Scleral Lens Update

Charles L. Stockwell, O.D.
Charles.stockwell@ttuhsc.edu
No Disclosures

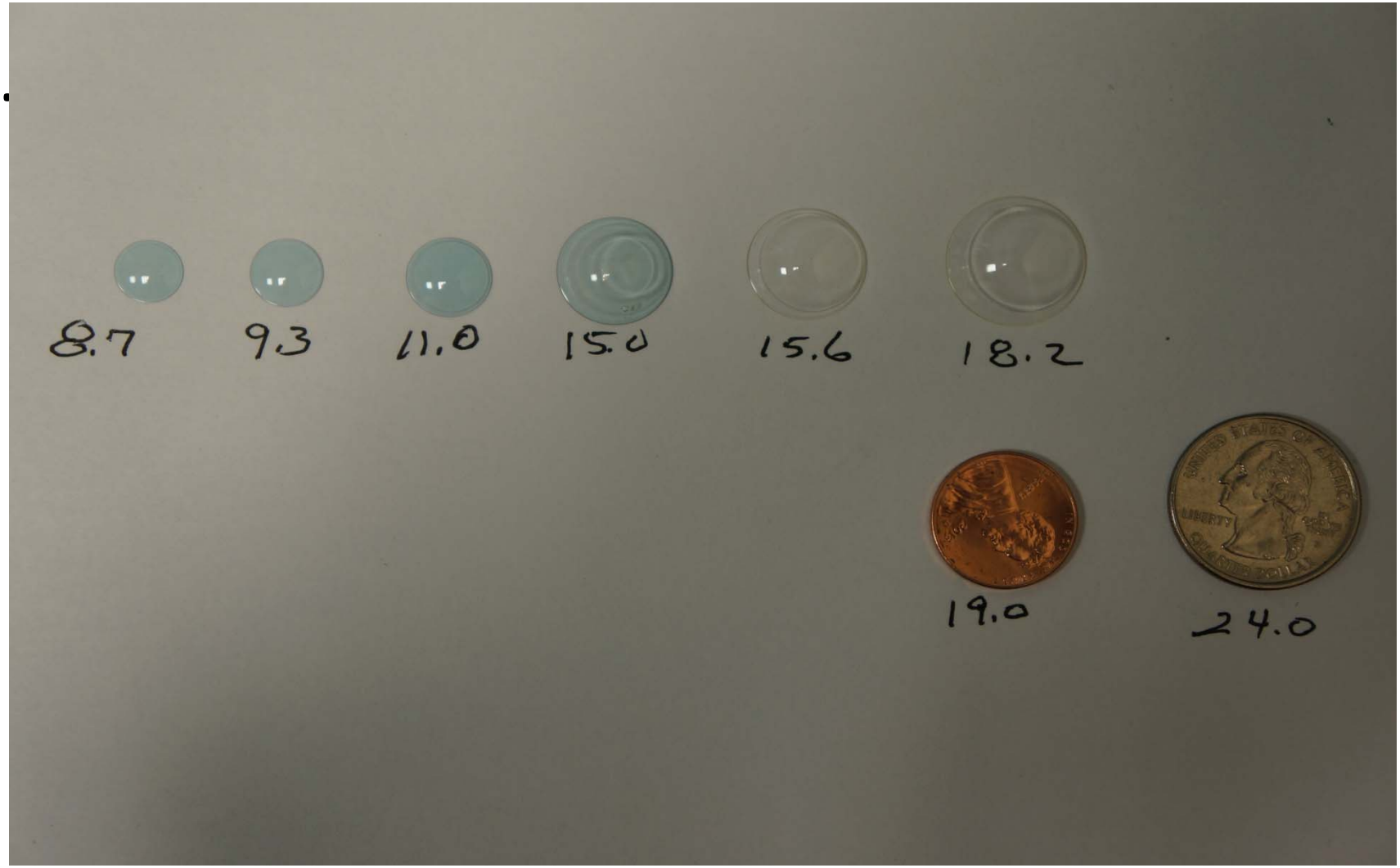
The Scleral Lens – A Confusing Term

- A Complex “Non-contact” lens that vaults the Cornea in most cases and rest for the most part on the Scleral Conjunctiva.
- A very large diameter lens. By definition is a lens greater than 18 mm. However, a Mini-Scleral is 15.0 mm or larger.
- Helps treat distorted corneas, surgically altered corneas, and dry eyes.

Who First Thought of the Scleral Lens

- A Politician
- Dolly Parton
- Leonardo da Vinci in the early 1500's
- Glass Blowers about 1885
- Dallos with glass Molding in 1936
- Lab that Lathe-cut PMMA's in the 1940's
- 1989 with Gas Permeable Material.

The Basic Idea



The Basic Idea

Design of the Scleral Lens

The Basic Idea

- Scleral Lens **Semiseals** to Trap a Tear Reservoir layer under the lens and allow for Tear Exchange through **Peripheral** Lens Flexure/Pump Secondary to the Blink.

- This Tear Reservoir Optically Neutralizes the Irregular Cornea and Becomes Optically Smooth.

The Basic Idea

- Sclerals are **fit** to align and rest upon the **scleral conjunctiva** – **completely vaulting the corneal surface** - It does not have to align with the cornea.
- Sclerals are **fit** using the **sagittal depth** of the cornea and sagittal depth of the lens to determine the relationship.
- Larger Kone/Larger Lens
- Larger Lens/Larger Tear Reservoir

The Basic Idea - Objectives

- You cannot apply GP **corneal fitting** to **Scleral Fitting** or you will not succeed.

- **3 Objectives**

  1. **Vault** the central cornea

  2. Achieve **complete** Limbal clearance

  3. **Align** with the Scleral Conjunctiva

How the Scleral Lens is Designed

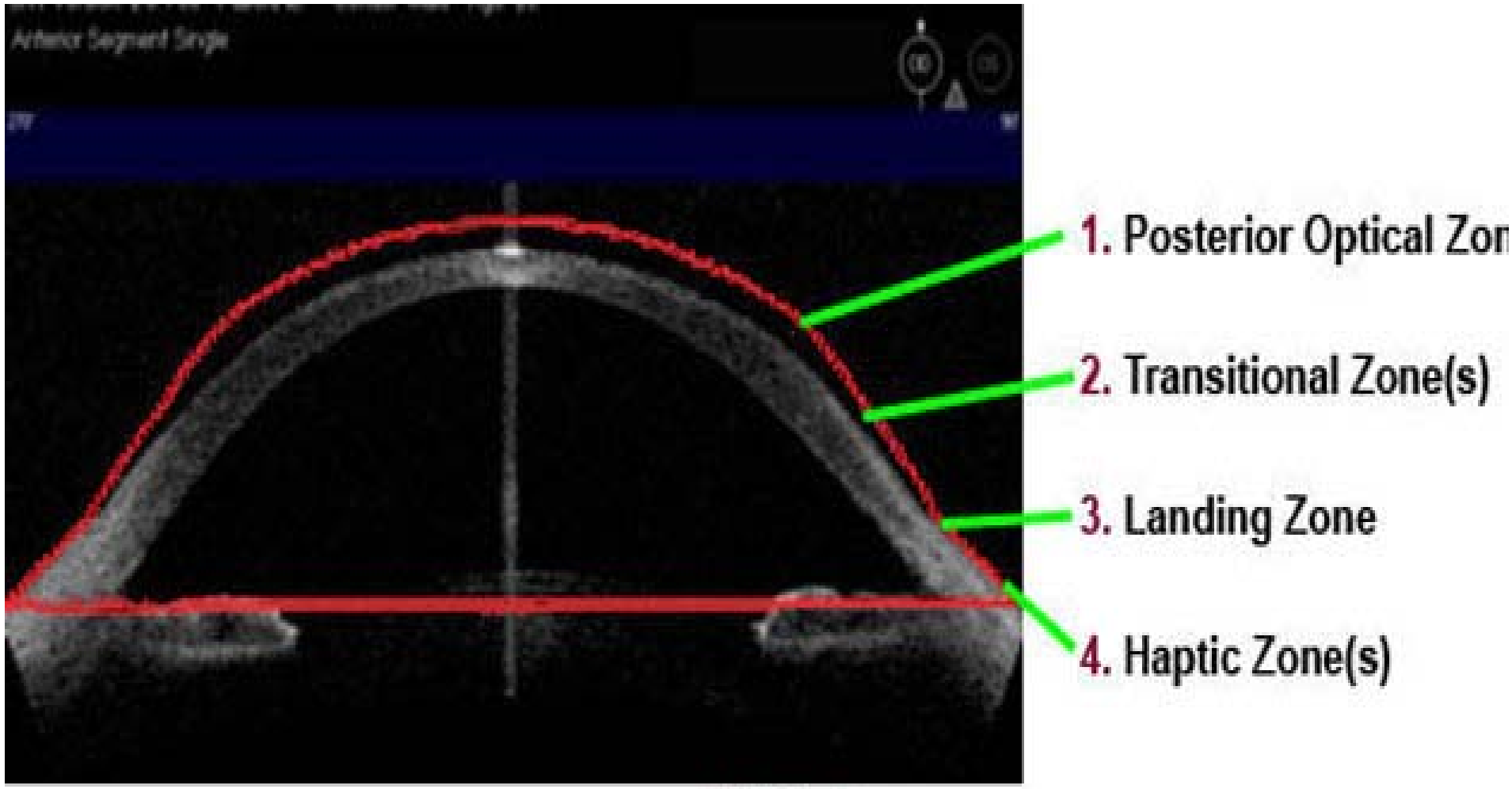


FIGURE 6

Why Sclerals over the Corneal GP

- Can fit the more **advanced** corneal problems as well as the **early** cases
- **Vision is improved** – at least the same or better.
- When smaller corneal GP will not center - **Sclerals Do!**
- Sclerals **do not rest on the cornea** and they center very well.
- Provides an **advantage over long term contact with the cornea** and possible disruption where an **unhealthy compromise** exists.

- **COMFORT**

Why Sclerals Have Become More Popular

- Improved Dk up to 163
  - Have to Balance Wetting Angle and Lens Deposits with the Dk.
- Improved Manufacture
    1. Regular Curves
    2. Steep Keratoconus Curves
    3. Reverse Geometry Curves
    4. Torric Central and Peripheral Curves

Can Fit Cornea's That Could Not Be Fit Before

Scleral Lenses Can

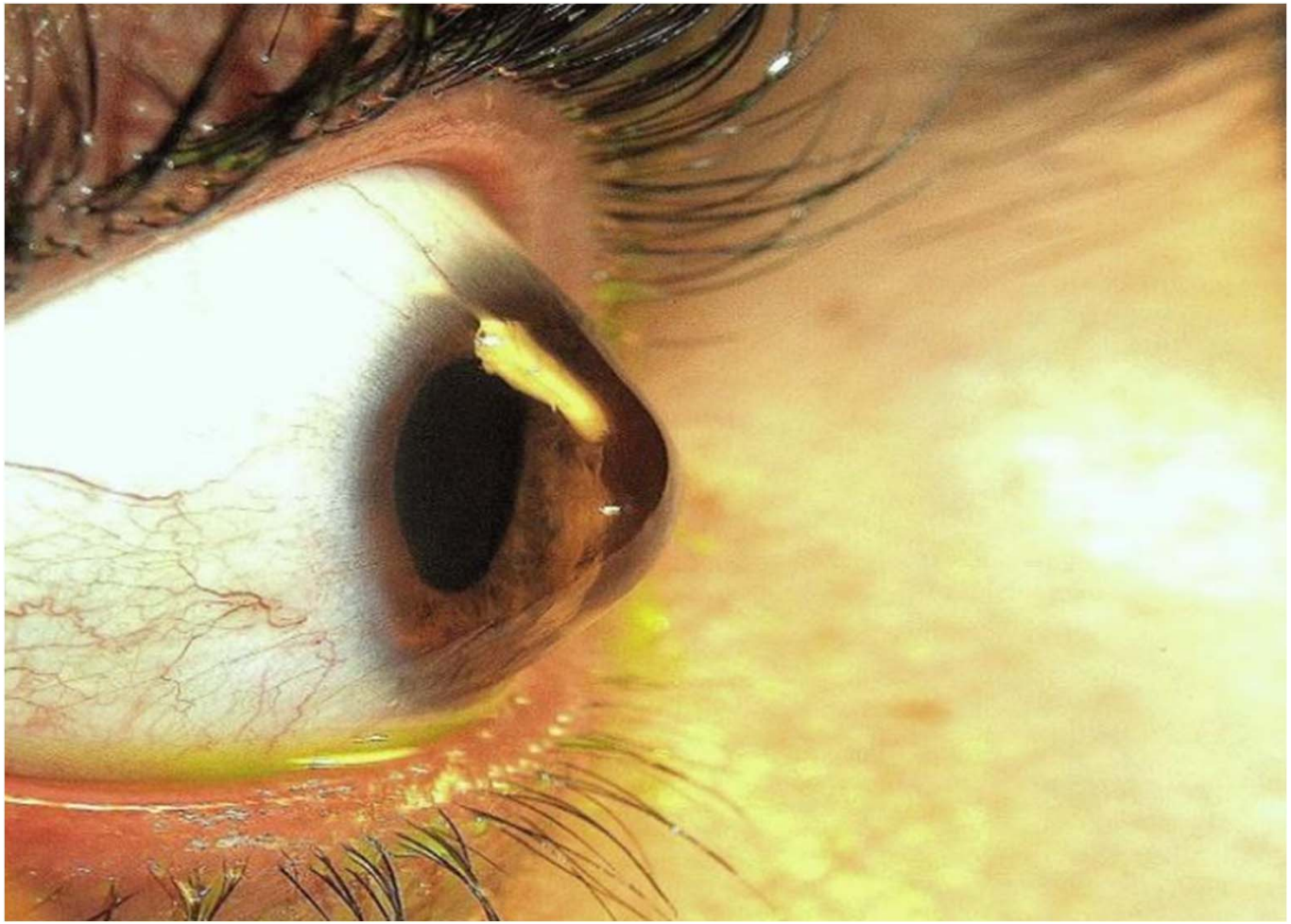
- Postpone or Prevent Surgical Procedures
- Fit Kerataconus, Pellucid Marginal Degeneration, Keratoglobus, Post Surgical Irregularities or Ectasia
- Decrease the Risk of Further Corneal Scarring from Trauma, HSV, Dystrophies
- Provide a Lubricated Surface in OSD, Sjogrens, Graph vrs Host Disease

The Use Of – Corneal Ectasia

- Keratoconus – PROLATE

The Use Of – Corneal Ectasia

Keratoconus, Ectasia, Spherical, Astigmatic

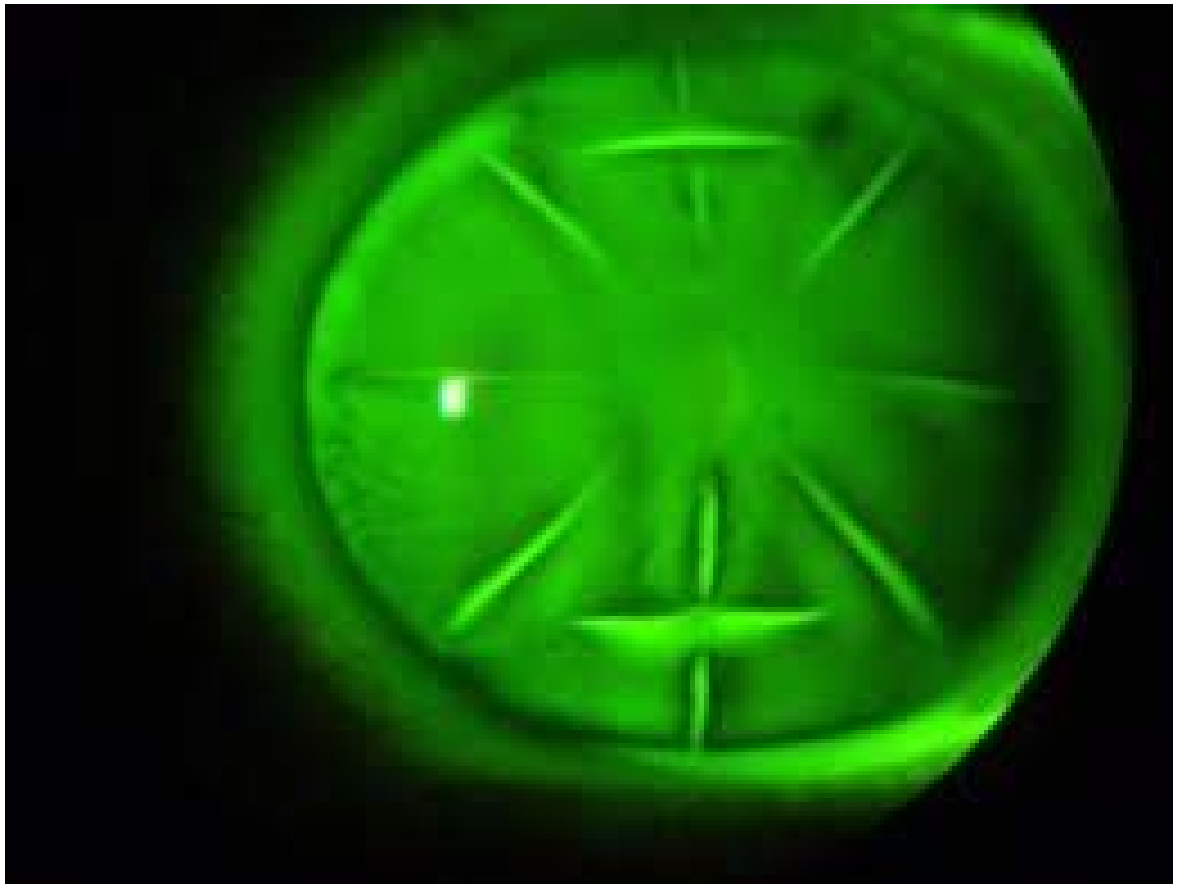


The Use Of – Corneal Ectasia

Keratoglobus

The Use Of – Cornea Surgery

RK, Lasik, PRK, CT - OBLATE



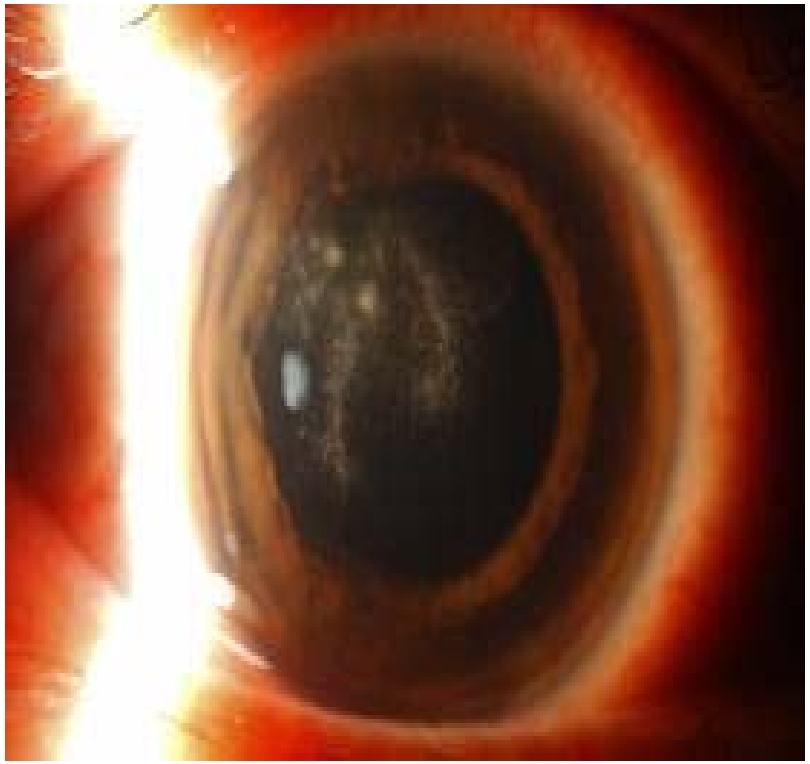
The Use Of
Post Surgical Irregularities

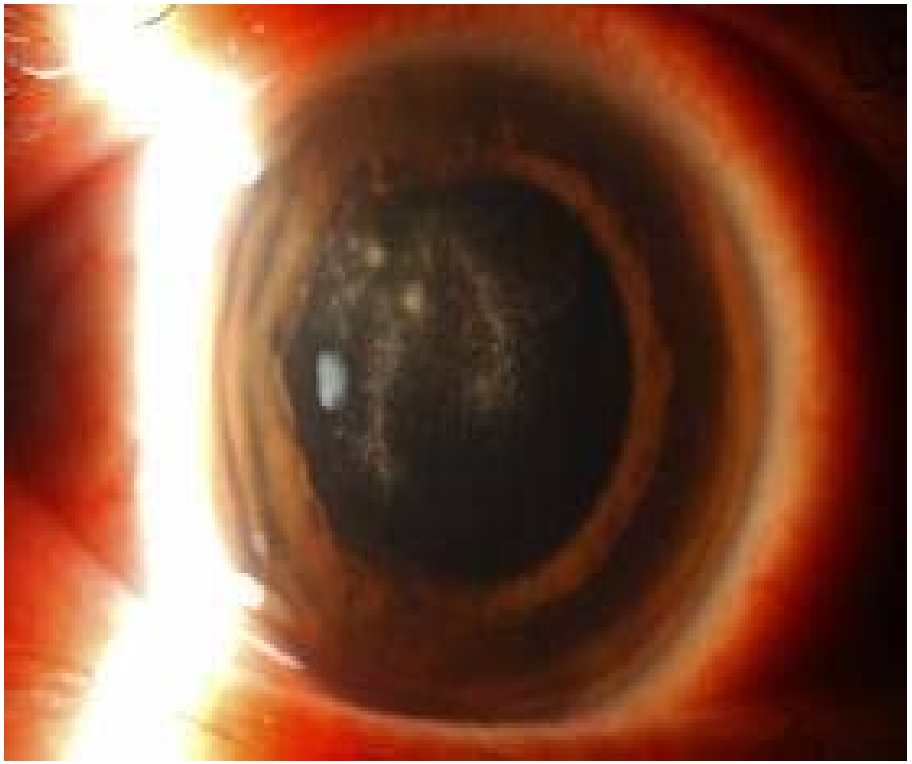
Corneal Transplants- PK – OBLATE

The Use Of - Trauma

The Use Of – Corneal Diseases

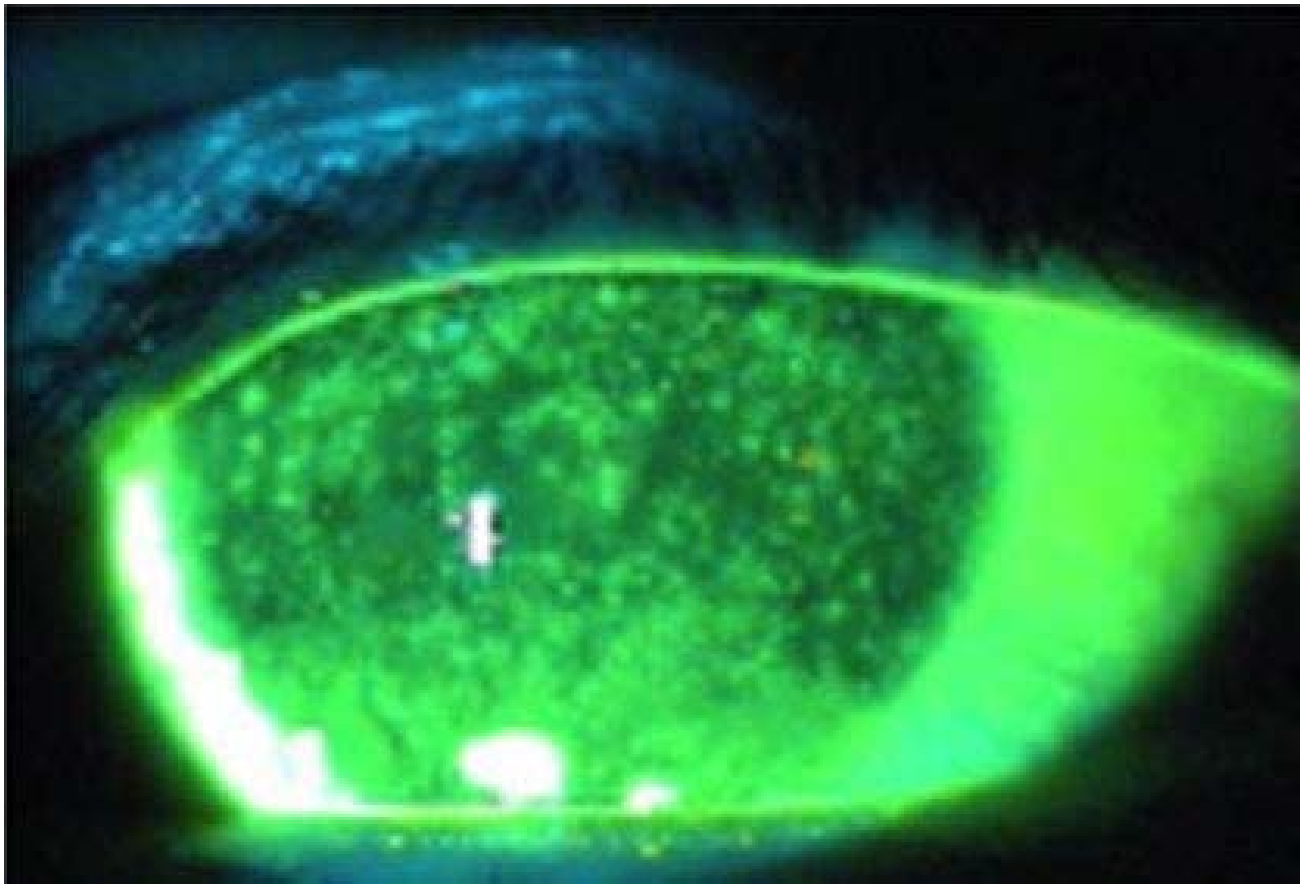
Scarring HSV Dystrophies Acanthamoeba





The Use Of – OSD/Keratitis

Sjogren's Steven's Johnson Graph Vrs Host



The Use Of – OSD/Keratitis

Persistent Epithelial Defects Neurotrophic

The Use Of

Sports Cosmetic

How Did the Classification of Scleral Lenses Come About?

- Flipping of a coin at the Super Bowl.
- The Europeans figured it out for us.
- By definition it is a lens greater than 18 mm.
- Congress decided on it.

How Did the Classification of Scleral Lenses Come About?

- Many arbitrary designations were made to the Scleral lens which created some confusion.

- Finally the Scleral Lens Education Society adopted a formal classification for the lenses which may still confuse you.

Classification of Scleral Lenses

Corneal Lens

Up to 12.5 mm diameter

Thin tear film 0 to 10 Microns – Not measurable with Fluorescein

Rest and Touch to full cornea

Corneo-scleral
Corneal-Limbal/Semi-scleral Limbal

12.5 to 15 mm diameter

Limited Tear Film Reservoir 20 - 100 Microns

Share Bearing on the Cornea/Limbal or Limbal/Scleral

Scleral (Full)

Mini-Scleral / Large Scleral

15.0 to 18.0 mm 18 to 24 mm

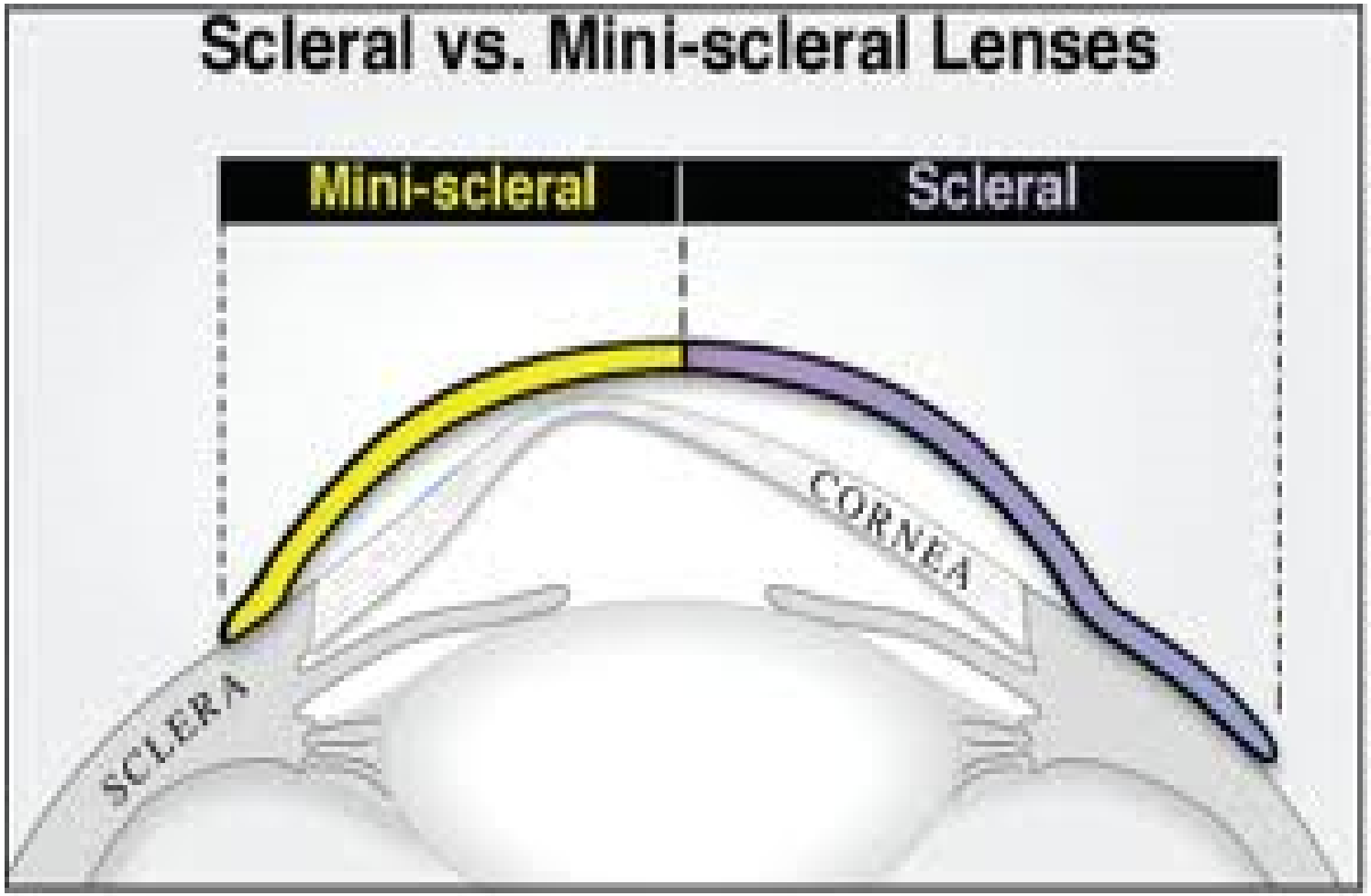
- Tear Reservoir 100 – 200 Microns
  (Can go up to 600 Microns)

We will concentrate on These Because:

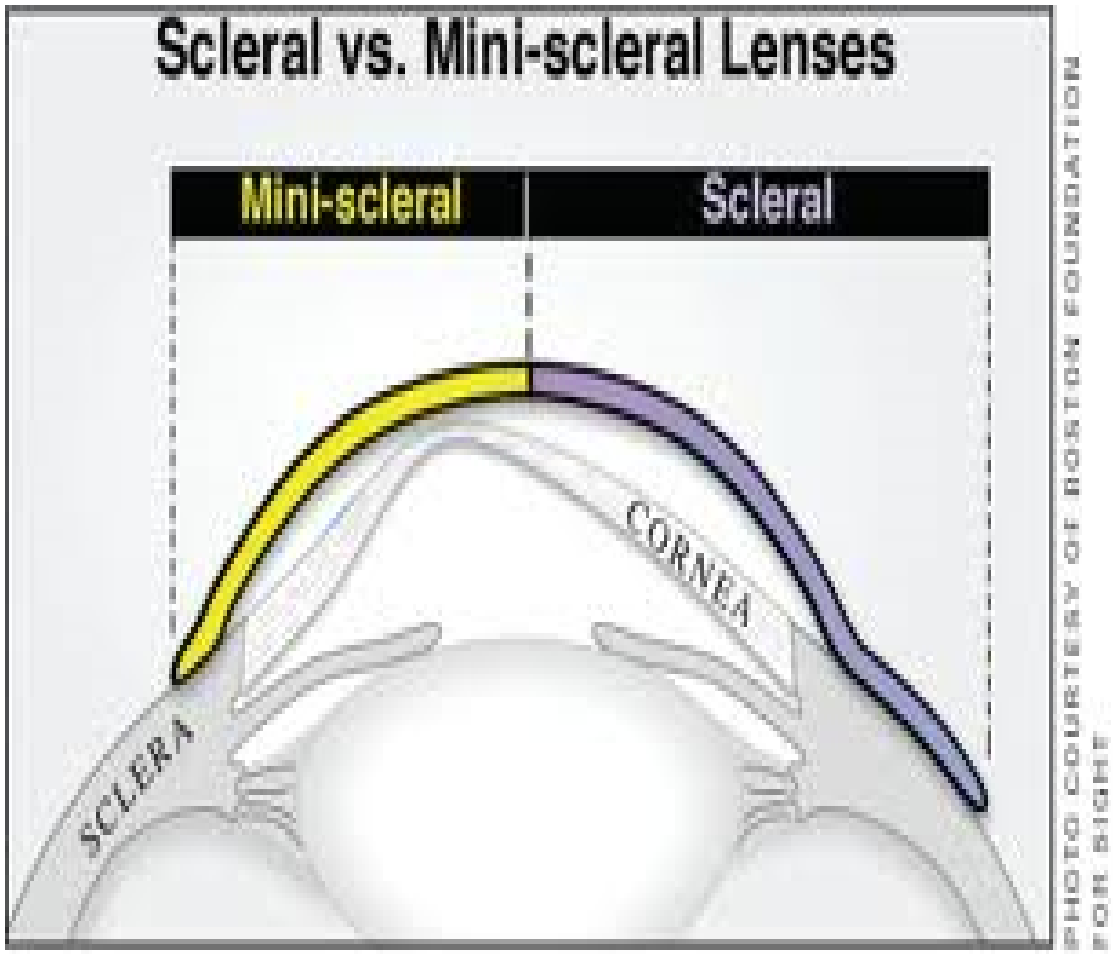
1. Smaller lenses may rest on cornea/limbus and
2. We Want complete Limbal clearance for Optimal Health of the Cornea/Stem Cells
3. **Most Common Lens Sizes Fit in United States**

Scleral (Full)
Mini-Scleral / Large Scleral

- 15.0 to 18.0 mm 18 to 25 mm

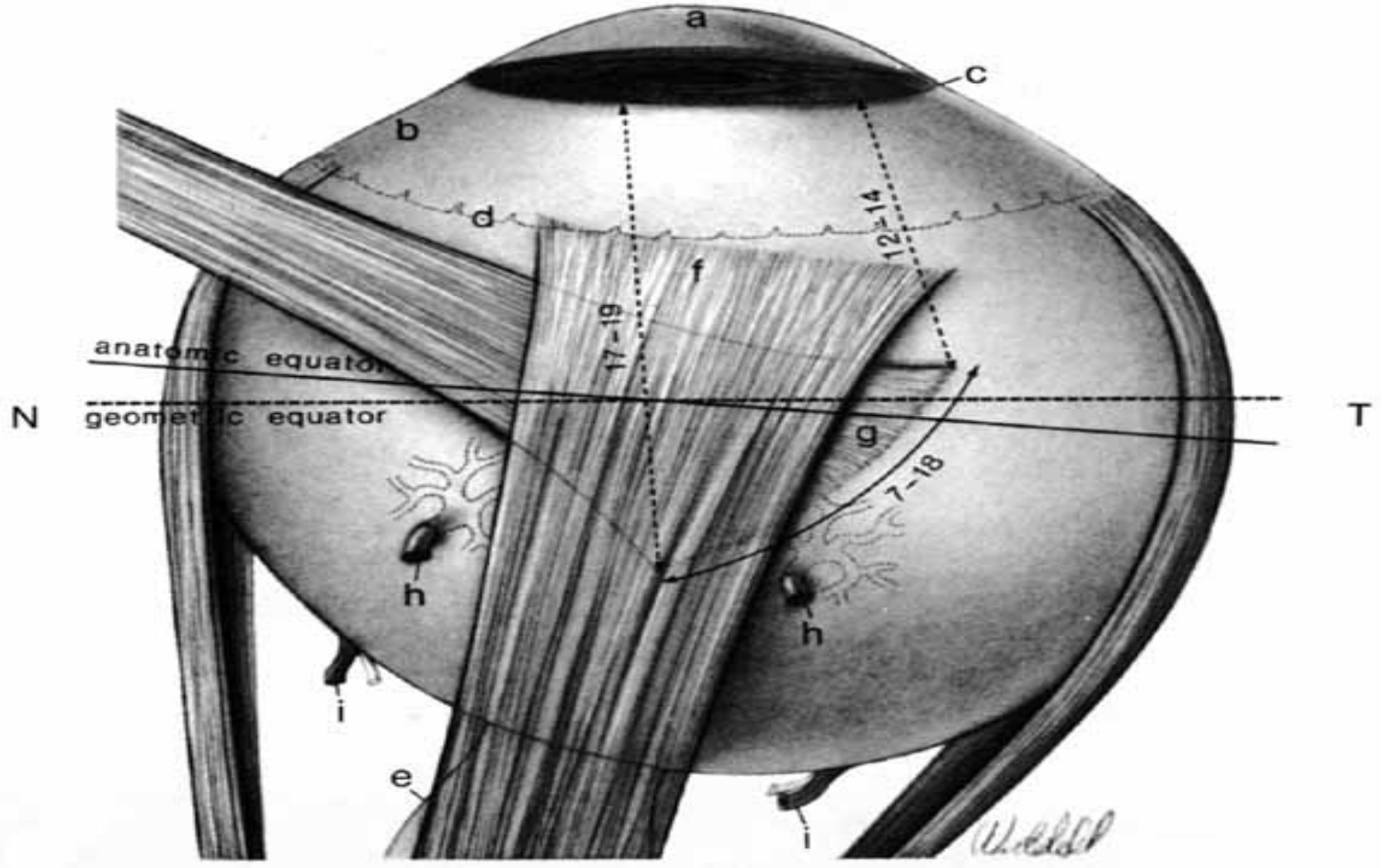


Anatomy and Shape of the Cornea and Sclera



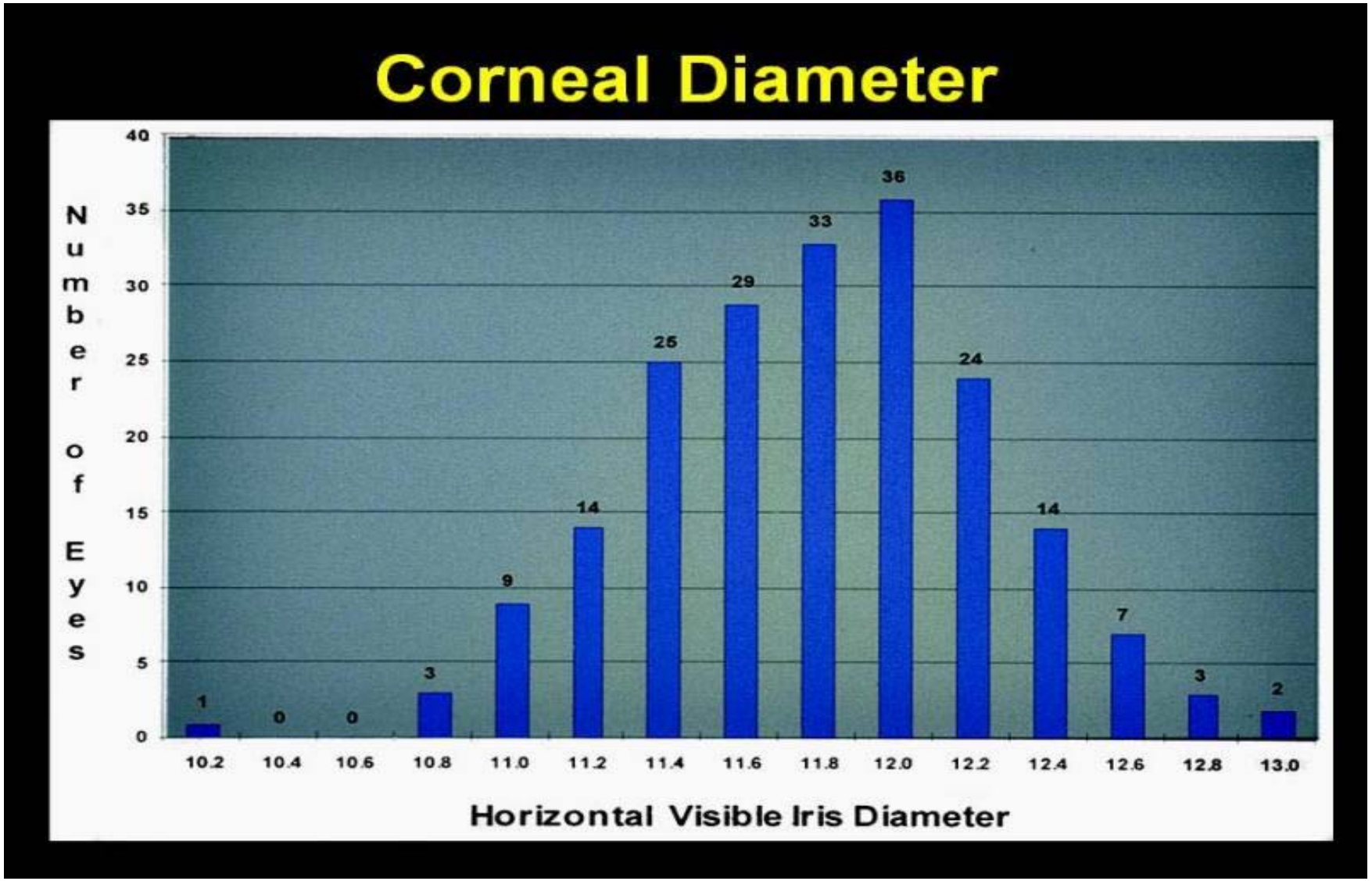
Anatomy and Shape of the Cornea and Sclera
Lens Size

- Diameter based on: 11.8



Anatomy and Shape of the Cornea and Sclera

Lens Size = 11.8 + 12.5 = 24.3

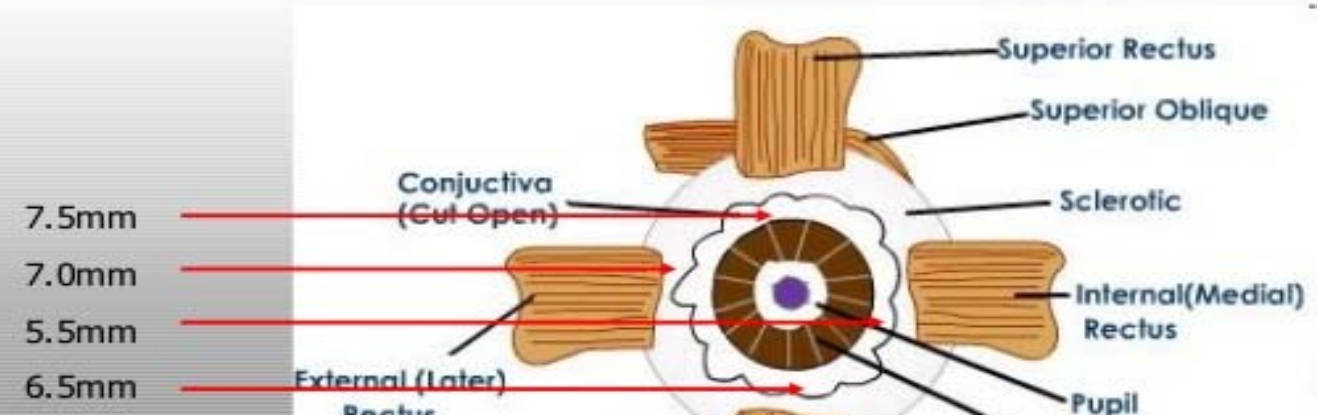


Anatomy and Shape of the Cornea and Sclera – Sagittal Height

90% of the Kone is Measured at the 10 MM Chord

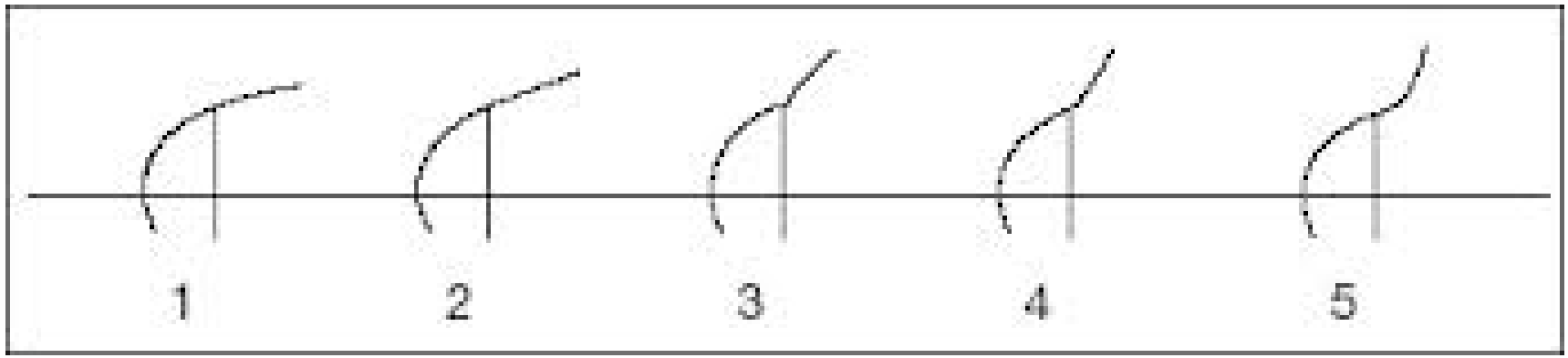
Anterior Ocular Anatomy

- Average corneal diameter of 11.8mm
- 24mm -the maximum diameter a scleral lens can have

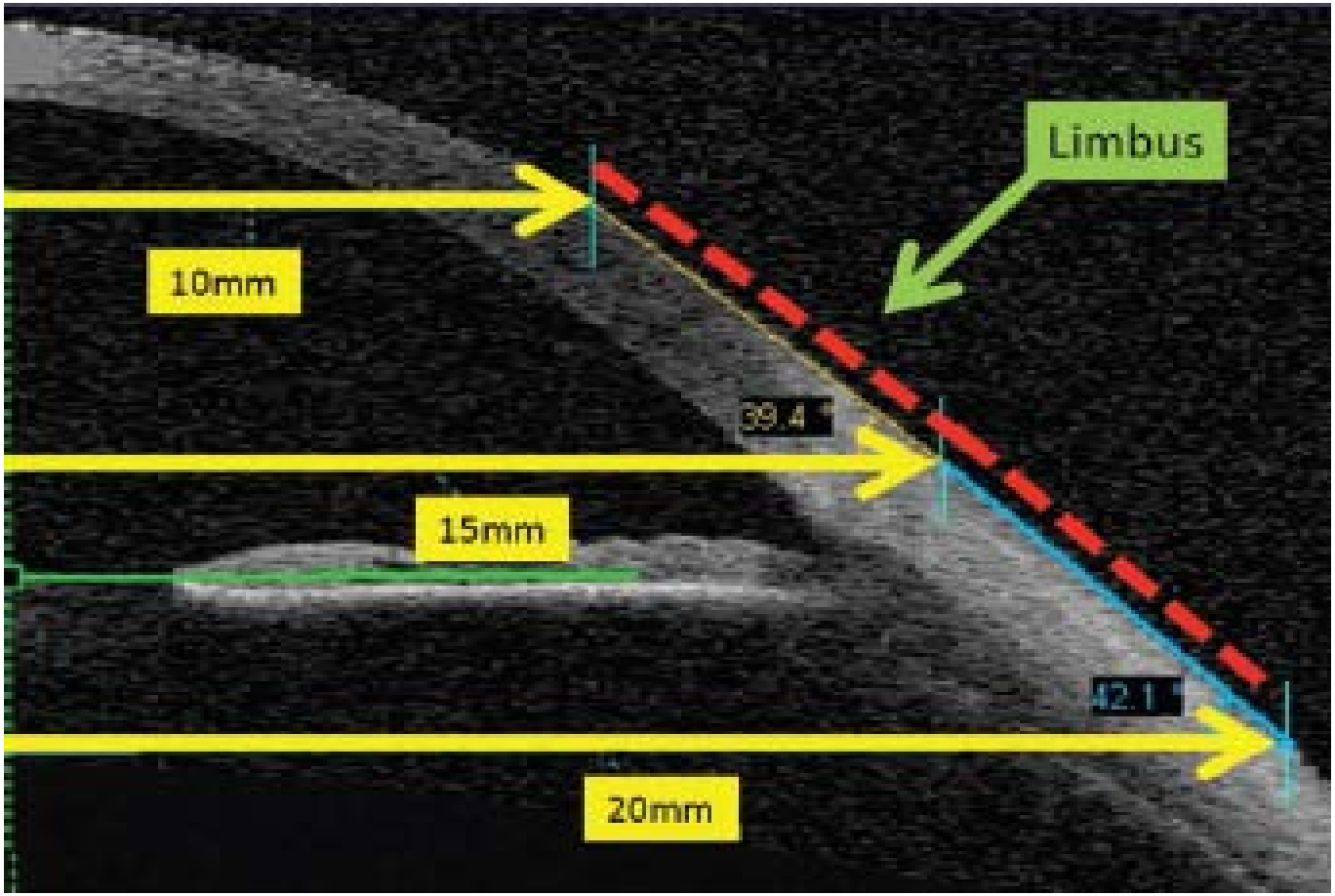


Anatomy and Shape of the Cornea and Sclera – Tangential/Straight

Meier (1992) – Swiss Doctor



Anatomy and Shape of the Cornea and Sclera – Tangential/Straight

- 

Anatomy and Shape of the Cornea and Sclera

- Non-rotational Symmetric Torric or Quadrant Specific the further out on the scleral the increasing amount of torricity.
- Normally **with the rule**:

  3-9 Flatter / 12-6 Steeper
- With the Scleral Anatomy there is **No Movement** or Very Little with the Lens.
- Lens is very stable on the eye

Design of the Scleral Lens
Vaults Cornea, Clears Limbus, Sclera

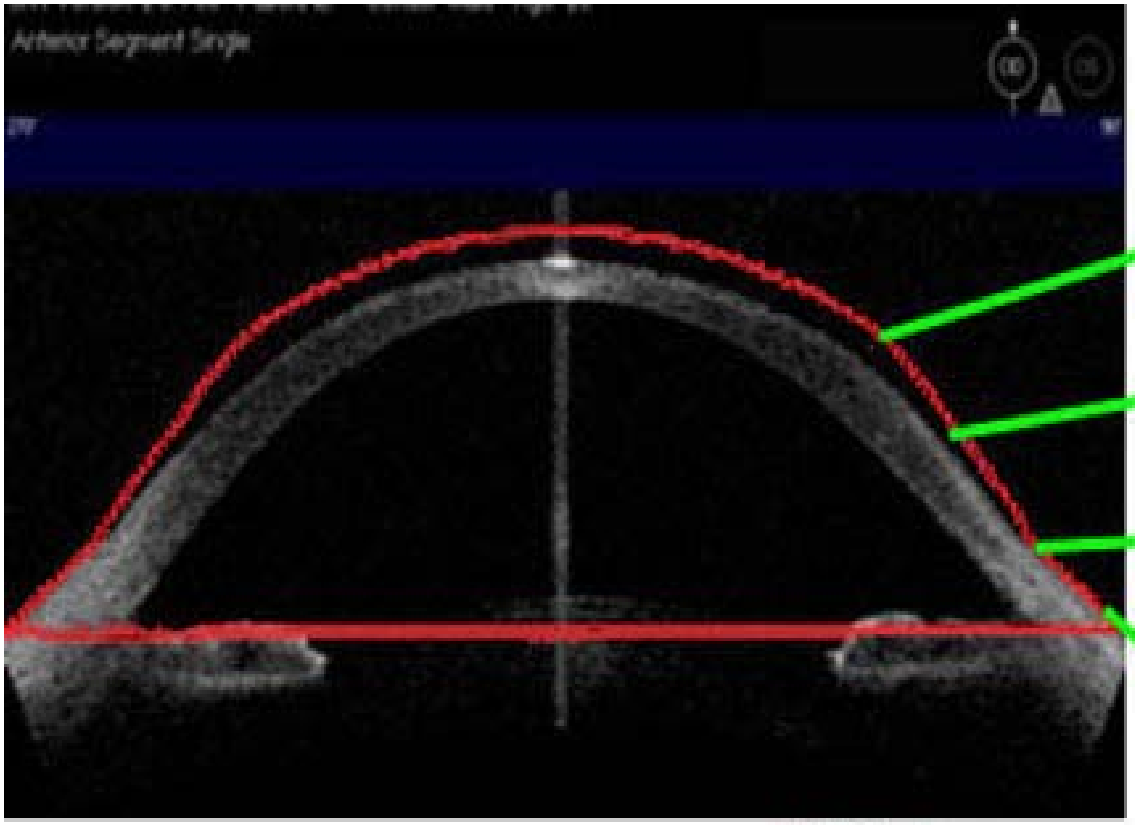


FIGURE 6

Design/Fitting the Scleral Lens

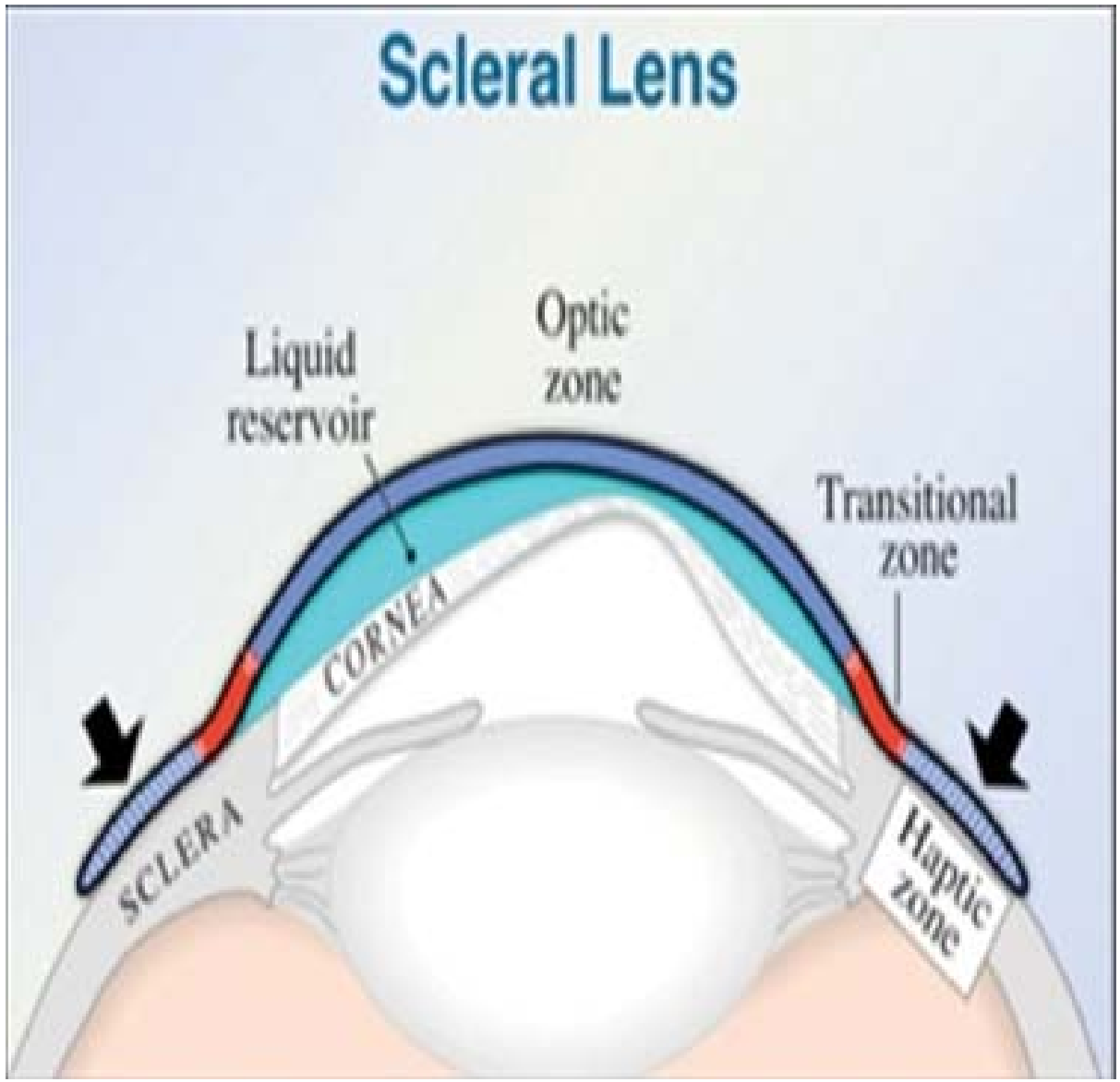
Is It A:

- An ART form /Trial Lens
- Instrument Evaluation or
- Empirical Fit?

Do You Fit it:

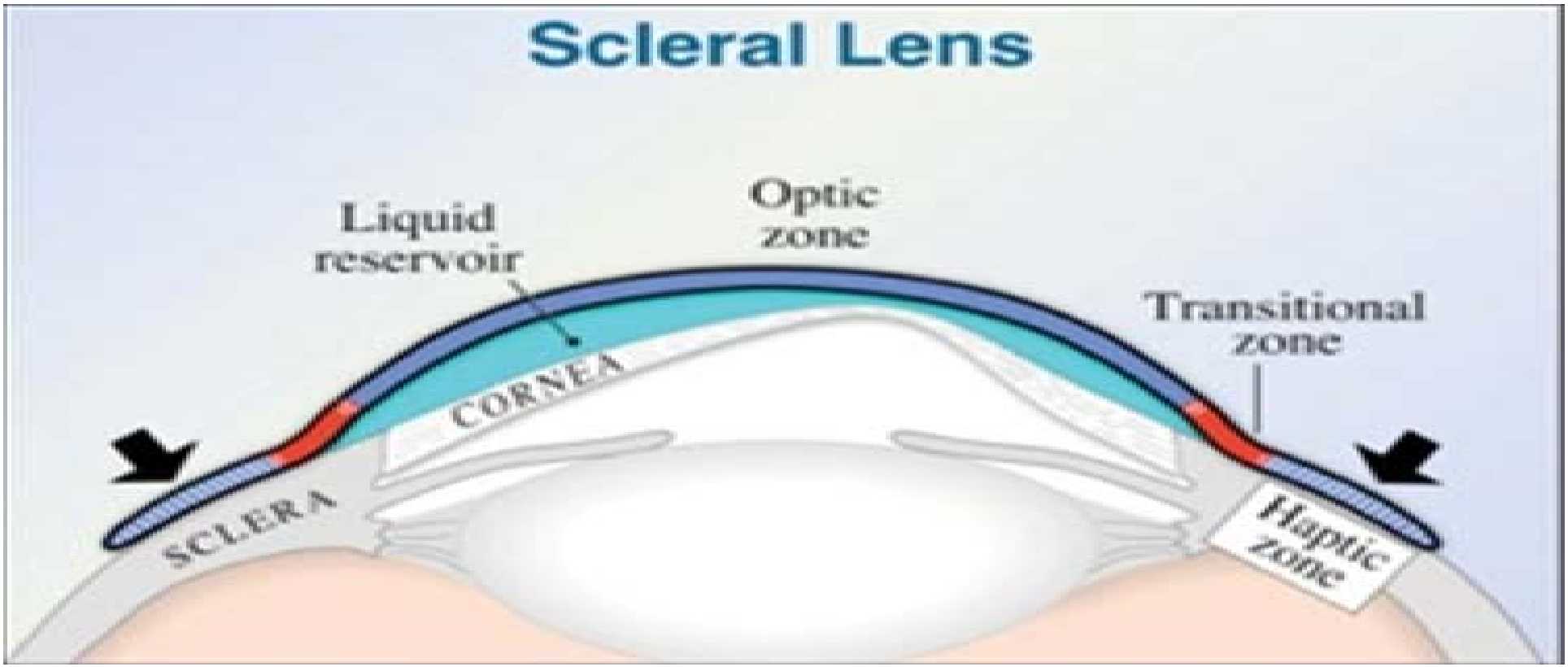
- Inside to Outside OR
- Outside to Inside?

Design of the Scleral Lens



Design/Fitting the Scleral Lens

Forget Empirical (for now)



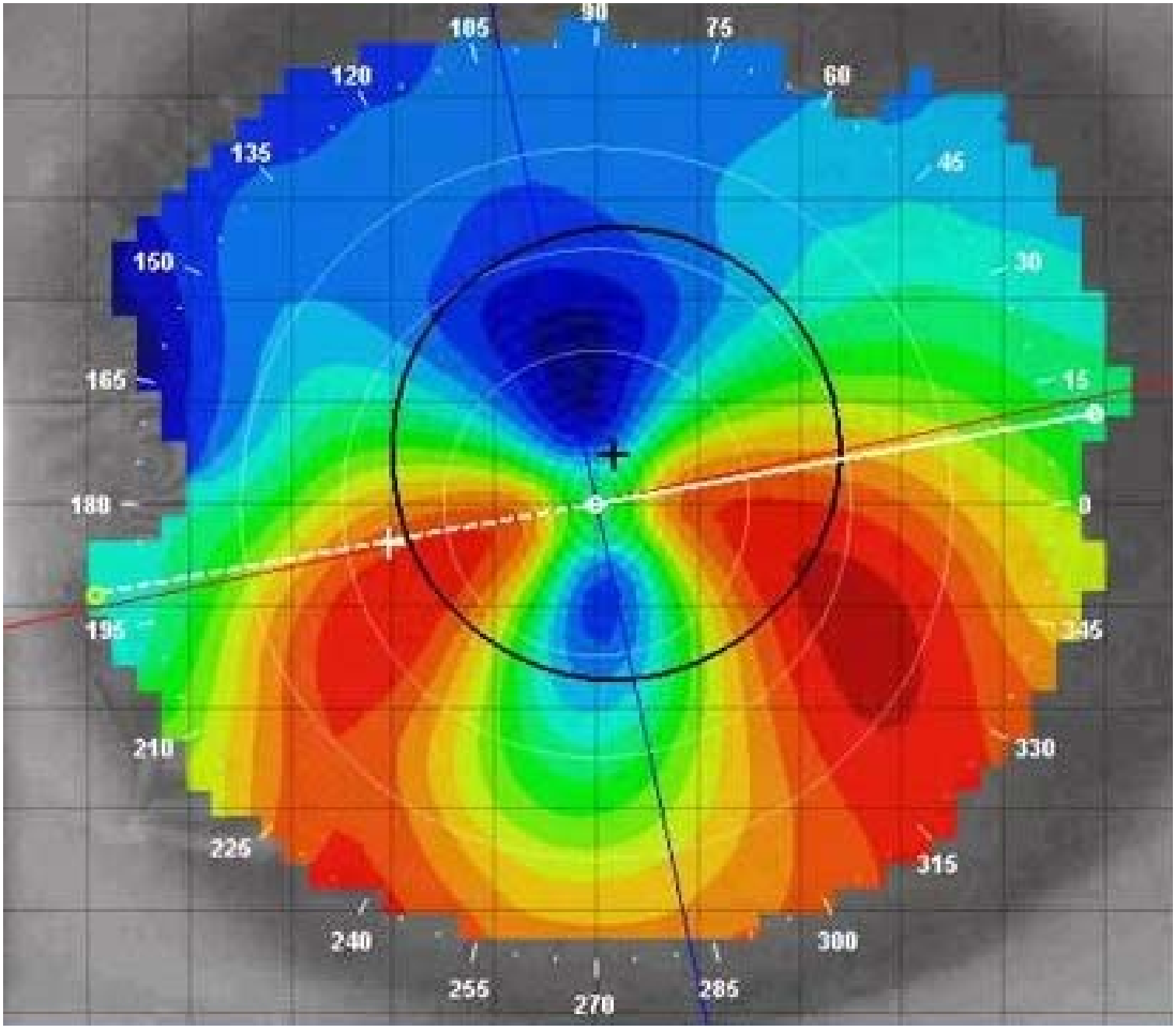
Design/Fitting the Scleral Lens Instruments Help

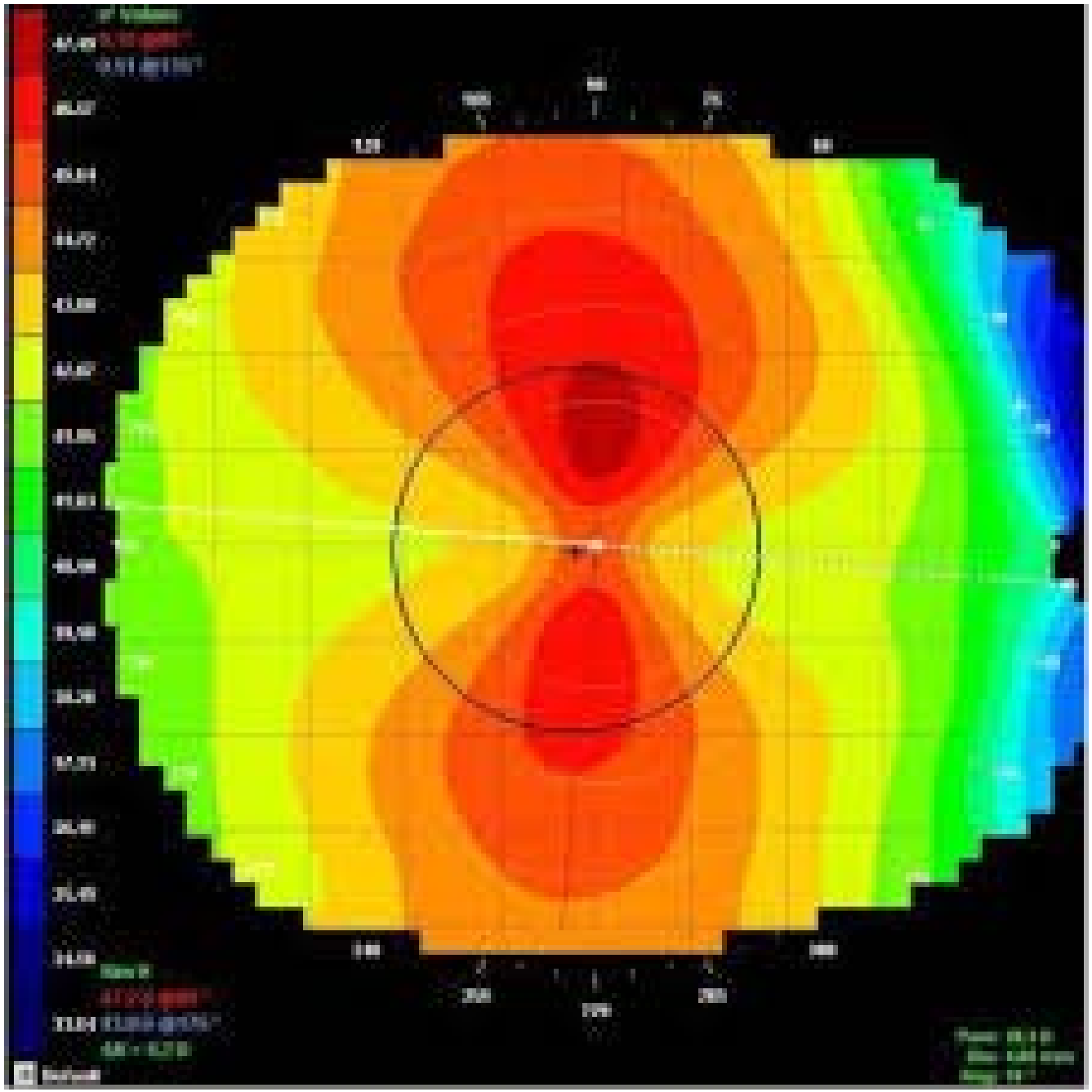
Keratometry or Topography and OCT for

1. Picture of the Corneal Surface Irregularities and Sagittal Depth
2. Flex warpage

Pachometer – Corneal Thickness

Slit Lamp with Fluorescein and/or
OCT to Evaluate the Fit


105
90
75
120
60
135
45
150
30
165
15
180
0
195
345
210
330
225
315
240
300
255
270
285



Design of the Scleral Lens

Fit of the Scleral Lens

Clearance of **TWO AREAS**

I. Corneal – Type of Disease/Irregularity

1. Irregular Cornea or Early Kerataconus – Standard Lens
2. Irregular Cornea from PK, Lasik, Trauma - Standard or Reverse Geometry Lens
3. Advanced Kerataconus in the:
   - A**. Central** – Kerataconus - Kone Lens
   - B. **Margin** – PMD/Kerataglobus
     - Reverse Geometry
     - Larger OZ/Steeper Transition
4. **OSD** – Standard Lens - Larger reservoir
   More Clearance – Larger Diameter

II. Limbal - Vault the limbal area to prevent Erosive Damage to the Limbal Epithelial (stem) cell.

Design/Fitting the Scleral Lens

Fit Spherical Scleral Lenses

A Four Step Approach

1. **Choose the Initial Diameter**
2. **Achieve Central and Limbal Clearance with Optical Zone and Transition Zone**
3. **Achieve Landing/Haptic Zone Alignment**
4. **Check edge Lift**

Design/Fitting the Scleral Lens
Begin with Initial Diameter Selection

Anatomy and size of HVID/Corneal Size

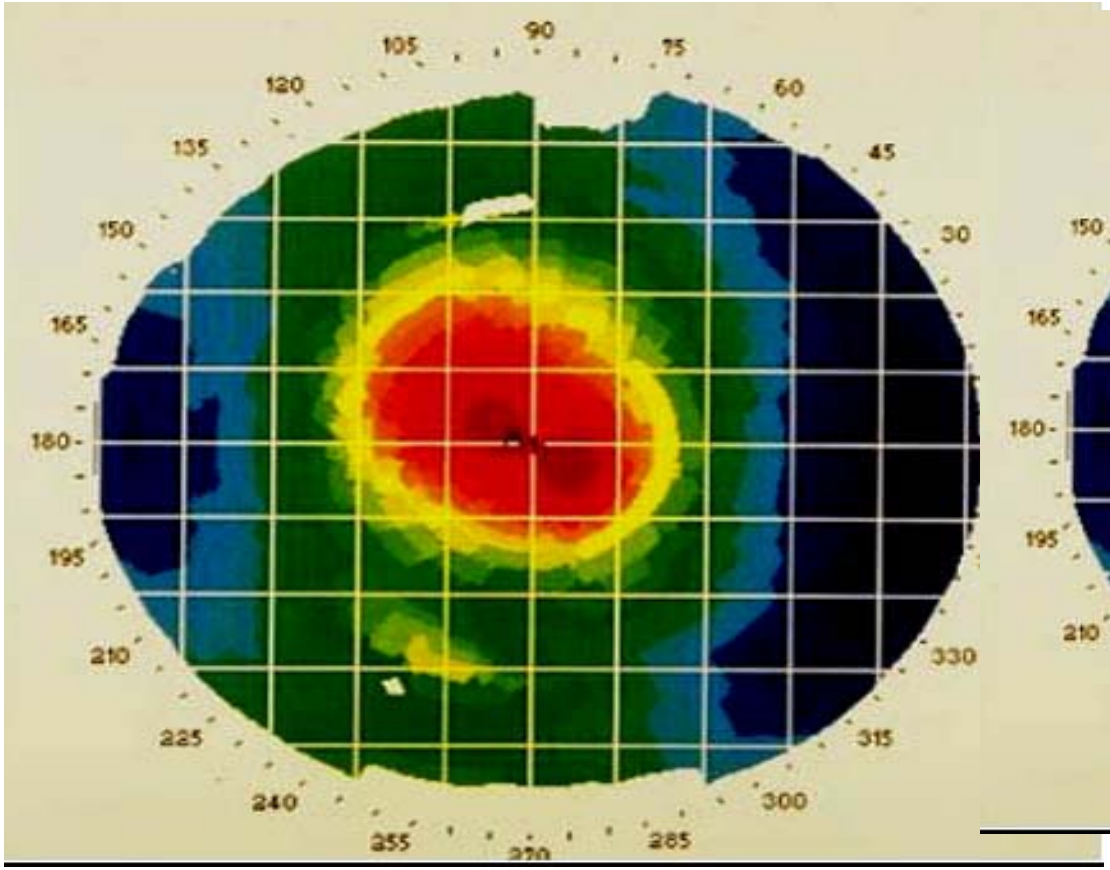
Type of Ocular Disease/Irregularity/Topography

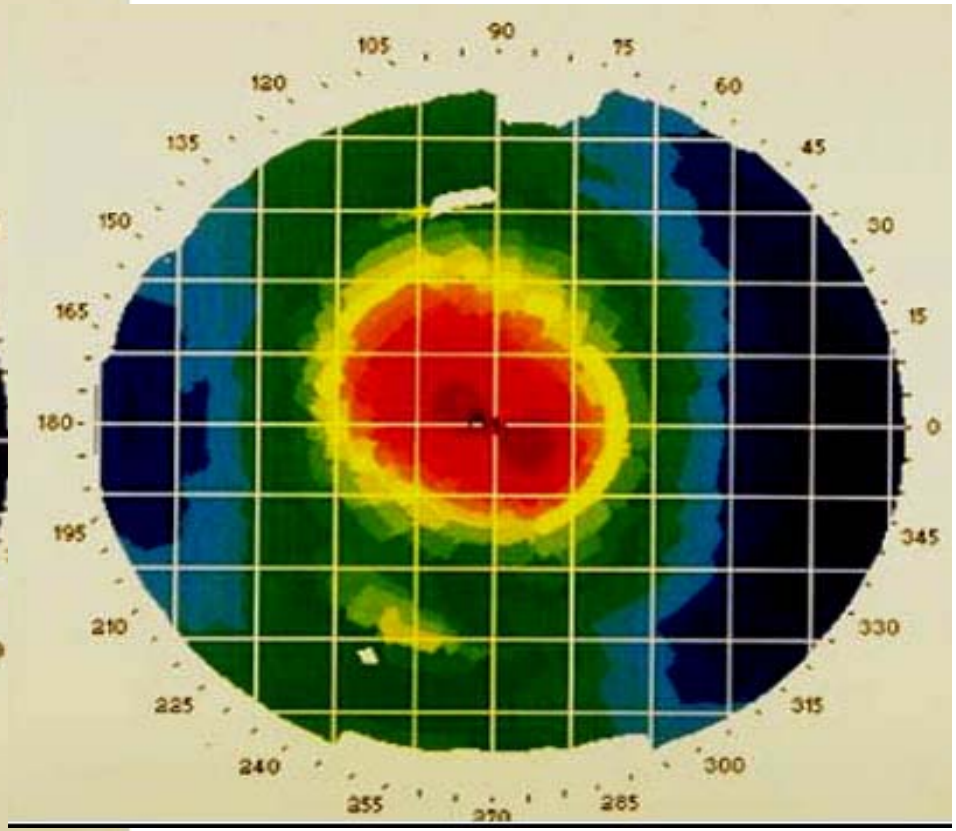
Amount of clearance needed. Sagittal Height with OCT, Side View, Munsons, Slit Lamp, or Fluorescein.

More the Clearance/Reservoir needed = Larger the Diameter.

Design/Fitting the Scleral Lens

- Diameter based on: Topo, Side View, Slit Lamp





Design/Fitting the Scleral Lens

- Diameter based on: Topo, W/R, Munsons

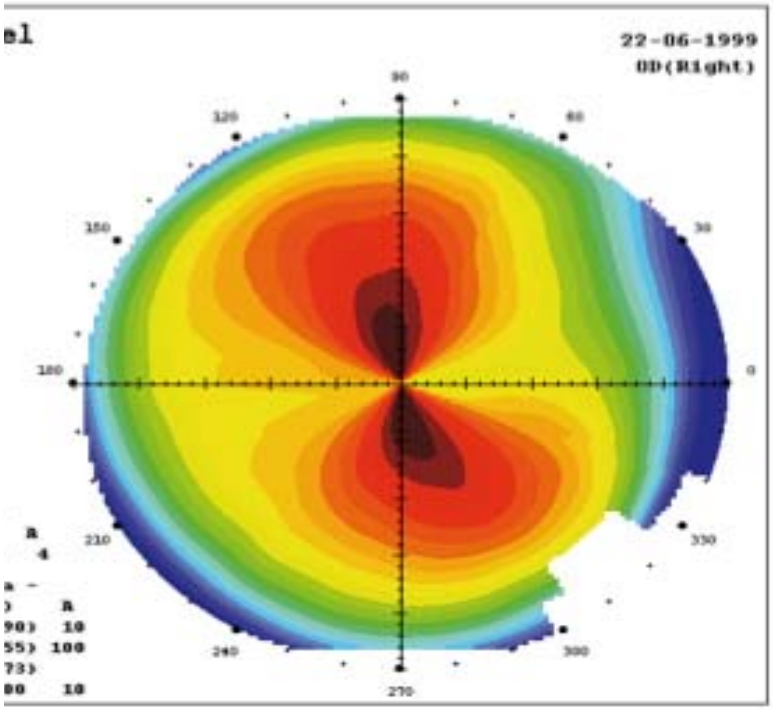
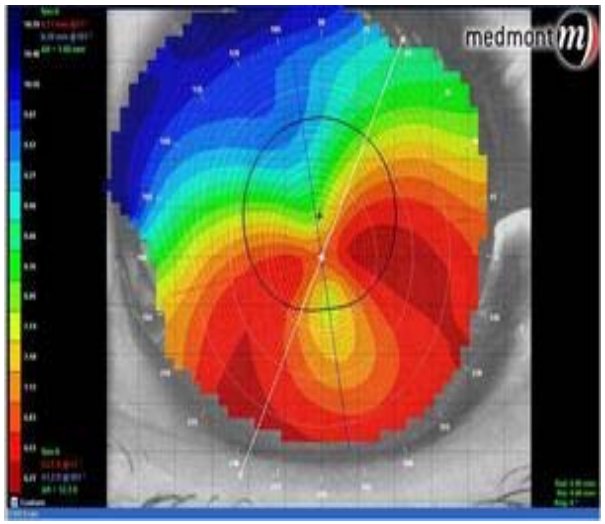


Fig. 1 keratoconus

Design/Fitting the Scleral Lens

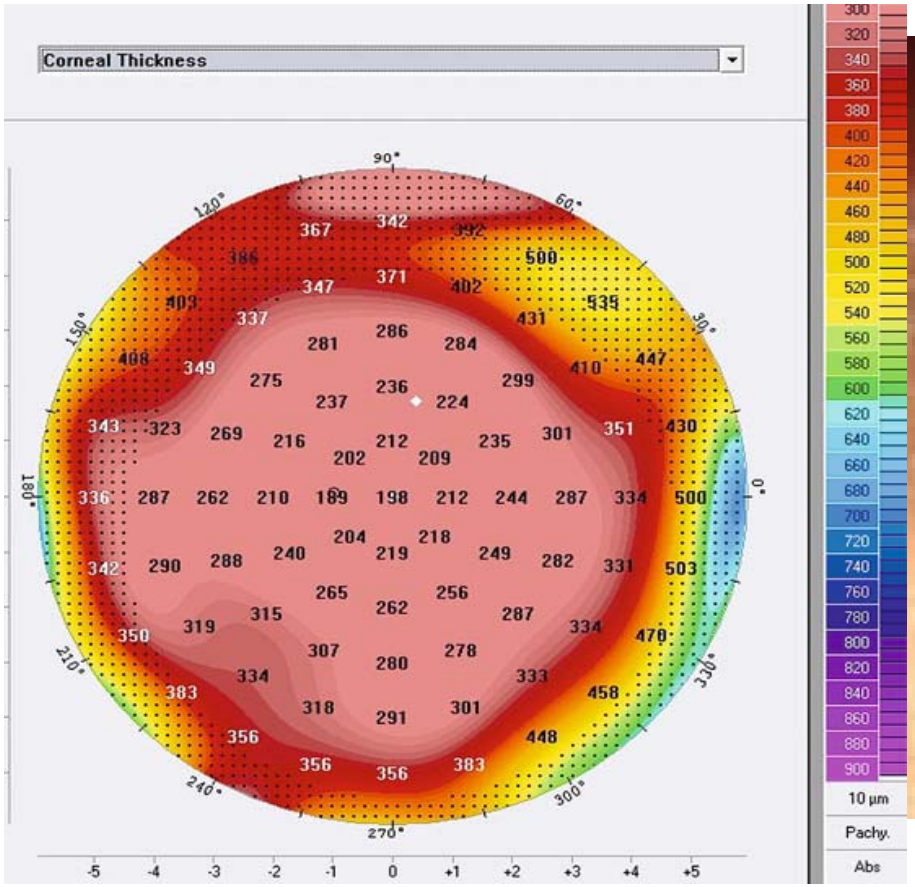
- Diameter based on: Topo, Side View

Fig. 1 keratoconus



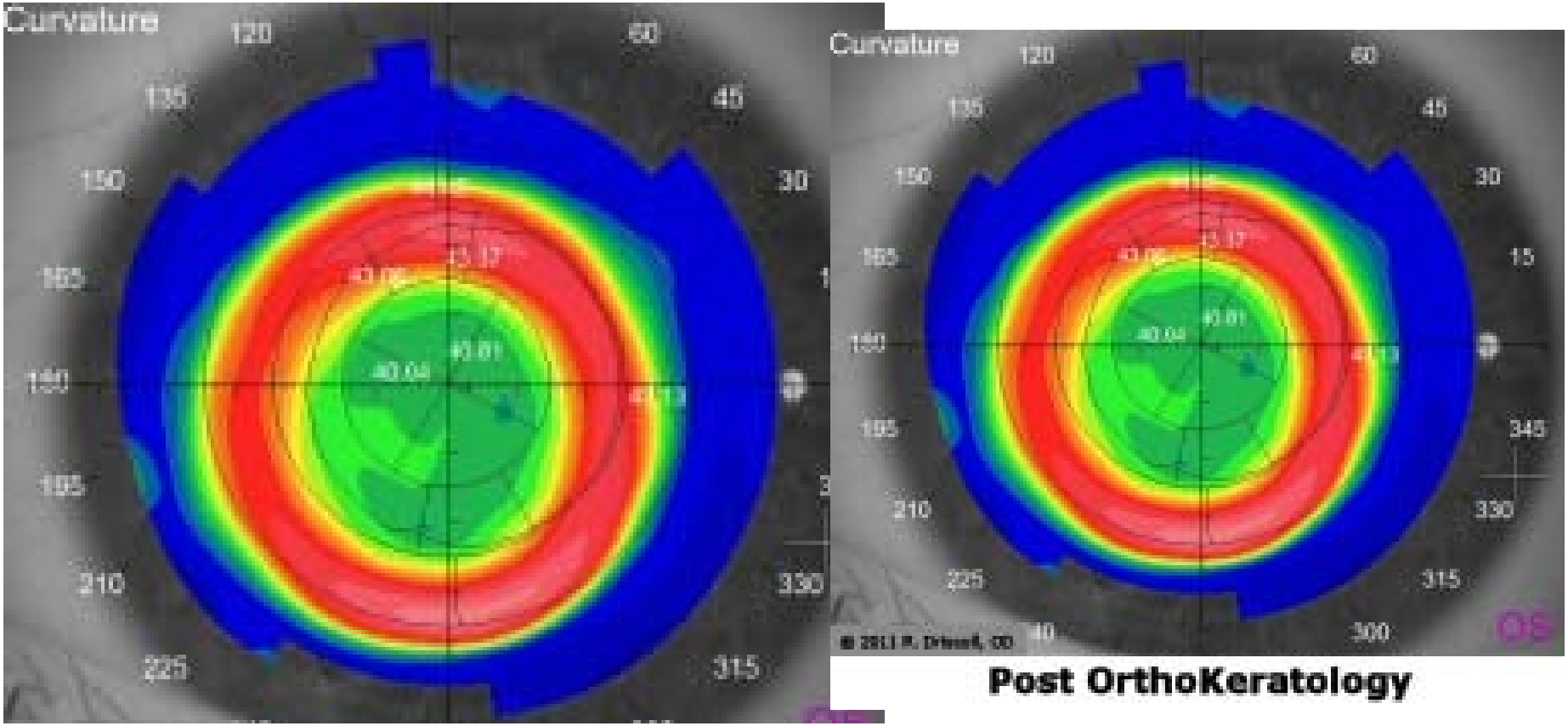
Design/Fitting the Scleral Lens

- Diameter based on: Topo, Impressive Munson



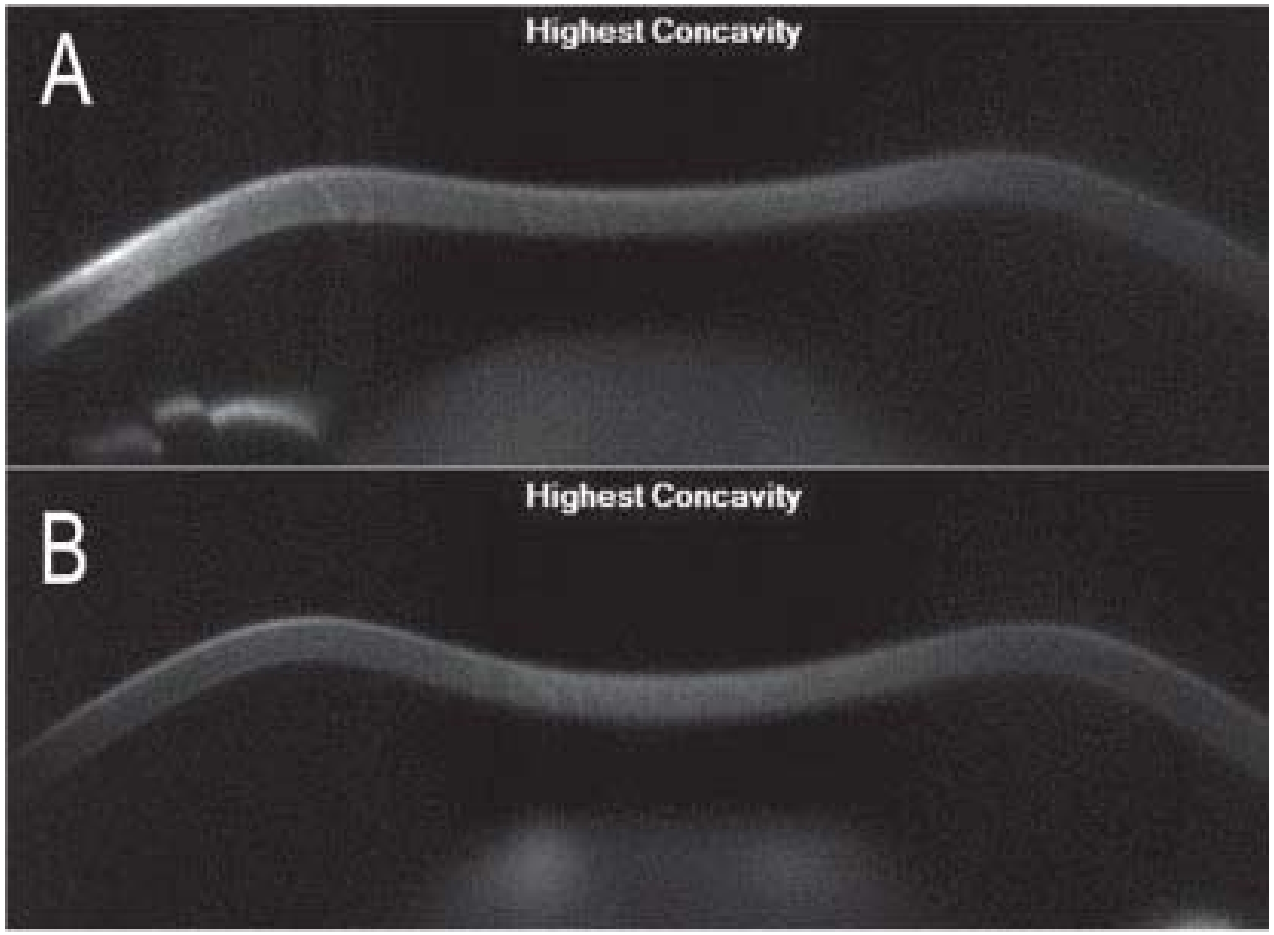
Design/Fitting the Scleral Lens

- Diameter based on: Topo, OCT



Design/Fitting the Scleral Lens

- Diameter based on: Disease

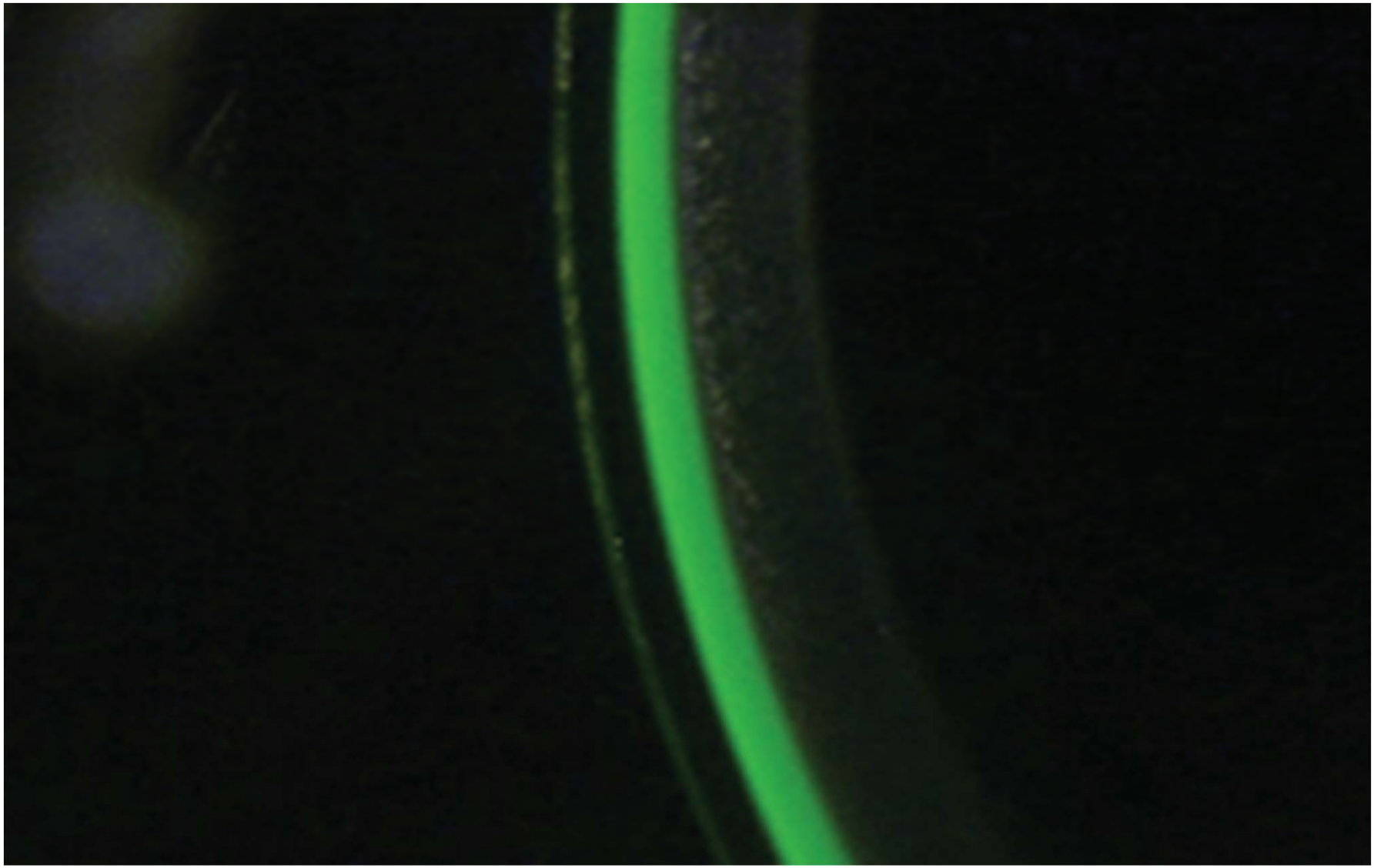


Fit of the Scleral Lens
OPTICAL ZONE

- Like Normal GP Lenses
- Can Increase or decrease Size or Curve
- Normally larger in Reverse Geometry lens to prevent touch in mid periphery and periphery of cornea

Fit of the Scleral Lens

OPTICAL ZONE/ VAULTING OF THE CORNEA



Design/Fitting of the Scleral Lens
TRANSITION ZONE/LIMBAL CLEARANCE

Controls Sagittal depth

Can increase or decrease the **angle** and/or **size** of Transition Zone

Want Complete limbal clearance

Fit of the Scleral Lens
LANDING/HAPTIC ZONE/FITTING

Area where the Lens “FITS”

Can increase or decrease to improve stability, comfort or sagittal height.

Little or no fluorescein visable, BUT NO - Blanching or severe conjunctival compression or edge lift off.

Fit of the Scleral Lens

TRANSITION ZONE/LIMBAL CLEARANCE

Design/Fitting the Scleral Lens
FIT and EVALUATION

Design/Fitting the Scleral Lens

Basic Start – Use the **ART Form**

Diagnostic lens Fit with Fluorescein

Design/Fitting the Scleral Lens

Basic Start – Use the **ART Form**

With the Vault Reduction Method

Fit Inside to Outside

Comfort, Easy to Evaluate and get to End Point

OR

Fit Outside to Inside

Fit Haptic and Increase Corneal/Limbal Clearance

Design/Fitting the Scleral Lens

Fitting Spherical Scleral Lenses

VAULT REDUCTION METHOD

The **Beginning Diagnostic Lens** that **completely vaults the cornea** and then select **progressively flatter lenses** until the lens **WHEN SETTLED (20 - 30 minutes)** is 100 to 200 microns above the surface. (Some exceptions will need more vault clearance)

Use Cornea Thickness To help Determine Vault.

Fit Spherical Scleral Lenses

If You Do Not Let the Lens Settle You Will:

Over-Estimate the Clearance

Under-Estimate the Haptic Impingement

Fit Spherical Scleral Lenses

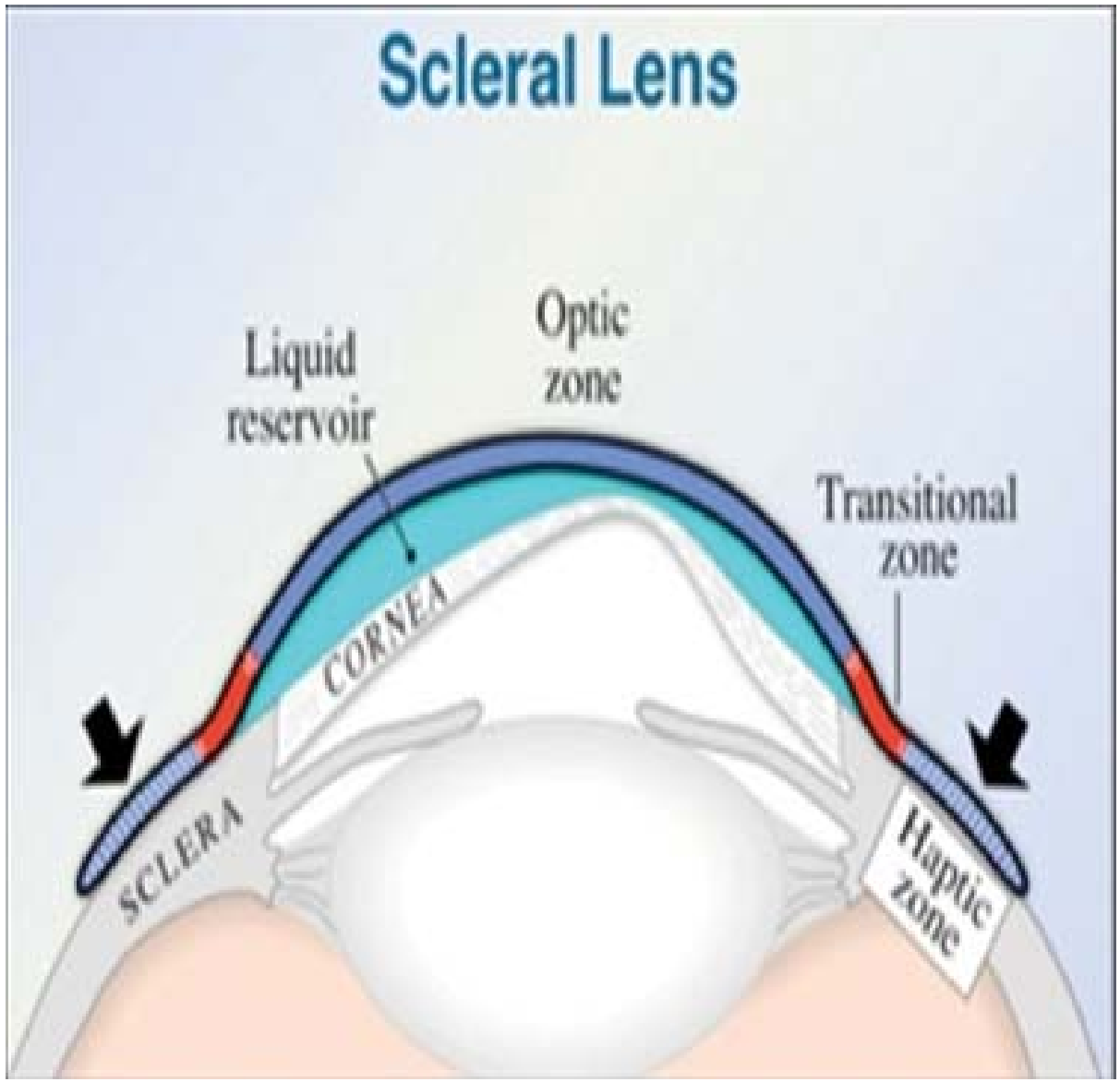
Movement

None or VERY LITTLE

Lens is Stable and Centered

Design of the Scleral Lens

Design of the Scleral Lens

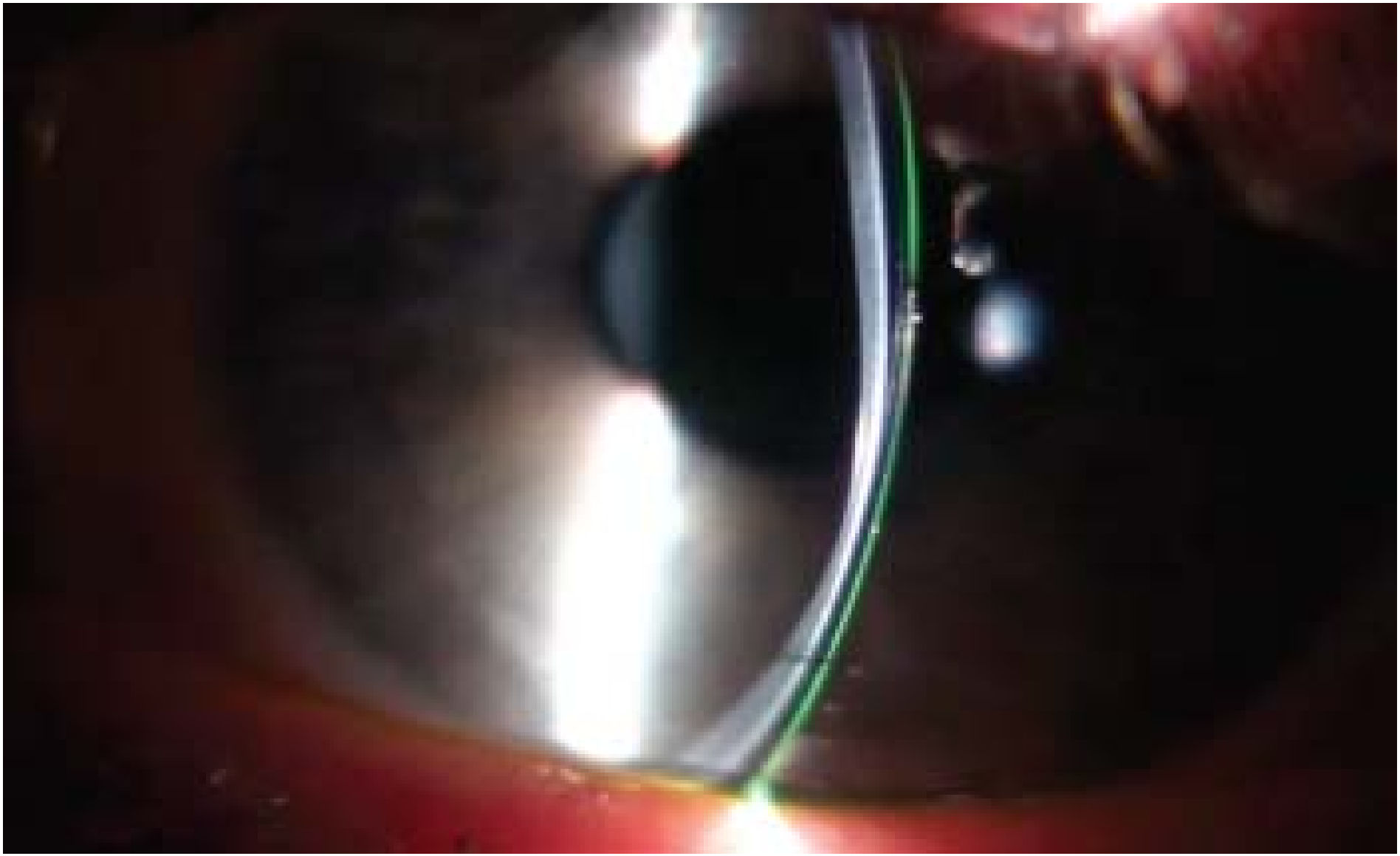


Fit of the Scleral Lens

OPTICAL ZONE/ VAULTING OF THE CORNEA

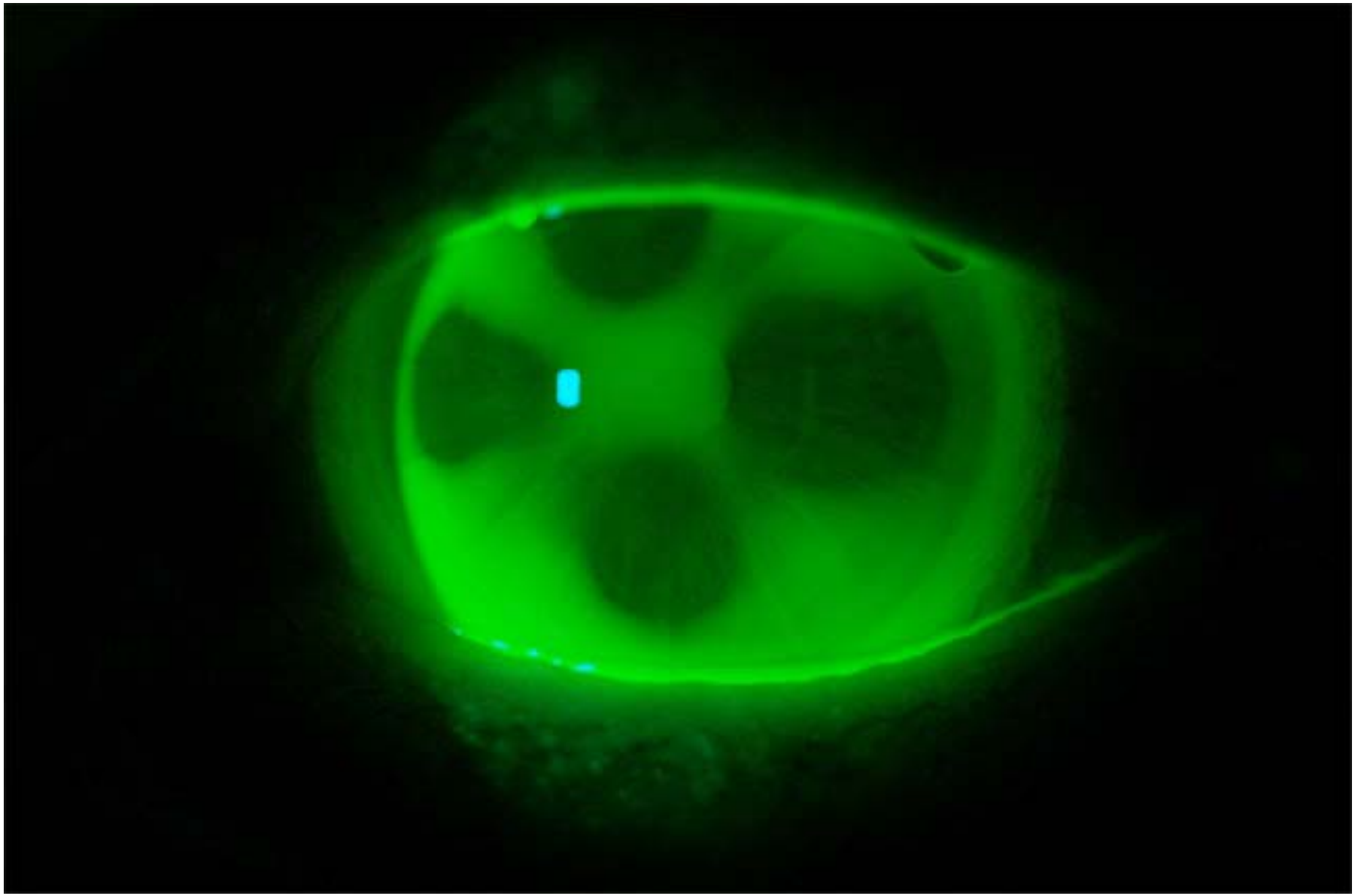
Fit of the Scleral Lens

OPTICAL ZONE/ VAULTING OF THE CORNEA

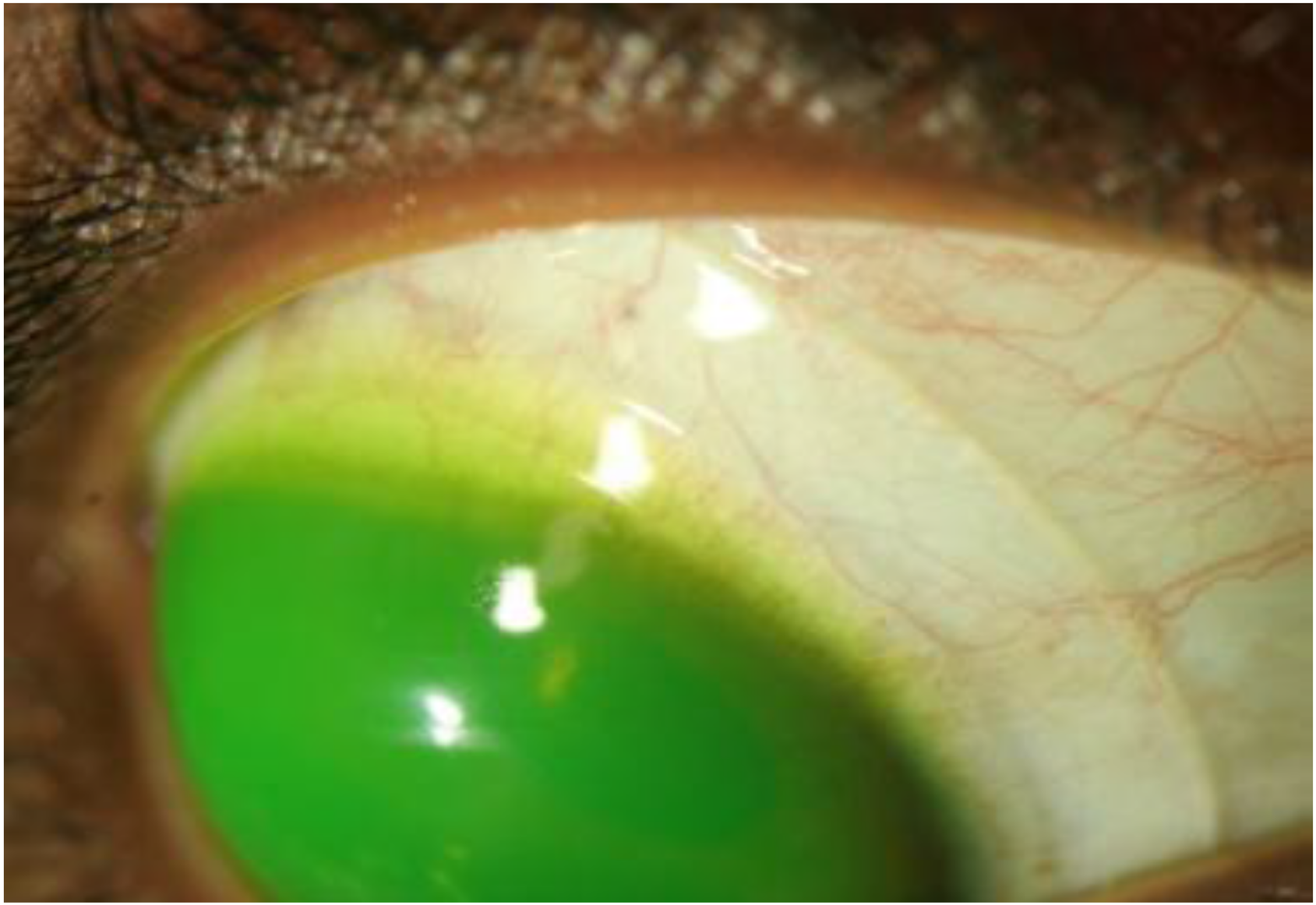


Fit of the Scleral Lens

OPTICAL ZONE/ VAULTING OF THE CORNEA

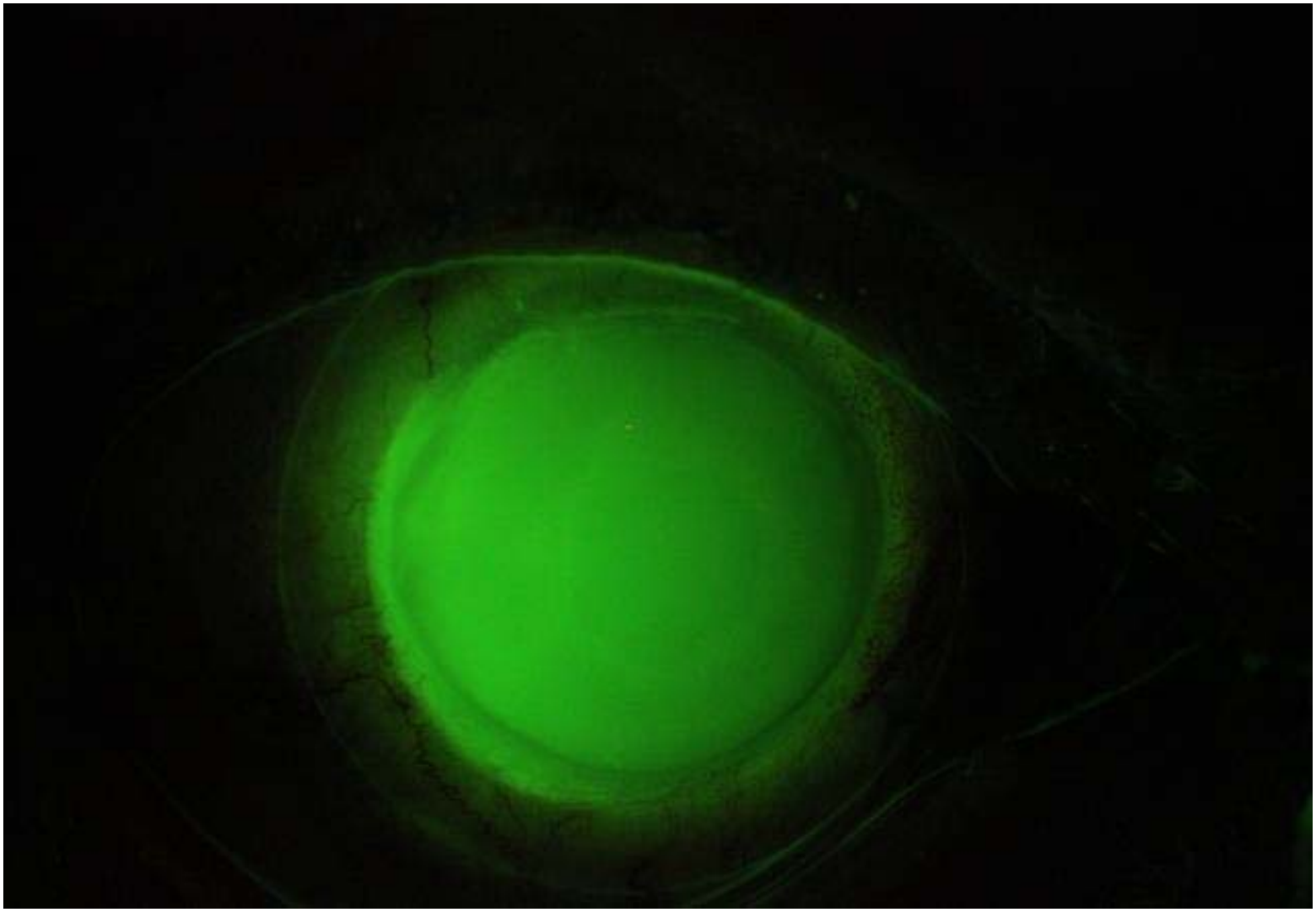


Fit of the Scleral Lens
TRANSITION ZONE/LIMBAL CLEARANCE

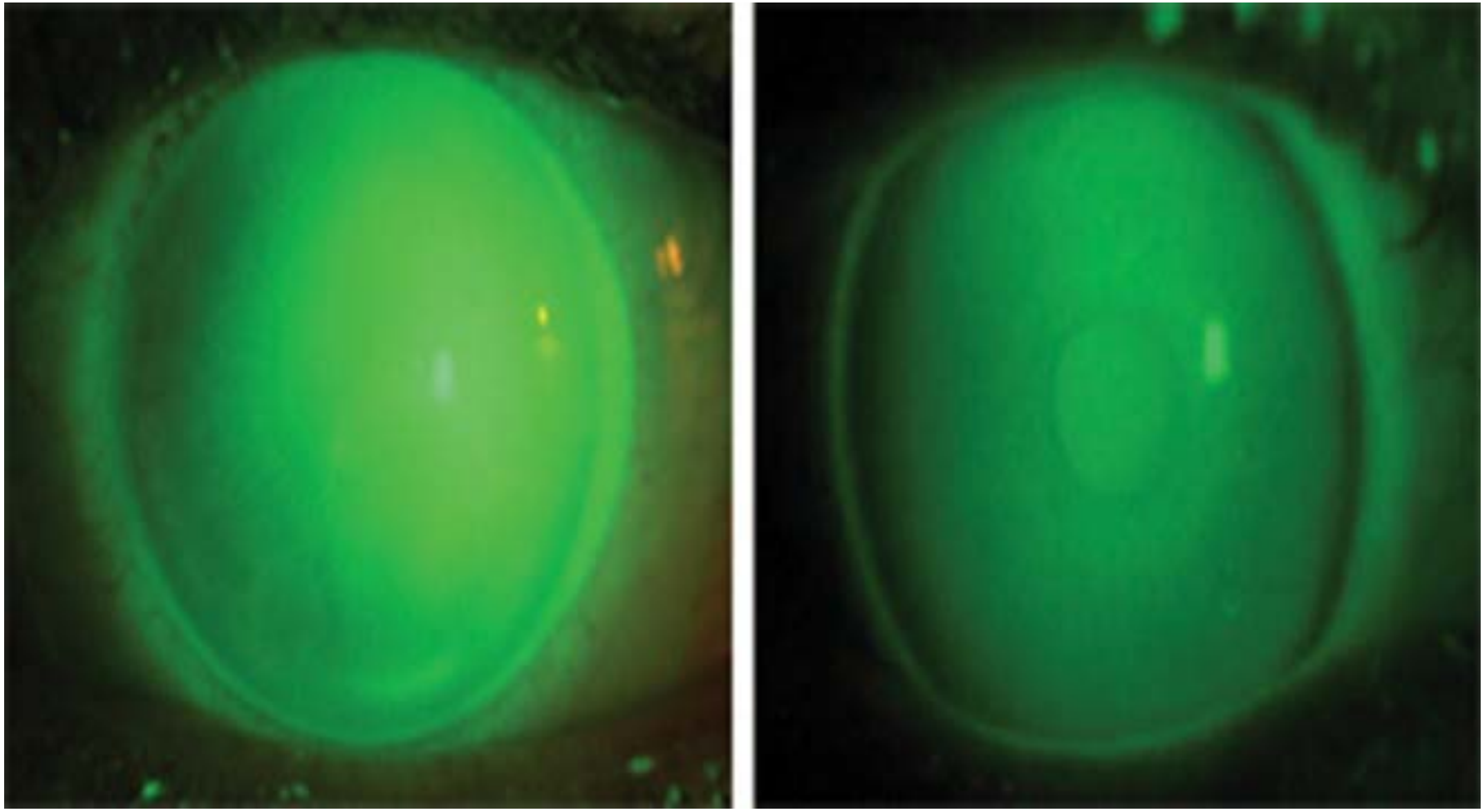


Fit of the Scleral Lens

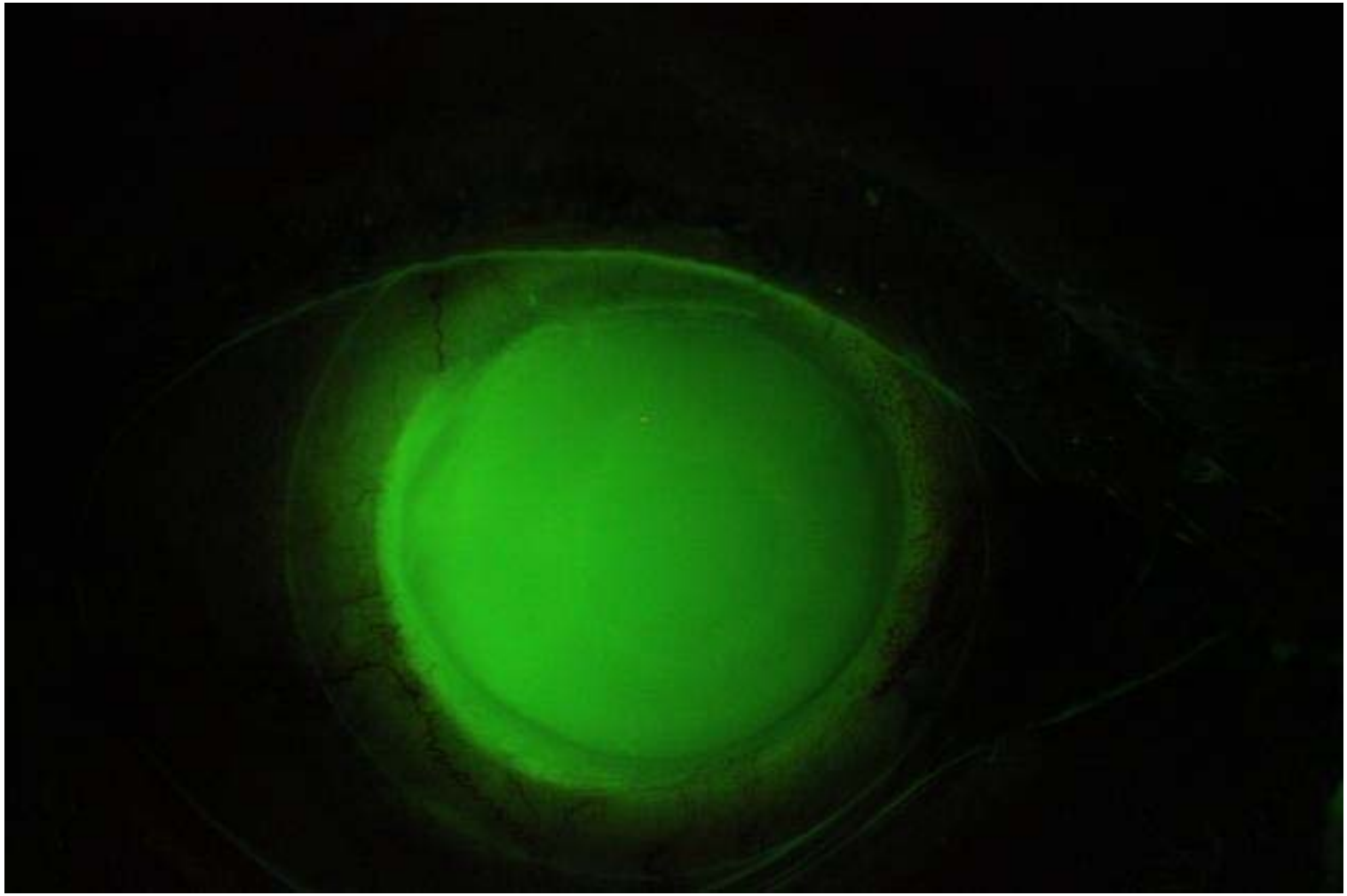
TRANSITION ZONE/LIMBAL CLEARANCE



Fit of the Scleral Lens
LANDING/HAPTIC ZONE – Limbal Bearing



Fit of the Scleral Lens
LANDING/HAPTIC ZONE-Edge



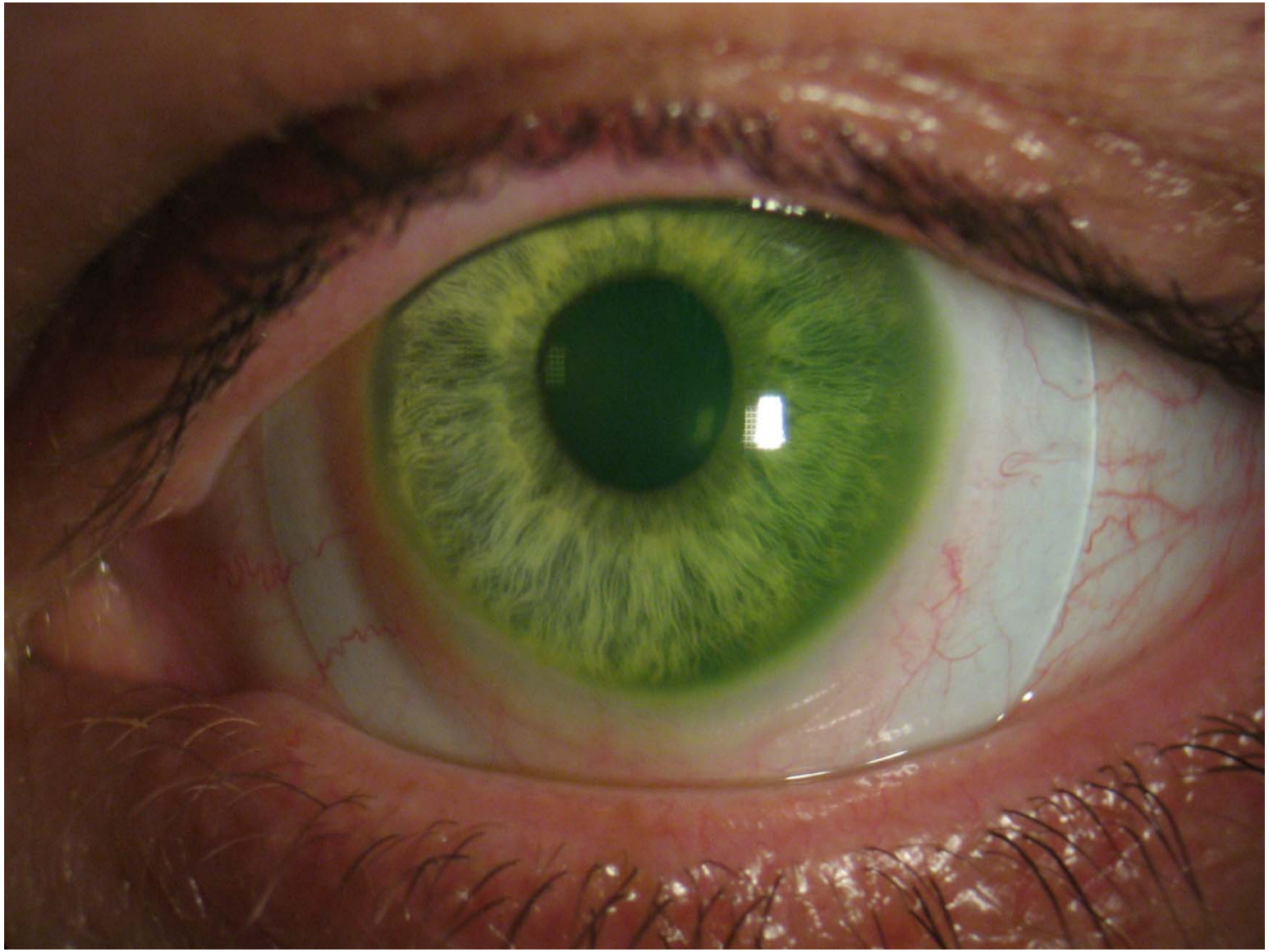
Fit of the Scleral Lens

LANDING/HAPTIC ZONE–Lens Off–Compression

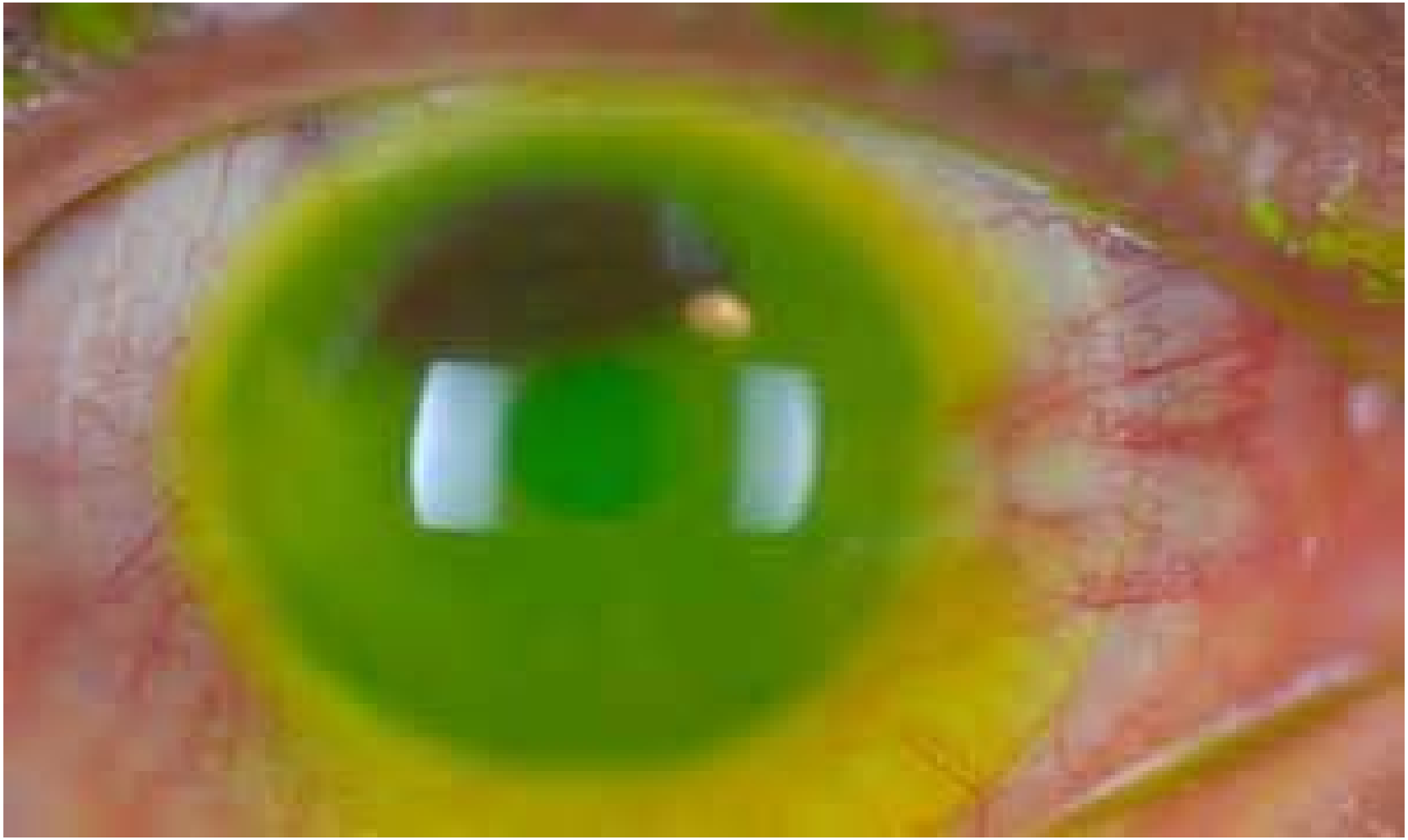
Fit of the Scleral Lens

LANDING/HAPTIC ZONE Blanching/Inpingment

Fit of the Scleral Lens
LANDING/HAPTIC ZONE/FITTING



Fit of the Scleral Lens
LANDING/HAPTIC ZONE - Loose

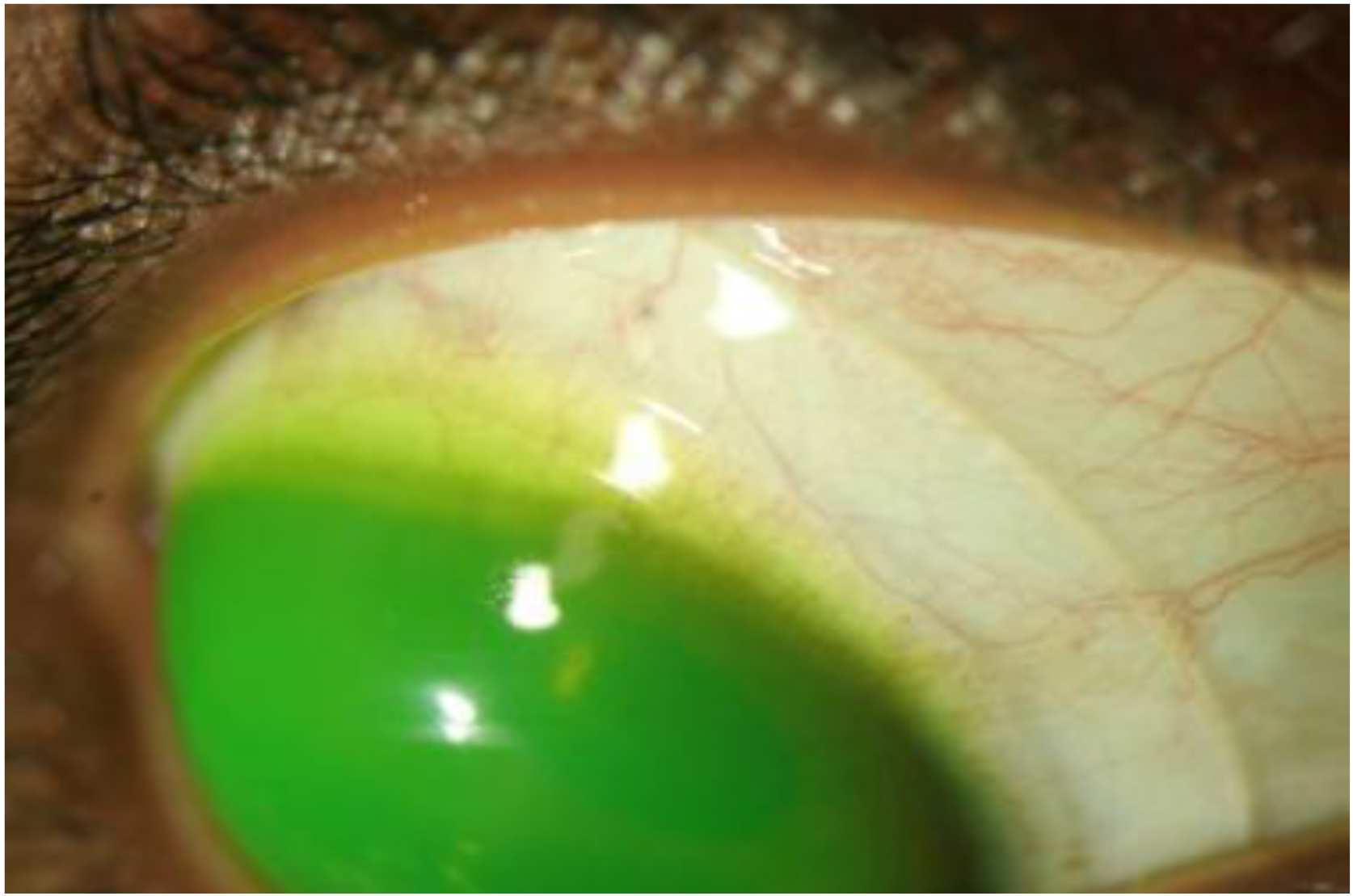


Fit of the Scleral Lens
EDGE/LIFT

Will show fluorescein

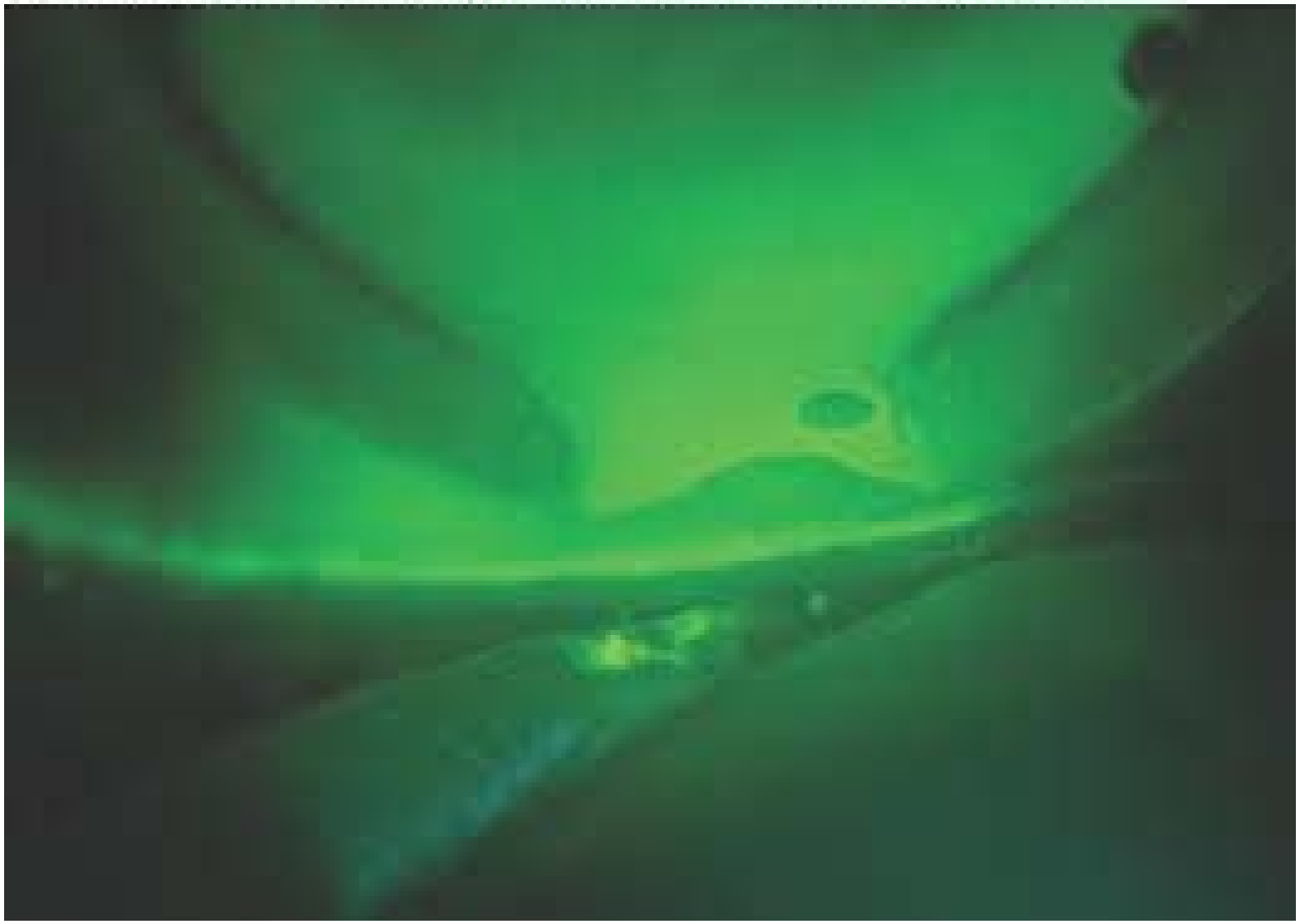
Push Test with Lower lid on Sclera and/or Bottom of Scleral Lens

Fit of the Scleral Lens
EDGE/LIFT – Just Right

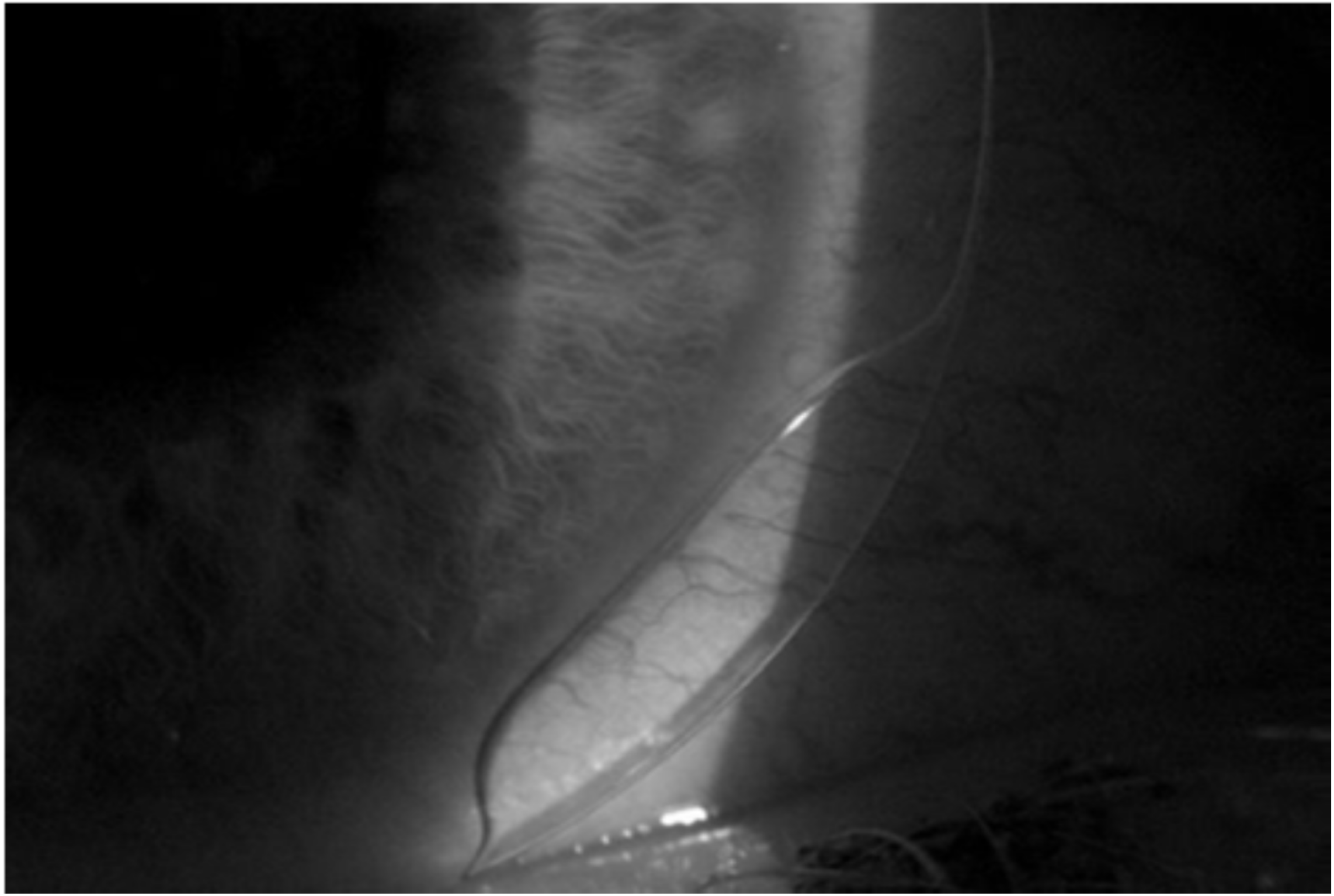


Fit of the Scleral Lens
EDGE/LIFT- Push Test

PHOTO COURTESY OF SOPHIE TAYLOR-WEST, BSC, MCOPTOM



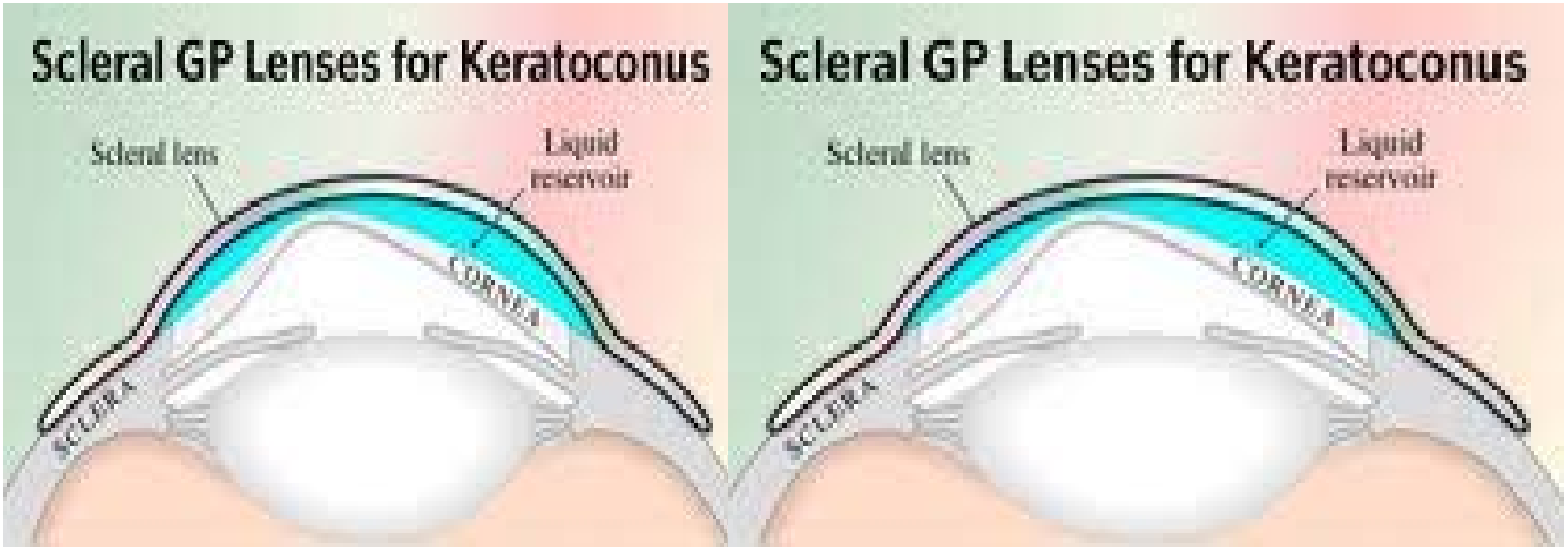
Fit of the Scleral Lens
EDGE/LIFT – Too Flat



Fit of the Scleral Lens

Edge/LIFT – Too Steep- Inpingment

Fitting the Scleral Lens
Adjusting the Fit



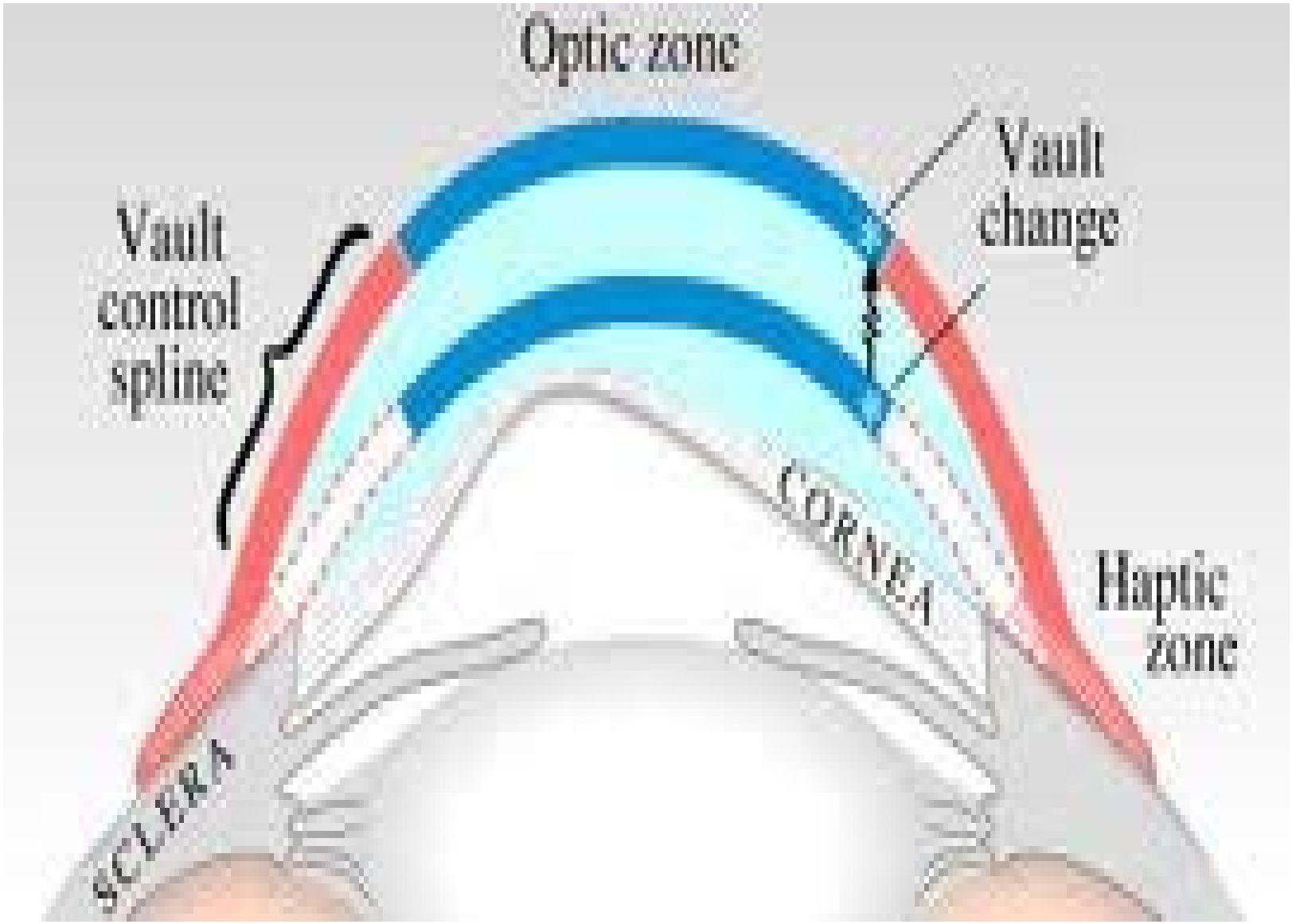
Fitting the Scleral Lens
Overrefraction

- What can you say about this?
- What about the initial Refraction?

Types of Lenses Avaliable

- ABB – DYNA, Quad Sym Option MF
- AccuLens – Maxim, EasyFit, Comfort SC
- Advanced Vision Technologies – AVT Scleral
- Alden Optical – ZenLens Scleral, Zen RC
- Art Optical Contact – AMPLeye, SO2 Clear MF
- Blanchard – ONEFIT, RoseK 2XL MF
- Essilor – Jupiter, ProLook
- Lens Mode – Porus OE
- Metro Optics – Genesis, Genesis RG, Insite (Oblate,Prolate) MF
- SynergEyes – Synergeye VS Scleral, UltraHealth
- Valley Contax – Custom Stable Prime and Elirte MF
- Visionary Optics – Europa , Elara MF
- X-Cel Specialty – Atlantis&3 D Vault, RG MF
- EyePrint PRO

EyePrint PRO



EyePrint PRO

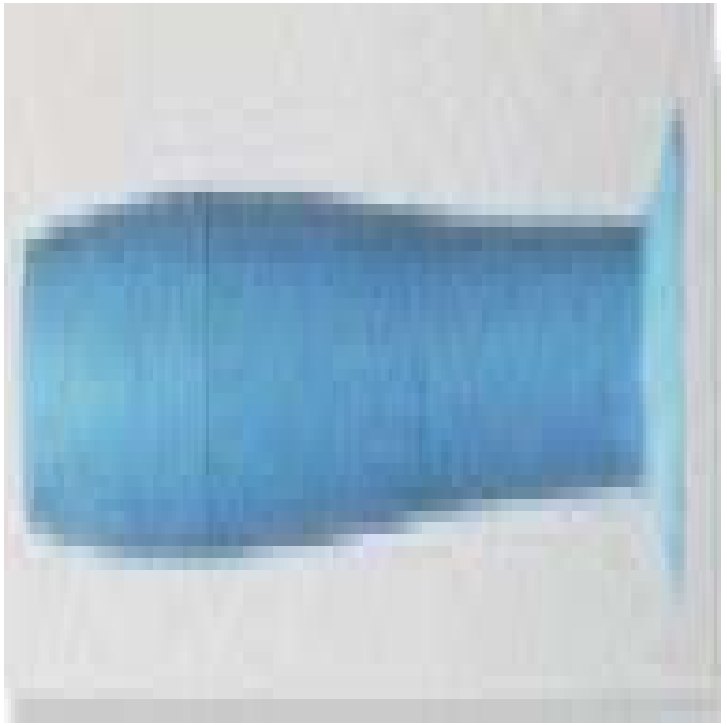
- Imprint 1,000, Lens 2,500, Other Visits 500
- Have Cost of putting into the Office as well.

EyePrint PRO

INSERTION

- **Before INSERTION**, it is best to rinse the lens with Non-preserved saline solution before applying the lens. (Tear circulation with a scleral lens is less than with smaller corneal lenses therefore, preservatives in the soaking solution remain in contact with the cornea longer and this increases the chance of a reaction to these solutions).
- **AVOID BUBBLES**

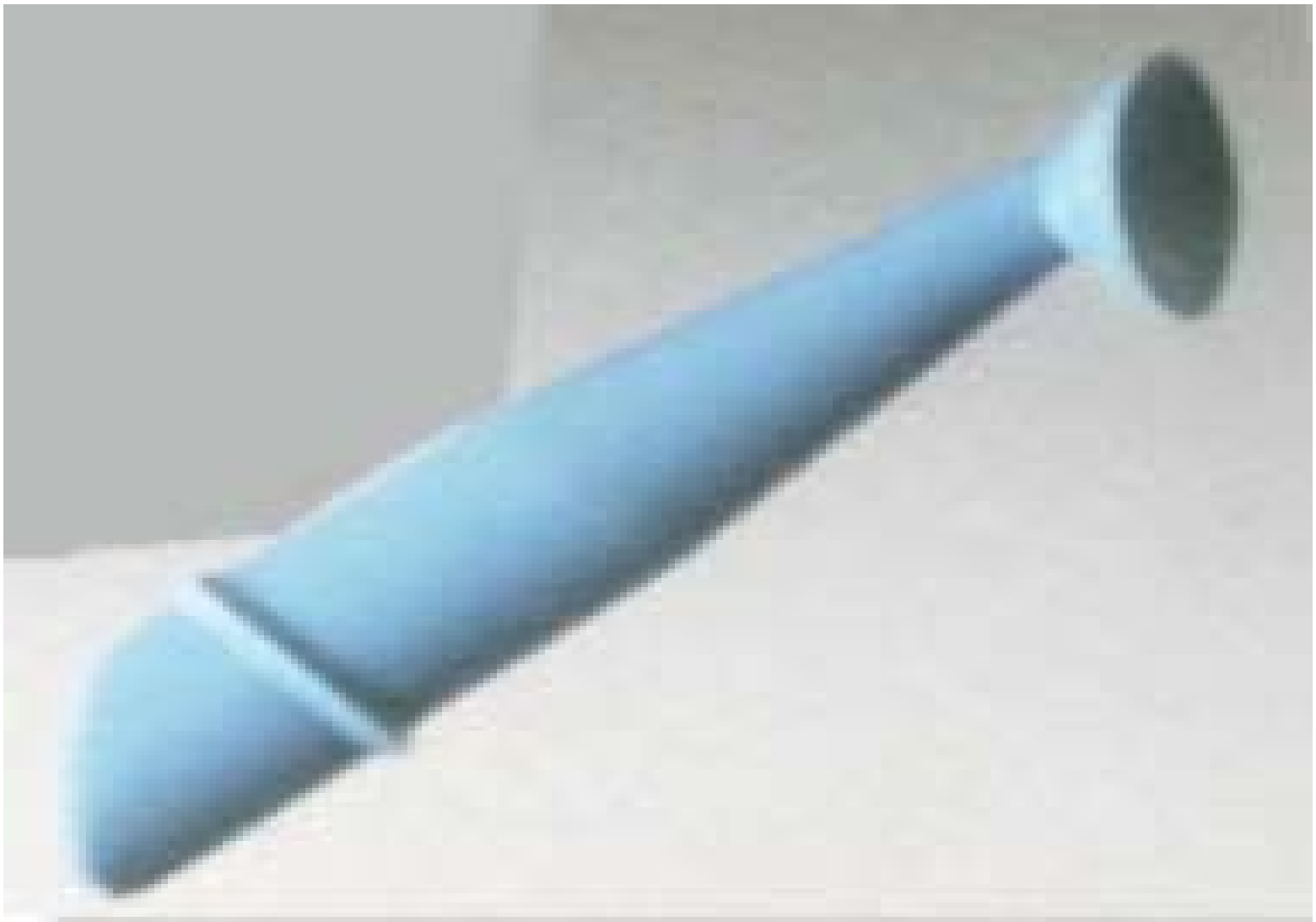
INSERTION - DMV



INSERTION

- **METHOD 1:**
- 1. Center the lens on the plunger. DMV Scleral Cup
- 2. Fill the lens with Non- preserved saline, or non-preserved Artificial Tears.
- 3. Lean forward with your head down and open eyelids as wide as needed, apply the lens.

INSERTION



INSERTION

- **METHOD 2 :**
- 1. Since it is difficult to balance a large lens on a single finger, it is best to form a tripod. With the thumb, index, and middle finger, and place the lens on these fingers.
- 2. Lean forward, look down, and open eyelids as wide as is needed.
- 3. Apply the lens.

INSERTION

INSERTION

INSERTION – See-Green

REMOVAL

- Since the scleral lens is large, the capillary forces which hold the lens on the eye are powerful.
- Removal is always best done by first lifting the edge to eliminate this force. Attempting to pull the lens from the center will create negative pressure and will rarely be successful.

REMOVAL

- **METHOD 1**

- 1. First, moisten the plunger with a few drops of saline solution.
- 2. Squeeze the plunger.
- 3. Place the plunger on the lens at the temporal EDGE so that the plunger is just inside lens. Release the Squeeze for suction.
- 4. Lift the EDGE of the lens and remove the lens from the eye.

REMOVAL

REMOVAL

- **METHOD 2**

.

- 1. With the head held in the straight ahead position, look up slightly, about 20 degrees.
- 2. With the index finger, pull the lower eyelid temporally and then up to get the eyelid under the lower edge.
- 3. Lift the EDGE of the lens.
- 4. With the other hand, pull upper lid up and temporal to remove it from the eye.

REMOVAL

Insertion and Removal
Solutions

- **May use:**
  - Gas Permable Solutions for cleaning and soaking OVER NIGHT.
  - Soft Lens solutions for cleaning and soaking OVERNIGHT.
  - Special Cleaning Agents
  - **ONLY use Non – Preserved Saline or Non-Preserved Artificial Tears In the Lens before Insertion.**

Solutions

- Saline: Lacri Pure, ScleralFil, PuriLens, Lens Plus, AddiPac, Nutrifill
- Soaking: Clear Care, AO Sept, Boston, Soft Lens Multi Purpose
- Cleaner: LoBob, Progent, Boston, Enzyme
- Non-Preserved Artificial Tears

Tips for Management of Problems
Fitting

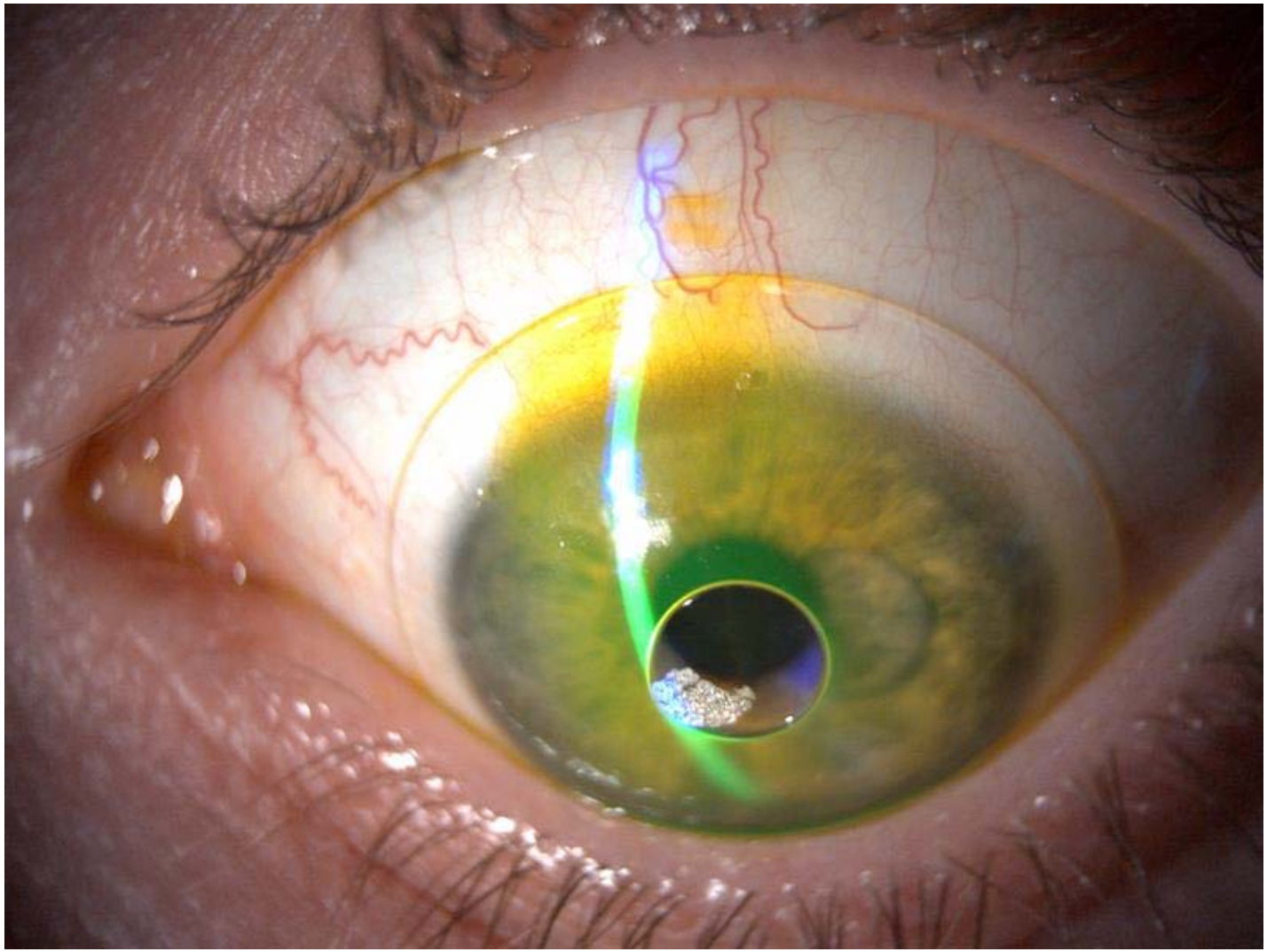
- Avoid Bubbles on insertion. Use Fluorescein.
- Allow the Lens to Settle 20-30 Minutes.
- Tight Lens – too much vault, central large bubble, minimal limbal clearance
- Loose Lens – Corneal touch, Mid Peripheral Bubbles, Fluorescein under Scleral Haptic
- Over Refraction
- Endo Cell counts of <800 can be problamatic.
- **On Revisit** – Fluorescein above the eye to see how much seeps behind lens in 10-20 minutes.

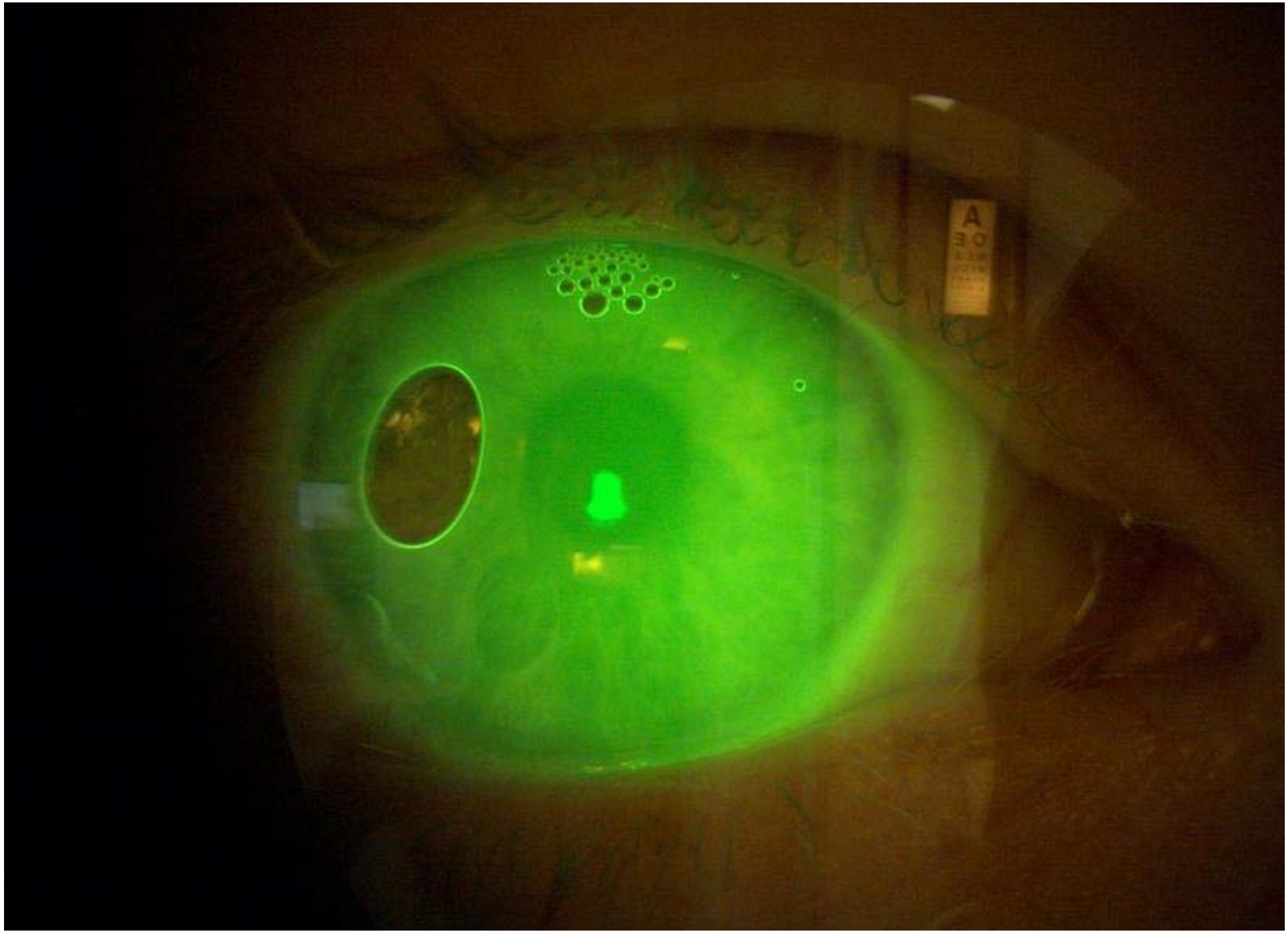
Tips for Management of Problems Modification/Special Needs

- Fenestrations – Will cause lens to settle down on the eye.
- Notching Lenses – Blebs, Pinguela
- Toric lens Designs –
  - Peripheral Haptic curve for stability and scleral torricity. Back Toric
  - Residual Astigmatism – Front Toric

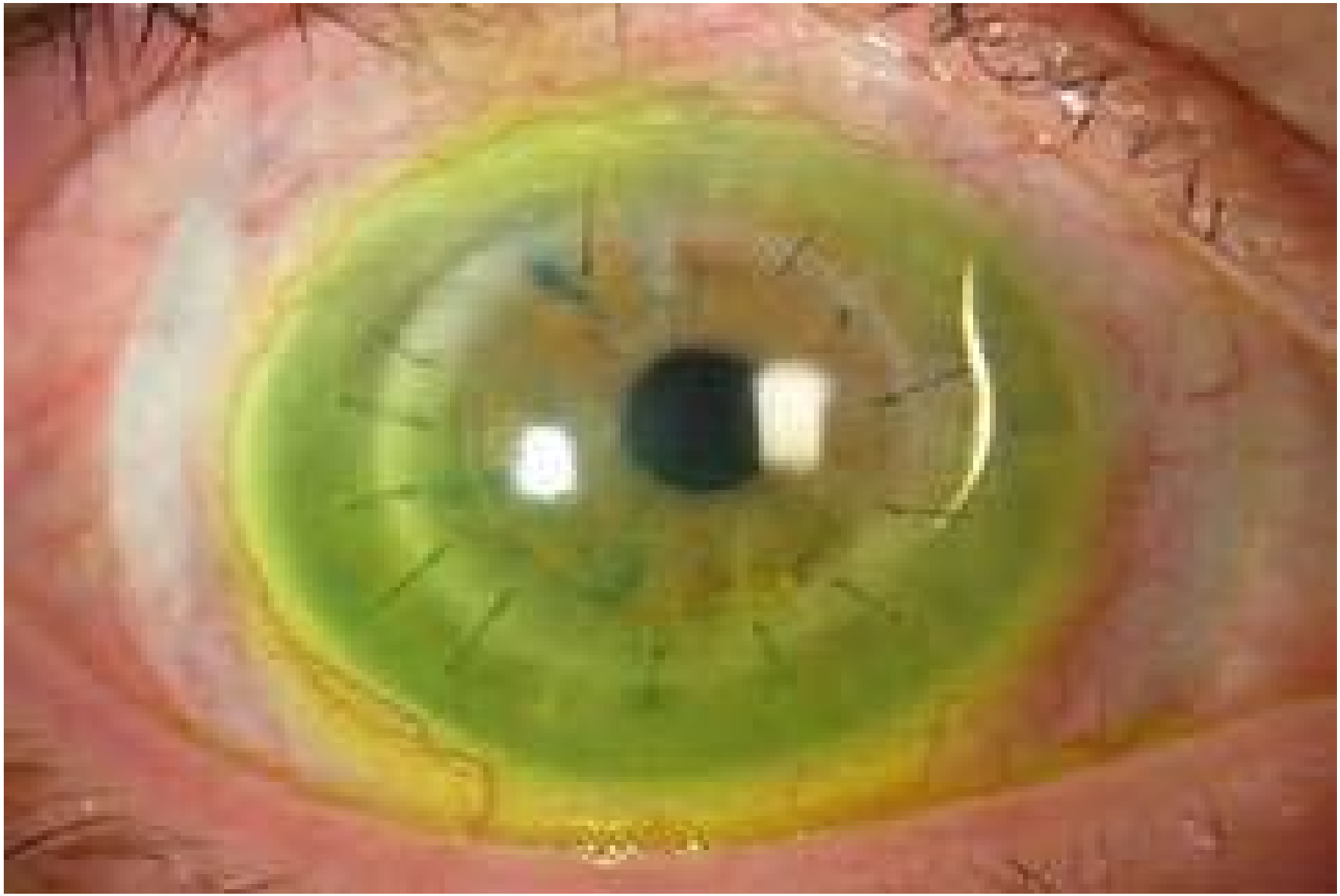
Tips for Management of Problems Patient Wearing

- Blurry Vision – Metabolic Waste, Mucous and Debris Trapped inside the lens tear layer
- Foggy Vision – Poor lens wetting, Protein
- Lens Uncomfortable – Too Tight/Compression, Bubbles, Bearing on the Cornea, Dry Surface
- Vision Fluctuations – Lens Flexure, Lens Movement (Increase Thickness, Diameter)





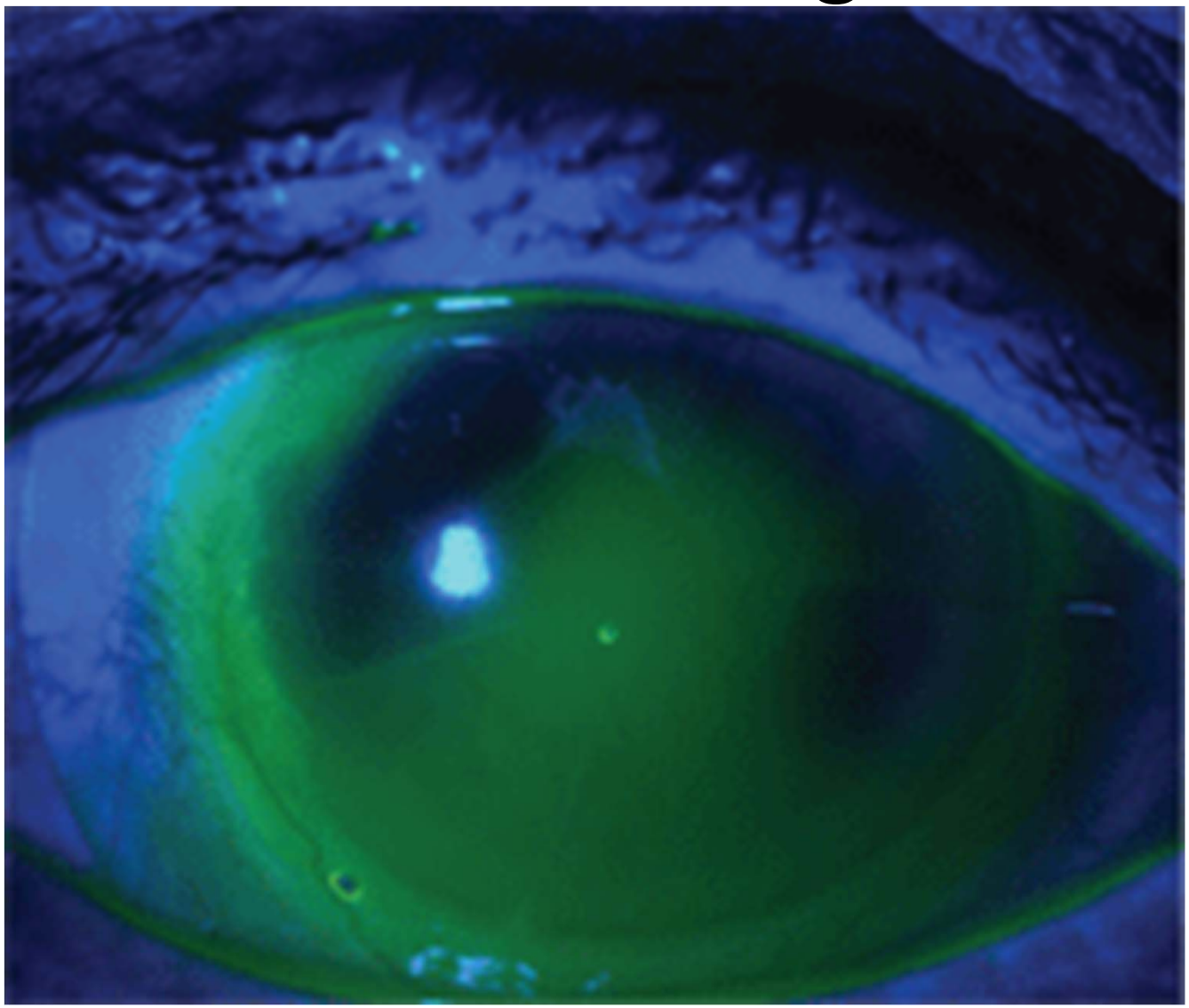
Problem Solving



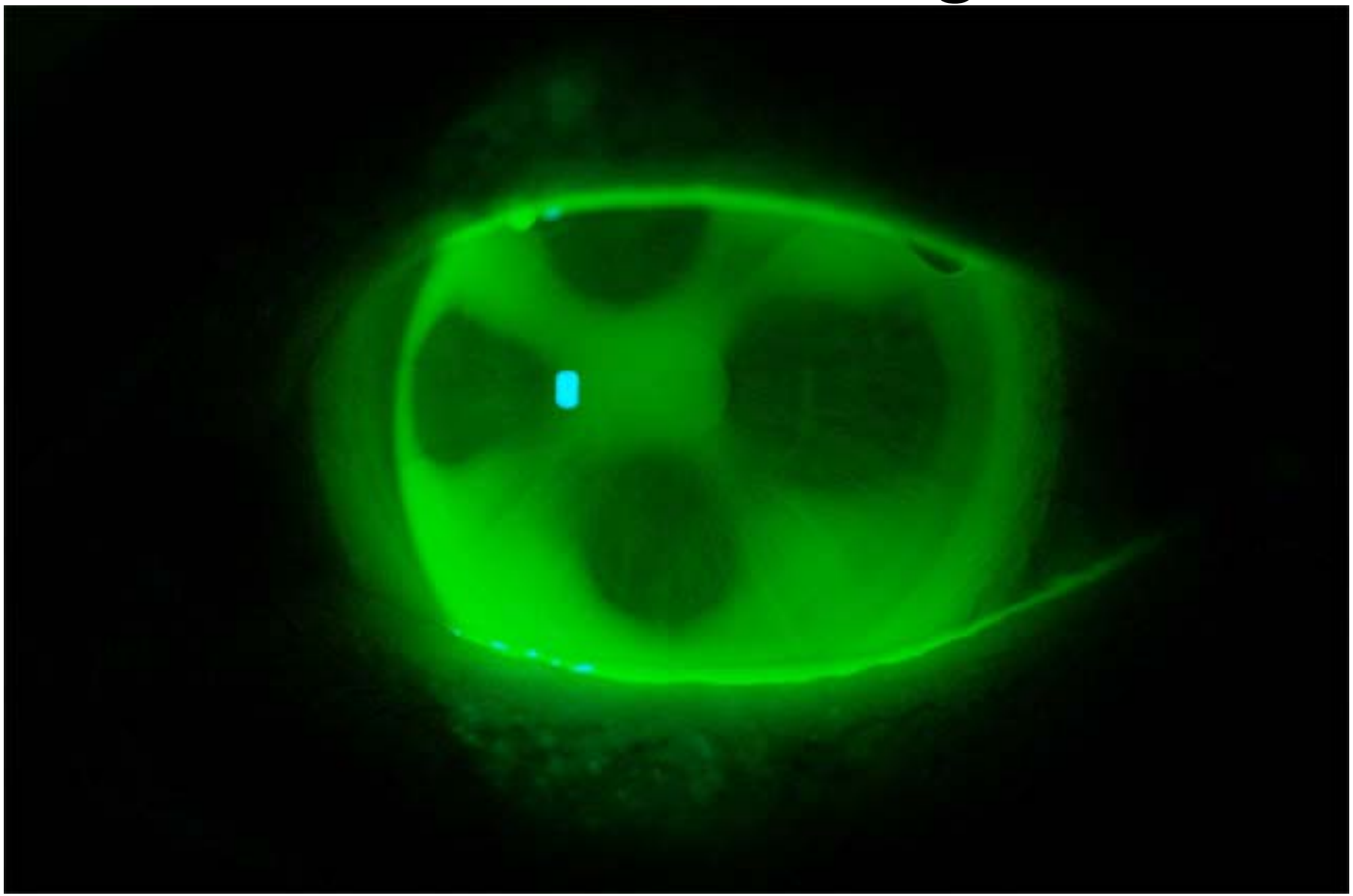
Problem Solving
Mid Peripheral Bearing

Problem Solving - PMD

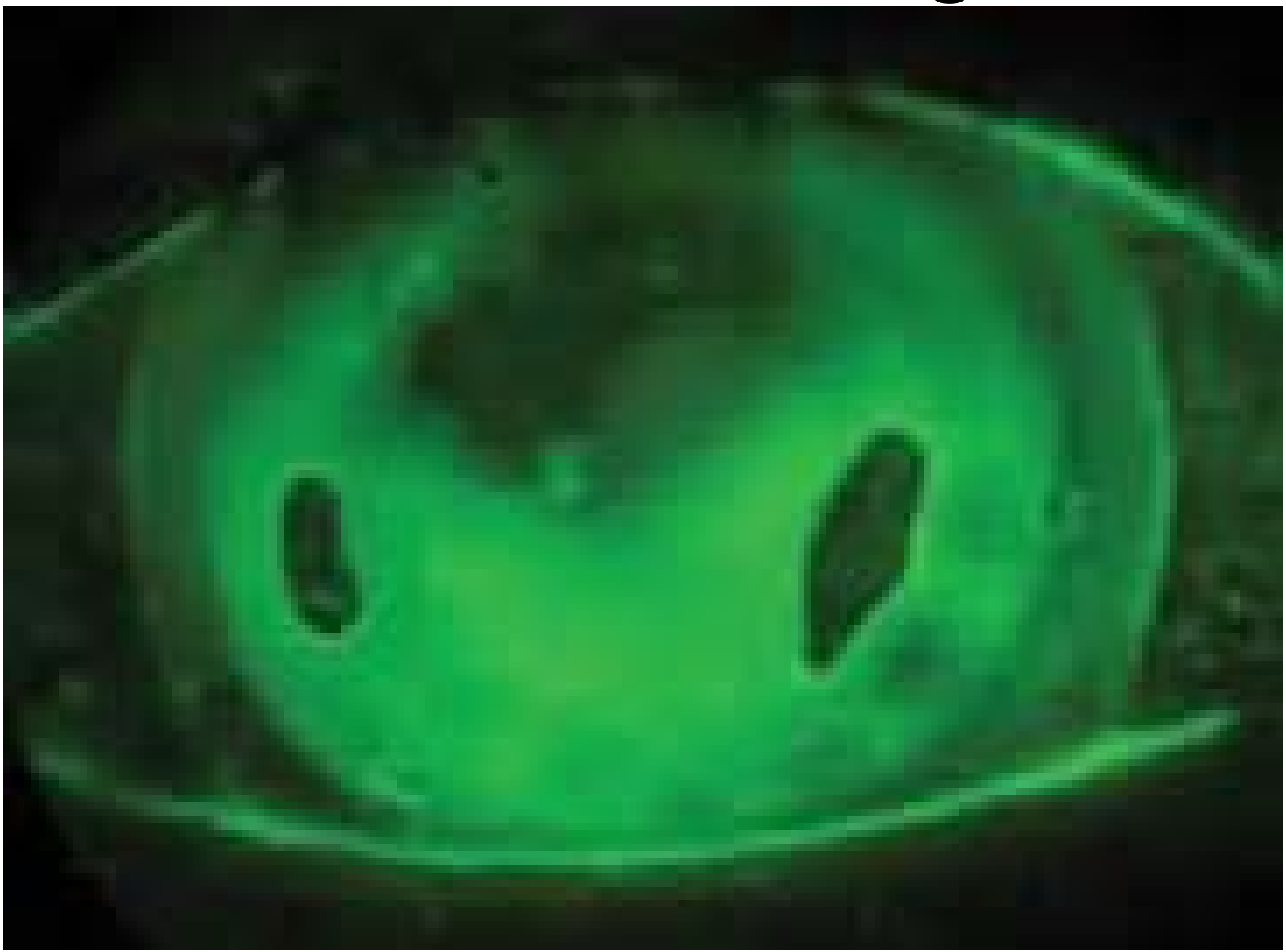
Problem Solving - RK



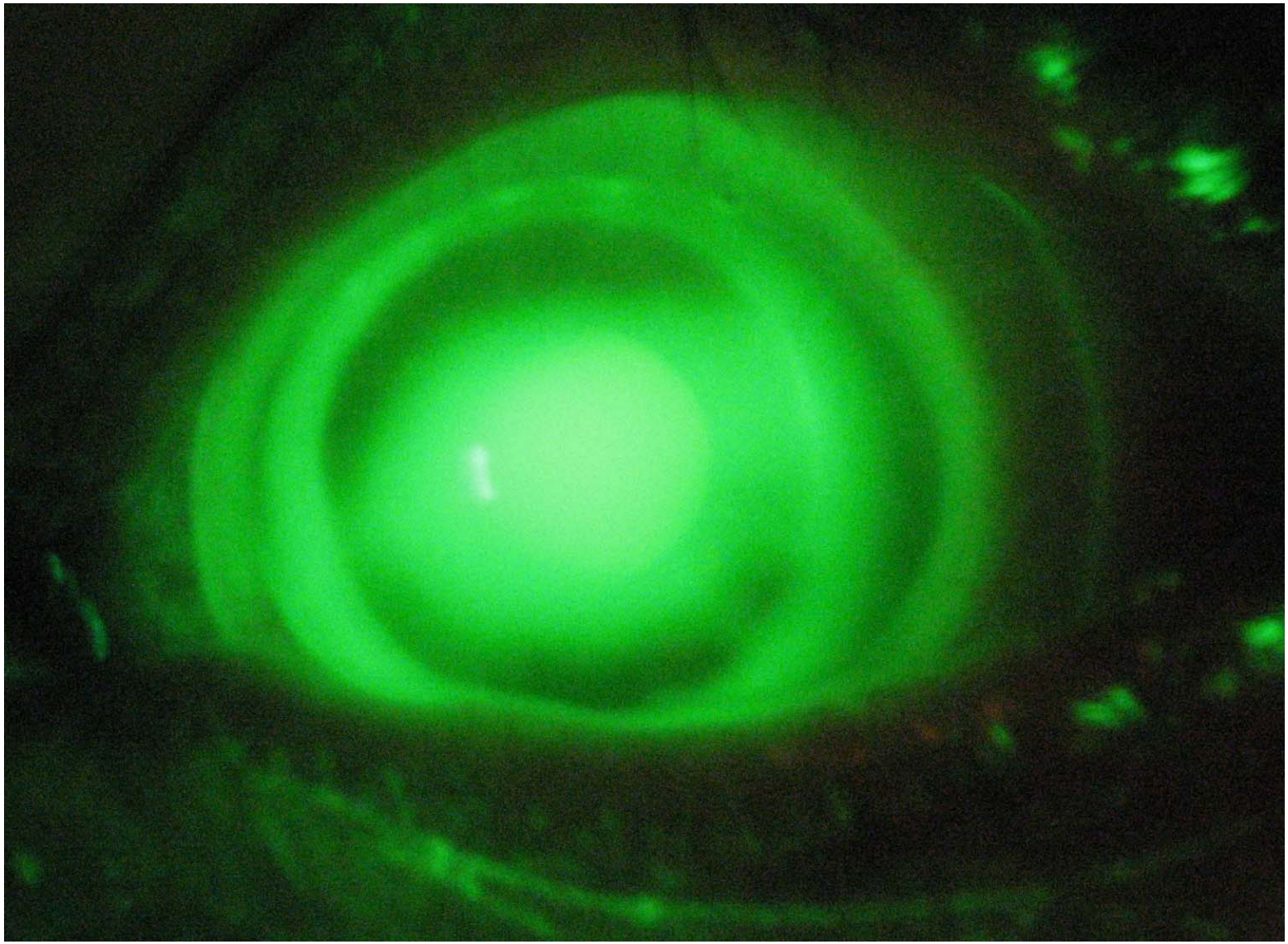
Problem Solving



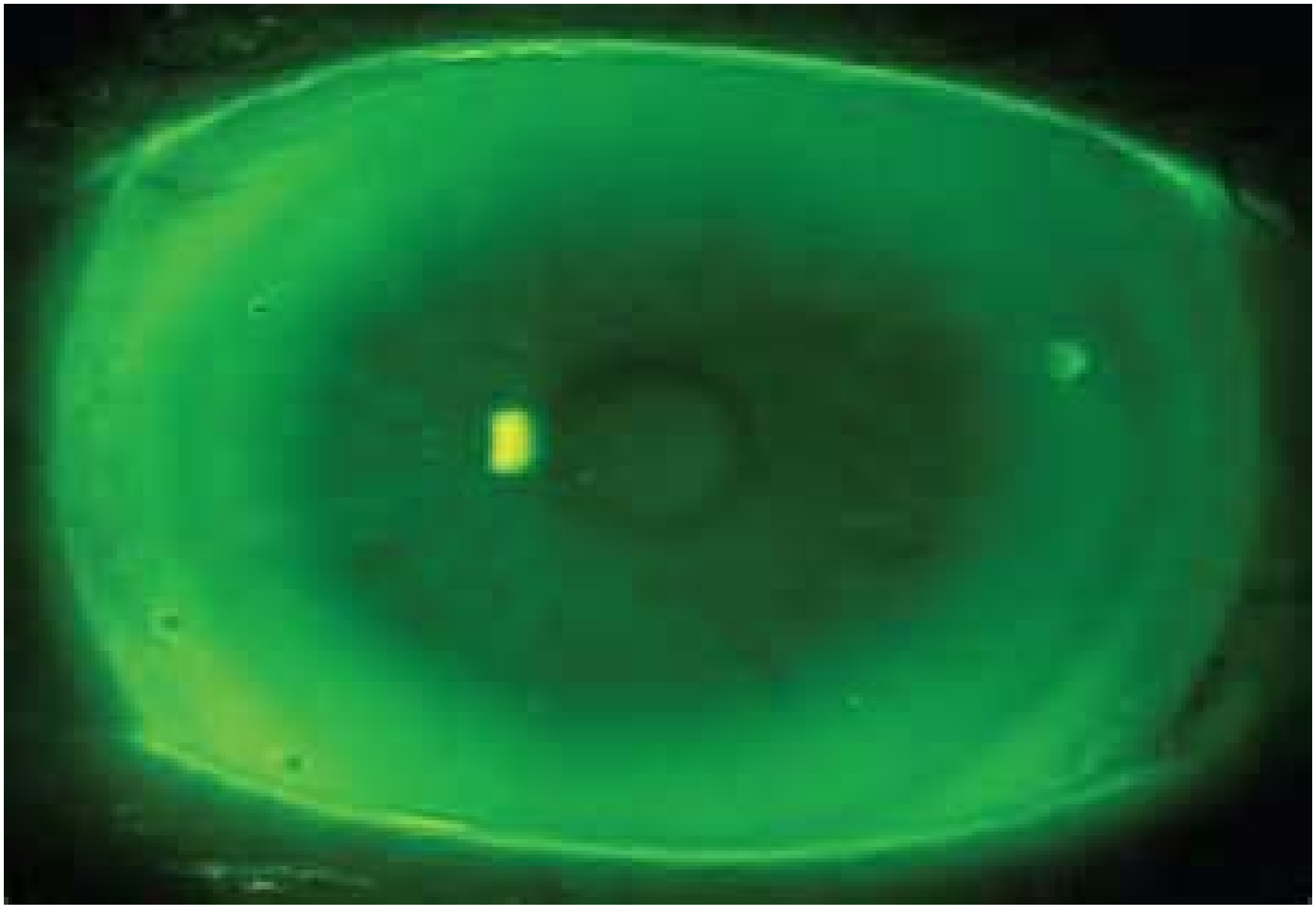
Problem Solving



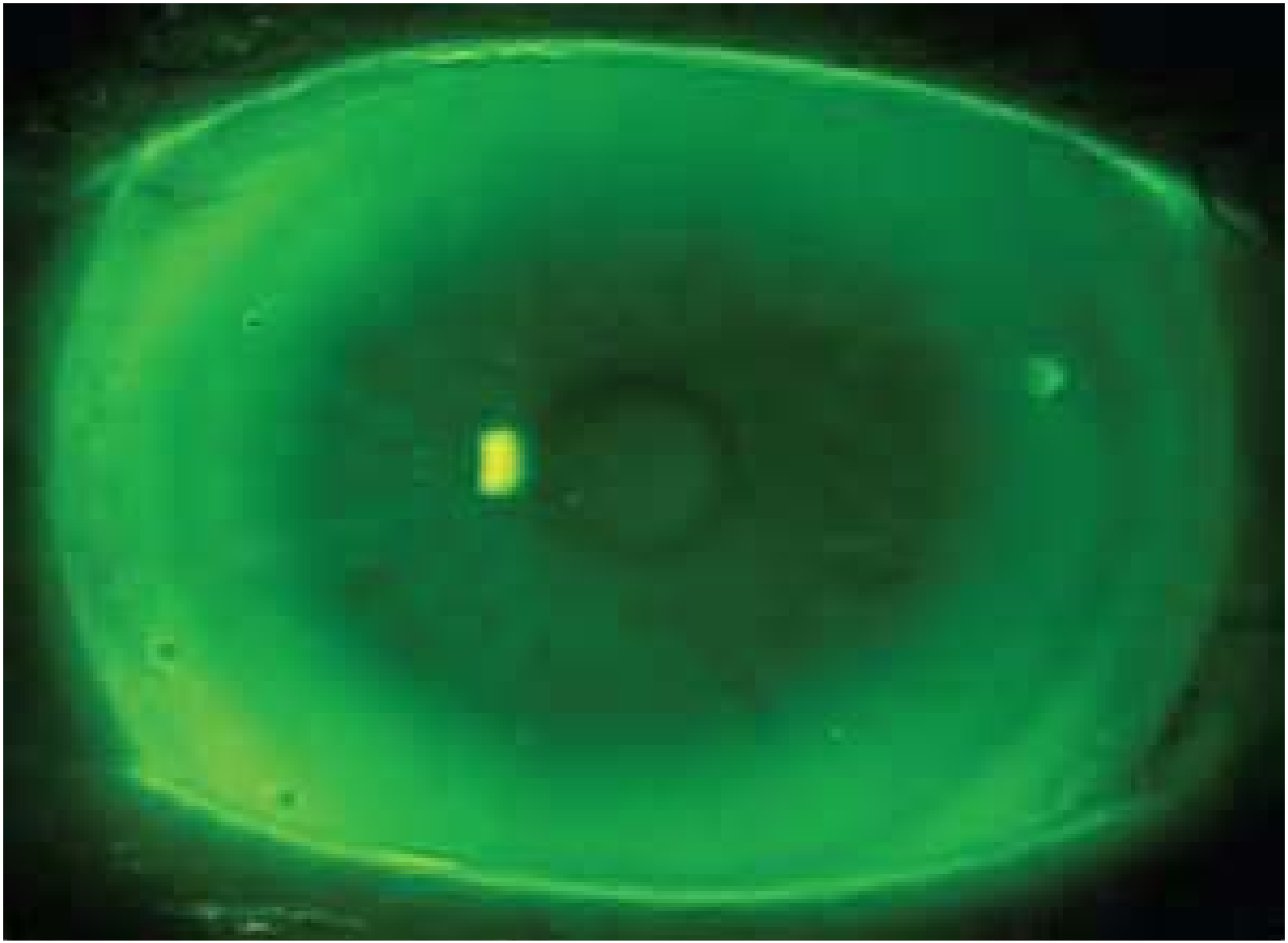
Problem Solving - Lasik

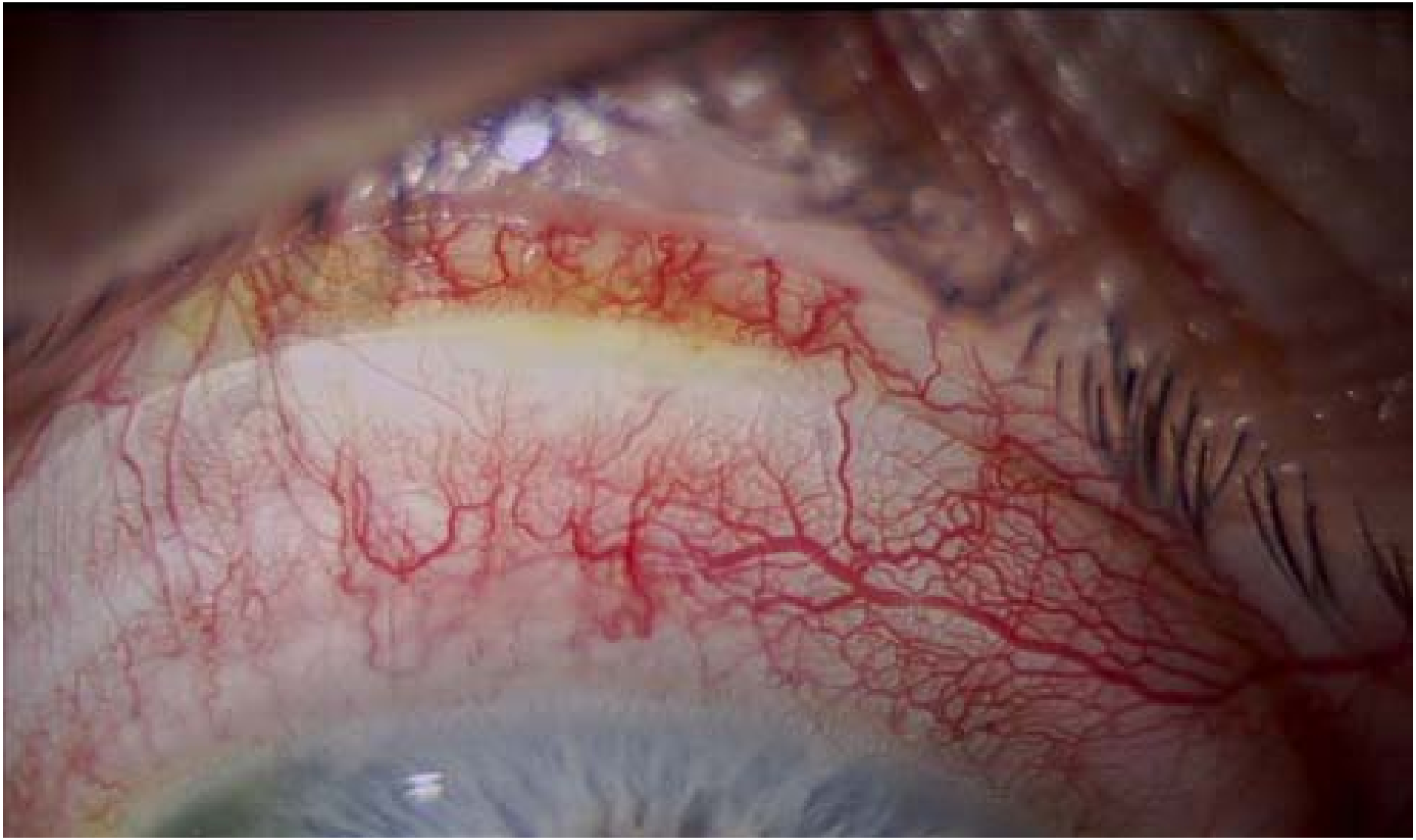


Problem Solving
Landing Zone/Haptic - Loose



Problem Solving - PK



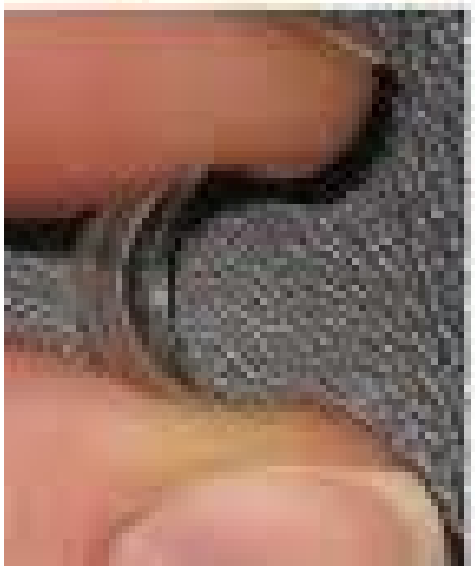


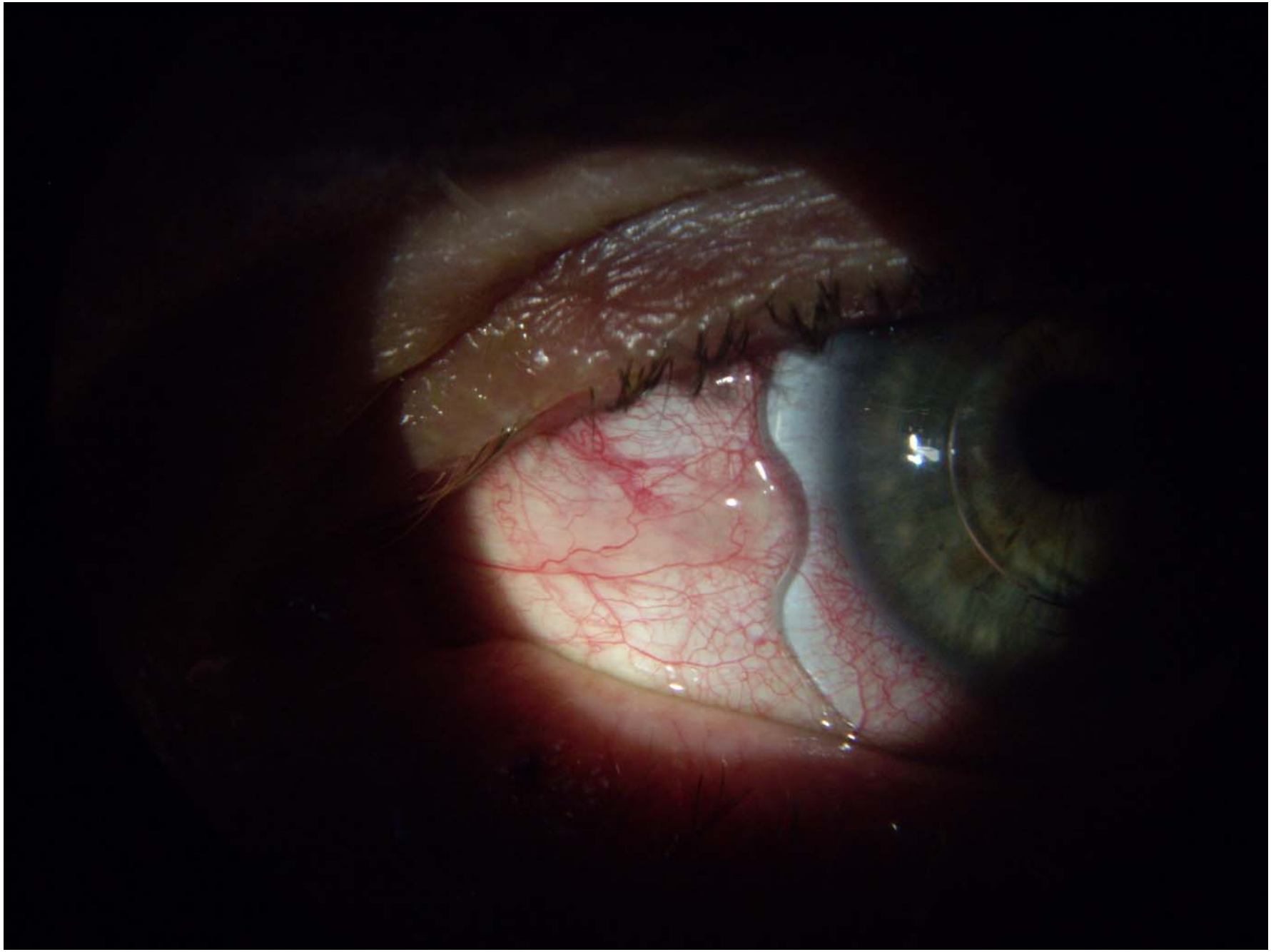
Problem Solving

Lens Edge – Impingment/Tight

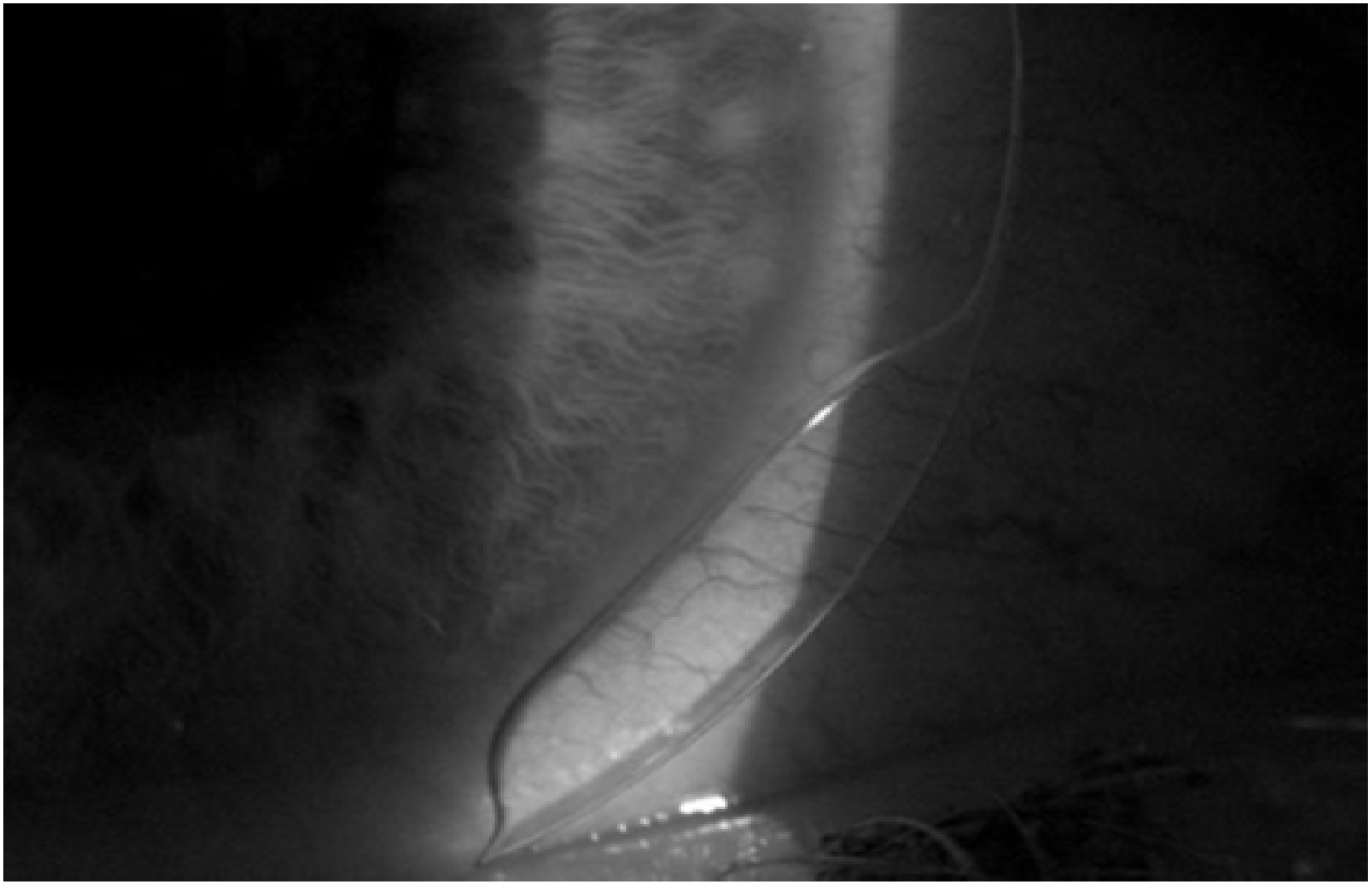
Problem Solving

Landing Zone – Impinge



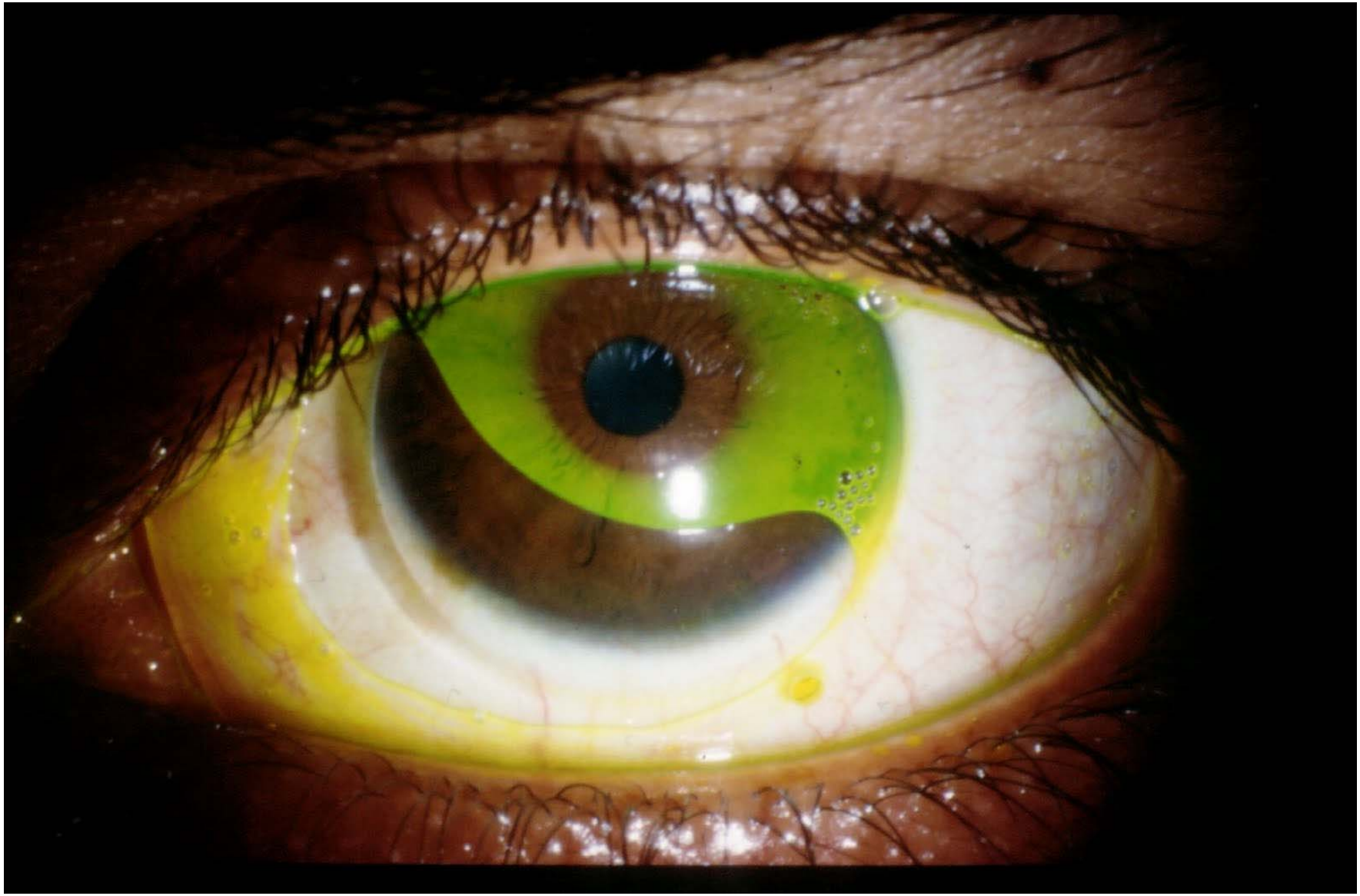


Problem Solving

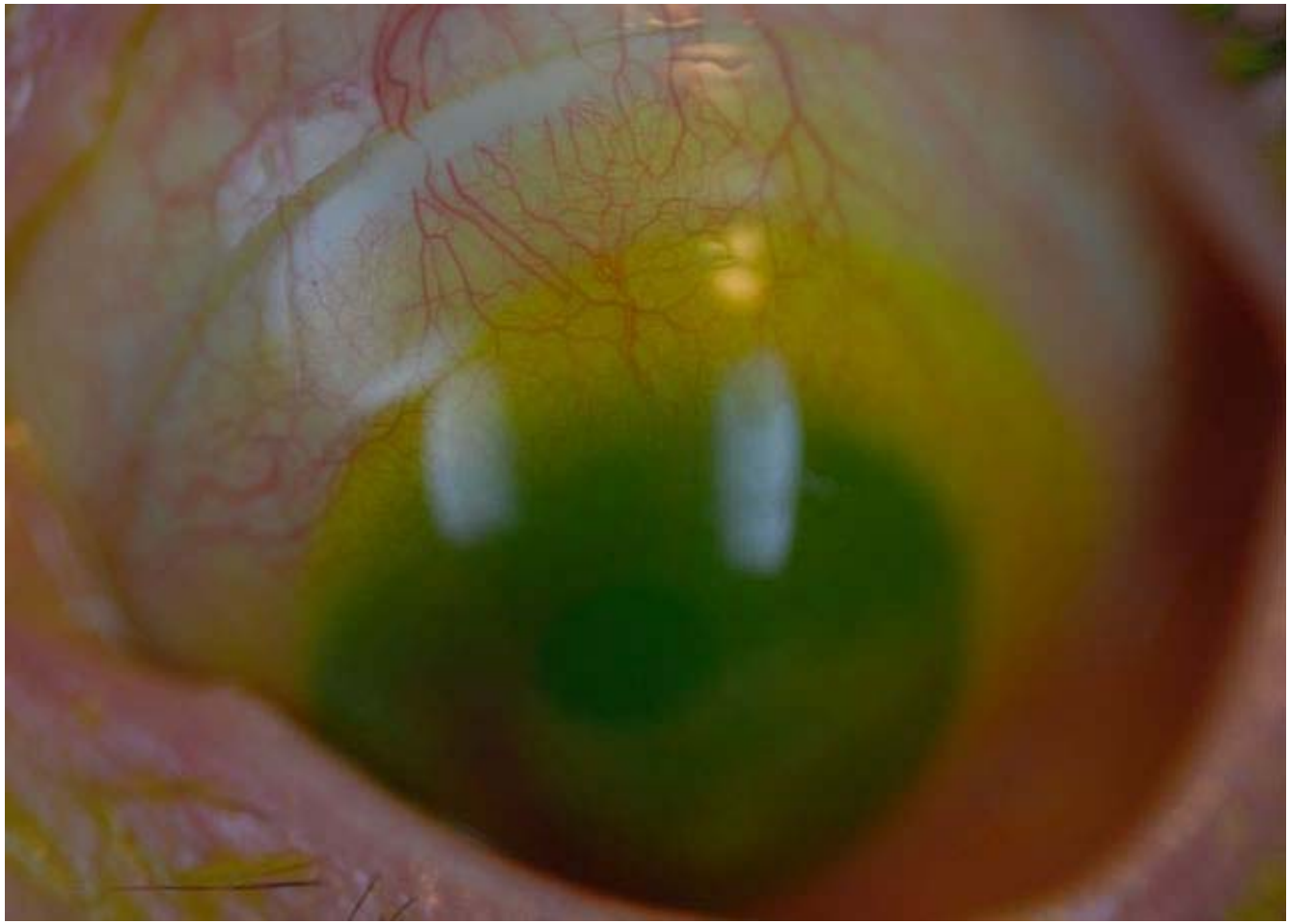


Problem Solving

Lens Edge – Excessive Edge Lift



Problem Solving



A Good Ending to Scleral Lens Fit