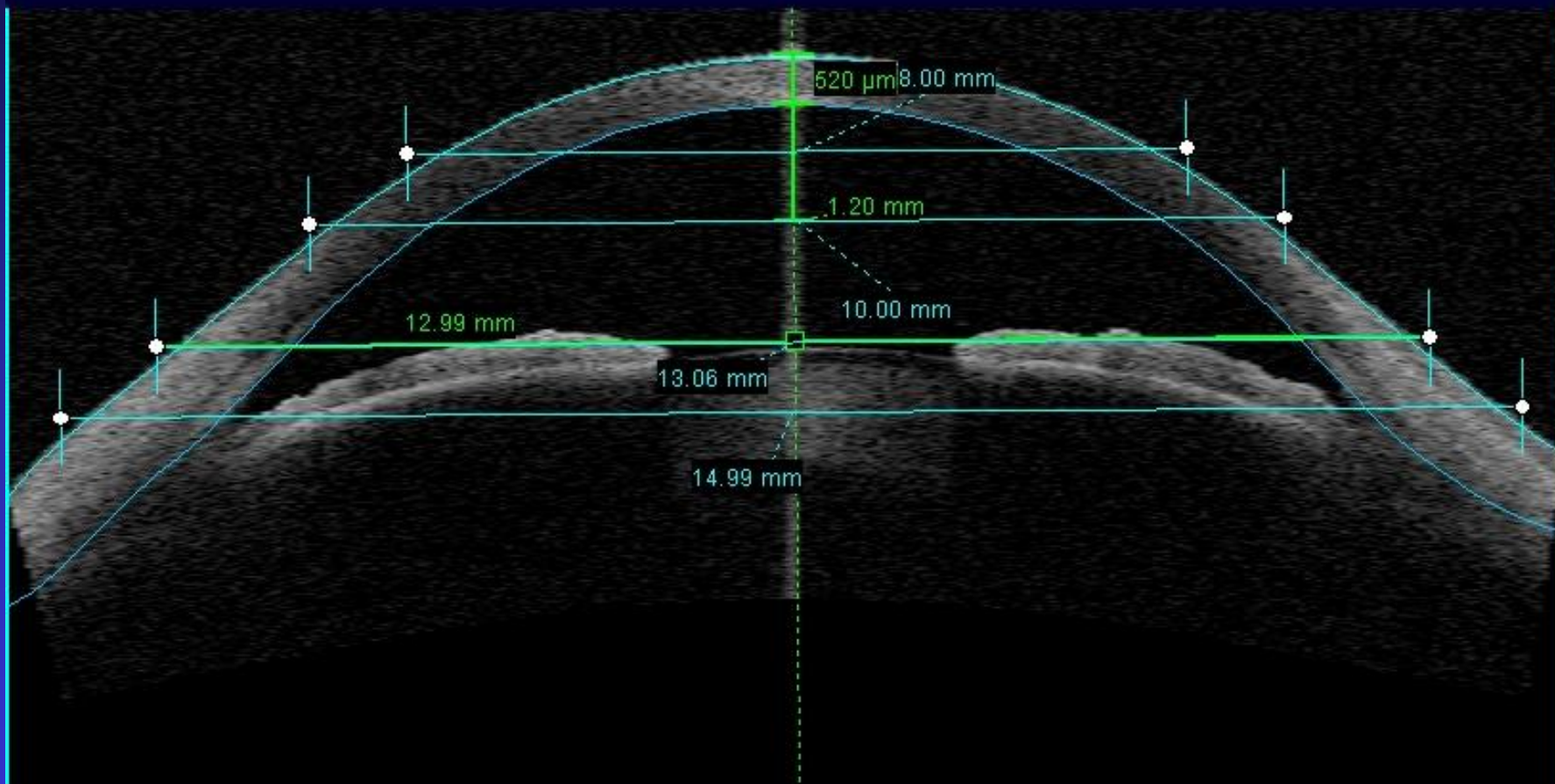
SW Version: 2.0.1.88 Patient ID: Gender: Female Age: 56

Anterior Segment Single



180°

0°



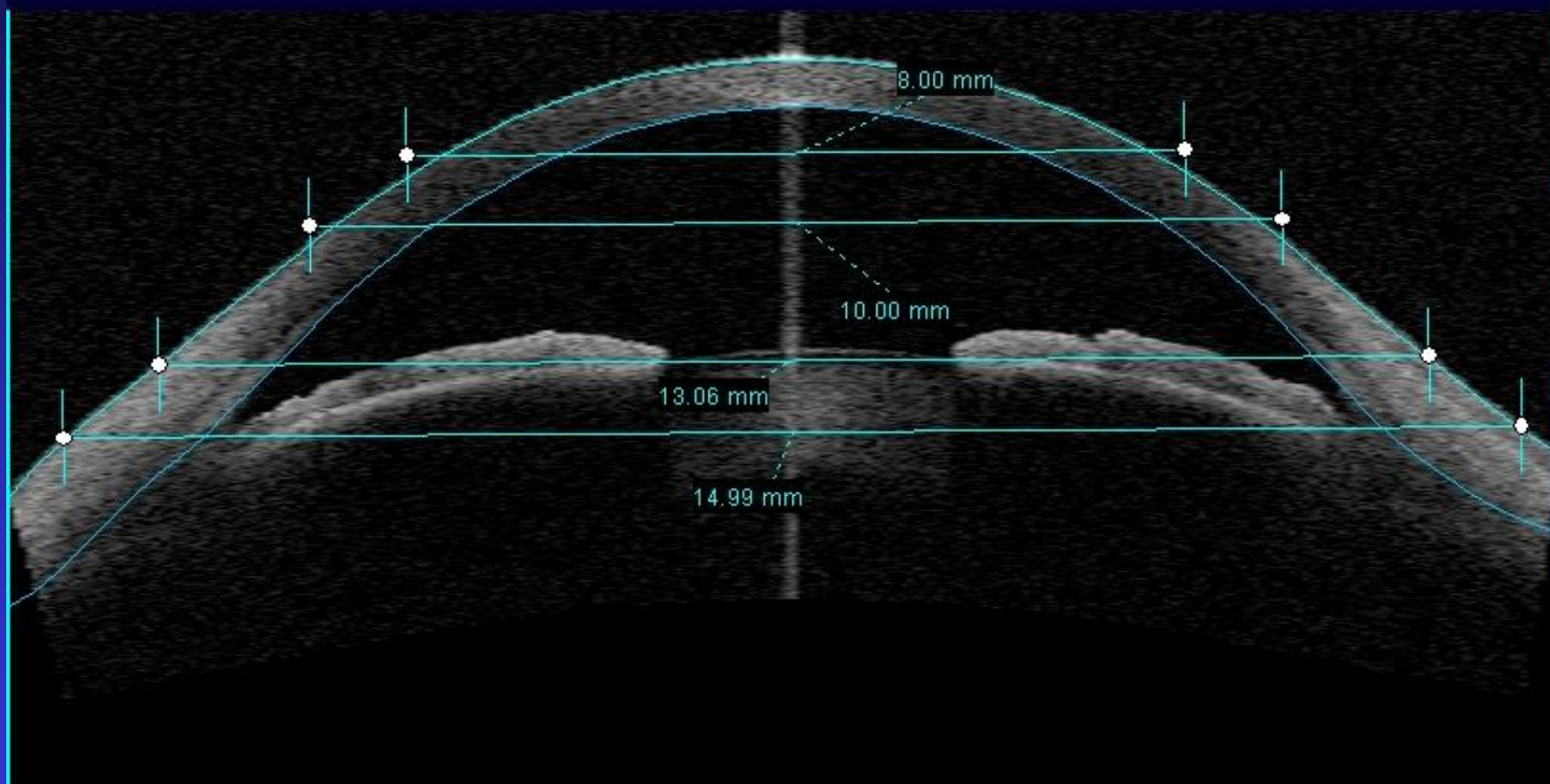
SW Version: 2.0.1.88 Patient ID: Gender: Female Age: 56

Anterior Segment Single



180°

0°



NOW THAT WAS EASY!



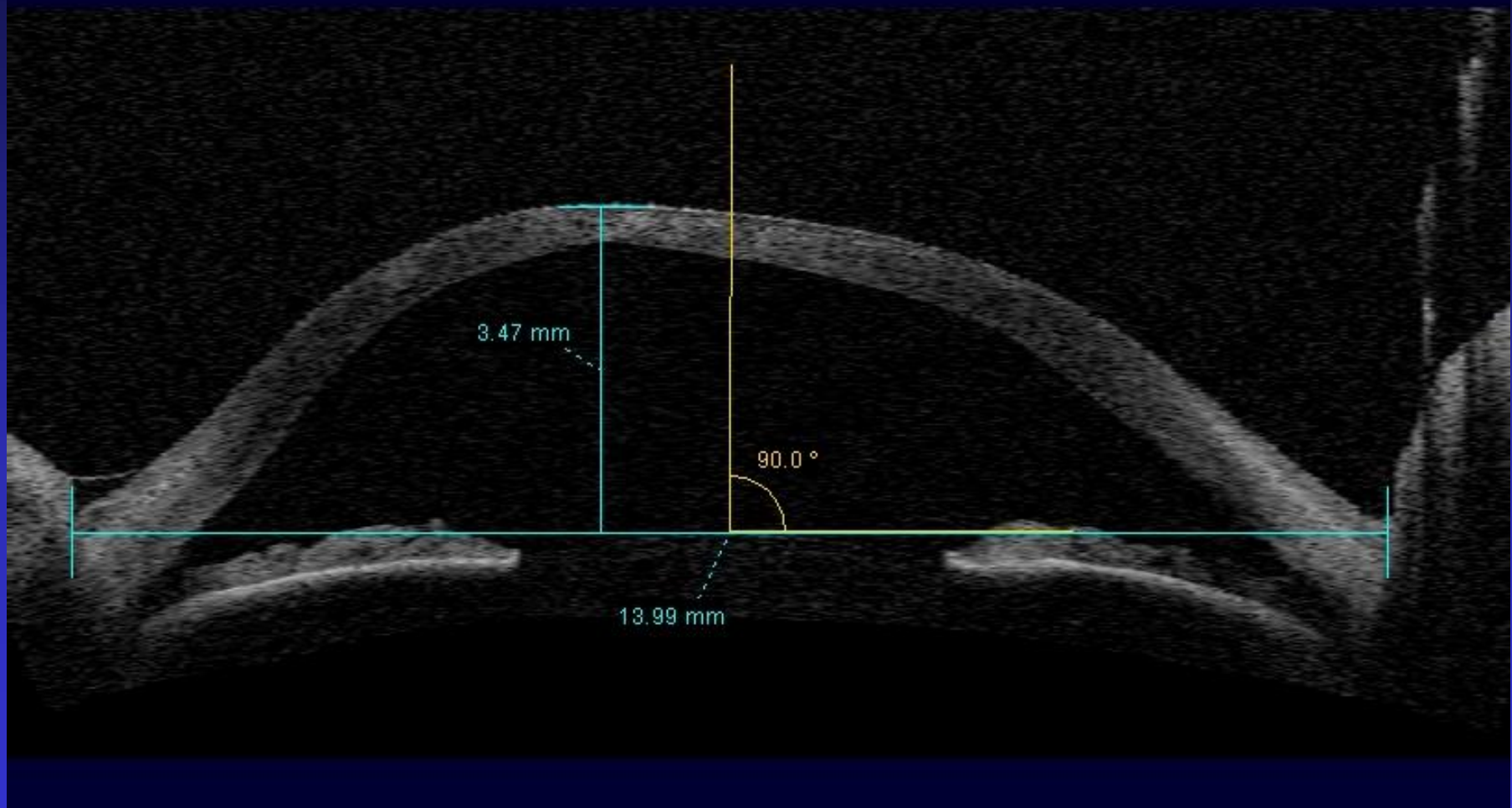
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50

Anterior Segment Single



270°

90°

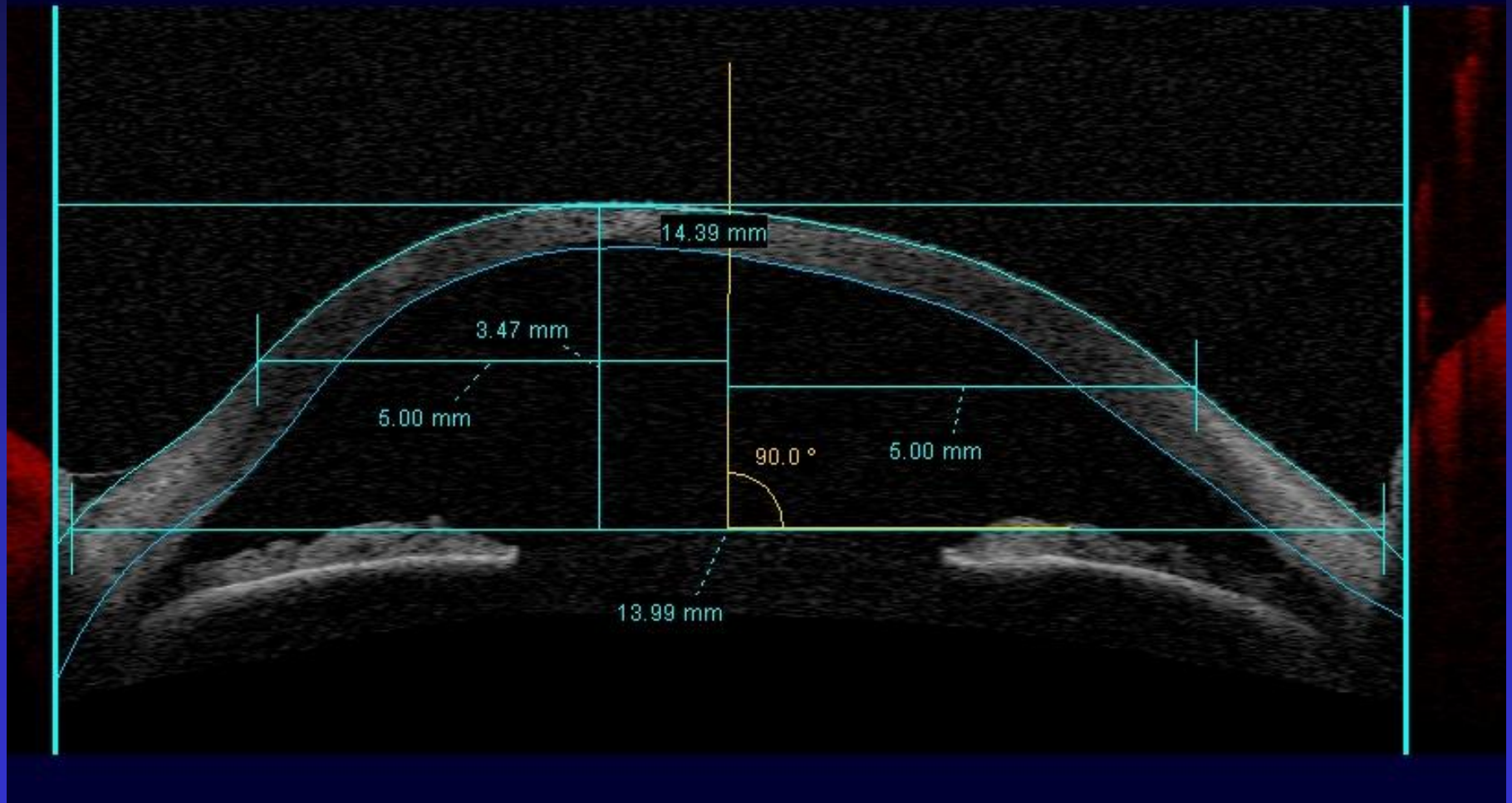


SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50
Anterior Segment Single

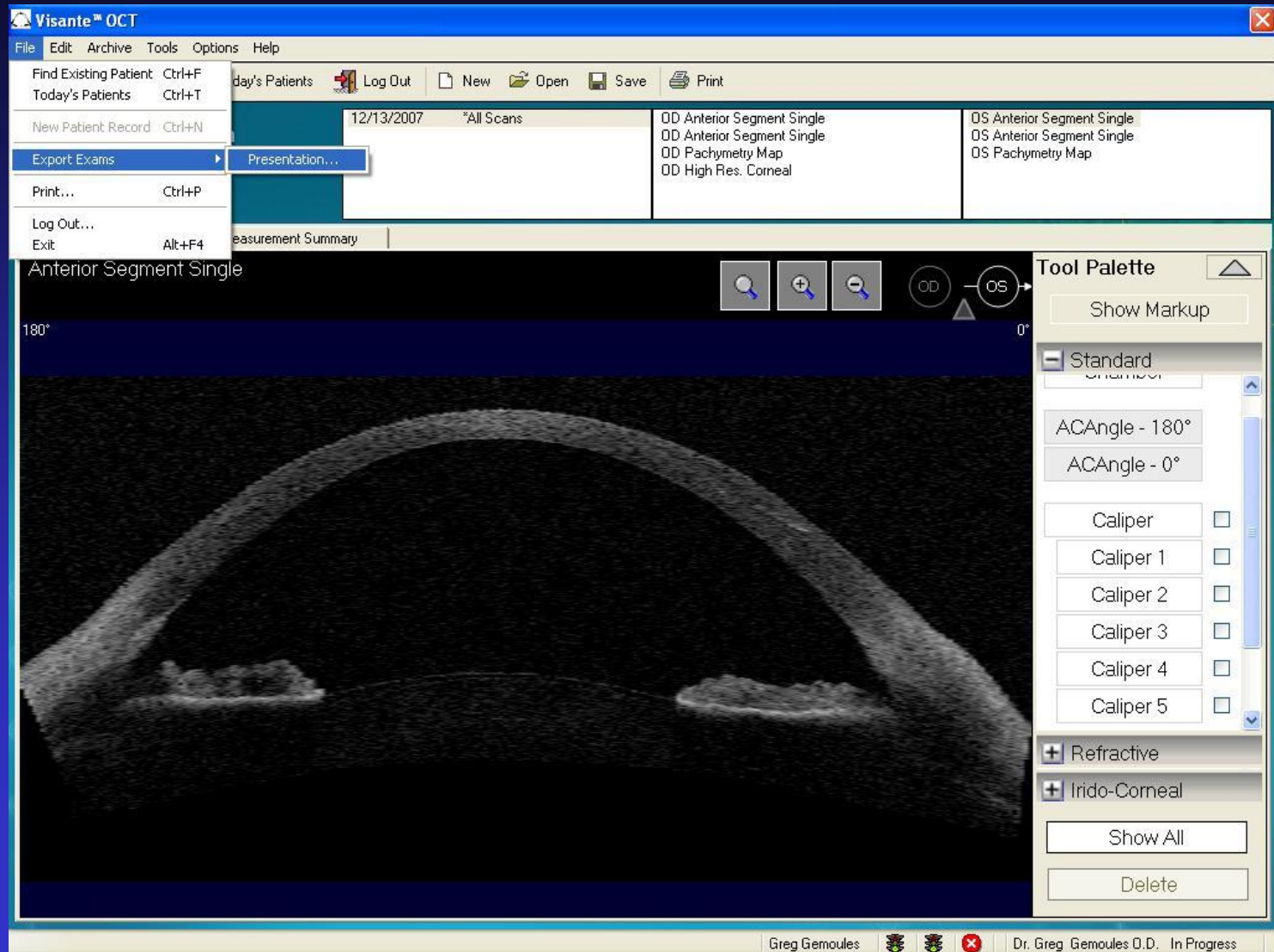


270°

90°



Exporting Images



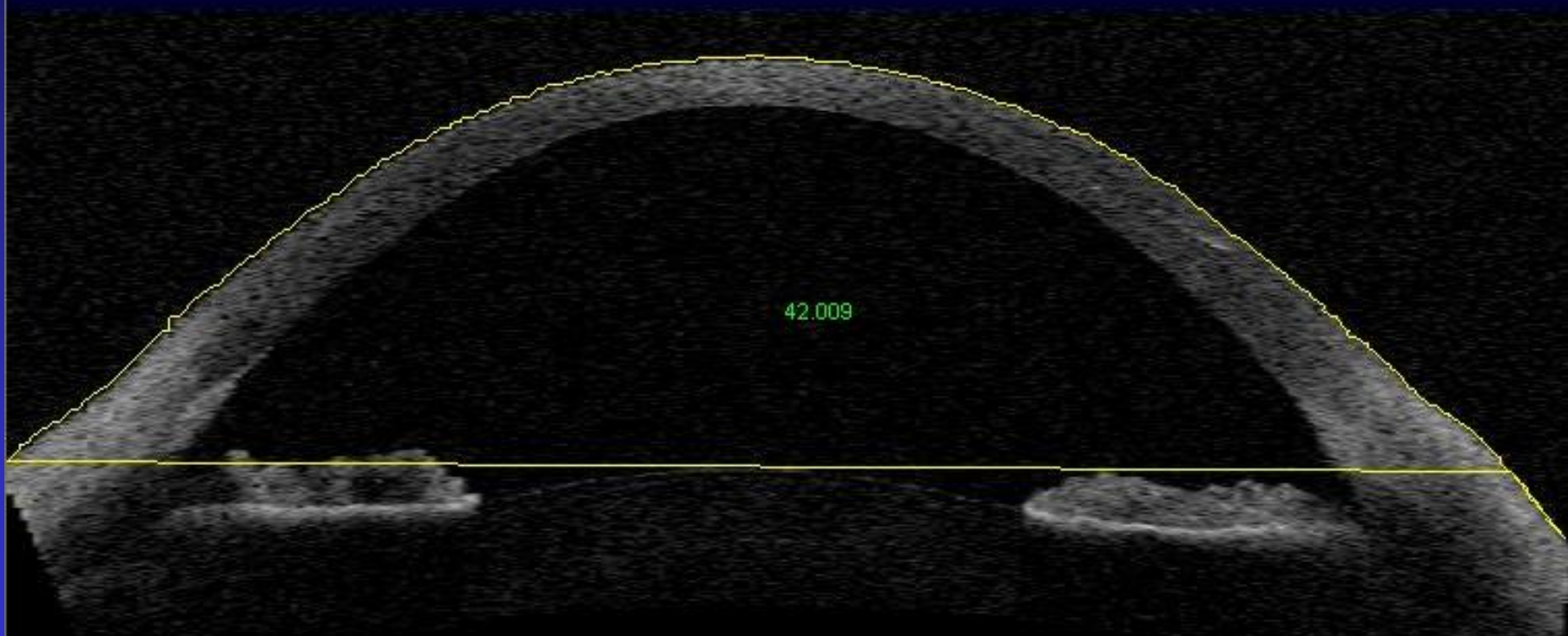
SWI Version: 2.0.1.88 Patient ID: Gender: Male Age: 48

Anterior Segment Single



180°

0°

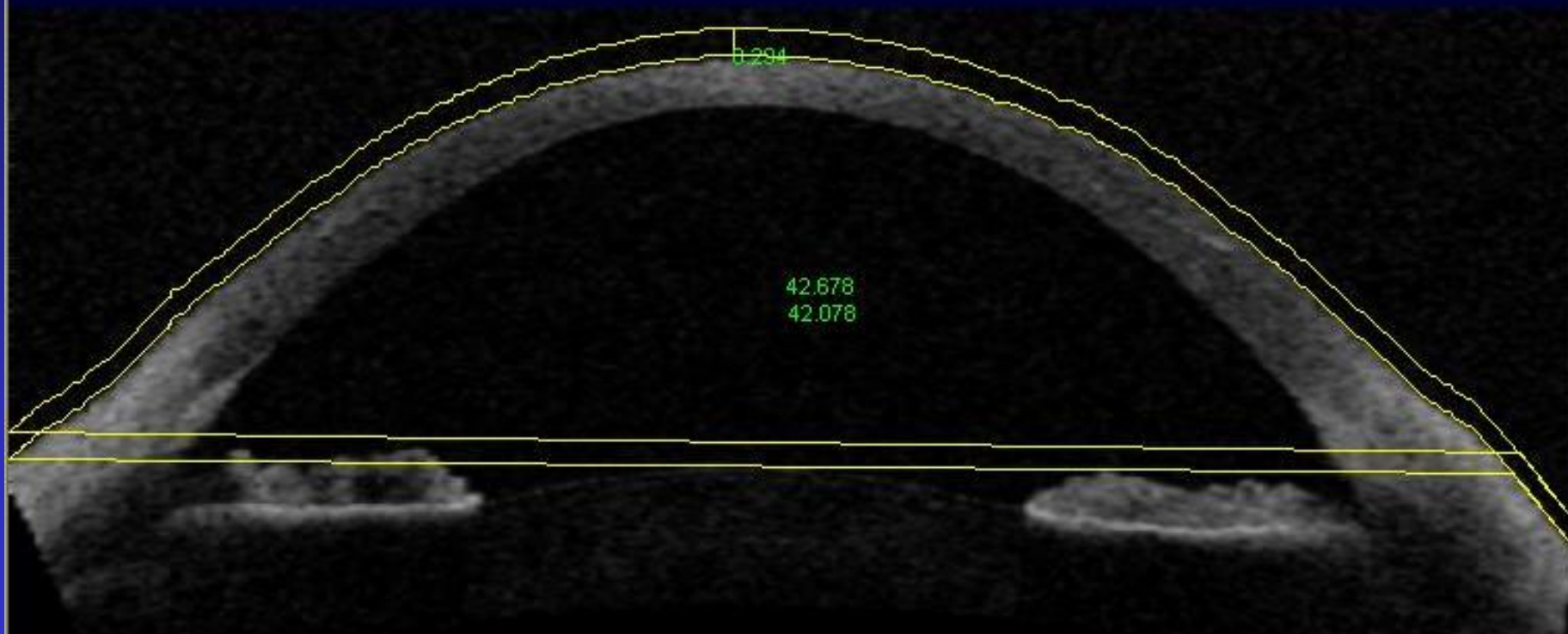


SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 48
Anterior Segment Single



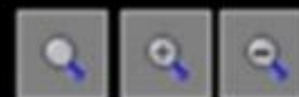
180°

0°



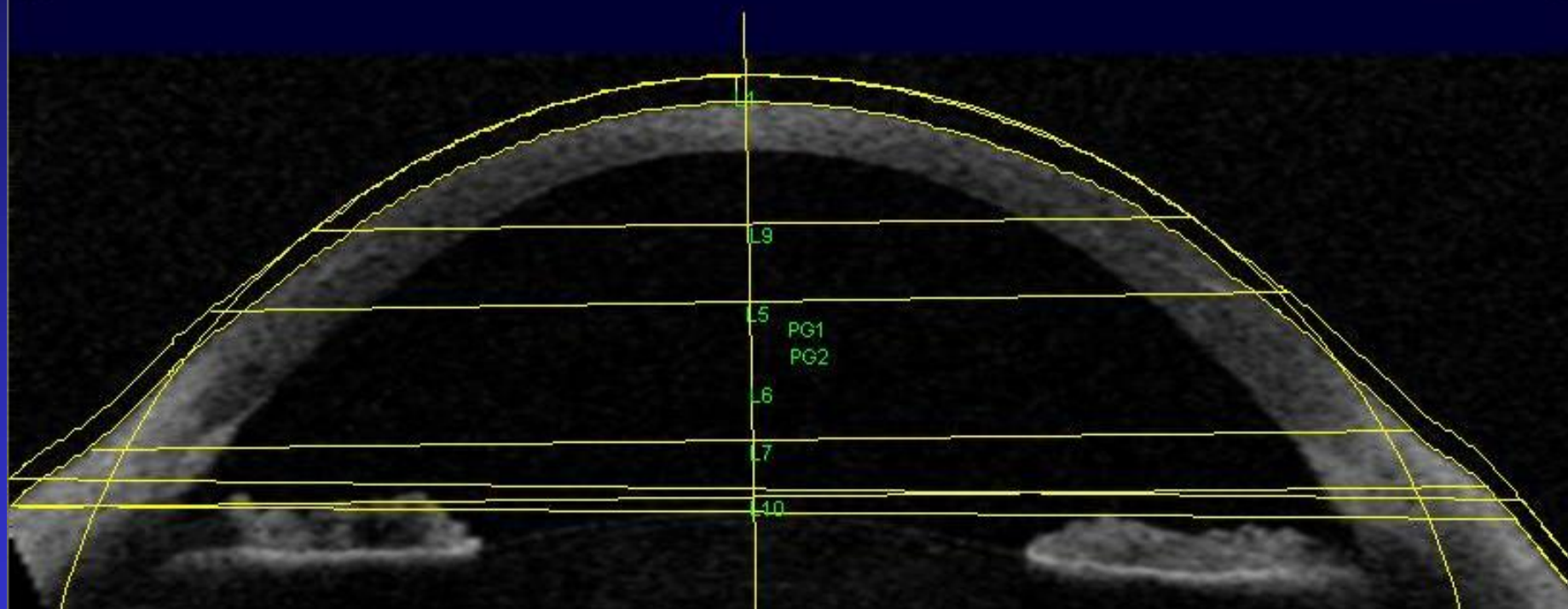
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 48

Anterior Segment Single



180°

0°



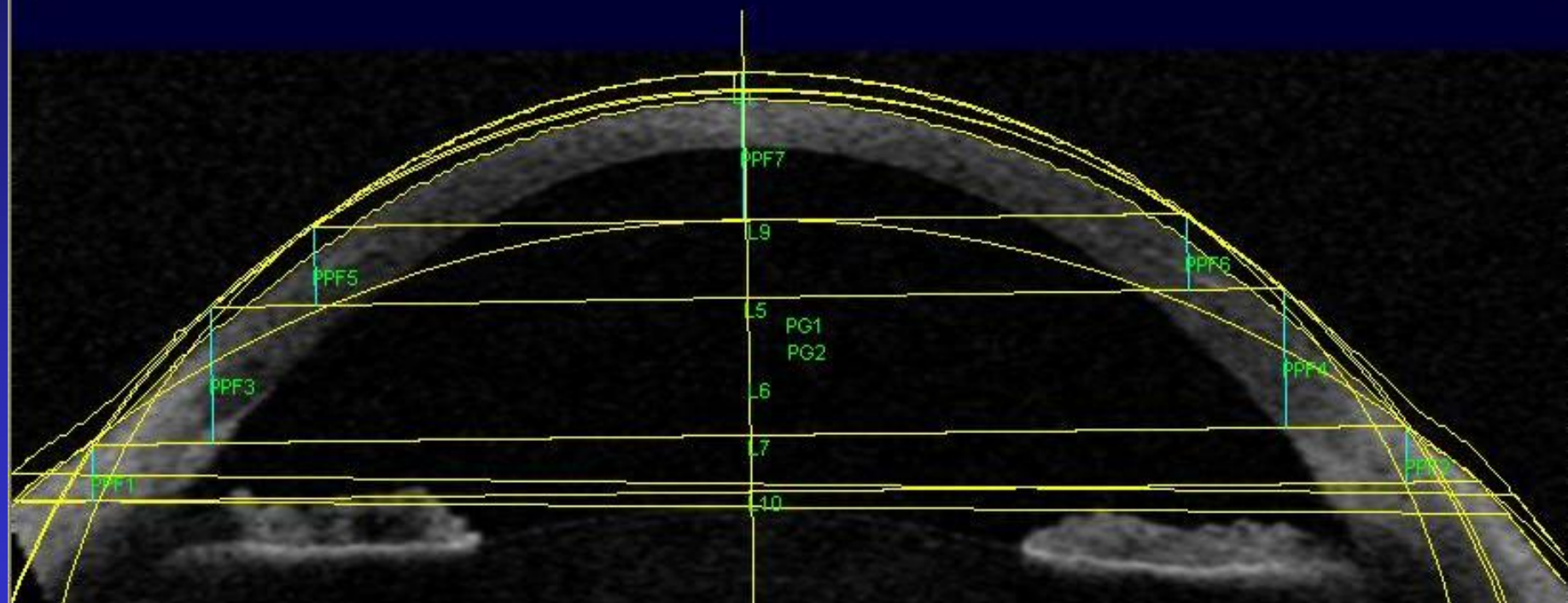
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 48

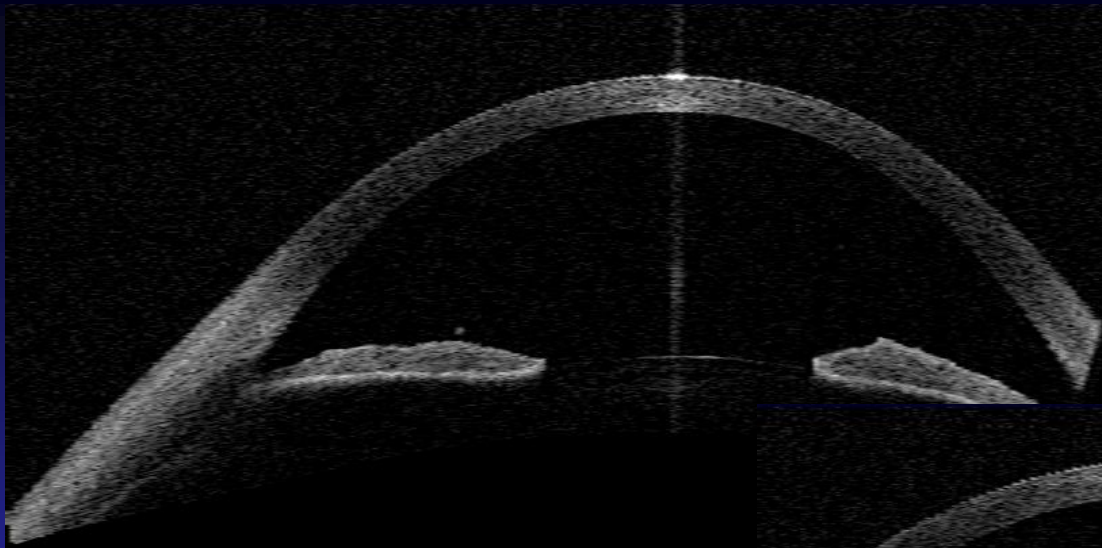
Anterior Segment Single



180°

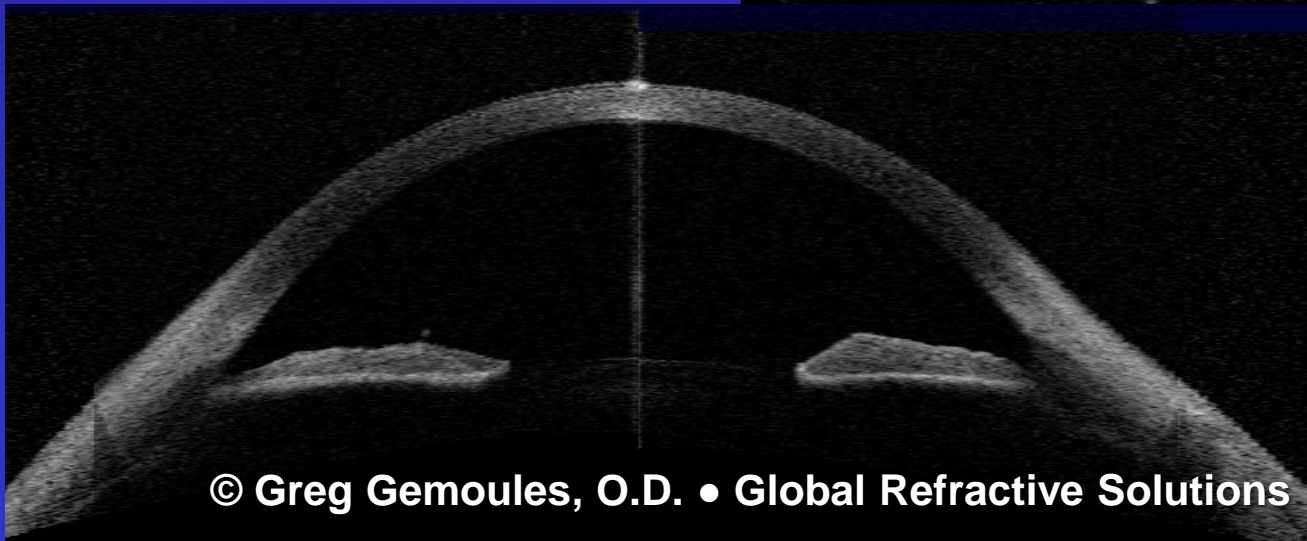
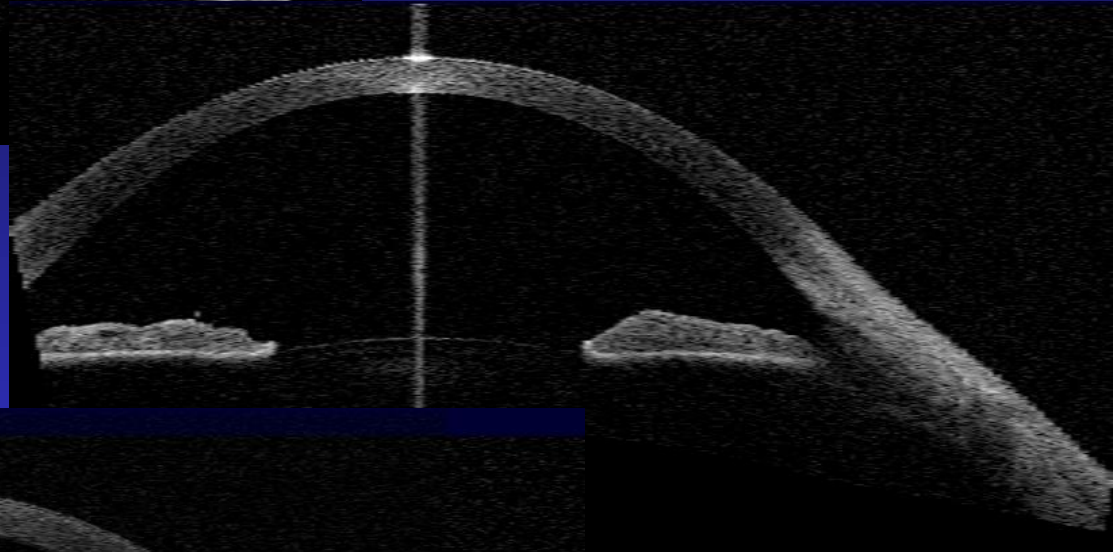
0°



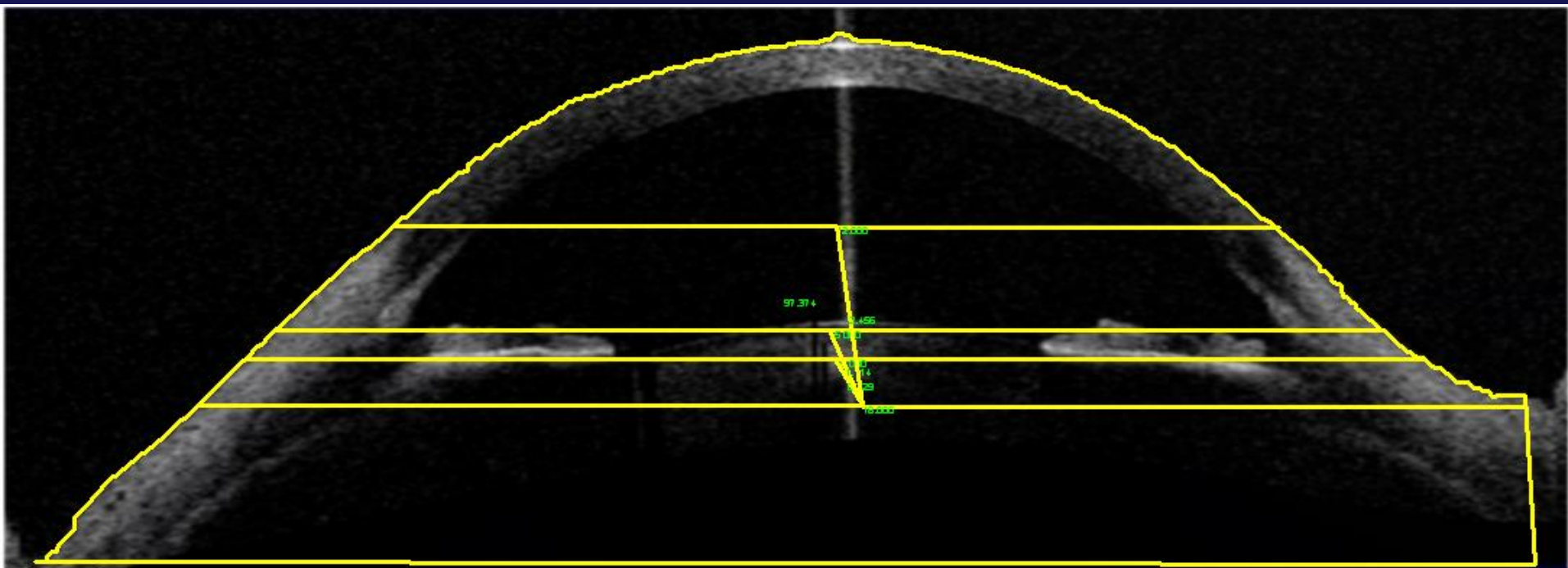


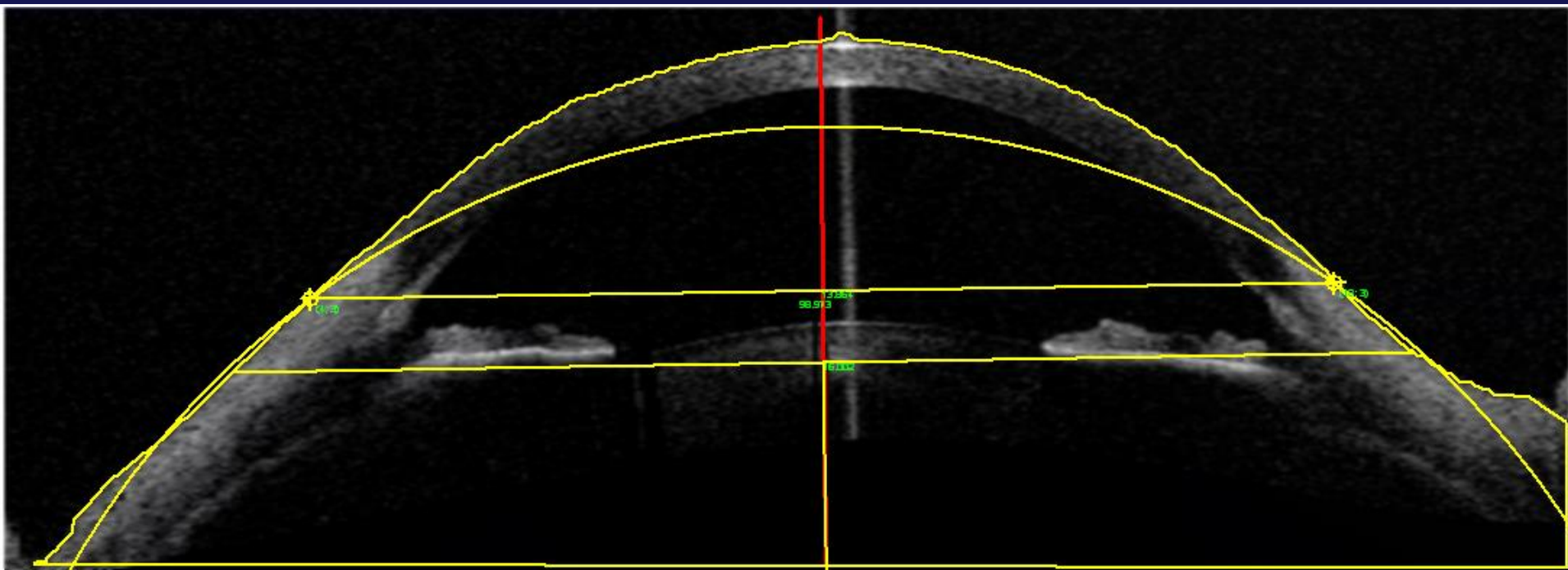
Temporal Scan

Nasal Scan



Composite





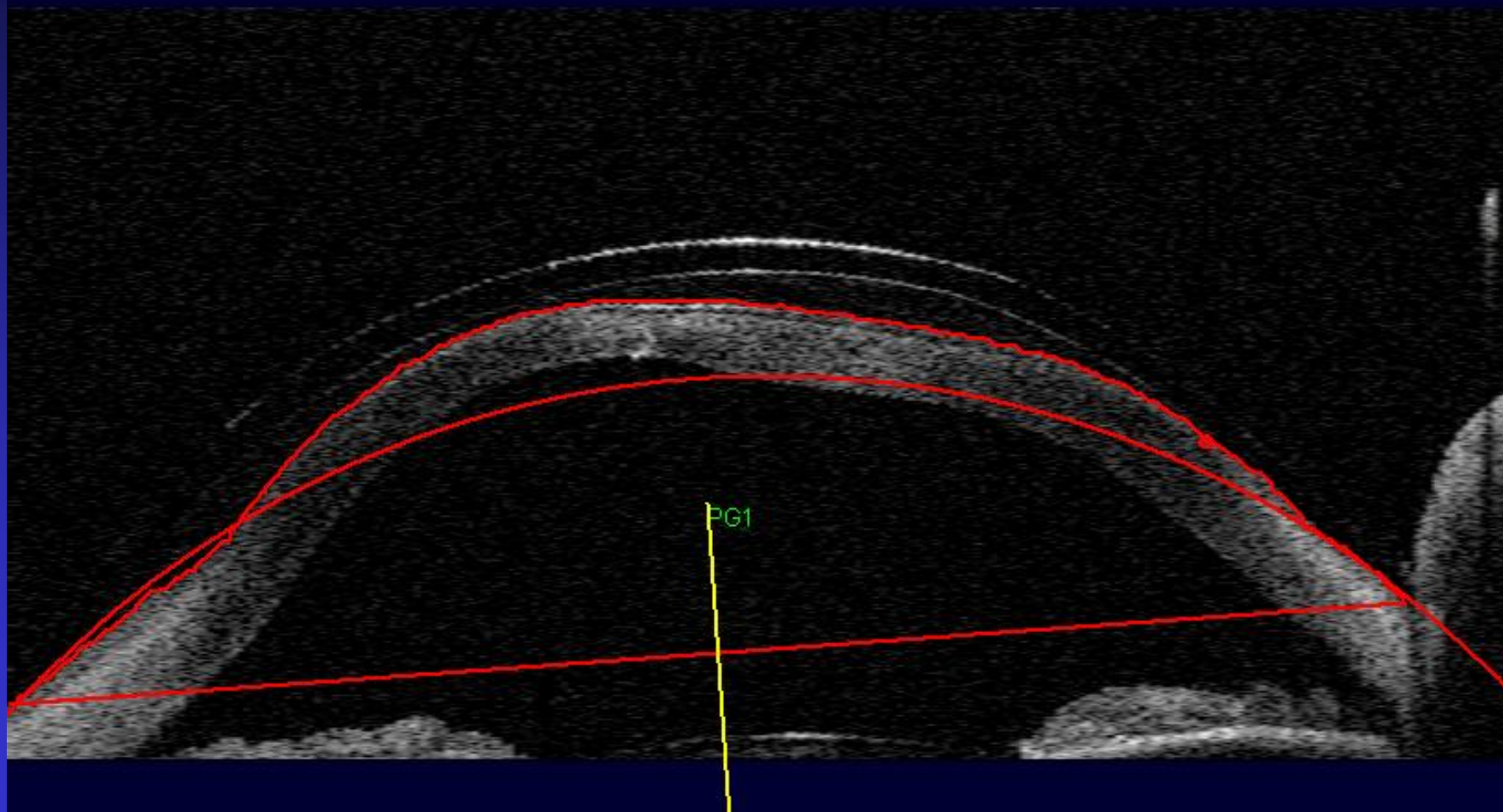
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50

Raw Image Mode



270°

90°



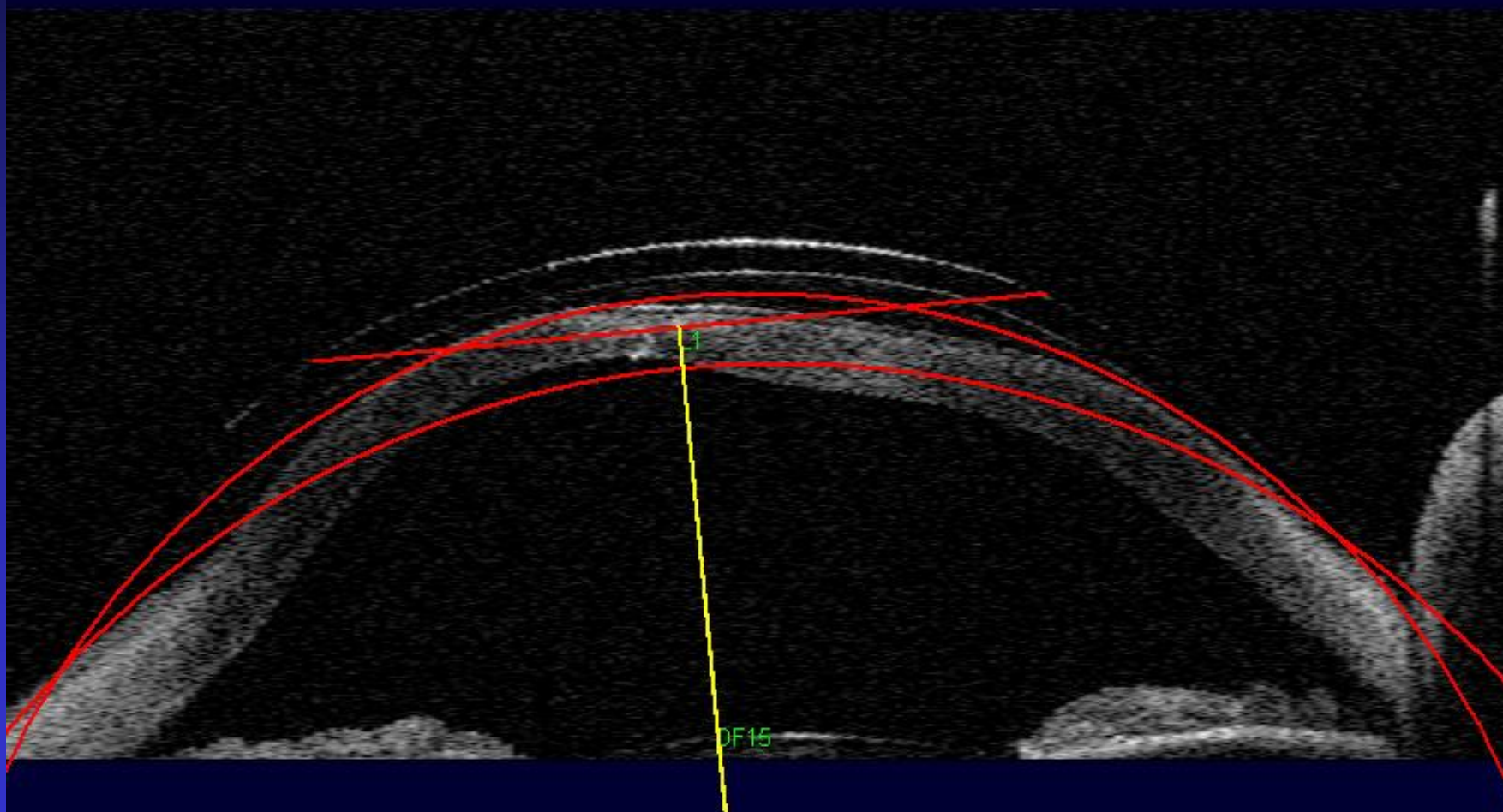
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50

Raw Image Mode



270°

90°



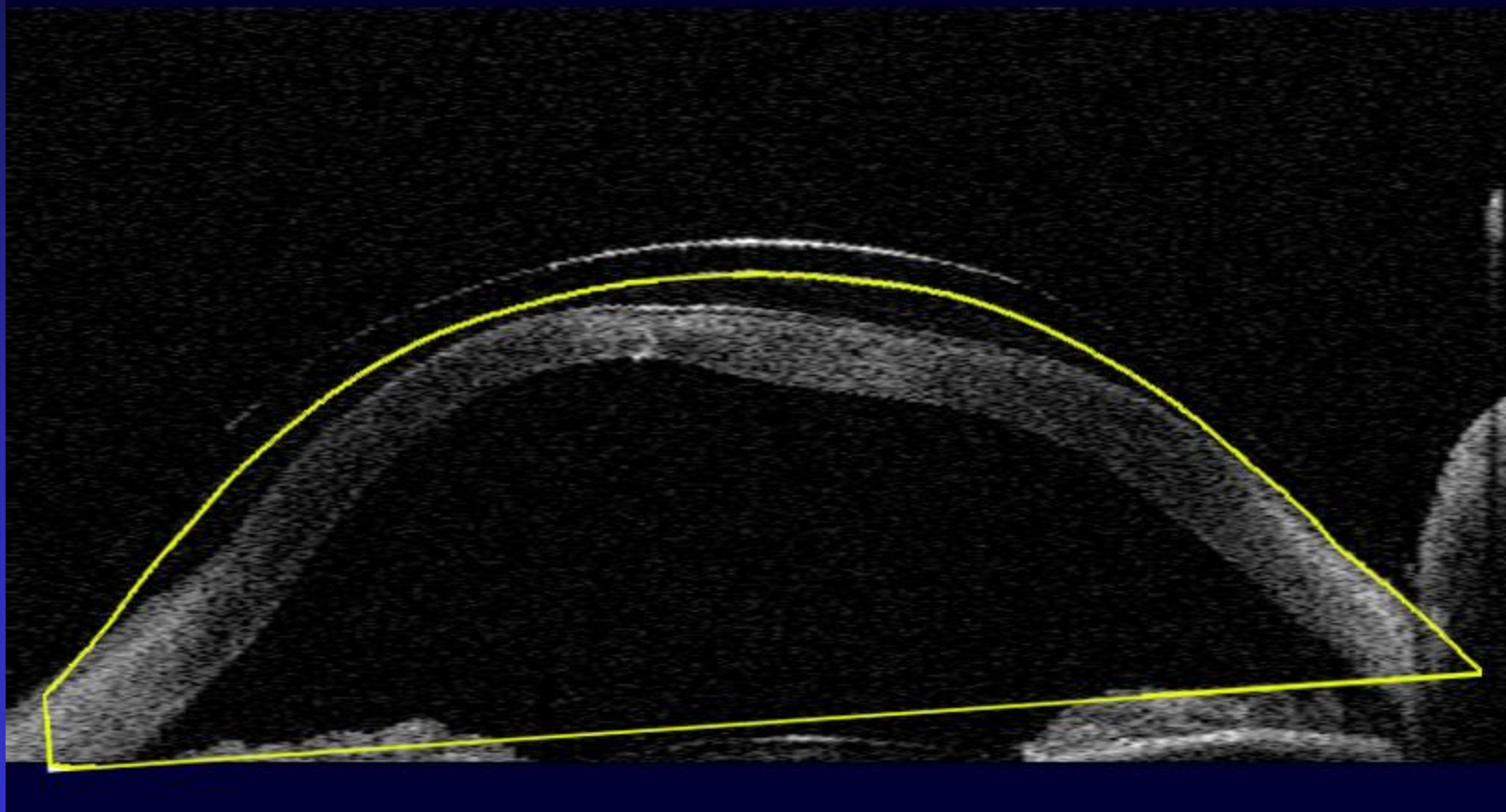
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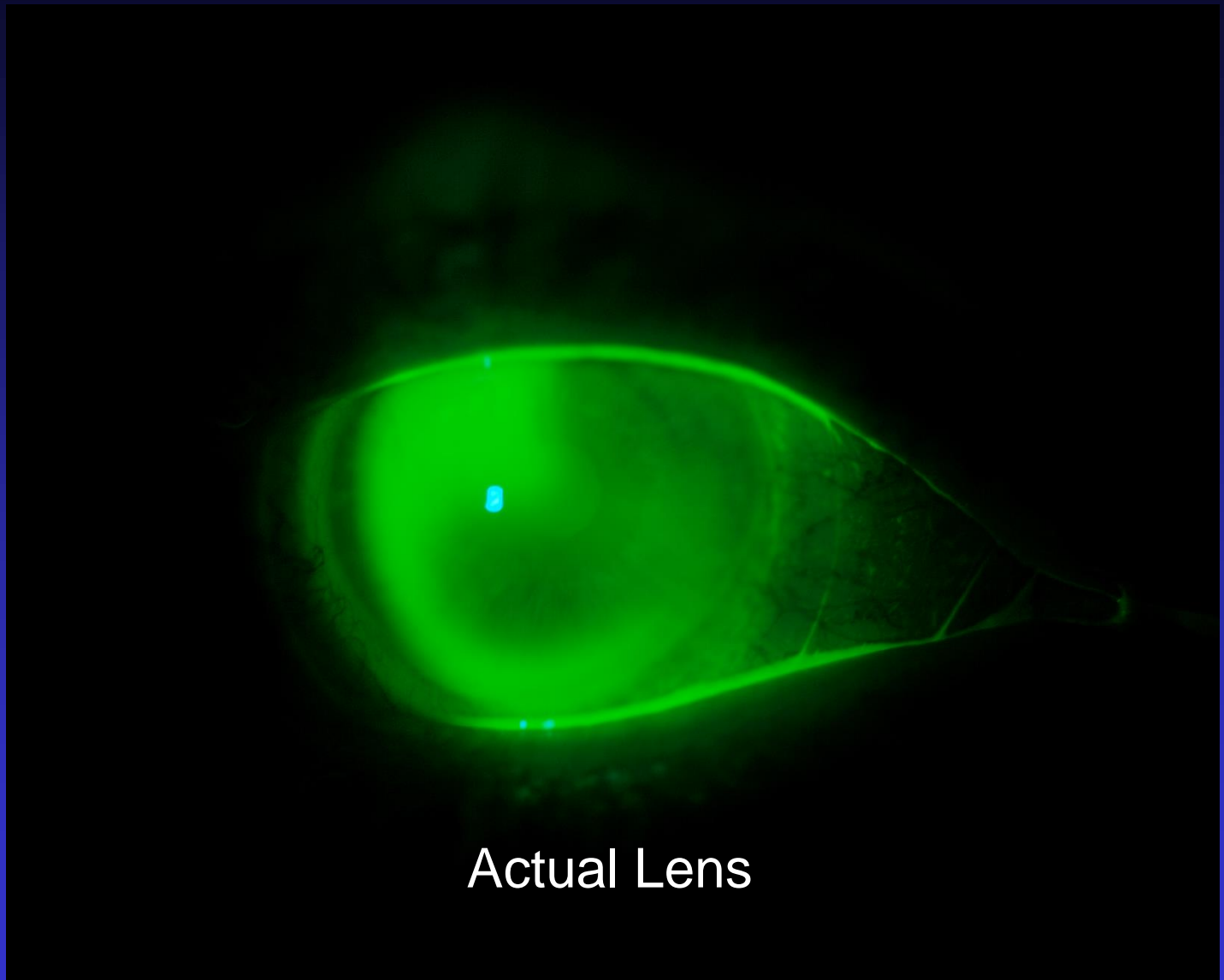
Raw Image Mode



270°

90°





Actual Lens

Quadrant Specific Design

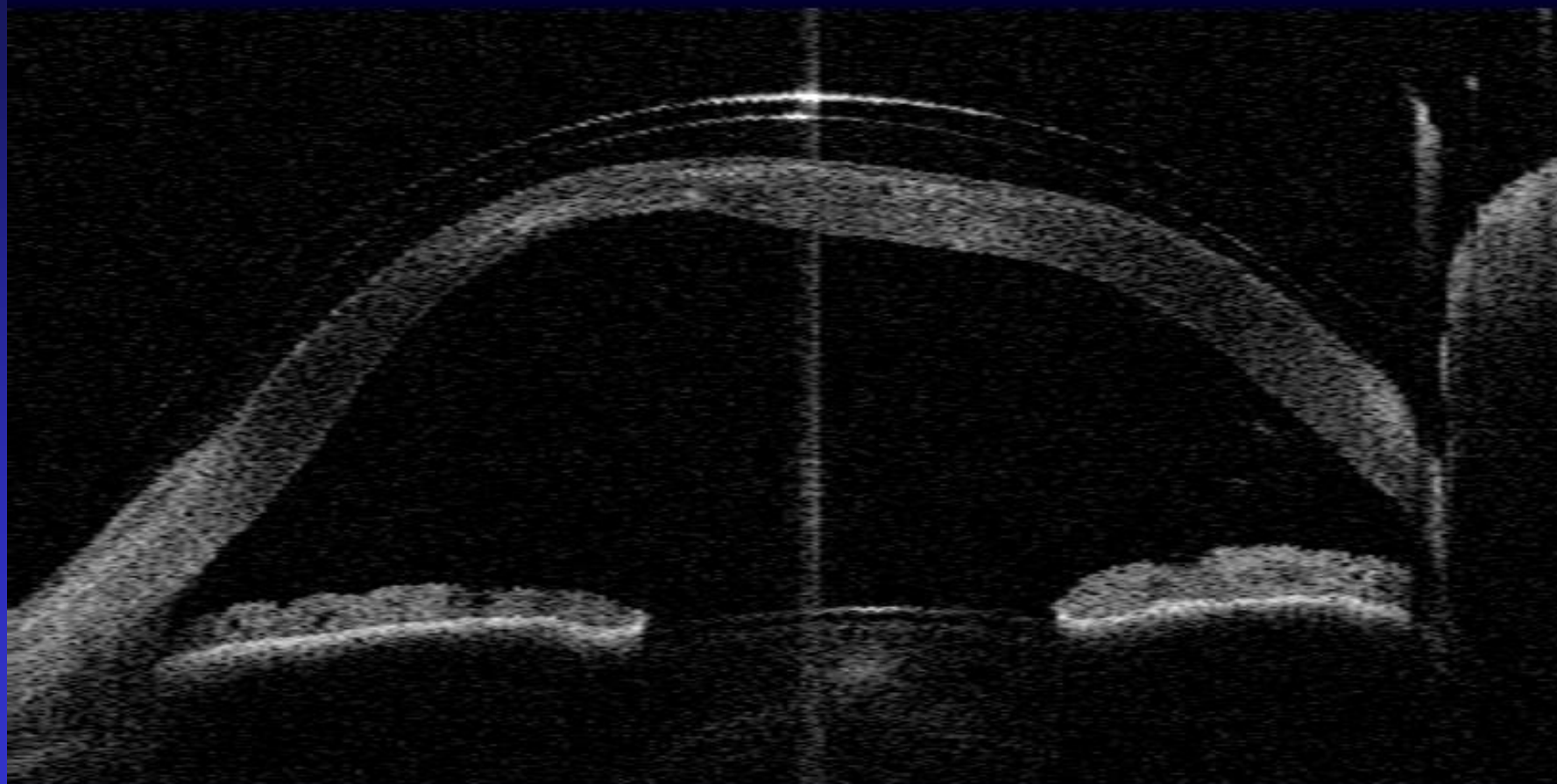
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50

Raw Image Mode



220°

40°



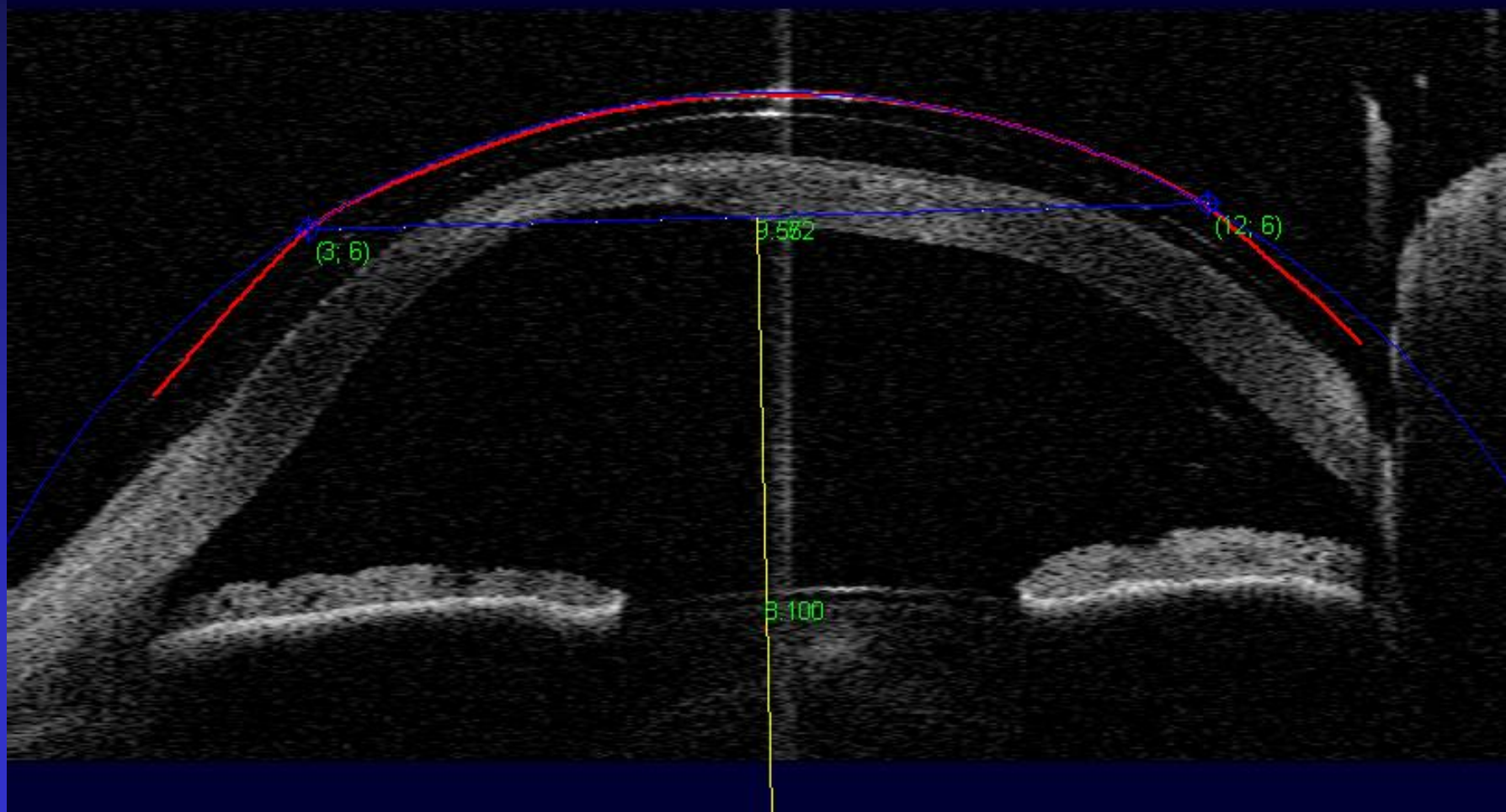
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 50

Raw Image Mode

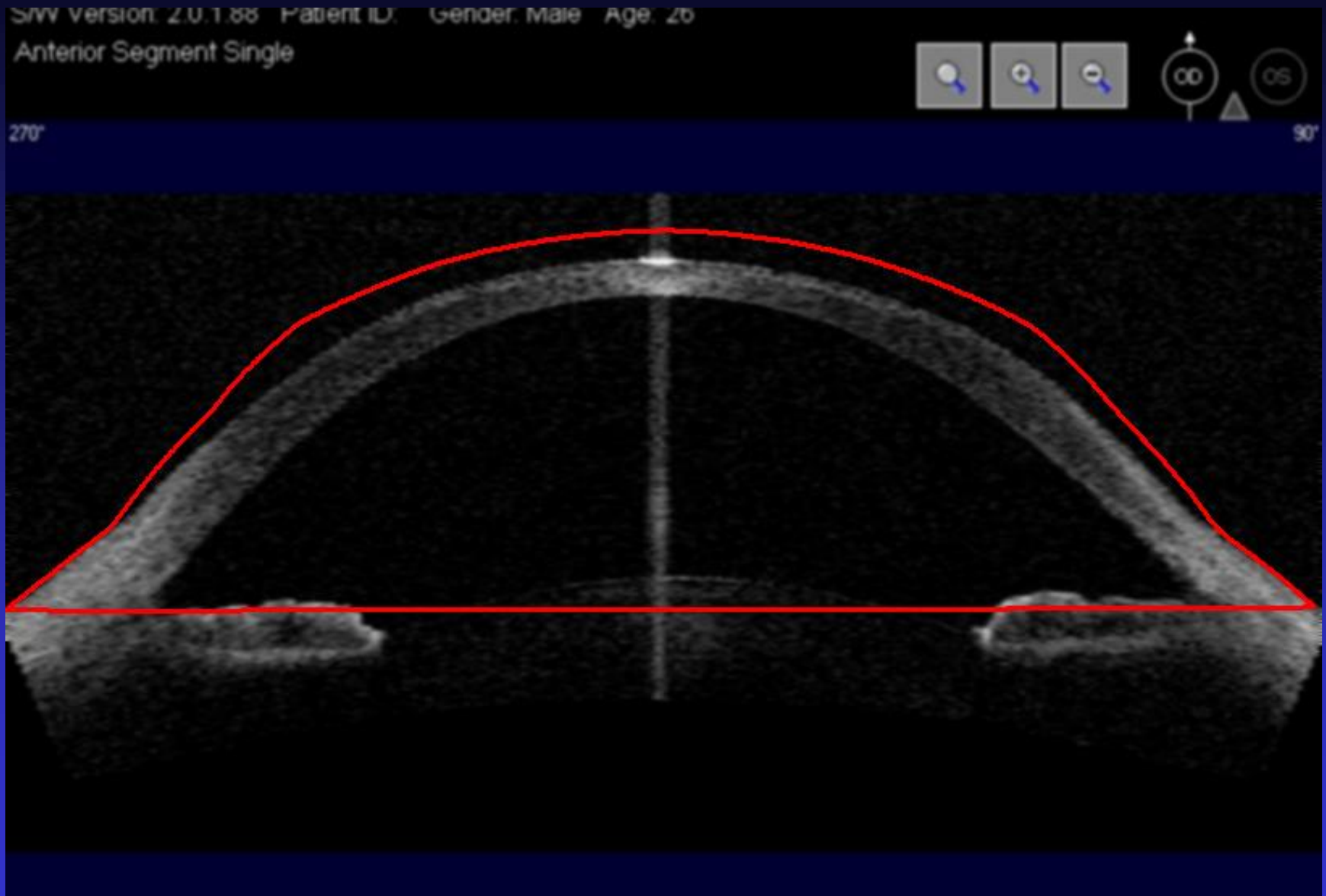


220°

40°



Proposed Design



Actual Lens

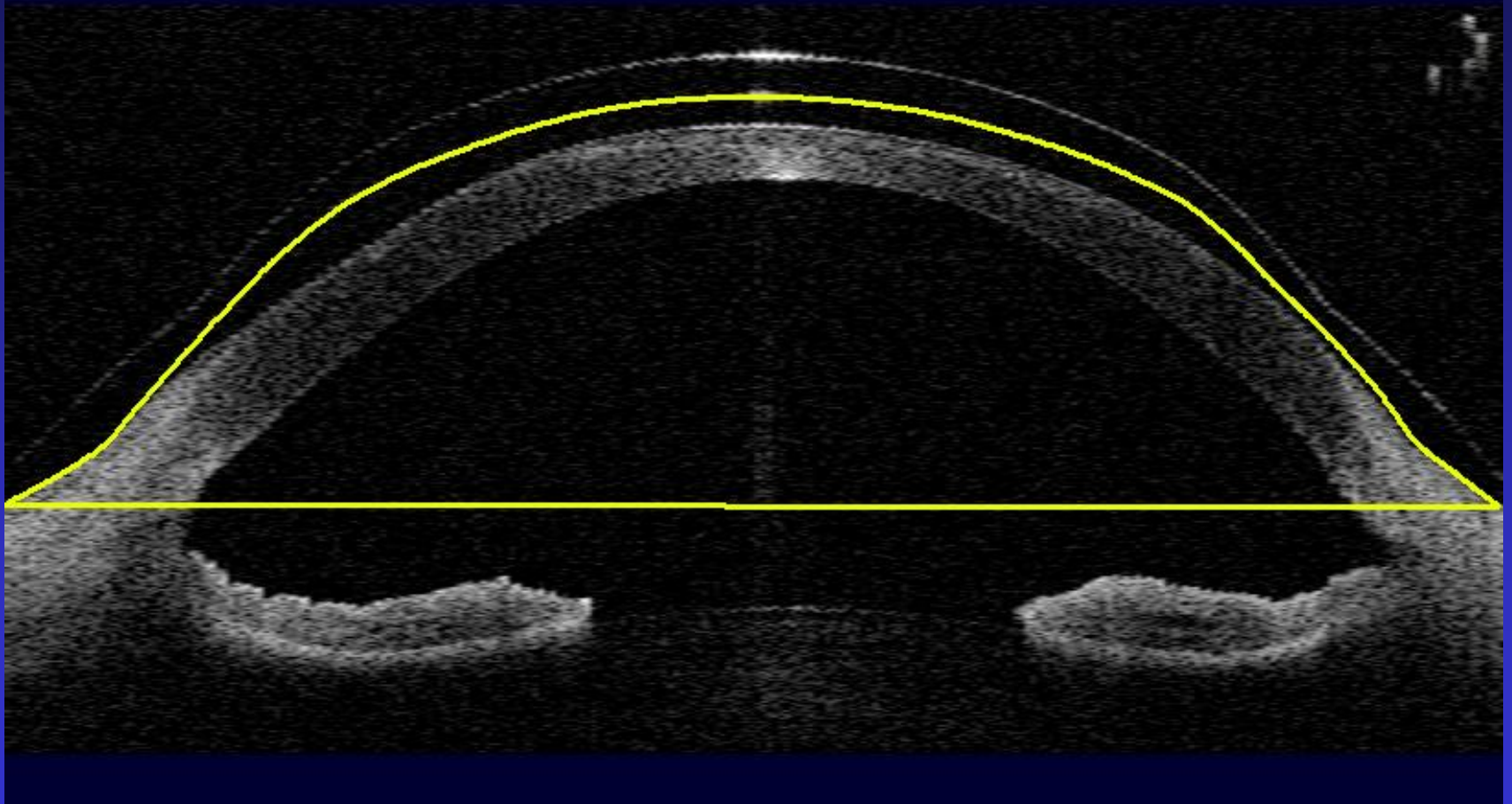
SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 26

Raw Image Mode

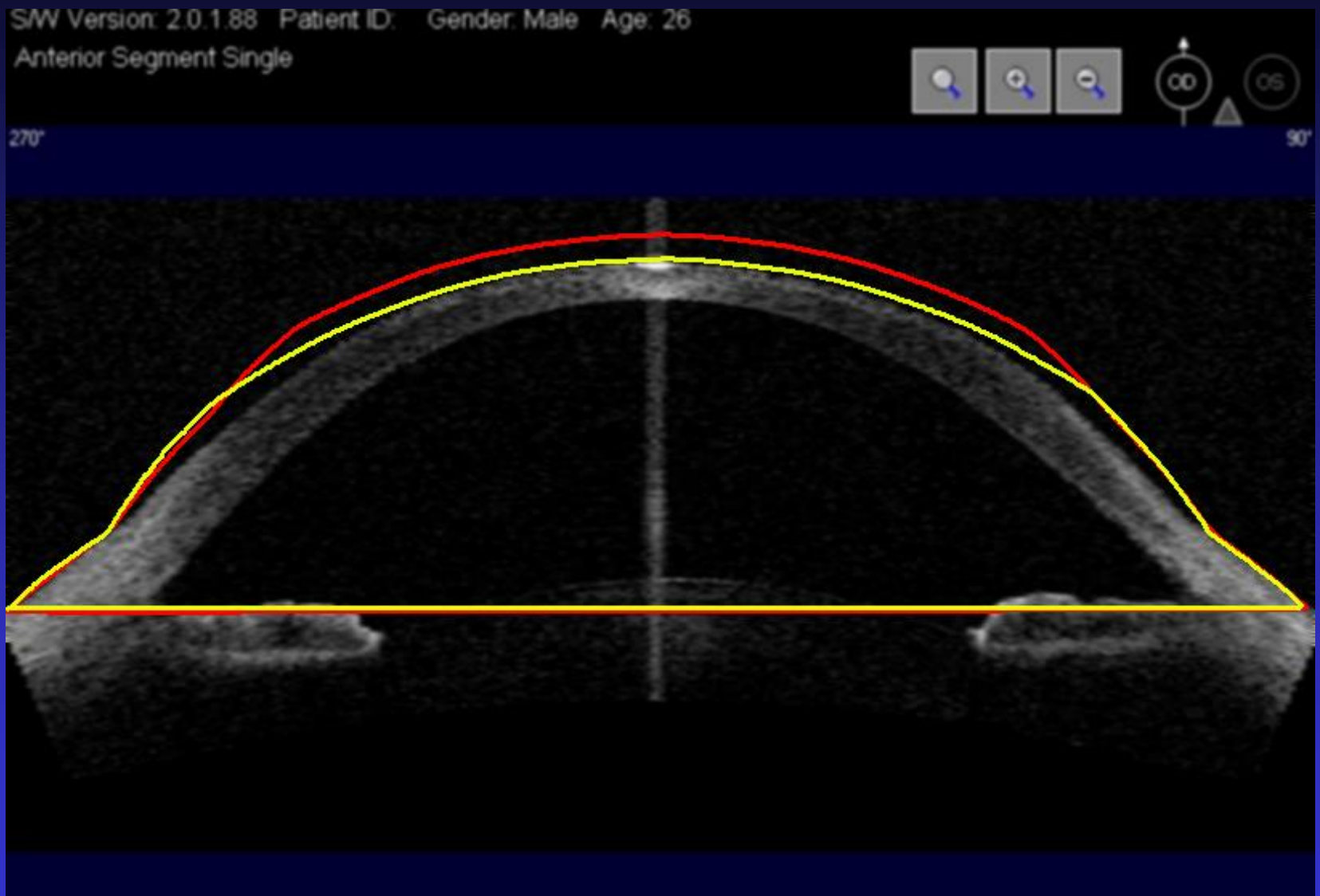


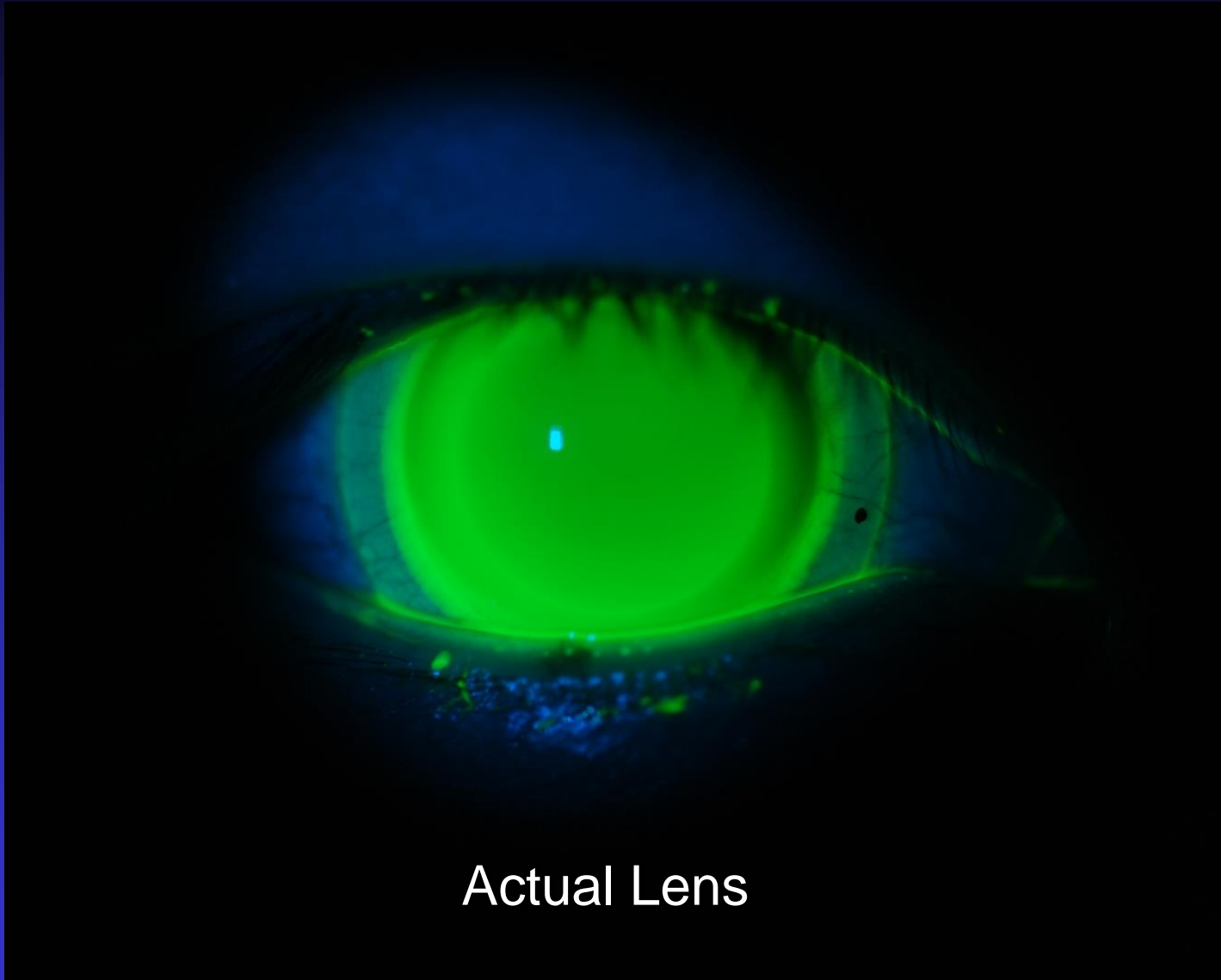
180°

0°



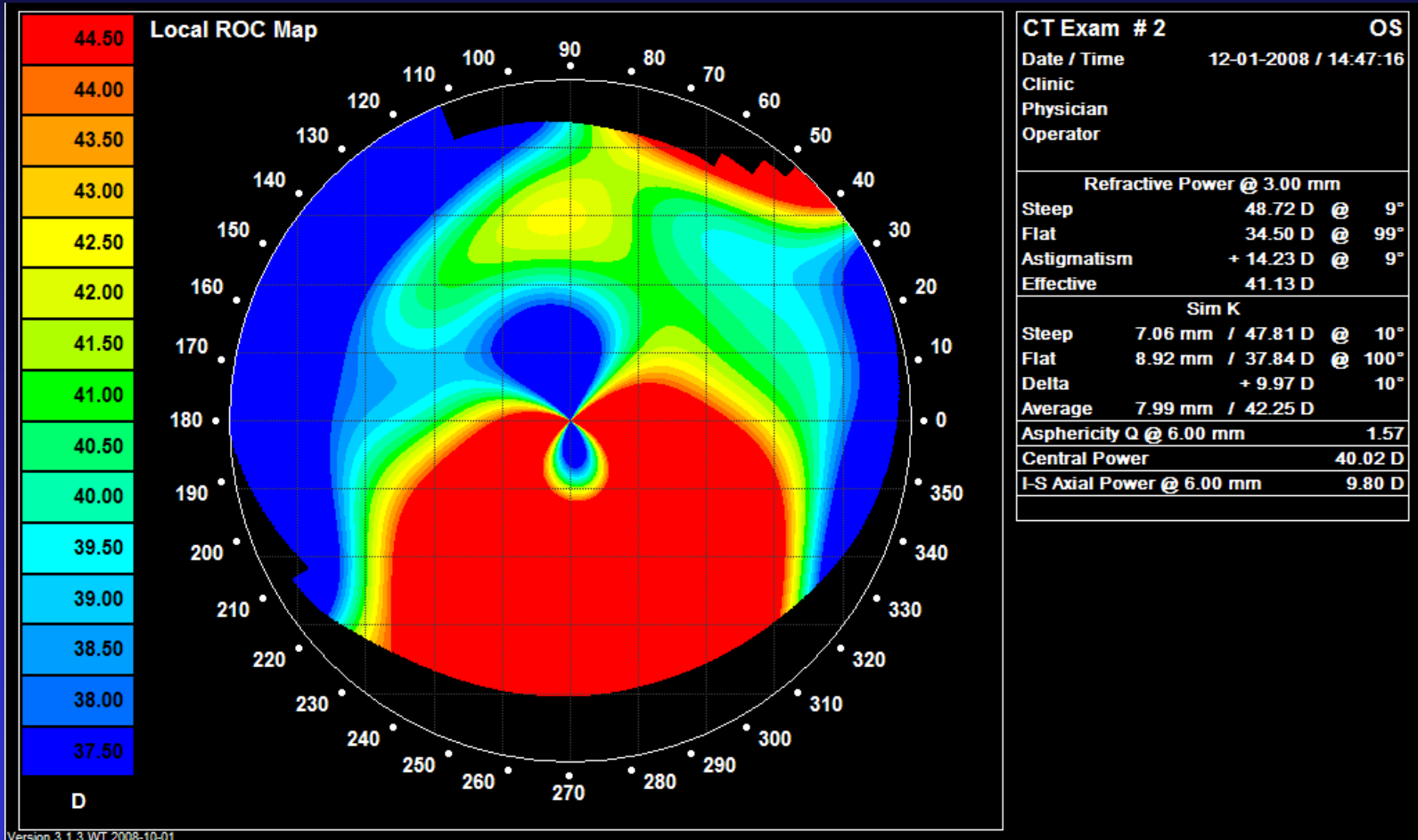
Scleral to Ortho-K





Actual Lens

Case Study



Case Study

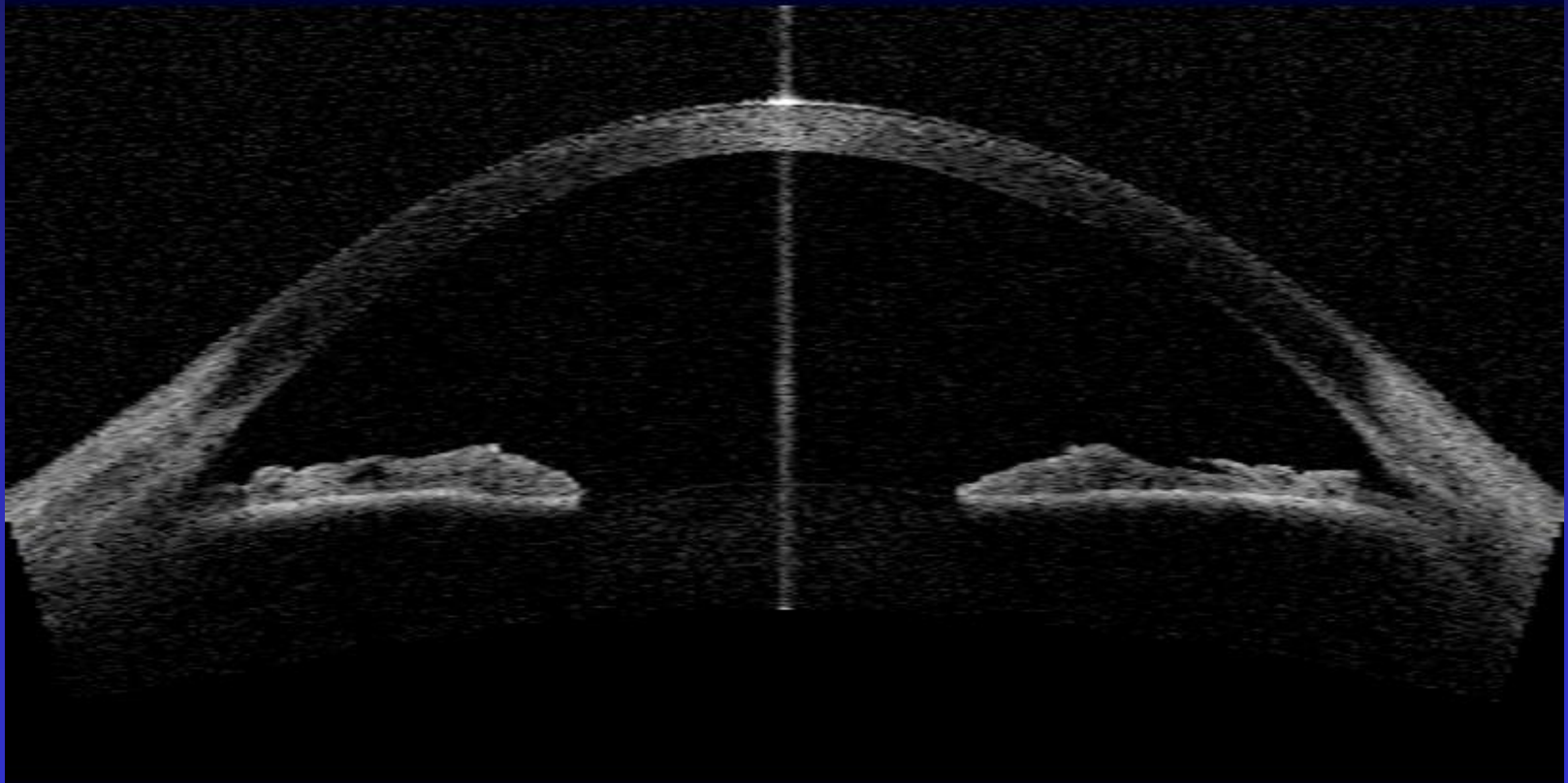
OCT Scan Axis 180

S/W Version: 2.0.1.88 Patient ID: Gender: Male Age: 36
Anterior Segment Single



190°

10°



Case Study

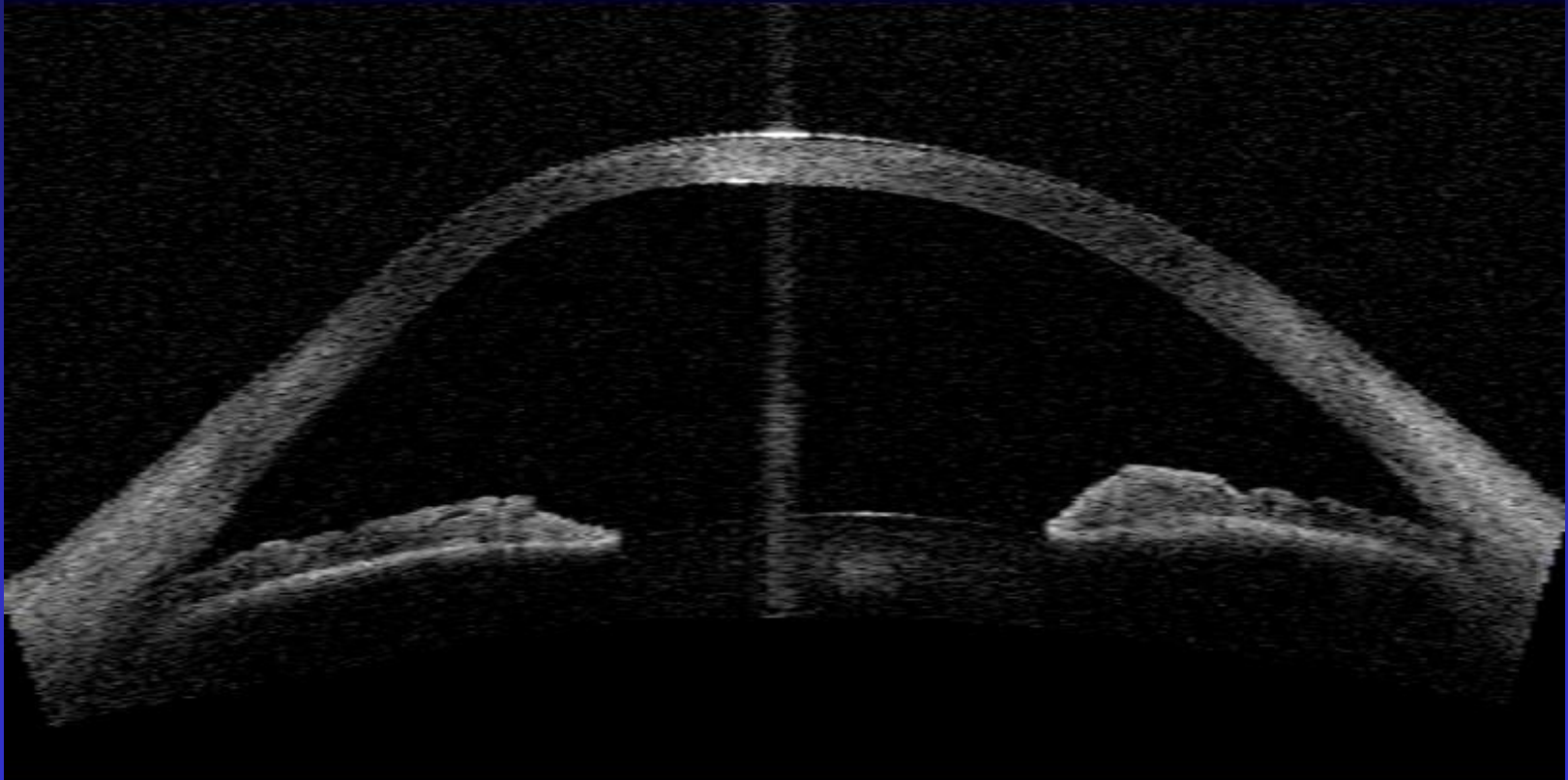
OCT Scan Axis 90

SWV Version: 2.0.1.88 Patient ID: Gender: Male Age: 36

Anterior Segment Single



280°



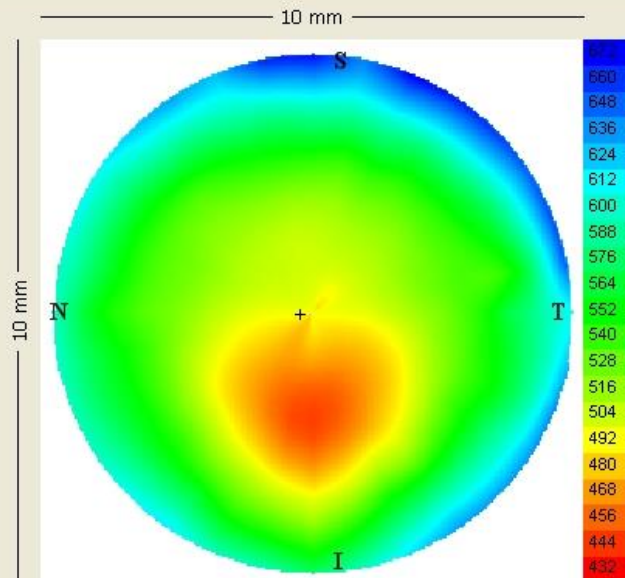
Case Study

Global Pachymetry

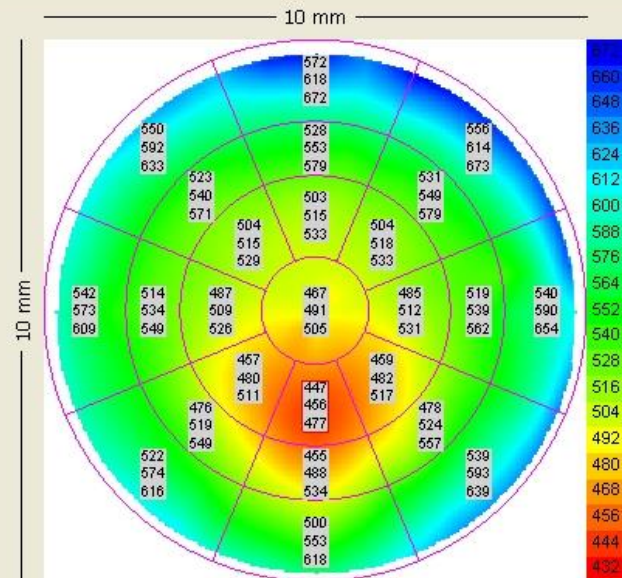


Visante™ OCT
ANTERIOR SEGMENT IMAGING

SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 36



OS



+ = Vertex Position

☐ Grayscale

☒ Auto

Create Difference Map

☒ Color

☐ Grid

☒ Orientation Markers

Range[mm]	Minimum	Average	Maximum
0 - 2	467	491	505
2 - 5	447	498	533
5 - 7	455	531	579
7 - 10	500	588	673

Case Study

Scleral Lens High Resolution

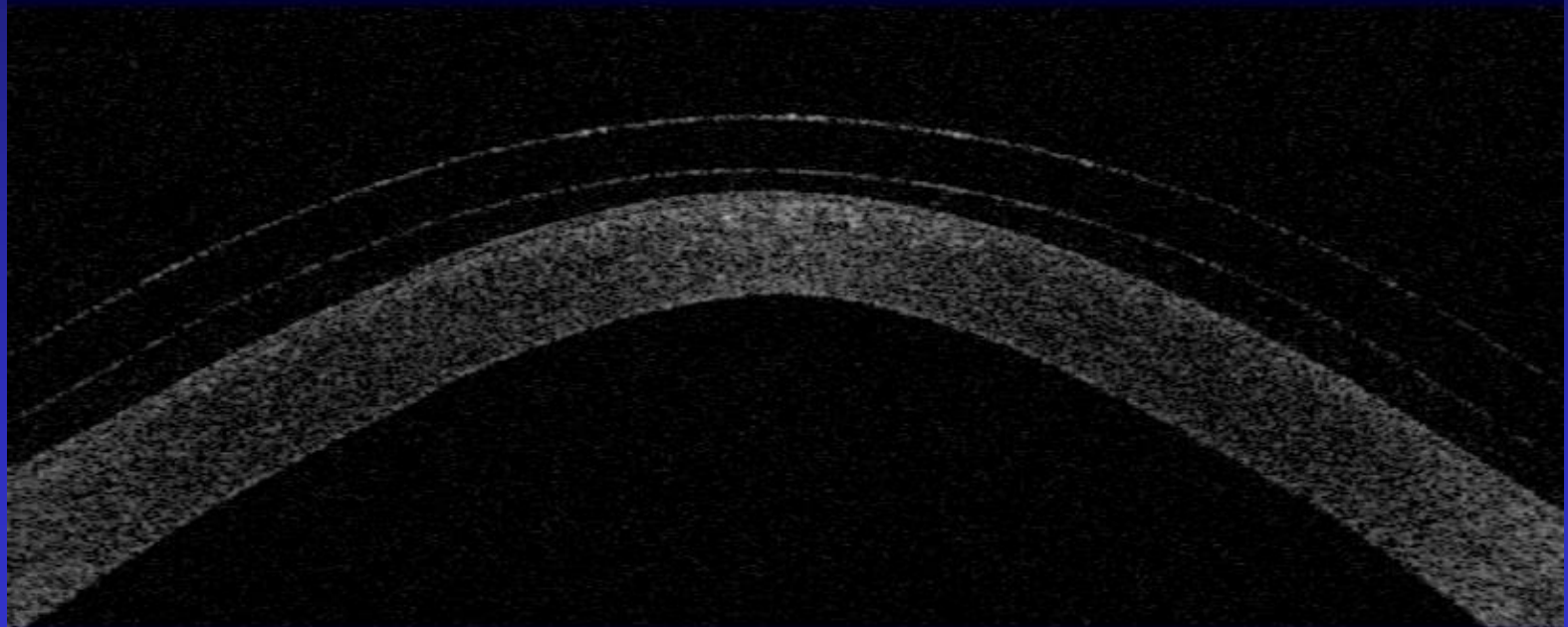
SIW Version: 2.0.1.88 Patient ID: Gender: Male Age: 36

Raw Image Mode High Res.

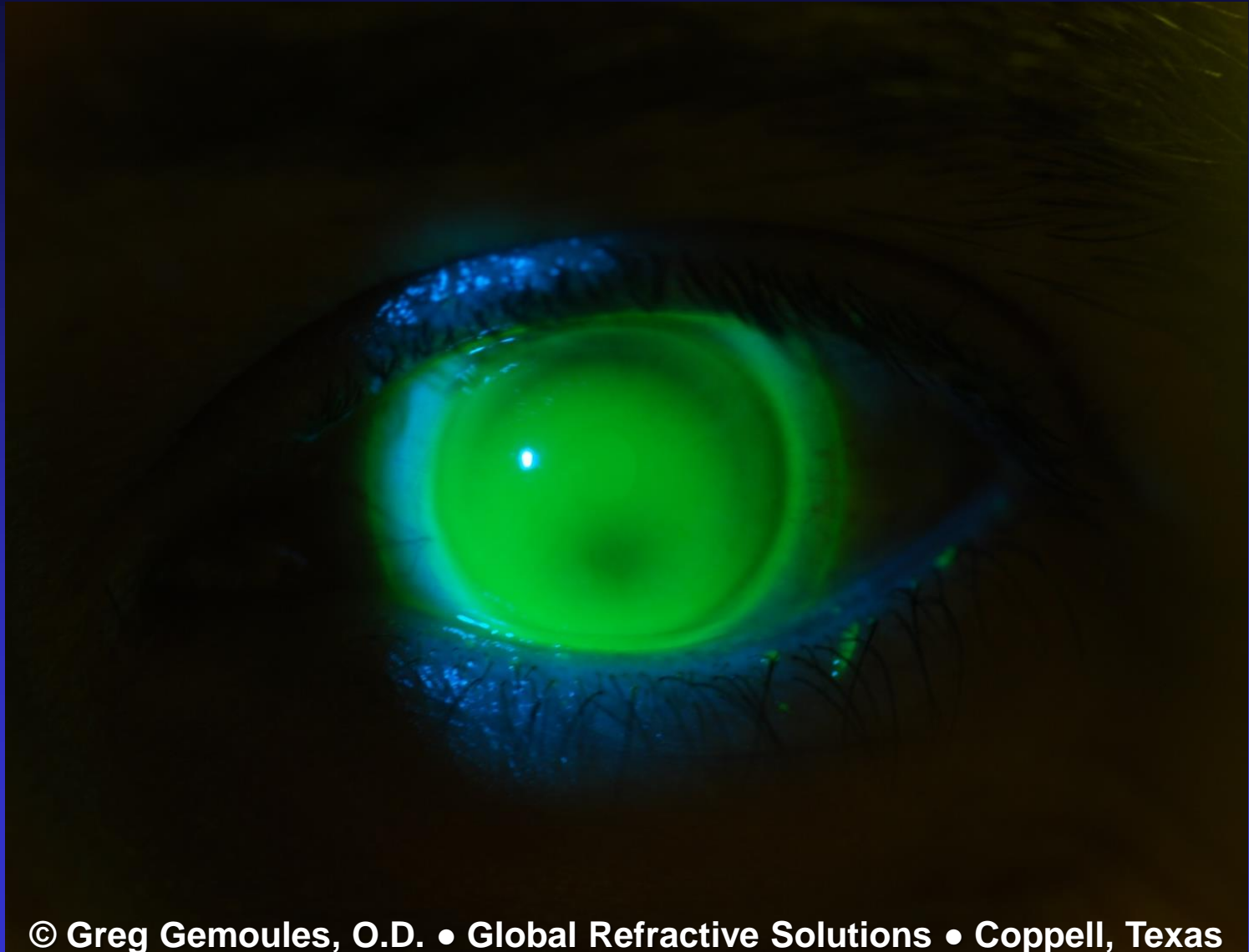


180°

0°



Case Study



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Retrospective Study (June 2008)

65 Eyes of 34 Patients

Non-Surgical = 16 patients

- Keratoconus = 4
- Others = 12

Surgical = 18 patients

- MLASIK = 6
- HLASIK = 2
- RK = 6
- PRK = 1
- PKP = 2
- Cataract = 1

Results

- 65 Eyes Required 182 Lenses or 2.8 Lenses Per Eye (5 maximum)
- Materials Used = Boston XO
- Diameters ranged from 14.5 mm to 16.0 mm with a median of 15.0 mm
- 50% of lenses are bitoric or quadrant specific

Results

Success Rate

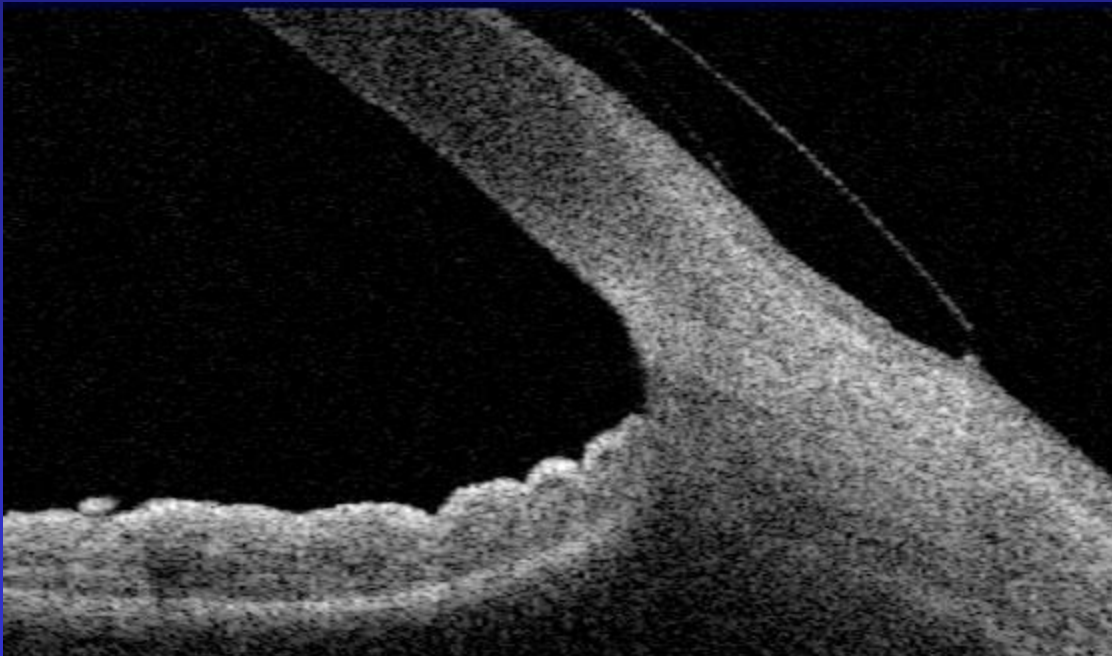
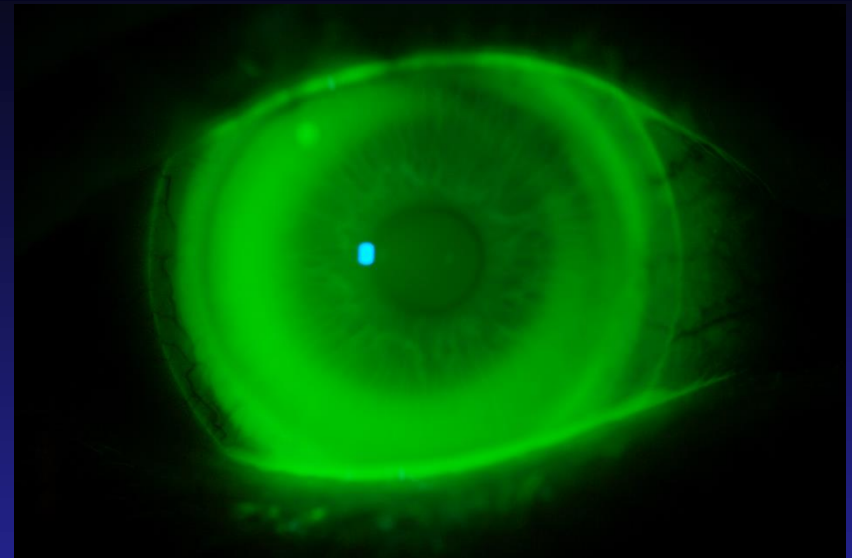
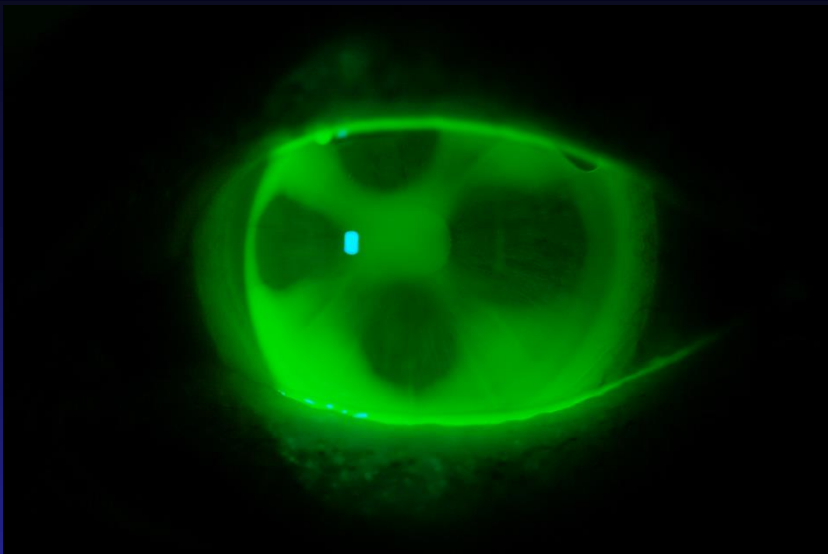
3 patients discontinued wear

- dryness = 1
- corneal abrasion (self-inflicted) = 1
- failure of multifocal vision = 1
- 91% success rate

Vision

98% achieved 20/20

70% average reduction in total HOA rms



Thanks to
Truform Optics
and
Carl Zeiss
for technical
assistance