

Scleral Lens Fundamentals

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Diplomate Cornea Contact Lens and Refractive Technologies

Alamo Eye Care

April 6, 2022

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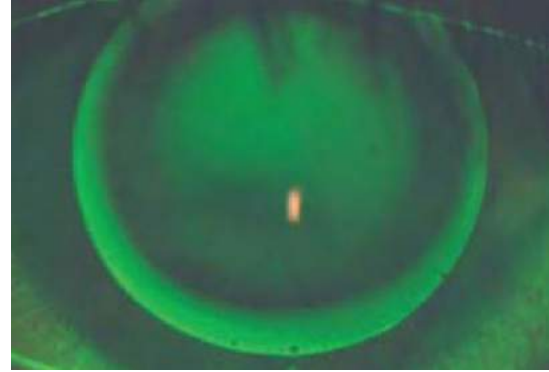
- **Disclosures**

- CooperVision
- LensTech

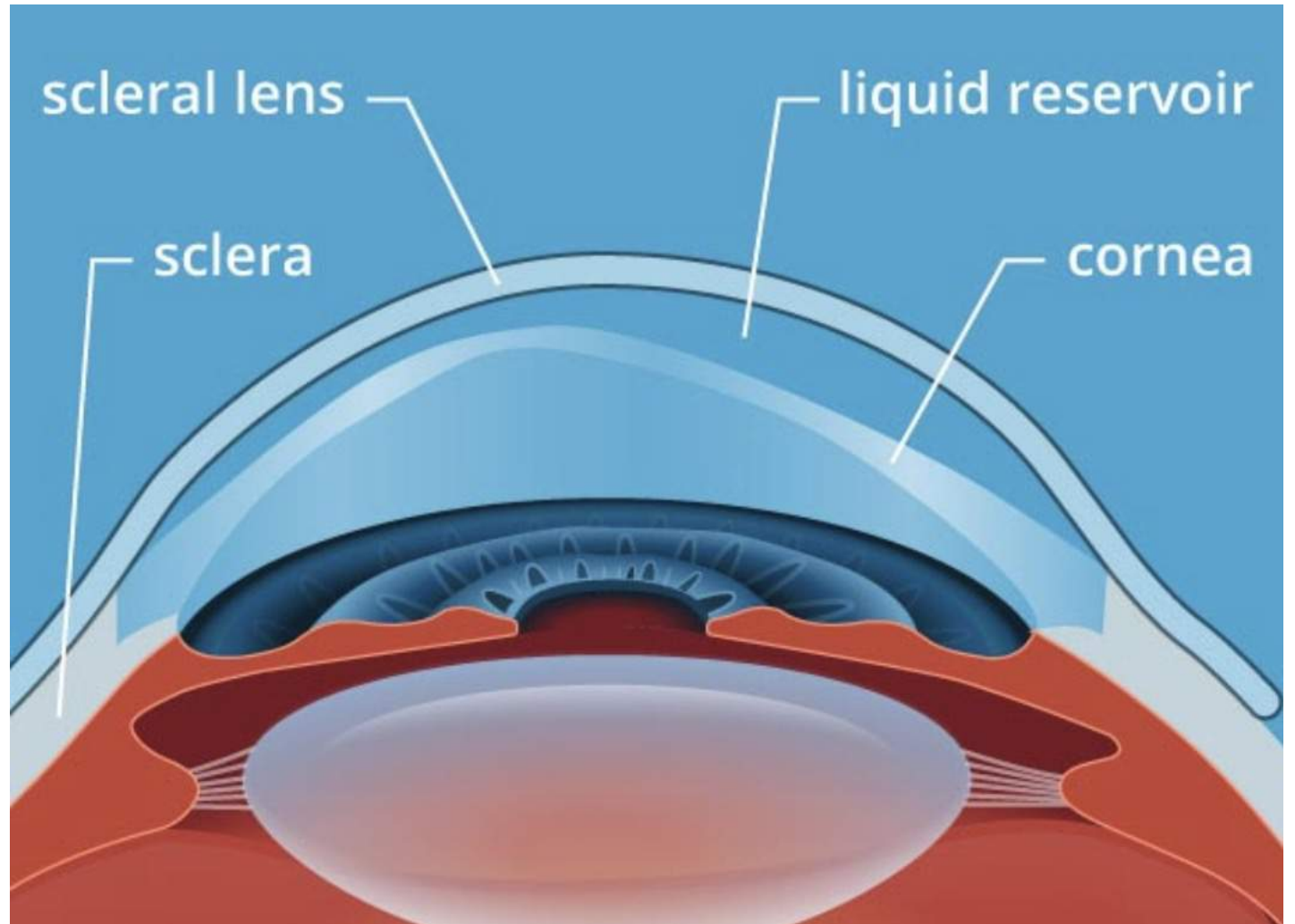


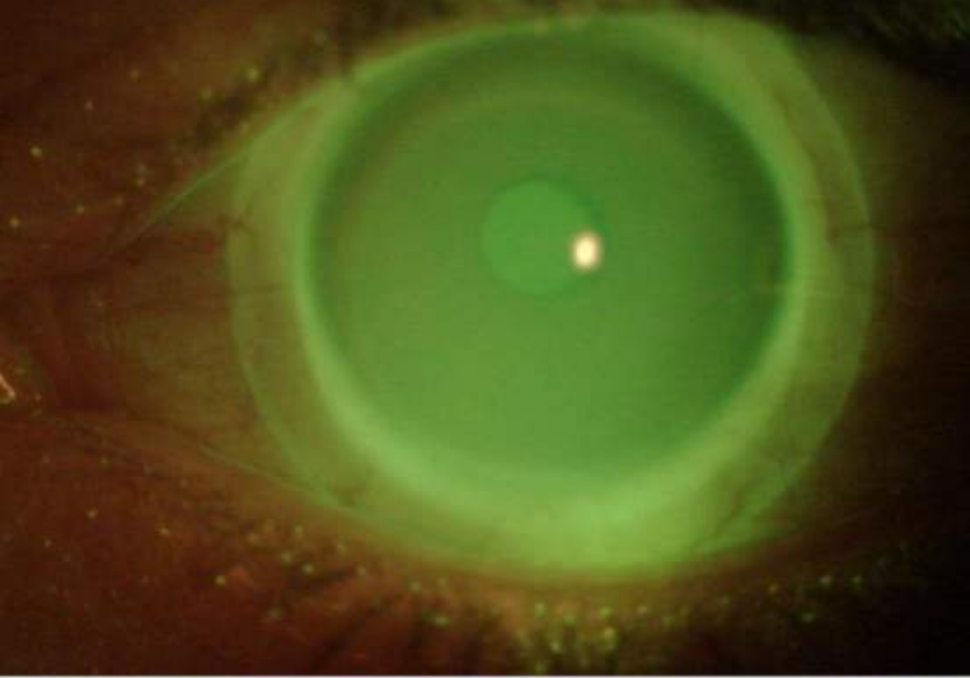
Anatomy Of Scleral Lenses

- Large Diameter GP Lens
- Vaults the Cornea
- Lands on the scleral conjunctiva



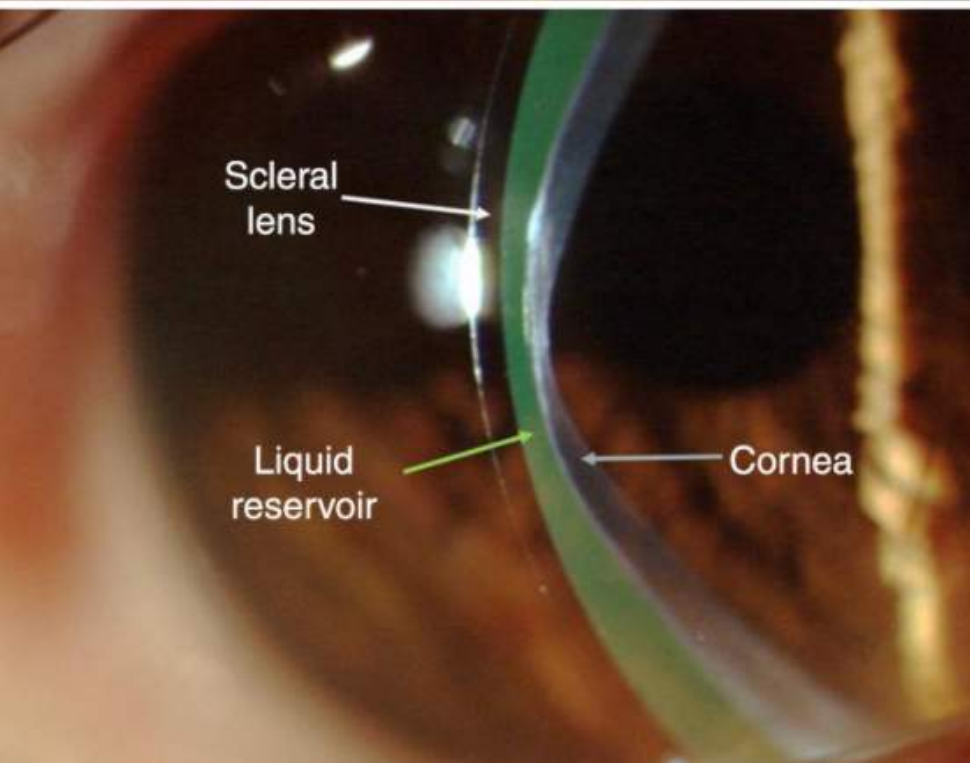
Anatomy of Scleral Lenses





Scleral Lens Anatomy

- Chamber Area
- Limbal Area
- Landing Area



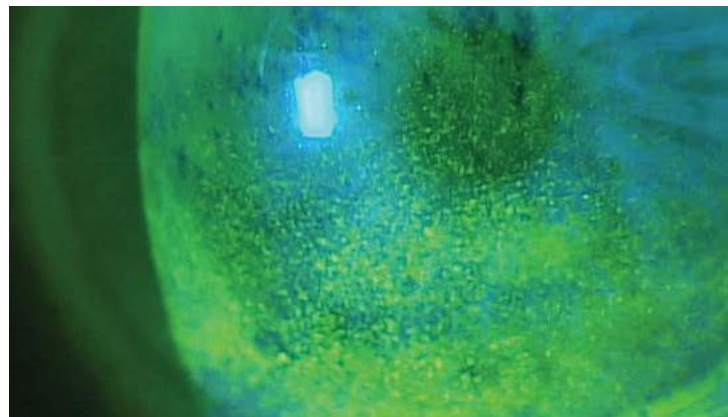
SCLERAL LENSES

- Definition based on diameter
 - OSD Larger
- High Dk
 - Considerations of tear film reservoir

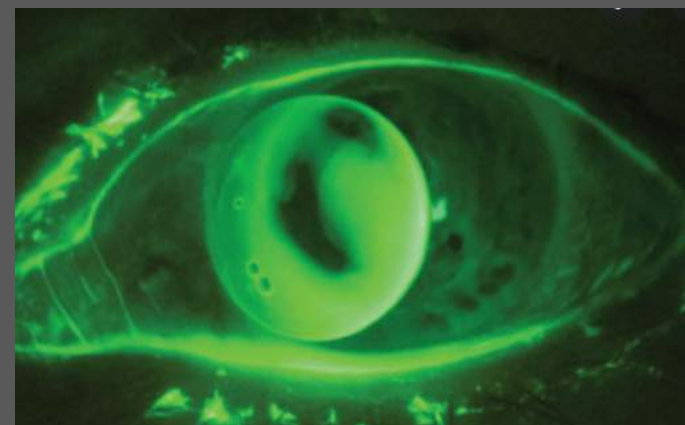
Terminology

	Alternative Names	Diameter	Bearing	Tear Reservoir
Corneal		8.0 to 12.5 mm	All lens bearing on the cornea	No tear reservoir
Corneo-scleral	Corneal-Limbal Semi-scleral Limbal	12.5 to 15.0 mm	Lenses share bearing on the cornea and the sclera	Limited tear reservoir capacity
(Full) Scleral	Haptic	15.0 to 25.0 mm	All lens bearing is on the sclera	
		Mini-scleral 15.0 to 18.0 mm		Somewhat limited tear reservoir capacity
		Large-scleral 18.0 to 25.0 mm		Almost unlimited tear reservoir capacity

Uses of Scleral Lenses



- Corneal Ectasia
- Irregular Astigmatism
- Ocular Surface Disease
- High Ametropia





AGE FOR FITTING SCLERAL CONTACT LENSES

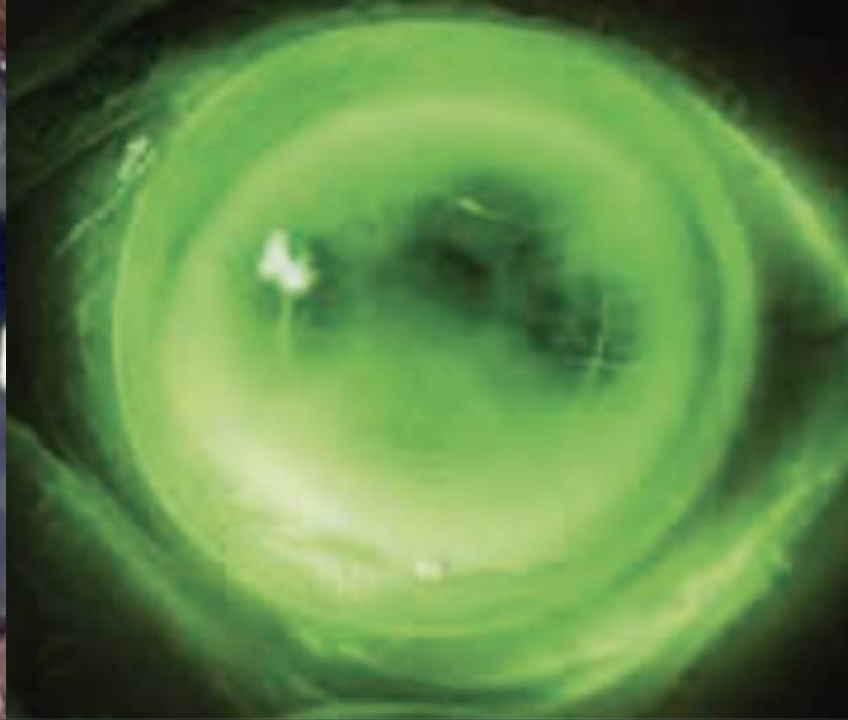
- None
- Parents, family and Caregivers can help
- Devices



How to Fit Scleral Lenses

- Diagnostic Fitting
- Technology
 - OCT
 - Scleral Topography and Tomography





INITIAL LENS SELECTION

- Large to vault cornea and limbus
- Touch avoided if possible
- Lid width = Largest Diameters
- Profile
- Fit is Best Topography

Keratometry and base curve

> [Eye Contact Lens](#). 2010 Nov;36(6):330-3. doi: 10.1097/ICL.0b013e3181eb8418.

Relationship between corneal topographic indices and scleral lens base curve

[Muriel M Schornack](#)¹, [Sanjay V Patel](#)

Affiliations + expand

PMID: 20631627 DOI: [10.1097/ICL.0b013e3181eb8418](#)

Conclusions: In eyes with normal and abnormal ocular contour, base curve of scleral lenses correlates with reference sphere and steep and flat keratometric powers, but the predictive relationship is weak ($r \sim 0.50$). Diagnostic fitting may be the most efficient method of fitting scleral lenses at present.

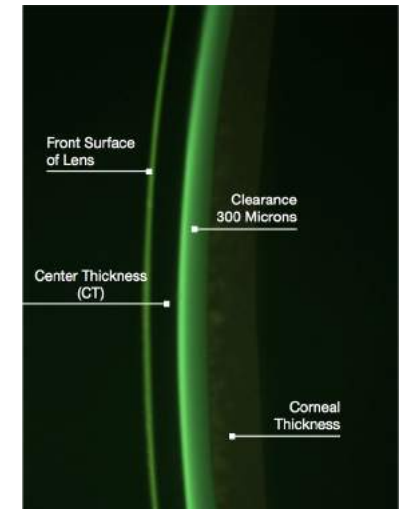
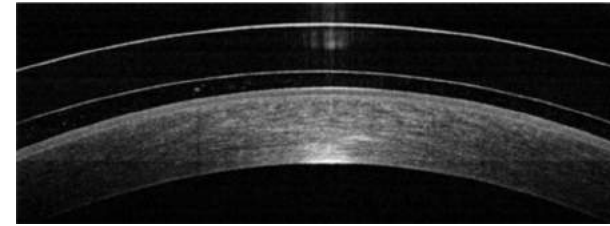
MEDICATIONS

- Preservative Free Tears
- Scheduling of medications
 - Before and after application
- Glaucoma Medications
 - BAK
 - Alternate Therapies



EVALUATION OF SCLERAL LENSES

- Clearance
 - Optic Section
 - Fluorescein
 - OCT
- Lens Settling
 - 1 to 8 hours
 - Plateaus at 2 hours
 - 80 to 100 microns



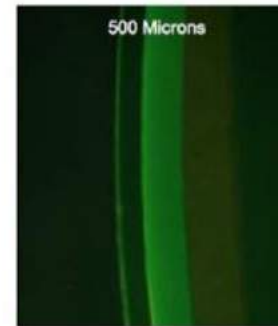
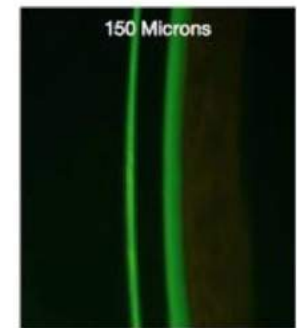
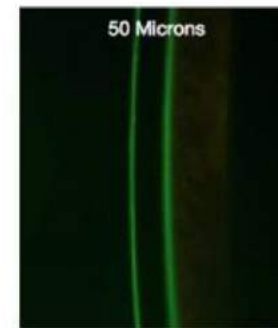
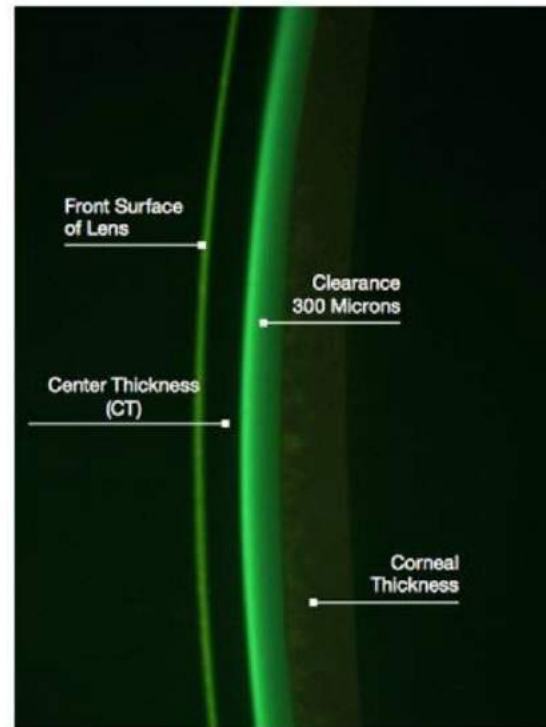
Vault Assessment

- Compare to thickness of cornea
- Compare to thickness of lens

SCLERAL LENS FIT SCALES

To accurately estimate the amount of vaulting (clearance) underneath the posterior surface of a scleral lens necessitates a reference point for comparison. Although some have suggested corneal thickness for the reference, we prefer the

center thickness (CT) of the lens itself which will be listed on the manufacturer's invoice. In each of the examples below, the CT is 0.30mm (300 microns). In most scleral lens designs, the ideal amount of clearance is about 300 microns.





Contents lists available at SciVerse ScienceDirect

Contact Lens & Anterior Eye

journal homepage: www.elsevier.com/locate/clae

BCLA
British Contact Lens Association



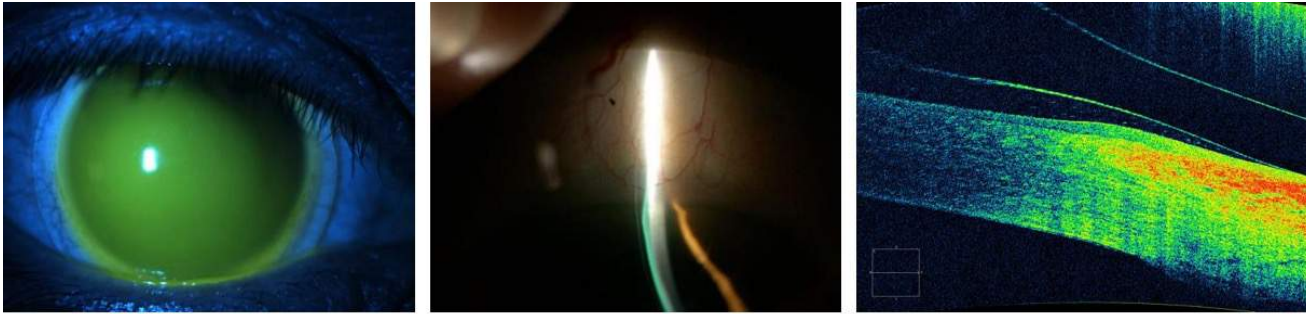
Predicting estimates of oxygen transmissibility for scleral lenses

Langis Michaud*, Eef van der Worp, Daniel Brazeau, Richard Warde, Claude J. Giasson

École d'optométrie, Université de Montréal, Québec, Canada

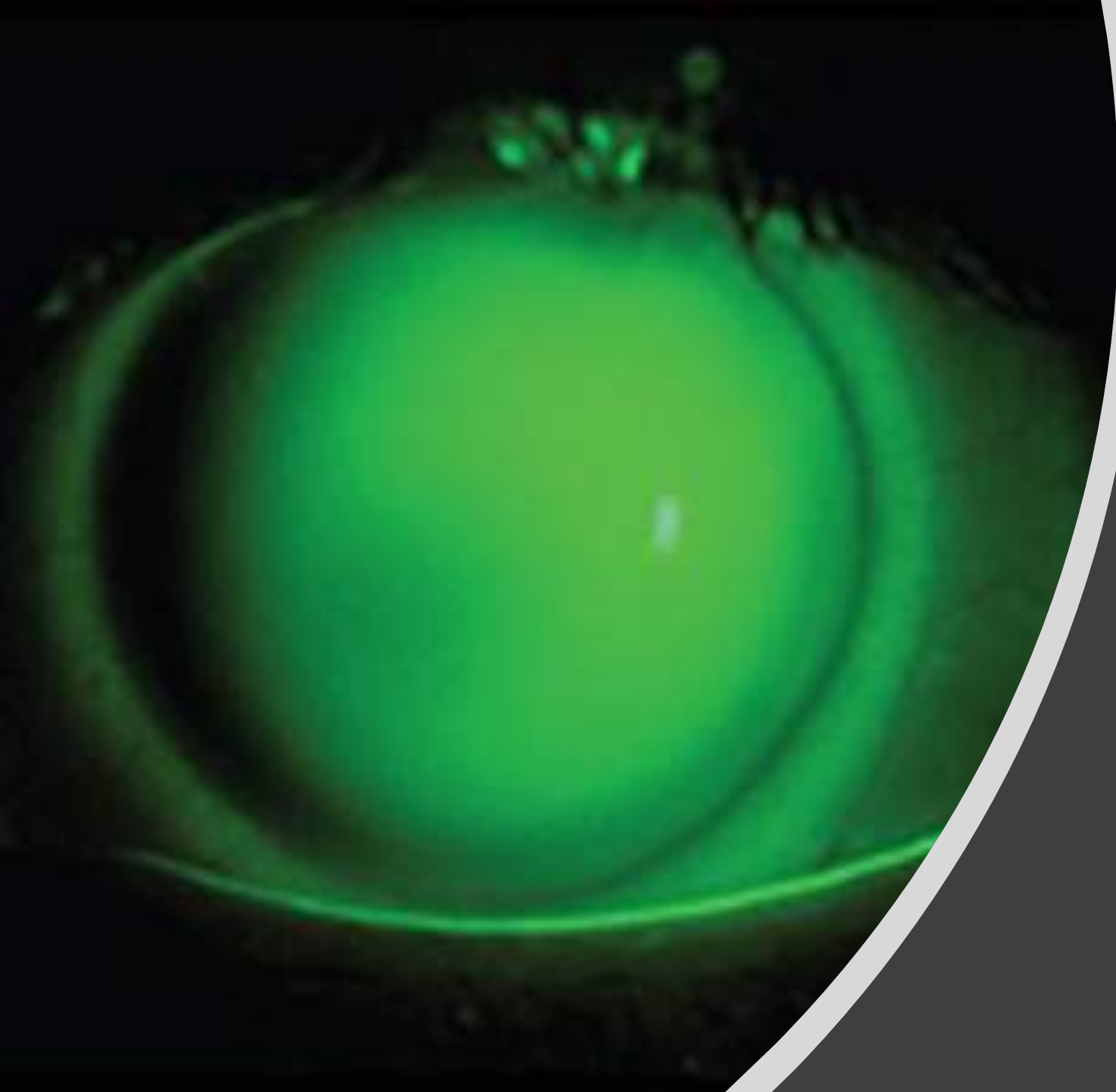
$$\frac{Dk}{t_{scl}} = \frac{1}{(t_1/Dk_1) + (t_2/Dk_2)}$$

Assessment of Chamber and Limbal Area



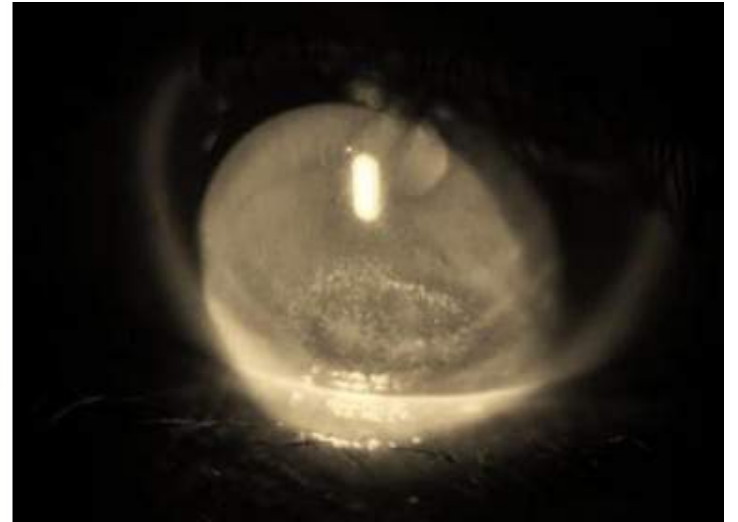
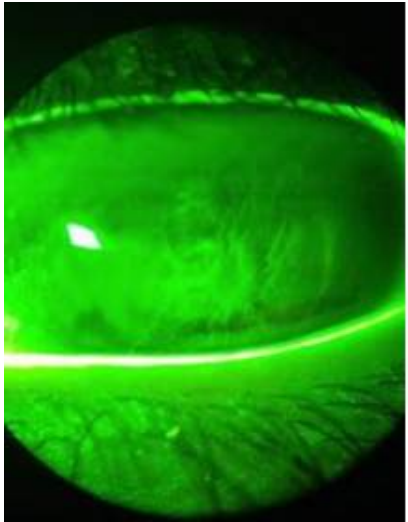
- Adequate vault over the cornea
- Adequate vault over the limbus
- Centration



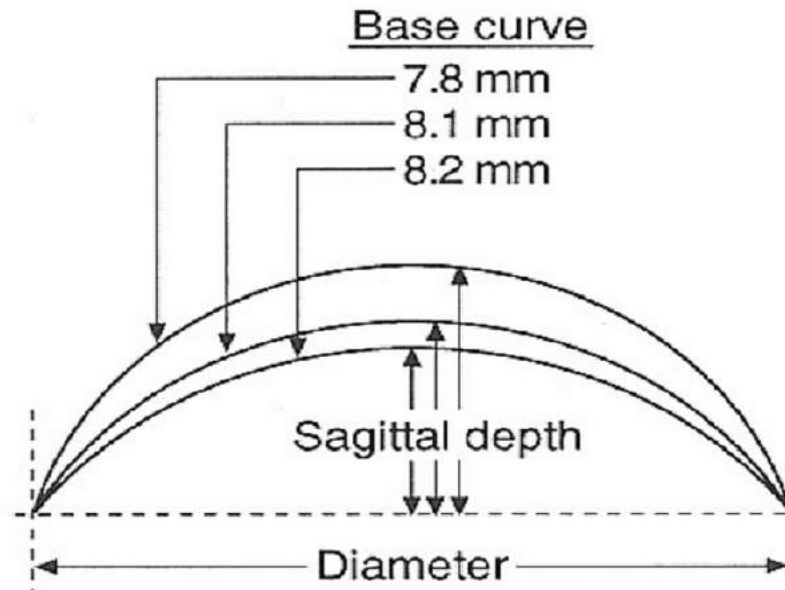


Bearing of the
Limbus

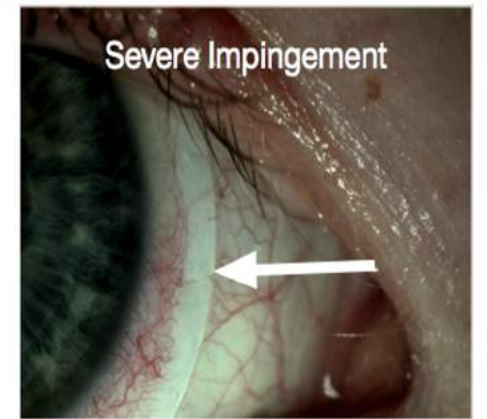
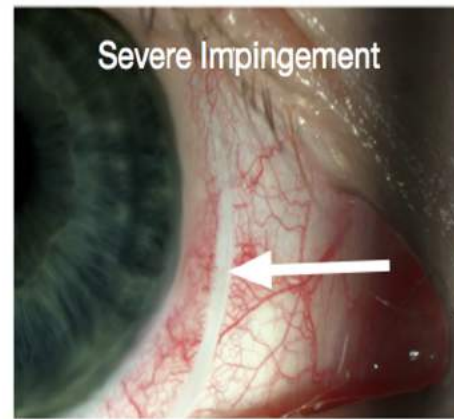
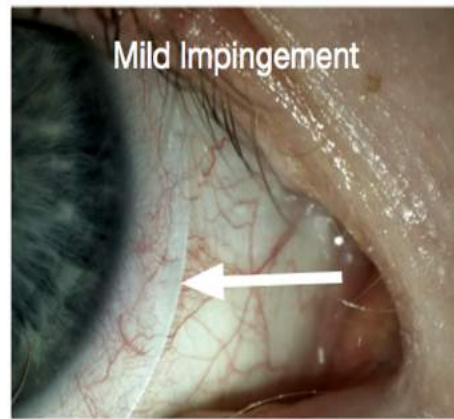
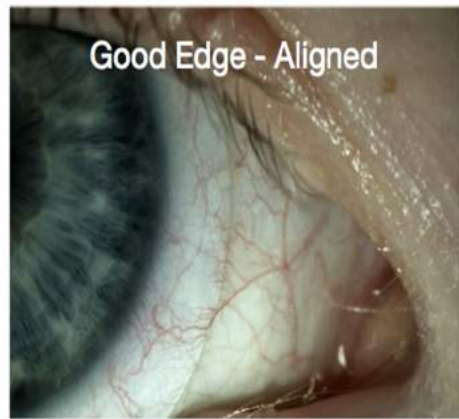
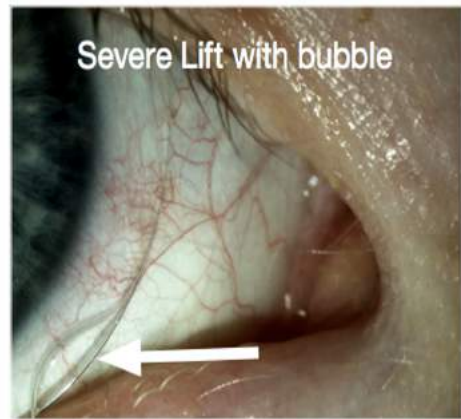
Bearing of scleral lens on cornea



Changing Sagittal Depth



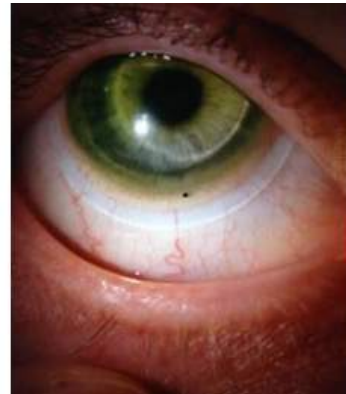
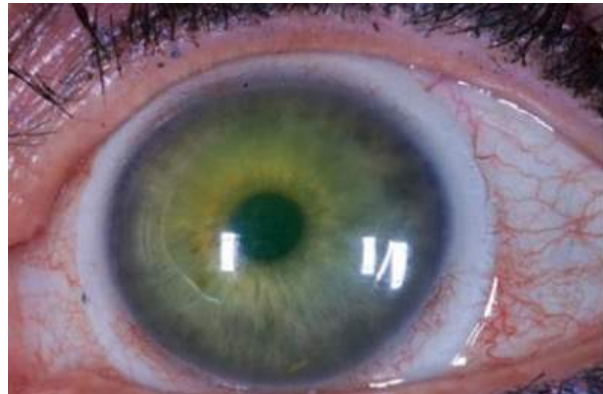
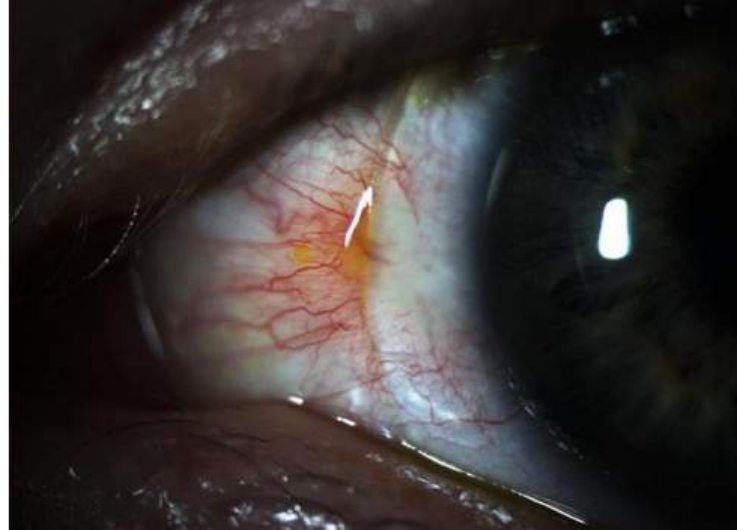
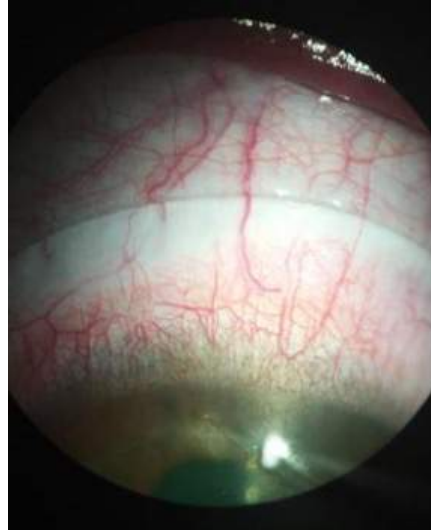
- Increase or decrease diameter
- Flatten or Steepen a curve



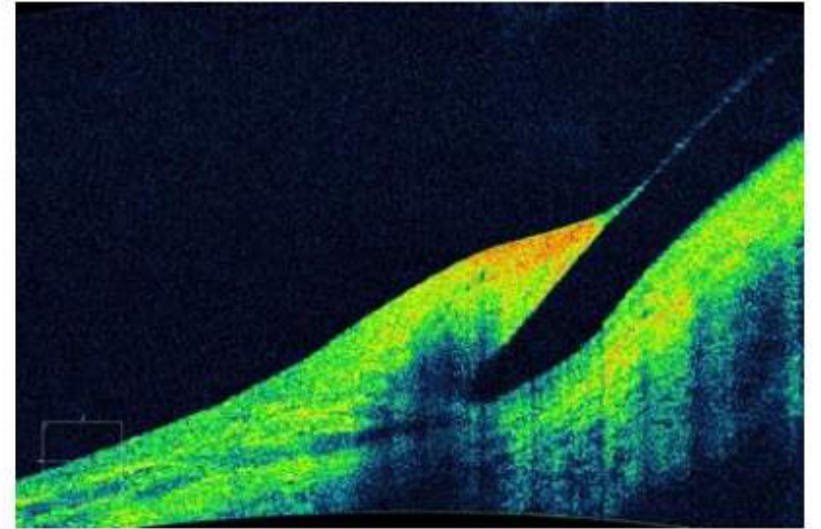
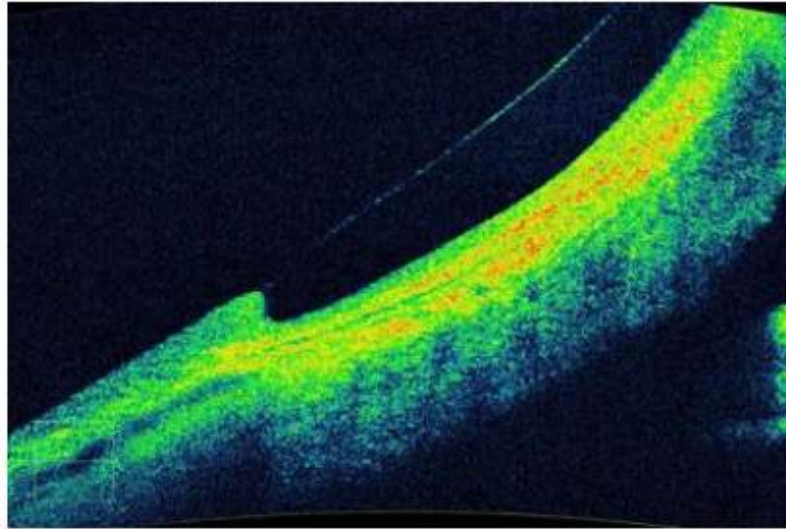
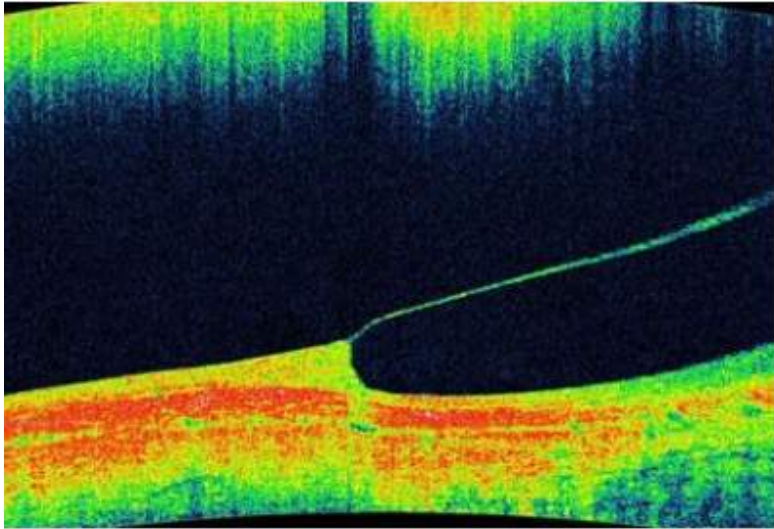
EVALUATION OF SCLERAL LENSES

- Landing
 - Diameter
 - Flattened or Steepen Haptic
 - Toric Haptic

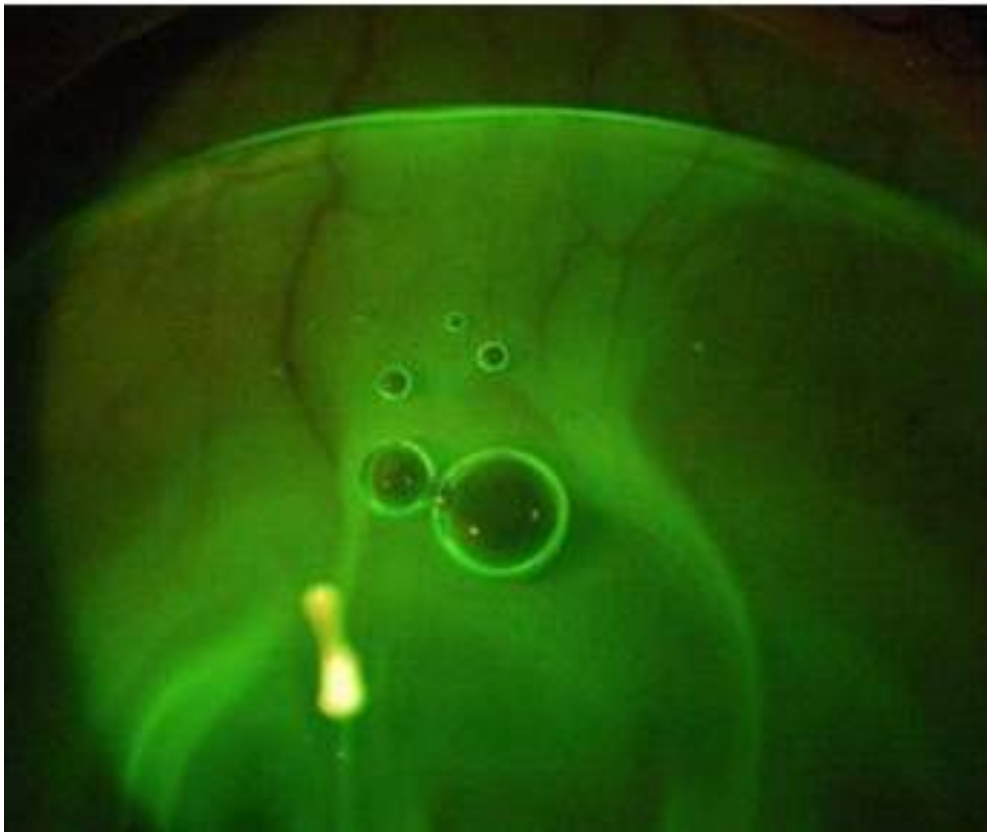
Impingement



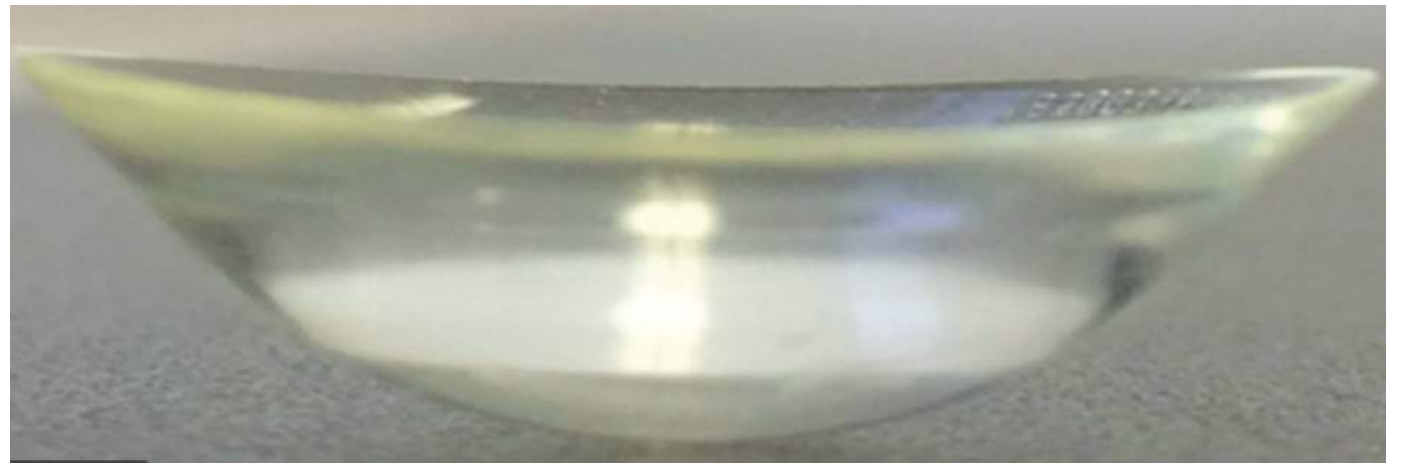
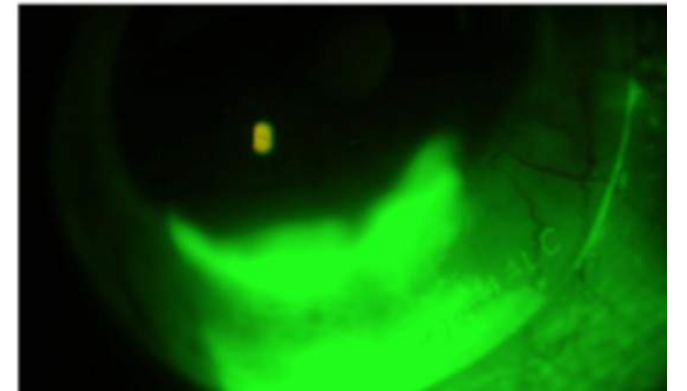
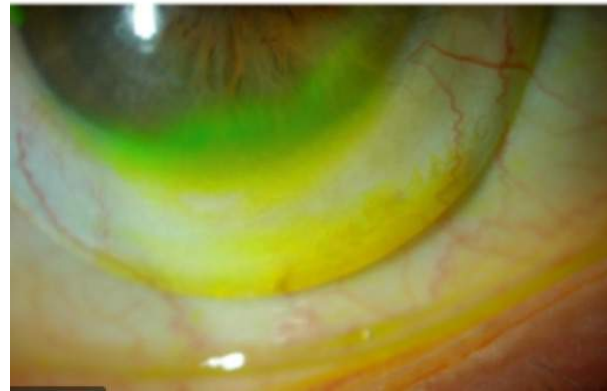
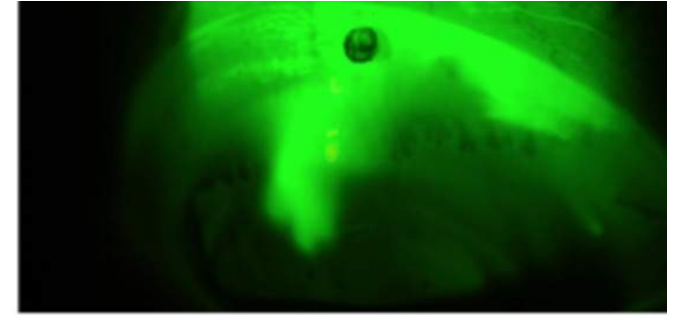
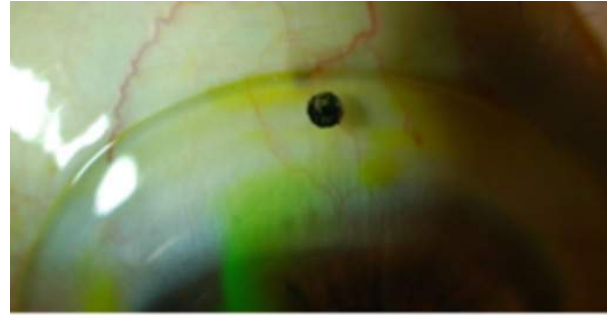
Embedded Edge or Toeing



Edge Lift

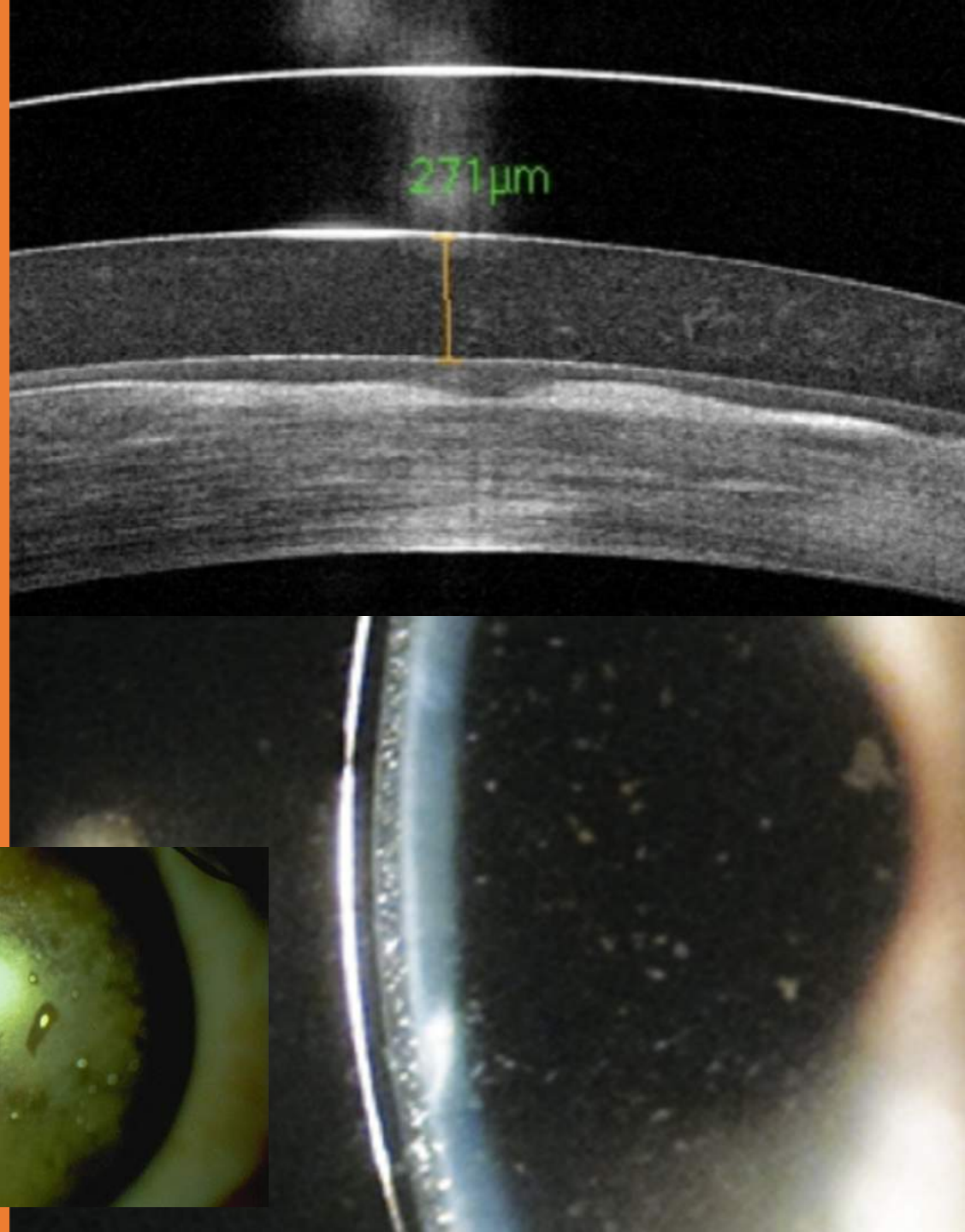
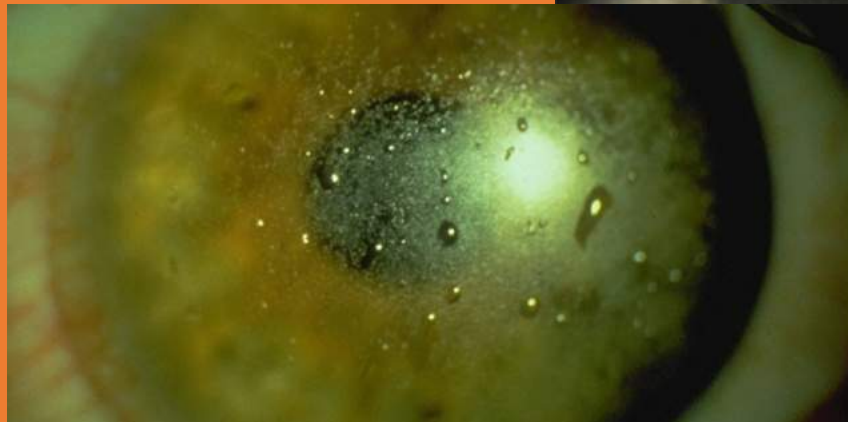


Toric Landing Zones



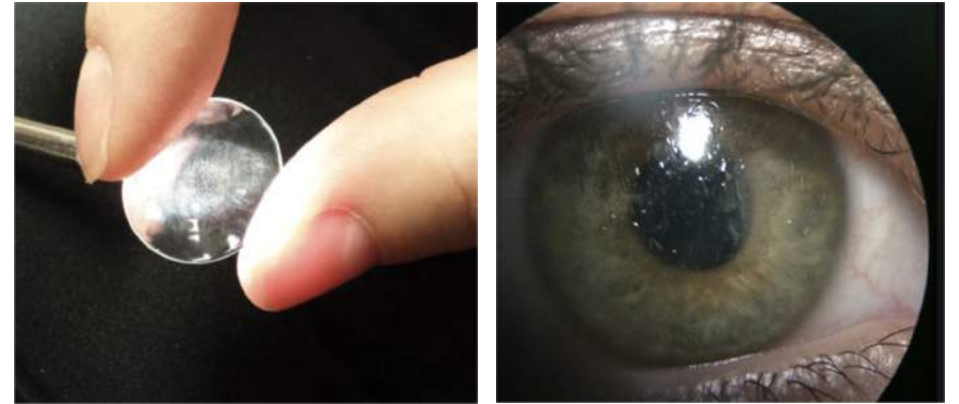
SCLERAL DEPOSITS AND FOGGING

- Common in Surface Disease
 - Fogging
 - under lens
 - midday rinse
 - Deposits
 - on top of lens
 - DMV inserter or cotton swab to manually remove
- Preservative Free Tears
 - Over lens
- Modification of vault
 - commonly seen when excess

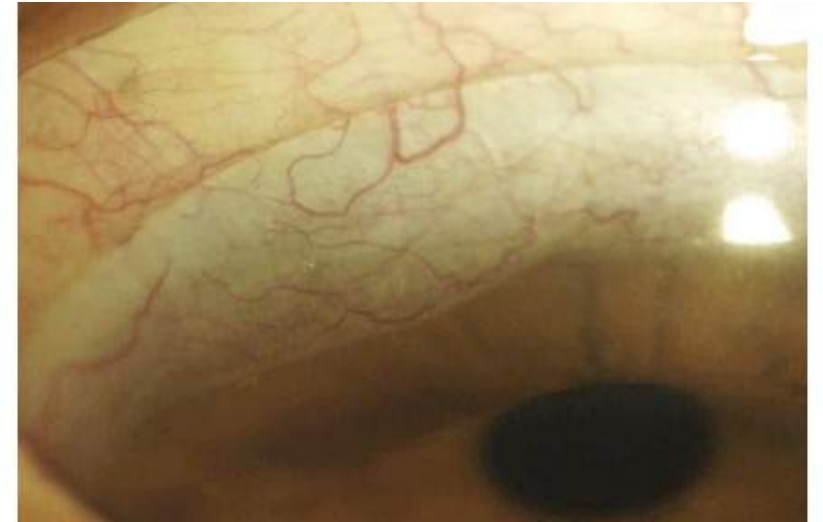
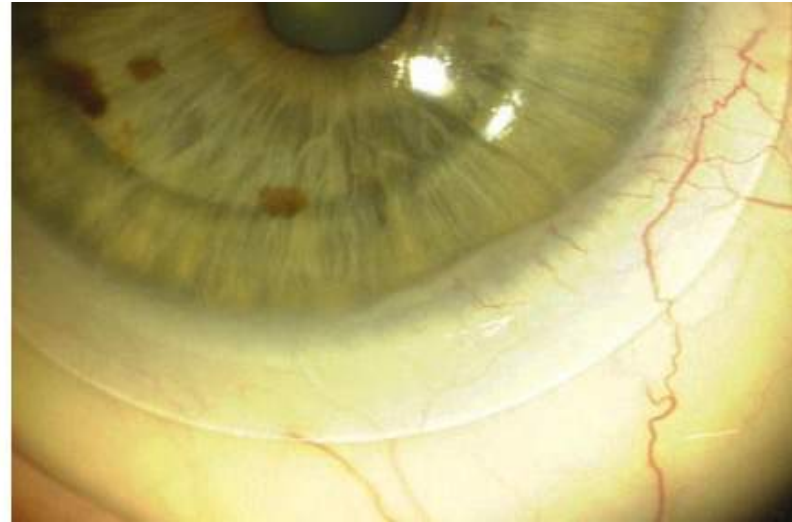
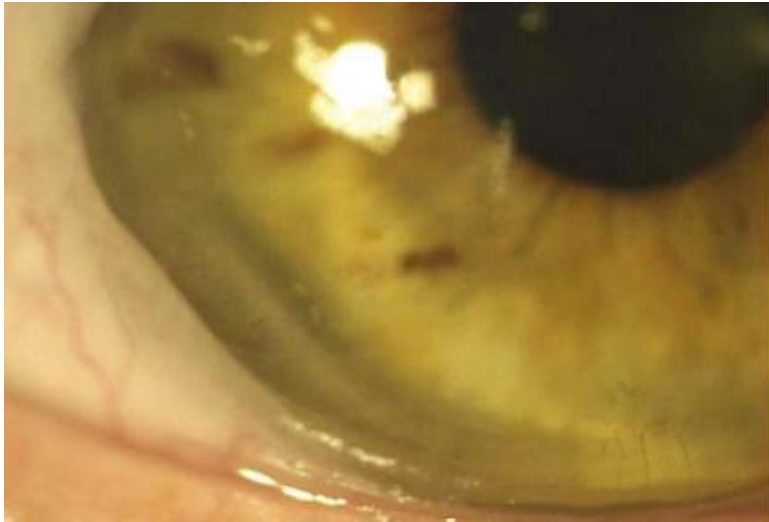


SCLERAL DEPOSITS AND FOGGING

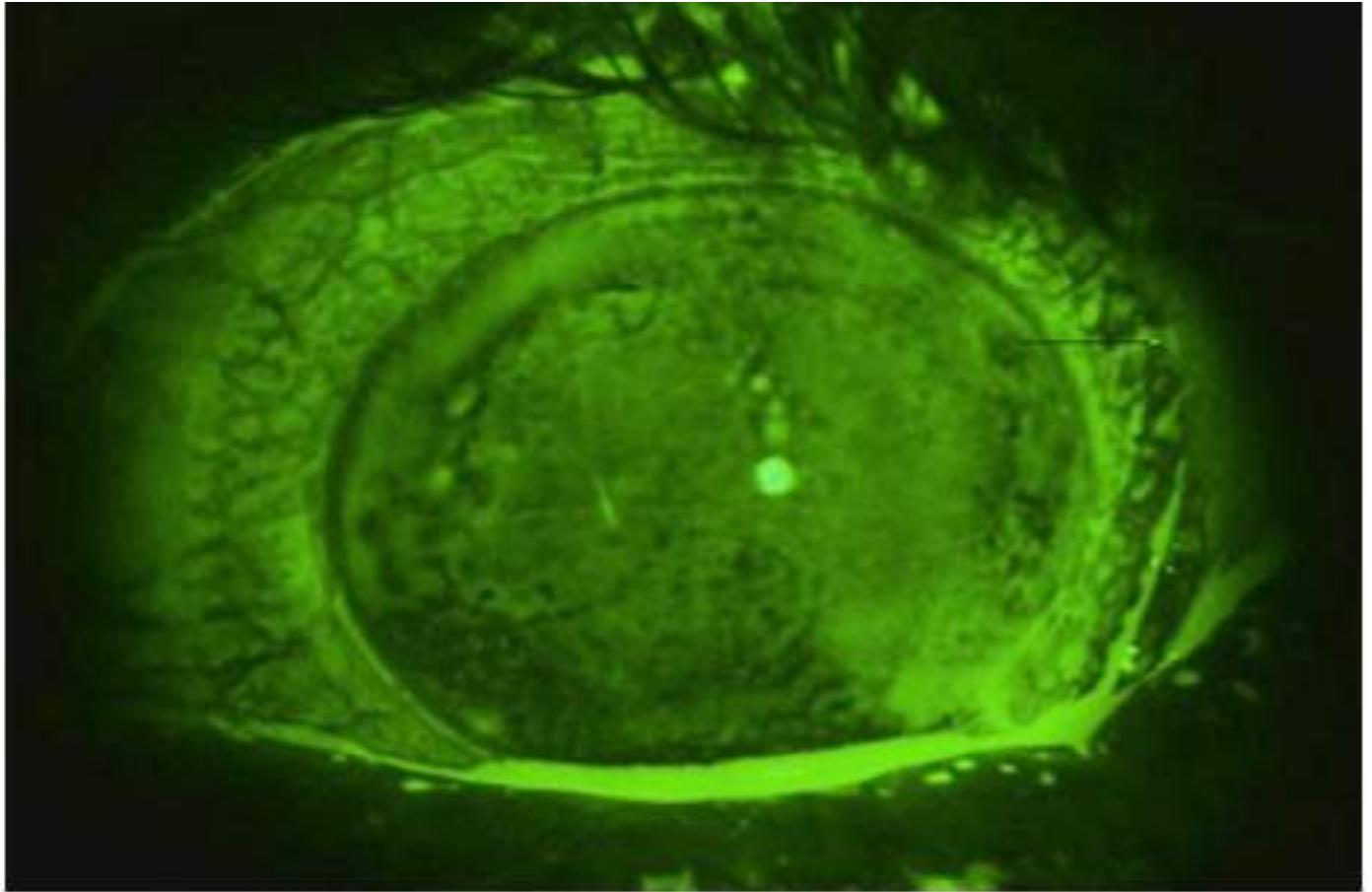
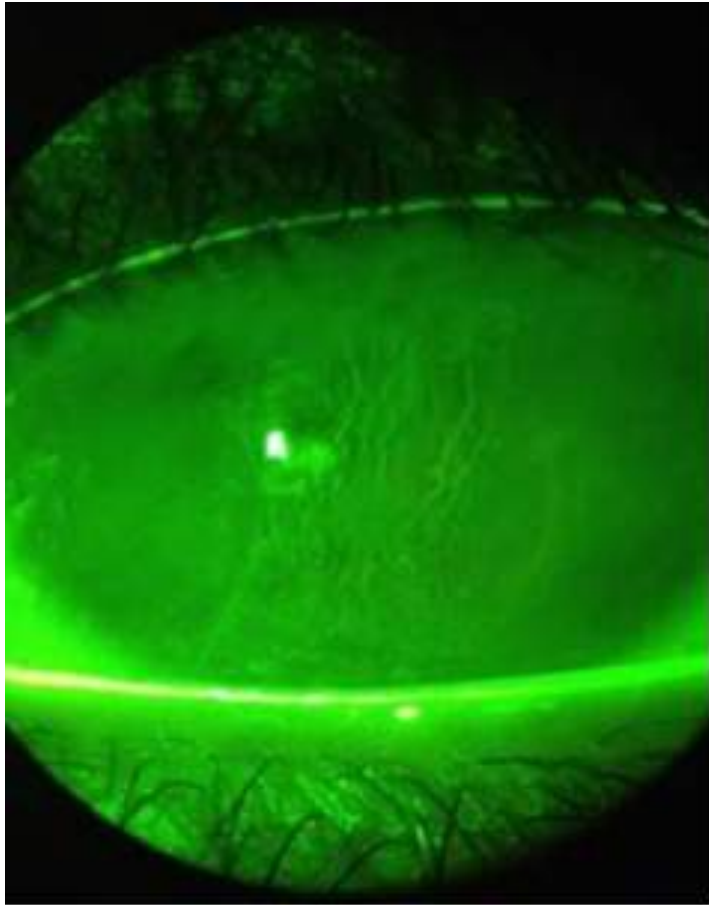
- Surface Coatings
 - Hydrapeg and plasma
 - New product on market to resurface hydrapeg
- Daily or Biweekly Cleaner
 - hydrogen peroxide
 - progent
- Treatment of lids
 - can enable more even distribution over lens surface



Conjunctival Prolapse

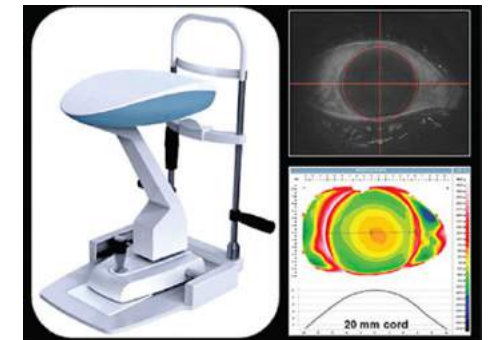
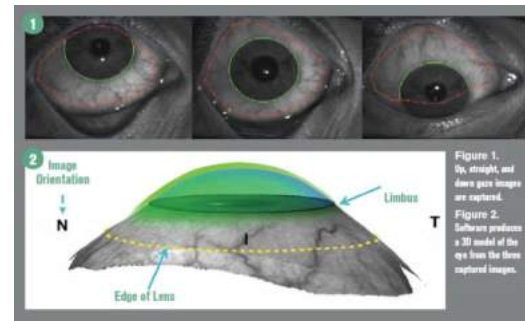
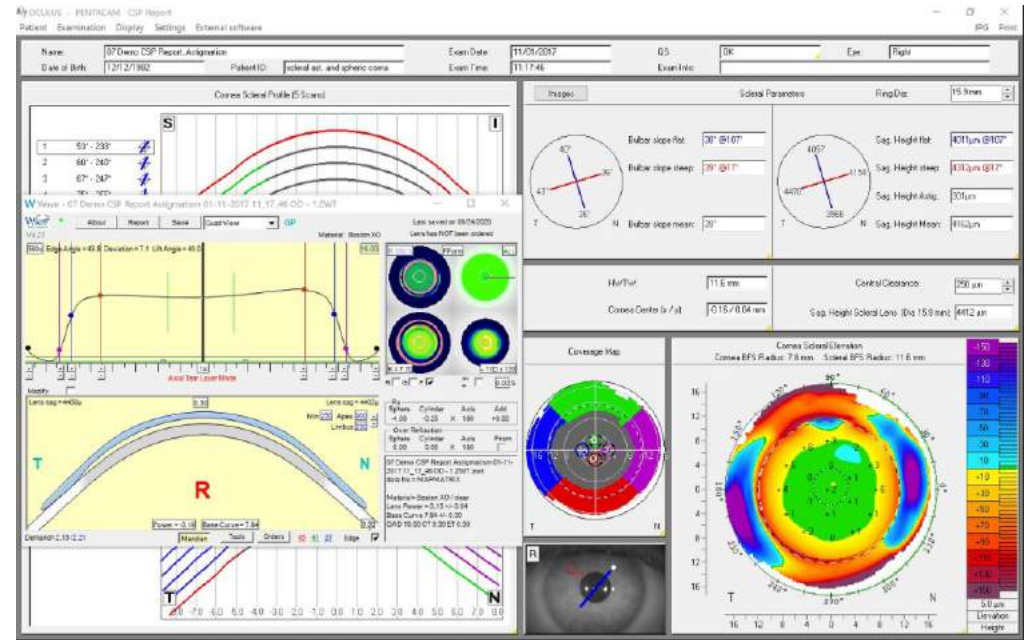


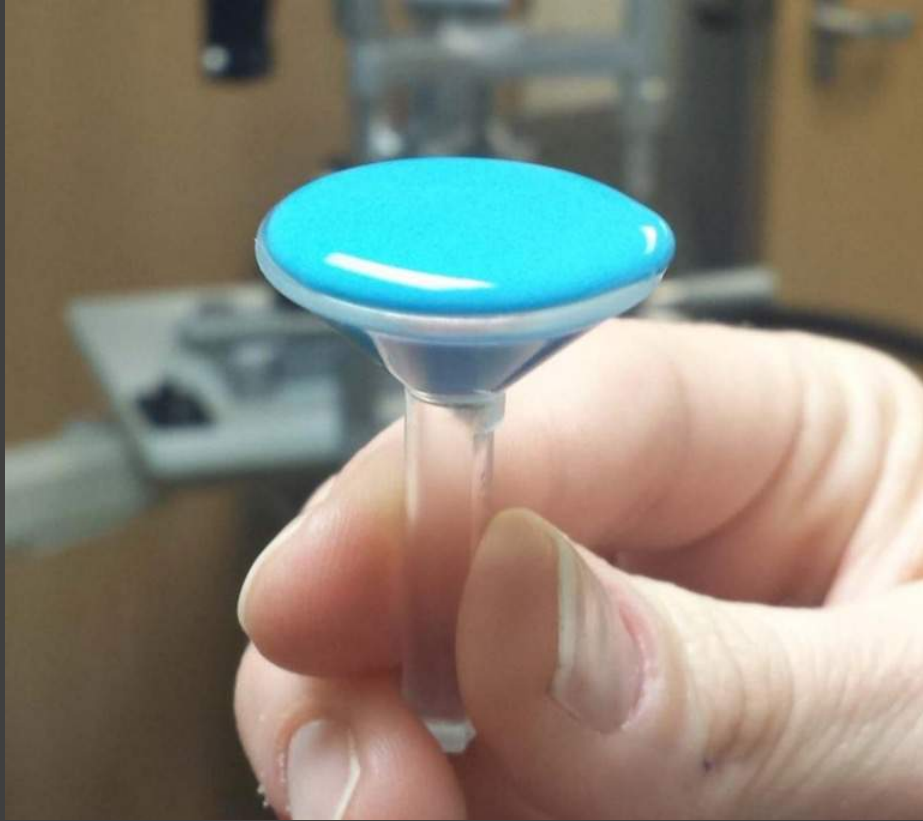
Epithelial Bogging



Technology for fitting

- Scleral Topography
- Scleral Tomography





Impression
Based
Fitting

SAFE HANDLING APPLICATION

- Technique
 - Fingers
 - Plunger Device
 - Ring Device



APPLICATION

- Solutions
 - preservative-free saline
 - medicamentosa or preservative toxicity
- Single-use preservative-free saline solutions
 - Buffer-free
- Buffered, non-preserved saline solution
- Toxic response to buffer agents?





Removal of Scleral Lens


REMOVAL AND DISINFECTION

- Removal
 - Plunger Device Suggested
- Disinfection
 - Hydrogen Peroxide Cleaning Systems
 - Multipurpose Gas Permeable Solutions
 - Avoid rinsing with water
 - microbial infection risk
 - hydrogen peroxide cleaning systems
 - Progent
 - 4 hour soak in 3% hydrogen peroxide (brown bottle)





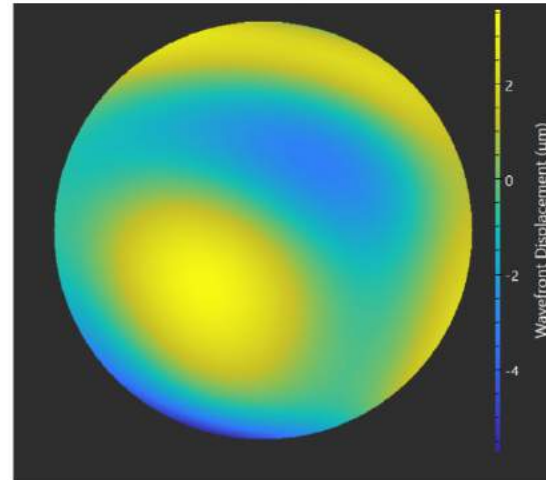
Goal: To Improve Vision

- Centers better compared to corneal GP
 - Stability
 - Customizable Optics
 - High Prescriptions
 - Manipulation of central and peripheral curvatures can decrease power, thickness and improve VA
 - Front Toric
 - Prism
 - Additional
 - Multifocal
 - Eccentricity
 - Wavefront Guided Correction of HOA
- 

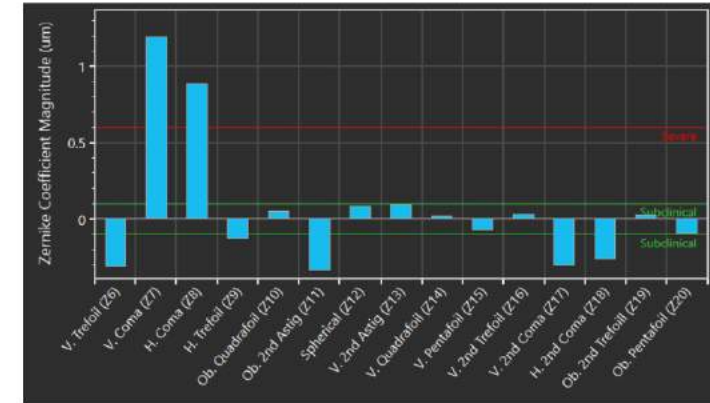
Optics
available on
scleral
contact lenses

Right Analysis Images

Wavefront Map (HOA Only)



Zernike Bar Plot



Typical Lens: 20/25 to 20/30 OD Pinholed to 20/20

Wavefront Correction Lens: 20/20 soft

- Front Toric
 - Prism stabilization
 - Back toric landing stabilization
- Higher Order Aberrations



April 2009

FREE

ARVO Annual Meeting Abstract | April 2009

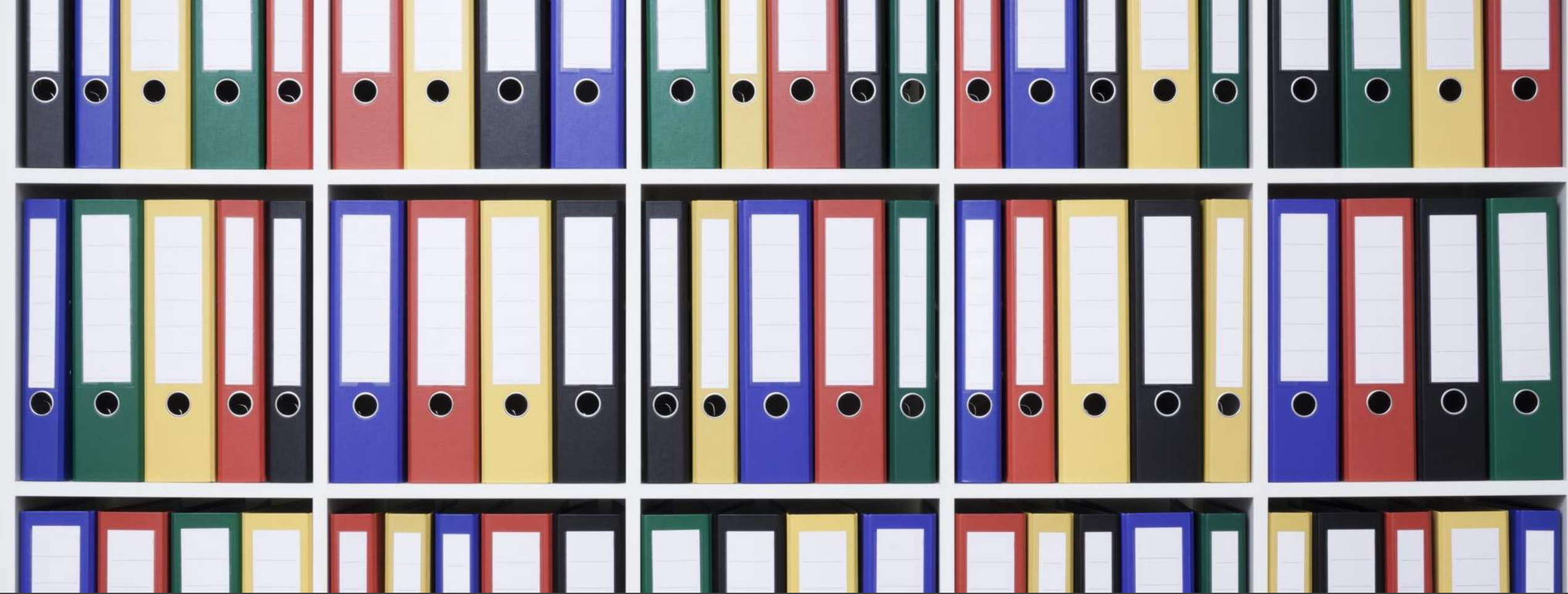
The Effect of Scleral Lens Eccentricity on Vision in Patients for Corneal Ectasia

T. R. Hussoin; D. S. Jacobs; P. Rosenthal

+ Author Affiliations & Notes

Investigative Ophthalmology & Visual Science April 2009, Vol.50, 6349. doi:

Conclusions: : Our results demonstrate that scleral lens front surface eccentricity modulates HOAs. Understanding the impact of front surface eccentricity on BCVA, low contrast visual acuity, and specific HOA may allow improved optical correction of vision in patients treated with scleral lens for corneal ectasia.



Case Reports |

Management of Congenital LSCD

- 15-year-old Caucasian Female referred for Medical Contact Lens Evaluation
- Congenital Aniridia
- Pediatric OMD Concerned about new Aniridic Keratopathy



Aniridic Keratopathy

- Congenital Aniridia
 - Bilateral
 - Panocular
 - Decreased BCVA
 - Foveal Hypoplasia
 - Nystagmus
 - Abnormalities
 - Cornea
 - Anterior Chamber
 - Iris
 - Lens
 - Optic Nerve
 - Macula
 - Retina
 - Prevalence 1:64,000 to 100,000
 - 1A PAX 6 Mutation
 - 2/3 of cases inherited

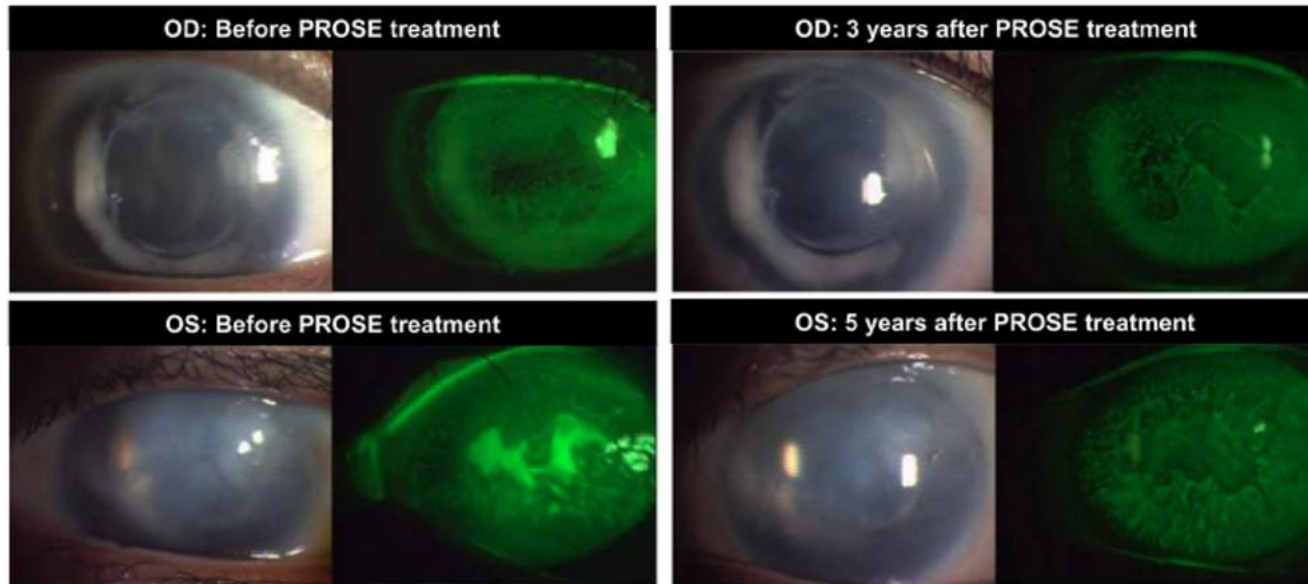
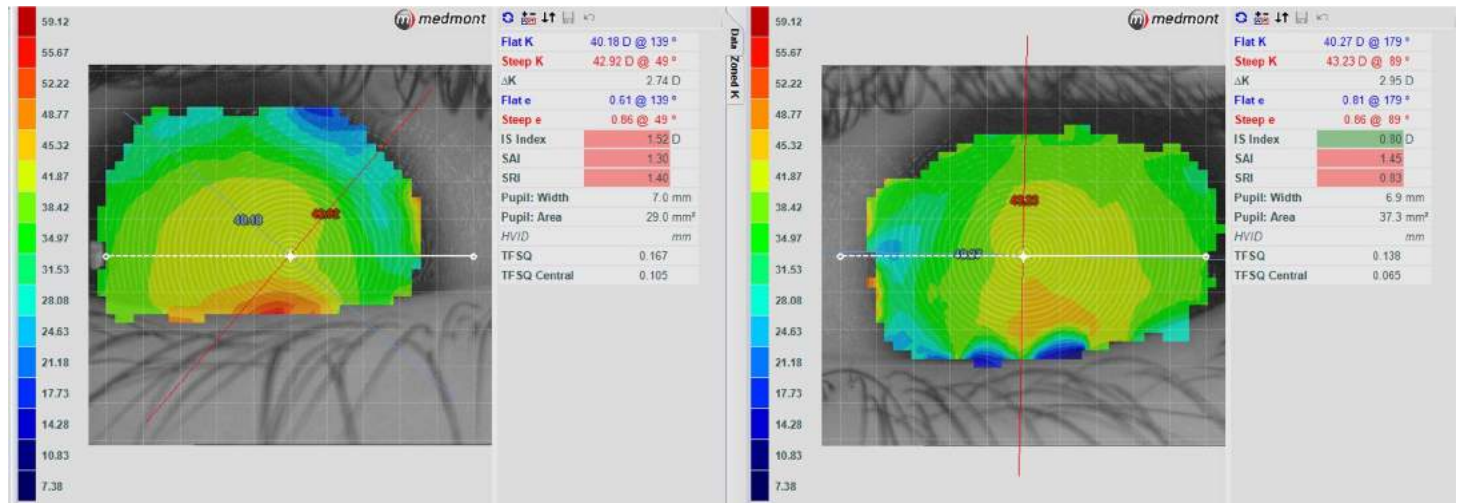


FIGURE 1.

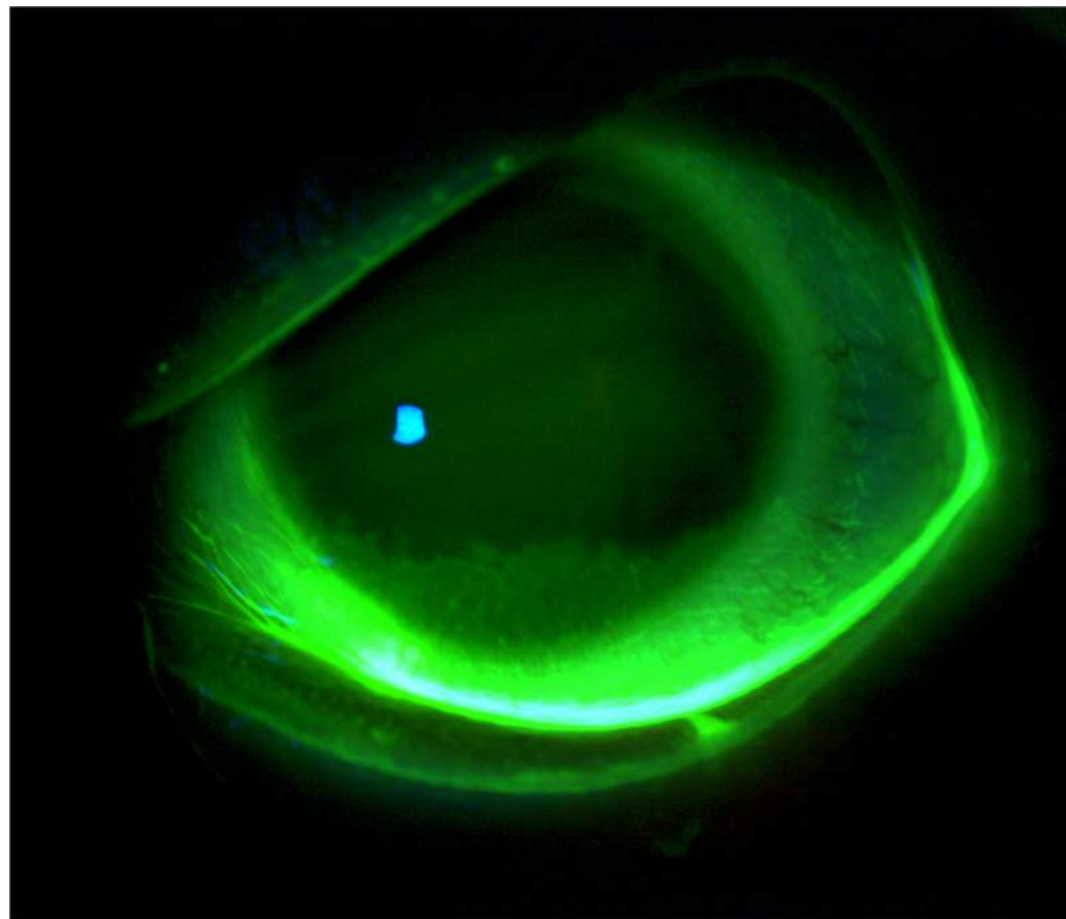
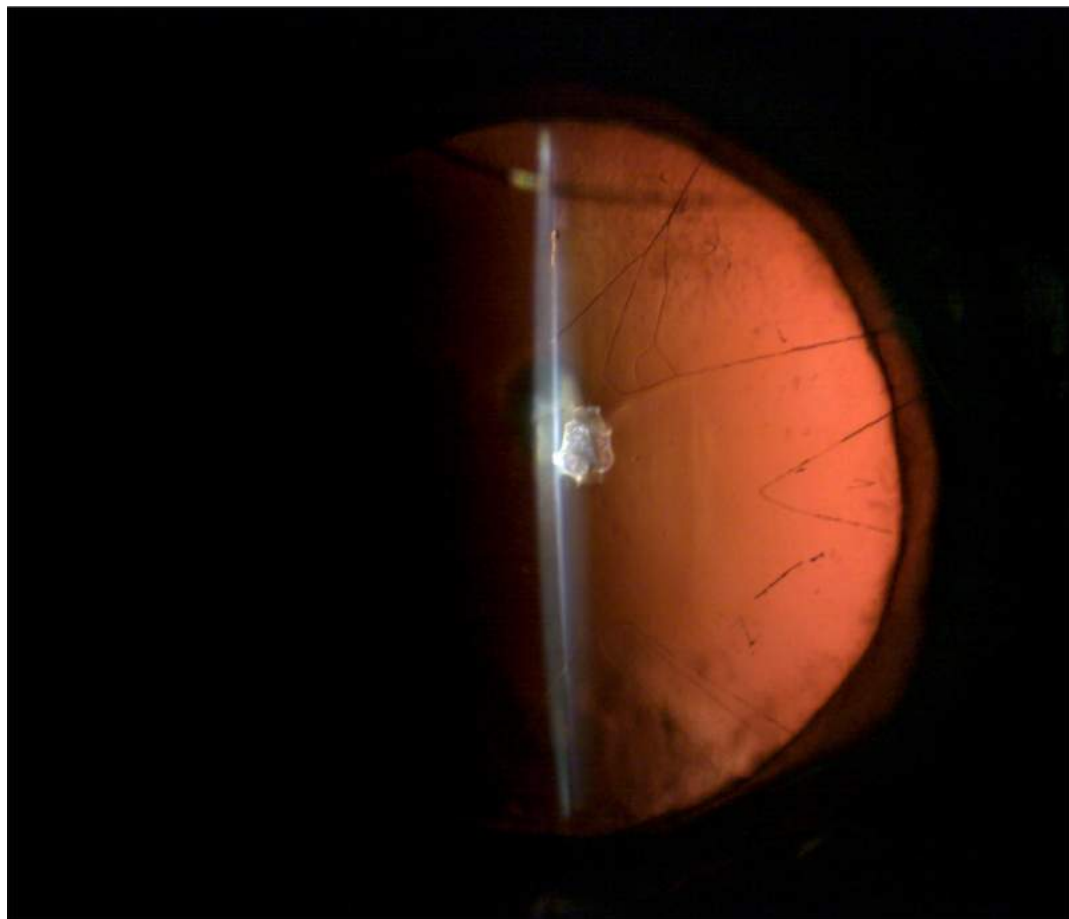
Slit-lamp photographs of the eyes affected with aniridic keratopathy, before and after PROSE treatment. The right eye showed superficial punctate keratopathy and conjunctival invasion from the superior part before treatment. Although conjunctival invasion progressed without scar formation after PROSE treatment, corneal transparency was maintained. The left eye showed epithelial defect, corneal stromal cell infiltration, and conjunctival epithelium invasion with fibrovascular tissue before PROSE treatment. After treatment, only the remnant of the stromal scar was observed.

Management of Aniridic Keratopathy

- High Hyperopic Astigmat
- Manifest Refraction
 - OD +6.75-2.50x175 20/100
 - OS +6.75-2.50x023 20/100
- Nystagmus
- Microcornea
- Cortical Spoking
- Foveal Hypoplasia



Stage 1A



Management Options

Aniridic Keratopathy is Progressive

Need to Protect Existing LSC

Pediatric OMD and patient elects
for Medical Scleral Contact Lens

Trial 1

- Over vaulted Limbus
- 600 microns throughout
- Inferior Decentration

BC 41.97 mm D

BC 2

Diam 16.5

Sph/Cyl/Axis -2.00 Cyl Axis

BC 39.98 mm D

BC 2

Diam 16.5

Sph/Cyl/Axis 0.00 Cyl Axis

CL Over-Refraction

	Sphere	Cyl	Axis			
OD	+1.00			20/	70	-2
OS	+1.50			20/	70	+1
OU				20/		

Method

BC 40.00 mm D

BC 2

Diam 15.0

Sph/Cyl/Axis +1.00 Cyl Axis

BC 40.00 mm D

BC 2

Diam 15.0

Sph/Cyl/Axis +1.50 Cyl Axis

CL Aided VA

Aided VA	Distance	Near @
OD	20/ 100 +2	20/
OS	20/ 100 +2	20/
OU	20/	20/

VA Method: Snellen

Rx Worn: Contact Lenses

CL Over-Refraction

	Sphere	Cyl	Axis		
OD	+1.50			20/ 100	+2
OS	+3.00			20/ 60	+1
OU				20/	

Method

OD Comments

decentered
 clearing limbus
 edge not well aligned
 175um vault
 **increase vault by 100um, steepen edge by 150um 360 degrees

OS Comments

lens too flat
 only 50um
 increase vault by 300
 increase edge by 150 by 360

BC 41.50 mm D

BC 2

Diam 15.0

Sph/Cyl/Axis +1.00 Cyl Axis

BC 43.50 mm D

BC 2

Diam 15.0

Sph/Cyl/Axis +1.50 Cyl Axis

CL Aided VA

Aided VA	Distance	Near @
OD	20/ 70 +2	20/
OS	20/ 60 +2	20/
OU	20/	20/

VA Method: Snellen

Rx Worn: Contact Lenses

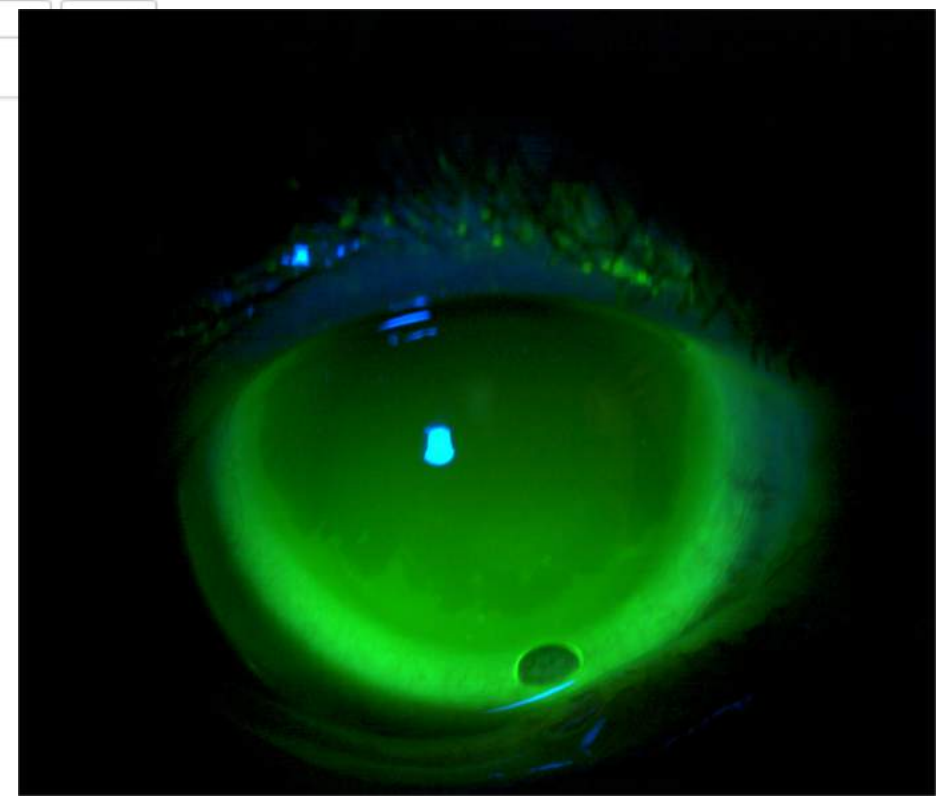
Pinhole VA	Distance	Comments
OD	20/	
OS	20/	

CL Over-Refraction

	Sphere	Cyl	Axis		
OD	+0.50			20/ 60	-2
OS	0.00			20/ 60	+2
OU				20/	

Method

- Allogenic Serum Tears from Mother in Bowl of Scleral Contact Lens



A Case of LSCD from Chemical Burn

6-year-old Hispanic Male

History of Dermoid Cyst Removed from
Left Brow at 2 years

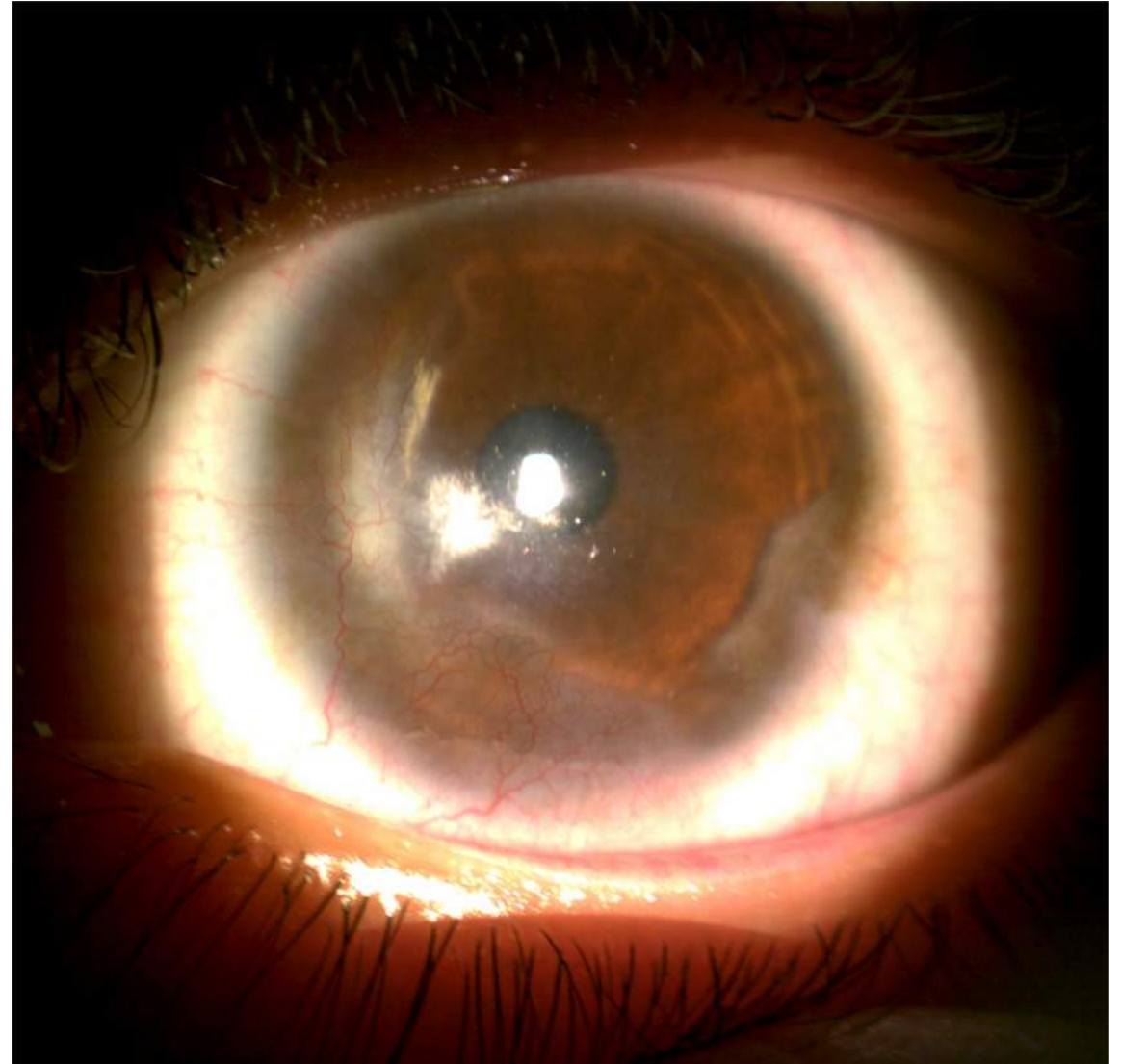
- Chlorohexidine Antiseptic
- Chemical Burn to Cornea

Referred by Cornea and Pediatric OMD
for Medical Lens

- Amblyopia
- Progression

Ocular Trauma- Chemical Burns

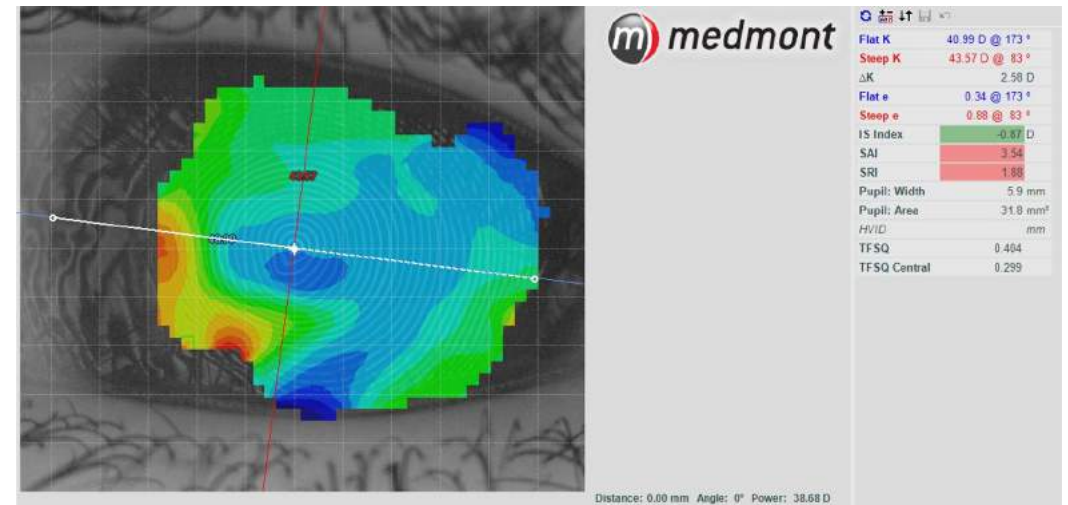
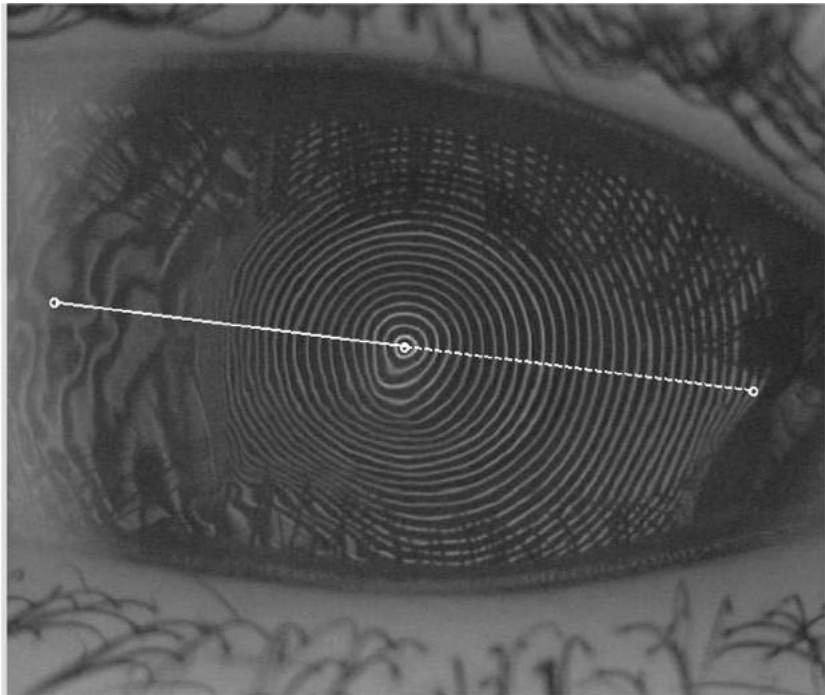
- 2nd Most Common Indication for Pediatric Contact Lens
- **Young** children are at greater
 - household cleaners are most often to blame
 - 1-year-olds are twice as likely to suffer compared to 24-year-olds
- Basic substances penetrate the eye more rapidly
 - Anterior chamber
 - Conjunctival and corneal epithelial defects
 - limbal stem cell deficiency
 - symblepharon
 - cicatricial entropion and ectropion, and trichiasis



Stage 1b

A Case of LSCD from Chemical Burn

- Manifest Refraction
- OD +0.50 20/20
- OS +2.25 20/100



Management Options

- GP optics indicated for correction of irregular astigmatism
 - Amblyopia Risk
- Scleral Lens
 - Protection
 - Decrease Opacification
 - Vehicle for topicals

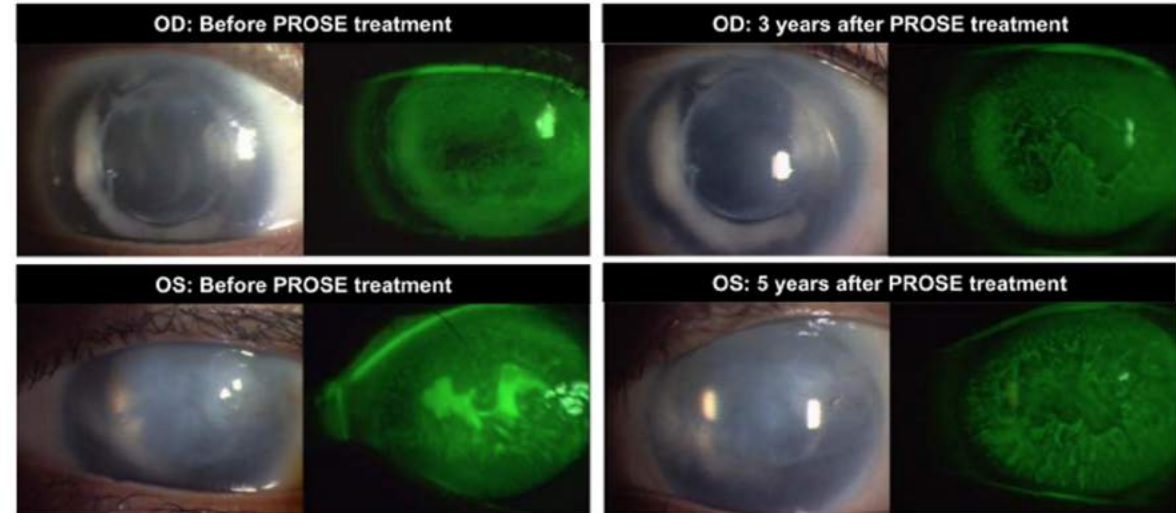


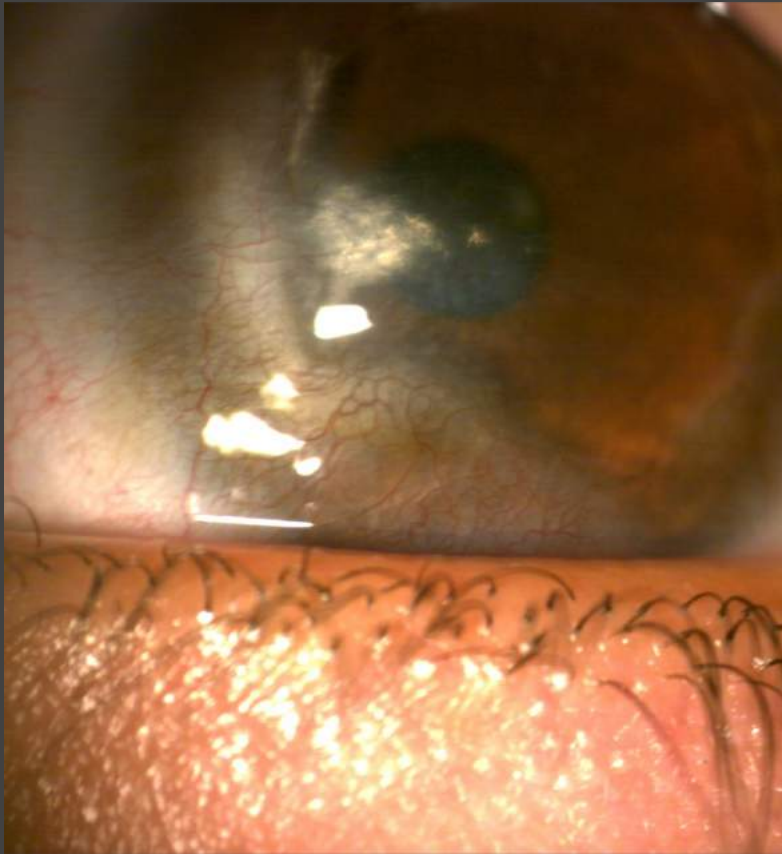
FIGURE 1.

Slit-lamp photographs of the eyes affected with aniridic keratopathy, before and after PROSE treatment. The right eye showed superficial punctate keratopathy and conjunctival invasion from the superior part before treatment. Although conjunctival invasion progressed without scar formation after PROSE treatment, corneal transparency was maintained. The left eye showed epithelial defect, corneal stromal cell infiltration, and conjunctival epithelium invasion with fibrovascular tissue before PROSE treatment. After treatment, only the remnant of the stromal scar was observed.

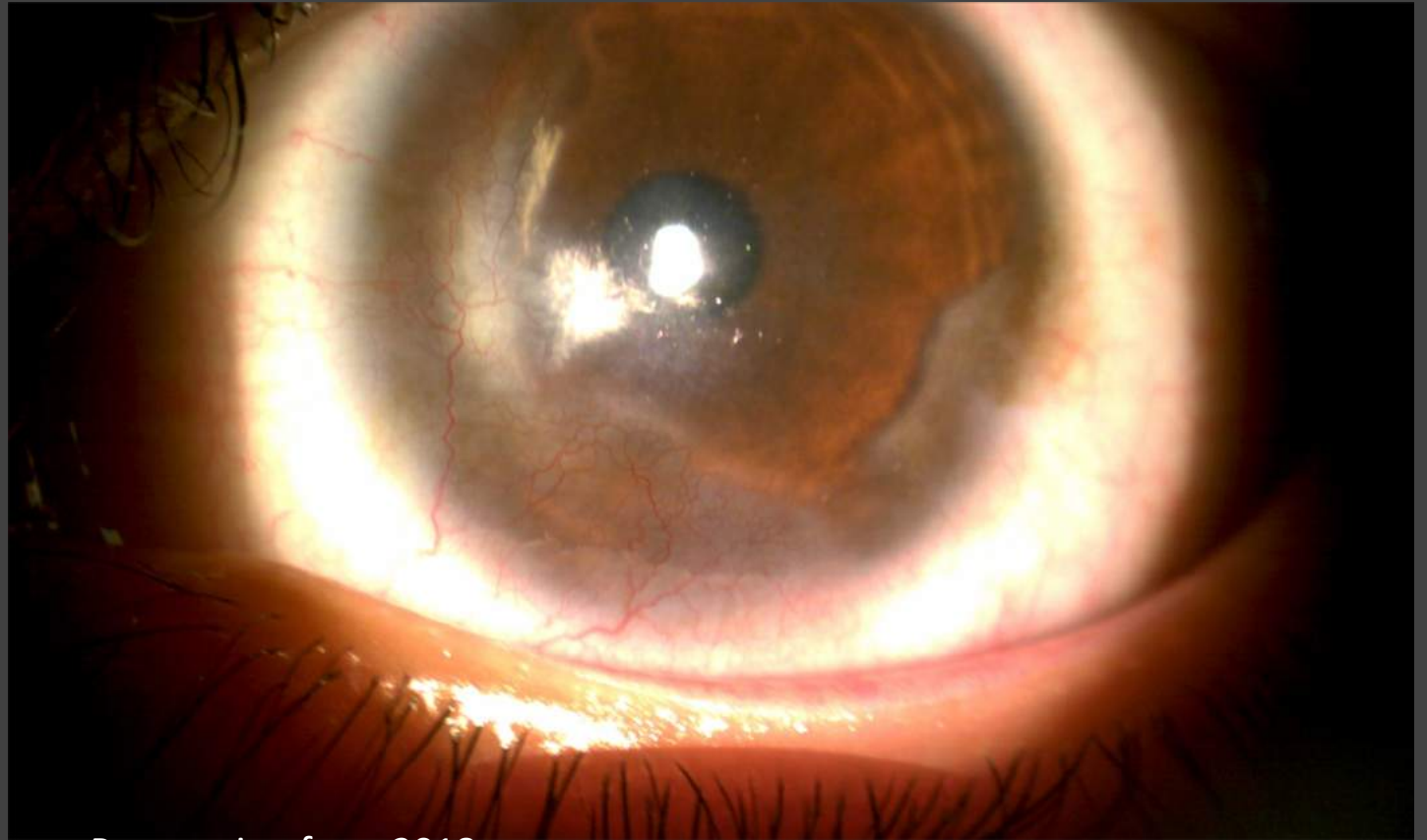


Medical Lens Fit

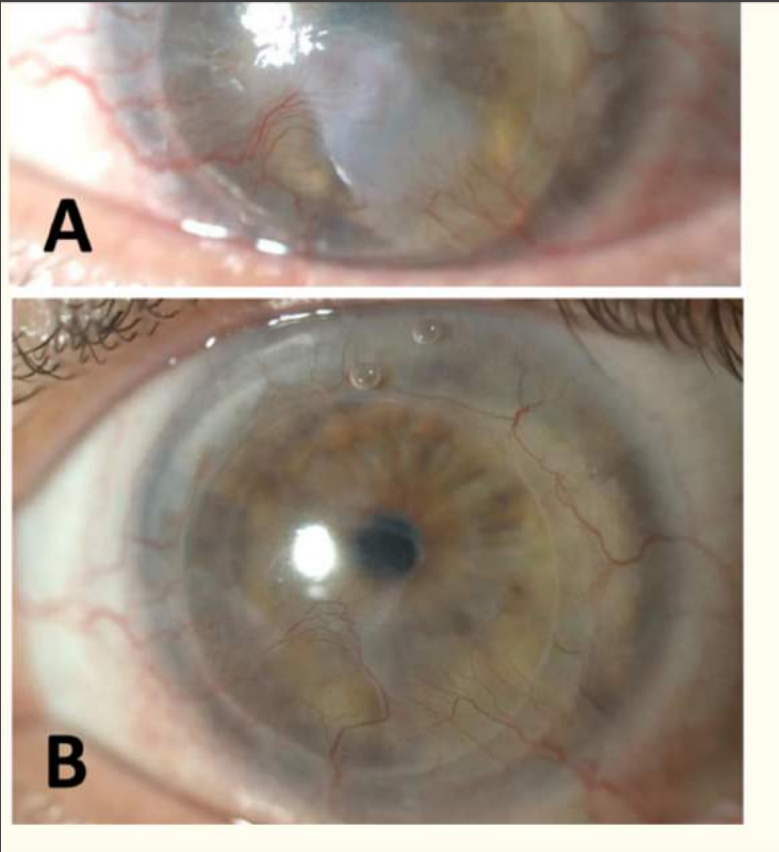
- 2018
 - 8.40/0.00/16.00 3600 36/42 OR +1.50 20/50
 - 250 microns central mild inferior decentration but vault from limbus to limbus
 - Mother is donor for serum tears
- 2019
 - No Change in Prescription



A Case of LSCD from Chemical Burn



- Progression from 2018
 - Lipid Keratopathy in Visual Axis
 - Increase Neovascularization
 - Vision is now 20/80 BCVA
- Management Options
 - Allogenic vs Autologous LSC transplant
 - Laser Coagulation with Possible Avastin Injections



Management Options

> *Ocul Surf.* 2019 Jan;17(1):134-141. doi: 10.1016/j.jtos.2018.11.008. Epub 2018 Nov 20.

Long-term outcome of using Prosthetic Replacement of Ocular Surface Ecosystem (PROSE) as a drug delivery system for bevacizumab in the treatment of corneal neovascularization

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Affiliations + expand

PMID: 30468876 PMID: [PMC6340761](#) DOI: [10.1016/j.jtos.2018.11.008](#)

[Free PMC article](#)

Abstract

Purpose: To report the long-term outcome of Prosthetic Replacement of the Ocular Surface Ecosystem (PROSE) for delivery of bevacizumab in the treatment of corneal neovascularization (KNV).

- **Mother did not want corneal transplant**
 - **Autologous**
 - Risk of good eye
 - **Allogenic**
 - Side Effects from Immune Suppressants
 - Risk of Failure
- **Risk for Injection and Laser**
 - Small children move and procedure done during fixation is needed
- **Avastin in Bowl of Scleral Lens**

A Case of LSCD from Chemical Burn



8.00/+1.00/16.00 Sag 2600
Eccentricity 1 BCVA 20/40



Avastin in Bowl of Scleral Lens
Stopped Growth

Customizable Optics: Oblate Lens Designs for High Minus

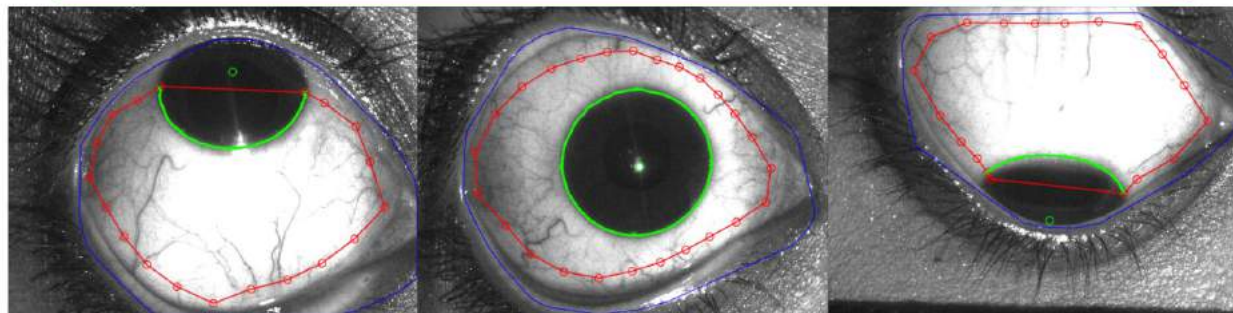
- 36-year-old Hispanic Female with History of LASIK OU 10 year ago
- Central flap striae OU
 - Distorted double vision more noticeable at night for 2 years
- Mother has a history of keratoconus

OD	Europa 18.0	RGP	48.00	-3.00	18.0
OS	Europa 18.0	RGP	46.00	-2.00	18.0

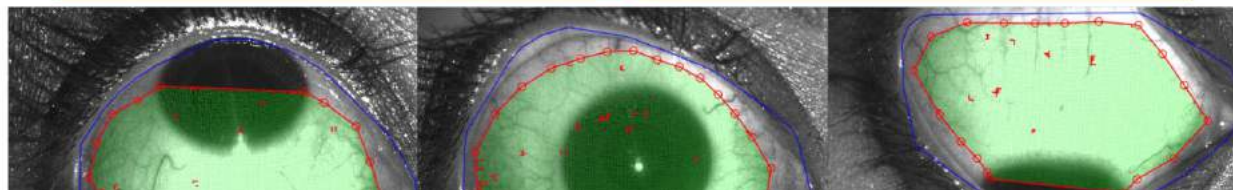
ORx: -11.75 20/30-2

ORx: -8.25 20/40

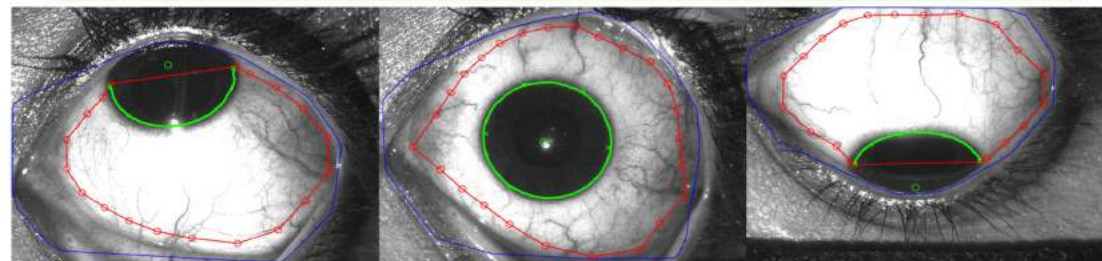
Limbal and Scleral Identification



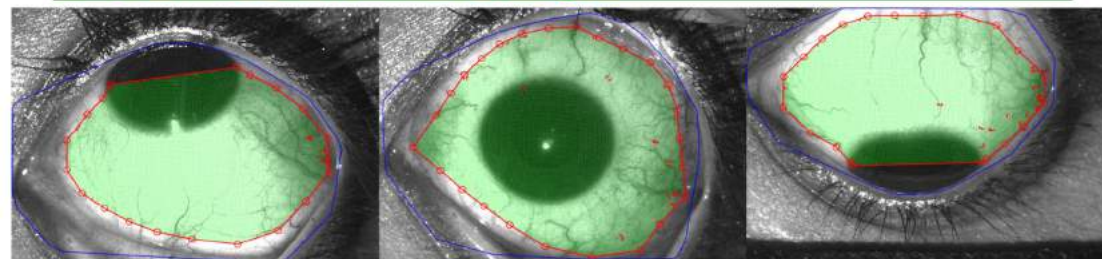
Fluorescein Coverage



Limbal and Scleral Identification



Fluorescein Coverage



Product: Visionary Optics Europa 18 mm

Dia: 18.000 mm Toricity: 0 um
 BC: 41.00D (8.232 mm) OZ: 9.000 mm
 PC1: 6.650 mm W1: 2.000 mm
 PC2: 10.000 mm W2: 1.000 mm
 PC3: 13.000 mm W3: 1.000 mm
 PC4: 15.000 mm W4: 0.500 mm
 Sag: 5.450 mm

Fitting Lens	Over Refraction	Total Power
BC: 48D	Sphere: -11D	Sphere: -5.75D
Sphere: -3D	Cyl: -.75D	Cyl: -0.50D
Cyl:	Axis: 090 deg	Axis: 90 deg
Axis:		

Coverage at Lens Diameter: 100.0%

Manufacturing Info: 0, 0, 0, 0, 0

0.766, 1.114, 1.232
 86, 82, 81

Product: Visionary Optics Europa 18 mm

Dia: 18.000 mm Toricity: 0 um
 BC: 42.00D (8.036 mm) OZ: 9.000 mm
 PC1: 7.050 mm W1: 2.000 mm
 PC2: 10.000 mm W2: 1.000 mm
 PC3: 13.000 mm W3: 1.000 mm
 PC4: 15.000 mm W4: 0.500 mm
 Sag: 5.329 mm

Fitting Lens	Over Refraction	Total Power
BC: 46.D	Sphere: -8.25D	Sphere: -5.50D
Sphere: -2.00D	Cyl: -.75D	Cyl: -0.62D
Cyl:	Axis: 135 deg	Axis: 135 deg
Axis:		

Coverage at Lens Diameter: 100.0%

Manufacturing Info: 0, 0, 0, 0, 0

1.999, 2.467, 2.555
 75, 74, 73

OD	Europa 18.0	41.00	-6.00	18.0	Yes
OS	Europa 18.0	42.00	-5.75	18.0	Yes

Thinner Lens
 Opens the front optic zone and improves vision

CL Aided VA

Aided VA	Distance		Near @
OD	20/20	-2	20/
OS	20/30	+3	20/
OU	20/		20/

VA Method: Snellen
 Rx Worn: Contact Lenses

Pinhole VA	Distance	Comments
OD	20/	
OS	20/	

CL Over-Refraction

	Sphere	Cyl	Axis		
OD	+0.50			20/ 20	
OS	+1.00			20/ 25	+2
OU				20/	

Method

Oblate Lens Designs

- Diagnostic Lens Sets Come In Flat Central Curvatures
- Flat Base Curves
 - 8.00mm, 8.40mm, and 9.50mm



Thanks

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