

# Coming out of the dark: Clearing Corneal Opacities with Scleral Lenses

Karen G. Carrasquillo  
OD, PhD, FAAO, FSLS, FBCLA






SVP, Clinical and Professional Affairs

BostonSight

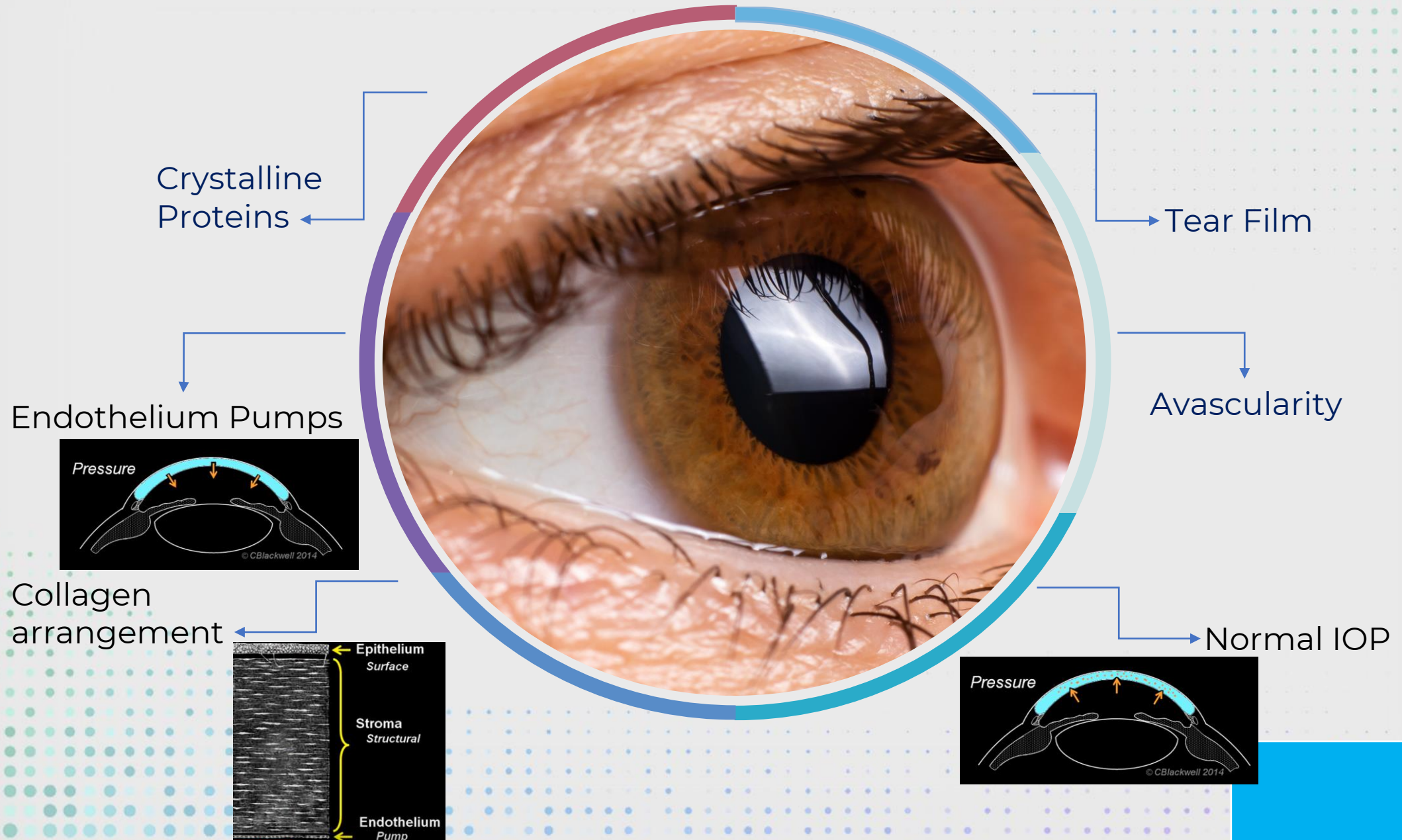
Salaried employee.

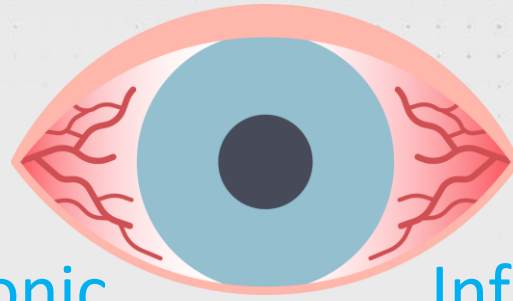
No proprietary interest in any BostonSight technologies





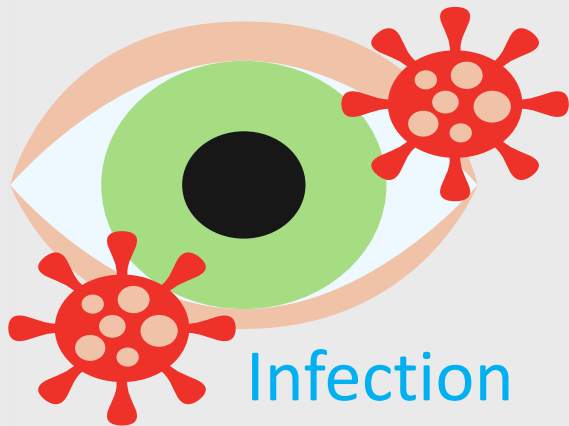
# Factors in corneal transparency



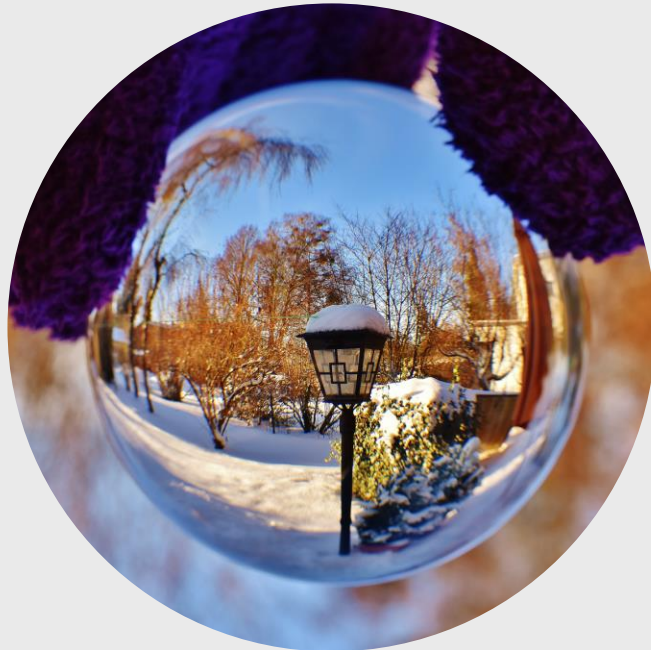


Chronic

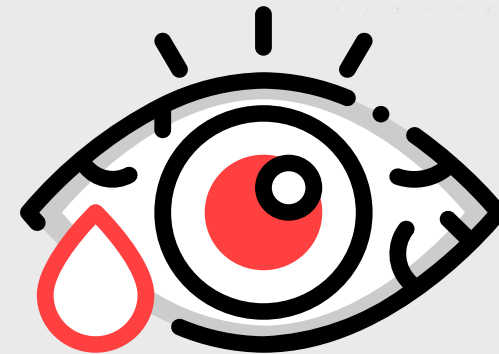
Inflammation



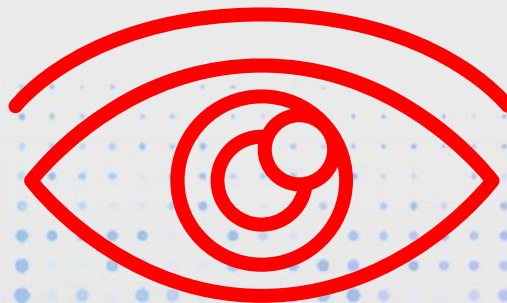
Infection



Ulceration

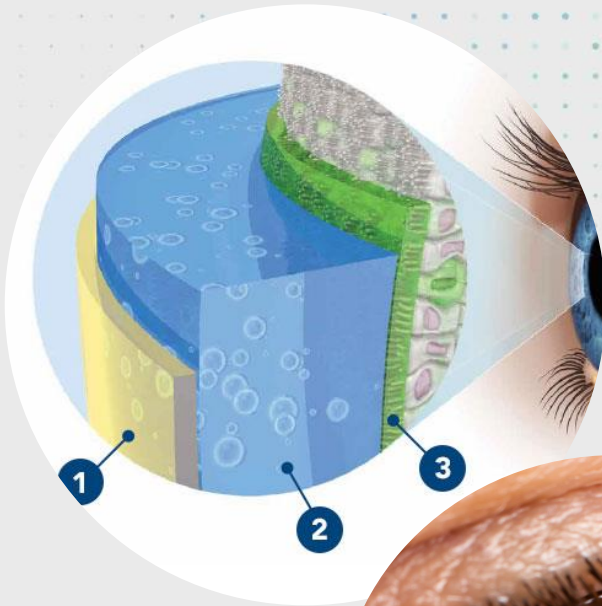
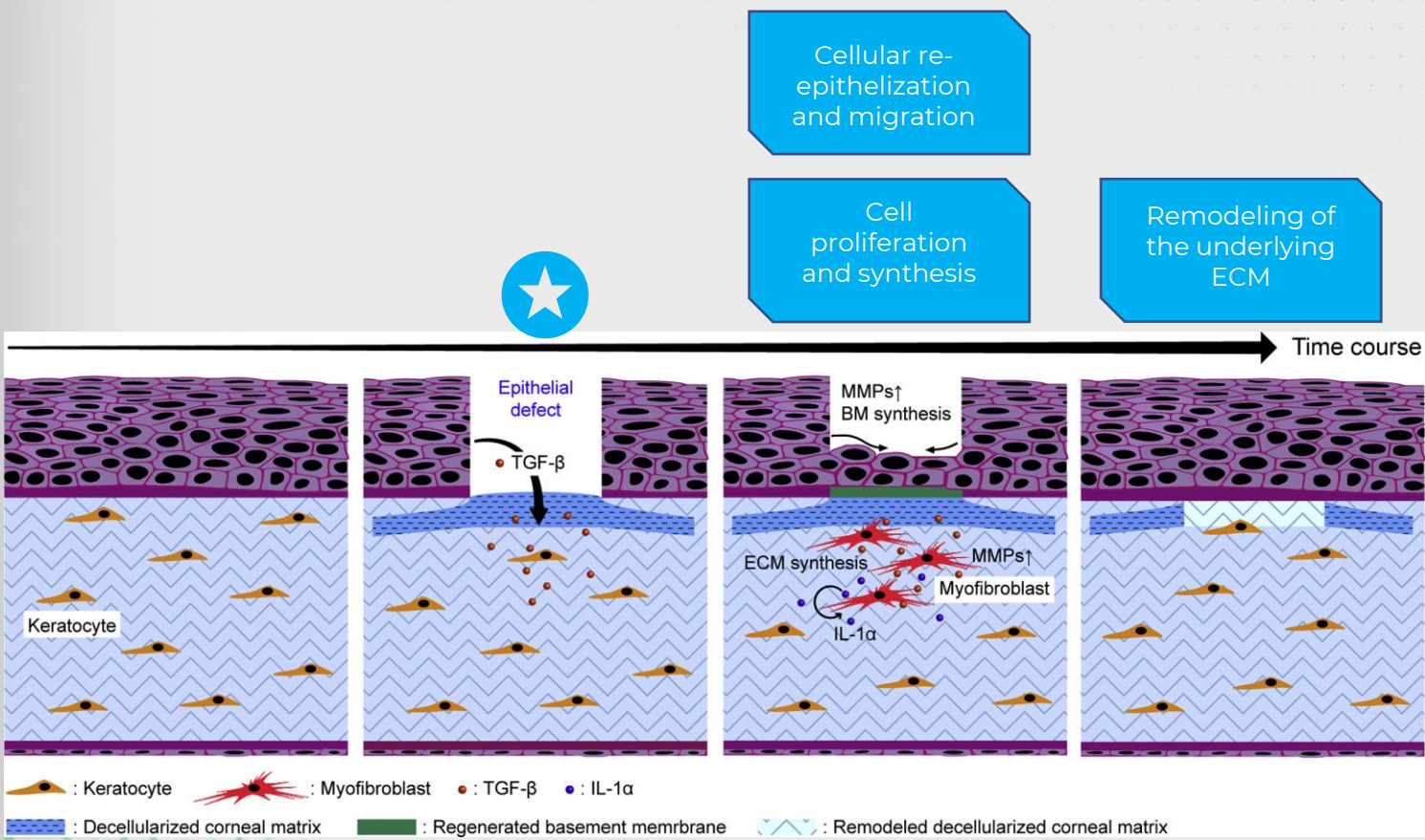


Trauma





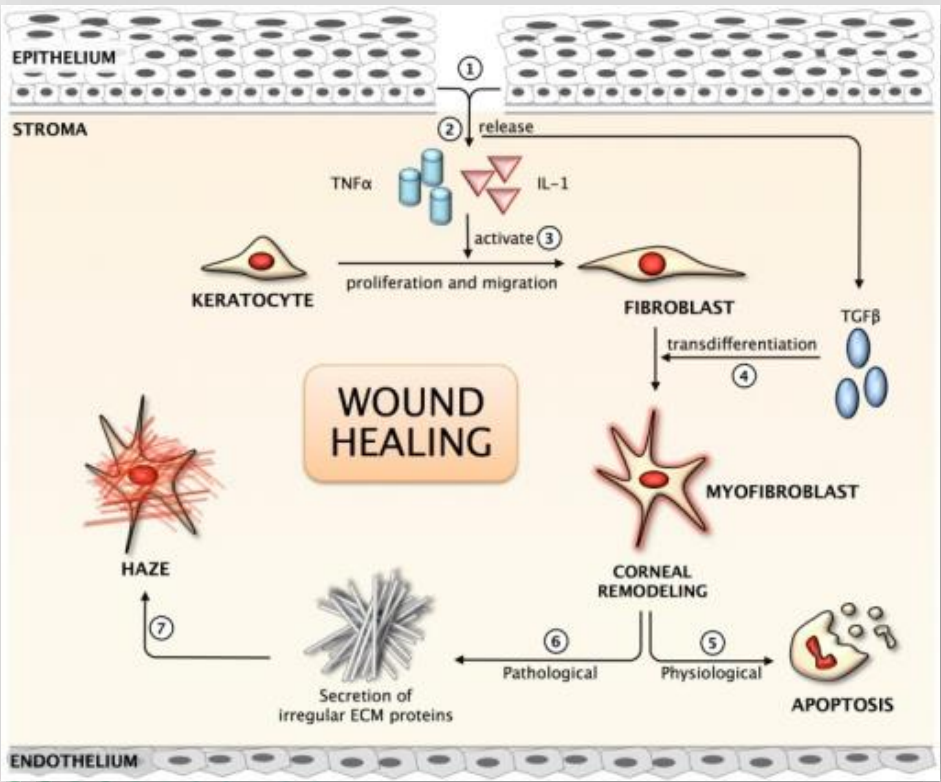
# Wound Healing – HIGH Level





# Wound Healing – More detailed

Schematic representation of the corneal wound healing mechanism. (Chaurasia S S, 2015)



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Contents lists available at ScienceDirect

**The Ocular Surface**

journal homepage: [www.elsevier.com/locate/itos](http://www.elsevier.com/locate/itos)

ELSEVIER

Check for updates

### Corneal stromal wound healing: Major regulators and therapeutic targets

Sabeeh Kamil<sup>a,b</sup>, Rajiv R. Mohan<sup>a,b,c,\*</sup>

<sup>a</sup> Harry S. Truman Memorial Veterans' Hospital, Columbia, MO, USA  
<sup>b</sup> One-Health Vision Research Program, Department of Veterinary Medicine & Surgery and Biomedical Sciences, College of Veterinary Medicine, University of Missouri, Columbia, MO, USA  
<sup>c</sup> Mason Eye Institute, School of Medicine, University of Missouri, Columbia, MO, USA

The diagram illustrates the role of myofibroblasts in corneal wound healing. It shows a myofibroblast with intracellular stress fibers (A) and its interactions with the extracellular matrix (ECM) and focal adhesions or fibronexus. The myofibroblast is shown causing increased backward scatter of light (B), preventing regeneration of the basement membrane (C), and preventing regeneration of corneal nerves (E). The myofibroblast is also shown secreting TGF $\beta$  (D), which promotes its own proliferation and activity.



## Corneal Repair and Regeneration: Current Concepts and Future Directions

Mohammadmahdi Mobaraki<sup>1</sup>, Reza Abbasi<sup>1</sup>, Sajjad Omidian Vandchali<sup>1</sup>, Maryam Ghaffari<sup>1</sup>, Fathollah Moztarzadeh<sup>1</sup> and Masoud Mozafari<sup>2\*</sup>

<sup>1</sup> Biomaterials Group, Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran, <sup>2</sup> Department of Tissue Engineering and Regenerative Medicine, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Iran

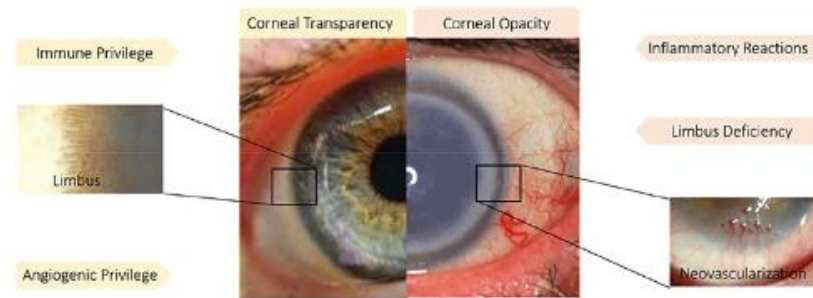
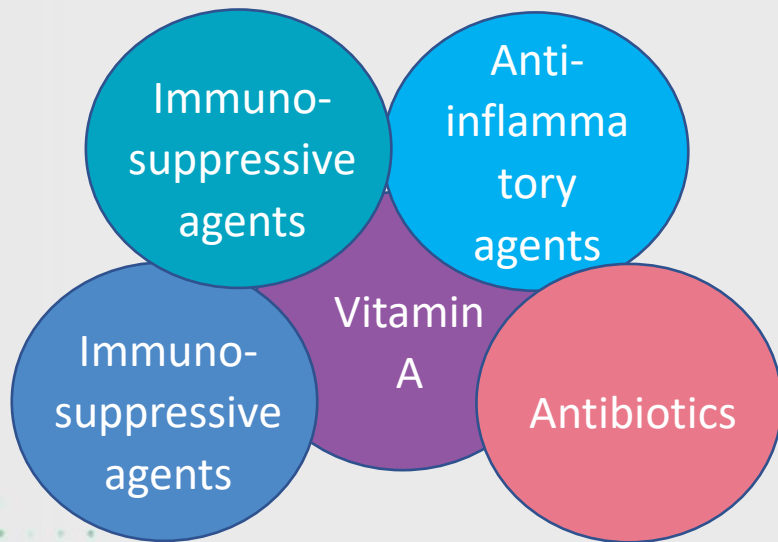


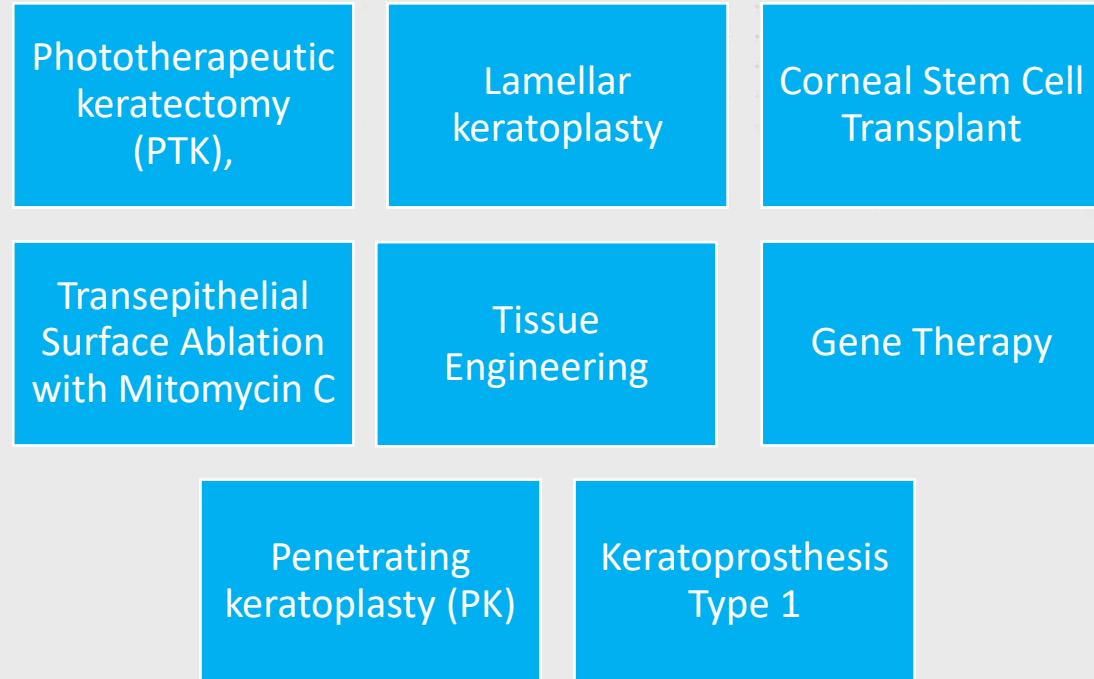
FIGURE 4. Immune and angiogenic privilege besides limbus structure play a pivotal role in corneal transparency. While inflammatory reaction, neovascularization and limbus deficiency endanger corneal transparency. Reprinted with permission from [Ellenberg et al. \(2010\)](#) and [Haagdorens et al. \(2016\)](#).

# Treatment for Corneal Scars

## Non-Surgical



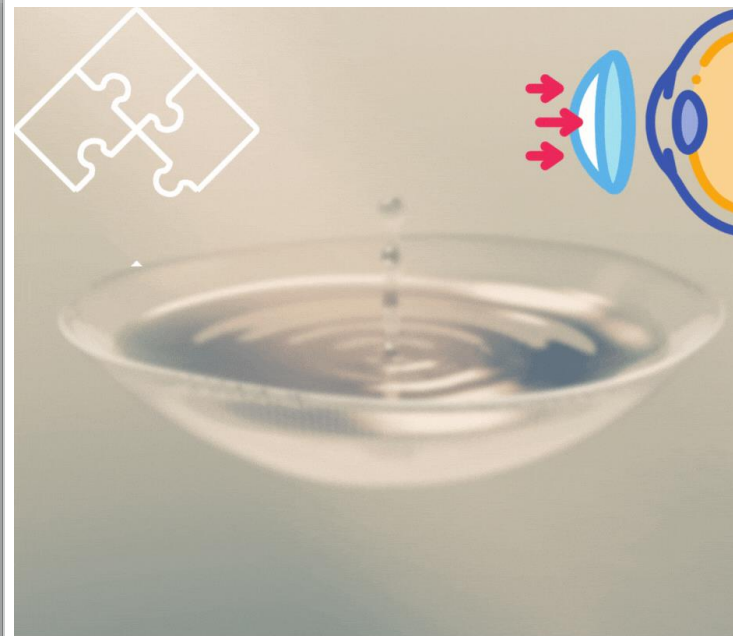
## Surgical





The remodeling process of the injured stroma is vital to the resulting architecture of the tissue deposited following injury.....

The remodeling process is able to alter the architecture of the initial repaired tissue so that it reverts to that of a non-injured state.



030642

*Review*

## **Control of Scar Tissue Formation in the Cornea: Strategies in Clinical and Corneal Tissue Engineering**

**Samantha L. Wilson, Alicia J. El Haj and Ying Yang \***

**OPEN ACCESS**

*Journal of*

**Functional  
Biomaterials**

**ISSN 2079-4983**

[www.mdpi.com/journal/jfb/](http://www.mdpi.com/journal/jfb/)

VLK and Lipid Keratopathy in 30+  
corneal GP wearer for Keratoconus

Longstanding Hybrid Lens  
wear for Keratoconus

Herpes Simplex  
Keratitis/Neurotrophic  
Persistent Epithelial Defect

Congenital Corneal Anesthesia from  
Hereditary Sensory and Autonomic  
Neuropathy Type III, Familial  
Dysautonomia

Limbal Stem Cell Deficiency  
and Neurotrophic Keratopathy

Toxic Epidermal Necrolysis  
(TENs) Syndrome

Chronic Exposure, Chronic  
DES

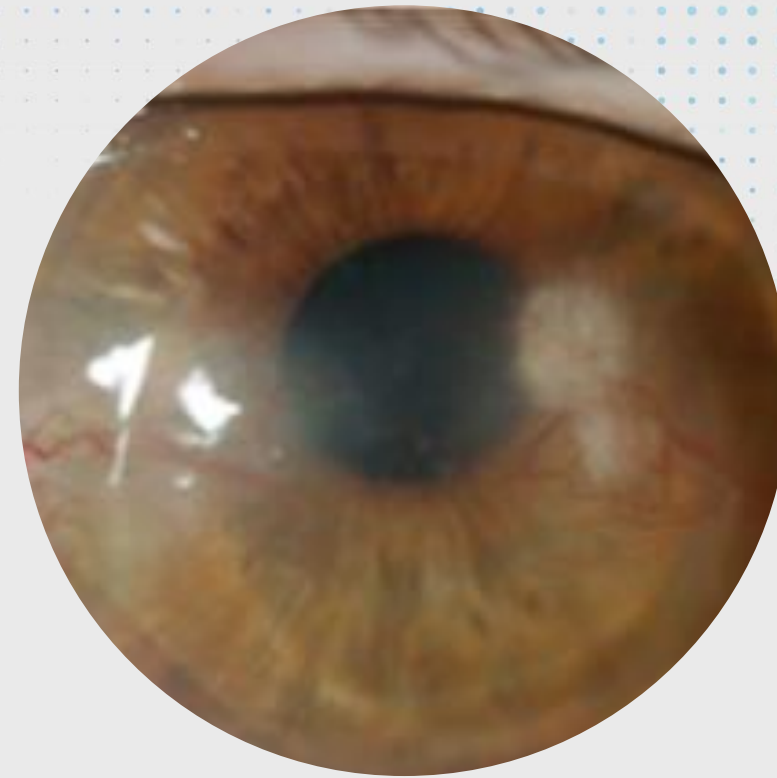
# Clinical Cases



VLK and Lipid  
Keratopathy in 30+  
corneal GP wearer for  
Keratoconus



~40yrs of CL wear, including PMMA, small-  
diameter, GP lenses, low-Dk  
hybrid, and piggyback lens modalities.



Sleeper, A, Jacobs, DS, and Carrasquillo, KG  
(2012) *Eye & Cont Lens*; 38: 137–140)

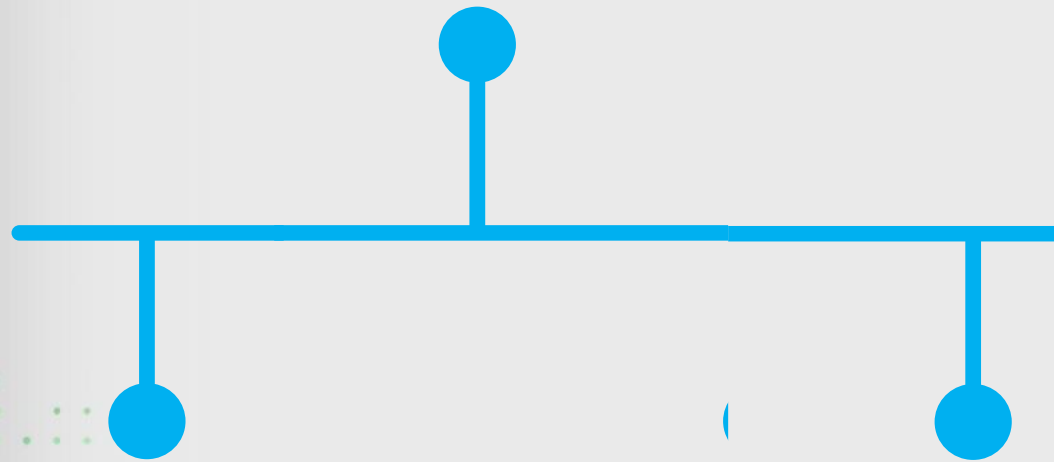
58-year-old white woman  
with a history of advanced  
keratoconus and

Complications of lens wear caused  
extensive VLK in both eyes, with  
vascularization, lipid  
keratopathy, and corneal scarring projecting  
into the central cornea, OS>OD

VLK and Lipid  
Keratopathy in 30+  
corneal GP wearer for  
Keratoconus

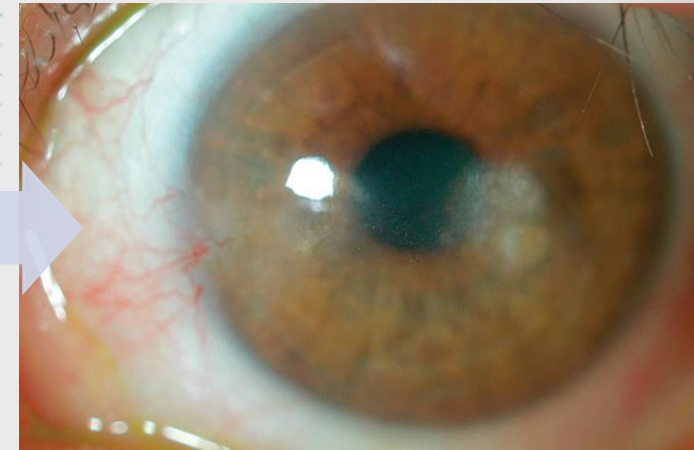
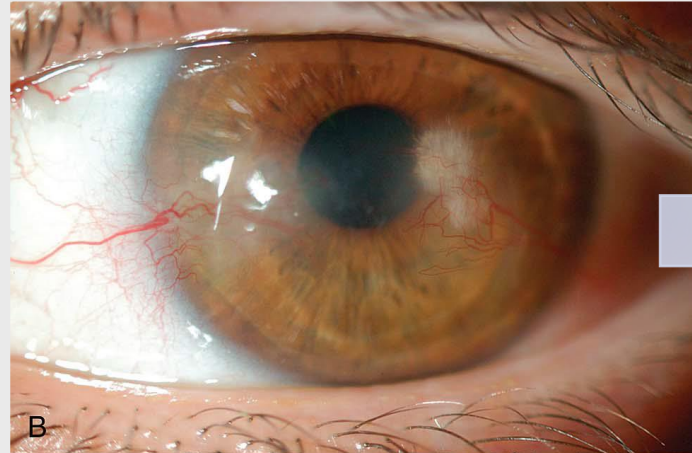


BCVA OD 20/25 (from 20/30-2), OS 20/20-2 (from 20/25) and tolerance of 16 hours/day wear.



Fitted 19.5-mm-diameter lens OD and 21mm OS

At **6 months**, improvement in neovascularization and a decrease in the lipid keratopathy were noted in the left eye



Sleeper, A, Jacobs, DS, and Carrasquillo, KG (2012) *Eye & Cont Lens*; 38: 137–140)







Baseline

6 months

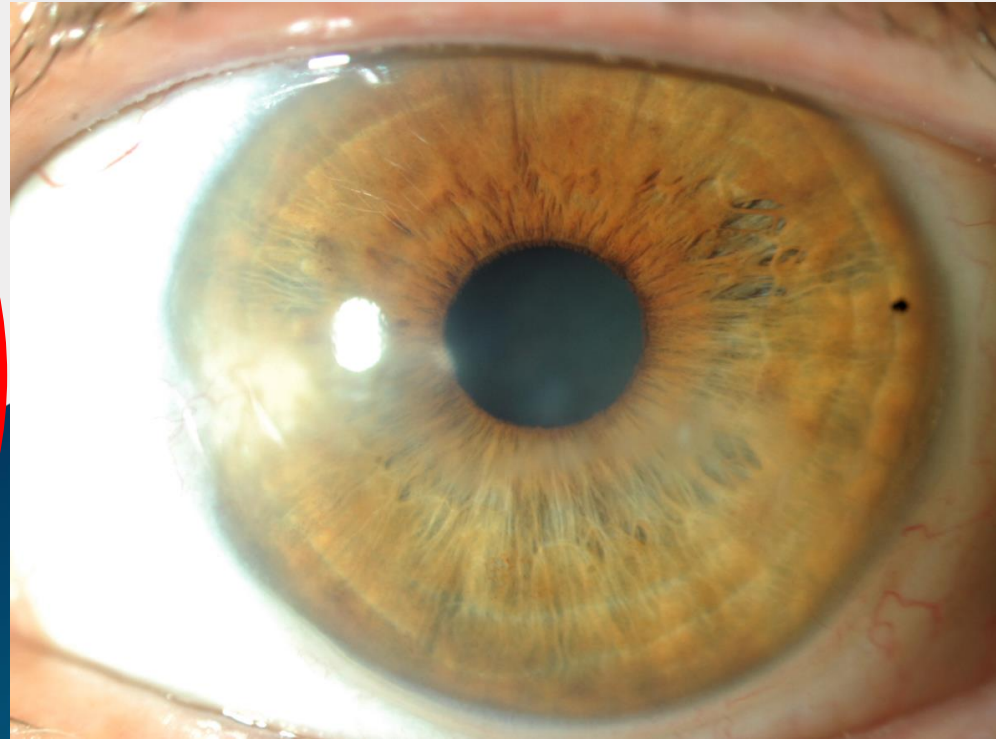
2 years

4 years

6 years



Sleeper, A, Jacobs, DS, and Carrasquillo, KG (2012) *Eye & Cont Lens*; 38: 137–140)



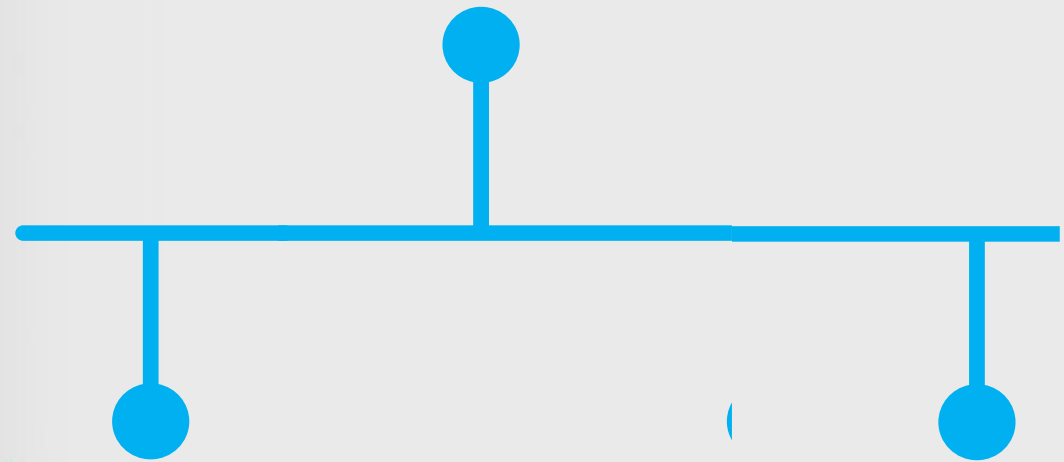
Is the benefit mainly  
in the regression of  
Lipid Keratopathy  
and neo regression?



VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

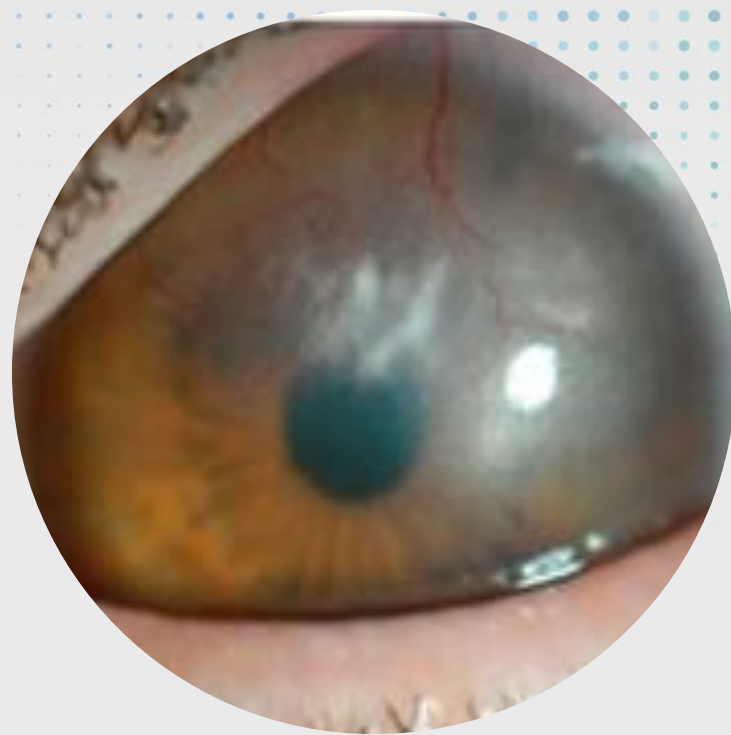
Longstanding Hybrid Lens wear for Keratoconus

C/O pain, irritation and photophobia OS>OD



51 yo Male with KCN Hybrid Lens wearer for 20yrs

Scarring, opacification and Neovascularization OS>OS at time of consultation



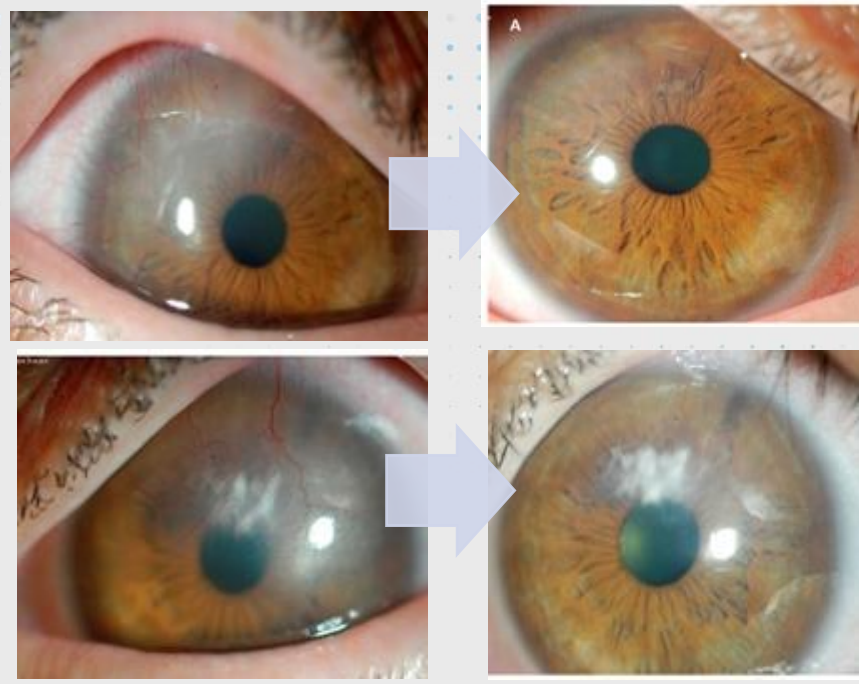
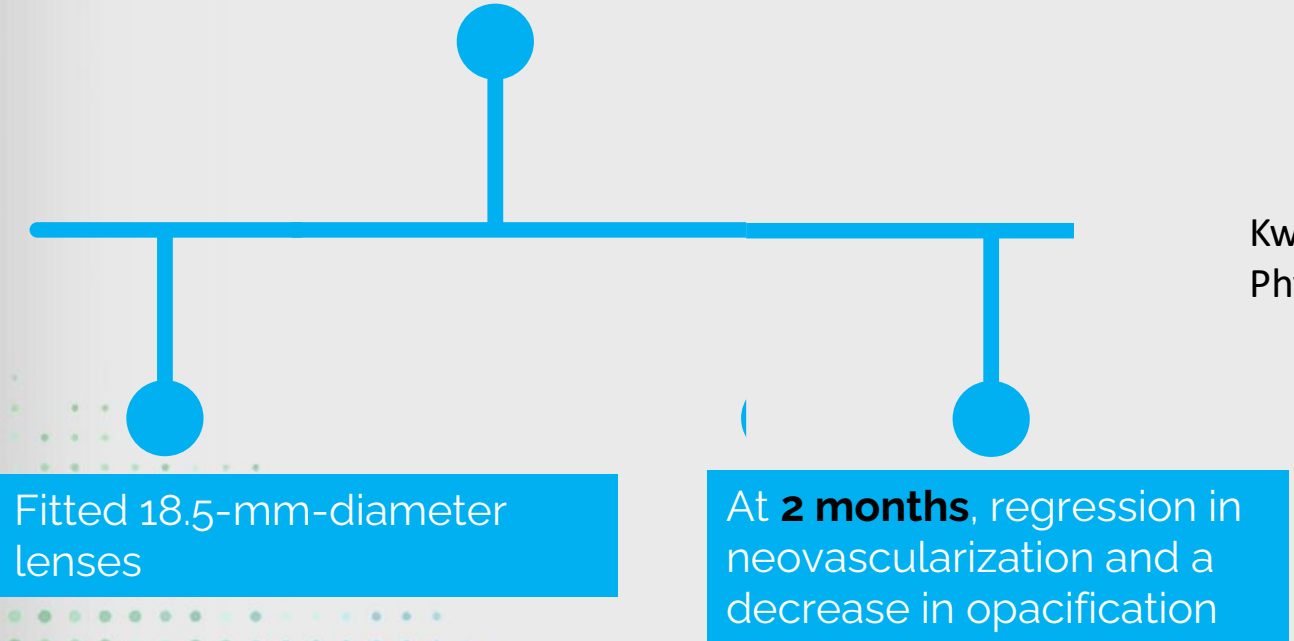
Kwok A, Carrasquillo KG (2018) What Makes a Scleral Lens Fit Physiological? A Case Report. J Ophthalmic Clin Res 5: 41.



VLK and Lipid  
Keratopathy in 30+  
corneal GP wearer for  
Keratoconus

Longstanding  
Hybrid Lens wear  
for Keratoconus

BCVA OD 20/15  
OU (from 20/25,



2 MONTHS

Kwok A, Carrasquillo KG (2018) What Makes a Scleral Lens Fit Physiological? A Case Report. J Ophthalmic Clin Res 5: 41.



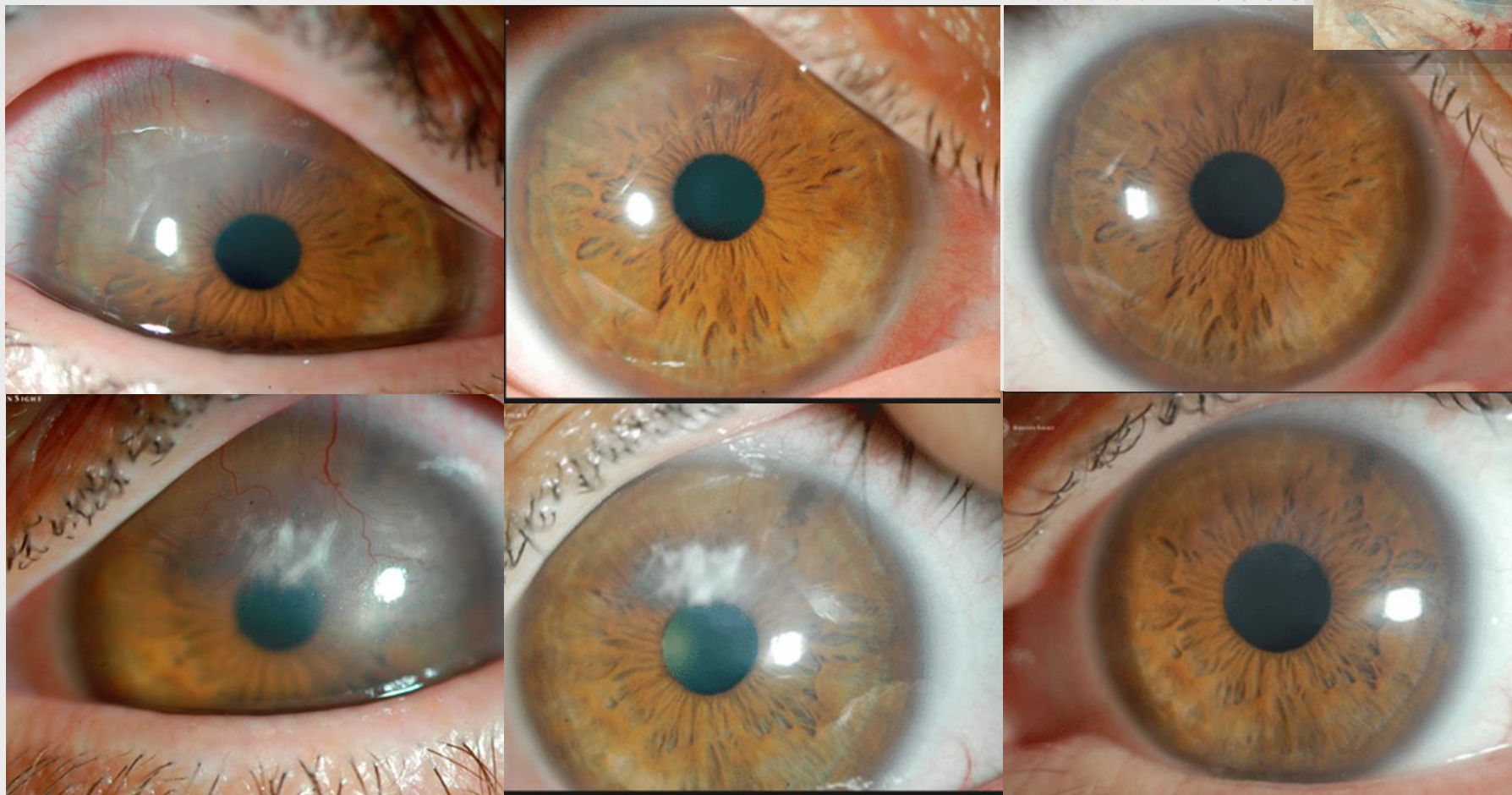


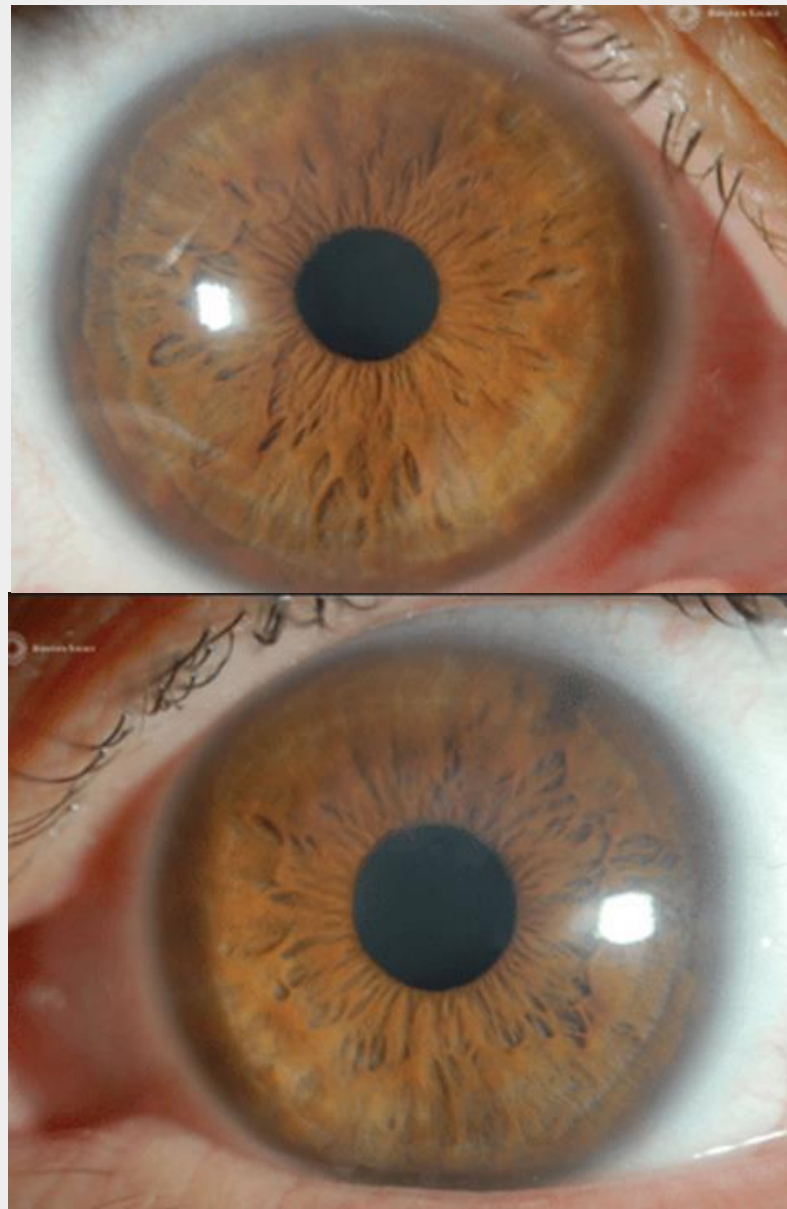
# CORNEAL REMODELING

Baseline

2 months

2 years





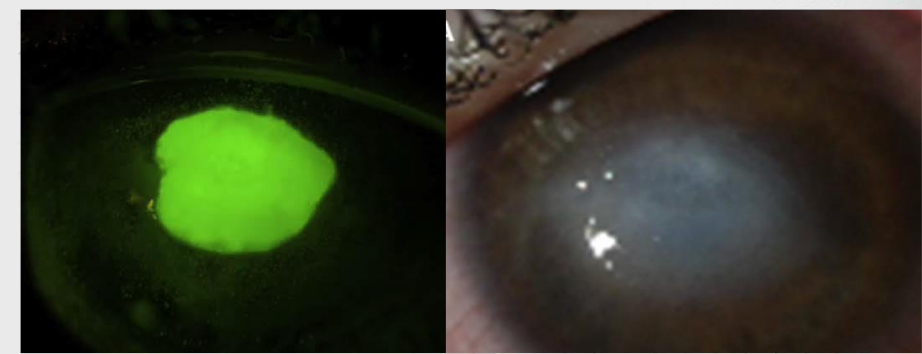


VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

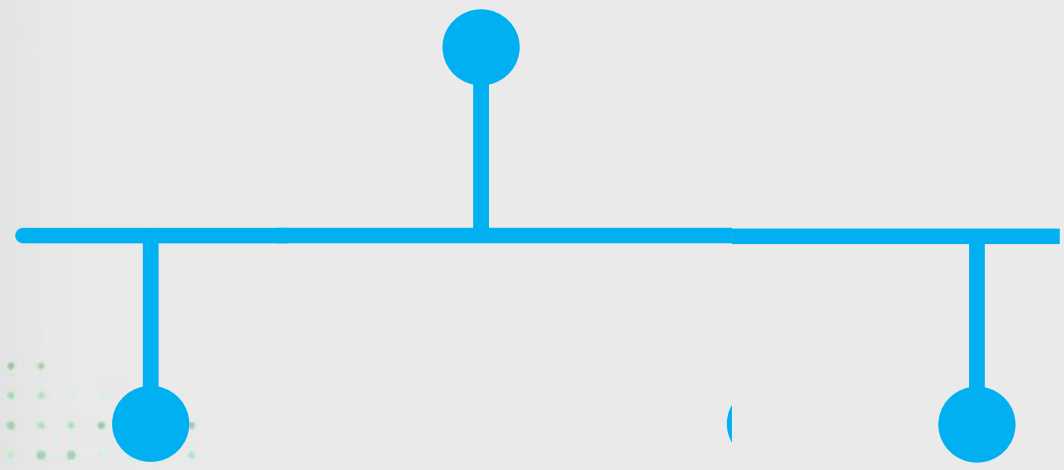
Longstanding Hybrid Lens wear for Keratoconus

Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

Previous Tx: 2 failed amniotic membrane grafts. Meds at time of referral 400 mg oral acyclovir BID daily, autologous serum tears QID OS and NaCl hypertonic ung QHS.



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113



11-yo male . H/O 18-month persistent epithelial defect (PED OS. H/O strabismic amblyopia OS

Entering UCVA 20/400 PH 20/70 with an active PED



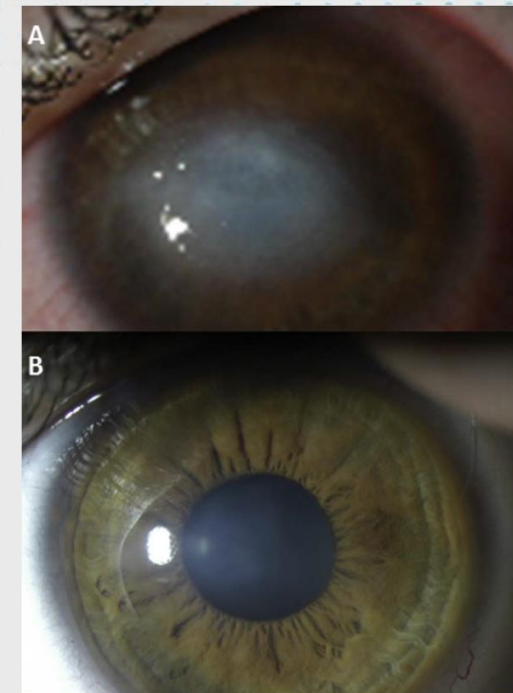


VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

Longstanding Hybrid Lens wear for Keratoconus

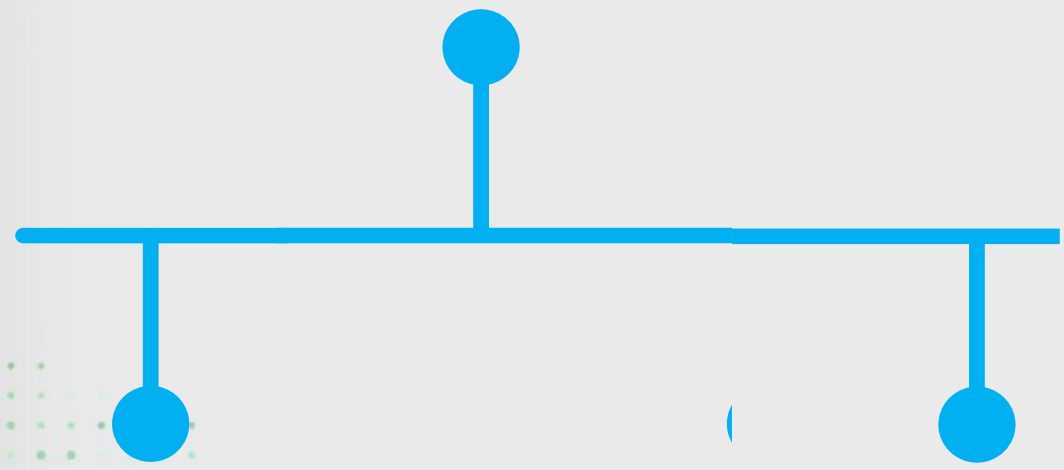
Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

Healed the defect with off-label overnight use of the lens and daily monitoring (including weekends).



3 years

Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113



Fit in 18.5mm lens

Resumed daily Scleral lens wear once PED healed

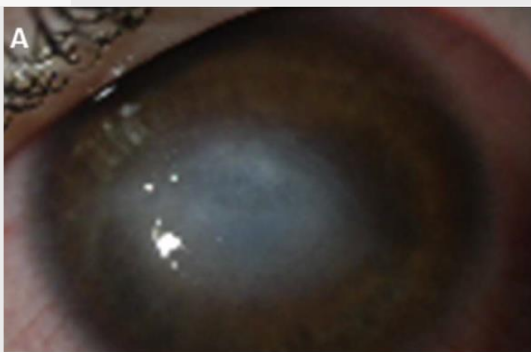


Baseline

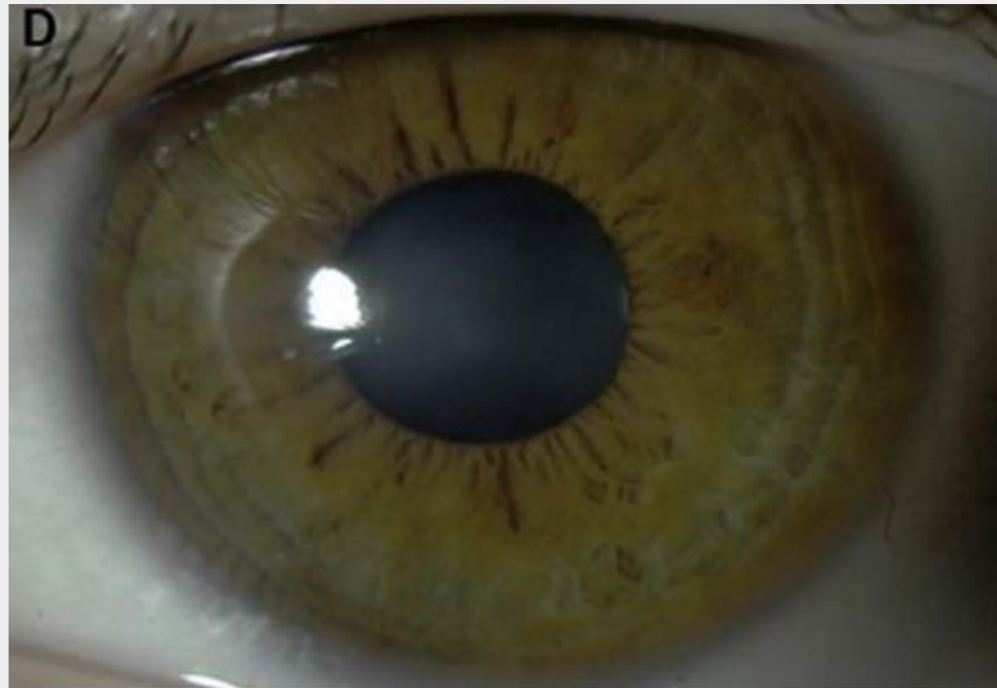
3 years

5 years

6 years



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113

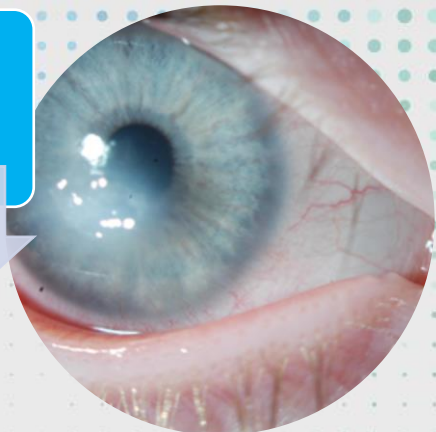


VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

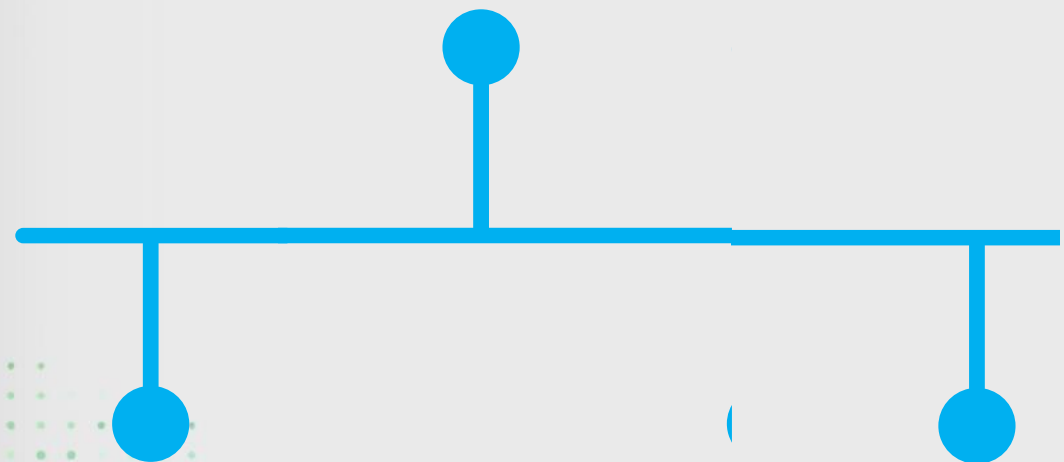
Longstanding Hybrid Lens wear for Keratoconus

Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

Brin tumor s/p Radiation

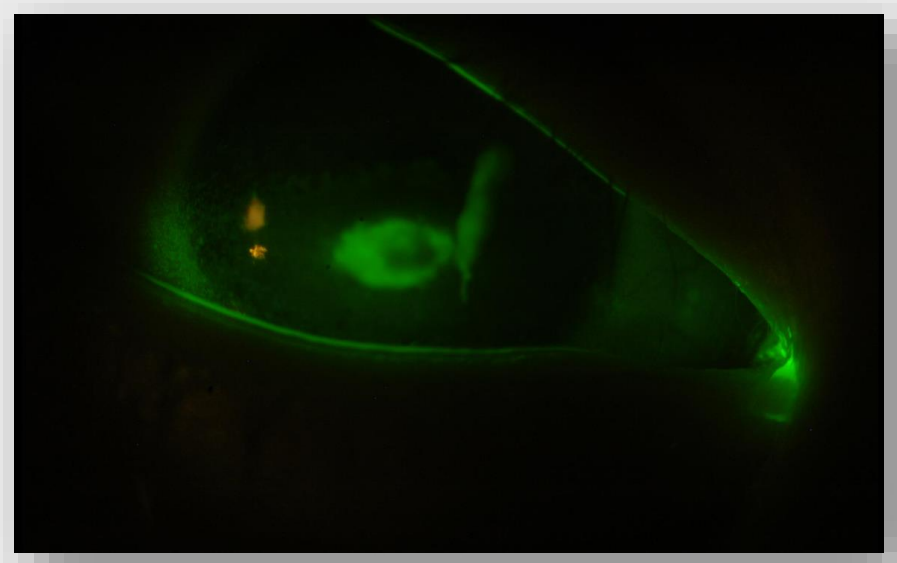


PED OD at baseline with opacification and neovascularization



5 yo Boy. H/O Brain Cancer. S/P Radiation right side

PED OD at baseline with opacification and neovascularization

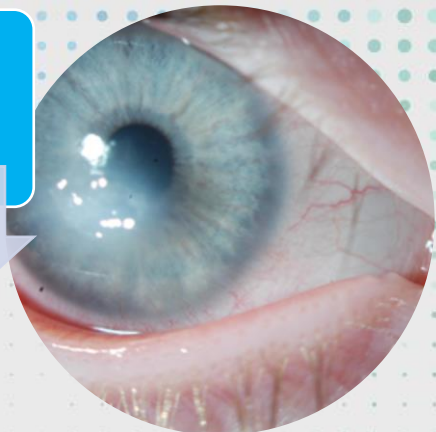


VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

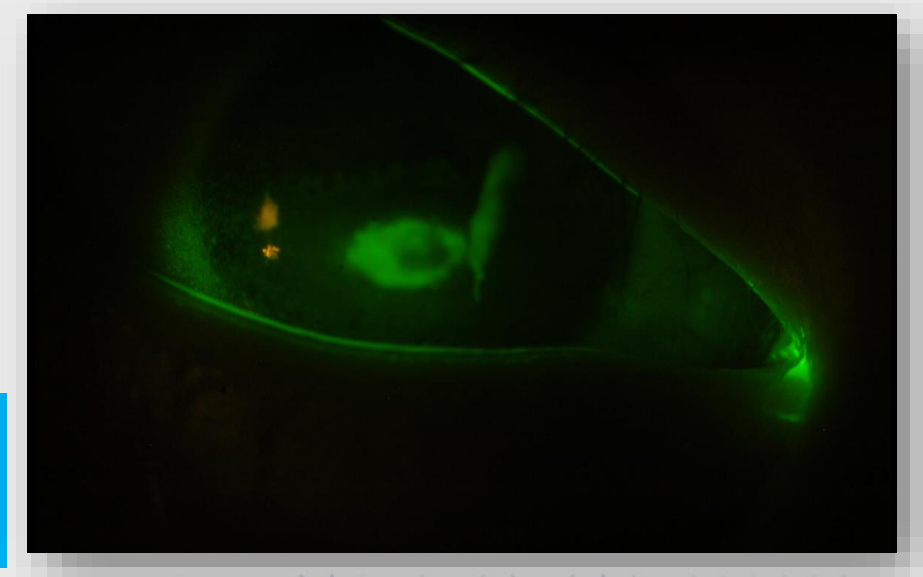
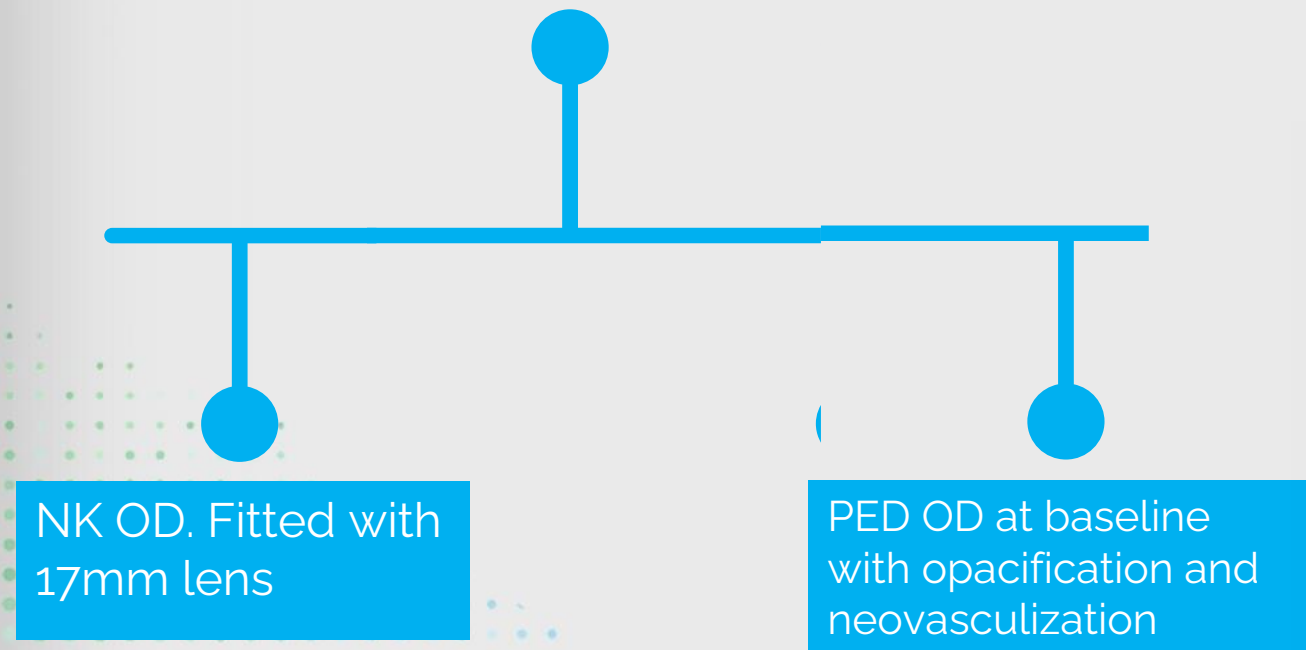
Longstanding Hybrid Lens wear for Keratoconus

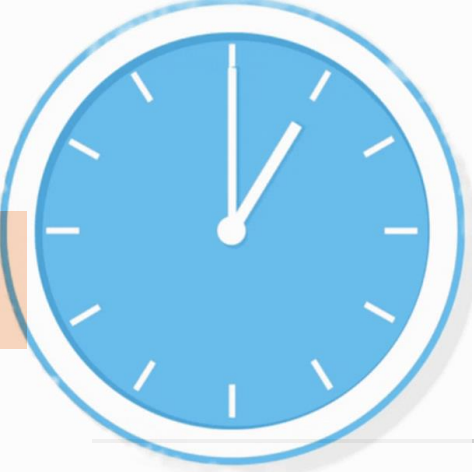
Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

Brin tumor s/p Radiation



Healed defect with scleral lens. Switched to DW OD





● \*\*\*\*



White Light



VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

Longstanding Hybrid Lens wear for Keratoconus

Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

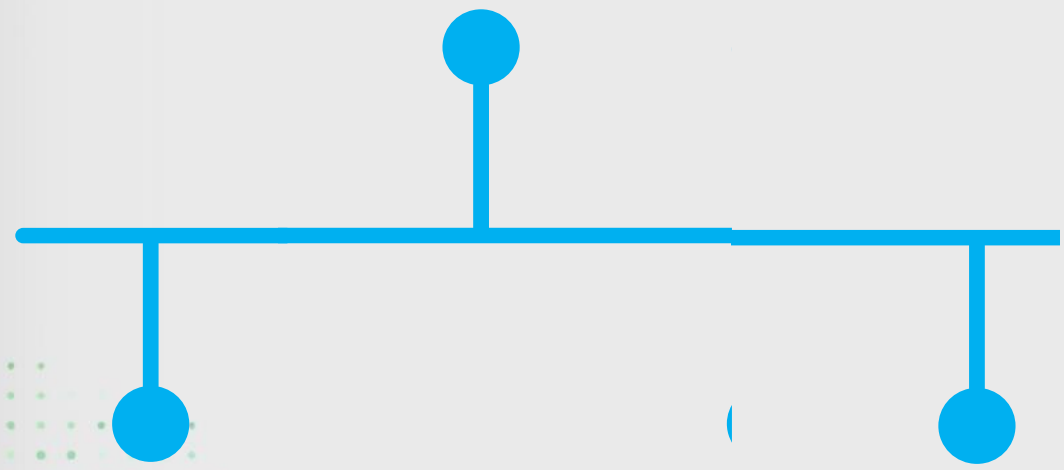
Brain tumor s/p Radiation

NK 2' FD

H/O ulceration and PED OD



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113



6-month old . H/O Familial Dysautonomia

Failed 3 AMG



Baseline

3 months

2 years

5 ears

6 years



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113





## Piggyback cosmetic contact lens as an occlusion therapy in a patient with familial dysautonomia

Langis Michaud <sup>1</sup>, Karen Carrasquillo

Affiliations + expand

PMID: 20935568 DOI: [10.1097/ICL.0b013e3181f57aed](#)

### Abstract

**Purpose:** The purpose of this case report is to explore the treatment of ocular and visual complications secondary to familial dysautonomia (Riley–Day syndrome) on an 8 month-old baby. Treatments for corneal scarring, ocular protection, and amblyopia were achieved by fitting a scleral lens with a unique piggyback combination involving a cosmetic soft contact lens.



VLK and Lipid Keratopathy in 30+ corneal GP wearer for Keratoconus

Longstanding Hybrid Lens wear for Keratoconus

Herpes Simplex Keratitis/Neurotrophic Persistent Epithelial Defect

Brin tumor s/p Radiation

NK 2' FD

Chronic Exposure/DES

Previous treatments of the right eye included: partial tarsorrhaphy, upper lid weight, superior and inferior punctal occlusion



49 yo F. H/O Chronic Exposure and Superficial Keratitis OD with facial nerve palsy 2' head trauma at age 15

DVA 20/50 + PH 20/30

Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113



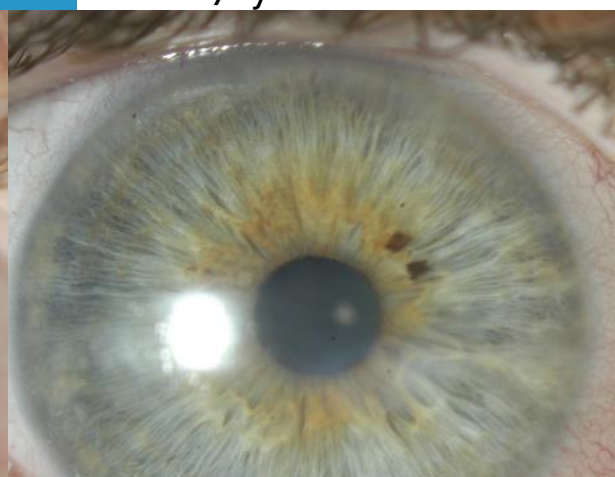
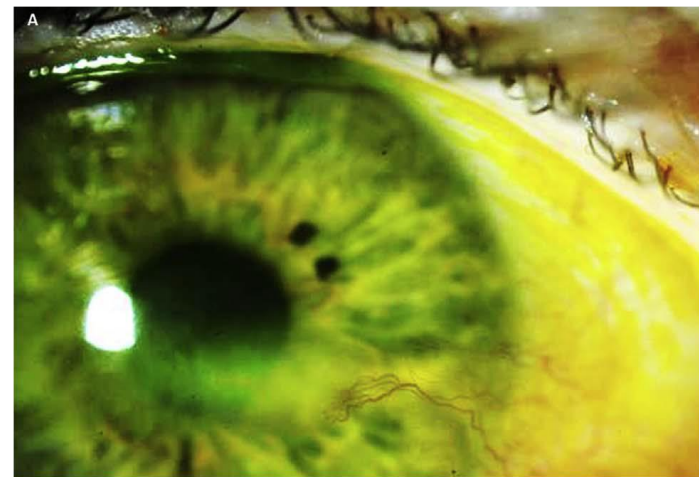


Baseline

1 year

5 years

7 years



Cressey, A., Jacobs, DS, Remington, C, Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113





Cressey, A., Jacobs, DS, Remington, C,  
Carrasquillo, KG. (2018) *Am J Ophthalmol Case Reports* 10: 108–113

Previously unpublished image – photo taken  
December 2022







So far.....

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- Ectasias
- Neurotrophic  
Keratopathy of various  
etiologies
- Chronic Exposure





What about other chronic conditions?

More complex/severe OSD cases?

Can we see remodeling as well?





## Corneal Repair and Regeneration: Current Concepts and Future Directions

Mohammadmahdi Mobaraki<sup>1</sup>, Reza Abbasi<sup>1</sup>, Sajjad Omidian Vandchali<sup>1</sup>, Maryam Ghaffari<sup>1</sup>, Fathollah Moztarzadeh<sup>1</sup> and Masoud Mozafari<sup>2\*</sup>

<sup>1</sup> Biomaterials Group, Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran, <sup>2</sup> Department of Tissue Engineering and Regenerative Medicine, Faculty of Advanced Technologies in Medicine, Iran University of Medical Sciences, Tehran, Iran

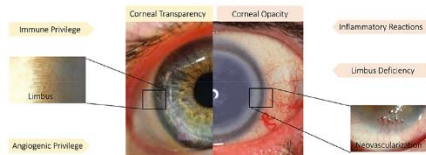
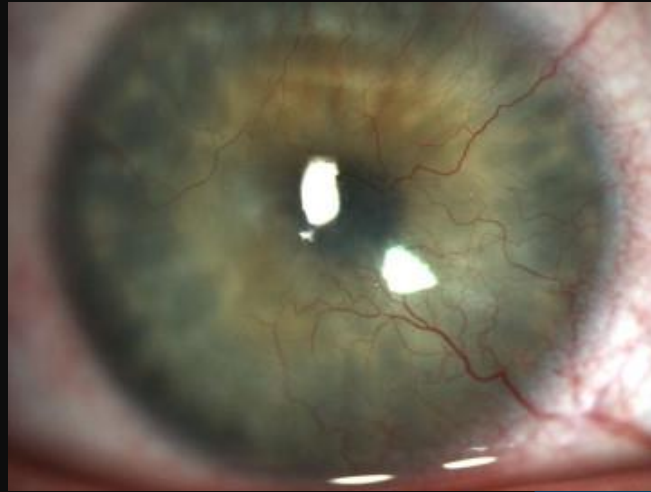


FIGURE 4. Immune and angiogenic privilege besides limbus structure play a pivotal role in corneal transparency. While inflammatory reaction, neovascularization and limbus deficiency endanger corneal transparency. Reprinted with permission from Ellenberg et al. (2010) and Haagdoorens et al. (2016).

DON'T  
FORGET!

# What about cases of Limbal Stem Cell Deficiency?



<https://entokey.com/severe-limbal-stem-cell-deficiency-from-contact-lens-wear-patient-clinical-features>

# LSCD Case 1 – Chronic Soft Contact Lens Use

58-year-old female

20-year H/O SCL wear

Corneal opacification, OS, due to recurrent surface breakdown, and limbal stem cell deficiency

Corneal erosion with ulceration first occurred eleven months prior to consultation

Previous Tx: BCL, amniotic membrane graft, autologous serum tears, loteprednol 0.5%, preservative free artificial tears, gel drops, and topical moxifloxacin.





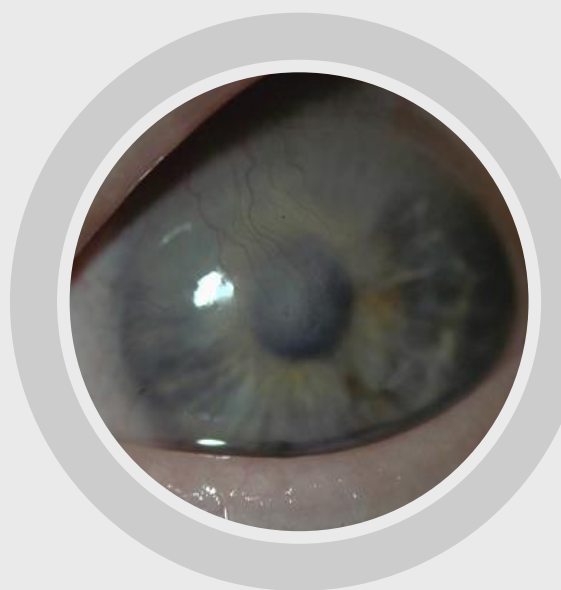
# LSCD Case 1 – Chronic Soft Contact Lens Use

Fitted  
in 18.5mm  
lenses

Goal – avoid limbal  
touch and  
compression. BCVA  
20/40-2 at  
consultation

After 3 mos,  
BCVA improved  
to 20/40+2 and  
After 6mos-1yr  
improved to  
20/30 with  
significant  
improvement at  
the ocular  
surface

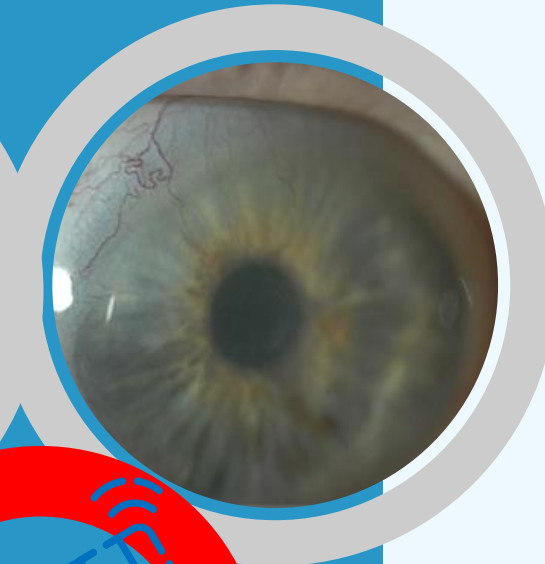
Baseline



3 months



6 months



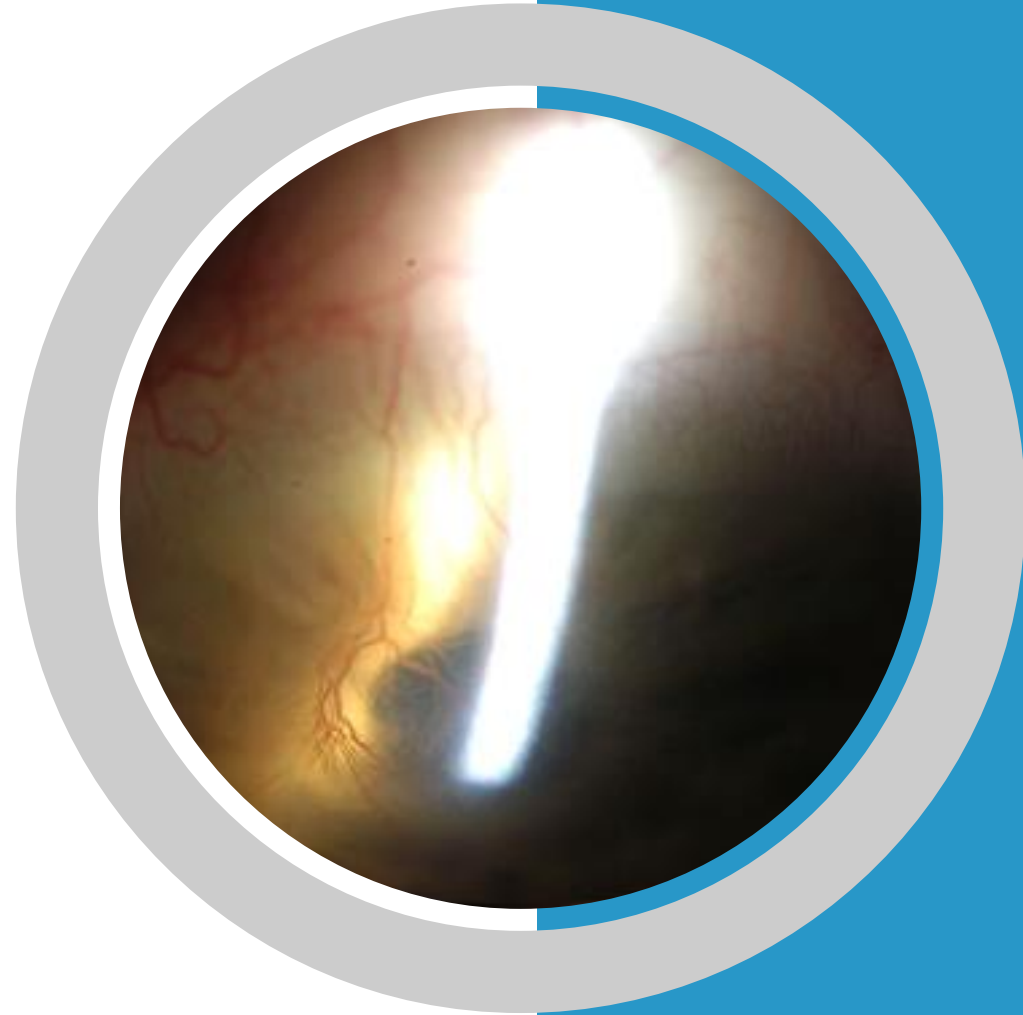
# LSCD Case 2 – Stevens Johnson Syndrome

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19-year-old  
female H/O  
SJS

H/O pain and  
fluctuating VA with  
recurrent infectious  
corneal ulcers OS>OD  
and trachiasis OU.

Previous Tx:  
Lash electrolysis,  
BCL, amniotic  
membrane graft,  
preservative free  
artificial tears,  
gel drops, and  
topical  
moxifloxacin.



# LSCD Case 1 – Stevens Johnson Syndrome

Fitted in  
19.0 mm  
lenses

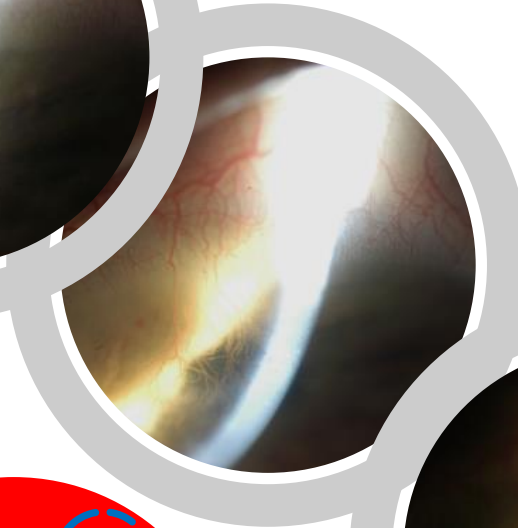
Goal – avoid limbal  
touch and  
compression. Fit to  
avoid suction  
as much as possible

After 1 mos,  
BCVA improved  
from 20/40+2 to  
20/15 with 12-14  
hr/day WT. With  
significant  
improvement at  
the ocular  
surface

Baseline



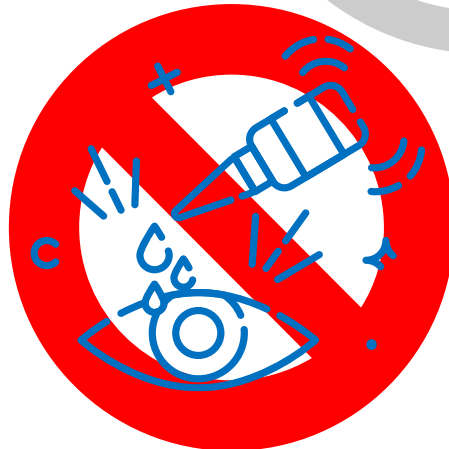
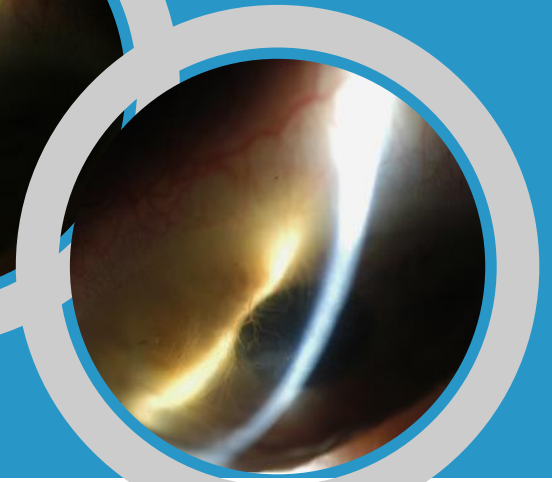
1 months



4 months



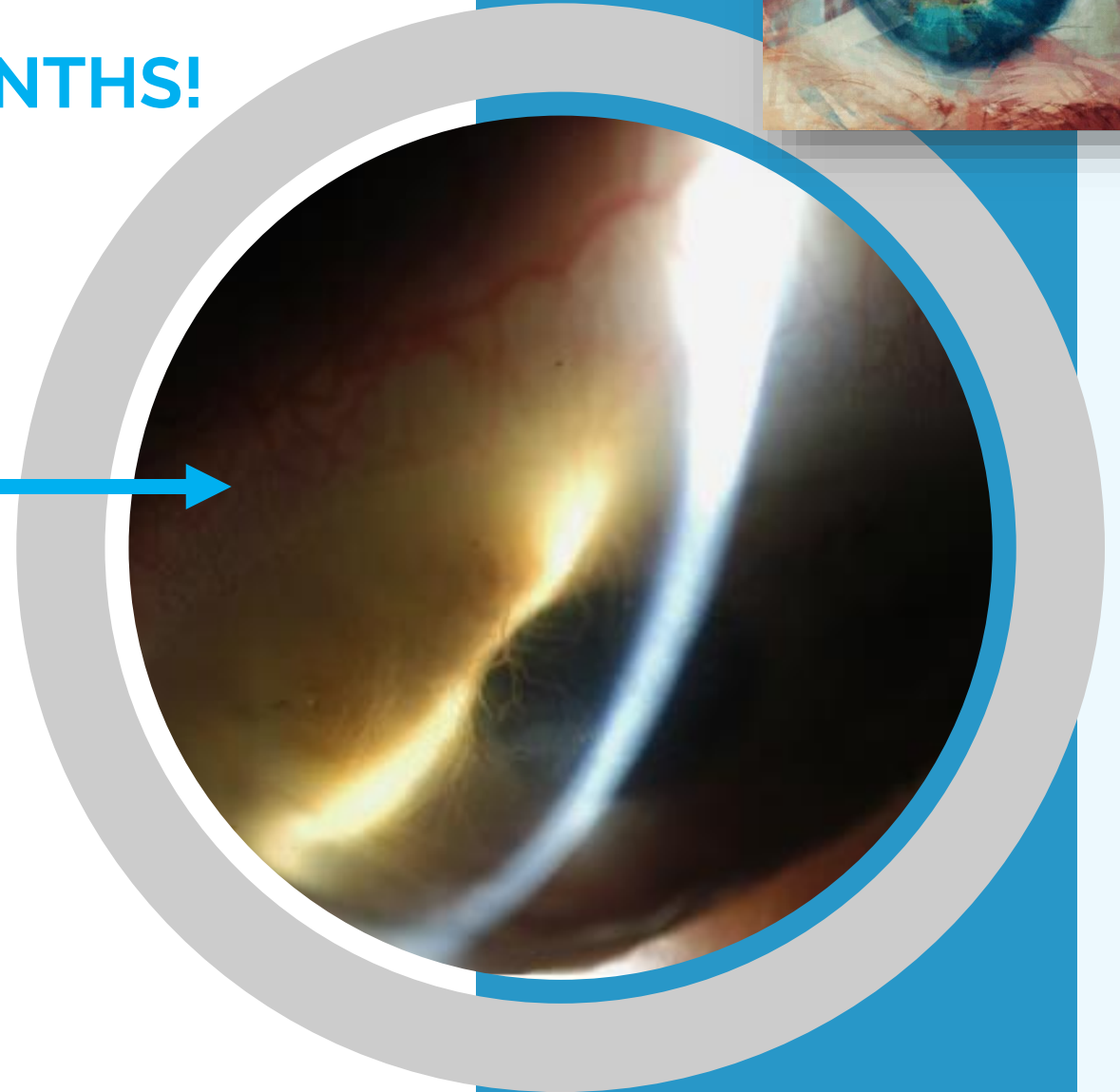
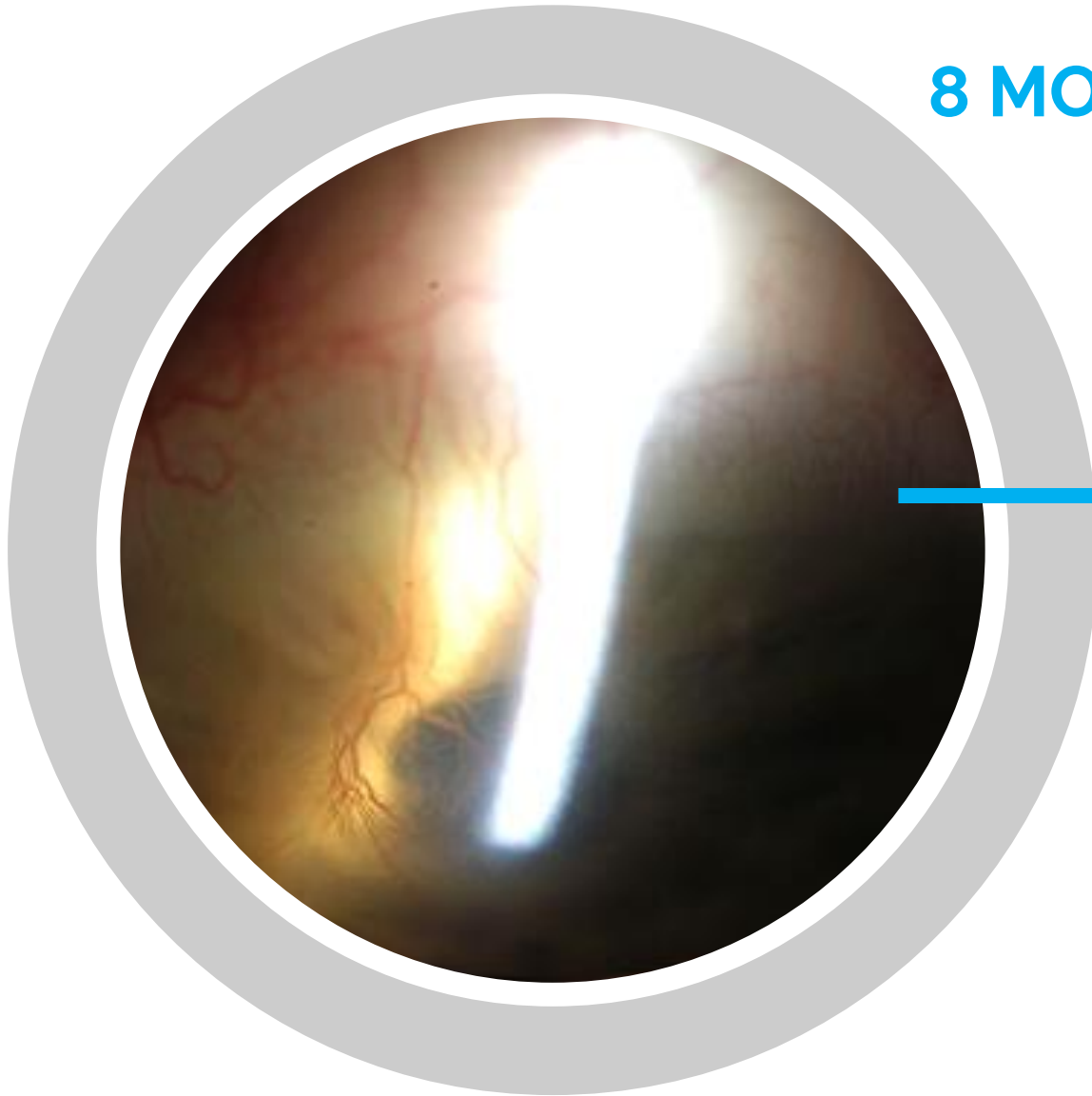
8 months







8 MONTHS!

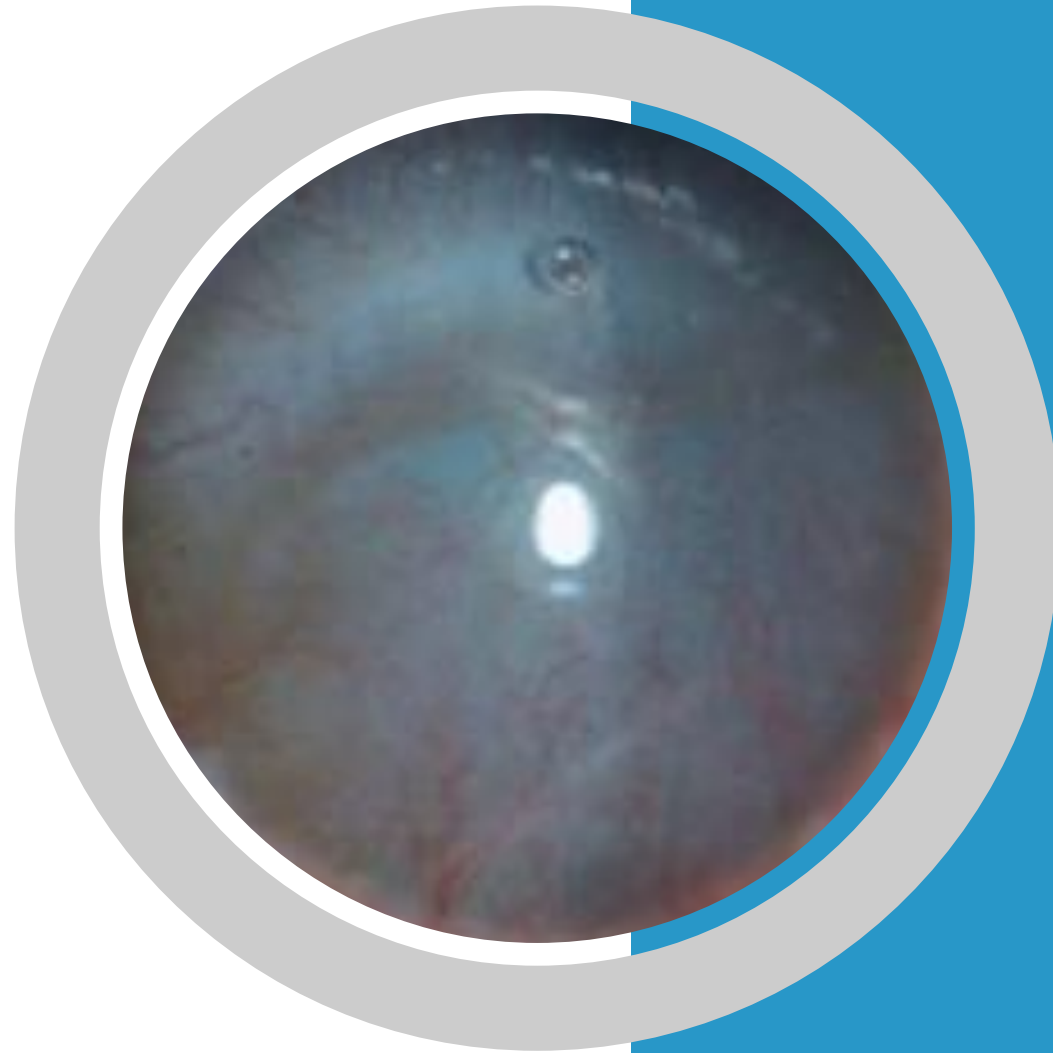


# LSCD Case 2 – Toxic Epidermal Necrolysis

26-yo male  
with a H/O  
TEN

H/O pain and  
photophobia,  
hyperemia OU.

Previous Tx:  
lubricating gel  
drops  
as needed and  
prednisolone  
acetate 1% four  
times daily for  
both eyes



## LSCD Case 2 – TENS

Fitted in  
19.0 mm  
lenses

Goal – avoid limbal  
touch and  
compression. Fit to  
avoid suction  
as much as possible

Baseline



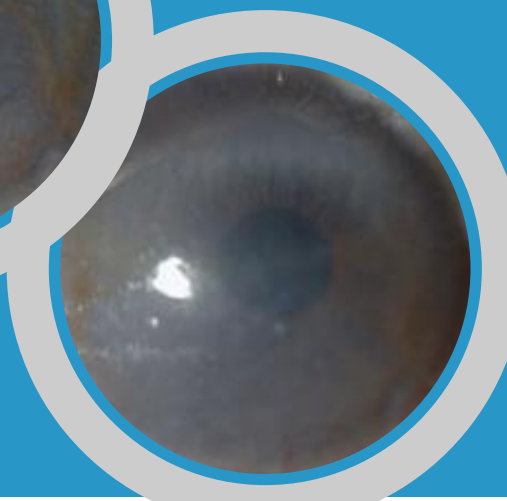
5 months



10 months



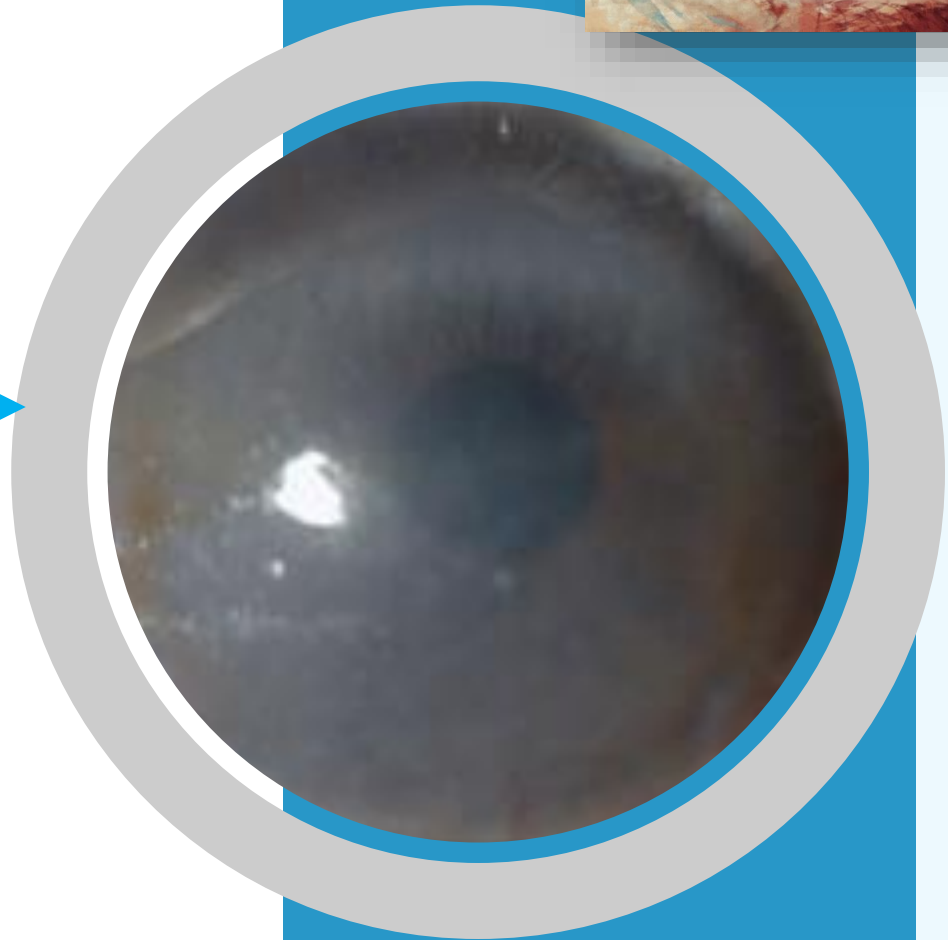
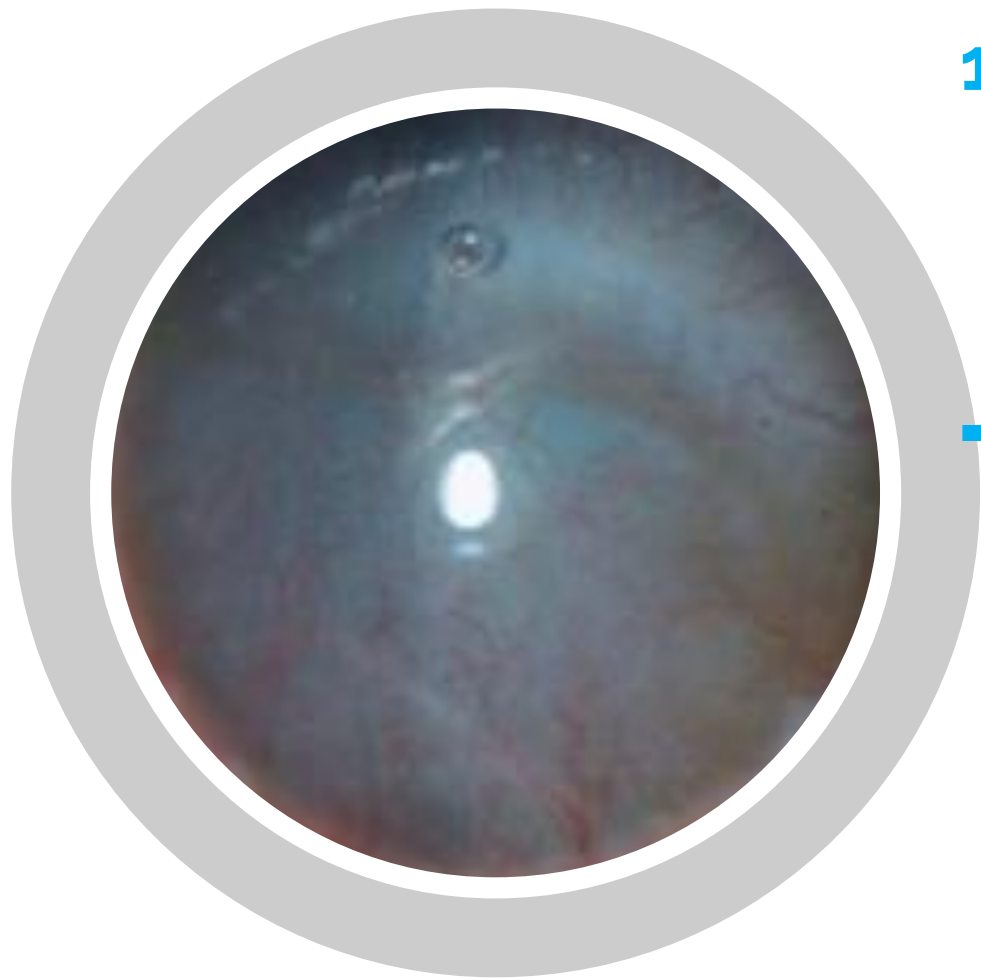
17 months






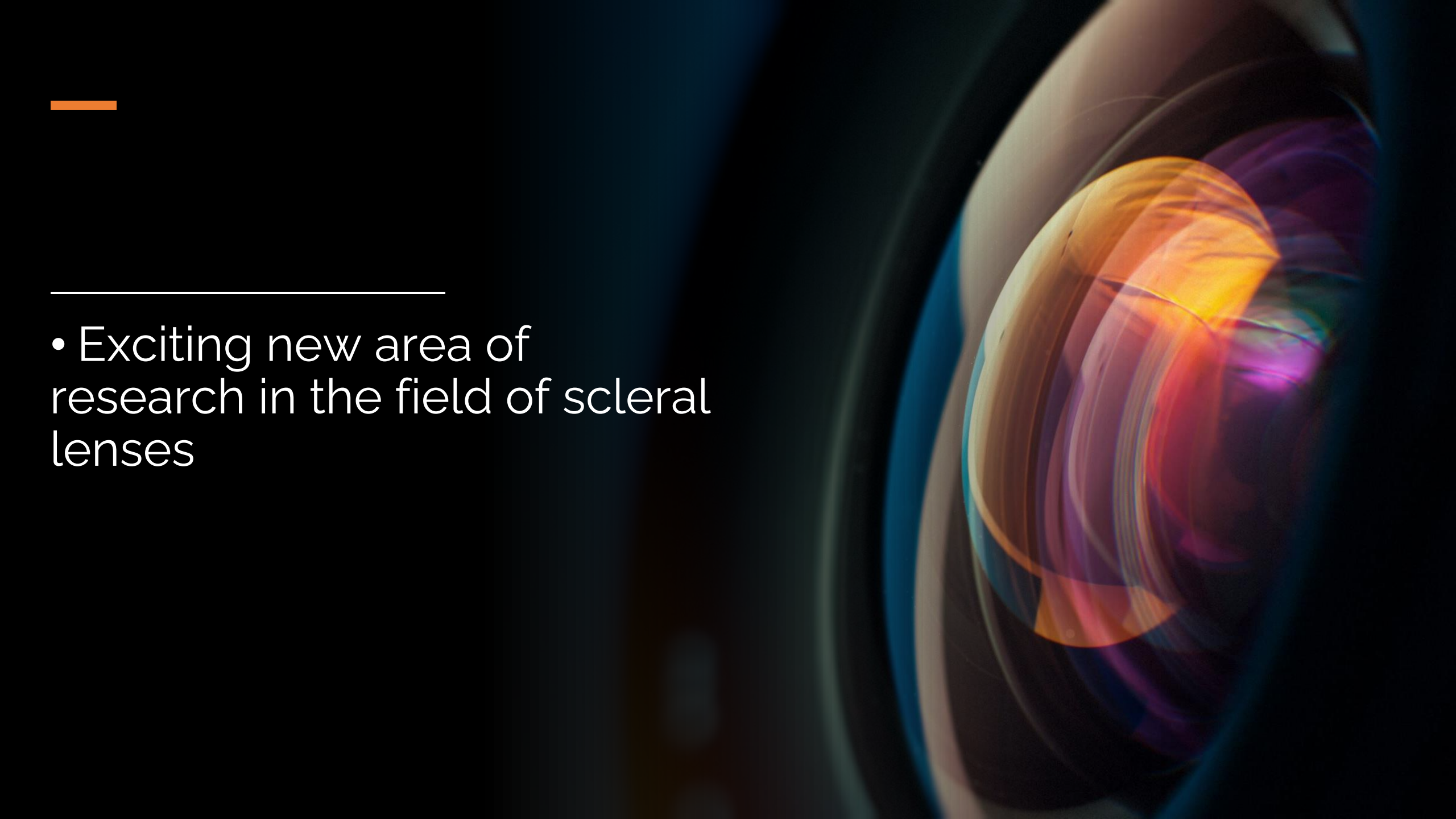


**17 MONTHS!**



- 
- 
- Possible in LSCD. All cases? If not, which cases? Why?



- 
- Exciting new area of research in the field of scleral lenses



- 
- If we fit these lenses well, we have seen that it is possible to “Come out of the Dark” with scleral lenses and clear corneal opacities
- 



THANK YOU  
FOR YOUR  
ATTENTION!