Refractive optics- Why did that happen?

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- I have no financial interest in anything mentioned in this presentation

Patient # 1

- 36 year old male with high myopia

OD	**-10.0 D**	**20/20-**	
OS	**-10.0 D**	**20/25**	**J1+ with correction**

- Undergoes successful refractive surgery and notices improvement in distance vision to 20/20 OU, but now complains of poor near vision.

- Post-Op refraction (dry & cylco)

OD	pl	20/20+		
OS	pl	20/20	J3	with correction

- **WHY?**

ACCOMMODATION AND TYPE OF CORRECTION

	Spectacles	PRK, Lasik or Contact Lens	Difference
10 D myope	3.2 D	4.6 D	1.4 more
10 D hyperope	6.9 D	4.6D	2.4 less

difficulty with near vision after refractive surgery (or with contact lenses). Hyperopes will have increased near vision after refractive surgery.

ACCOMMODATION AND TYPE OF CORRECTION

POINT – Tell myopes that distance vision clear first and near vision clears second. I the 35-45 year old myope who undergoes refractive surgery, it may take 2-3 weeks for their near vision to clear

Tell hyperopes that near vision clears first and distance vision clears second.

Patient # 2

- Why is a 22 year old uncorrected hyperope (+1.00 OU) asymptomatic, while a 22 year old surgically overcorrected myope symptomatic ?

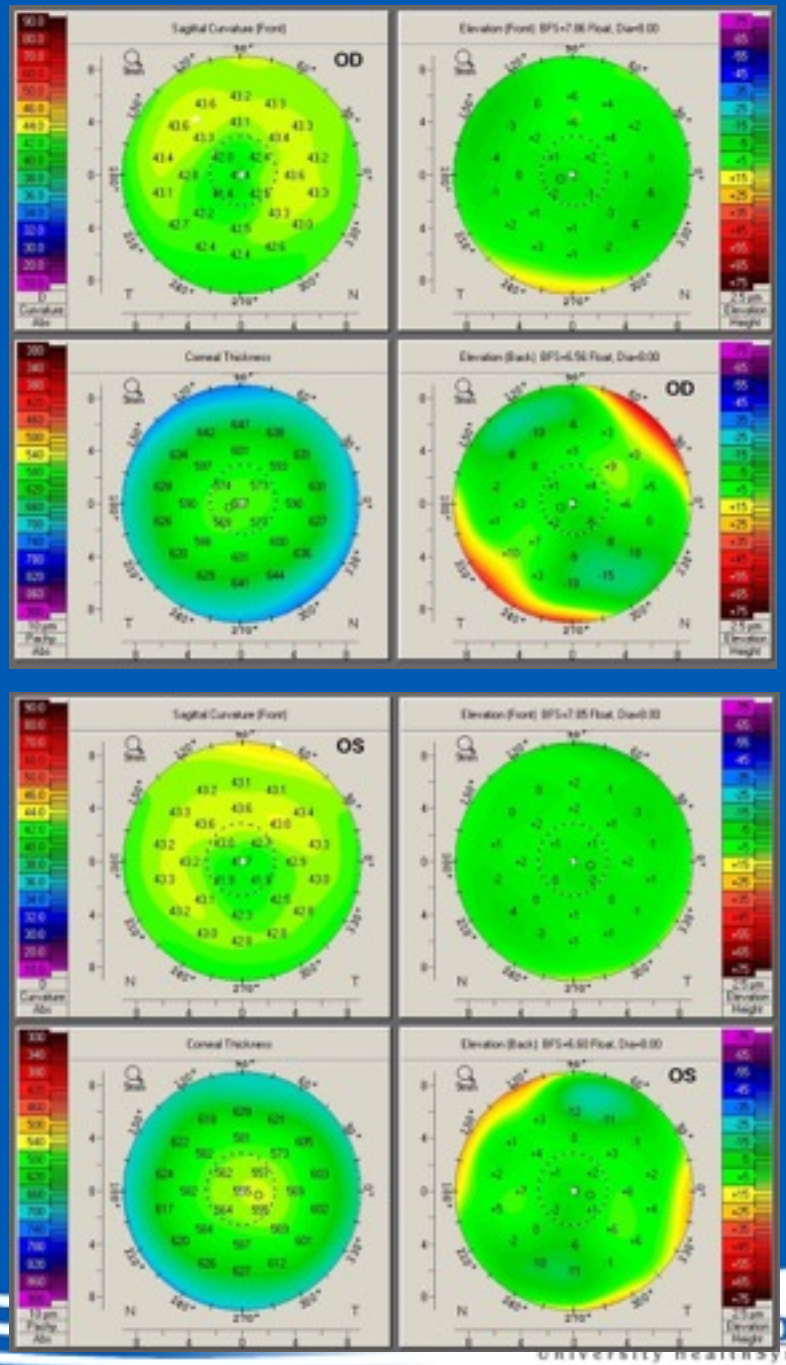
  - (*Pre-Op -3.00, Post-Op +1.00 OU*)

The uncorrected hyperope learned early in life to dissociate accommodation and convergence. The hyperope had to actually use fusional divergence to counter the normal accommodative convergence.

The over corrected myope does not have this fusional divergence (actually used fusional convergence when reading without glasses). At this age it is probably the accommodative convergence more than the overcorrection that accounts for most of the symptoms.

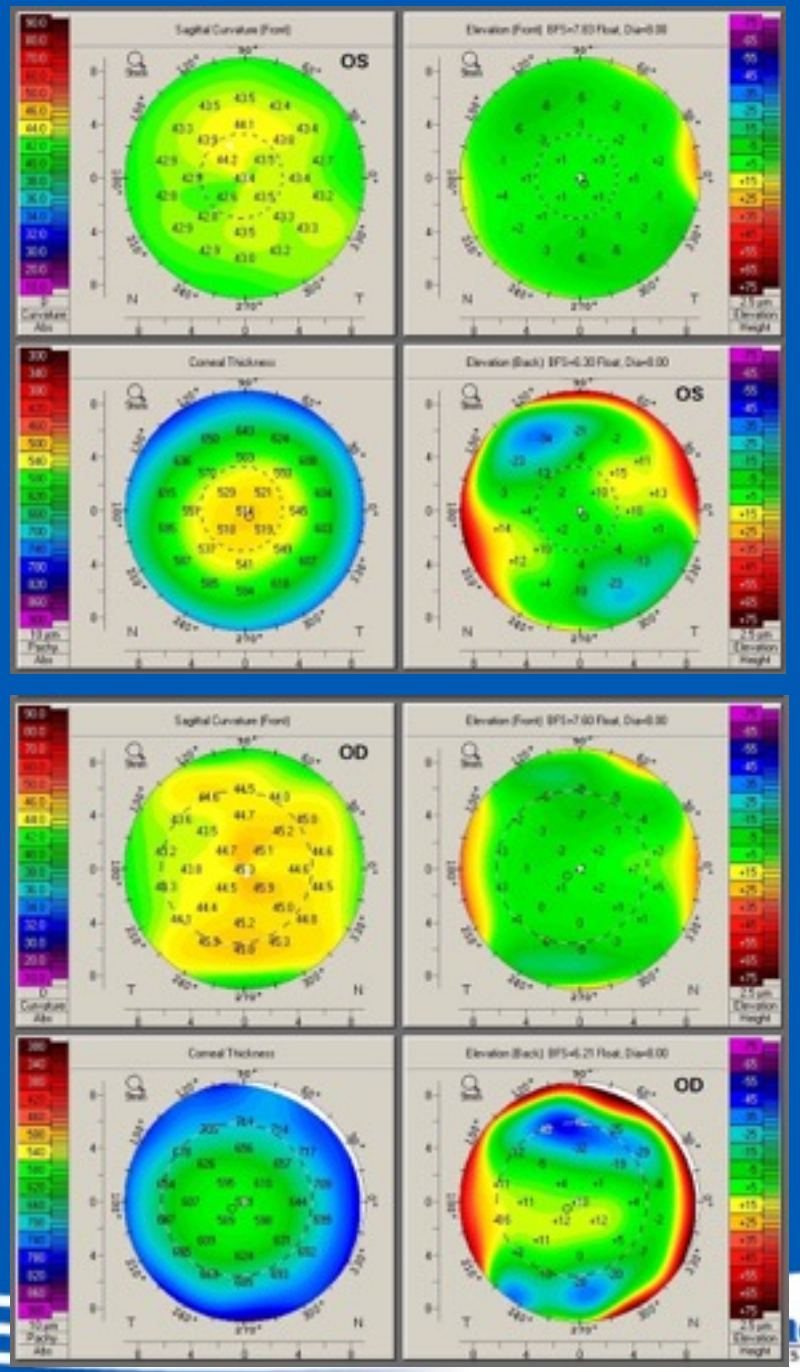
Patient 3a

- 48 year old female with long standing unilateral myopia.
  - exam is otherwise normal.
- OD -1.00 +0.50 X 85
  - K's 42.25 X 42.75
- OS -5.25 + 0.25 X 105
  - K's 42.50

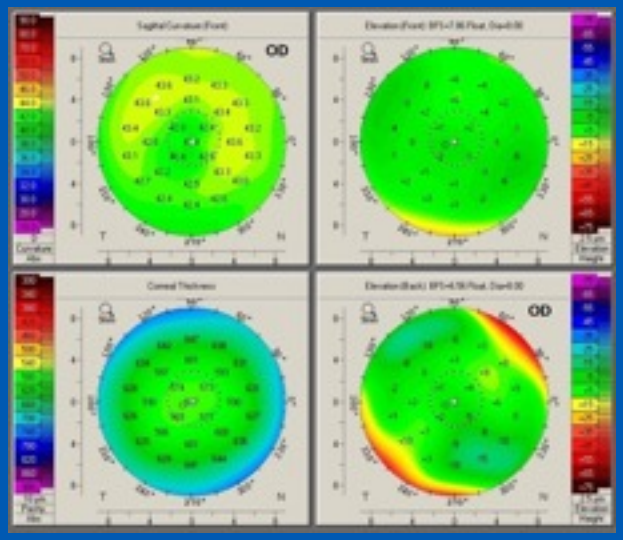


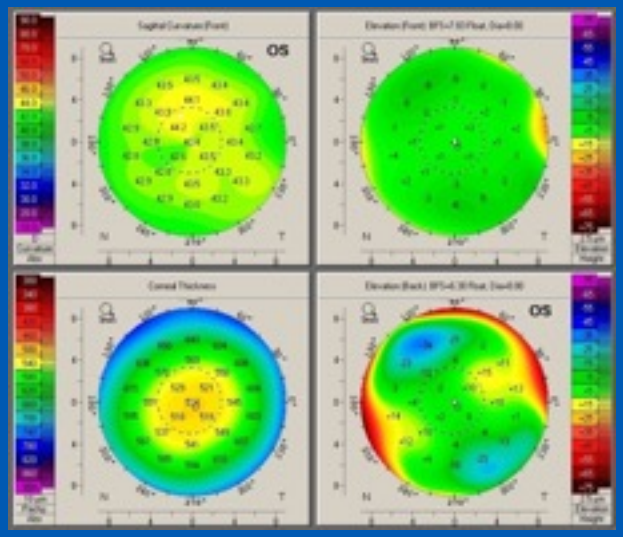
Patient 3b

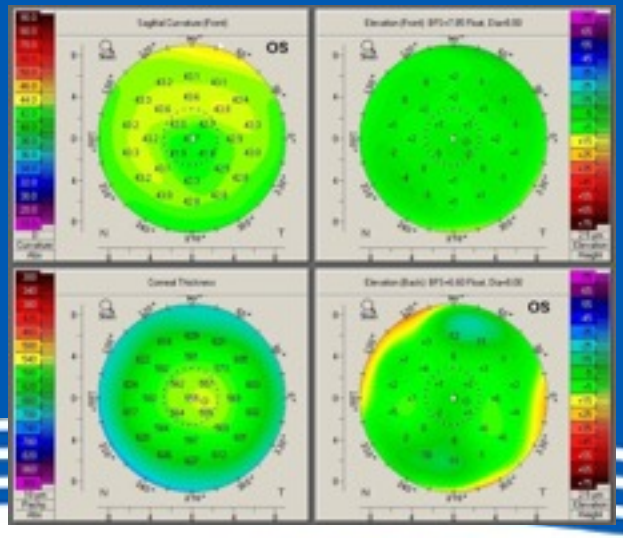
- 57 year old male S/P PK OS for a corneal scar.
  - Graft clear & compact
  - Exam is otherwise normal
- OD -0.75 + 0.25 X 95
  - K's 42.00 X 42.50
- OS -5.50 +0.75 X 85
  - K's 45.75 X 46.00

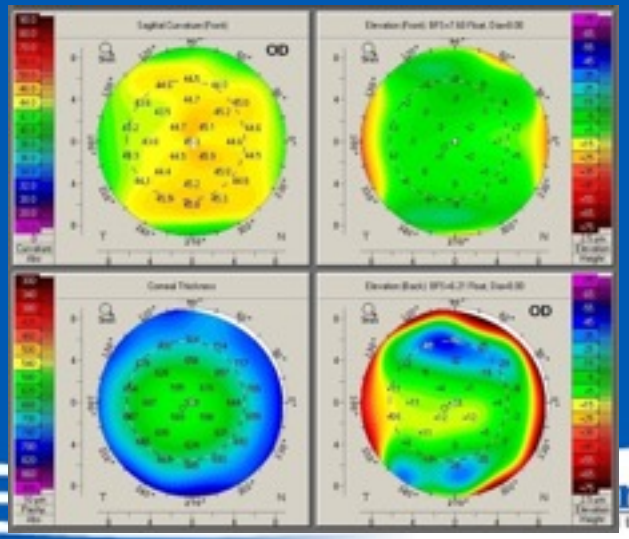


Two patients with similar prescriptions but differing spectacle tolerance – WHY?









Two patients with similar prescriptions but differing spectacle tolerance – WHY?

- 48 year old female with long standing unilateral myopia.
  - rest of the eye exam is normal.
- OD -1.00 +0.50 X 85
  - K's 42.25 X 42.75
- OS -5.25 + 0.25 X 105
  - K's 42.50 X 42.25

- 57 year old male S/P PK OS for a corneal scar.
  - Graft clear & compact
  - Rest of exam is normal
- OD -0.75 + 0.25 X 95
  - K's 42.00 X 42.50
- OS -5.50 +0.75 X 85
  - K's 45.75 X 46.00

- The poor spectacle tolerance is more likely in the second patient because the standard anisometropic spectacle will exaggerate the induced aniseikonia more in a refractive anisometrope than an axial anisometrope.

Knapp's Rule

- Knapp's rule - states that if the anisometropia is purely axial, then a spectacle correction if placed at the anterior focal plane will produce equal retinal image sizes
  - (*limited application*) – Spectacles are rarely placed at the spectacle plane (16 mm)
  - Eyes with axial elongation have some compensatory corneal flattening
    - » Sorsby's emmetropization principal
      - (The validity of this has been called into question)

Spectacle Induced Aniseikonia

- Spectacle induced aniseikonia is related to:
  - Power of the lens - + lenses magnify - lenses minify
  - Shape of the lens - Greater anterior curvature greater magnification
  - Lens Thickness - Thicker lens gives greater magnification
  - Vertex distance -
    - increase for + increases mag
    - increase for - increases min.
- Normally, lenses are constructed on a series of corrected curves designed to minimize aberration and not aniseikonia.
  - The reason for this is that most patients have reasonably symmetric corrections and spectacle aberration is more clinically significant than spectacle induced aniseikonia
- **YOU NEED TO RECOGNIZE WHEN THIS IS NOT THE CASE**

Case # 4

- 42 year old patient has had the following stable refraction for over 10 years:

- OD +2.00 + 2.50 X 05
- OS -1.00 + 2.75 X 100

- 43 year old patient has had the following stable refraction for over 10 years:

- OD +2.00 + 2.50 X 95
- OS -1.00 + 2.75 X 180

- Both patients were asymptomatic until last year, when the first patient became intolerant of his new glasses. **WHY?**

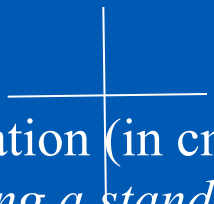
+4.50 -1.00

+2.00 **OD** +1.75 **OS**

PATIENT 1

+2.00 +1.75

+4.50 **OD** -1.00 **OS**



PATIENT 2

Prentice's rule - induced prism decentration (in cm) times the lens power. In the first patient the right eye (*assuming a standard 8 mm bifocal drop from the O.C*) induces 3.6 base up prism. The left eye induces 0.8 base down prism. The total vertical fusions requirement for this patient is 4.4 prism diopters. This is beyond most patients.

What can be done to alleviate this patients symptoms?

Prentice's Rule

- induced prism decentration (in cm) times the lens power. In the first patient the right eye (*assuming a standard 8 mm bifocal drop from the O.C*) induces 3.6 base up prism. The left eye induces 0.8 base down prism. The total vertical fusions requirement for this patient is 4.4 prism diopters. This is beyond most patients.

- What can be done to alleviate this patients symptoms?

Case # 4 Continued

- What can be done to alleviate the patients symptoms?

- Slab off technique can be utilized, but this is typically limited to no more than 3.0 prism diopters and is expensive. For lower amounts of anisophoria changing the O.C. and bifocal position may be all that is needed. In this case if we tell the optician to set the bifocal seg at 6 mm below instead of 8 mm and ask that they decenter the O.C of OD 2 mm down the following occurs.

Case # 4 Continued

- The induced prism for OD is now (4.5 times {6-2}) 1.8 prism diopters base up. The left is 0.4 base down. The total vertical fusional requirement is now 2.2 instead of 4.4 prism diopters.

- We have, however, induced some fusional requirement for distance (1.1 prism diopters), but this small amount is typically well tolerated. Typically decentering O.C, adjusting seg position, and slab-off techniques are combined to maximize the results.

Patient # 5

- 38 year old female presents for a LASIK Consultation and C/O poor vision at work (computer operator)

- **OD pl + 1.00 X 90 20/20+**
- **OS +0.50 + 0.50 X 8520/20+**
- **ADD 1.75 OU J1+**

- **Does this make sense? 38 yo with +1.75 Add?**

NO

- **What should you do??**

38 year old female C/O poor vision at work (computer operator)

OD pl + 1.00 X 90 20/20+

OS +0.50 + 0.50 X 85 20/20+

ADD 1.75 OU J1+

Accommodative amplitude 3.0 D (should be about 6.0 - 6.5 D at age 38)

Cycloplegic Refraction

OD +3.25 + 1.00 X 90

OS +3.75 + 0.50 X 85

Post Cycloplegic Refraction

OD +3.00 + 1.00 X 90

OS +3.50 + 0.50 X 85 Near J1+

Range of Clear Vision - You can comfortably exert about ½ of your accommodative amplitude. Current glasses allow distance vision at infinity (chronic use of 3 D) and using the distance correction plus the chronic 3 D with 1.5 diopters (½ of 3.0 D remaining) near vision to 26" (1 meter/1.5).

The bifocal allows distance vision to 23" (1 meter / 1.75 D) and near point of 12" (1 meter / 1.5 D + 1/75). The zone between 23" and 26" represents a small intermediate blur zone.

What happens at age 45 when the accommodative amplitude is 2 D less ?

OD	pl	+ 1.00 X 90	20/20+
OS	+0.50	+ 0.50 X 85	20/20+

ADD 1.75 OU J1+

Accommodative amplitude 1.0 D (should be about 4.0 - 4.5 D)

Distance is still clear at infinity to a near point of 2 meters (1 meter / 0.5 D)
Near vision at 1/3 meter would require an add of + 2.50 D. Range of near vision is from 16” to a near point of 13”. While the reading is still acceptable, there is a very large intermediate blur (16” to 6 feet).

POINT - Bifocals at an early age or an inappropriate add should alert you to an under corrected hyperope.

Refractive Enhancement: Options & Choices

- LASIK

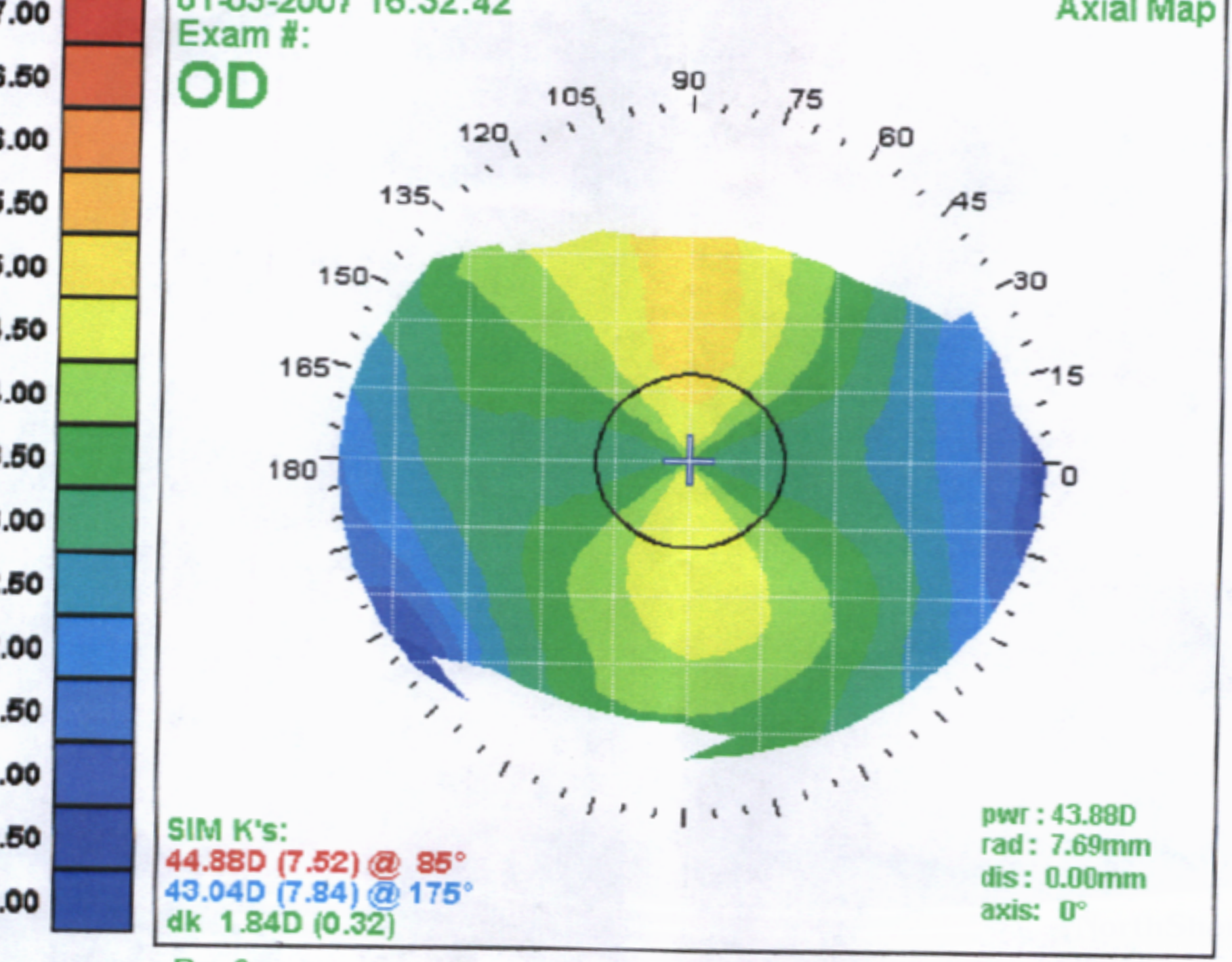
- Piggyback IOL

Pre Op
Refractive Lens Exchange

- 48 female, likes to garden & quilt

- - 8.50 + 2.50 X 108 20/30 OD
  - AL 26.66
  - 43.04 X 44.88 @ 85
  - AT 45 10.75 D → -0.19 SEQ

- - 7.00 + 1.25 X 90 20/20 OS
  - AL 26.35
  - 43.60 X 45.24 @ 67
  - AT 45 11.50 D → -0.33 SEQ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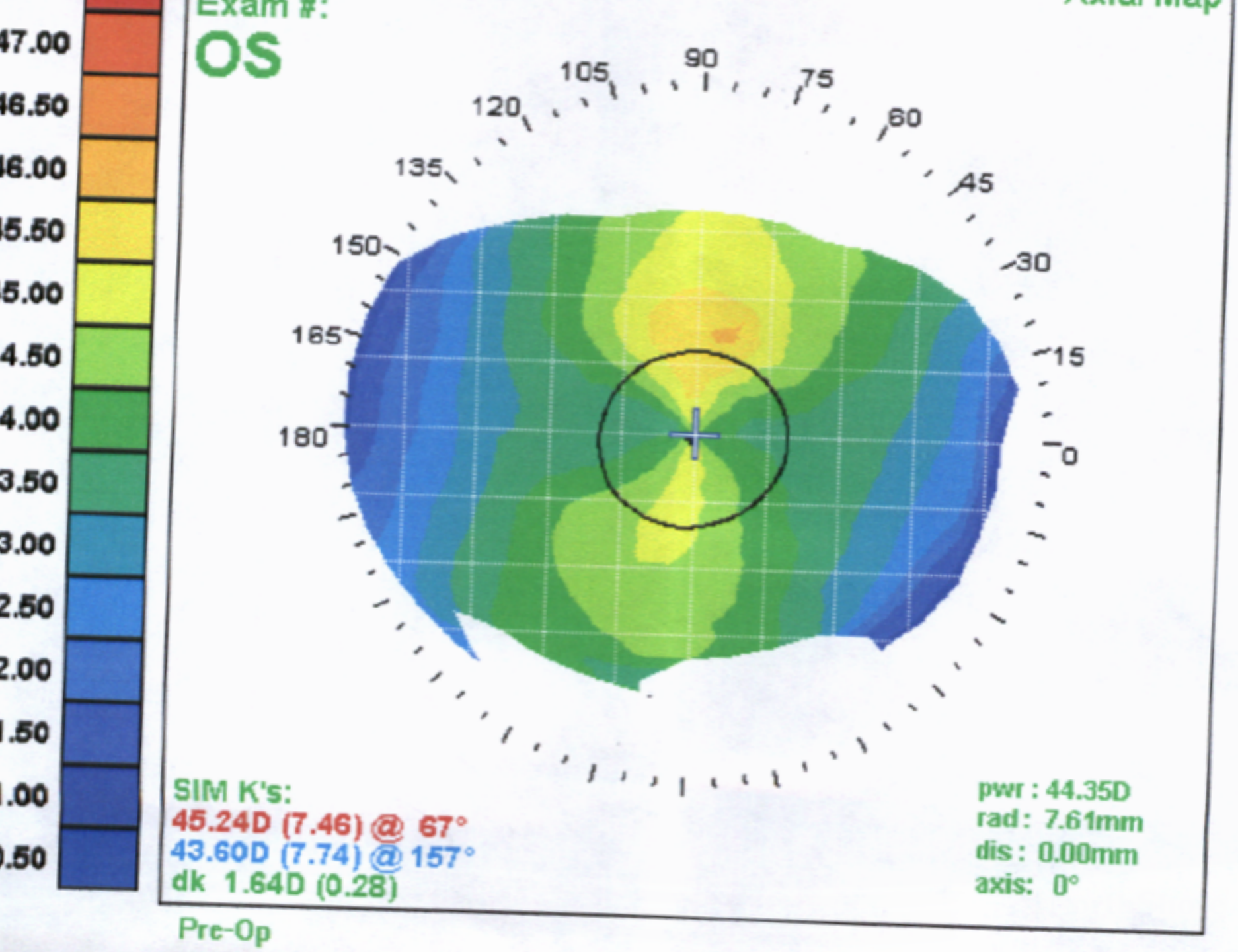
Exam #:
OD
Axial Map
90
105
75
120
60
135
45
150
30
165
15
180
0
SIM K's:
44.88D (7.52) @ 85°
43.04D (7.84) @ 175°
dk 1.84D (0.32)
pwr : 43.88D
rad : 7.69mm
dis : 0.00mm
axis: 0°
Pre-Op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OS
47.00
46.50
46.00
45.50
45.00
44.50
44.00
43.50
43.00
42.50
42.00
41.50
41.00
40.50
90
105
75
120
60
135
45
150
30
165
15
180
0
SIM K's:
45.24D (7.46) @ 67°
43.60D (7.74) @ 157°
dk 1.64D (0.28)
pwr : 44.35D
rad : 7.61mm
dis : 0.00mm
axis: 0°
Pre-Op

Post Op
RLE with Crystalens
Day 1

- 20/30 OD
- 20/20, J7 OS

2 weeks S/P RLE OU

- c/o blurred vision
- 20/80 OD
  - - 1.25 + 1.50 X 97 20/20
  - - 0.50 SEQ
- 20/60 OS
  - - 0.25 + 1.00 X 77 20/20
  - + 0.25 SEQ

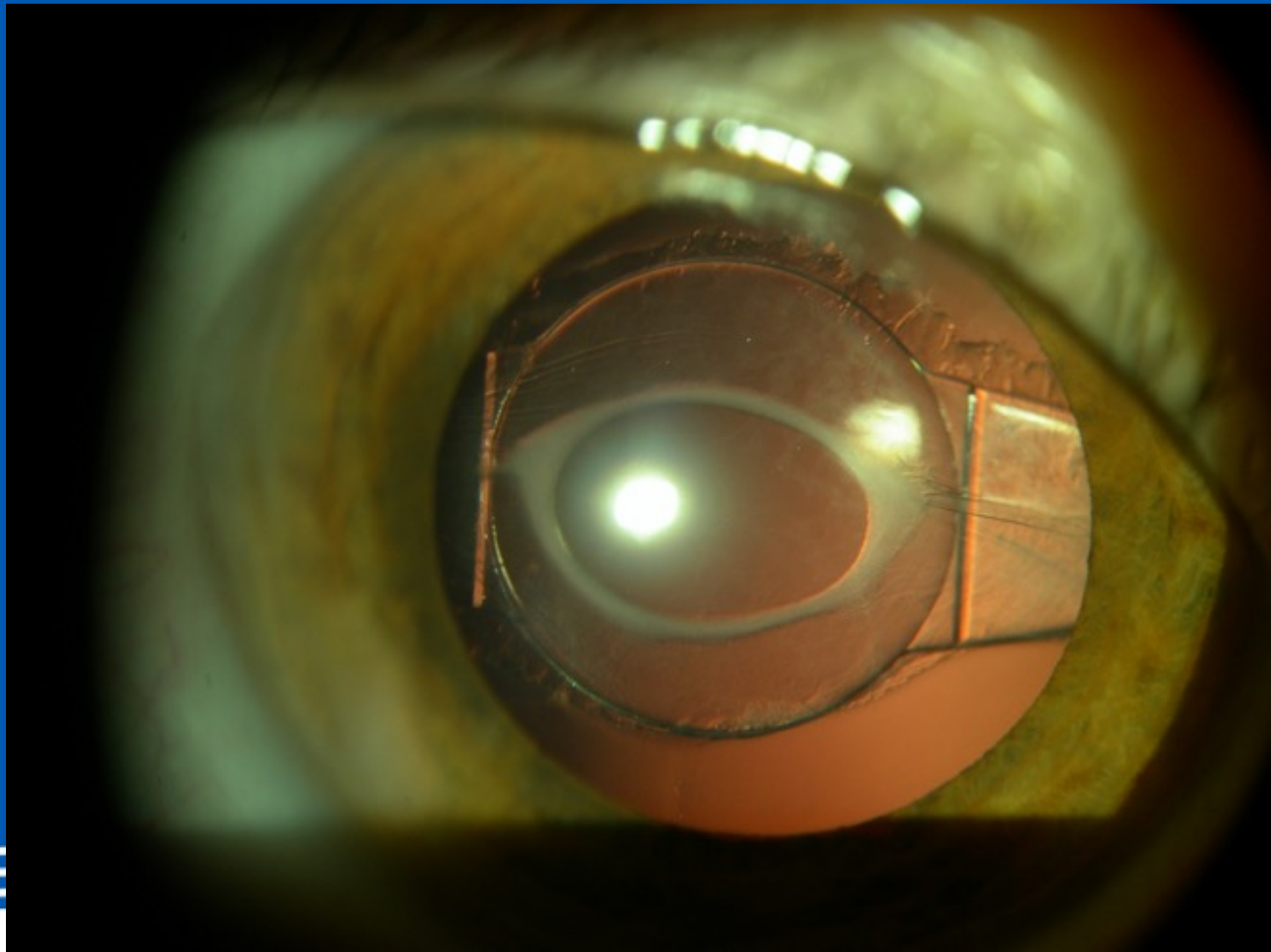
2 weeks S/P RLE OU

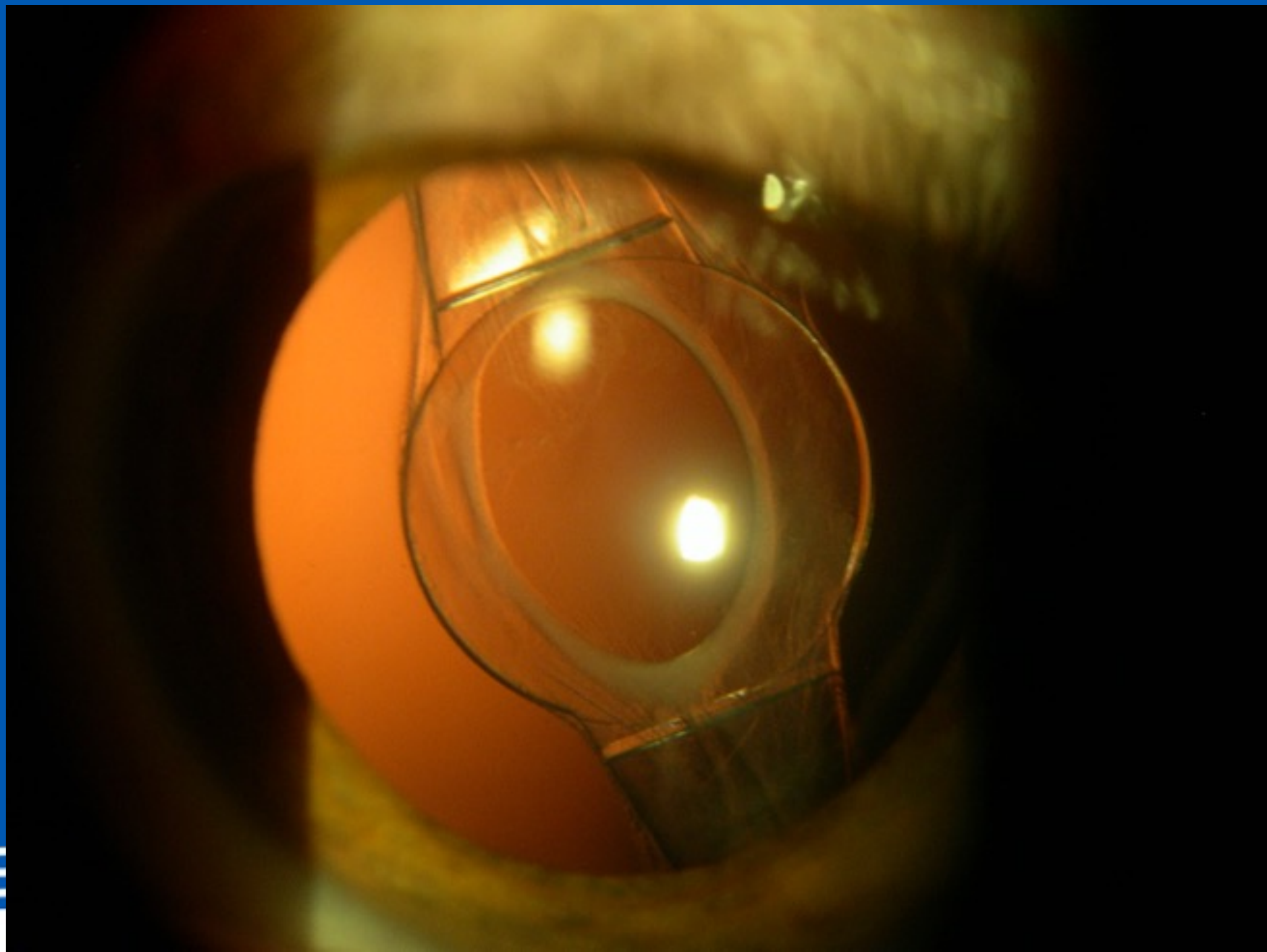
- Diagnosis
- Regression of Astigmatism

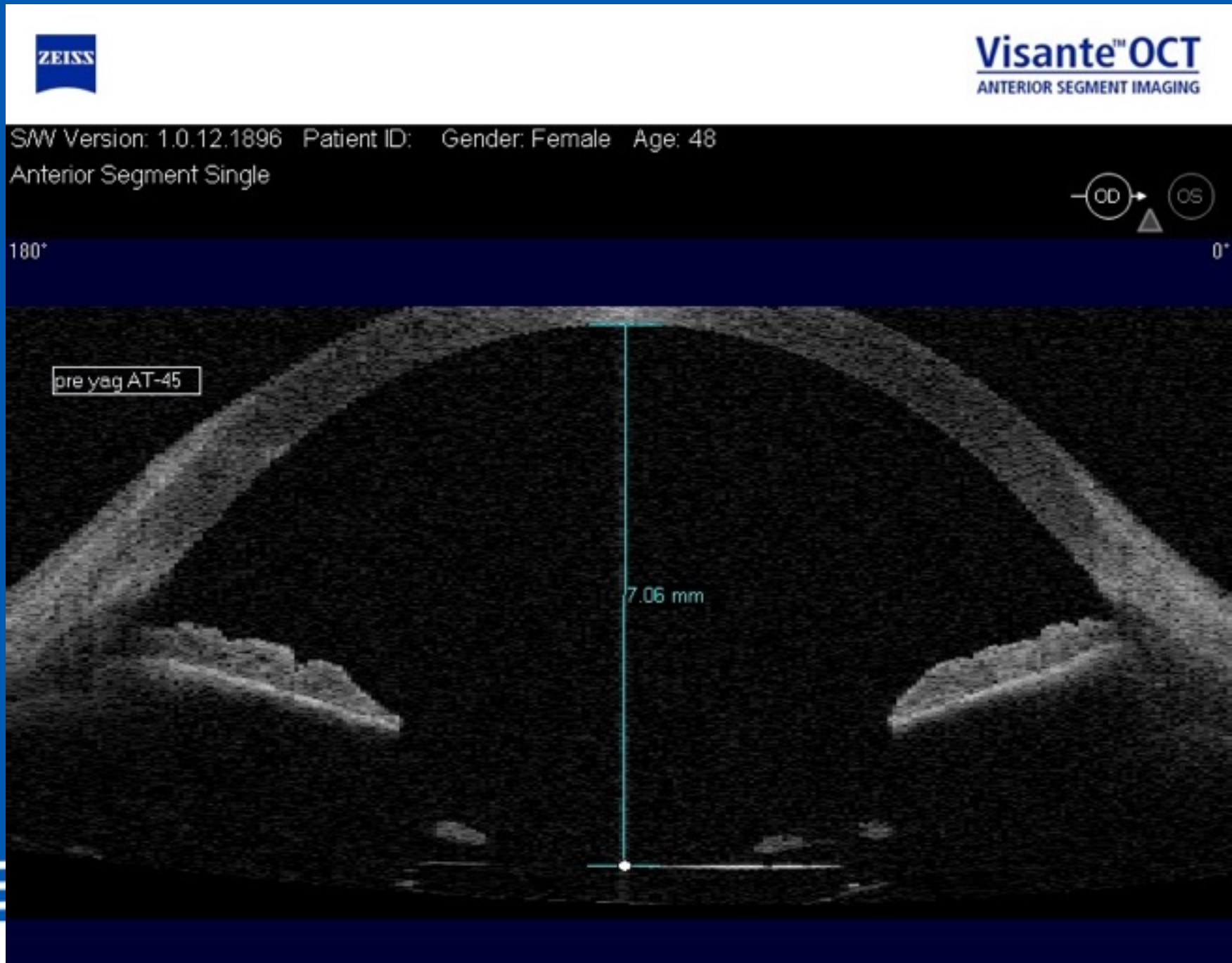
- Plan
- Temporary specs
- Wait for stability
- LASIK

6 wks S/P RLE

- c/o blurred vision worse even with correction!
- - 0.75 + 1.50 X 95 20/40 OD
  - Plano SEQ
- - 0.75 + 1.75 X 90 20/50 OS
  - + 0.125 SEQ

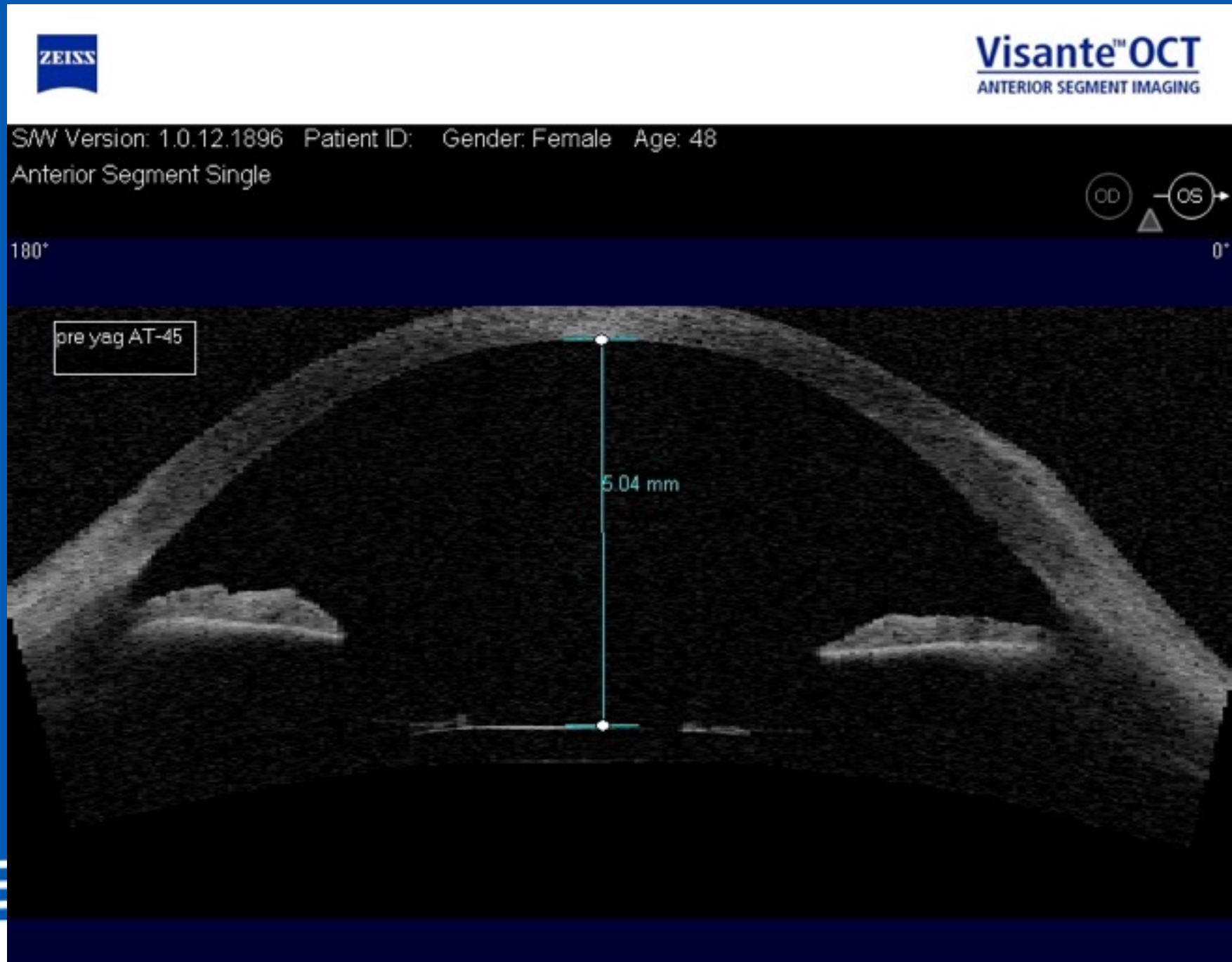





ZEISS
Visante™ OCT
ANTERIOR SEGMENT IMAGING
S/W Version: 1.0.12.1896 Patient ID: Gender: Female Age: 48
Anterior Segment Single
OD
OS
180°
0°
pre yag AT-45
7.06 mm

ZEISS

Visante™ OCT
ANTERIOR SEGMENT IMAGING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OD
OS
180°
0°
pre yag AT-45
5.04 mm

ZEISS

Visante™ OCT
ANTERIOR SEGMENT IMAGING

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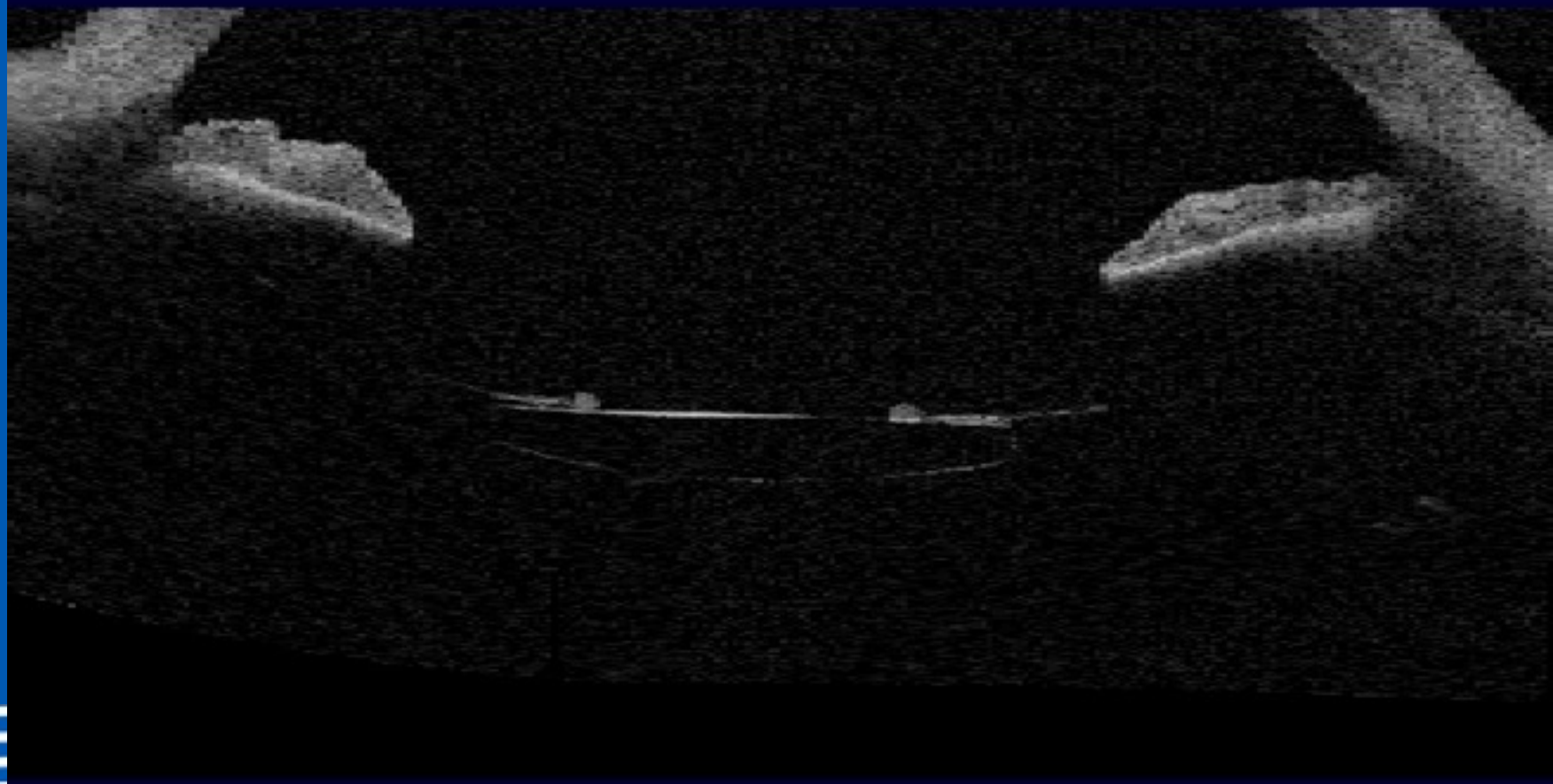
Anterior Segment Single

OD OS

180° 0°



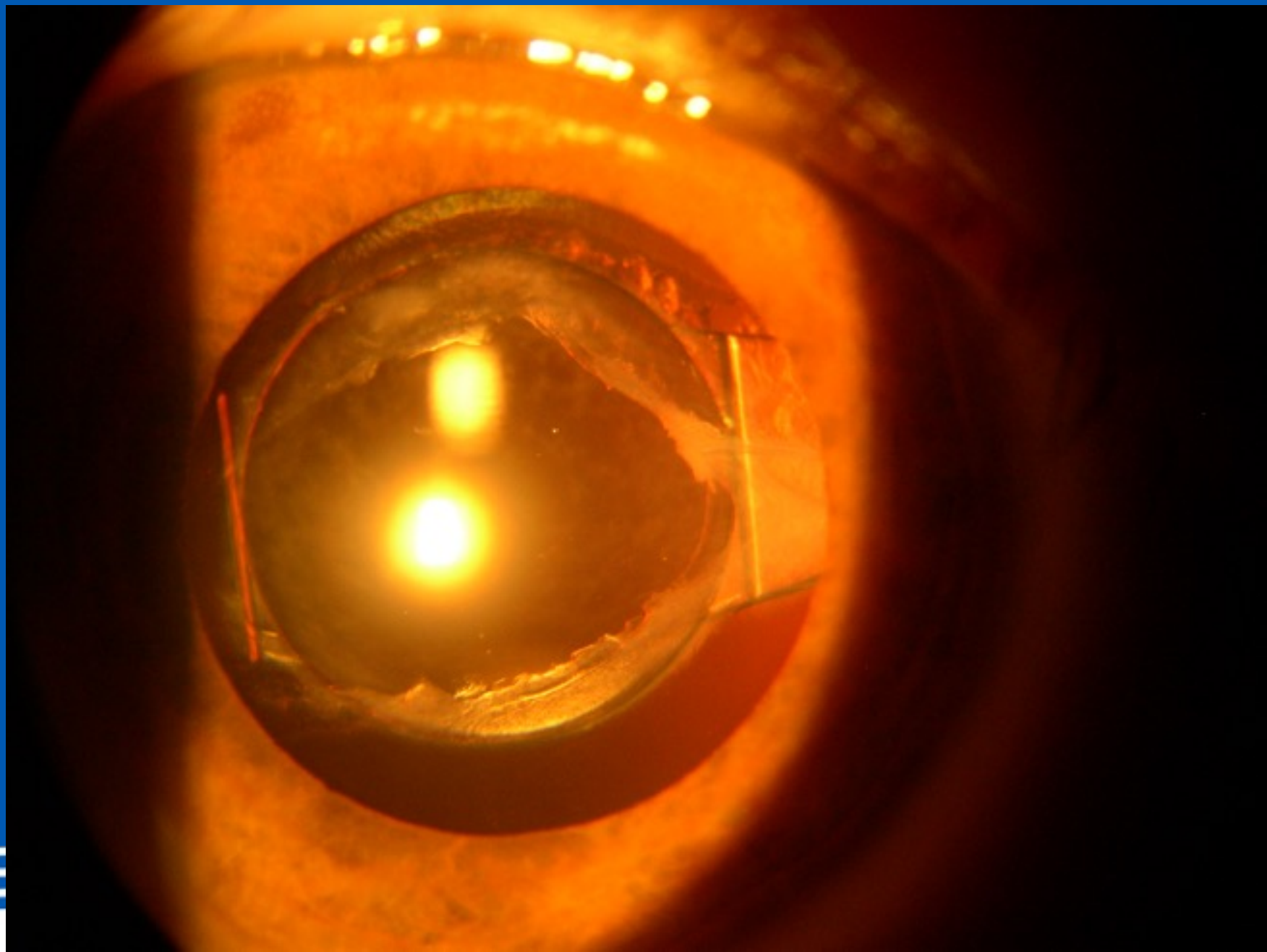
Why the refractive shift?

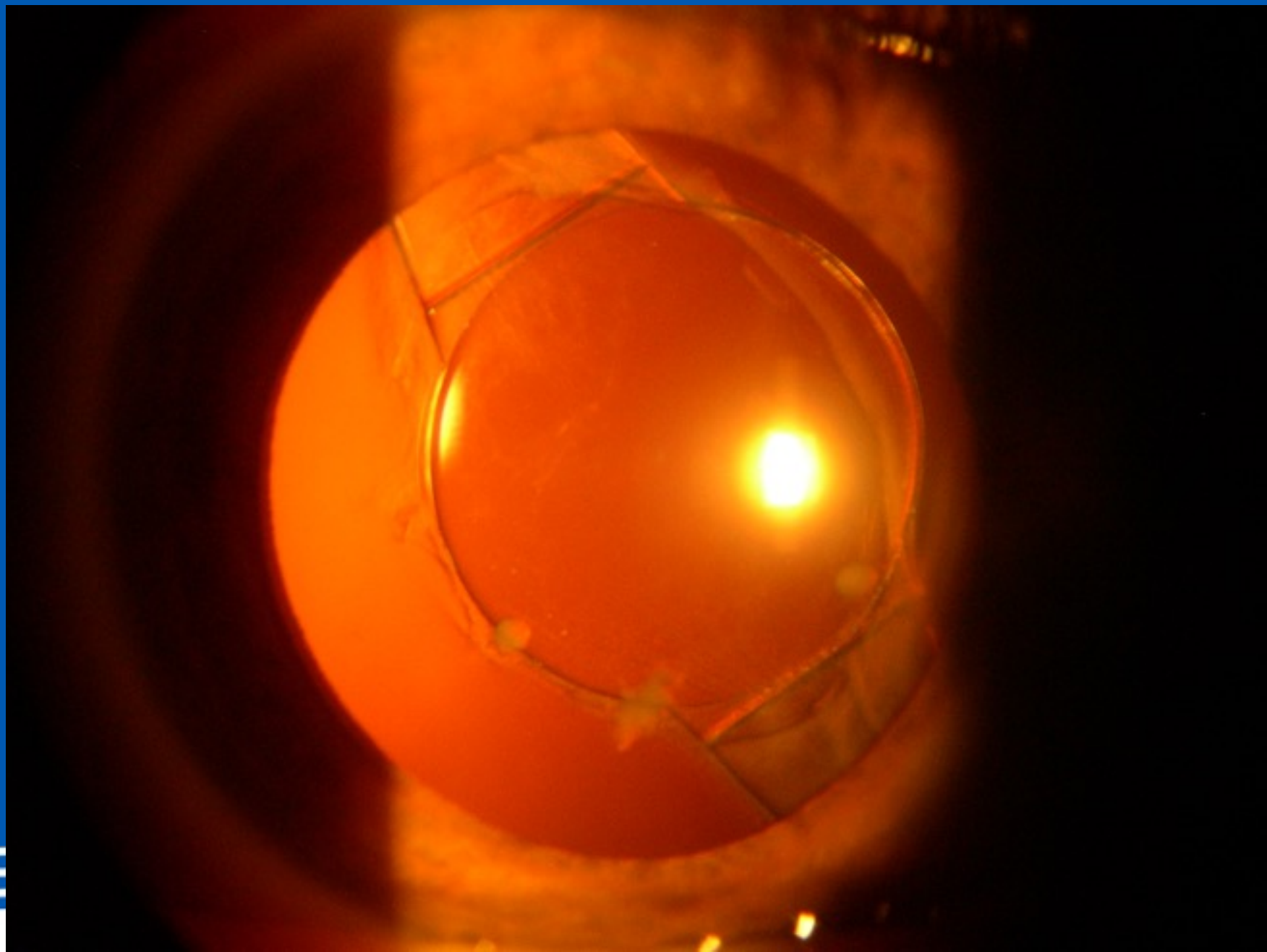
- Diagnosis
- Capsular Phimosis

- Plan
- YAG

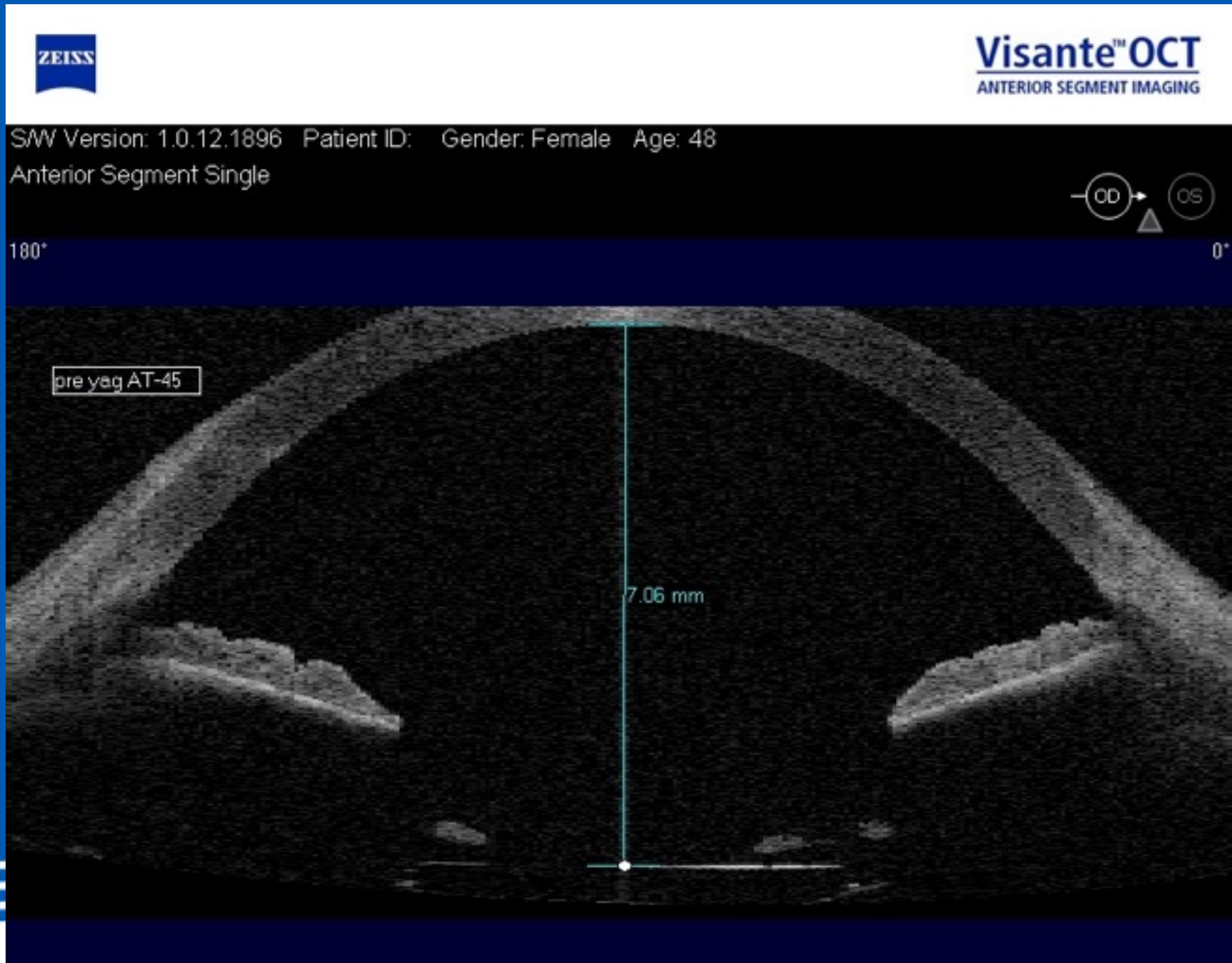
YAG Anterior Capsulotomy OU

- Sequential same day
- Low power, careful placement
- No pitting of optic





- Pre to Post YAG Shift OD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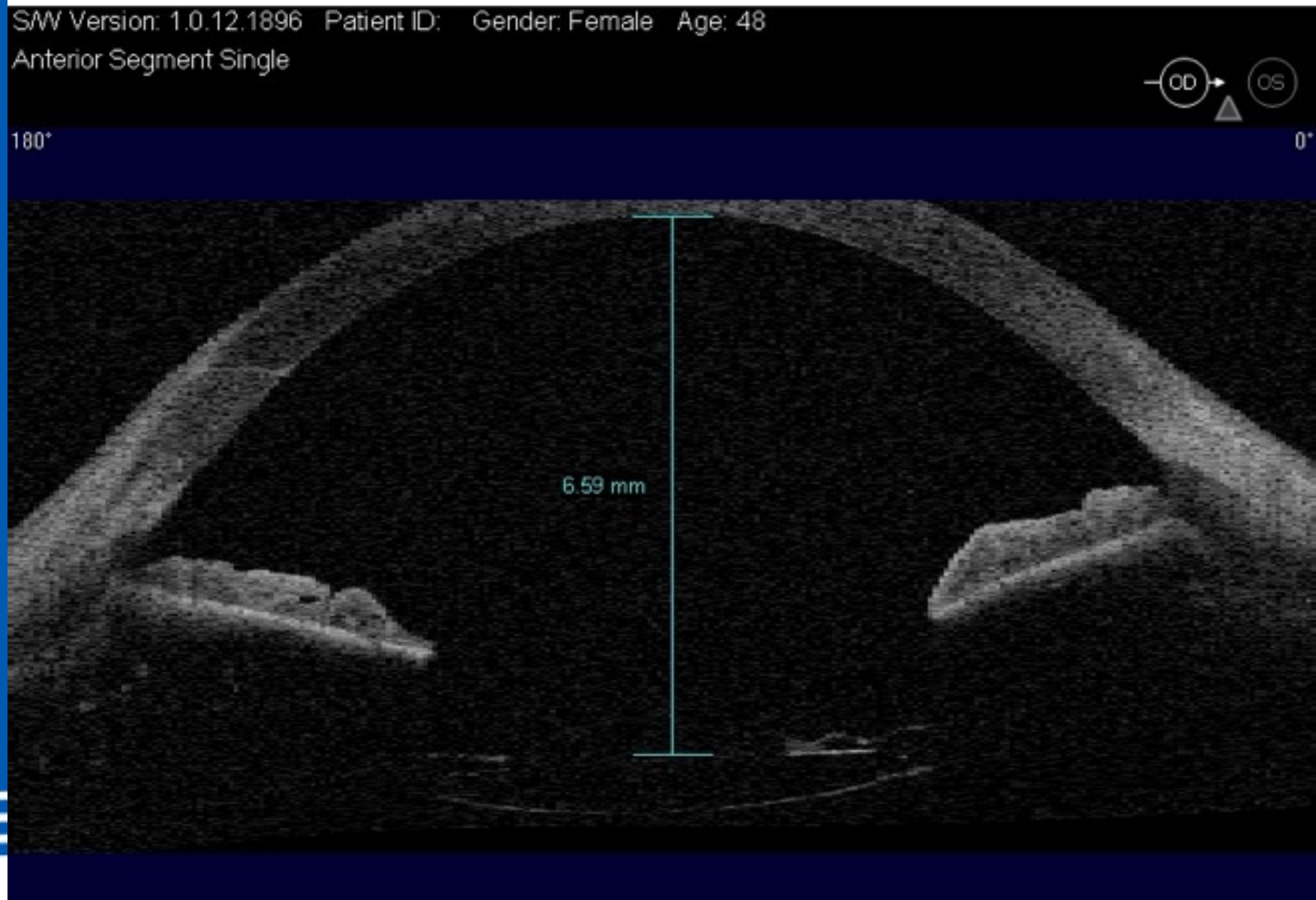
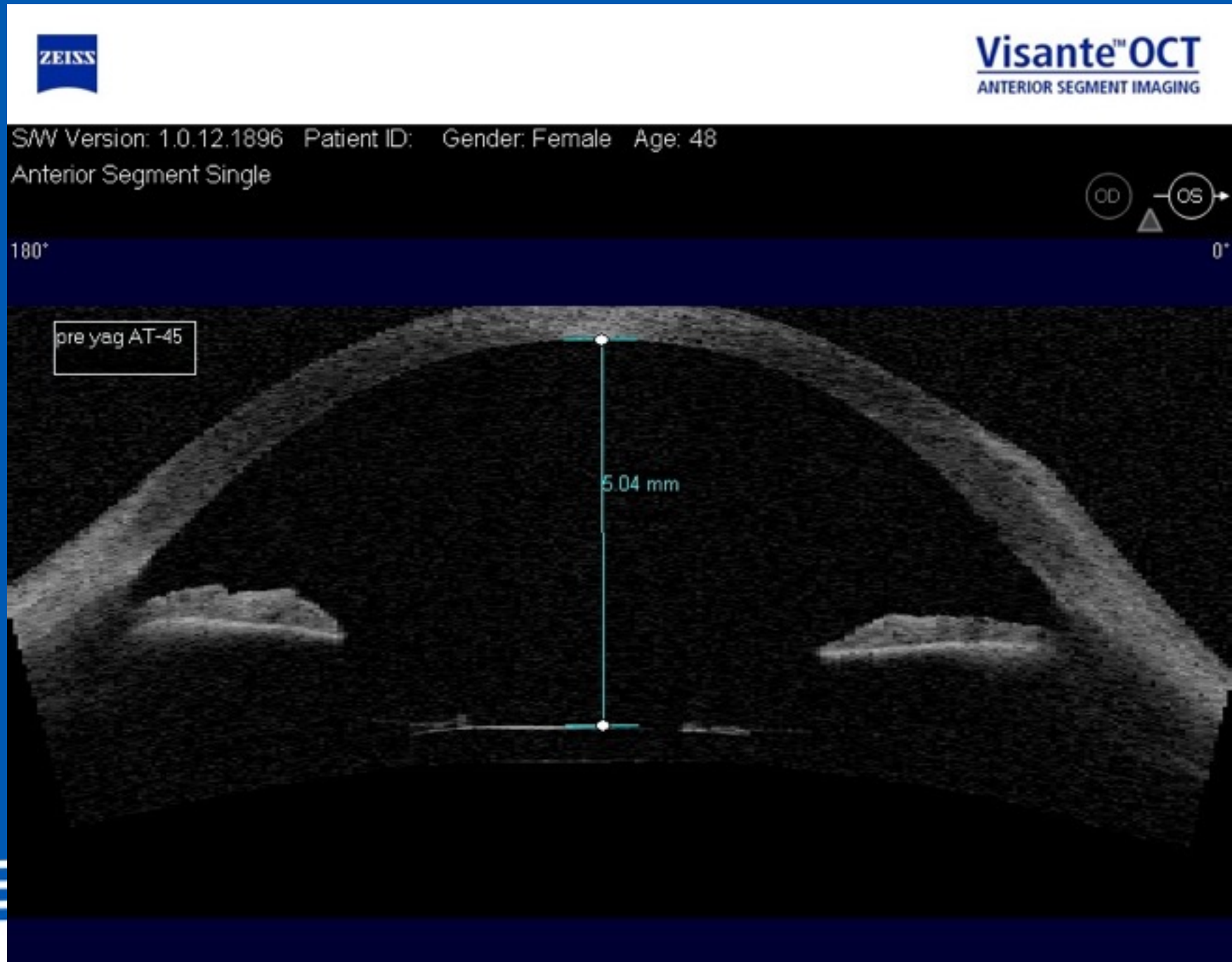
Visante™ OCT
ANTERIOR SEGMENT IMAGING
S/W Version: 1.0.12.1896 Patient ID: Gender: Female Age: 48
Anterior Segment Single
OD
OS
180°
0°
pre yag AT-45
7.06 mm

ZEISS

Visante™ OCT
ANTERIOR SEGMENT IMAGING



- Pre to Post YAG Shift OS


ZEISS
Visante™ OCT
ANTERIOR SEGMENT IMAGING
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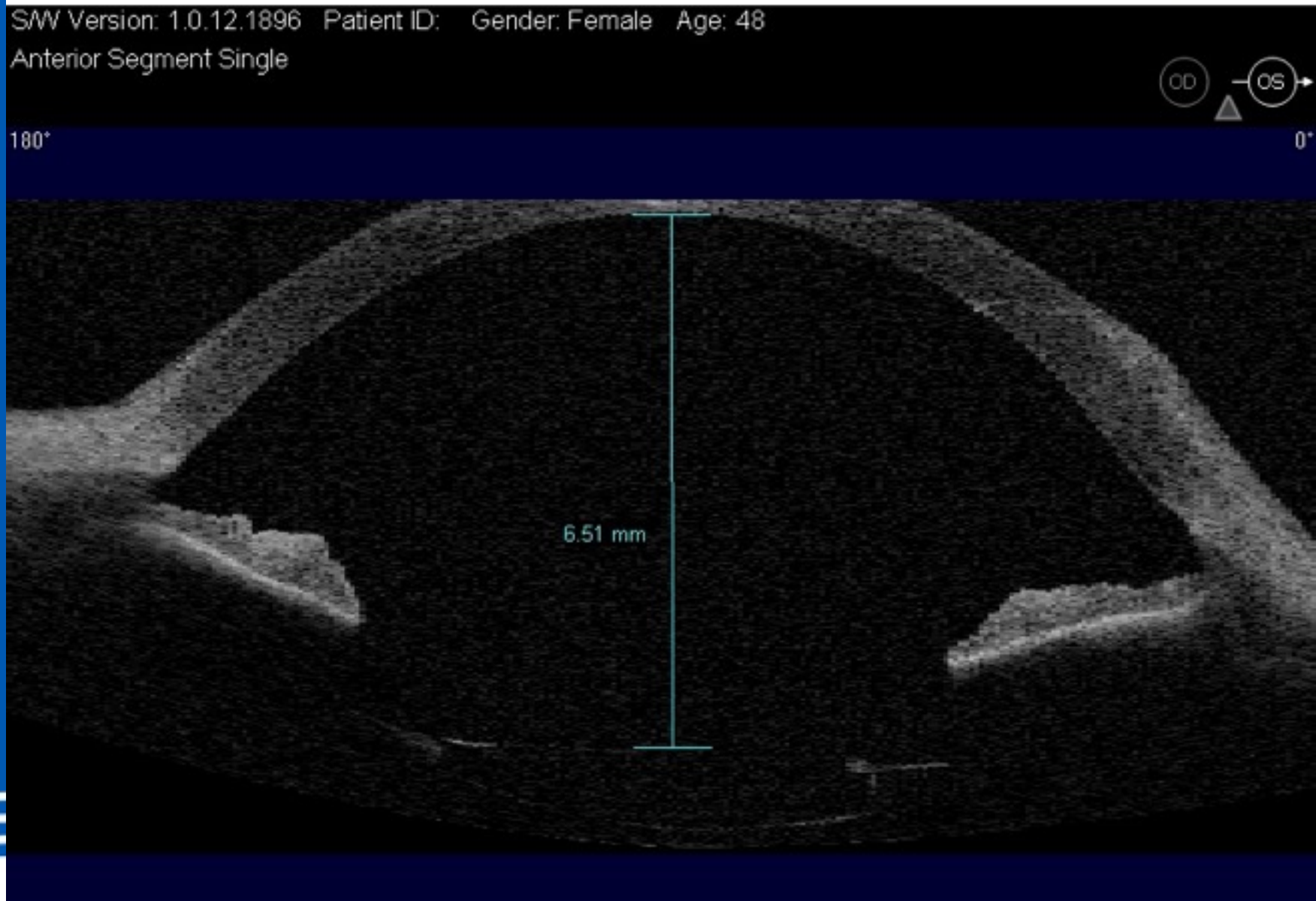
Anterior Segment Single
OD
OS
180°
0°
pre yag AT-45
5.04 mm


ZEISS
Visante™ OCT
ANTERIOR SEGMENT IMAGING
S/W Version: 1.0.12.1896 Patient ID: Gender: Female Age: 48
Anterior Segment Single
OD
OS
180°
0°
6.51 mm

2 wks S/P YAG OU

- “better!”
- - 0.75 + 1.25 X 92 20/20
  - - 0.125 SEQ (pre YAG: Plano)
- - 0.50 + 1.75 X 80 20/20
  - + 0.375 SEQ (pre YAG: + 0.125)

Axial Shift Effects

- Δ ACD OD = 6.59 - 7.06 = -0.47 mm *anterior* shift of +10.75 D IOL
- → - 0.125 D refractive shift

- Δ ACD OS = 6.51 - 5.04 = 1.47 mm *posterior* shift of +11.50 D IOL
  - → + 0.250 D shift refractive shift

Plan: LASIK based on stable refraction after YAG

- -1.25 + 1.75 X 90 20/20 OD
- -0.75 + 1.50 X 83 20/20 OS

2 weeks S/P LASIK OU

- Patient states VA OU improved, distance VA “wonderful” OU

2 weeks S/P LASIK OU

- OD 20/25, J 10
- +0.25 + 0.50 X 90 20/20

- OS 20/20, J 10
- Plano 20/20

2 weeks S/P LASIK OU

- Diagnosis
- Pseudophakic Presbyopia

- Plan
- + 1.25 readers prn

9 months S/P LASIK OU

- Happy! Distance vision good, gardens and quilts without correction, wears specs prn reading

- OD: 20/25, J10
- + 0.50 + 0.25 x 75 20/20

- OS: 20/20, J10
- + 0.25 + 0.50 x 75 20/20

Conclusions

- LRIs are less predictable in thick corneas.
- Anterior YAG capsulotomy successfully treats anterior capsular phimosis.
- There is good correlation between the IOL position and the refractive spherical equivalent.
- LASIK provides a very effective means of enhancing the results of RLE, especially astigmatism.

Conclusions

- Accommodation and correction
- POINT – Pre-Presbyopic Myopes will have more difficulty with near vision after refractive surgery (or with contact lenses). Hyperopes will have increased near vision after refractive surgery.

Conclusions

- Undercorrected Hyperope
- The uncorrected hyperope learned early in life to dissociate accommodation and convergence.
- The over corrected myope does not have this fusional divergence.

Conclusions

- Spectacle Induced Aniseikonia
- Anisometropic spectacle will exaggerate the induced aniseikonia more in a refractive anisometrope than an axial anisometrope.

Conclusions

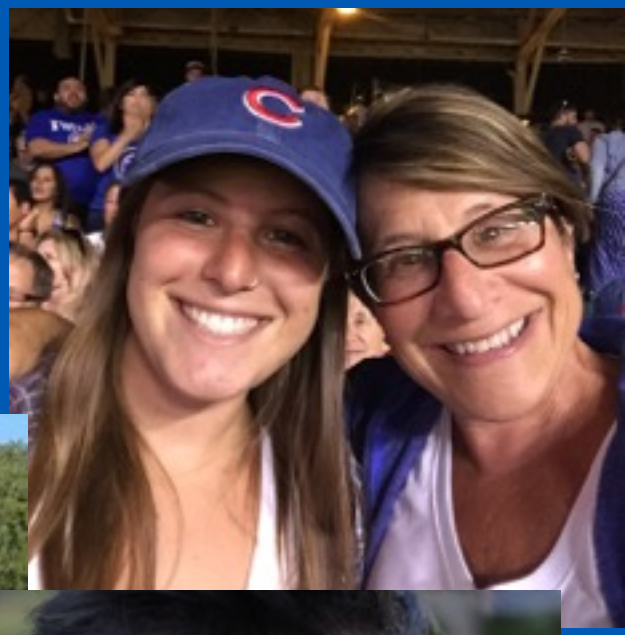
- **Prentice's rule** - induced prism decentration (in cm) times the lens power
- Typically decentering O.C, adjusting seg position, and slab-off techniques are combined to maximize the results.

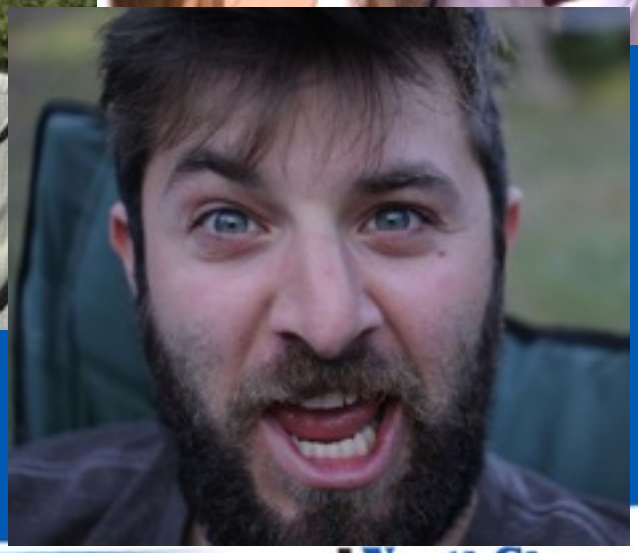
Conclusions

- **POINT** - Bifocals at an early age or an inappropriate add should alert you to an under corrected hyperope.

THANK YOU FOR YOUR ATTENTION

- QUESTIONS?
- mmacsai@northshore.org





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