

# **Real-Life Keratoconus Cases: Contact Lens Grand Rounds**

**Clark Chang, OD, MS, FAAO, FSLs**

## **Financial Disclosure: Clark Y. Chang, OD, MS, FAAO, FSLs**

- EssilorLuxottica (Sr. Director, Medical & Surgical Operations)
- Oculus
- Wills Eye Hospital (Director of Specialty CL, Cornea Service)

The opinions expressed in this presentation are my own and do not represent the views of my employers

## BCVA Is All that KC Patients Care About?

- "...patients with keratoconus may still suffer detriments to their mental health despite having relatively good VA..."
- "...when compared with patients with glaucoma, the keratoconus cohort had lower mental health outcomes despite most having BCVA<0.5 (logMAR)."
- Demonstrated KC is associated with significantly impaired Vr-QoL that continues to decline over 7-year (despite many CLEKS patients wears CLs)
- Mean Vr-QoL utility in KC is much lower than those with diabetic retinopathy (DR), incl PRD or severe DME.
- Lower Vr-QoL scores in KC than DR or AMD may be related to early onset, concerns of progression & frequent Spec or CL Rx changes.

### Mental Health Impact of Keratoconus: A Systematic Review

Emily Durakovic, MD, Himal Kandel, PhD, and Stephanie L. Watson, PhD, FRANZCO

Published in final edited form as:

*Am J Ophthalmol.* 2008 April; 145(4): 611-617. doi:10.1016/j.ajo.2007.11.017.

### Changes in the Quality of Life of People with Keratoconus

Steven M. Kymes, PhD<sup>1,2,3</sup>, Jeffrey J. Walline, OD, PhD<sup>4</sup>, Karla Zadnik, OD, PhD<sup>4</sup>, John Sterling, OD<sup>5</sup>, and Mae O. Gordon, PhD<sup>1,2</sup> for the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study Group

RESEARCH PAPER

Assessing disutility associated with diabetic retinopathy, diabetic macular oedema and associated visual impairment using the Vision and Quality of Life Index

*Clin Exp Optim* 2012; 95: 362-370

DOI:10.1111/j.1444-0938.2012.00742.x

## Before We Get Started

### General Approach(es) to Optimize Outcomes

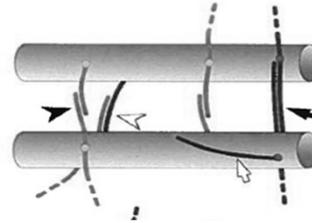
Retrospective Study (n= 329 Consecutive KC/Ectasia eyes)

- Clark Chang, Angela Shin, & Peter Hersh (Unpublished Data)

|                           | Non-Surgical       | Surgical          |
|---------------------------|--------------------|-------------------|
| Success Rate              | 94.2%<br>(229/243) | 97.70%<br>(84/86) |
| Habitual VA               | 20/60.52           | 20/56.14          |
| Final CLVA                | 20/27.88           | 20/28.70          |
| Tolerance at Presentation | 63.4%*             | 39.4%*            |
| Tolerance after Fitting   | 95.8%              | 98.5%             |

# Corneal Collagen Cross-Linking (CXL)

- Uses UV light, riboflavin, and oxygen to stiffen the cornea
  - Prevents KC progression (loss of vision, transplantation)
- FDA-approved epi-off only since 2016

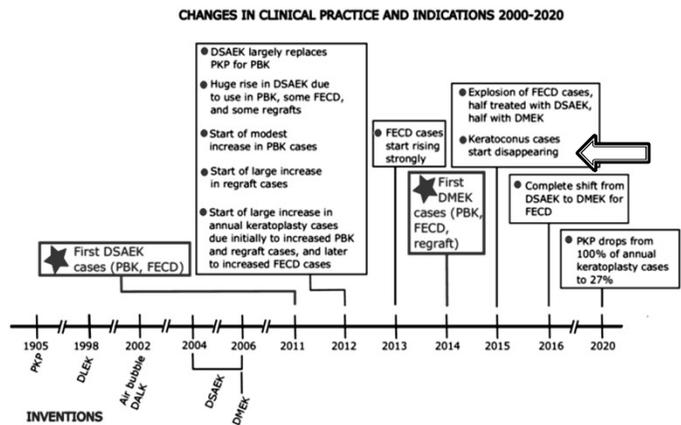


**AAO Corneal Ectasia Preferred Practice Pattern recommends prompt referral of patients who have been diagnosed with progressive KCN for corneal cross-linking to "reduce or stop KCN progression & preserved good VA with eyeglasses and/or contact lenses".<sup>1</sup>**

1. Garcia-Ferrer FJ, Akpek EK, Amescua G, Farid M, Lin A, Rhee MK, Varu DM, Musch DC, Mah FS, Dunn SP; American Academy of Ophthalmology Preferred Practice Pattern Cornea and External Disease Panel. Corneal Ectasia Preferred Practice Pattern\*. Ophthalmology. 2019 Jan;126(1):P170-P215

# Reduction of Corneal Transplant With CXL

- Over 21 years, KCN accounted for 11% of keratoplasties
  - PKP remained the KCN surgical choice until 2012 when DALK utilizations started to rise
  - But starting in 2015, the number of KCN cases underwent keratoplasty dropped sharply
  - **81.2% of reduction** in utilization of keratoplasties in KCN treatments
    - 16% (2013 – 2016) vs 3% (2016 – 2020)
    - Due to **rise of Cross-linking & improvements in rigid and scleral lenses**



Malleron V, Bloch F, Zevering Y, Vermion JC, Semler-Collery A, Goetz C, Perone JM. Evolution of corneal transplantation techniques and their indications in a French corneal transplant unit in 2000-2020. PLoS One. 2022 Apr 29;17(4):e0263686

## CLF (CL Fitting) Post FDA-Approved CXL

- “Our little secret”: It’s the same as before CXL!
- Just ensure epithelium is completely healed after FDA-approved epi-off CXL
  - Start CL fitting ~ **3 to 4 weeks**,
  - Especially Scleral, Hybrid or Piggyback CL designs
    - Vault and/or protect cornea
    - “Wiggle room” if cornea changes; lacrimal lens

ARTICLE

### Topographical and Refractive Outcomes After Corneal Cross-linking in Novice Scleral Lens Users

*Faith Aisien, B.S., Laura Di Meglio, O.D., Craig Bower, M.D., and Amanda Crum, O.D.*

**Conclusion:** On average, no significant differences were observed between preoperative and postoperative corneal measurements or refractive correction. These findings suggest that scleral fittings could be introduced before CXL to expedite the process of lens prescription and future acquisition. Safe scleral lens use with a lens fit before surgery could resume 1 month postoperatively.

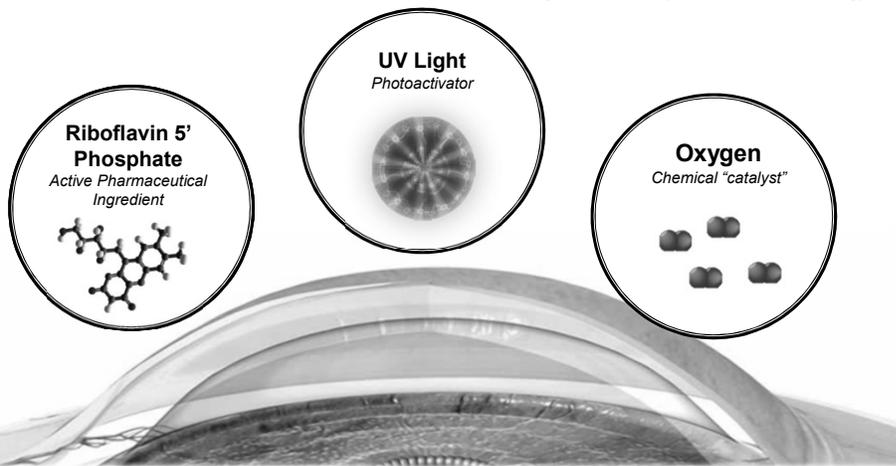
**Key Words:** Keratoconus—Post-LASIK ectasia—Corneal cross-linking—Scleral lens.

*(Eye & Contact Lens 2025;00: 1–5)*

**Aisien F, Di Meglio L, Bower K, Crum A. Topographical and Refractive Outcomes After Corneal Cross-linking in Novice Scleral Lens Users. Eye Contact Lens. 2025 Apr 1;51(4):190-194.**

## CLF Time May Change with Epi-On CXL Approval

- Corneal collagen cross-linking combines UV light + Riboflavin (vitamin B2) drops
- *UV light and oxygen activate the pharmaceutical agent to form additional covalent bonds within the intracellular matrix of the collagen stroma (= corneal stiffening)*

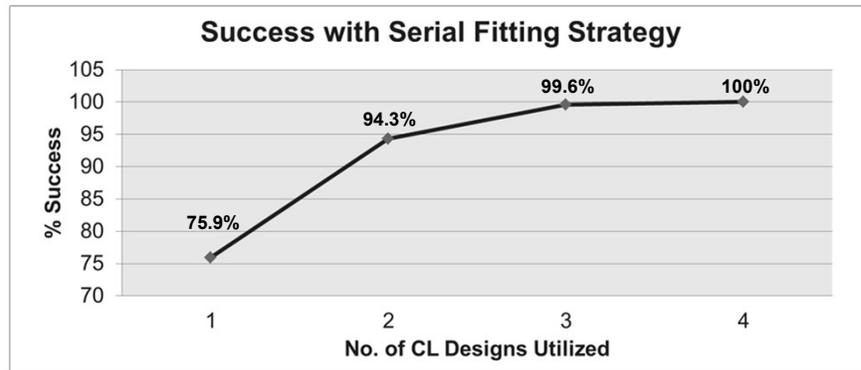


**N.B.: Epi-On CXL is Not Currently Approved in US**

## Before We Get Started

### General Approach(es) to Optimize Outcomes

Overall Success Rate = 95.1%

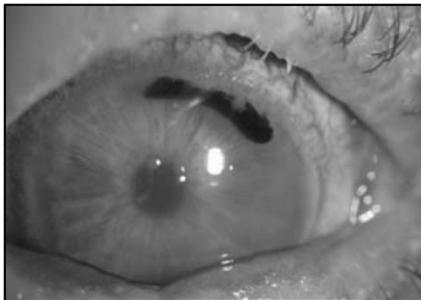


*Retrospective Study (n= 329 Consecutive KC/Ectasia eyes)*

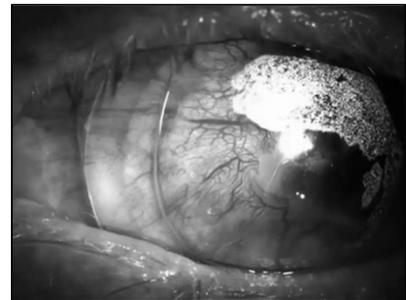
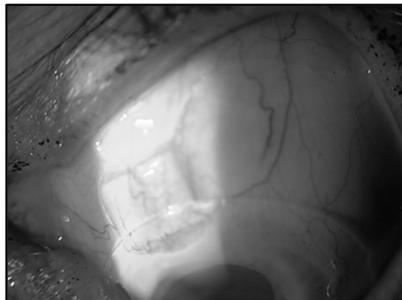
- Clark Chang, Angela Shin, & Peter Hersh (Unpublished Data)

## Before We Get Started

### Not One Size Fits All

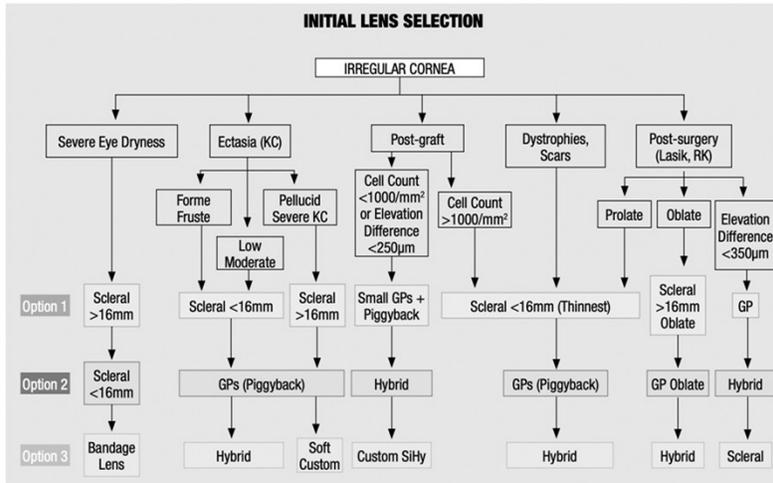


Courtesy, Lynette Johns, O.D.



Courtesy of J Sonsino, O.D., FAAO

## Before We Get Started General Approach(es) to Optimize Outcomes



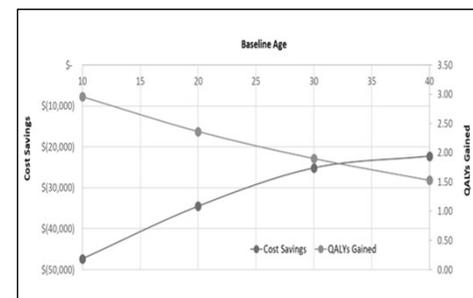
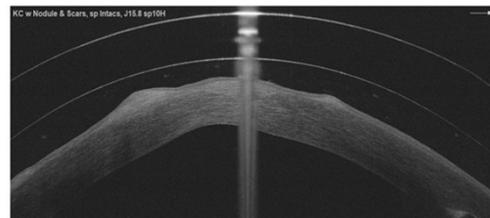
Michaud, L., Review of Cornea/CL (Jan/Feb 2020)

### Also consider:

- Hx & Dx
- Pt Goals
- Pt Attributes
  - Comorbidity & other impairments
  - Mental fortitude
  - Anterior Seg & Adnexa, ie, Pupil sizes, HVID/VVID, Lid tonus & lid positions
  - VA & potentials

## Management Challenges

- Early Detection of KCN & KCN Progression
  - Preserving best visual potentials
  - Cost of technology
  - Routine pediatric screening for KCN
- Increased chair time in KCN management
- Cost of treatments over lifetime
  - Conventional Tx (ie, Spec, CLs & tectonic surgery)
  - Medical treatment (new U.S. health economic data)
- Decline in quality-of-life with progression
  - Scleral CL improve BCVA & Vr-QoL<sup>1</sup>
  - High prevalence (40.6%) of depression in KCN especially with binocular CL use (GP and/or hybrid)<sup>2</sup>



1. EO Kreps, K Pesudovs, I Claerhout, C Koppen. Mini-Scleral Lenses Improve Vision-Related Quality of Life in Keratoconus. *Cornea*. 2021 Jul 1;40(7):859-864.  
 2. Al-Dairi W, Al Sawayigh OM, Al Saeed AA, Alsaad A. Depression Among Keratoconus Patients in Saudi Arabia. *Cureus*. 2020 Dec 6;12(12):e11932.

Lindstrom R, Berdahl J, Donnerfeld E. Cross-Linking versus Conventional Management for Keratoconus: A Lifetime Economic Model. *J Medical Economics* 2020.

## Management Challenges

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  - High prevalence (40.6%) of depression in KCN especially with binocular CL use (GP and/or hybrid)<sup>2</sup>
- New approach of "Interventional KC"<sup>3</sup>

Feature DETECTING KERATOCONUS

PEER REVIEWED

### DECODING THE KERATOCONUS MATRIX

Expanding treatments and diagnostics are revolutionizing interventional management of this condition. More than ever, early detection is paramount to preserving patients' vision and quality of life.

BY CLARK CHANG, OD, MSA, MSc, FAAO, FSLs, AND TRACY SWARTZ, OD, PHILADELPHIA, PA

**S**tandard of care in keratoconus (KC) management has changed similarly to glaucoma: we promptly treat the disease because of expanding treatment options and diagnostic tools that enable earlier detection. As an example, visual field loss was the hallmark of glaucoma, but now ganglion cell loss is routinely used for early diagnosis. Like glaucoma, the ultimate management goal is to treat progressive KC prior to loss of vision or visual quality, thus preserving quality of life (QoL) in these patients.<sup>1,2</sup>

Successful contact lens fitting and maintaining higher visual acuity may improve vision-related QoL, but it's important to remember these lenses are removed daily, leaving patients with visual disability as part of their daily burden.<sup>3</sup> Despite most patients in the Collaborative Longitudinal Evalua-

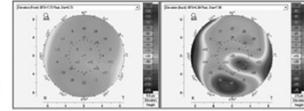


Fig. 1. Significantly elevated max elevation points seen in both anterior elevation and posterior elevation maps (10mm and 4mm) in a KC patient.

tion of Keratoconus Study successfully wearing contact lenses for functional vision, many continued to report a significant decline in their vision-related QoL over a period of seven years.<sup>4</sup> A mean best spectacle-corrected visual acuity (BCVA) reduction of net ETDRS letters per year has also been reported among KC patients receiving only conventional optical management while being actively monitored by their optometric physicians.<sup>5</sup>

In 2015, the Global Consensus on Keratoconus and Ectatic Diseases

concluded that the condition is a bilateral disease hallmarked by both abnormal posterior stromal elevation (Figure 1) and spatial distribution of corneal thickness.<sup>6</sup> Note that a thin central corneal pachymetry is not a reliable indicator of early or moderate KC. Alternatively, anomalous corneal elevation and thickness distribution profiles are critical indicators of early ectasia which signify the importance of supplemental corneal imaging techniques like Scheimpflug- or OCT-based tomography.

Dr. Chang is the global medical affairs director of Clinixia and director of Specialty Contact Lenses in the Cornea Service at Wills Eye Hospital in Philadelphia. He is a fellow of the American Academy of Optometry (AAO) and received the Young Professional Achievement Award of the Year Award in 2023. Dr. Swartz attended Indiana University School of Optometry for her doctorate and master's degree in optological optics. She is also a fellow of the AAO and a diplomate from the American Board of Optometry, specializing in management and contact lensing. Dr. Swartz is the past president of the Optometric, Contact, Cornea and Refractive Surgery Society and a member of the American Optometric Association and American Optometric Association. She is a consultant for Clinixia and Avalliance Group.

REVIEW OF OPTOMETRY | APRIL 15, 2025

3. Chang CY, Swartz T. Decoding the Keratoconus Matrix. Review of Optometry, 2025 April; 42-49. Available online at <https://www.reviewofoptometry.com/article/decoding-the-keratoconus-matrix>

## Corneal Gas Permeable (GP) lenses

## Candidacy:

- PROS:
  - Best candidates mild/moderate, centered or nipple cones
  - More cost effective vs. custom soft, hybrid or scleral lenses
  - Correct some higher order aberrations (HOAs)
  - Typically better VA potential vs. soft CL

## Candidacy:

- CONS:
  - Longer adaptation time in achieving comfort
  - Potential for poor retention
  - Potential for SPK (central and/or 3+9 staining)
  - Foreign body under lens common and painful

## Real-Life KC Cases

### Corneal GP: A Well-and-Alive Convention

- Avoid “Apical Bearing”!
- Match peripheral Q-values (if possible)
- “Size Matters”
  - Asymmetry that is larger and/or more decentered may need larger lenses & OZ
- Address Vision Needs
  - Irregularity, astigmatism, presbyopia

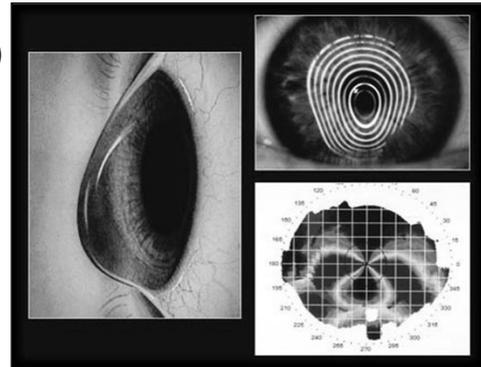
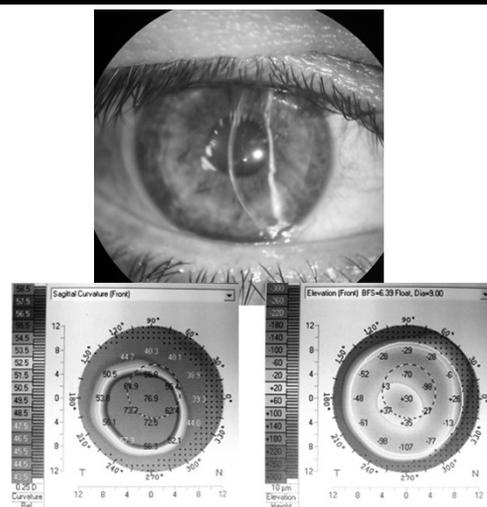


Image Courtesy, Patrick Caroline

## Real-Life KC Cases

### Corneal GP: A Well-and-Alive Convention

- 50-year-old female presents with blurred vision and discomfort
- She has piggybacked in the past
- Currently wears scleral contact lenses which are 3 years old.
- Pt reports she has better comfort with her scleral lenses but had better vision with her old piggyback system
- Recently tried her old lenses again but could not tolerate the comfort



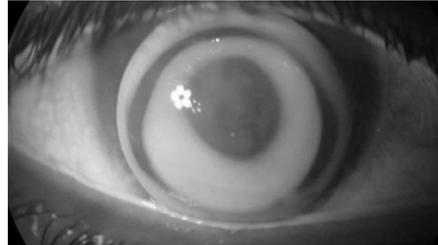
Courtesy, Christine Sindt, OD, FAAO

## Real-Life KC Cases

### Case: Advanced KC with Central Cone

#### OD Diagnostic Fitting

- X Cone 5.63 BC/ 9.5mm
- Reverse geometry
  - This was the steepest lens in the fitting set, yet still had harsh apical bearing
  - Lens touched lower lid which caused discomfort
  - Therefore, try a smaller diameter

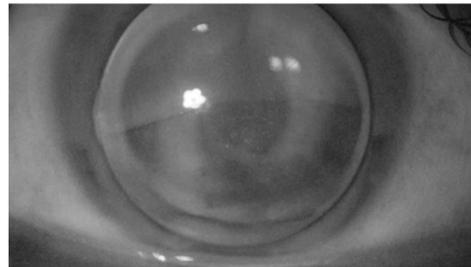


Courtesy, Christine Sindt, OD, FAAO

## Real-Life KC Cases

### Case: Advanced KC with Central Cone

- Rose K 5.30 BC/ 8.3mm
- STD PC's
  - Less lid interaction but...
  - Central bearing
  - So needed to go steeper

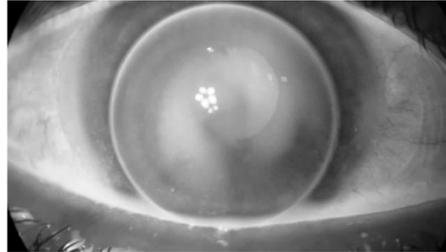


Courtesy, Christine Sindt, OD, FAAO

## ***Real-Life KC Cases***

### ***Case: Advanced KC with Central Cone***

- Rose K 5.10 BC/ 8.3mm
  - Cone clearance, but...
  - Drops to lower lid, (because it's steeper) and now pt has lid discomfort

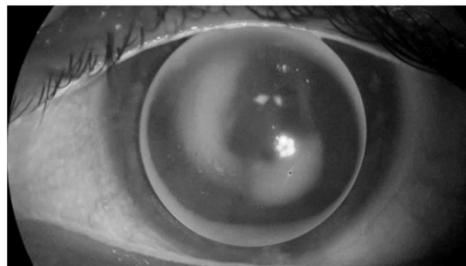


Courtesy, Christine Sindt, OD, FAAO

## ***Real-Life KC Cases***

### ***Case: Advanced KC with Central Cone***

- Rose K 5.20 BC/ 8.3mm
- STD PC's
  - Gracing touch over cone
  - No lower lid interaction
  - Pt sees well and feels good!



Courtesy, Christine Sindt, OD, FAAO

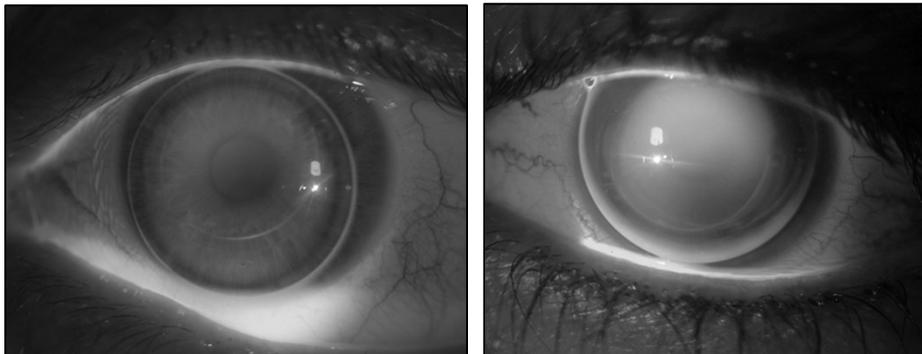
## ***Real-Life KC Cases***

### ***Case: Advanced KC with Central Cone***

- Patient's comfort problems concerned her lids, so piggybacking did not help her comfort
  - Going with a smaller design allowed for a steeper fit while still staying clear of the lower lid
- A reverse geometry lens allows for flatter BC to be used and results in lower powers/ thinner lenses, BUT
  - In this case the reverse geometry lens touched her lower lid causing discomfort
  - Since the cone was centrally located, a large lens was not needed to center the lens on the pupil
- A scleral lens can give excellent comfort, BUT
  - Old lens may develop deposits or become warped, compromising VA
  - When CL completely vaults the cornea, some KCN patients don't see as well

## ***Real-Life KC Cases***

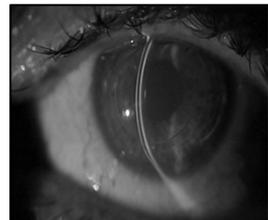
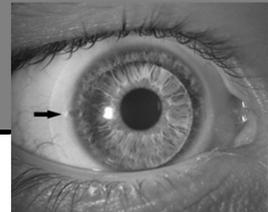
### ***Case: cGP Considerations in Post-Intacs***



## Custom Soft KC lenses

### Candidacy:

- PROS:
  - Early/moderate KC (Nipple - mild decenter cone)
  - Centration & Comfort (Draping)
  - Wide Rx range ( $\pm 20D$  & Cyl up to  $-12D$  at  $1^\circ$ )
  - Lens handling & care
- CONS:
  - May not result in optimized vision (Draping)
  - Thicker CT (dK/t) may result in chronic hypoxia

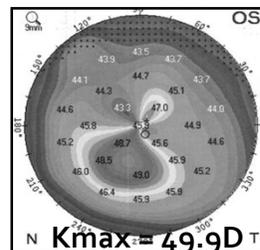
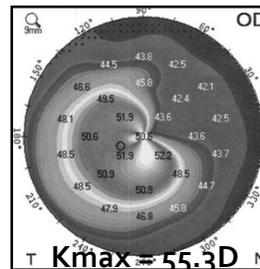


# Case

## Real-Life KC Cases

### Case: Longstanding & Stable KC, But I want CXL or PKP

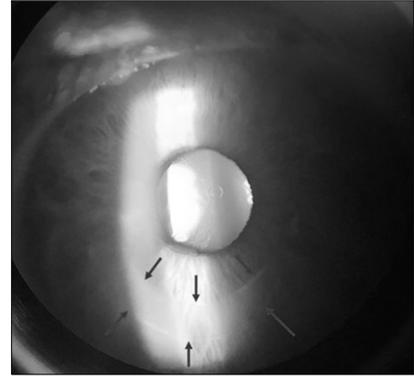
- 68 y/o WM, HX of KCN OU, ~40 yrs
- GP intolerance & d/c CL wear
- unhappy with UCVA & BSCVA
- Ant seg exam consistent with KCN
  - (-) Scar/Nodule
  - NS 1+ OU & otherwise WNL
- MR
  - OD: +3.50, -5.25 x030 20/60-
  - OS: -1.50, -1.75 x140 20/25-



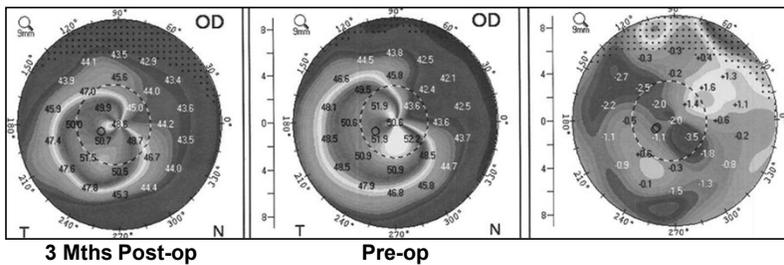
## Real-Life KC Cases

Case: Longstanding & Stable KC, But I want CXL or PKP

- Pt ed on 1) CL refit OU, and/or 2) ICRS OD
- Asymmetrical Tx Plan, OD (Intacs, 210/450)
  - Post-Op 3 Mths
  - MR (OD) **+0.50, -3.25 x065\*\* 20/40**



Liao G, Yeh F & Chang C. A New Multi-faceted Approach to the Holistic Management of Keratoconus. Modern Optometry. October 2023



## Real-Life KC Cases

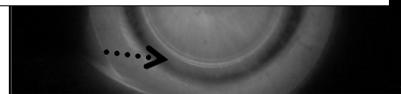
Case: Longstanding & Stable KC, But I want CXL or PKP

**CLOR (OD) +0.75, -1.50 x065 20/30+**

**CLOR (OS) +0.75, -1.00 x050 20/20-3**

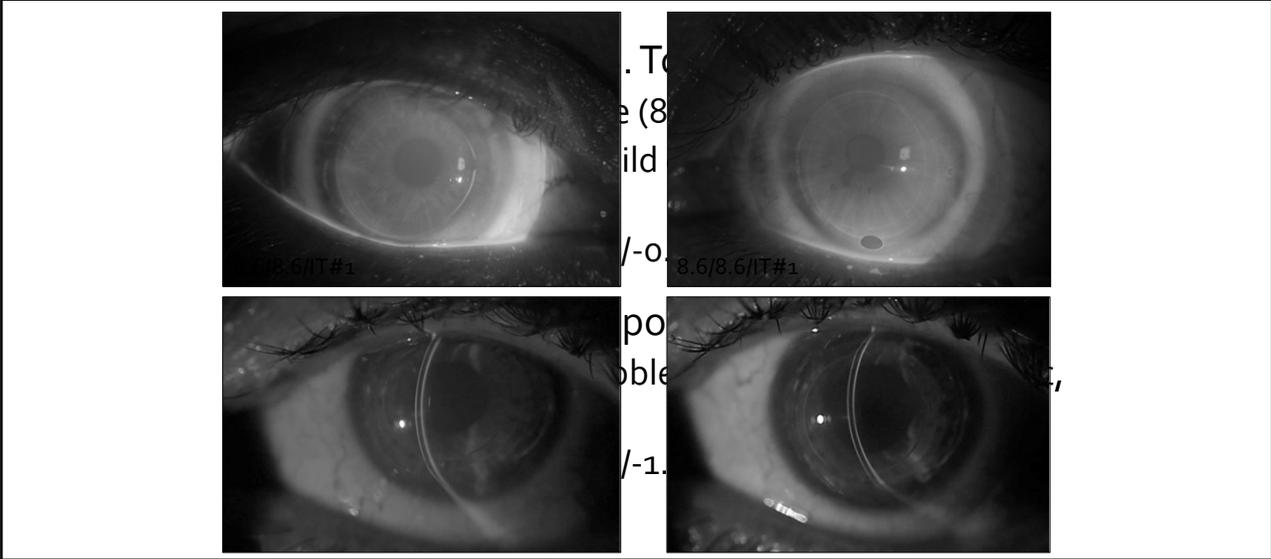
**A: Residual Cylinder OU**

**P: Discuss CL Refit OU in Custom Soft KC CLs**



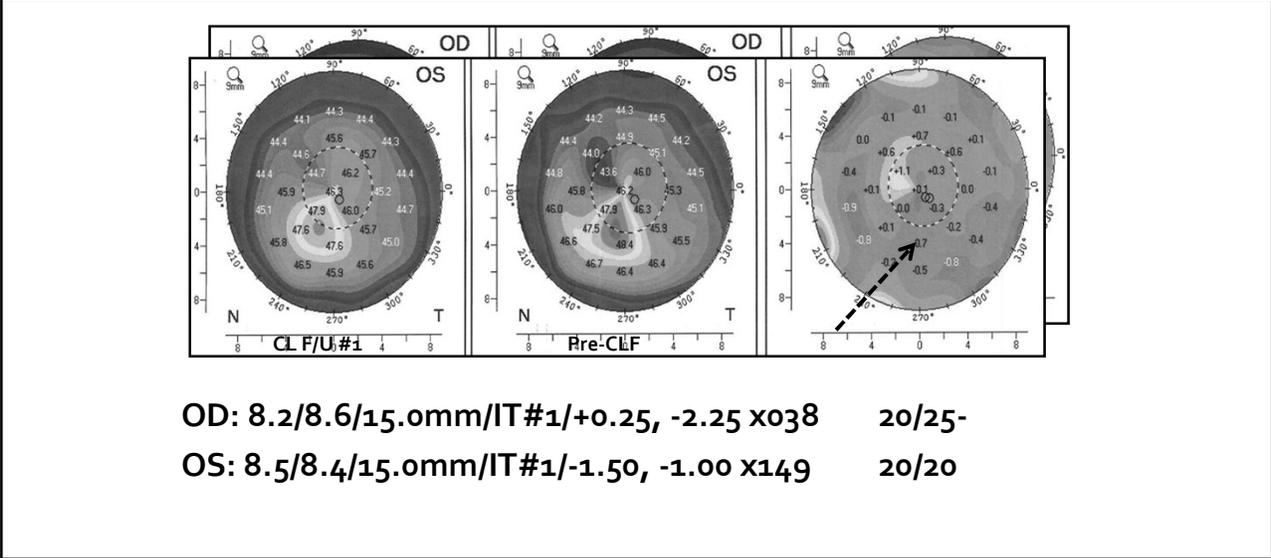
## Real-Life KC Cases

Case: Longstanding & Stable KC, But I want CXL or PKP



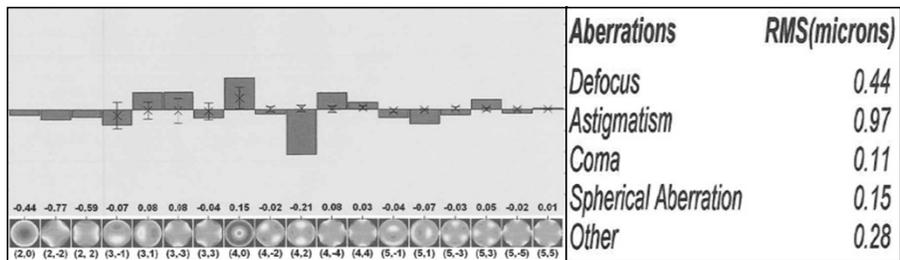
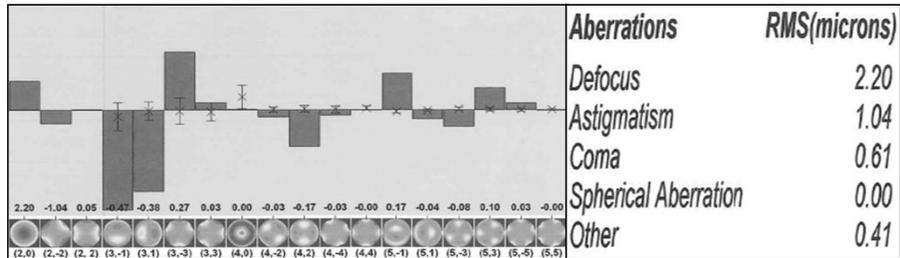
## Real-Life KC Cases

Case: Longstanding & Stable KC, But I want CXL or PKP



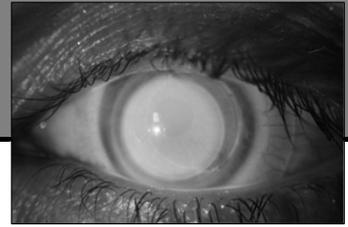
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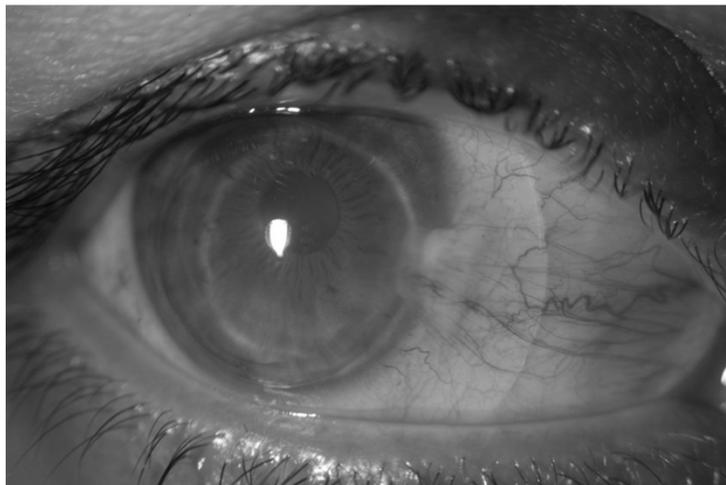
## Hybrid or Tandem Lens System

## Candidacy (Hybrid)



- PROS:
  - Early – Mild Severe KC (Nipple - Mod decentered Cone)
  - Centration (Soft Skirt Draping)
  - One lens to handle & Care
  - Multiple hybrid fitting designs & high dK material
- CONS:
  - Lens handling (Skirt Draping & junction impingement)
  - Relatively small OZ size

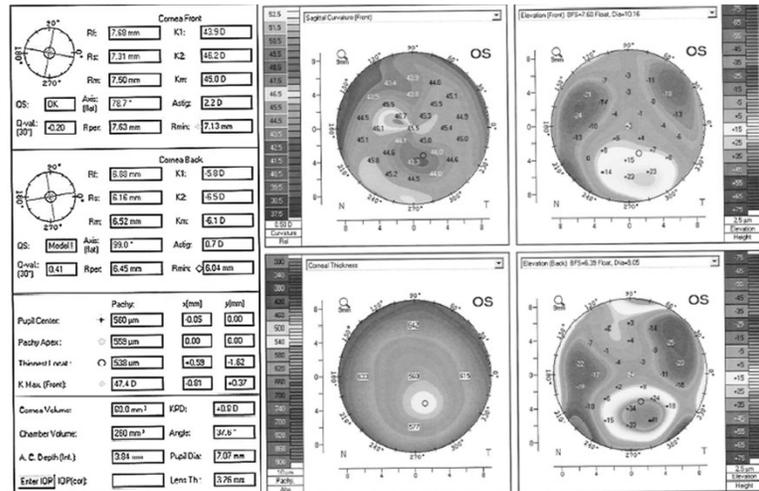
## Candidacy (Hybrid)



## Real-Life KC Cases

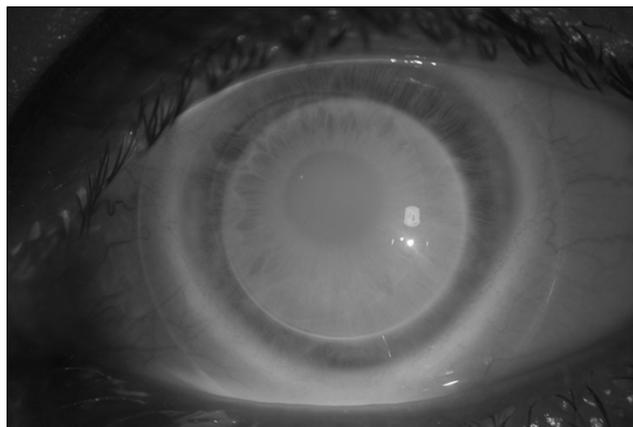
### Case: Aberrant Pupil Sizes or Is It KC?

- OD Toric SCL/8.5/-4.75 -0.75 x090 20/25-2  
OS Toric SCL/8.5/-3.50 -1.50 x065 20/25
- MR OD -4.00, -1.75 x110 20/20-1  
MR OS -2.75, -2.25 x095 20/20-3
- Retinoscopy: (-) Scissor reflex



## Real-Life KC Cases

### Case: CL Refit at 1 mo Post-Op & Follow-Up

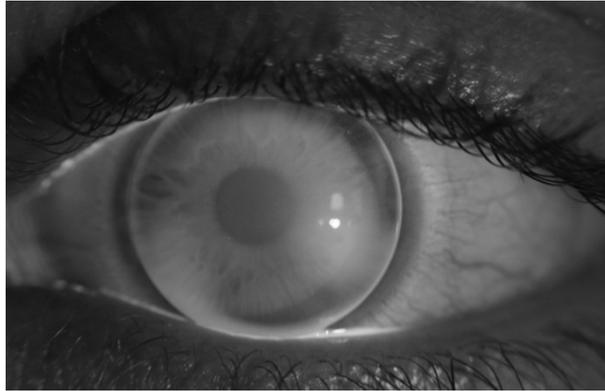


Quality of Vision at Night improves with Brimonidine

- OD - Synergeyes A/7.2/8.2/-6.50/EP (20/20)
- OS - Synergeyes A/7.3/8.3/-5.00/EP (20/20)

## Real-Life KC Cases

### Case: CL Refit at 1 mo Post-Op & Follow-Up

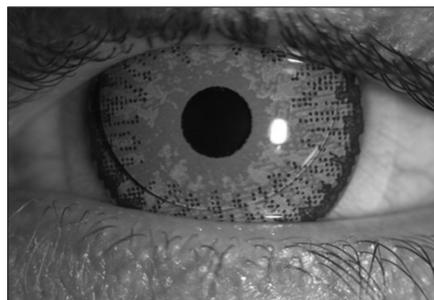


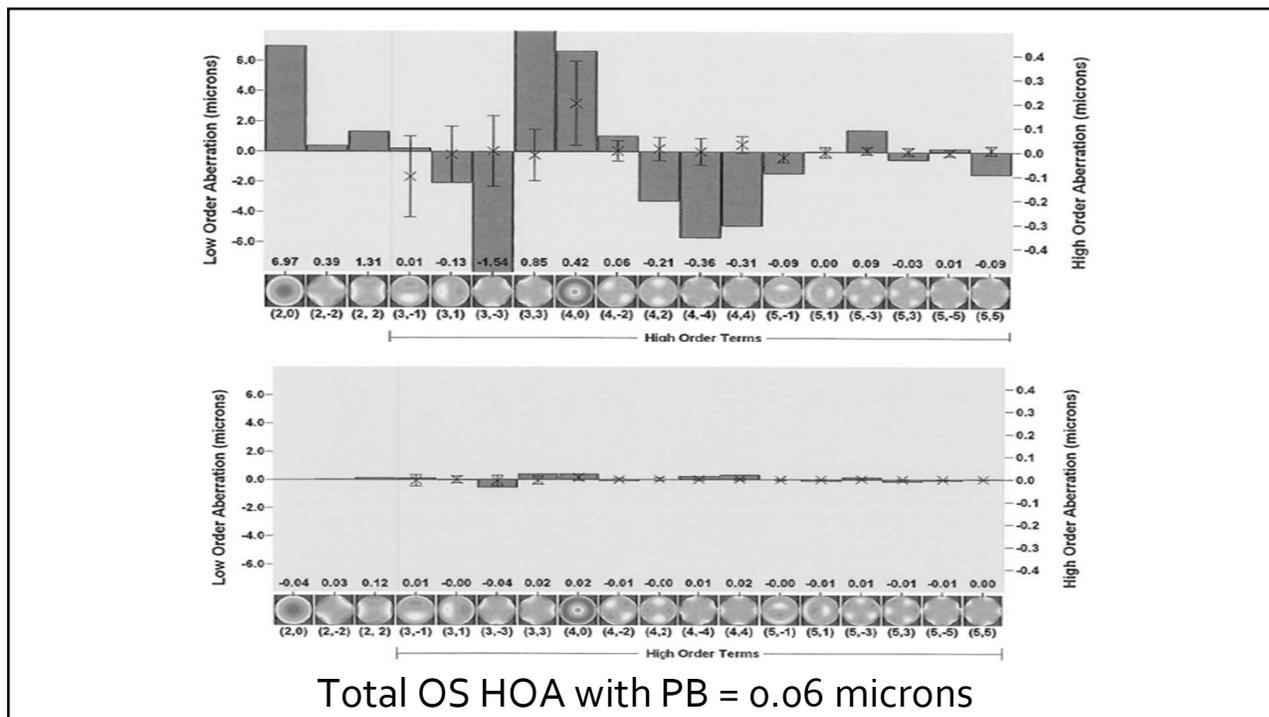
- OD 44.00(7.67mm)/-3.75/11.2mm/OZ 10.0/1-STP PC (20/20)
  - OS 43.75(7.71mm)/-2.75/11.2mm/OZ 10.0/1-STP PC (20/20)
- \* Boston XO material and plasma treatment ordered

## Real-Life KC Cases

### Case: CL Refit at 1 mo Post-Op & Follow-Up

- f/u #3
  - CLVA OD 20/20 (OR: PL) OS 20/20 (OR: PL)
- SLE: Good movements (SCL & GP)
  - Good GP NaFL
  - Cornea: (-) SPK





## KCN CL Management

### Still Seeing Double: Residual HOA-Correcting Optics

**Measurement 1: Base Lens w/ Markings (02/23/2022)**

**Measurement 2: Aberrometry Only (03/11/2022)**

| Zernike Term          | Measurement 1 (um) | Measurement 2 (um) |
|-----------------------|--------------------|--------------------|
| V Tilted (Z0)         | 0.3                | 0.0                |
| V Coma (Z1)           | 1.8                | 0.5                |
| H Coma (Z8)           | 0.4                | 0.1                |
| H Tilted (Z9)         | 0.3                | 0.0                |
| Ob. Quadrantile (Z10) | 0.1                | 0.0                |
| Ob. 2nd Astig (Z11)   | 0.0                | 0.0                |
| Spherical (Z2)        | 0.0                | 0.0                |
| V 2nd Astig (Z13)     | 0.7                | 0.1                |
| V. Quadrantile (Z14)  | 0.0                | 0.0                |
| V. Tilted (Z15)       | 0.0                | 0.0                |
| V. 2nd Tilted (Z16)   | 0.0                | 0.0                |
| V. 2nd Coma (Z17)     | 0.0                | 0.0                |
| H. 2nd Coma (Z18)     | 0.0                | 0.0                |
| Ob. 2nd Tilted (Z19)  | 0.0                | 0.0                |
| Ob. Tilted (Z20)      | 0.0                | 0.0                |

Measurement 1: Base Lens w/ Markings (02/23/2022)  
Vision Simulation (Gretl 20/20 1)  
Total HOA RMS: 2.01 um

Measurement 2: Aberrometry Only (03/11/2022)  
Vision Simulation (Gretl 20/20 1)  
Total HOA RMS: 0.49 um

Case Courtesy, Kevin Feng O.D.

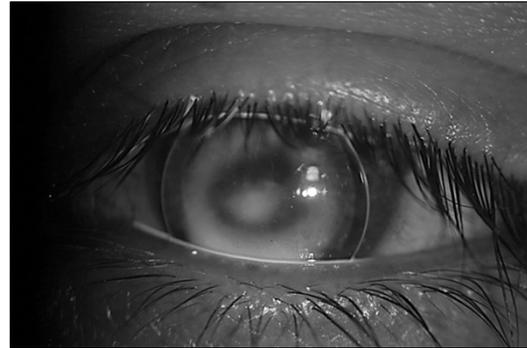
**27 YO, WM – MD Referral after Ruling Out Cross-linking or ICRS as Tx Options**

**Q: Predicting VA from scar characteristics?**



**CLVA  
(GP, ~6mo)**

**20/30+  
OR: PL**



**20/50  
OR: PL**

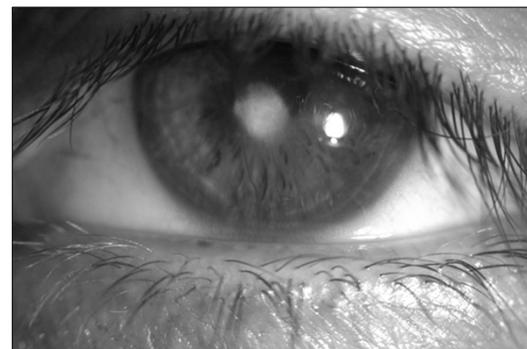
**27 YO, WM – MD Referral after Ruling Out Cross-linking or ICRS as Tx Options**

**Q: Only a centrally located scar can affect vision?**



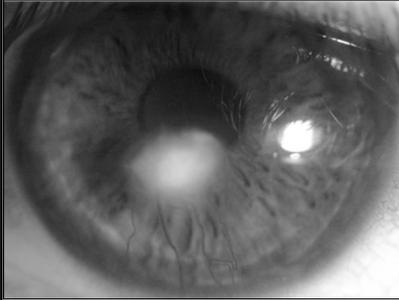
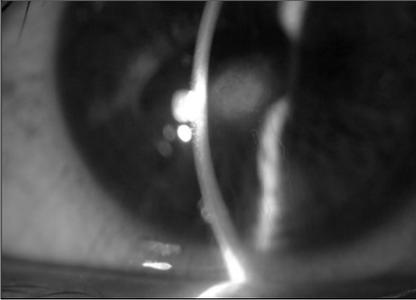
**CLVA  
(GP, ~6mo)**

**20/30+  
OR: PL**

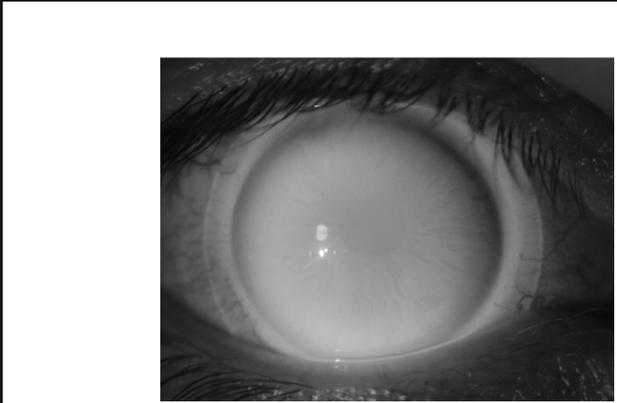
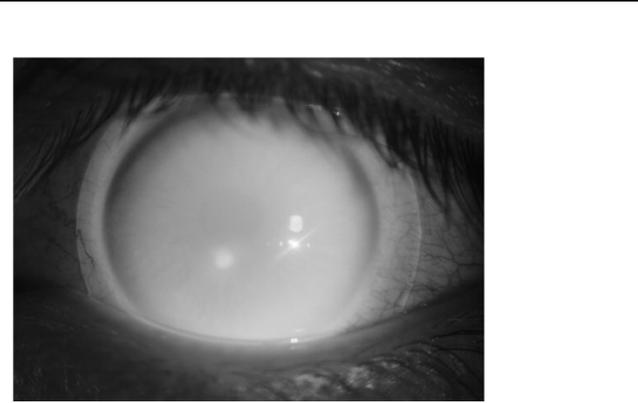


**20/50  
OR: PL**

**27 YO, WM – MD Referral after Ruling Out Cross-linking or ICRS as Tx Options**

| V1  | V2 (3mo sp PB CL)<br>(Avaira/8.4/+1.00)   | V3 (12mo sp SL)<br>(SL Fit at gmo from V1)  |
|---|---|---|
|  |  |  |
| 20/50   | 20/40   | 20/25+  |

**27 YO, WM – MD Referral after Ruling Out Cross-linking or ICRS as Tx Options**

|   |  |
|---|--|
|    |  |
| <p>Jupiter 16/45.00/-4.00/OZ 8.6/6.89-1.8/8.70-0.9/12.75-0.6/14.25-0.4<br/>                     Jupiter 16/43.50/-3.50/OZ 8.6/7.11-1.8/8.70-0.9/12.75-0.6/14.00-0.4</p> |  |

## Scleral GP lenses

### Characteristics:

- Large diameter GP lens resting on conjunctiva/sclera
- Vault/do not touch cornea
- Fill with non-preserved solution

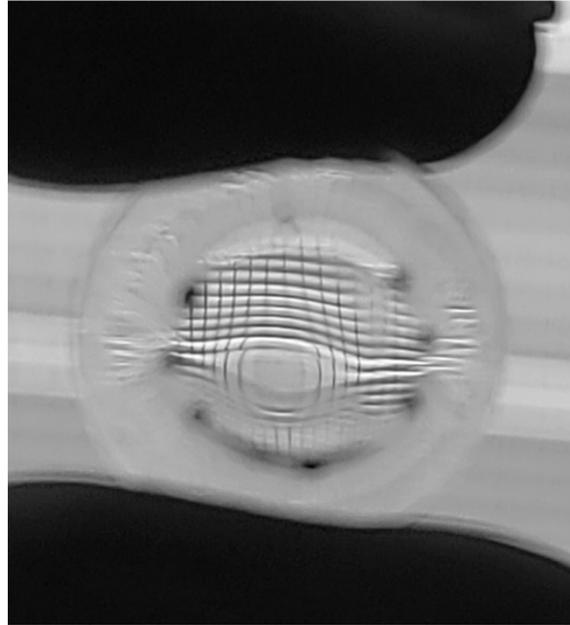
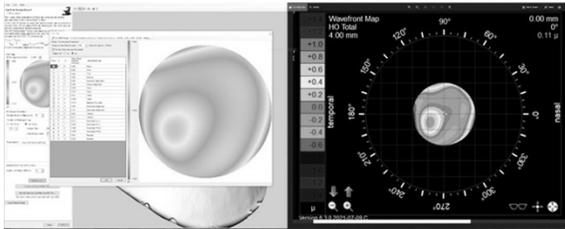
## Candidacy:

- PROS:
  - Best for moderate/severe KC with highly ectatic or decentered cornea
  - 350 microns or greater corneal elevation difference
  - Enhanced retention
  - Enhanced comfort
  - Larger OZ “sweet spot” vs. corneal GP

## Candidacy:

- CONS:
  - Can be more complex to fit
    - E.g. matching edge of lens to sclera, especially with larger lenses
  - I+R can be challenging
  - Can mask adverse symptoms

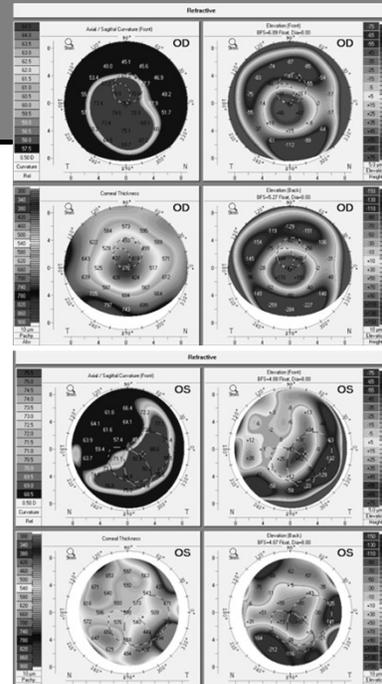
# HOA OPTICS



## Real-Life KC Cases Still Seeing Double sp PKP with SL

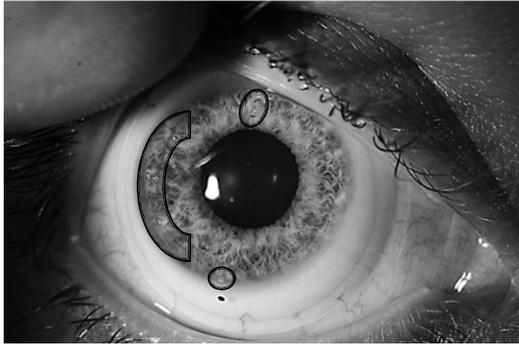
- 50 yo Caucasian female presents for annual CL eval
  - Occ Hx: OU (dx 1999) & PK OS (2004) due to OS GP intolerance
  - Now wearing scleral lenses (CSE) - *"These scleral lenses are incredibly comfortable, and my vision has drastically improved. I can wear these all day long without any issues."*
- Entering VA w/ CSE sclerals
  - OD 20/30, OR Plano & PHNI
  - OS 20/40, OR Plano & PHNI
- "When I read the vision chart, I get ghosting and shadowing of images, mostly or only in my right eye."

Case Courtesy, Kevin Feng O.D.



## Real-Life KC Cases

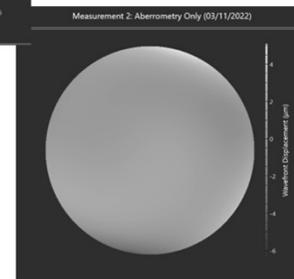
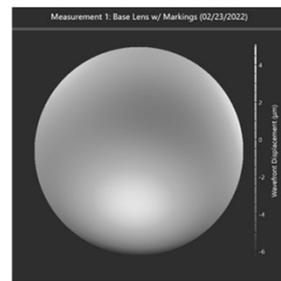
### HOA Scans Over Std LOA "Base" Scleral Lens



## Real-Life KC Cases

### Still Seeing Double: Residual HOA-Correcting Optics

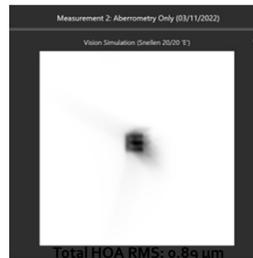
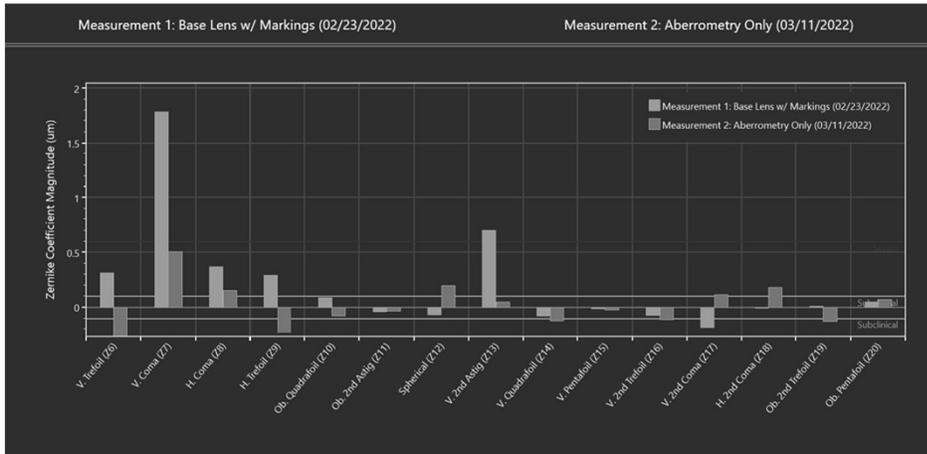
- Habitual LOA scleral lenses
  - BCVA 20/30
  - Pt complains of "ghosting/shadowing"
- New HOA scleral lens
  - BCVA 20/25+
  - No more complaints of "ghosting/shadowing"
- ~1.5 lines of visual acuity improvement
  - Substantial improvement in subjective VA quality!



Case Courtesy, Kevin Feng O.D.

# Real-Life KC Cases

## Still Seeing Double: Residual HOA-Correcting Optics



Case Courtesy, Kevin Feng O.D.

Oculus Optikgeräte GmbH | 35582 Wetzlar | Tel. (0641) 20 05-0 | www.oculus.de  
Munichholzhauser Str. 29 | Fax: (0641) 20 05-255

### OCULUS - PENTACAM 4 Maps Refractive

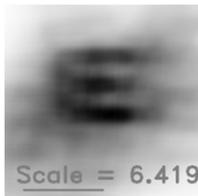
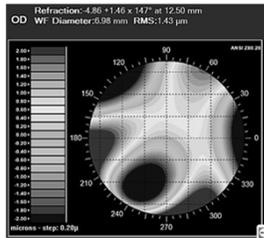
Retractive

|   |   |  |
|---|---|--|
| <p><b>Cornea Front</b></p> <p>R1: 572 mm K1: 50.0 D<br/>R2: 568 mm K2: 50.0 D<br/>R3: 570 mm K3: 50.0 D<br/>R4: 570 mm K4: 50.0 D<br/>R5: 570 mm K5: 50.0 D<br/>R6: 570 mm K6: 50.0 D<br/>R7: 570 mm K7: 50.0 D<br/>R8: 570 mm K8: 50.0 D<br/>R9: 570 mm K9: 50.0 D<br/>R10: 570 mm K10: 50.0 D</p> <p><b>Cornea Back</b></p> <p>R1: 488 mm K1: 83.0 D<br/>R2: 478 mm K2: 106.0 D<br/>R3: 471 mm K3: 93.0 D<br/>R4: 471 mm K4: 93.0 D<br/>R5: 471 mm K5: 93.0 D<br/>R6: 471 mm K6: 93.0 D<br/>R7: 471 mm K7: 93.0 D<br/>R8: 471 mm K8: 93.0 D<br/>R9: 471 mm K9: 93.0 D<br/>R10: 471 mm K10: 93.0 D</p> <p><b>Pachy</b></p> <p>Pachy Center: 580 <math>\mu\text{m}</math>   50.27   40.13<br/>Pachy Apex: 520 <math>\mu\text{m}</math>   5.00   5.00<br/>Thinnest Local: 240 <math>\mu\text{m}</math>   -1.01   0.44<br/>H. Max. (Front): 652.0 <math>\mu\text{m}</math>   5.00   40.31</p> <p><b>Cornea Volume</b></p> <p>Cornea Volume: 62.8 mm<sup>3</sup>   MH-Tu: 12.4 mm<br/>Chamber Volume: 162 mm<sup>3</sup>   Angle: 84.0°<br/>A. C. Depth (mm): 3.03 mm   Pupal Dia: 4.02 mm<br/>Eleva (SD) (Kerat): 13 <math>\mu\text{m}</math><br/>Antax Length: DNRAu-Len</p> | <p><b>Asid / Sagittal Curvatures (Front)</b></p> <p>OS</p> <p><b>Elevation (Front)</b></p> <p>OS</p> <p><b>Corneal Thickness</b></p> <p>OS</p> <p><b>Elevation (Back)</b></p> <p>OS</p> |  |
|---|---|--|

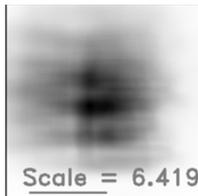
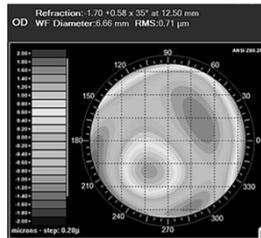
# Real-Life KC Cases

Which Lens Would You and Patient Choose?

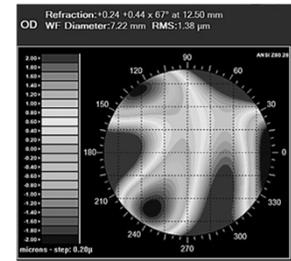
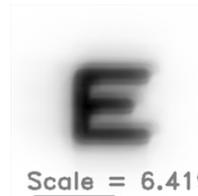
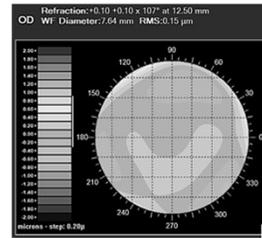
**Bare Eye**



**Standard Scleral**



**HOA Scleral**



**New Soft -3.00, -1.25 x50**

# Questions? Thank you

Clark Chang: [cchang@willseye.org](mailto:cchang@willseye.org)