

## Speaker Bio

Dr. Tiffany Andrzejewski graduated from the Illinois College of Optometry and completed a residency in Cornea and Contact Lens at Indiana University. Currently she resides in Chicago and is an optometrist at Chicago Cornea Consultants, where she has worked for the past 10 years. She also serves as an adjunct Assistant Professor of Optometry at the Illinois College of Optometry as well as the Chicago College of Optometry.

Her clinical work is dedicated exclusively to specialty contact lenses and surgical co-management. She strives to find the appropriate optical solution for each of her patients, utilizing new technology and industry developments as they become available.

Dr. Andrzejewski is a member of both the Illinois Optometric Association as well as the American Optometric Association, the Scleral Lens Educational Society, a Fellow of the American Academy of Optometry, and a member of the Gas Permeable Lens Institute advisory board.



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## Financial Disclosures

Bausch & Lomb Specialty Vision Products - speakers bureau, honorarium  
 Synergeyes - key opinion leader, consulting, honorarium  
 Essilor Contact Lenses - honorarium  
 Ocular Therapeutix - honorarium

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# SCLERAL CONTACT LENSES DIDN'T WORK - NOW WHAT!?!

Tiffany Andrzejewski, OD, FAAO  
Woo University  
April 20, 2022



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## LENS OPTIONS FOR THE IRREGULAR CORNEA

"Off-the-shelf" soft lenses

Custom/specialty soft lenses

Corneal GP lenses

Piggybacking

Hybrid Lenses

Scleral Lenses

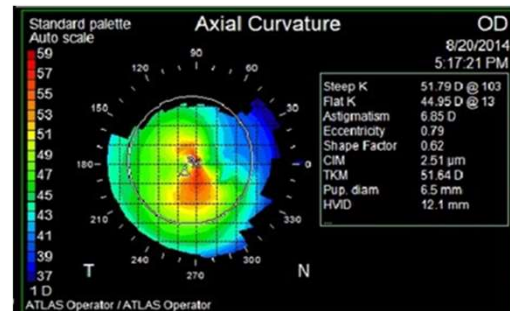
Scan/Impressed Based Scleral Lenses

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# SOFT CONTACT LENSES

Irregular cornea  $\neq$  gas permeable lenses only

- Mild irregularity..
- OR
- Topography is symmetrical centrally..
- OR
- Spectacle vision is acceptable..
- OR
- Patient is satisfied and is able to perform daily functions..



THEN soft lenses just may work!

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## SOFT CONTACT LENSES

Used if minimal optical distortion and adequate vision in glasses

Acceptable fit must be achieved

Options:

"Off-the-shelf" disposable soft lenses

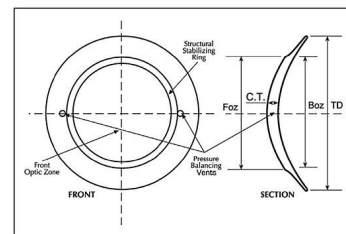
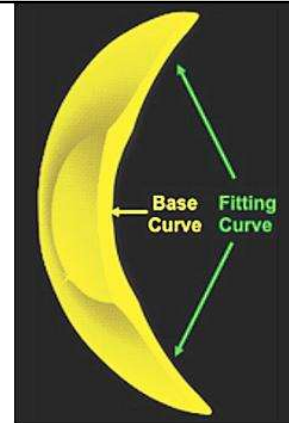
Extended range soft lenses

Conventional replacement custom soft lenses

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## SPECIALTY SOFT LENSES

- designed specifically to correct the irregular/keratoconic cornea
- two classes:
  - increased center thickness (CT) to mask irregular astigmatism
  - aspheric designs to limit aberrations



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## SPECIALTY SOFT LENSES

- Mild to moderate KCN and corneal irregularity
- Patients that are hesitant about trying gas permeable designs
- Fitting pearls:
  - Use highest possible Dk/t material whenever possible
  - Careful refraction, paying close attention to cylinder axis
  - Set proper patient expectations



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# SOFT CONTACT LENSES

## Advantages

- Very short adaptation time
- Comfortable
- Great for active lifestyles
- Greater familiarity

## Disadvantages

- Unstable vision
- Replacement schedule
- Higher risk of infection
- Do not correct all vision problems

## Mixed Reviews

- Cost
- Ease of fitting
- Handling can be challenging
- Oxygen transmissibility

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# CORNEAL GPS

## Advantages

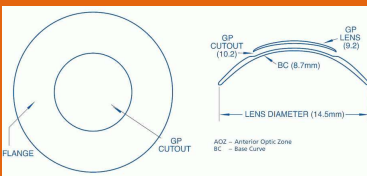
- High oxygen permeability
- Healthy corneal physiology maintained with active tear pump
- Durable
- Superior optics
- Relatively quick & inexpensive to manufacture
- Relatively easy for patients to handle

## Disadvantages

- Patient discomfort
- Longer adaptation period
- Possible instability - can pop out/shift off cornea
- Debris can get under the lens
- May require a few office visits for follow up fitting

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## WHAT ABOUT PIGGYBACKING?



### Advantages

- Soft lens cushions AND protects the cornea from the GP
- Soft lens covers the entire cornea eliminating debris
- Can help with GP stability and/or centration
- Can help avoid need for more complex/expensive lens designs

### Disadvantages

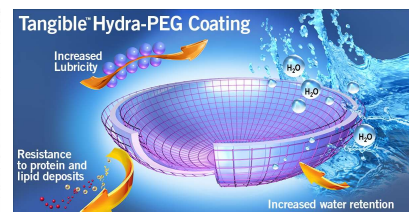
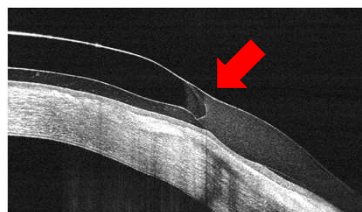
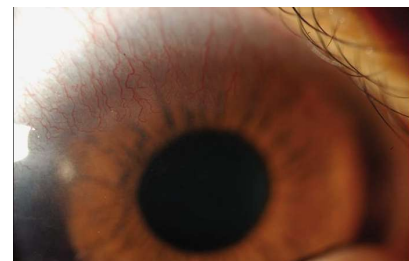
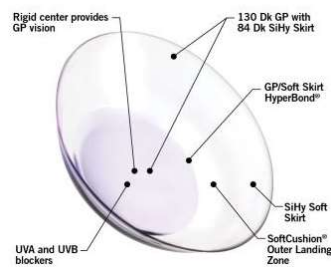
- Insertion, removal, care of 2 different lenses
- Must pay attention to Dk/t of the "system"
- SiHy can "wrinkle/flute" with more irregular/steeper inferior corneas

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## HYBRID CONTACT LENSES

Modern hybrid lenses take advantage of several features to improve lens comfort and performance

- vaulting of corneal apex/irregularity
- HyperBond™ junction prevents tearing
- incorporates hyper Dk soft and GP material
- Class II UV blocker: >80% of UVA & >95% UVB
- standard treatment with Hydra-PEG (2nd generation designs)



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## HYBRID CONTACT LENSES: ADVANTAGES

- Comfort
- Adaptation
- Centration
- Stability
- Quality of vision
- Protections
- Doesn't pop out!
- Less minus power necessary
- Convenience (1 lens vs 2)
- More rapid tear exchange (vs sclerals)
- Reduced PTL "fogging"/debris
- Fit with less clearance than sclerals
- Streamlined fitting approach (only OR 1x)

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## HYBRID CONTACT LENSES: DISADVANTAGES

- Handling
- 6 mo replacement schedule
- Potential hypoxia/edema (older generation)
- Cost
- Multiple solutions
- More complex fitting (initial chair time, attention to lens–cornea relationship)
- Limited customization
- Many not accommodate some highly asymmetric or irregular corneas

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# SCLERALS - WHAT'S WITH THE EXPLOSION???

- Sclerals have become the "IT" lens to prescribe for irregular cornea patients because:
  - Improved comfort
  - Stable optics
  - Can be customized in a myriad of ways
  - Ability to vault over any cornea no matter how steep/irregular

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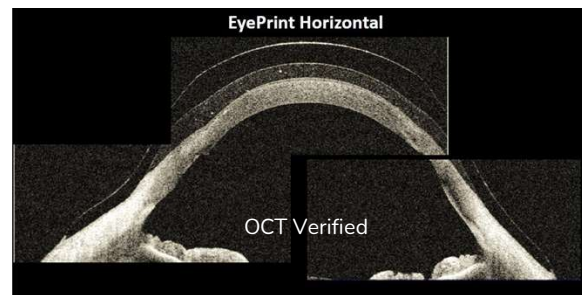
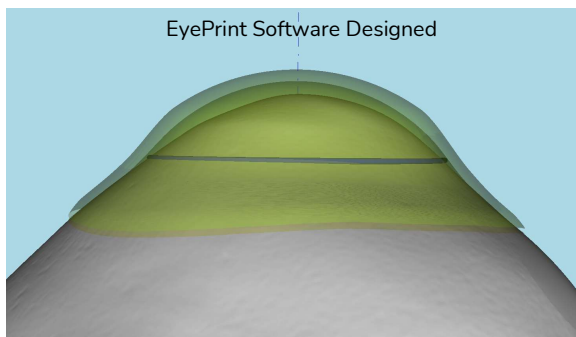
## SCLERAL LENSES - NOT SO EASY PEASY...

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	FIT	Can be difficult to obtain, multiple office visits Larger lenses require more toricity in their haptics
	VISION	Lenses tend to decenter inferiorly which can skew visual performance Lens "fogging" (surface vs tear reservoir vs corneal edema)
	PHYSIOLOGICAL CONCERNS	Decreased oxygen supply to the cornea Increased IOP?

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## SCAN/IMPRESSION BASED SCLERALS



- Allows for a prosthetic device to fit exactly over the specific anatomy of the eye
- Utilizes "elevation specific technology"

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## SCAN/IMPRESSION BASED SCLERALS: INDICATIONS

### Insufficient alignment of the scleral landing zone:

- Significant scleral asymmetry/toricity
- Conjunctival irregularities (pingueculae, pterygium, glaucoma bleb/drainage tubes)

### Atypical corneal profile:

- Highly asymmetric corneal apices (PMD)
- Proud plateau grafts
- Advanced nipple cones
- Any corneal shape that results in highly irregular tear layer pattern

### Need for precise control of optics

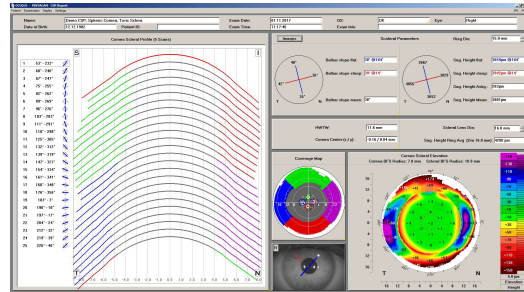
- Toric optics
- Decentered optics
- Prism
- Multifocal
- HOA correction

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# SCAN/IMPRESSION BASED SCLERALS



- Advantages
  - Precise fit from the very first lens
  - Stable optics
  - Quicker end result = less chair time
  - Stability = can correct HOAs
- Disadvantages
  - Cost
  - Special equipment needed
  - Availability



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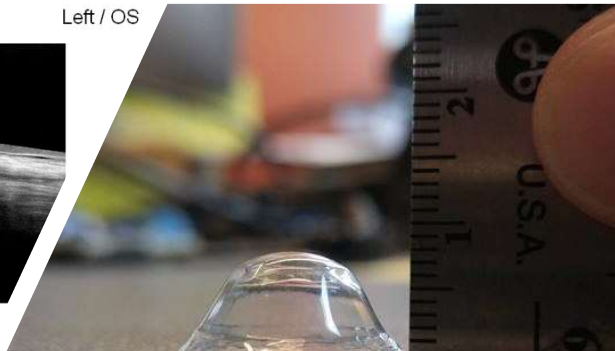
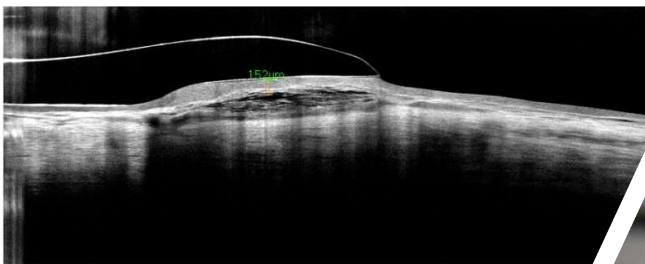


Select images  
courtesy of:  
Dr. Christine Sindt  
EyePrint PRO  
Dr. David Slater  
Dr. Ryan McKinnis

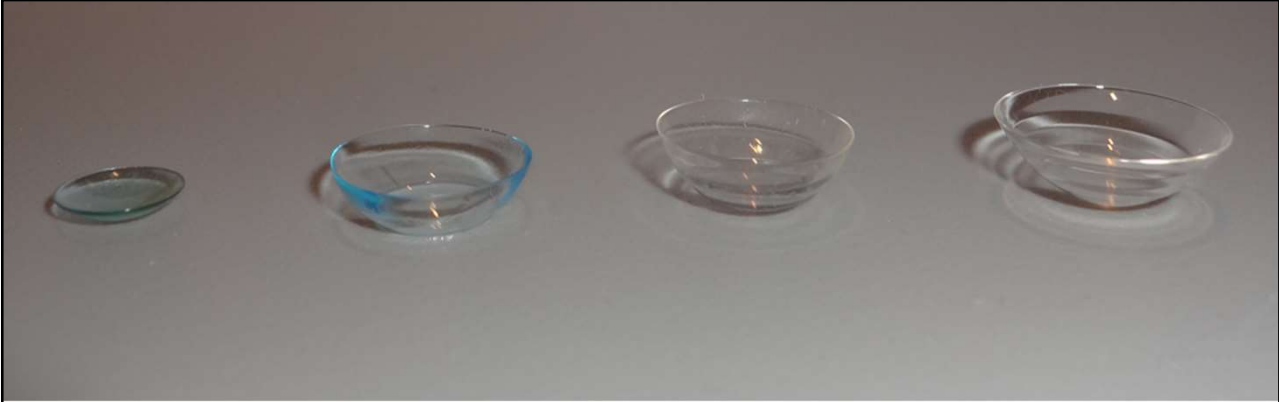
Cornea Angle

Scan Quality Index Good 34

Left / OS



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WHAT DETERMINES THE "RIGHT" LENS DESIGN?

- Patient History?
- Disease State?
- Vision?
- Oxygen?
- Ocular Geometry?
- Physiological response?

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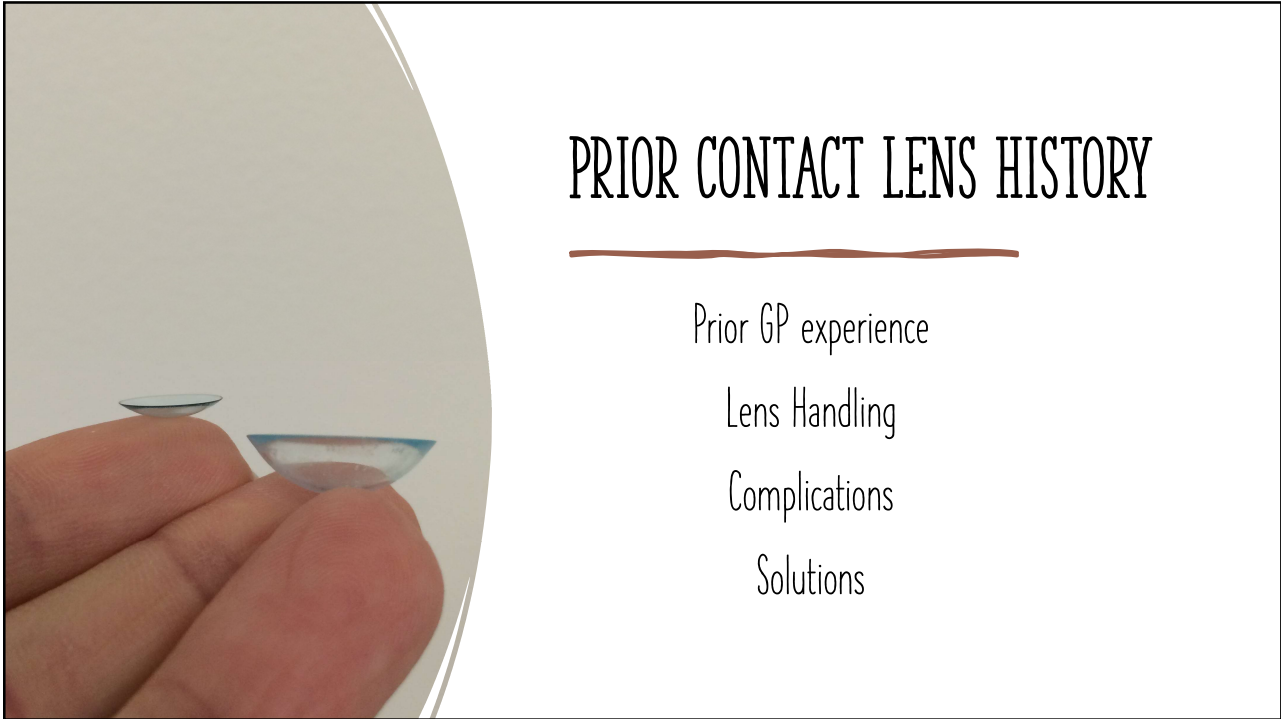


WHAT QUESTIONS SHOULD WE ASK?





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OCCUPATION/HOBBIES		<ul style="list-style-type: none"> <li>• Consideration of lens type/modality</li> </ul>	 <p>Credit: Dr. Tom Arnold</p>	
DEXTERITY/PHYSICAL LIMITATIONS		<ul style="list-style-type: none"> <li>• Protective eyewear</li> </ul>	 <p>Dalsey Adaptives</p>	
	<ul style="list-style-type: none"> <li>• Handling</li> <li>• Assistive devices</li> </ul>	 <p>i-ring</p>		
			S5 inserter	

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# MOTIVATION!

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## EYE ALIGNMENT


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Strabismus/Amblyopia

Stereo/Fusion


Protective Eyewear

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## ANTERIOR SEGMENT EVALUATION

- Pupil size (bright & dim)
- HVID/VVID, Fissure width
- Corneal status (neo, scarring, sutures, transplant)
- Lens status (cataracts, IOL, aphakia)
- Conjunctiva (pinguecula/pterygium, chalasis, trab/tube)
- Lid abnormalities (MGD, incomplete blinker)
- Dry eye evaluation



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## POSTERIOR SEG EVALUATION

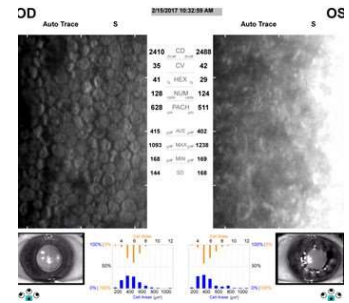
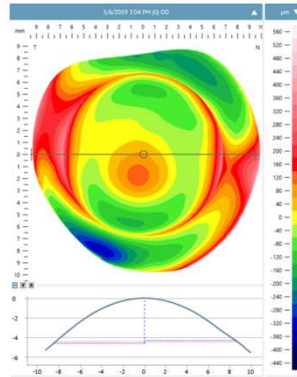
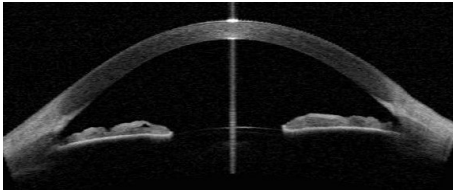
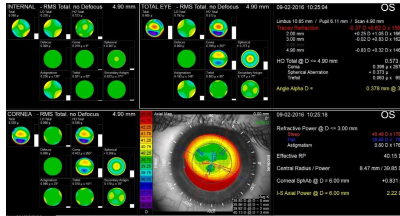
Retinal abnormalities

Past retinal surgeries

Visual limitations, including field

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# DIAGNOSTIC TESTING

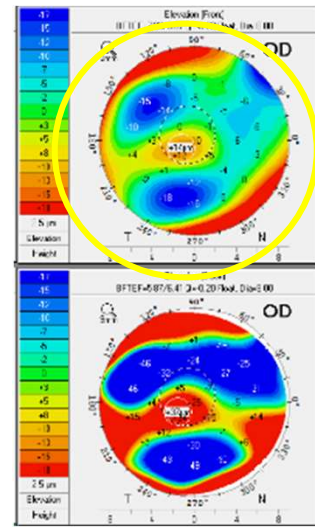
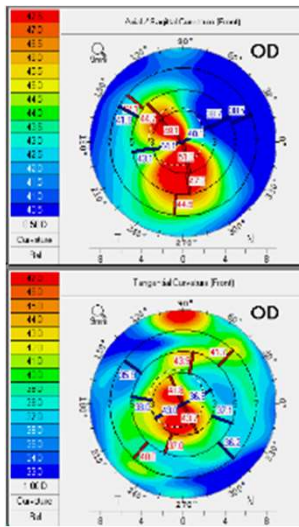


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# CONSIDER THE MAP

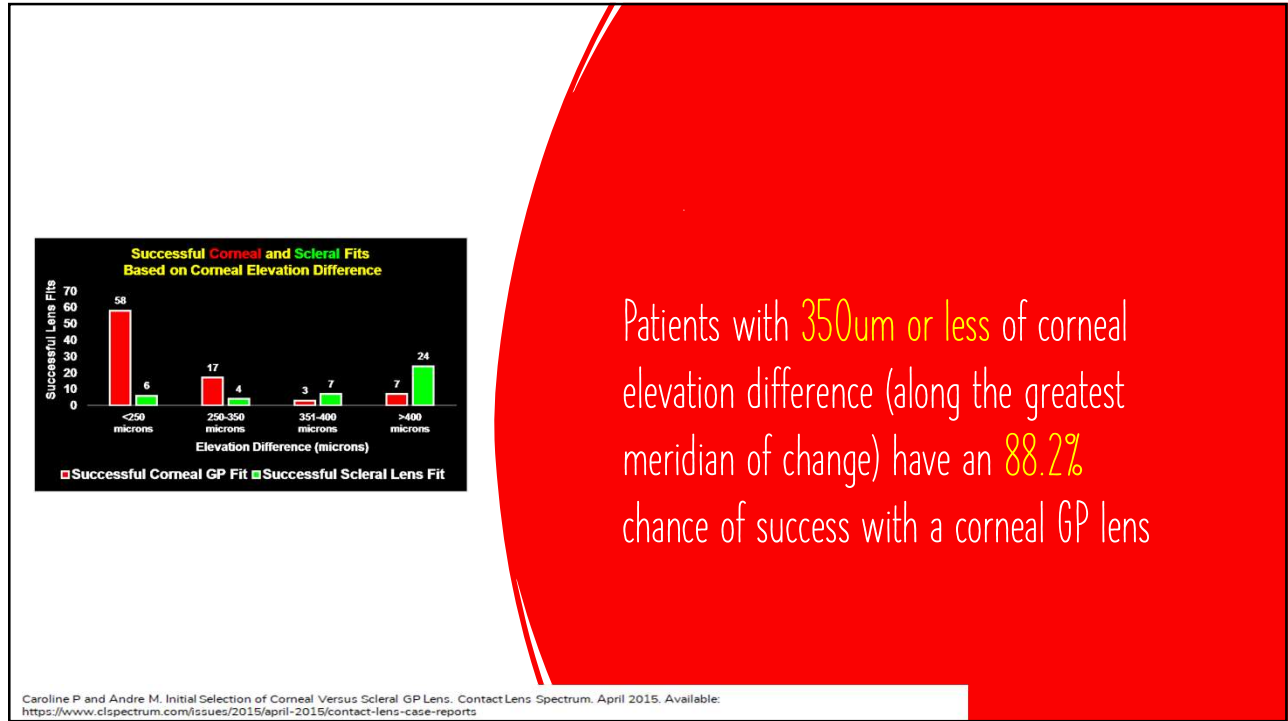


## AXIAL TANGENTIAL ELEVATION

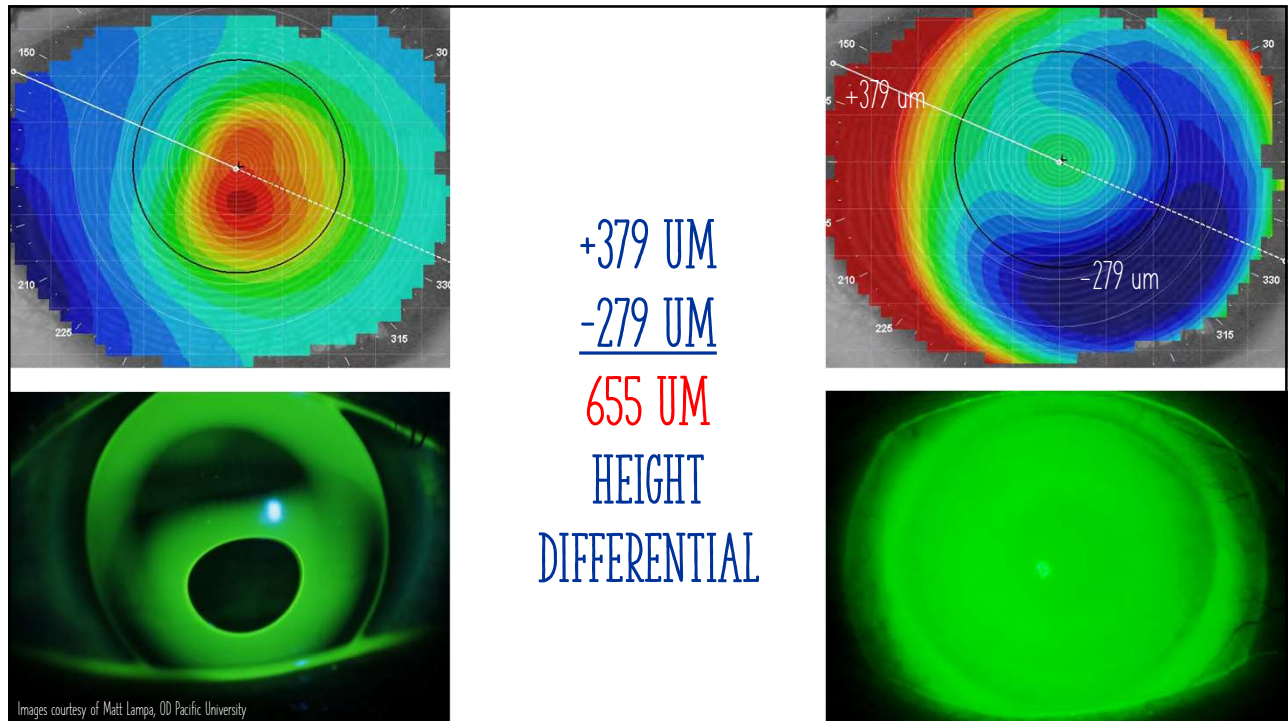


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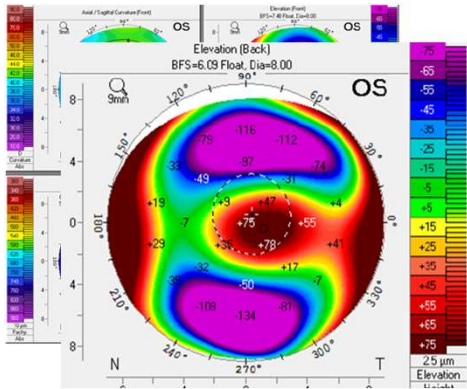


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## WATCH THE POSTERIOR ELEVATION!



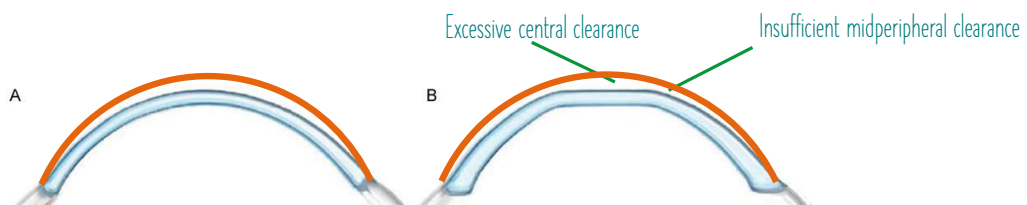
- If  $>100\mu\text{m}$  posterior back bowing, vision will be compromised
  - Reduced visual acuity
  - Increased aberrations
  - Worse with large pupils



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## CLASSIFYING CORNEAL SHAPE

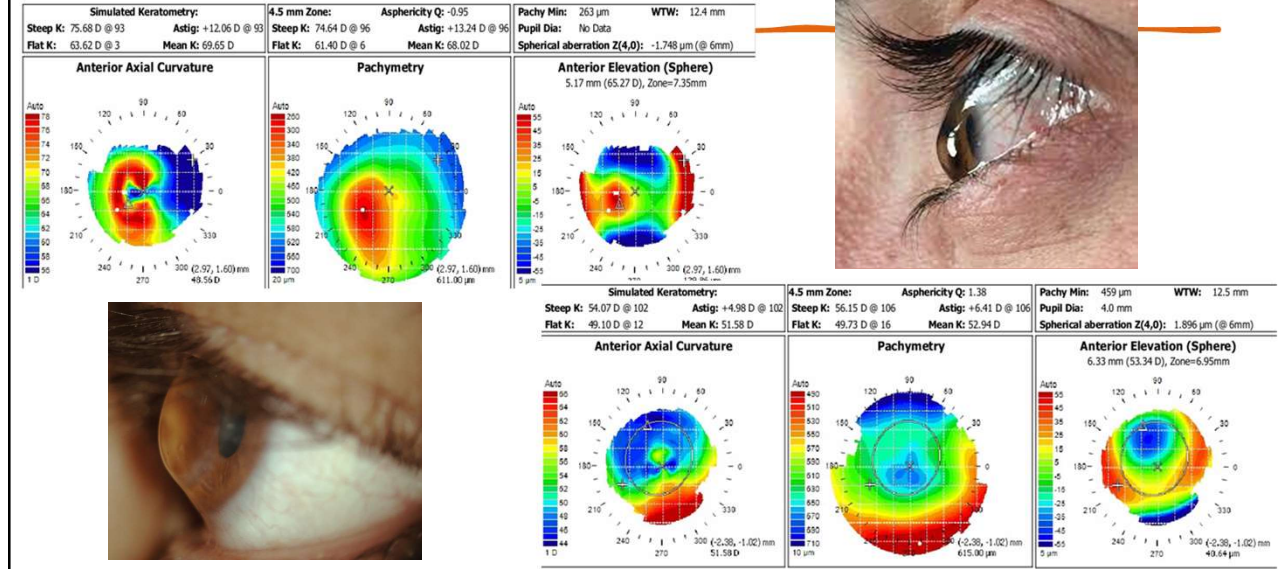
Prolate  
Oblate  
Tilted/Eccentric



Korean J Ophthalmol. 2009 Mar; 23(1):1-5

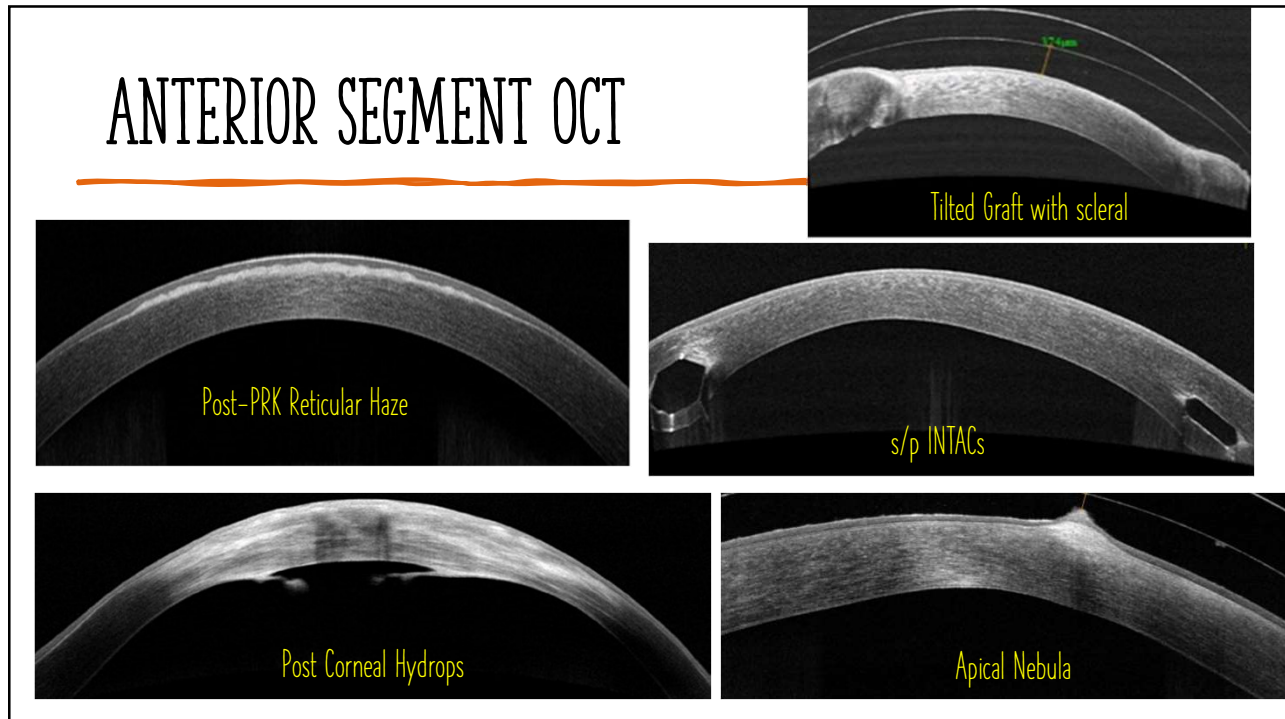
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# GRAFT SHAPE



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# ANTERIOR SEGMENT OCT



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# WHY DON'T SCLERAL LENSES ALWAYS WORK?

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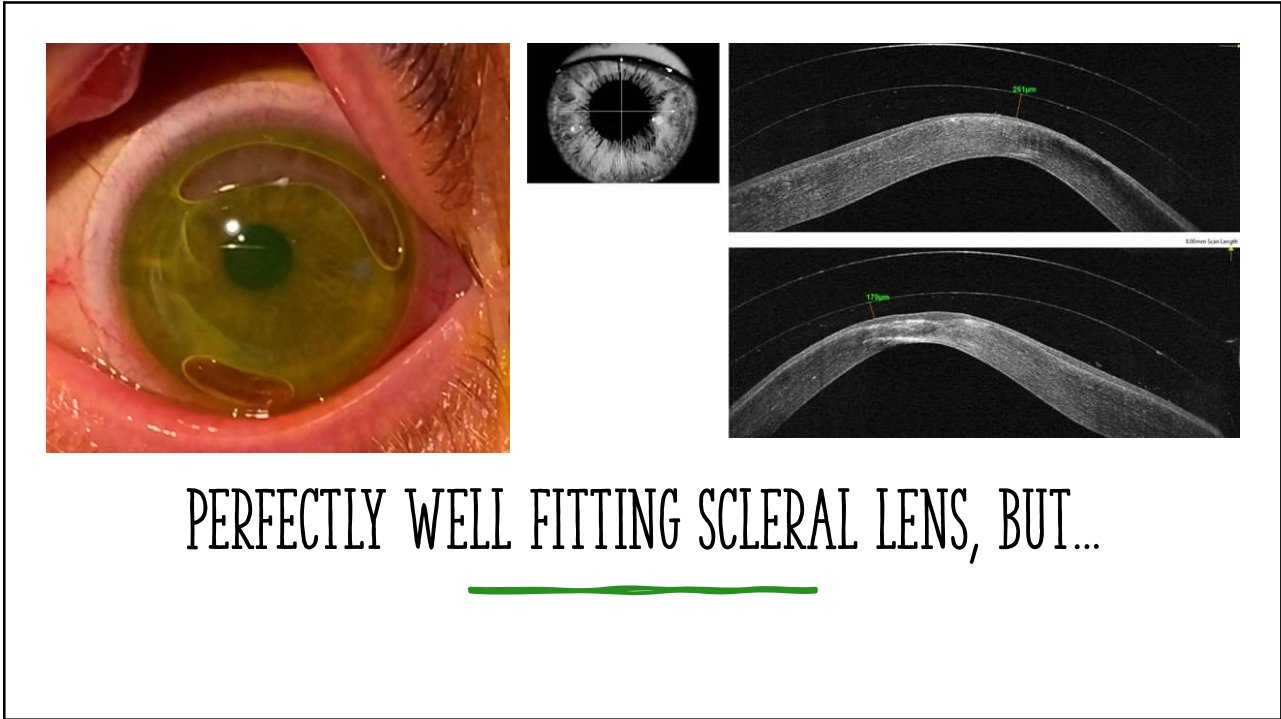
## SCLERAL LENS COMPLICATIONS

"User Error"

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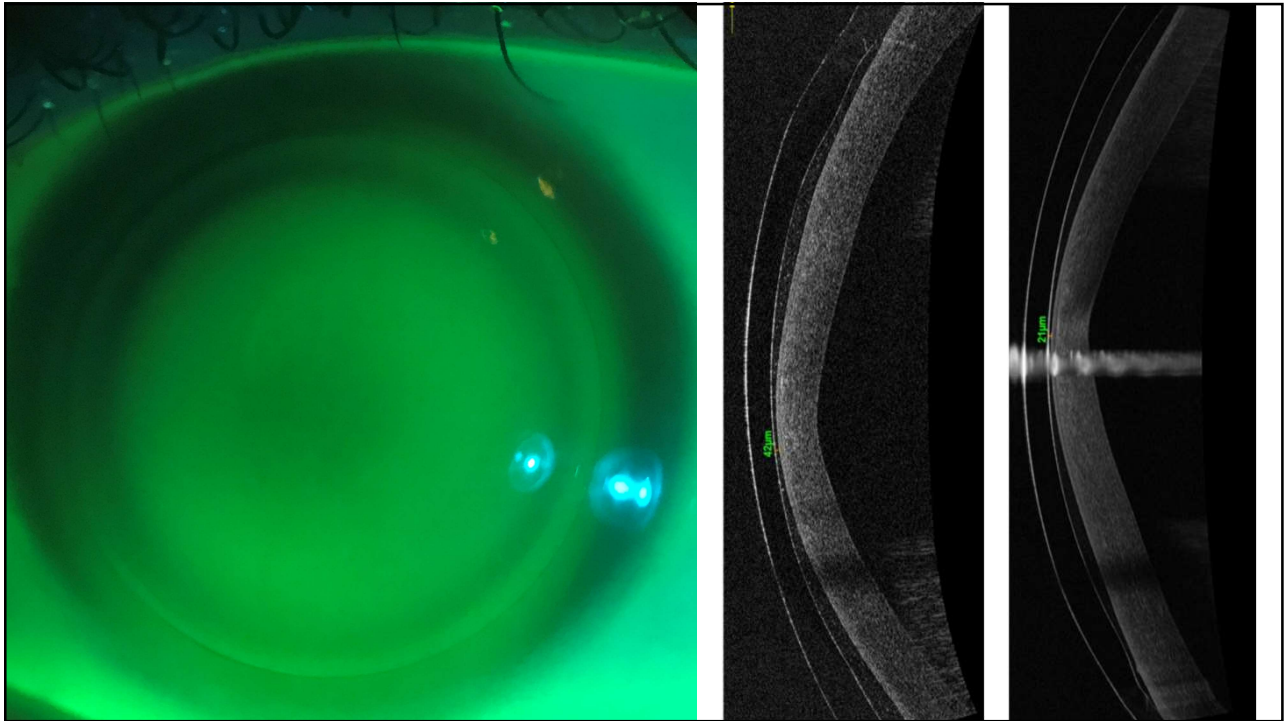


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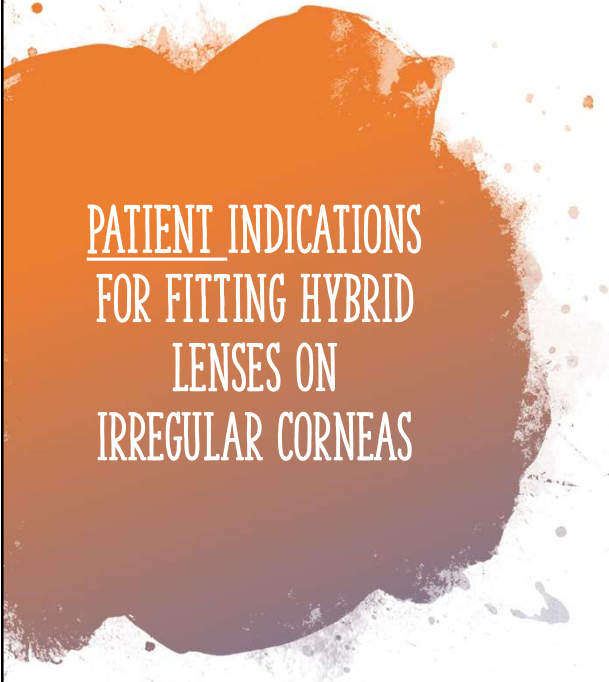








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PATIENT INDICATIONS  
 FOR FITTING HYBRID  
 LENSES ON  
 IRREGULAR CORNEAS

- Unilateral irregularity/kones
- Central irregularities
- Alternative and improvement over soft toric lenses
- Corneal GP failure due to
  - Poor Centration
  - Discomfort
  - Dislodgement
- Piggyback patients wanting to try new options or improve comfort
- Poor Scleral Lens candidate due to fogging, handling, cost, availability
- Dissatisfied with piggybacking due to cost, handling, hassle

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# CONTACT LENS CONTINUUM OF CARE - WHEN IS A HYBRID LENS A SUITABLE OPTION?

Corneal Condition*	Topography	Pachymetry	Keratometry Readings	Myopia, Astigmatism and Cone Location	Lens Choices
Forme Fruste	Topography shows eccentric steepening	Normal: 500µm or greater	Mean central K < 48.00D	Myopia and astigmatism less than 5.00D <sup>2</sup>	<ul style="list-style-type: none"> <li>• Soft toric</li> <li>• Custom soft toric</li> <li>• Corneal gas permeable</li> <li>• Hybrid</li> </ul>
Mild	Topography shows inferior steepening	Pachymetry is greater than 2 standard deviations from normal 550µm (less than 500µm)	Mean K ranges from 40.00D to 48.00D <sup>2</sup>	Myopia and astigmatism 5.00-8.00D	<ul style="list-style-type: none"> <li>• Corneal gas permeable: Keratoconic design</li> <li>• Hybrid</li> <li>• Thick custom soft: Keratoconic design</li> </ul>
Moderate	Topography shows significant steepening	Corneal thickness 300-400µm	Mean K ranges from 48.00D to 52.00D <sup>2</sup>	Location of cone is central or paracentral (2-5µm from center)	<ul style="list-style-type: none"> <li>• Hybrid</li> <li>• Scleral</li> </ul>
Severe	Topography shows significant steepening	Corneal thickness 200-300µm	Mean K greater than 52.00D <sup>2</sup>	Apex is peripheral (outside central 5µm)	<ul style="list-style-type: none"> <li>• Scleral</li> <li>• Custom scleral</li> </ul>
Surgical	Topography shows significant steepening Significant central scarring	Corneal thickness < 200µm		Refraction not measurable	

Courtesy of Jeffrey Sorsino, OD

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**PROPRIETARY SILICONE SKIRT (84DK)**

- Higher modulus: improves wearability while maintaining durability & resistance to protein binding
- Patent-pending HealthyEyes surface treatment increases wettability to maximize comfort

**PROPRIETARY GP CENTER (130DK)**

- Higher modulus = enhanced flexure control
- Class II UV blocker: >80% of UVA & >95% UVB
- Low wetting angle maintains moisture & comfort

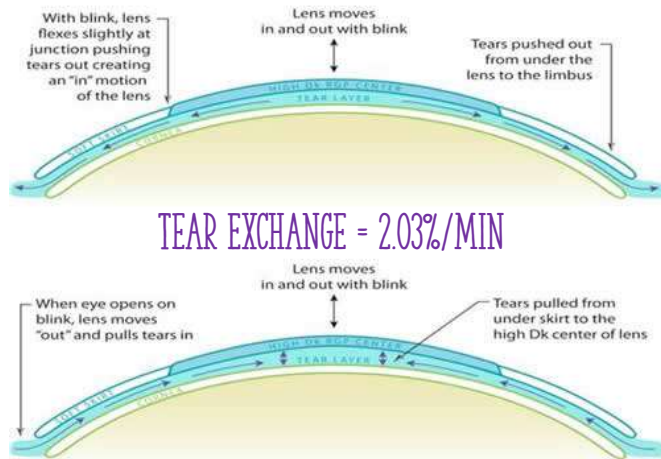
## HYBRIDS IN THE YEAR 2022

Optional Treatment with Hydra-PEG

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# RESULTS OF TERC STUDY

Incorporates hyper Dk material & a reverse geometry as a standard feature in all new hybrid designs for regular & irregular corneas

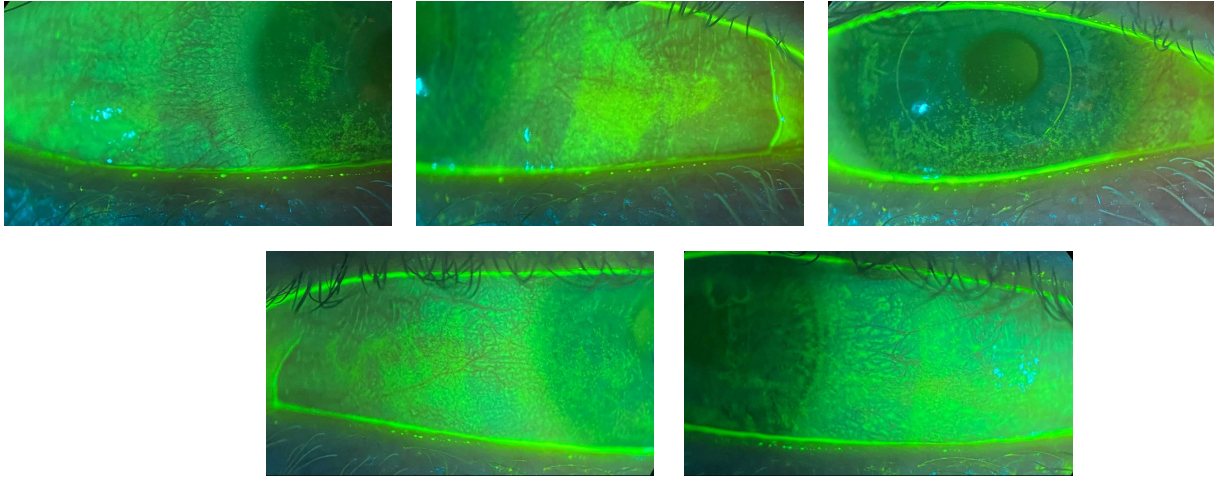


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# WEARING SCLERALS BUT EYES ARE STILL DRY...



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## SCLERAL LENS COMPLICATIONS

"User Error"

Fitting Issues

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EVERYTHING IS FOGGY...

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CURRENT  
THINKING ON  
MIDDAY FOGGING

Sequestered lipids, proteins, cell fragments, make-up, mixture of all these components

Can mostly be managed by lens fit and hygiene

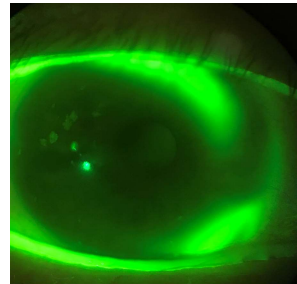
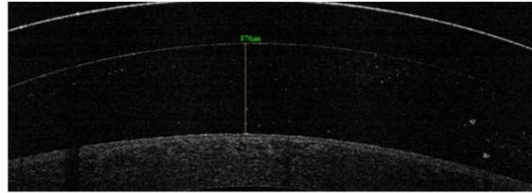
No apparent increase in inflammation

Visually FRUSTRATING!

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## CAUSES OF MDF

- Ocular Surface Disease
- Fit issues?
  - Poor haptic alignment
  - Excessive apical clearance
  - Excessive limbal clearance
  - Tight fit
- Corneal epithelial cell turn over



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## REDUCING MDF

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Reduce clearance

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Adjust landing zone

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Change solution...

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Address eyelid health

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Treat OSD/allergies

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Eyewash

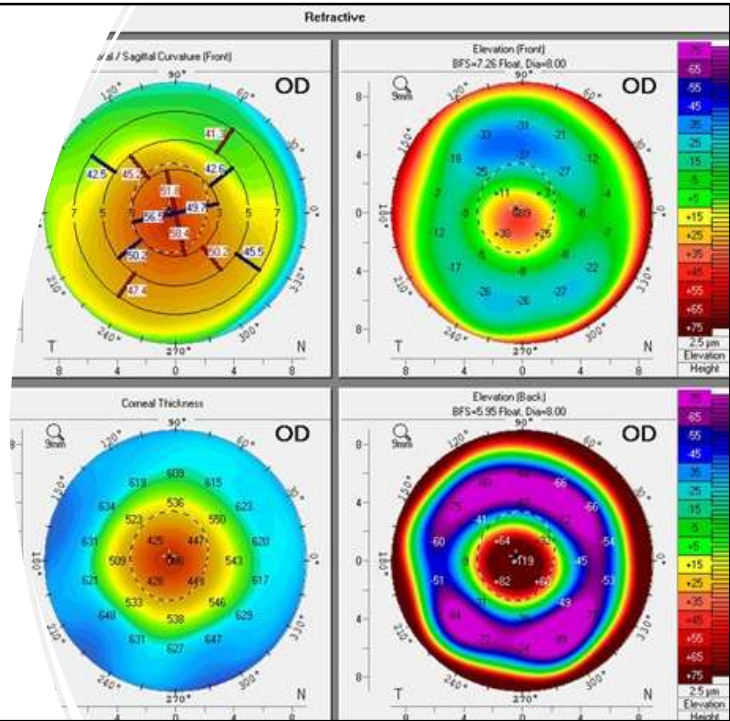
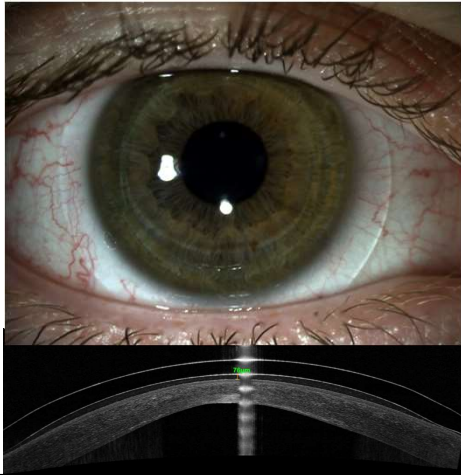
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REFIT???

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# ALTERNATIVE OPTION



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## HYBRIDS VS. SCLERALS

### PROs

- Soft part adapts to scleral shape
- Allows tear flow behind the lens - doesn't seal off
- Reduces post-lens tear layer "fogging"
- Fit with lower clearance
- Optics of the lens closer to entrance pupil
- Increased oxygenation
- Streamlined fitting approach

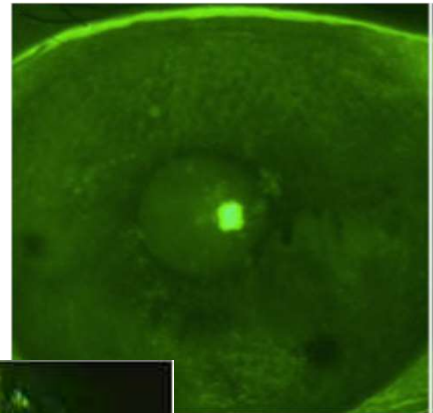
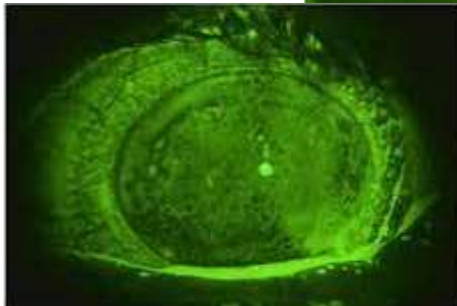
### CONs

- More difficult to fit with very asymmetric profile or very irregular corneas
- More frequent replacement
- Smaller OZ can result in issues with glare/flare
- Less customizable

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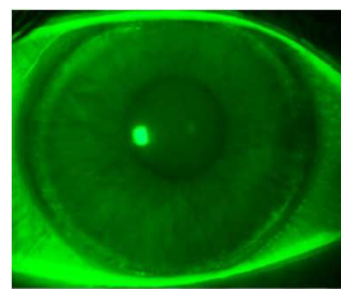
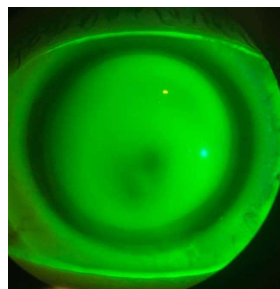
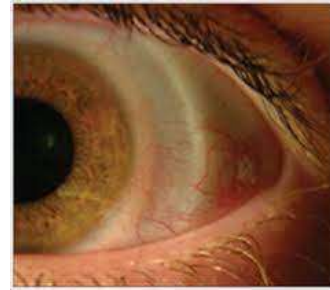
## EPITHELIAL BOGGING

- Cause unknown
- Does not appear to be a long-term effect
- Potential etiologies:
  - Loss of glycocalyx layer
  - Epithelial edema
  - Osmotic imbalance



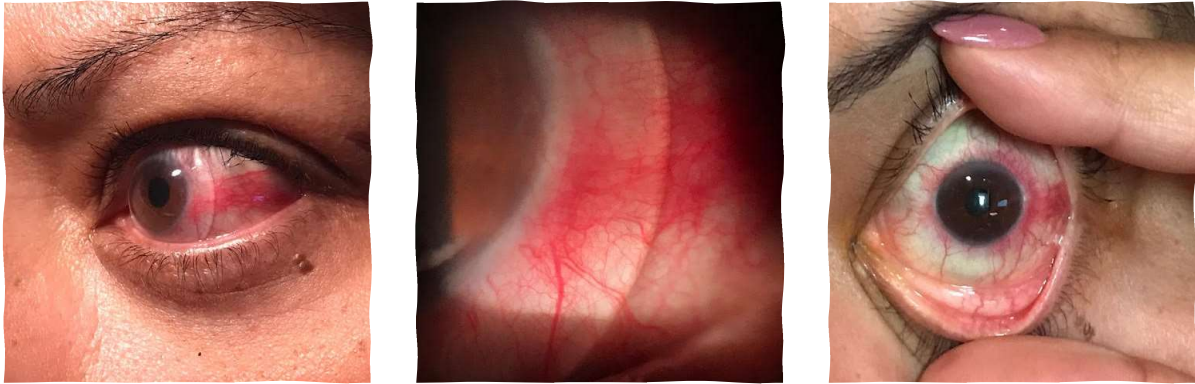
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## LIMBAL STAINING OR CHEMOSIS



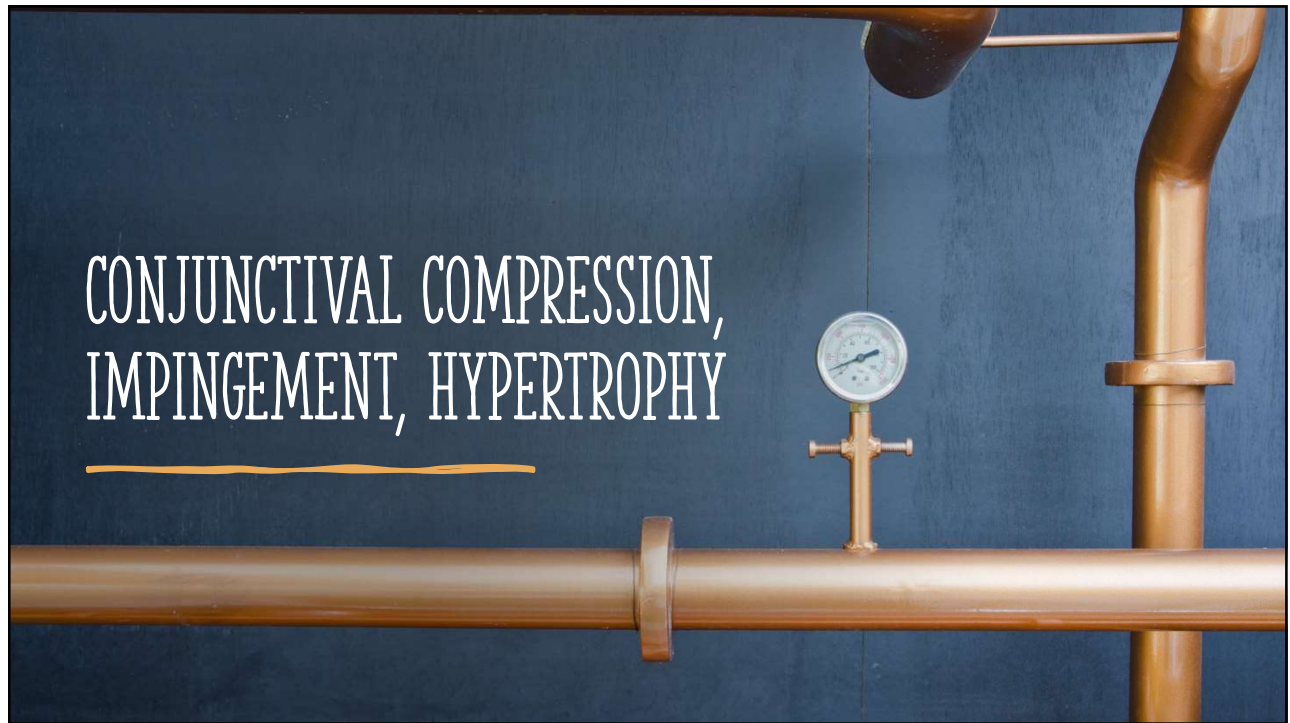
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I CAN SEE GREAT, BUT MAN ARE MY EYES RED...



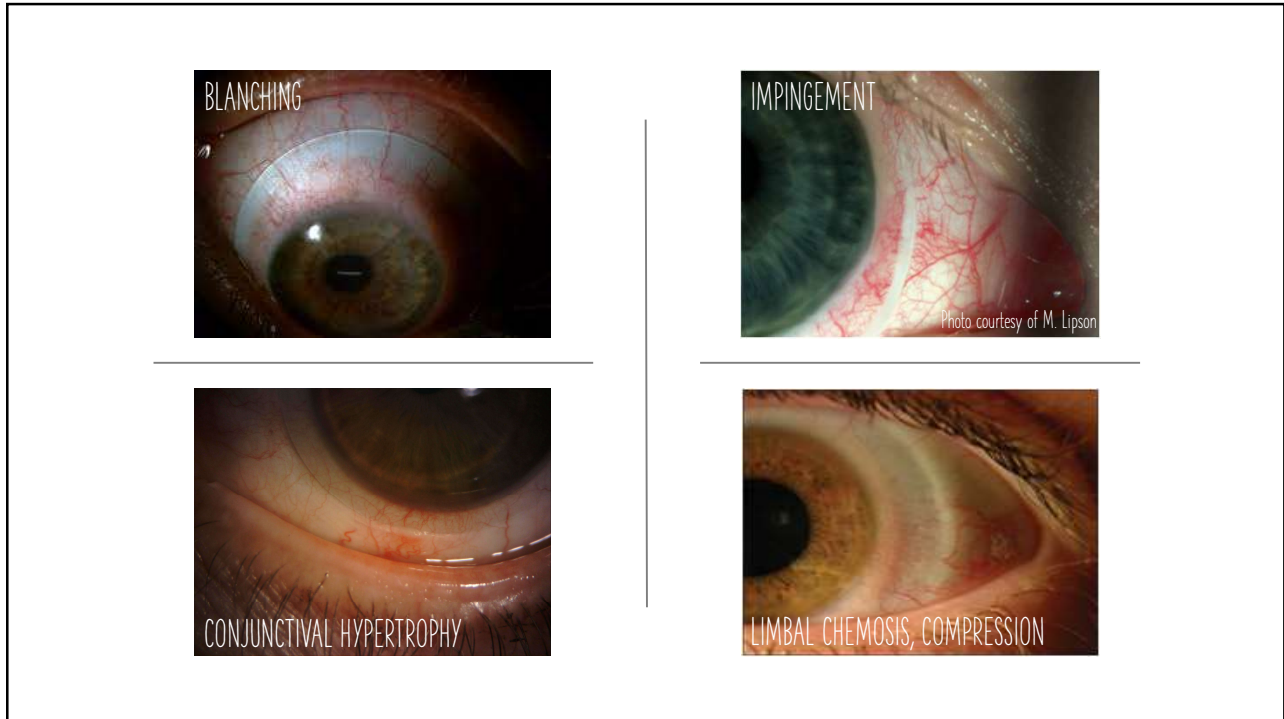
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CONJUNCTIVAL COMPRESSION,  
IMPINGEMENT, HYPERTROPHY



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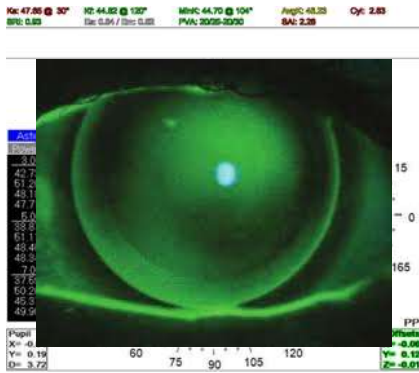




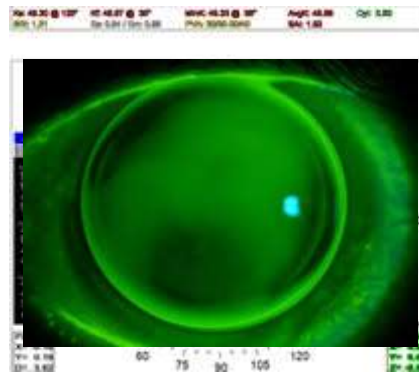
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## ALTERNATIVE OPTION

- c/o redness and discomfort with soft lenses
- Tried commercial sclerals had worse redness, suction, soreness
- Came to me wearing 17.5mm impression based sclerals that were 1.5 y/o



MR: -6.75+2.00x010 20/30  
BCVA with scleral = 20/25-2

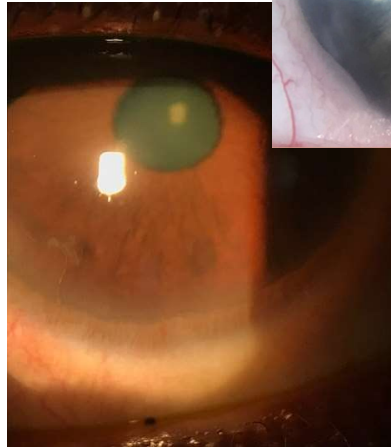


MR: -8.00+3.00x020 20/40+2  
BCVA with scleral = 20/30+2

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# CONJUNCTIVAL PROLAPSE

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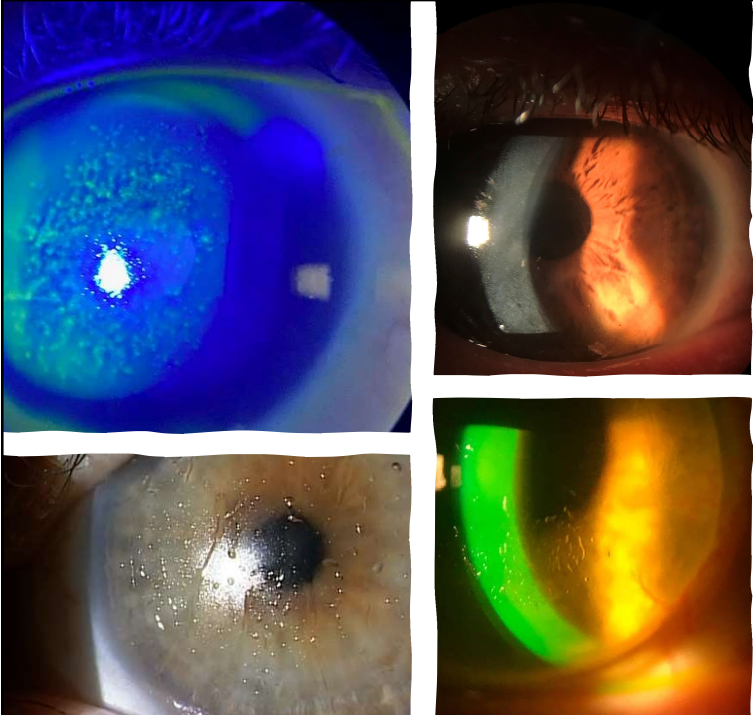


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## SCLERAL LENS COMPLICATIONS

- "User Error"
- Fitting Issues
- Vision Issues

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## POOR WETTABILITY

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- Causes:
  - Hydrophobic material
  - OSD
  - Hand lotion
  - Cosmetics
  - Dirty suction cups

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**MY VISION IS WORSE WITH MY SCLERAL THAN MY GLASSES**

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## ALTERNATIVE OPTION

- c/o shadowing & glare with scleral OD>OS, concerned that KCN is getting worse

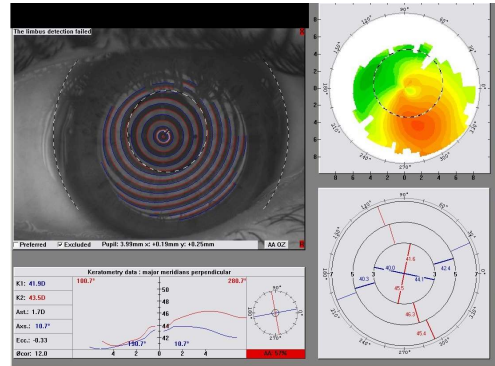
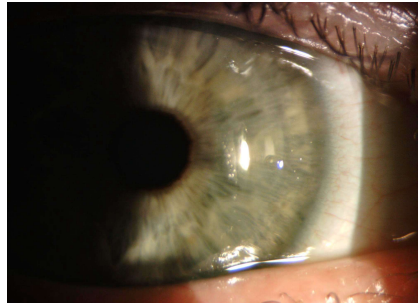
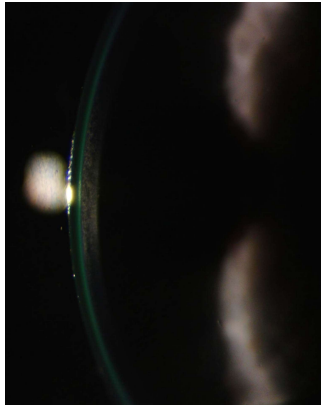
MR: -3.25-2.50x090 20/20 BCVA with scleral = 20/25-2

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# ALTERNATIVE OPTION

- Tried commercial soft toric → Experienced fluting
- Tried custom soft toric → Experienced fluctuating vision
- Specialty keratoconic soft toric → Good stability, vision just as good as SRx

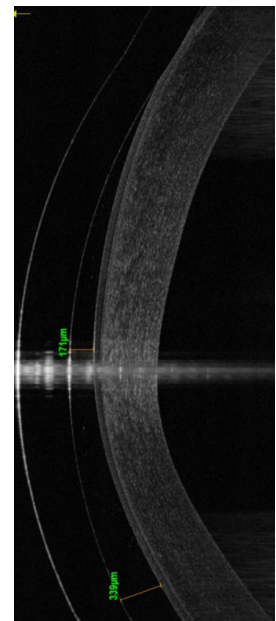
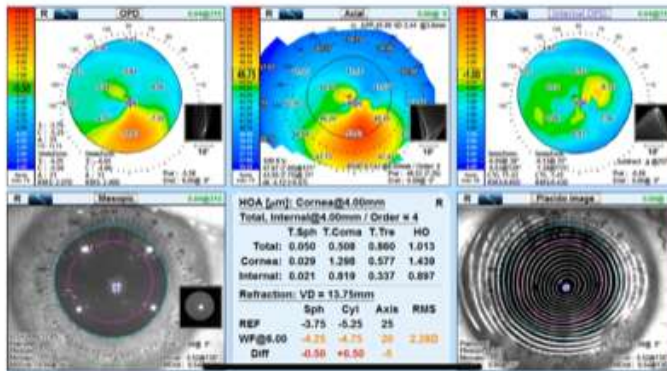


8.8BC/8.4 fit curve/15.0/-3.75-1.75x090/IT=1 BCVA = 20/15-2

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# HOAs vs RESIDUAL ASTIGMATISM

## Posterior Corneal Shape Anomaly Induced Internal HOAs



Oskika T, Sugita G, Miyata K, et al. Influence of tilt and decentration of scleral-sutured intraocular lens on ocular higher-order wavefront aberration. British Journal of Ophthalmology 2007;91:185-188

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# SCLERAL LENS COMPLICATIONS

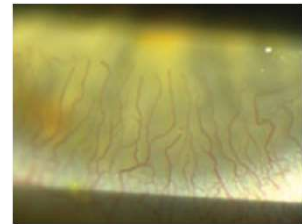
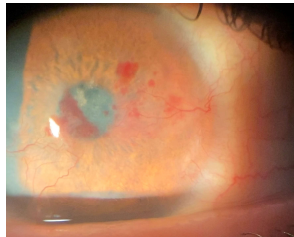
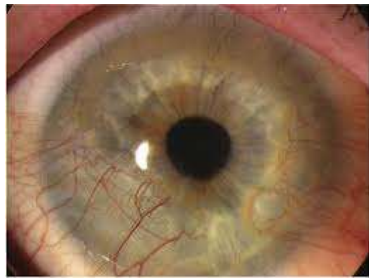
"User Error"

Fitting Issues

Vision Issues

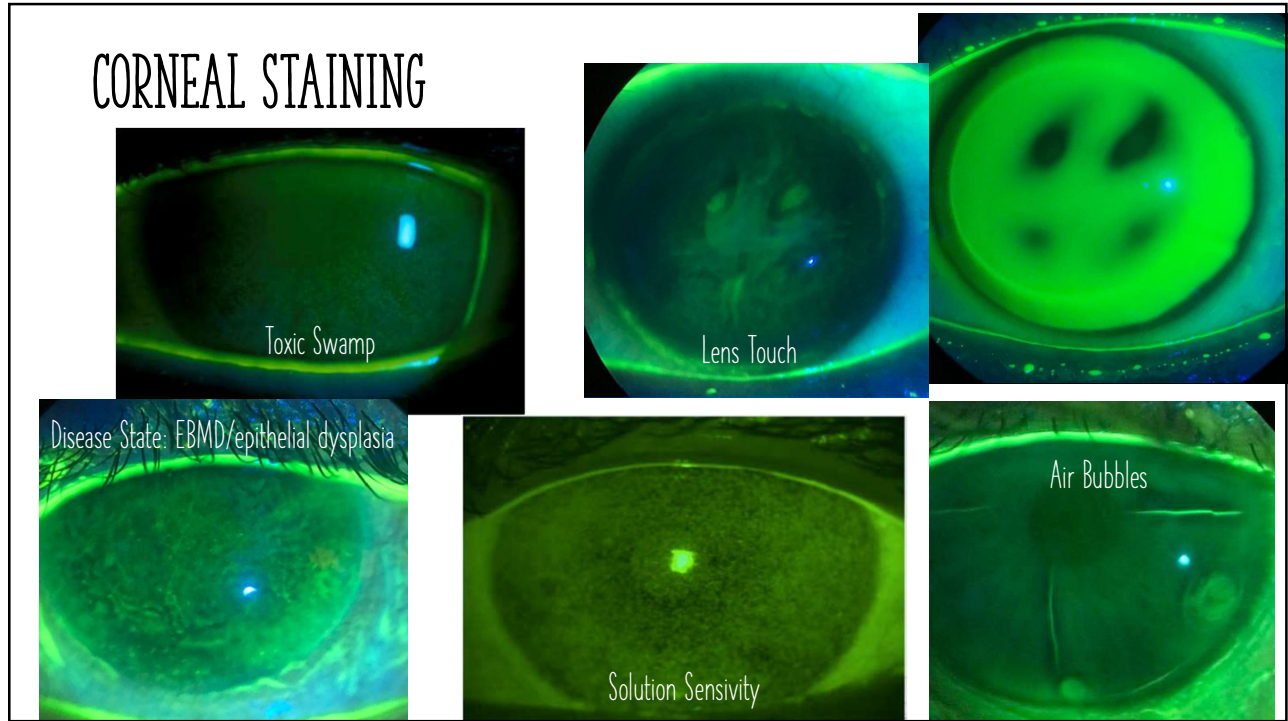
Health Issues

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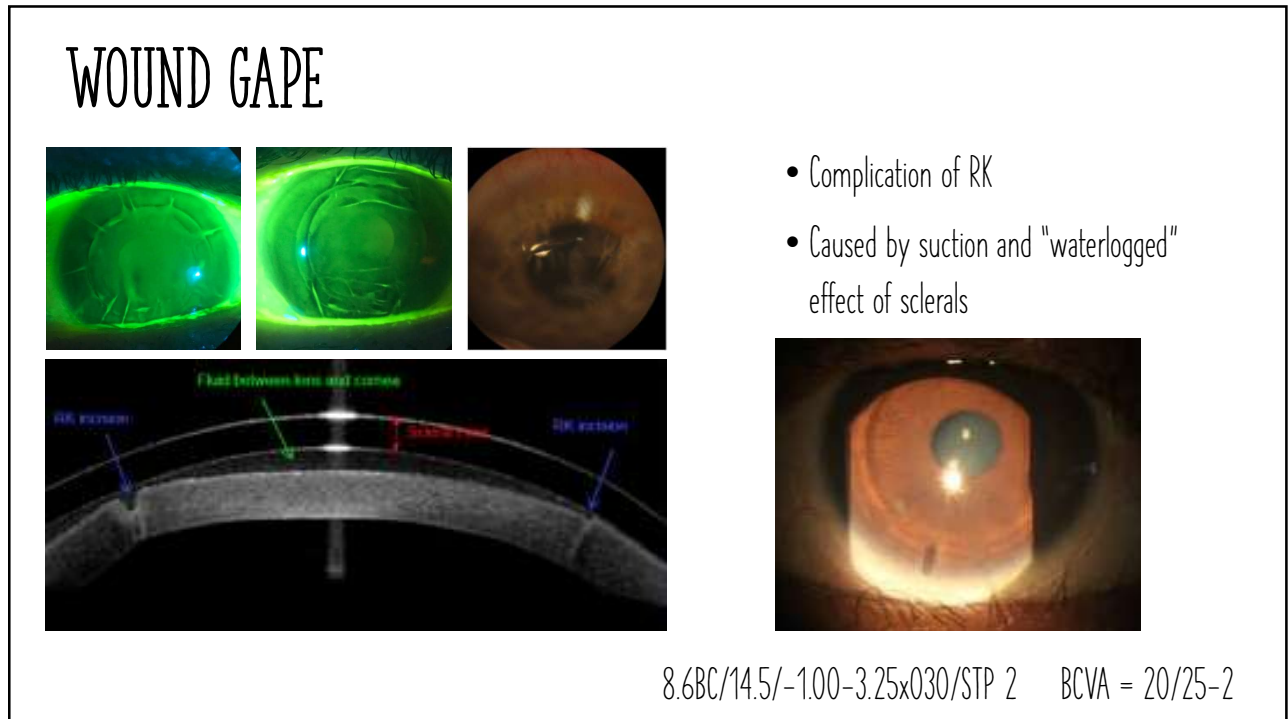


## CORNEAL NEOVASCULARIZATION

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## GPC/OCULAR ALLERGIES



Set Expectations	May be more susceptible to MDF
Optimize the Fit	Avoid mechanical irritation from ill-fitting haptic
Optimize the Surface	Low wetting angle materials, polyethylene glycol coating
Optimize Lens Hygiene	Digitally rub, H2O2 solutions, consider more abrasive cleaners
Eliminate Preservatives	Preservatives are proinflammatory
Use Pharmacologics	Oral antihistamines, topical antihistamines/mast-cell stabilizers, topical cyclosporine, topical steroids

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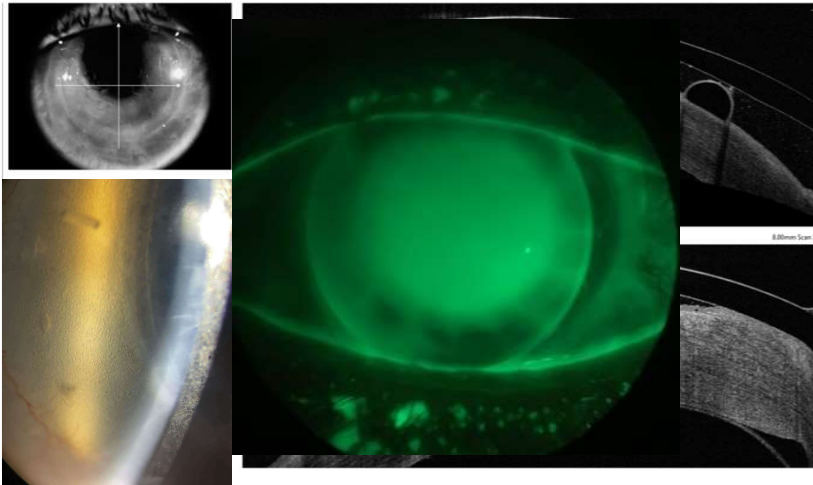
## INFECTIOUS KERATITIS

- Low incidence
  - Only 70,000 wearers vs 30 million commercial soft wearer
- Likely same risk factors as soft lens wearers at play
  - Poor hygiene, overnight wear, exposure to tap water
- Seen in the presence of compromised ocular surface + immunosuppressive therapy
  - Higher risk in OSD, pre-existing epithelial defects, post-surgical cases

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# CORNEAL EDEMA



- There is little evidence that a clinically significant corneal edematous response is provoked by today's modern sclerals in healthy eyes (~2%)
- Use caution in transplants (~4%) and eyes with endothelial dysfunction

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## SCLERAL LENS CONTRAINDICATIONS

Corneal Endothelial Compromise

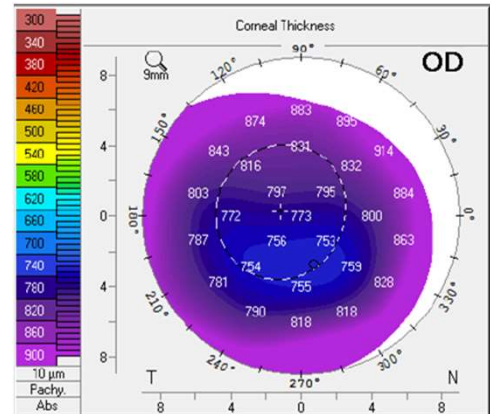
Glaucoma

Overnight Wear

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# PACHYMETRY

- Indirect way measure endoth function
- Mean central thickness 540 +/- 30um
- CCT > 700um  $\Rightarrow$  decompensation
- Change > 40-50um significant
- 4 ways to measure:
  - Ultrasound
  - Optical: Scheimpflug, OCT, specular microscopy



Barnett, Melissa, and Lynette K. Johns, eds. *Contemporary Scleral Lenses: Theory and Application*. Vol. 4. Bentham Science Publishers, 2017.

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## SPECULAR MICROSCOPY

Cell Density

Cell Size Variations (polymegathism)

Cell Shape Variations (pleomorphism)

Corneal Thickness (pachymetry)

Overall Morphology/Health/Clarity

Sindt, C. Endothelial Considerations in Scleral Lens Wear. AiLES June 2018.

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# SPECULAR MICROSCOPY: WHAT ARE WE LOOKING AT?

**OD Auto Trace S** 12/11/2017 1:51

2740	CD	µm²/mm²
30	CV	%
48	HEX	%
144	NUM	cells
598	PACH	µm
365	µm	µm
739	µm	µm
172	µm	µm
109	µm	µm

**HEX = % of hexagonal cells**  
Indicative of pleomorphism  
> 50% is normal

**CD = Cell Density (cells/mm<sup>2</sup>)**  
High density is better

**CV = Coefficient of Variation**  
>0.40 is abnormal  
Large CV = wide variety in size

**NUM = # of cells analyzed in the sample**  
Higher # is better statistically

**PACH = corneal thickness**

KONAI MEDICA

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**OD Auto Trace S** 5/4/2017 2:31:08 PM

2475	CD	µm²/mm²	2538
30	CV	%	42
49	HEX	%	41
128	NUM	cells	134
---	PACH	µm	---
404	µm	µm	394
760	µm	µm	1055
185	µm	µm	130
121	µm	µm	165

**OS Auto Trace S**

SPECULAR MICROSCOPY: WHAT ARE WE LOOKING AT?

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## TAKE HOME POINTS

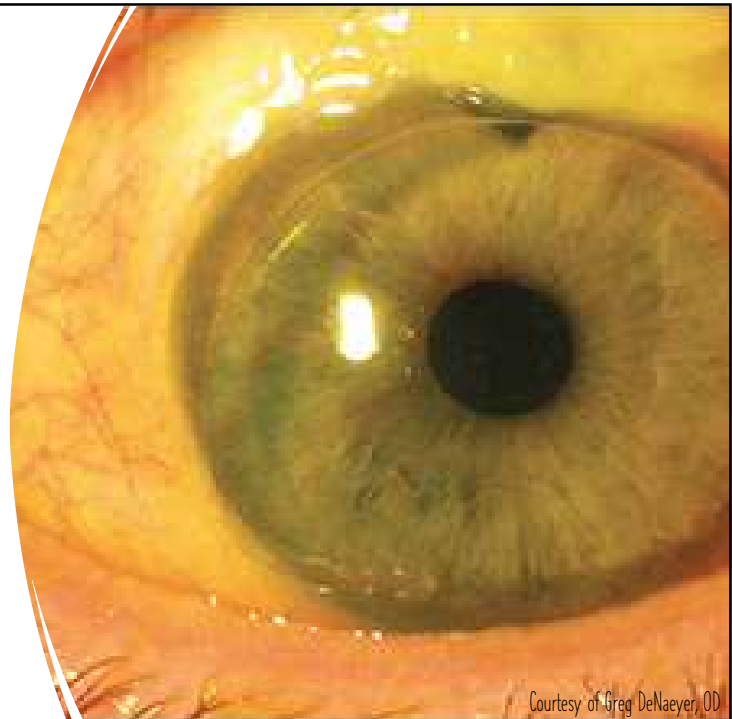
- Know who is at greatest risk BEFORE you consider a scleral lens fit
  - Discuss risk vs benefit
  - Discuss possibility of limited wear time
  - Discuss possibility of PKP or EK
  - Discuss signs of complications
- Can't always tell the risk at the slit lamp

Sindt, C. Endothelial Considerations in Scleral Lens Wear. AiLES June 2018.

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## GLAUCOMA FILTRATION- DRAINAGE DEVICES

- Avoid contact/compression/rubbing of the contact lens
- Scleral lenses can compress and block tube shunts
- ANY lens can cause an erosion
- Overhanging blebs usually need a surgical revision
- When a GP is not fittable then need a rotational stable scleral (make notch or localized vault at edge, impression based scleral)



Courtesy of Greg DeNaeyer, OD

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