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2025
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**EDUCATION
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San Antonio

Course # 117

**Simplifying Scleral Lenses: Fitting Pearls
& Therapeutic Applications**

Jeff Anastasio, OD

Please Silence All Mobile Devices.

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Disclosure statements:
No financial relationships to disclose

All relevant relationships have been mitigated.

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**Simplifying Scleral
Lenses: Fitting Pearls
and Therapeutic
Applications**

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**FINANCIAL
DISCLOSURES**

I only speak occasionally,
primarily clinician in
private practice

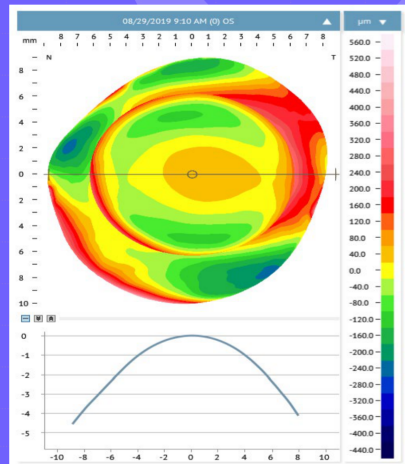
Subsequently I have no
disclosures

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TYPICAL CORNEAL SHAPES

Prolate

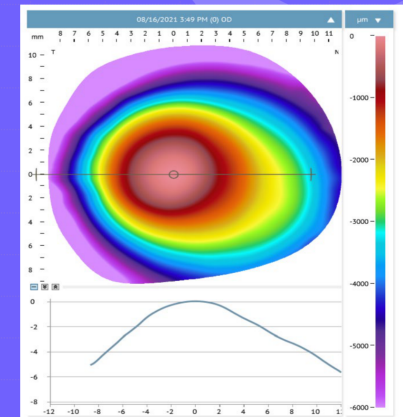
- Normal corneal shape.
- A cornea that flattens as you travel from the apex to the limbus.



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Prolate Cornea

- Corneal Ectasia while irregular still follow a Prolate pattern



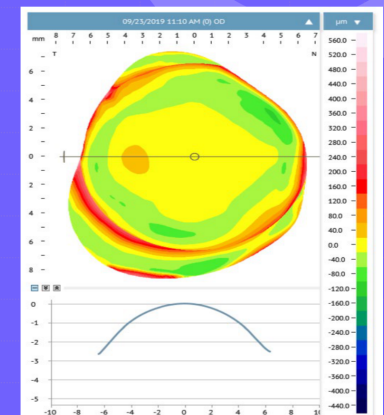
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OBLATE CORNEA

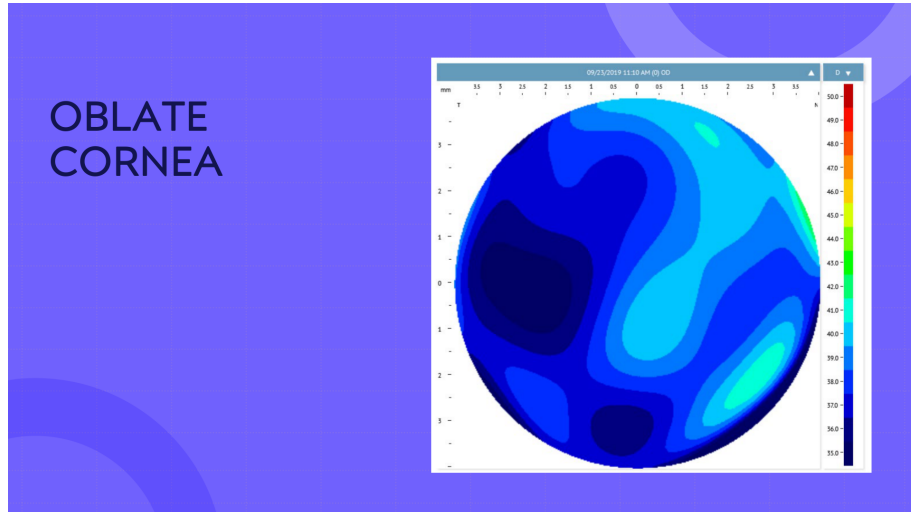
- Corneas that are:
- Flatter in the middle
- Steeper in the mid periphery
- Flatter at the limbus
- Oblate = "Reverse Geometry"

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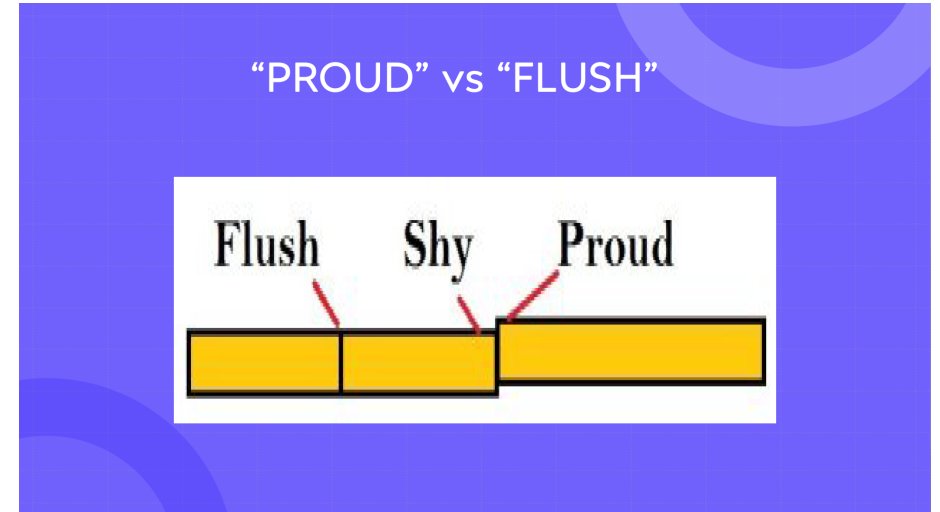
OBLATE CORNEA



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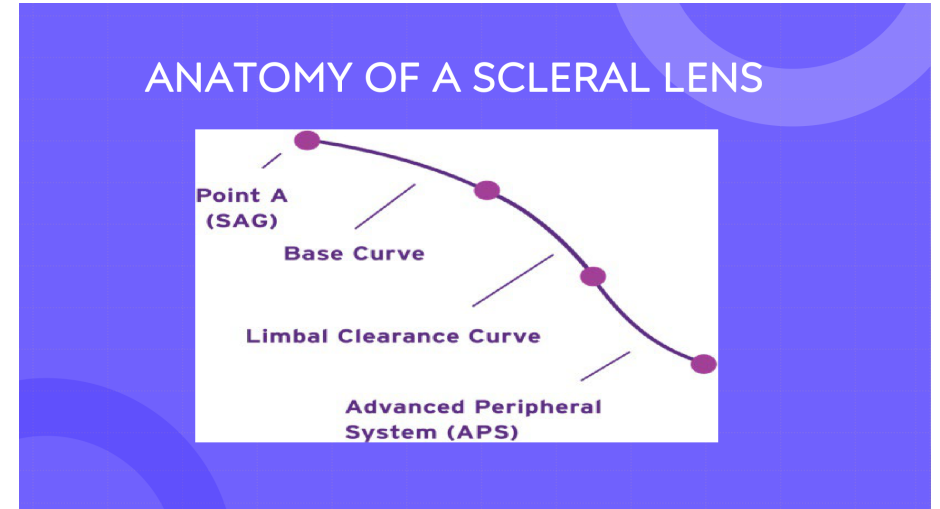
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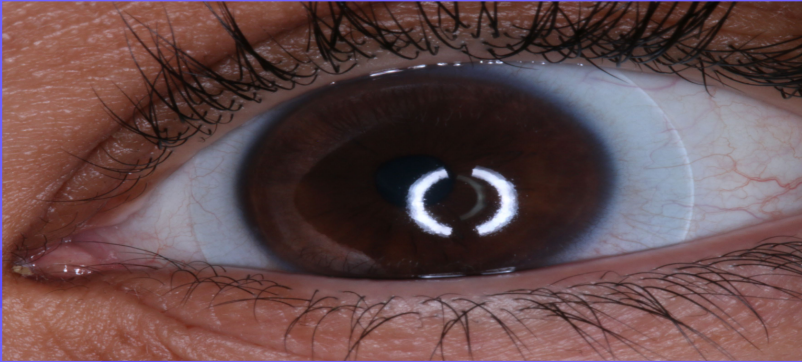


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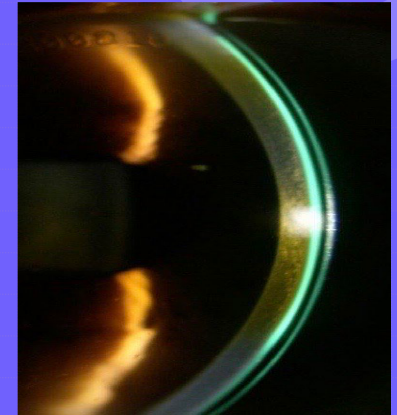
SCLERAL LENS FITTING



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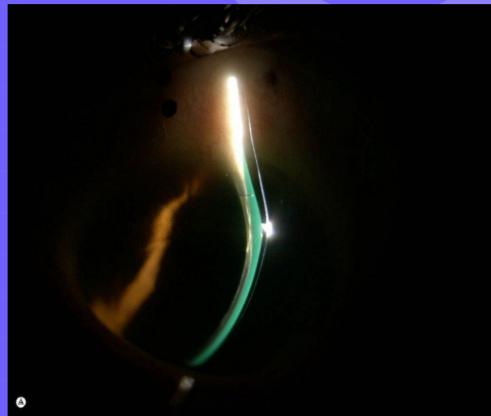
CENTRAL CLEARANCE

Target minimum of 125 microns, maximum 350 microns after settling



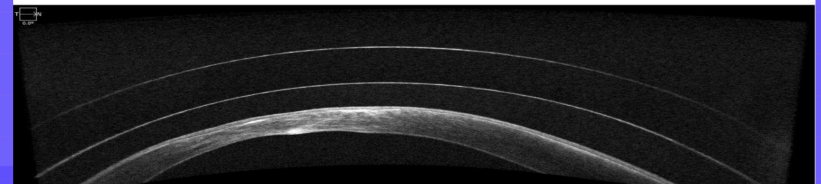
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CENTRAL CLEARANCE



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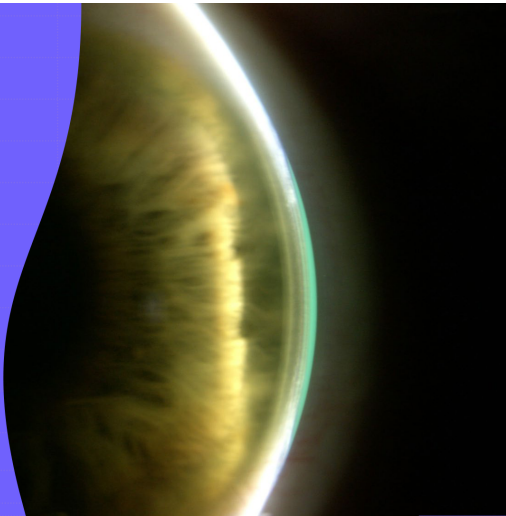
CENTRAL CLEARANCE



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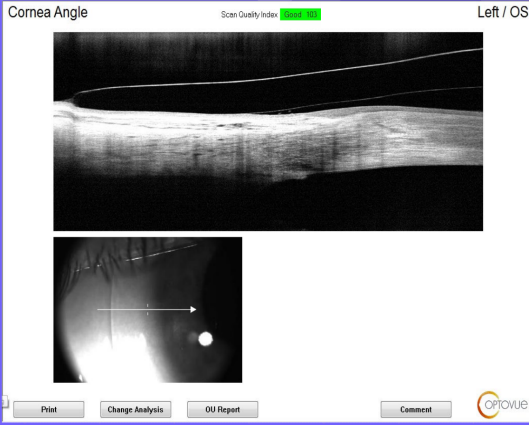
LIMBAL CLEARANCE

- Ideally need at least 30 microns of clearance after lens settles



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LIVING ON THE EDGE

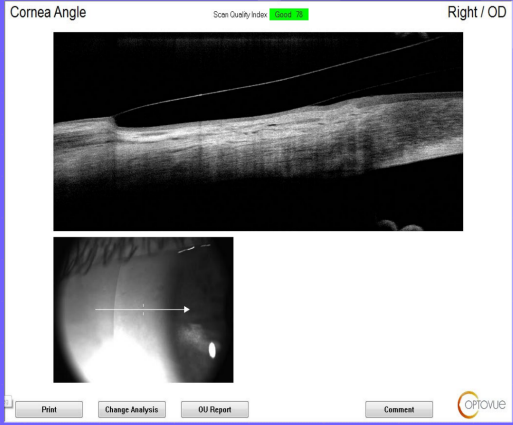


Cornea Angle Scan Quality Index: **Good: 36** Left / OS

Print Change Analysis OU Report Comment 

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TIGHT EDGE "TOE IN"

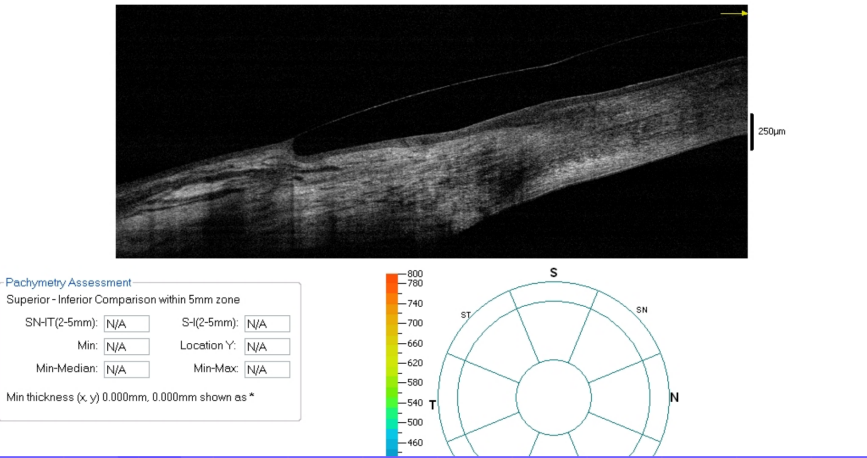


Cornea Angle Scan Quality Index: **Good: 36** Right / OD

Print Change Analysis OU Report Comment 

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Cornea Pachymetry



Cornea Pachymetry Scan Quality Index: **Good: 36** Right / OD

Pachymetry Assessment

Superior - Inferior Comparison within 5mm zone

SN-HT(2-5mm):	N/A	S-I(2-5mm):	N/A
Min:	N/A	Location Y:	N/A
Min-Median:	N/A	Min-Max:	N/A

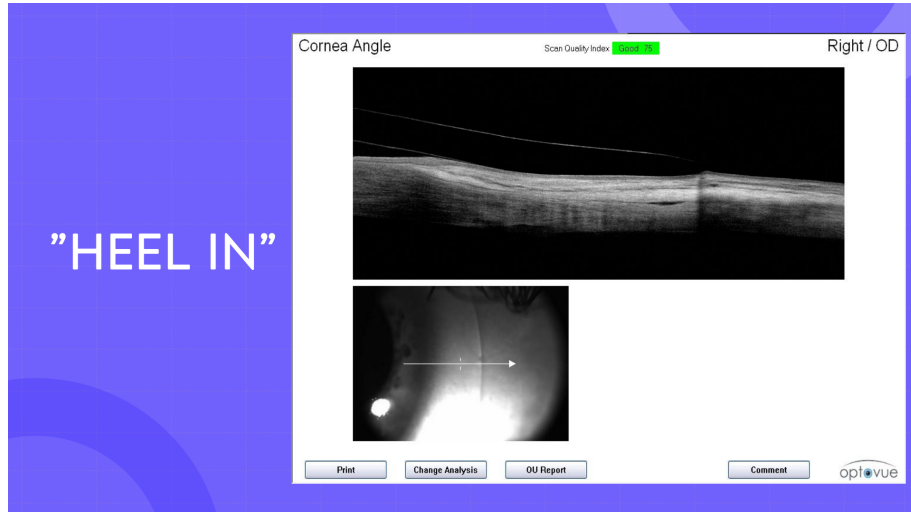
Min thickness (x, y) 0.000mm, 0.000mm shown as *

250µm

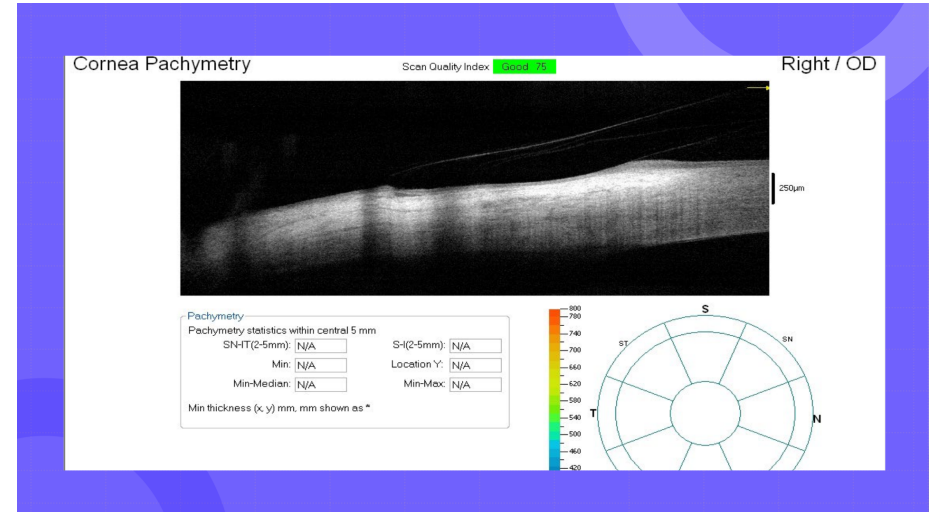
Color scale: 460 to 800

Diagram: S, ST, SN, N, T

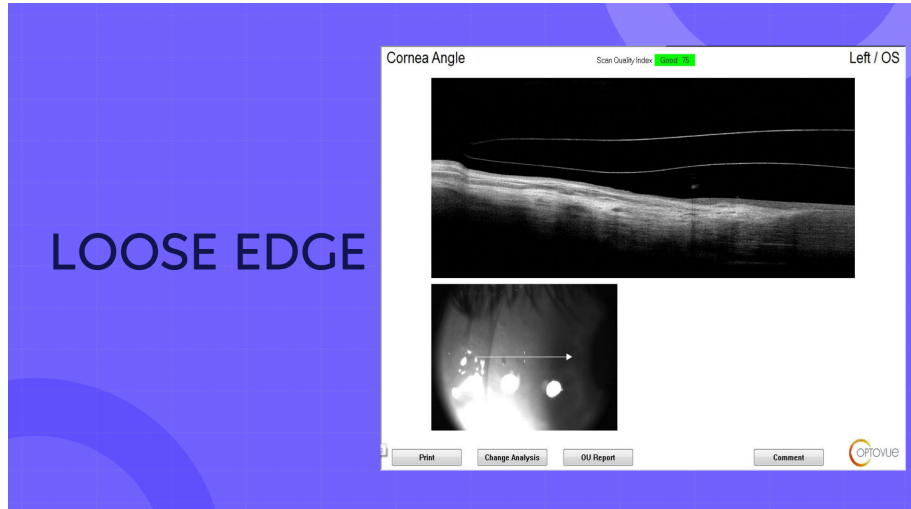
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HYPOXIA AND SCLERAL LENSES

- WHEN FITTING SCLERAL LENSES HYPOXIA **MUST** ALWAYS BE CONSIDERED.
- OXYGEN MUST PASS THROUGH THE LENS AND POSTERIOR TEAR LAYER,
- THIS IS OFTEN 500 MICRONS OR MORE IN DEPTH

OXYGEN REQUIREMENTS

- Units to measure Oxygen Permeability = Dk
- Units to measure Oxygen Transmissibility = Dk/T
- Central corneal requirement to avoid hypoxia = Dk/T 24¹
- Peripheral corneal requirement to avoid hypoxia = Dk/T 35¹
- Tear PO₂ = Partial Pressure of Oxygen in Tear Film
- Critical Tear PO₂ = 100 mmHg ¹
- ¹ = Jaynes Jm et al. Predicting scleral GP lens entrapped tear layer oxygen tensions

OXYGEN REQUIERMENTS

- Janes JM, et. al. Predicting Scleral GP lens entrapped tear layer oxygen tensions:
- “our analysis suggests that only the best case scenario for current GP scleral lenses/tear layer values allow sufficient tear layer oxygen tension (approximately 100 mmHg) to preclude corneal hypoxia”

MATERIAL CONSIDERATIONS

• Boston XO	Dk/T	100
• Boston XO ₂	Dk/T	141
• MeniconZ	Dk/T	189
• Optimum Extra	Dk/T	100
• Optimum Extreme	Dk/T	125
• Acuity 100	Dk/T	111
• Acuity 200	Dk/T	200
• Tear Film	Dk/T	80

OXYGEN REQUIERMENTS

1. “Predicting Estimates of Oxygen Transmissibility for Scleral Lenses. L.Michaud et. Al.

Predicted values of oxygen transmissibility (Fatt Dk/t units) under the center of scleral contact lenses with a Dk of 100.

Dk=100	Clearance (µm)	100	150	200	250	300	350	400
Lens thickness (µm)								
250		26.7	22.8	20.0	17.8	16.0	14.5	13.3
300		23.5	20.5	18.2	16.3	14.8	13.5	12.5
350		21.1	18.6	16.7	15.1	13.8	12.7	11.7
400		19.1	17.1	15.4	14.1	12.9	11.9	11.1
450		17.4	15.7	14.3	13.1	12.1	11.3	10.6
500		16.0	14.5	13.3	12.3	11.4	10.6	10.0

□ : satisfies HM criteria

OXYGEN REQUIERMENTS

- 1. "Predicting Estimates of Oxygen Transmissibility for Scleral Lenses. L.Michaud et. Al.

Predicted values of oxygen transmissibility (Fatt Dk/t units) under the center of scleral contact lenses with a Dk of 150.

Dk=150	Clearance (μm)	100	150	200	250	300	350	400
Lens thickness (μm)								
250		34.3	28.2	24.0	20.9	18.6	16.6	15.0
300		30.8	25.8	22.2	19.5	17.4	15.7	14.3
350		27.9	23.7	20.7	18.3	16.4	14.9	13.6
400		25.5	22.0	19.3	17.2	15.6	14.2	13.1
450		23.5	20.5	18.2	16.2	14.8	13.5	12.5
500		21.8	19.2	17.1	15.5	14.1	13.0	12.0

: satisfies HM criteria
 : satisfies HM and HB criteria

OXYGEN REQUIERMENTS

- "Predicting Estimates of Oxygen Transmissibility for Scleral Lenses. L.Michaud et. Al.

Table 3
Predicted values of oxygen transmissibility (Fatt Dk/t units) under the center of scleral contact lenses with a Dk of 170.

Dk=170	Clearance (μm)	100	150	200	250	300	350	400
Lens thickness (μm)								
250		36.7	29.9	25.2	21.7	19.1	17.1	15.5
300		33.1	27.5	23.4	20.4	18.1	16.3	14.8
350		30.2	25.4	21.9	19.3	17.2	15.5	14.2
400		27.8	23.6	20.6	18.2	16.3	14.9	13.6
450		25.6	22.1	19.4	17.3	15.6	14.2	13.1
500		23.8	20.8	18.3	16.5	14.9	13.7	12.6

: satisfies HM criteria
 : satisfies HM and HB criteria

OXYGEN REQUIERMENTS

- "Predicting Estimates of Oxygen Transmissibility for Scleral Lenses. L.Michaud et. Al.

Table 5
Predicted maximal central lens thickness (μm) to prevent hypoxia-induced corneal swelling in daily scleral lens wear (HM criterion) considering determined clearance values.

	Clearance	100 μm	125 μm	150 μm	200 μm	250 μm	300 μm	350 μm	400 μm
Lens Dk									
100		291	260	229	167	104	42	-20	-80
125		364	325	286	208	130	52	-25	-100
150		437	391	343	250	156	62	-30	-120
170		495	443	389	283	177	70	-35	-136
200		583	521	458	333	208	83	-40	-160
250		729	651	575	417	260	104	-50	-200
300		875	781	687	500	312	125	-60	-240

: negative thickness indicates impossibility to manufacture such a lens
 : possible to manufacture the lens- but it is likely to flex/break because of a reduced thickness
 : optimal lenses to manufacture

What does this all mean?

- In summary all scleral lenses fitters should strive to achieve the following:
- Use a lens material with a Dk/T of greater than 150
- Design a lens with a CT of 250-500 microns, the thinner the better
- Minimize the PTL thickness and try to keep to 250 microns or less, ideally closer to 200 microns.

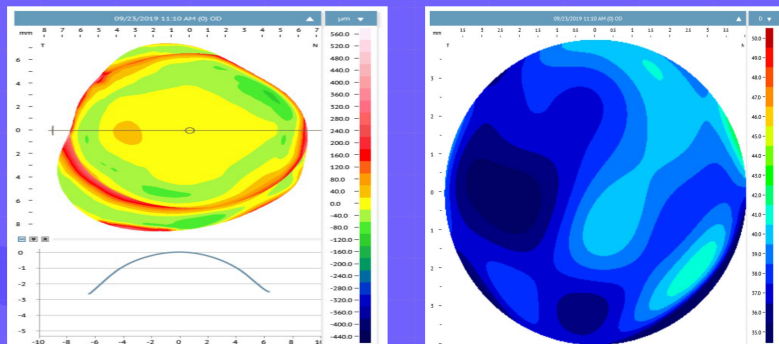
Patient Example JS

- 61 YO Male
- Had CNV OD 1985, created a partial macular scar
- Due to decreased BVA had RK in 1987 to remain in military
- No pertinent systemic medical history
- Current Manifest Rx:
- OD +250-050X100 20/40-2
- OS +500-275X088 20/30+1

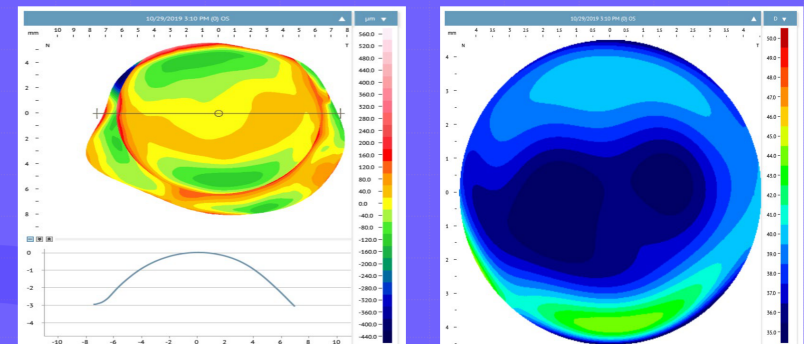
Patient Example JS

- JS suffers with constant visual acuity fluctuations daily
- JS also has extreme glare issues
- JS also has extensive Dry Eye problems currently takes lifitegrast BID, has both inferior puncta plugged
- JS is unable to wear conventional SCL's due to dryness and lack of visual acuity
- JS unable to wear corneal RGP due to comfort issues

Patient Example JS

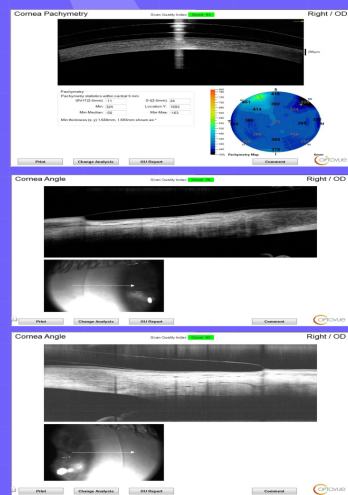


Patient Example JS



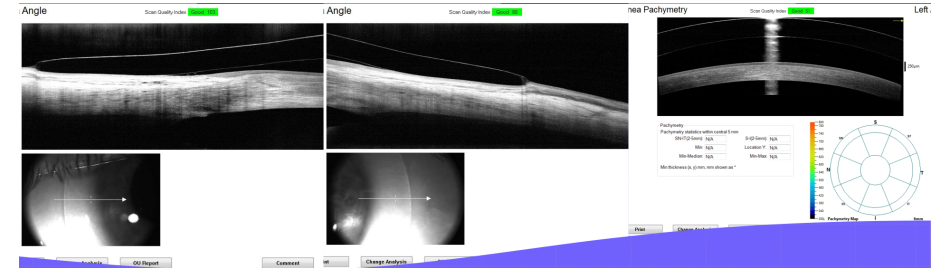
Patient Example JS OD

- Initial Lens:
 - Base Curve 7.30/Oblate
 - Diameter 17.0
 - Flat curve Flat 2 = -40 microns
 - Steep Curve Steep 4 = +80 microns
 - SAG 5500 microns
 - Power -6.50 20/40-



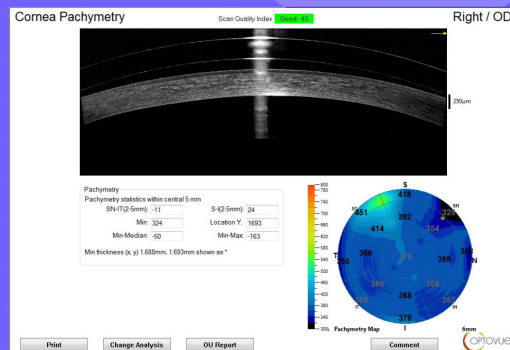
Patient JS OS

- Initial Lens:
 - Base Curve 7.30/Oblate
 - Diameter 17.0
 - Flat Curve Flat 2 = -40 microns
 - Steep curve Steep 2 = +40 microns
 - SAG 5750 microns
 - Power -7.00 20/25-



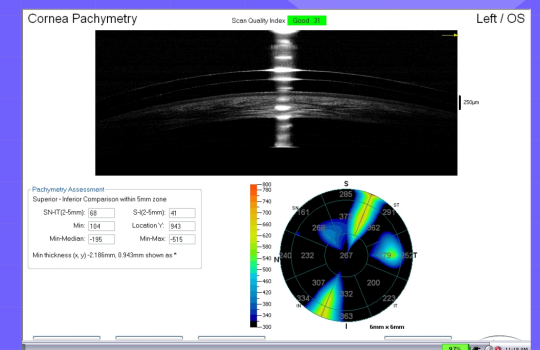
Patient Example JS OD

- Final Lens
 - Base Curve 7.30/Oblate
 - Diameter 17.0
 - Flat Curve Standard (Steep by 40)
 - Steep curve +80 microns (same)
 - Limbal Curve added 50
 - SAG 5650 (added 150)
 - Power -650-075X125 VA 20/25-2



Patient Example JS OS

- Final Lens:
 - Base Curve 7.30
 - Diameter 17.0
 - Flat Curve +40 microns (steep by 80)
 - Steep Curve +40 microns (same)
 - SAG 5500 (decreased 250)
 - Power -675-050X090 20/20+2



Patient Example JS

- JS has the best Visual Acuity he has ever had free from glare and distortion!
- Due to Scleral lens wear he no longer needs lifitegrast or punctal plugs he only occasionally uses PF AT's PRN.
- JS is able to do his job travelling the state and country wearing his lenses for 14-18 hours a day with stable non fluctuating vision.

Patient Everest

- Pt presents with previous Dx of Keratoconus
- Unable to wear glasses or soft contact lenses. Current RGP lenses give him little improvement and he can wear for a maximum of 2 hours.
- Entering acuity WITH RGP lenses OD HM @ 2 feet, OS HM @5 feet.
- Pt unable to leave his home, no job, can't drive basically home bound secondary to decreased vision.

Patient Everest

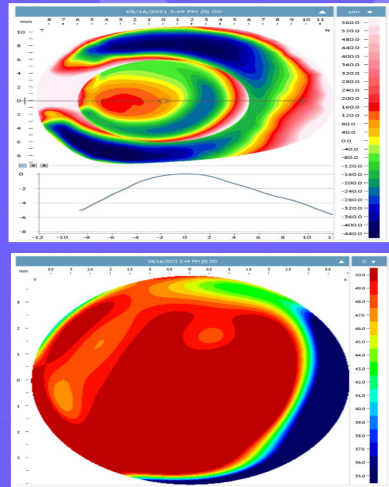
- Everest has strong family history of blindness
- Had two family members go blind from PKP surgeries in the past
- Does NOT want any surgery
- Looking for a way to have functional vision

Patient Everest

- BVA:
- OD -12.00 HM 5 feet
- OS -10.75-1.00X170 HM 10 feet
- K's OD: 69.50/85.25@ 108 OS: 47.00/64.25@ 054
- Pt has 2mm corneal scar OD from previous Hydrops episode

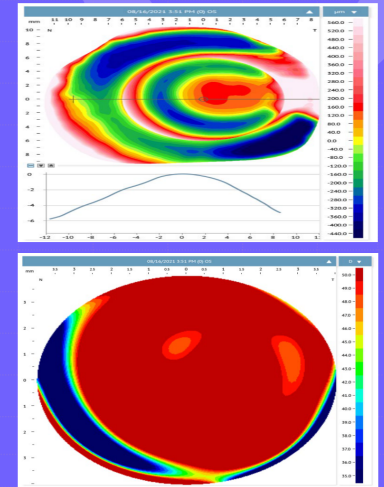
Patient Everest OD

- Steepest measurement on Topography (K MAX) 113.4D



Patient Everest OS

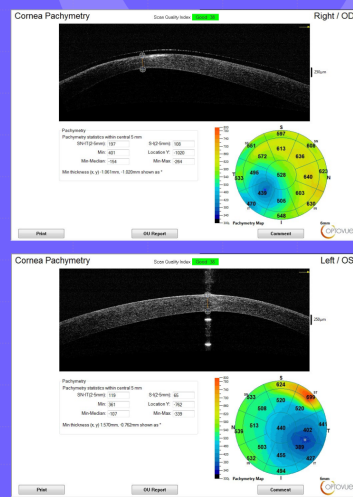
- Steepest point on topography
- (K MAX) 88.75D



Patient Everest

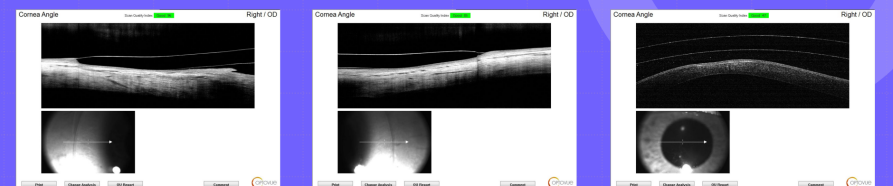
OD Thinnest part of Cone 274 microns

OS Thinnest point of Cone 388 microns

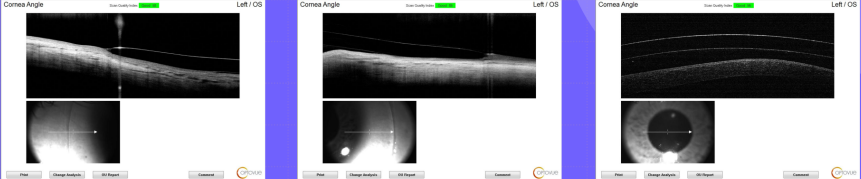


Patient Everest OD

- BC 7.30/Prolate/Quad Curve
- Diameter 17.0
- C1Flt 8 = -160, C2 Flt 6 = -120
- C3Flt 3 = -60, C4Stp 6 = +120
- SAG 5325
- -5.00 20/70+



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Patient Everest OS

- BC 7.80/ Prolate /Bi-Curve
 - Diameter 17.0
- C1Flat 4 = -80, C2Stp 4 = +80
 - SAG 5125
 - -1.00 20/40+2

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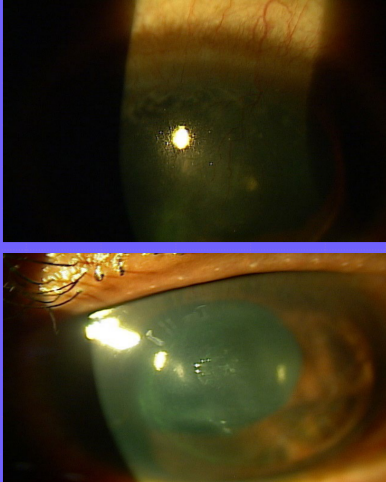
Patient Everest Final Lens

- OD
 - 7.30BC / Prolate/ QuadCurve
 - C1Flt6 = (stp 40) -120,
 - C2Flt4 = (stp 40) -80,
 - C3Flt1 = (stp 40) -20
 - C4Stp 7(stp 20) +140
 - SAG 6275
 - Rx: -625-075X125
 - VA 20/25-1
- OS
 - 7.80/ Prolate/ Bi-Curve
 - C1 Flt4 = -80
 - C2 Stp4 = +80
 - Added 75 to LC
 - SAG 5500
 - Rx: -125-175X068
 - VA 20/20+1

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Everest One Year Later

- Now has a Full Time Job and a Car
 - Leaves the house every day
 - Has a social life and a Girlfriend
 - Can't bear to be without his lenses
- Now removes lenses every 2-3 weeks "for a few hours"

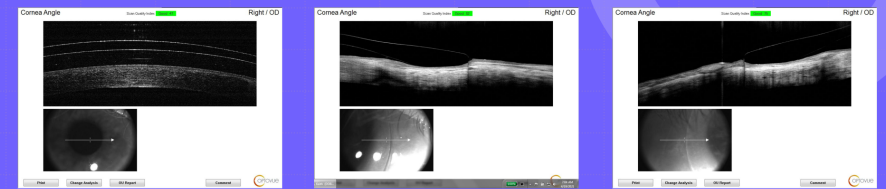
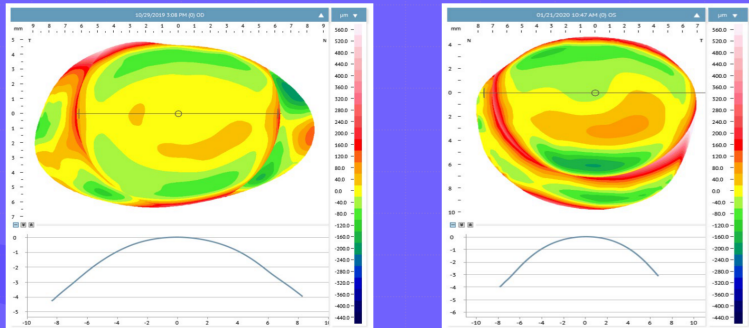


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Patient Flat Top

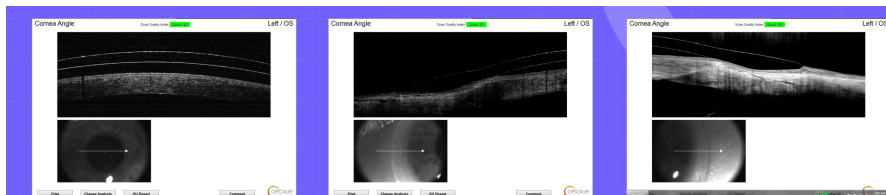
- Sent to our clinic by local Corneal Specialist
- 72 YO WM
- Had bilateral PKP 32 years ago secondary to Keratoconus
- Pt has become intolerant to RGP's
- Has Endothelial Cell count of approximately 1400 OU.
- MR: OD +100-375X060 20/100 OS +275-175X135 20/80
- K's OD 43.50/47.75 @ 018 OS 41.75/44.50 @ 043

Patient Flat Top



Patient Flat Top OD

- 7.00 BC/Oblate/Bi-Curve
 - Diameter 14.2
 - C1 Flat 1 = -30
- Steep Curve Standard
 - SAG 4350
 - Rx -2.87 20/25



Patient Flat Top OS

- 7.4 BC/Oblate/ Bi-Curve
 - Diameter 14.2
 - Flat Curve Flat 2 = -60
- Steep Curve Steep 1 = +30
 - SAG 4125
 - Rx +0.62 VA 20/20-2

Flat Top Final Lens

- | | |
|---|---|
| <ul style="list-style-type: none"> • OD • 6.9 BC/Oblate/Bicurve • C1 Stp 2 = +60 (increased 90) • C2 Stp 3 = +90 (Increased 90) • Added 50 microns to LC <ul style="list-style-type: none"> • SAG 4250 • Rx -3.12-1.25X060 • BVA 20/20-2 | <ul style="list-style-type: none"> • OS • 6.9 BC/Oblate/Bicurve • C1 Stp 1 = +30 (increased 90) • C2 Stp 3 = +90 (increased 60) • Added 50 microns to LC <ul style="list-style-type: none"> • SAG 4050 • Rx +275 • BVA 20/20 |
|---|---|

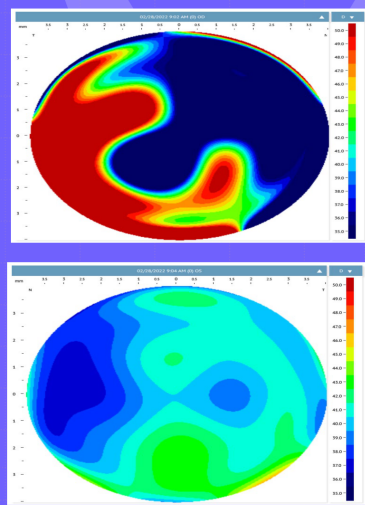
From RK to PKP

- Referred from local corneal Specialist current RGP irritating her graft
- Pt had RK OU in 1997, One incision became infected OD.
- Pt had to have a partial PKP OD to remove diseased cornea after infection cleared.
- Pt prefers glasses and decreased vision because her eyes don't hurt with glasses.

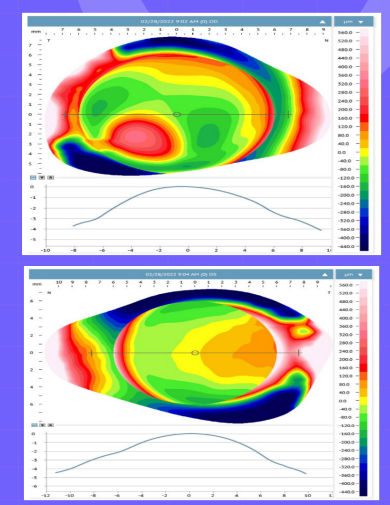
From RK to PKP

- Manifest Rx:
- OD -350-075X051 BVA 20/70
- OS -050-200X017 BVA 20/20
- K's:
- OD 34.25/47.50 @ 153
- OS 42.25/44.25 @ 092
- Endothelial Cell count OD Graft 1,830

From RK to PKP



From RK to PKP

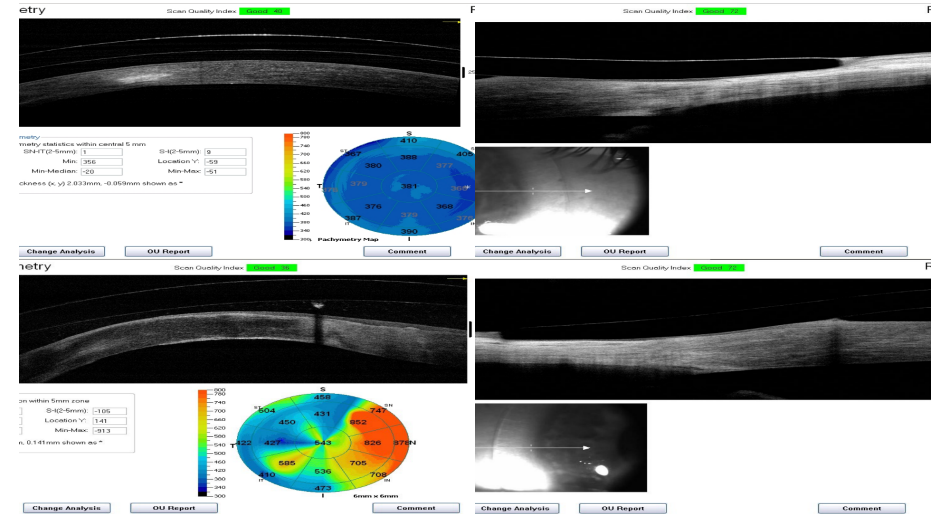


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From RK to PKP OD

- BC 9.00/ Oblate / Spherical edge
- Diameter 16.0
- Peripheral Curve Flat 2 = -40
- SAG 4820
- Rx +1.50
- VA 20/30 -2 "halos bother me, vision not clear"
- HOARMS 1.96 μm

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From RK to PKP OS

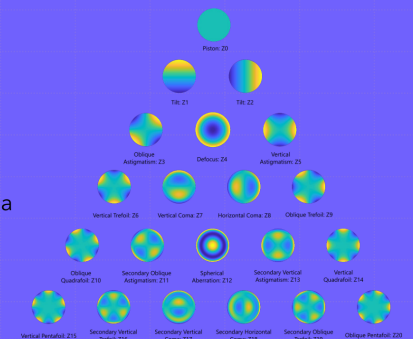
- BC 7.60/ Prolate/ Spherical edge
- Diameter 16.0
- Peripheral Curve Flat5 = -100
- Sag 4700
- Rx -375-100X015
- VA 20/20

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What are Zernike Polynomials?

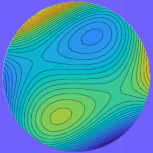
Zernike Polynomials:
Used for quantifying any possible aberration.

Similar to how Sphere quantifies myopia



Slides Courtesy of Nick Brown and Chen Chang OD

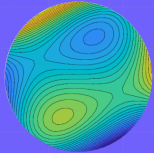
Zernike Polynomials Form the Recipe



Example Measured Wavefront

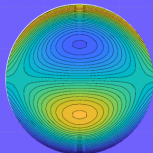
Slides Courtesy of Nick Brown and Chen Chang OD

Zernike Polynomials Form the Recipe



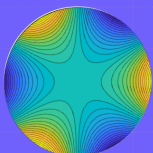
Example Measured Wavefront

=



Coma (Z7) Component

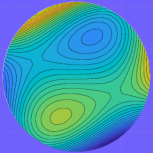
+



Trefoil (Z9) Component

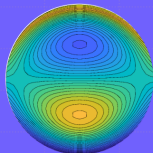
Slides Courtesy of Nick Brown and Chen Chang OD

Zernike Polynomials Form the Recipe



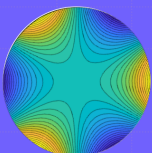
Example Measured Wavefront

=



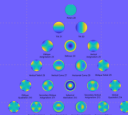
Coma (Z7) Component

+



Trefoil (Z9) Component

Zernikes: Communicate complex wavefronts by breaking them down into a recipe.



Slides Courtesy of Nick Brown and Chen Chang OD

The Clinical Process

- 1 Fit the Lens**

- 2 Measure Marked Lens**

- 3 Make HOA Lens**

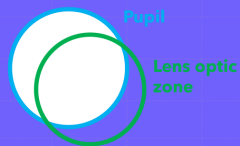
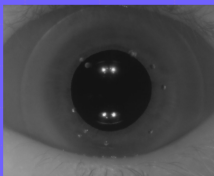

Slides Courtesy of Nick Brown and Chen Chang OD

1: Fitting the Lens

1 Fit the Lens



- Same as a normal fit, but...
- Heavy emphasis on **lens stability**
- How stable? Roughly $< 5-10$ degrees rotation
- Need to avoid optic zone limits
- Reduce decentration or ask for bigger optic zone



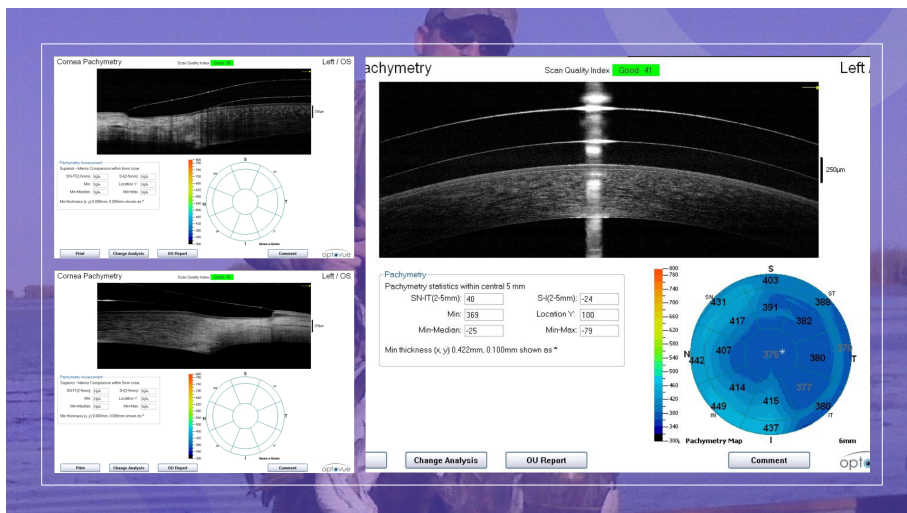
Slides Courtesy of Nick Brown and Chen Chang OD

2: Measure the Marked Lens ("LOA Lens")

2 Measure Marked Lens



- Order marked lens on *finalized fit*
- *Can't change it after this!*
- Let the lens fully stabilize
- Aberrometry measurement:
 - (1) Measures aberrations
 - (2) Measures position of the lens using marks
- *Measure big pupils! Dark room or dilate.*
- Submit scans for HOA design



From RK to PKP Final lens

- OD
 - 9.00 BC/ Oblate/ Spherical
 - C1 Steep 4 = +80 (stp by 120)
 - SAG 4870 (inc by 50)
 - Increased LC by 75
 - Rx +1.50
 - HOARMS corrected 0.37
 - VA 20/20 "It's perfect!"
- OS
 - BC 7.60/ Prolate/ Bicurve
 - C1 Flat 3 = -60 Add 20
 - C2 Flat 1 = -20 Add 80
 - SAG 4750 (inc by 50)
 - Rx -375-100 x 015
 - VA 20/15



THANK YOU!!!

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