Contact Lenses

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Objectives

Introduce the basic concepts of contact lenses

Provide guidance on selecting and fitting gas-permeable and soft contact lenses

Introduce the concepts behind specialty contact lens fittings

Help you do well on OKAPs and boards

Our Contact Lens Goal

Provide the most clear, comfortable, and healthy vision with contact lenses

Contact Lens Types

- Soft Contact Lenses
- Gas-permeable contact lenses
  - “Hard lenses”
- Specialty Contact Lenses
  - Hybrids
  - Scleral lenses
  - Specialty soft lenses
  - Bandage contact lenses
  - Piggyback

Benefits of Contact Lenses

- Improve vision at distance, intermediate, and near
- Rehabilitate dry/diseased corneas
- Significantly improve symptoms of anisometropia and image size changes
- Improve decreased **vision** (vs. **visual acuity**)
- Freedom from glasses
- Correct vision better than glasses in many cases
- Used when glasses are not an option (aphakia, very high myopia)

Accommodation, Convergence, and Contact Lenses

Compared to glasses, contact lenses:

- *Increase* accommodative requirements of myopic eyes
- *Decrease* accommodative requirements of hyperopic eyes
- This is due to the differences in vergence of light rays

Compared to glasses, contact lenses also:

- *Increase* convergence demand for myopes
- *Decrease* convergence demand for hyperopes
- This is due to induced prism

More details and a lengthy example in the book

Soft Contact Lenses

Advantages:

- Overall good vision
- Comfortable
- Breathable
- Usually straightforward

Disadvantages:

- Unacceptable vision
- Limited parameters
- Non-customizable
- Difficult for high astigmatism/irregular corneas

Gas Permeable Contact Lenses

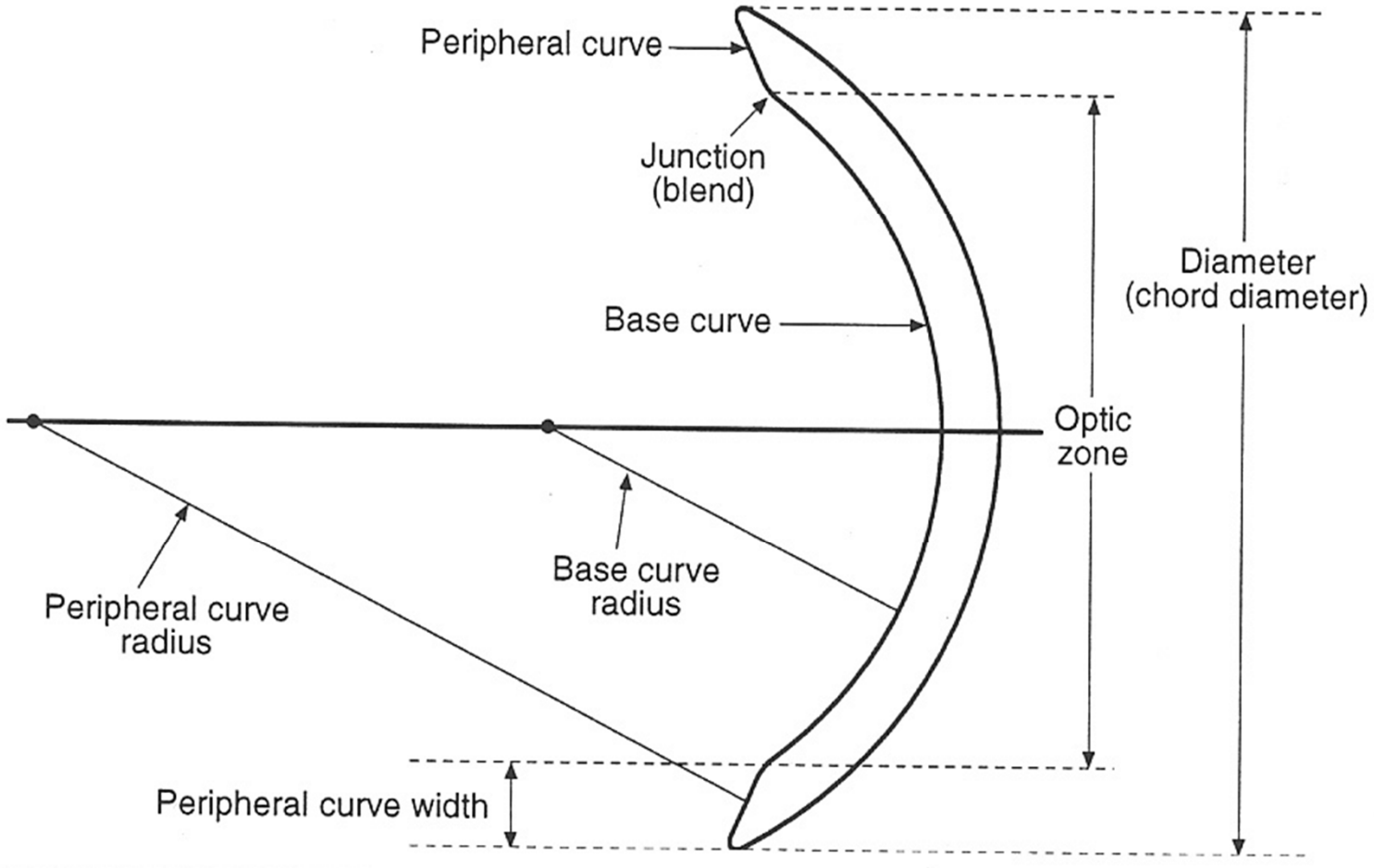
Advantages:

- Sharp vision
- Customizable
- Breathable
- Durable
- Great for irregular astigmatism/irregular corneas

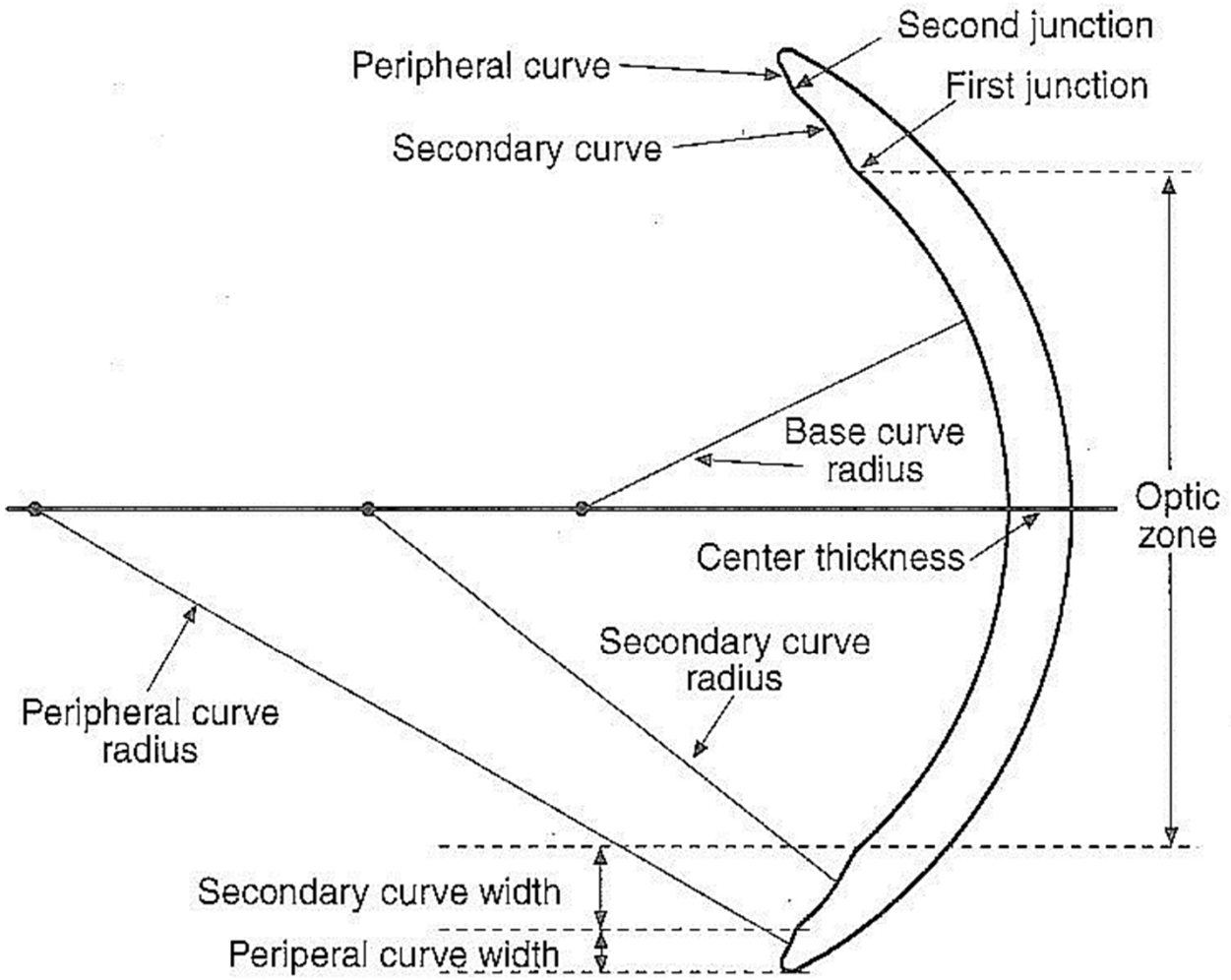
Disadvantages:

- Adaptation
- Dust/debris
- Generally more complicated

Rigid Gas Permeable (GP) Bicurve Lens



GP Tricurve Design



Important Terms for Contact Lenses

Base Curve: The curvature of the central posterior surface

Diameter: The width of the contact lens

Power: Determined by lens shape

Dk: The oxygen permeability of the lens material

Optic Zone: The area of the front surface that has the refracting power

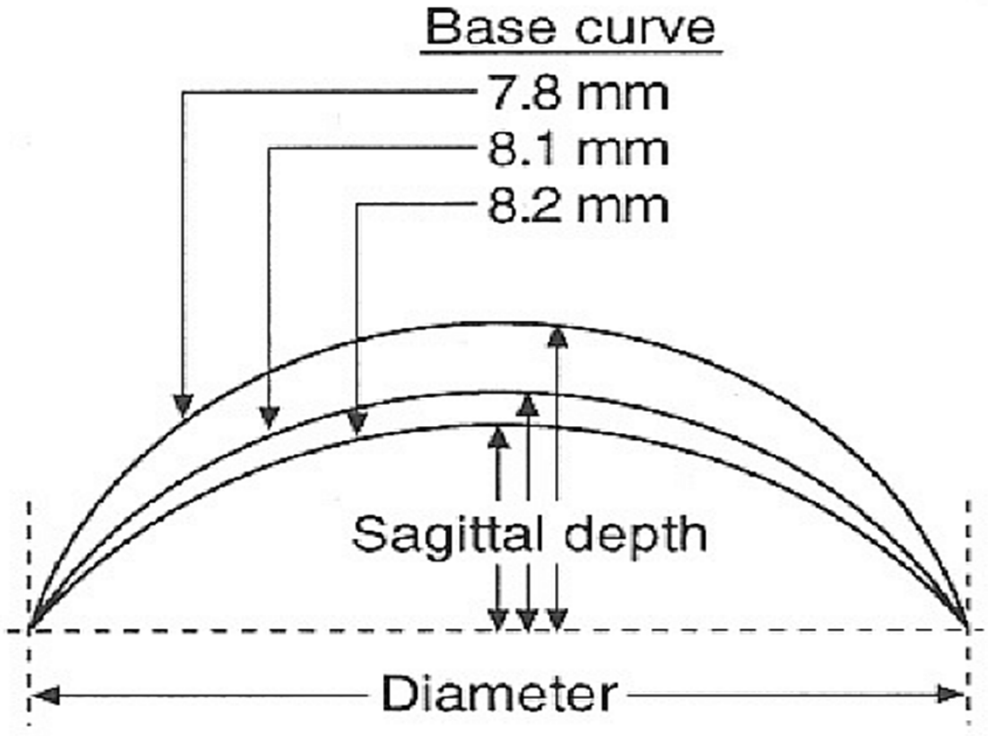
Edge Lift: The peripheral lens in relation to the underlying cornea

Fluorescein Pattern: The color intensity of fluorescein dye in the tear lens beneath the GP lens

- Areas of contact are black, areas of clearance are green

Sagittal Depth and Base Curve

Definition: “A measurement from the flat plane of a given diameter to the highest point of a concave surface of the contact lens”

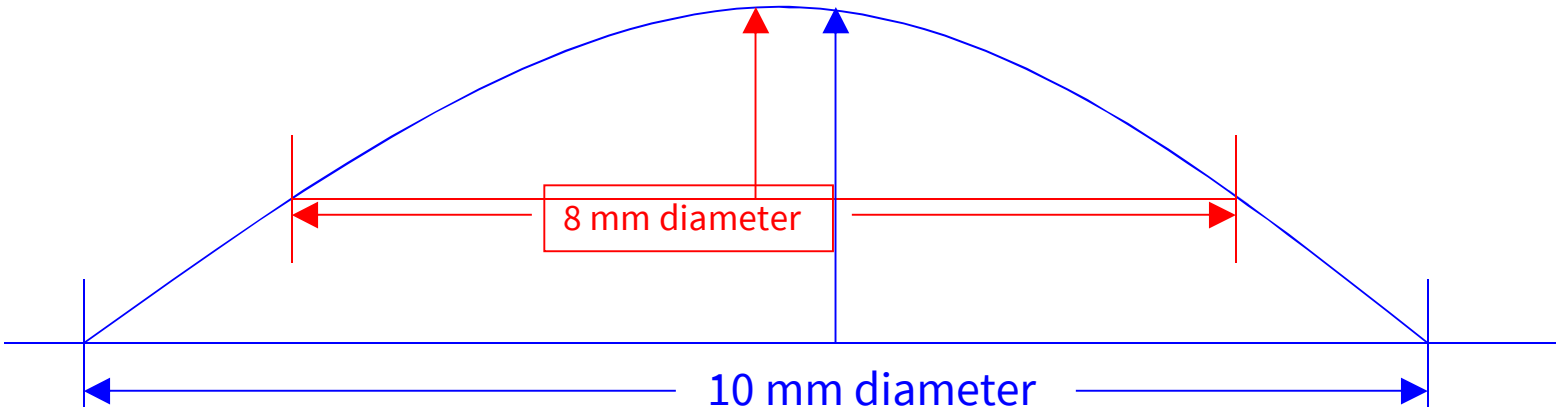


Sagittal Depth

Can increase sagittal depth by:

- Steepening the base curve **and/or**
- Increasing the diameter

Sagittal Depth and Diameter



Tear Lens

Gas-permeable (GP) lenses have a reservoir of tears that forms between the contact lens and the eye

- Adds plus or minus power to the refracting surface
- Important for fitting GPs
- Important for proper tear exchange

Tear Lens (aka tear reservoir)

Plus Tear Lens

STEEPER
THAN "K"

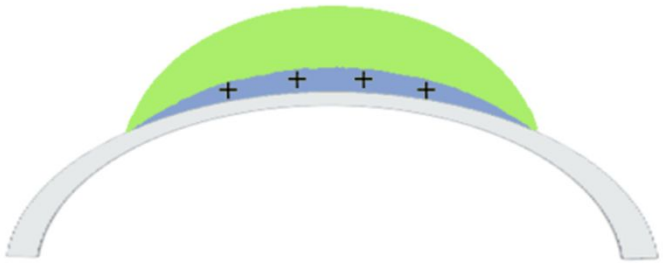
Plano Tear Lens

ON "K"

Minus Tear Lens

FLATTER
THAN "K"

Plus Tear Lens



- Steep lens
- Convex tear lake

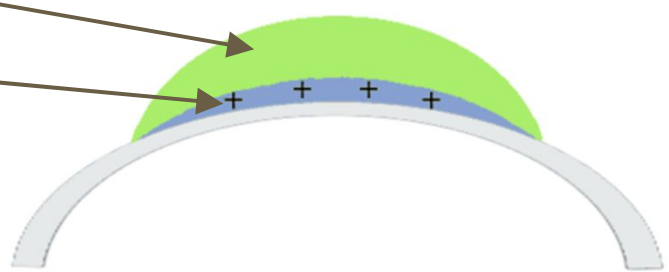
- For every diopter the contact lens is steeper than cornea, the tear lens contributes 1D more plus power

Plus Tear Lens Example

Place a GP that is 1D steeper than the cornea

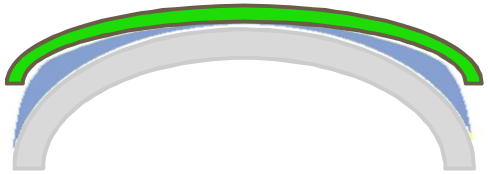
CL power: +2.00

Tear Lens: +1.00



Refractive power: +3.00

MINUS TEAR LENS



- Flat Lens
- Concave tear lake

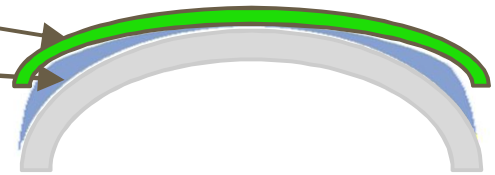
- For every diopter the contact lens is <u>flatter</u> than cornea, the tear lens contributes 1D more <u>minus</u> power

Minus Tear Lens Example

Place a GP that is 1D flatter than the cornea

CL power: +2.00

Tear Lens: -1.00



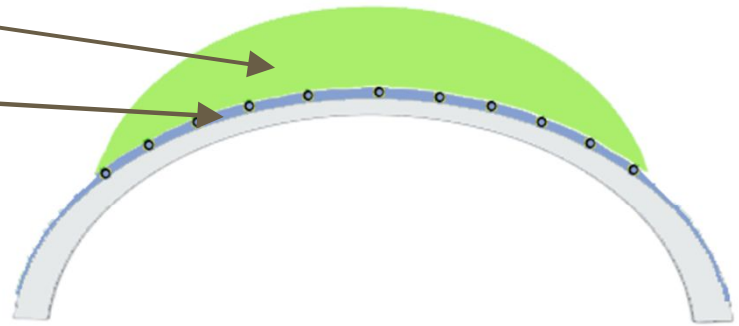
Refractive power: +1.00

No Tear Lens Example

Place a GP that is the same curvature as the cornea

CL power: +2.00

Tear Lens: Plano



Refractive power: +2.00

Quiz

Lisa has a refractive error of -3.00 D

Her K measurements are 44.00D spherical

You give her a contact lens with a base curve of 43.00D

What is the anticipated power of the contact lens?

Base curve is 1D flatter than K, so it contributes -1.00D to the refracting power

Contact lens power + tear lens power = Patient's refractive error

Contact lens power + (-1.00) = -3.00

Final contact lens power: -2.00

Tear Lens and Power

The power of the GP must account for:

The eye's refractive error AND

The power introduced by the tear lens

Easy way to remember: SAM FAP

Steeper Add Minus

i.e. if you make the lens steeper, add minus

Flatter Add Plus

i.e. if you make the lens flatter, add plus

Tear Lens

Remember that you must consider each meridian separately

GP lenses are excellent at correcting astigmatism

Let’s do an example…

What About a Toric Cornea?

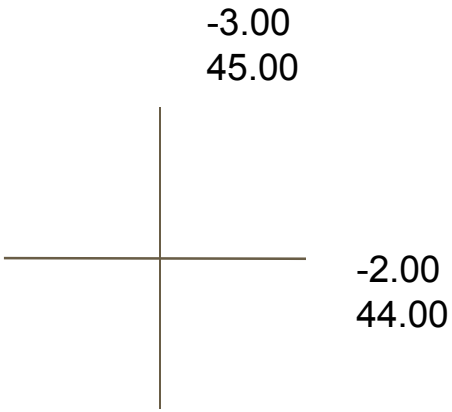
Mathilda's SRx: -3.00 +1.00 x 090

Convert to minus cyl: -2.00 -1.00 x 180

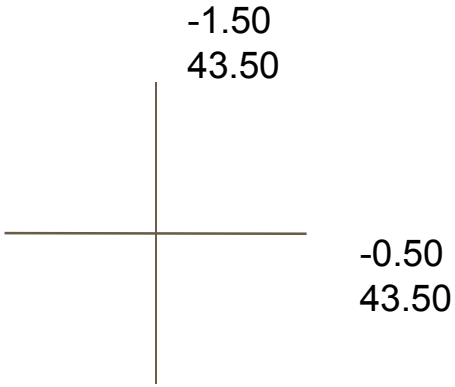
Her Ks: 45.00/44.00 @ 180

You select a 43.50 BC GP lens. What is the anticipated power of the lens?

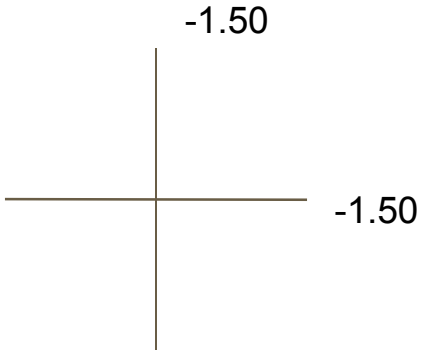
Quiz



Mathilda's Ks and
Desired Power
(-2.00 -1.00 x 180)



Tear Lens and BC of
the contact lens



Contact Lens Power

Final CL Power: -1.50

Bottom Line: A spherical GP lens can neutralize the astigmatism in a toric cornea because of the tear lens

Points to Remember

Convert all Rxs to minus cylinder

If refractive cylinder is approximately equal to corneal toricity, then the tear lens will neutralize the cylinder component

Contact lens power is determined by the eye's refractive error and the tear lens employed

You typically shoot for a lens that is close to the FLAT K meridian

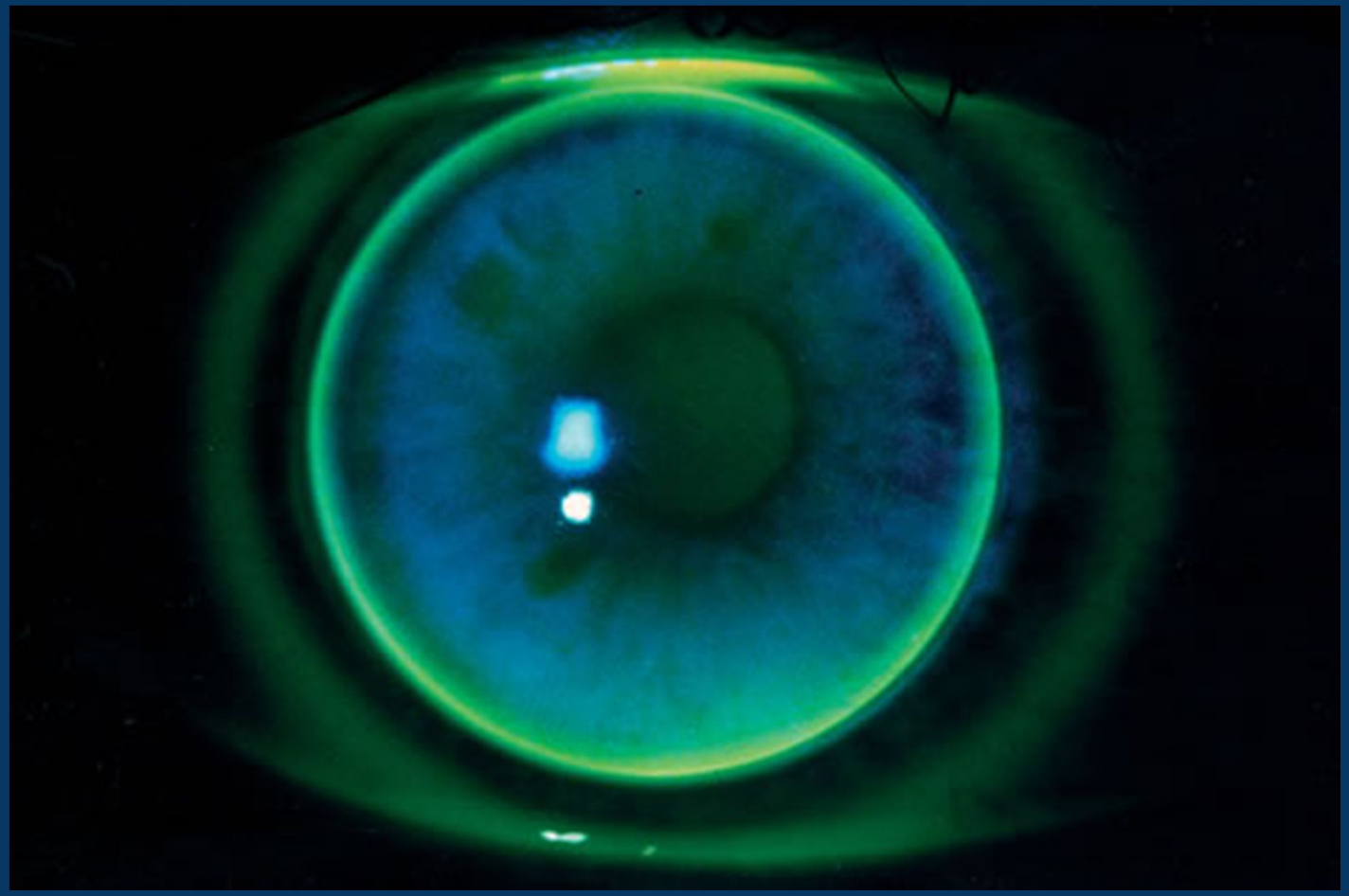
- That employs a minus tear lens along the steeper meridian

GP Fitting Considerations

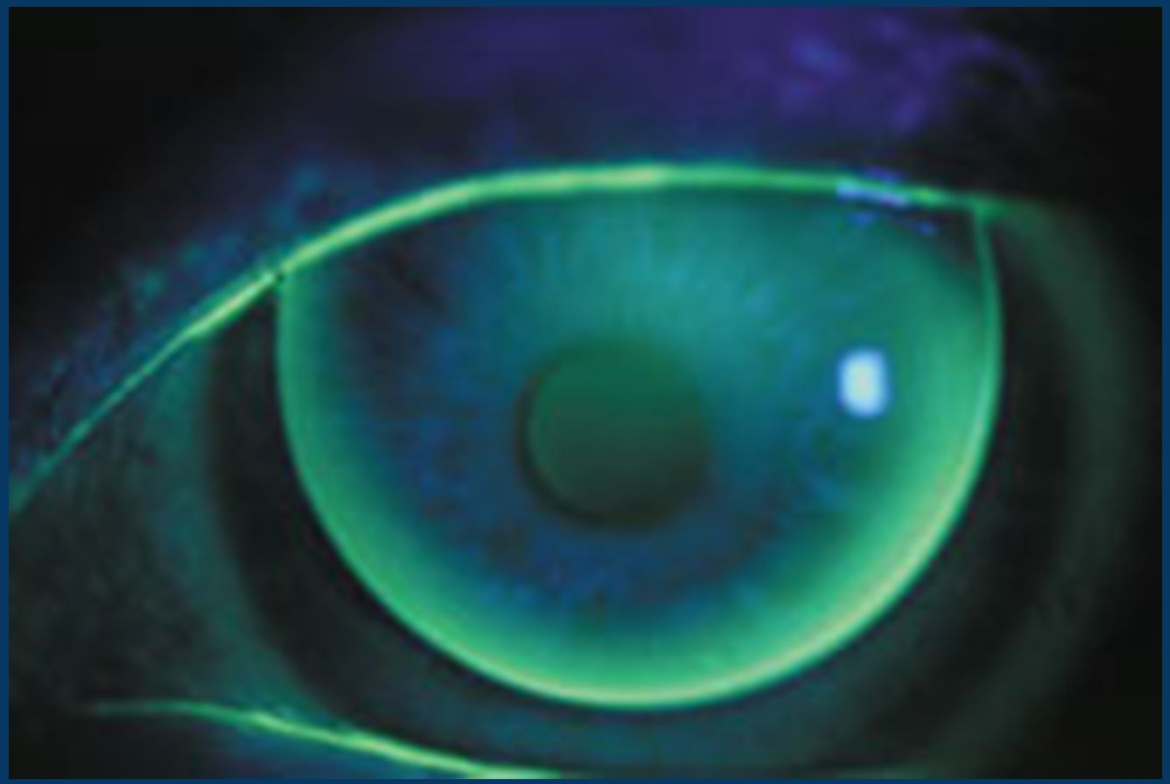
Base curve depends on relationship to flat K and varies according to amount of corneal astigmatism.

△K (Diopters)	Contact Lens Base Curves
0 (spherical cornea)	0.50 flatter than K
0 to 0.75	Plano to 0.25 steeper than flat K
1.00 to 1.75	0.25 to 0.75 steeper than flat K
2.00 or greater	⅓△ + K flat

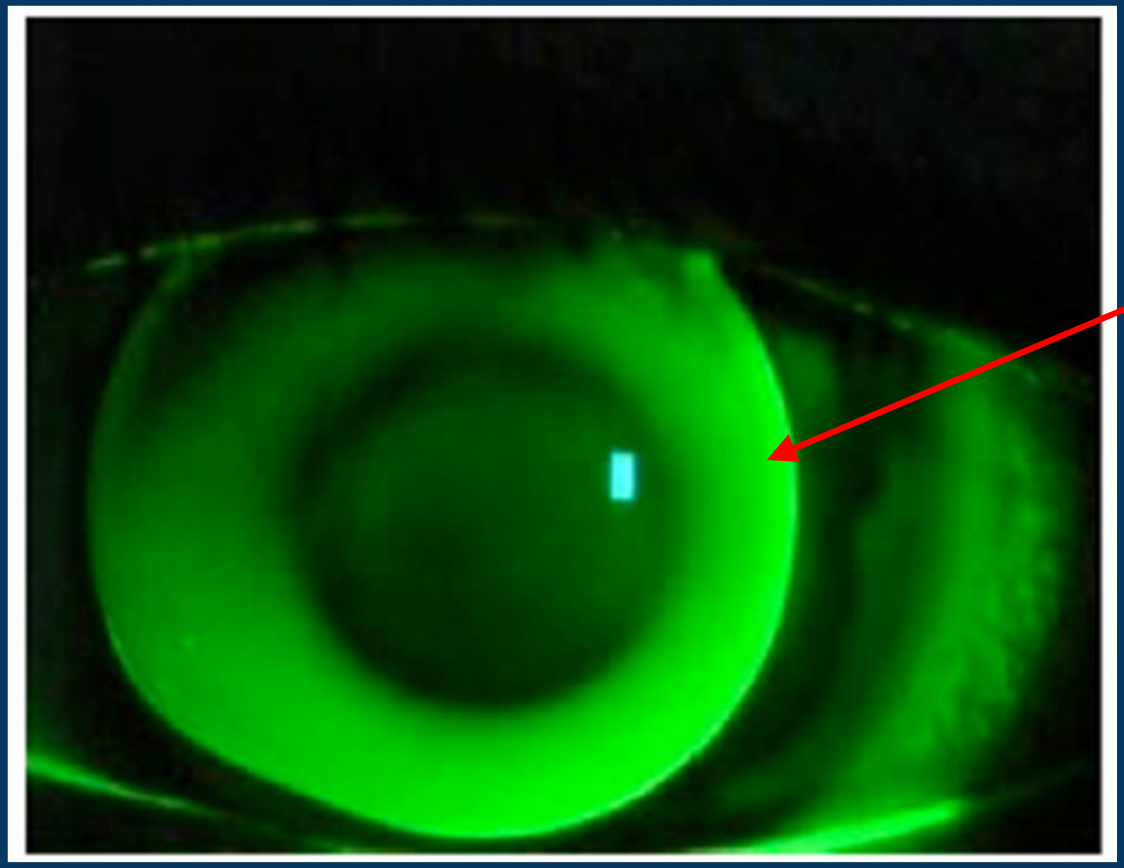
Alignment Fit



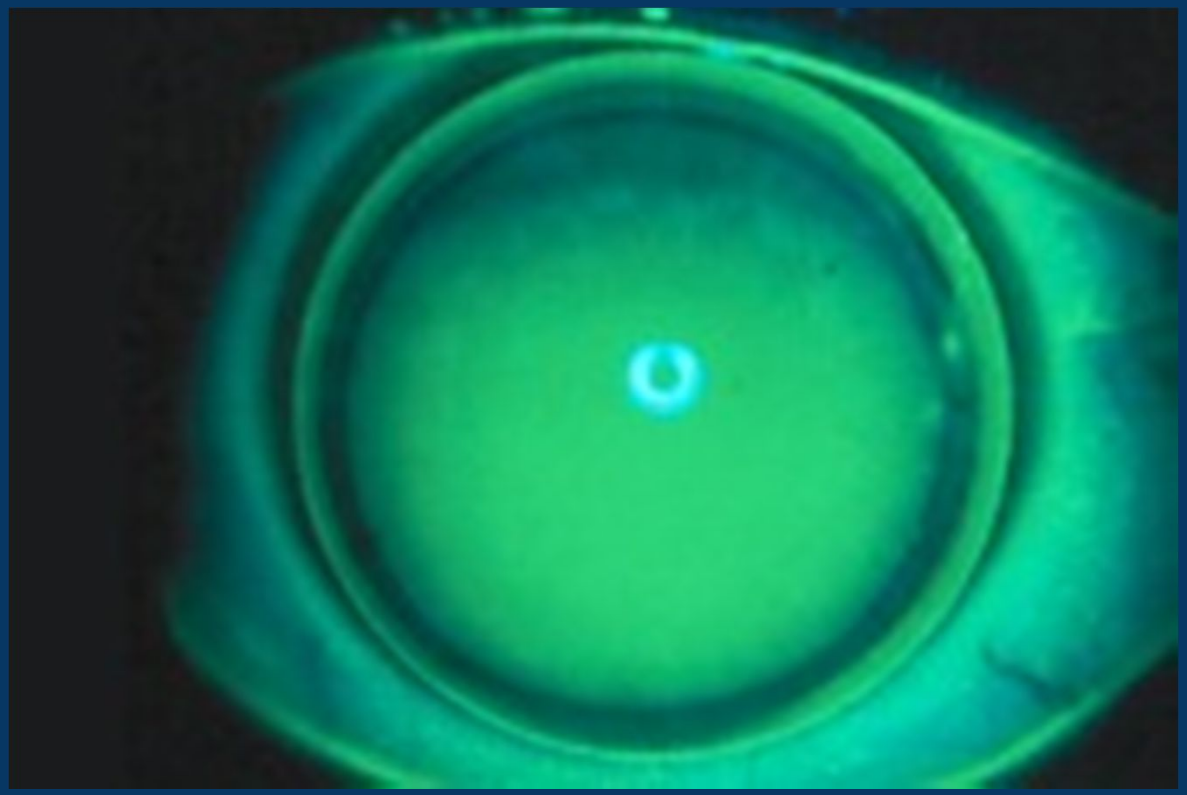
Apical Alignment Fit - “Lid Attached”



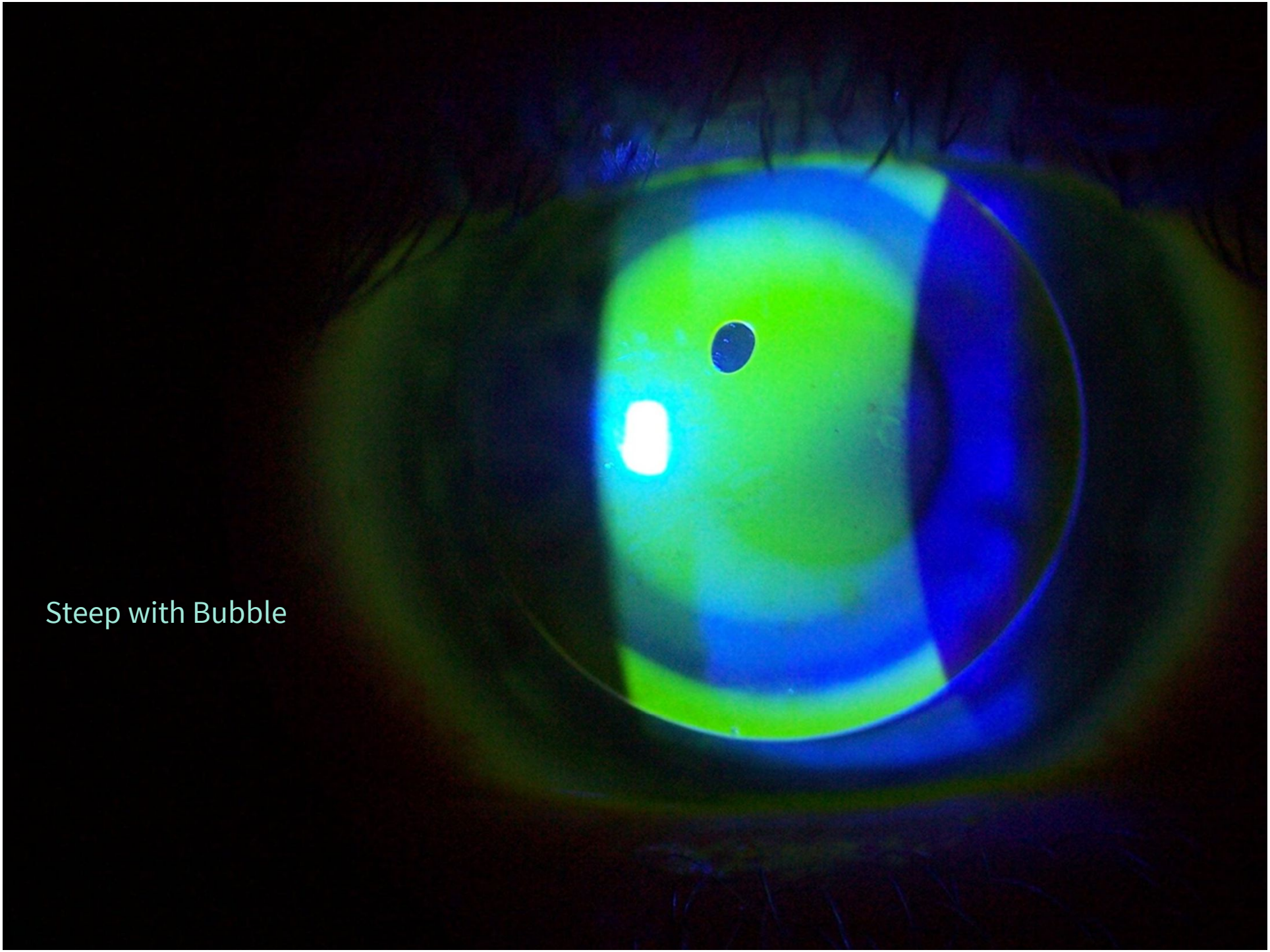
Heavy Central Bearing



Excessive Central Clearance

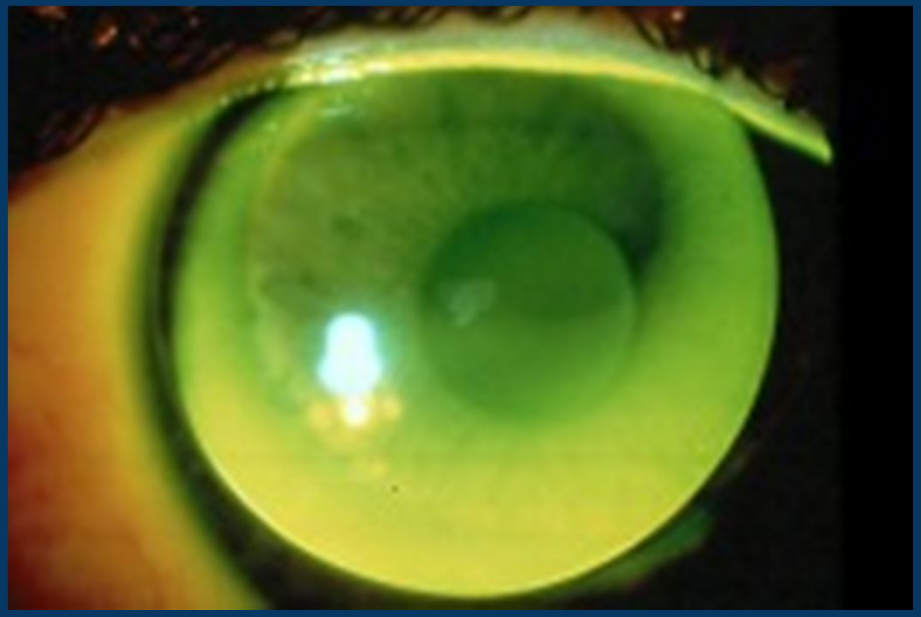


1D steeper than "K"
Mild peripheral sealoff

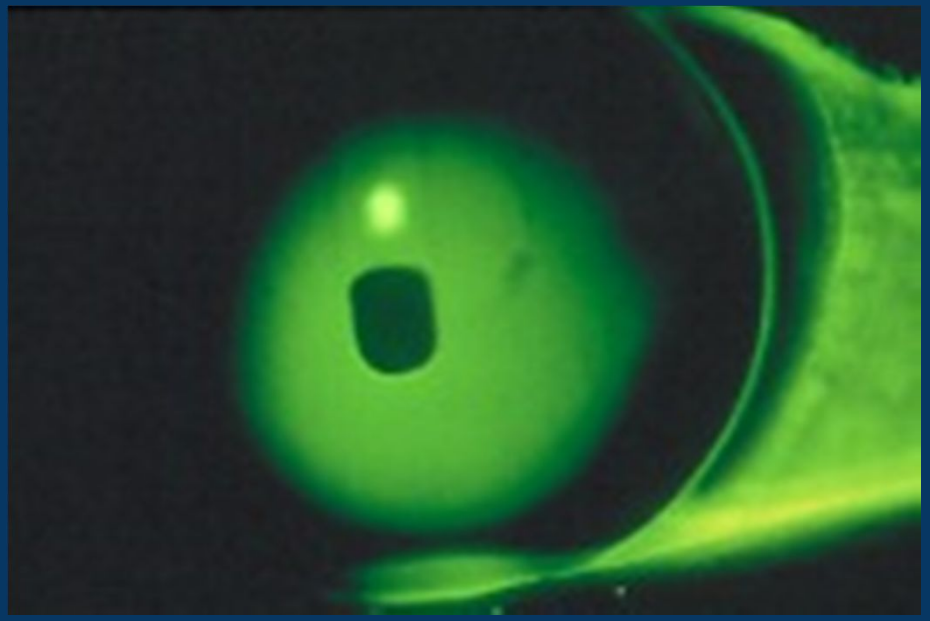


Steep with Bubble

Other Examples

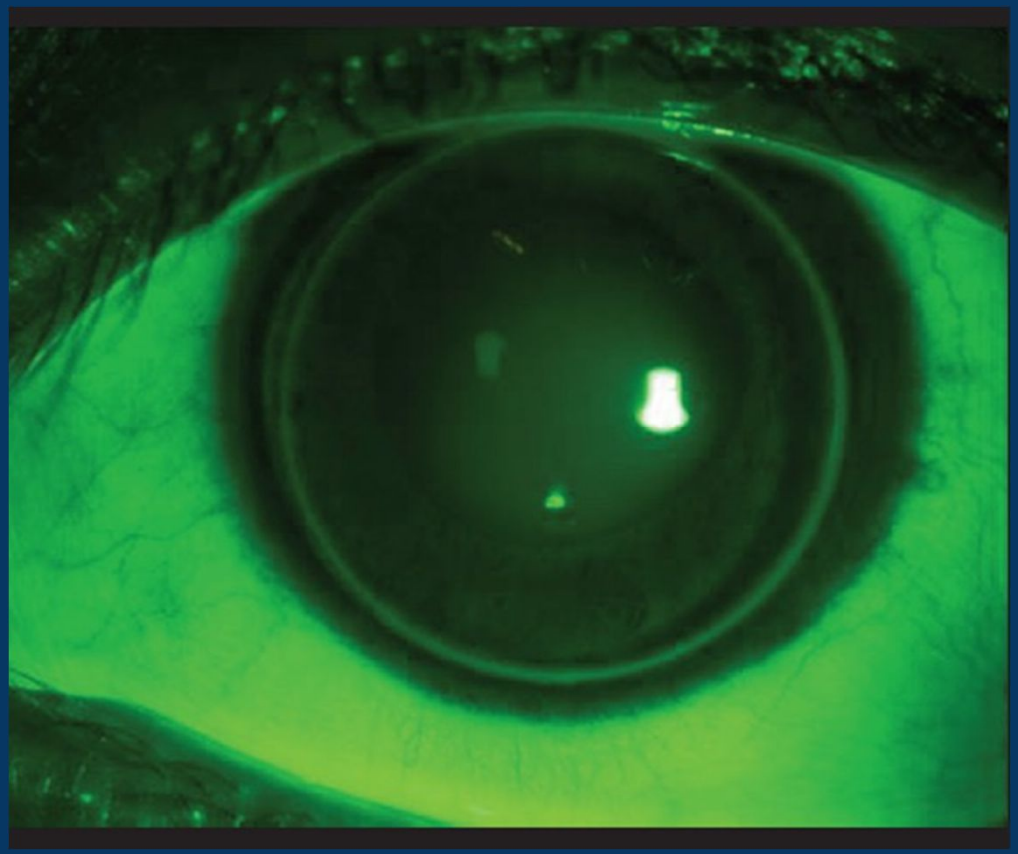


2D flatter than "K"
Excessive apical bearing, excessive inferior edge standoff

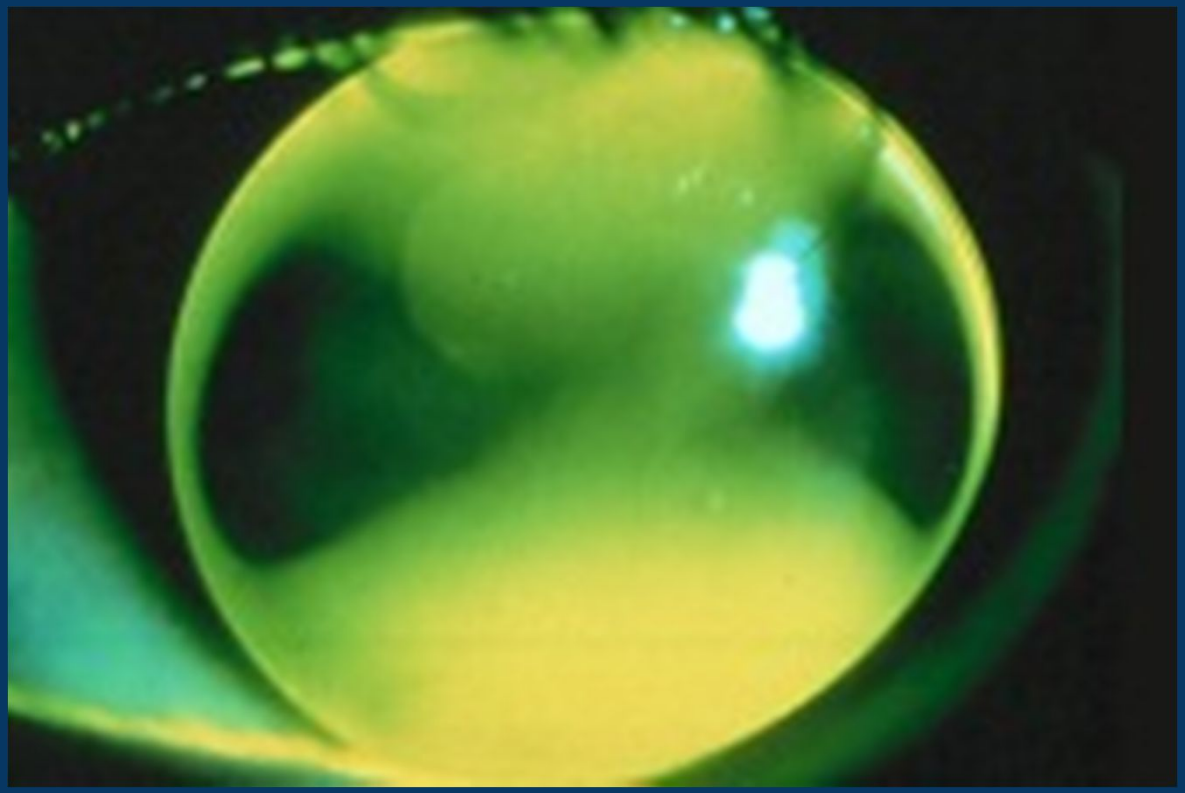


2D steeper than "K"
Excessive peripheral sealoff
Central bubble formation

Poor Edge Lift



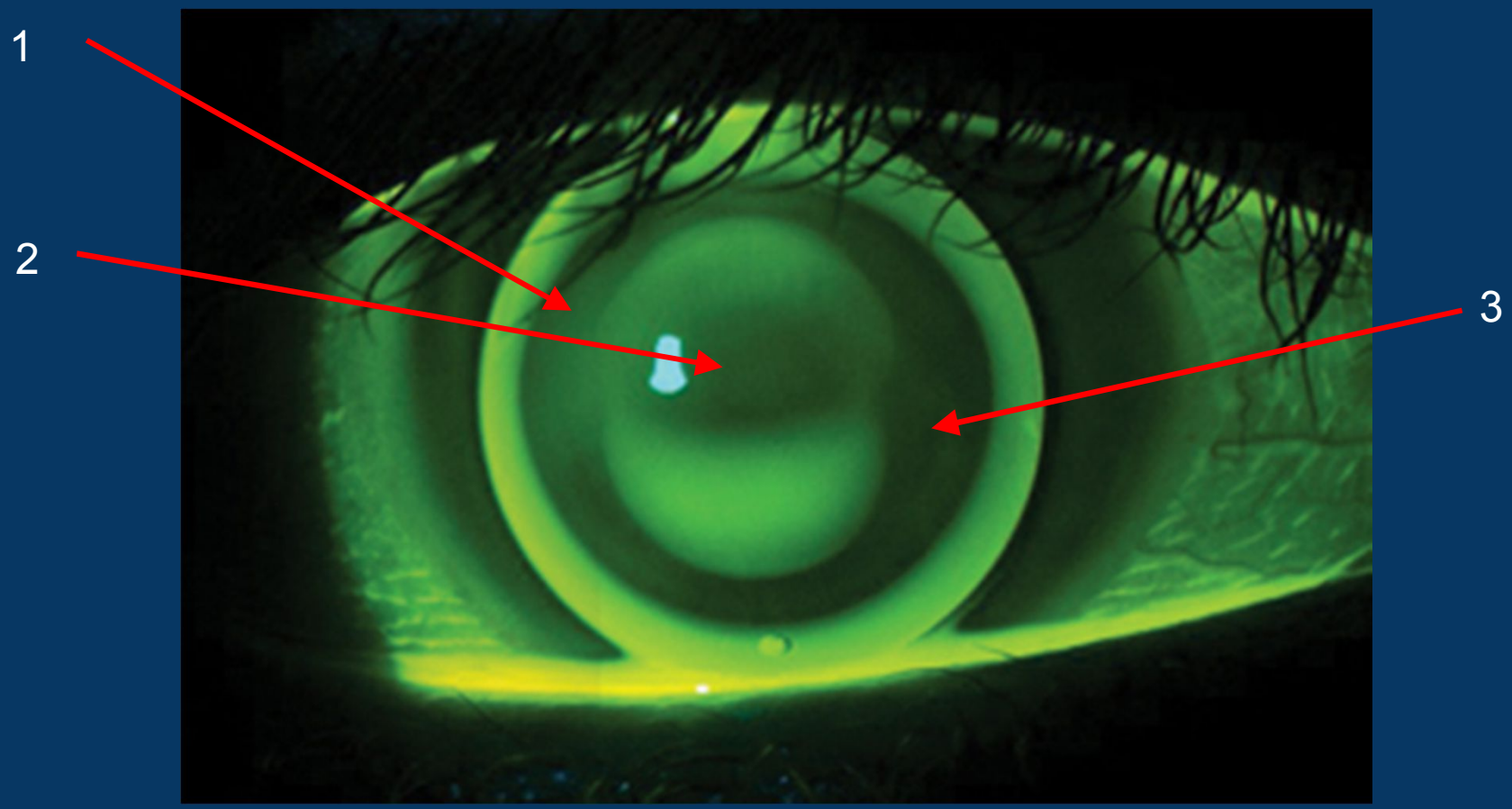
Poor Edge Lift



Spherical BC on 3D WTR astigmatic cornea

Horizontal bearing and excessive vertical pooling is observed

Keratoconus 3-point Touch



Irregular Corneas and the Overrefraction

Overrefraction is critical for power determination

- For regular or irregular corneas

Diagnostic GPs are excellent for determining the source of vision decrease

- Find a decent-fitting GP lens
- Perform an overrefraction
- Helps direct treatment decisions

  i.e. related to the irregular cornea or not?

Contact Lens Materials - GPs

PMMA (“hard contacts”)

- 0 Dk
- Not really used anymore; avoid like the plague

Silicone acrylate

- Dk of 12-54, but some concern with wettability

Fluorpolymer

- Fluorine was added for even greater oxygen transmissibility
- Typically good comfort and stability
- Fluorosilicone acrylate is the most common material used today

Contact Lens Materials - Soft Contact Lenses

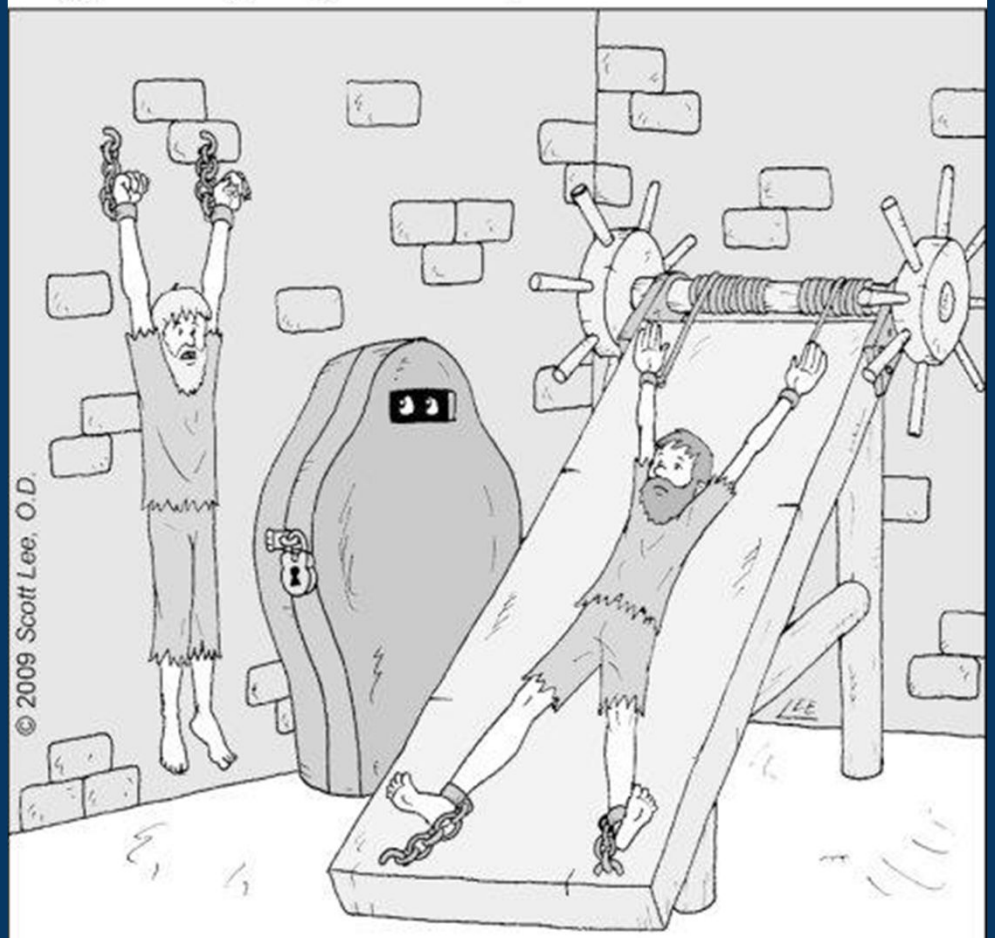
Hydrogels

- Older material
- Typically not as breathable
- ↑Water content =↑oxygen permeability =↑tendency to dehydrate
- Examples: Proclear (Dk = 34), Acuvue 2 (Dk = 21.4)

Silicone hydrogels

- Newer material
- Typically more breathable
- Oxygen transmission is a function of their silicon content
- Examples: Air Optix Night and Day (Dk = 140), Acuvue Oasys (Dk = 103)

Sight Gags *by Scott Lee, O.D.*



"At least they don't have the machine that blows air in your eye."

GP Lenses

Types:

- Corneal
- Scleral (mini-scleral, semi-scleral, full-scleral)

Corneal Lenses

- Smaller, usually less than 12.5mm
- Rest exclusively on the cornea

Scleral Lenses

- Larger than 12.5mm
- Rest on the sclera, not the cornea

Corneal GPs vs. Scleral Lenses

Pros of corneal GPs

- Smaller/easier to handle
- Less expensive
- Easier to fit (sometimes)
- Great option for most corneas

Cons of corneal GPs

- Adaptation time
- Easier to lose/eject from eye
- Decentration problems
- Dust and other irritants

Corneal GPs vs. Scleral Lenses

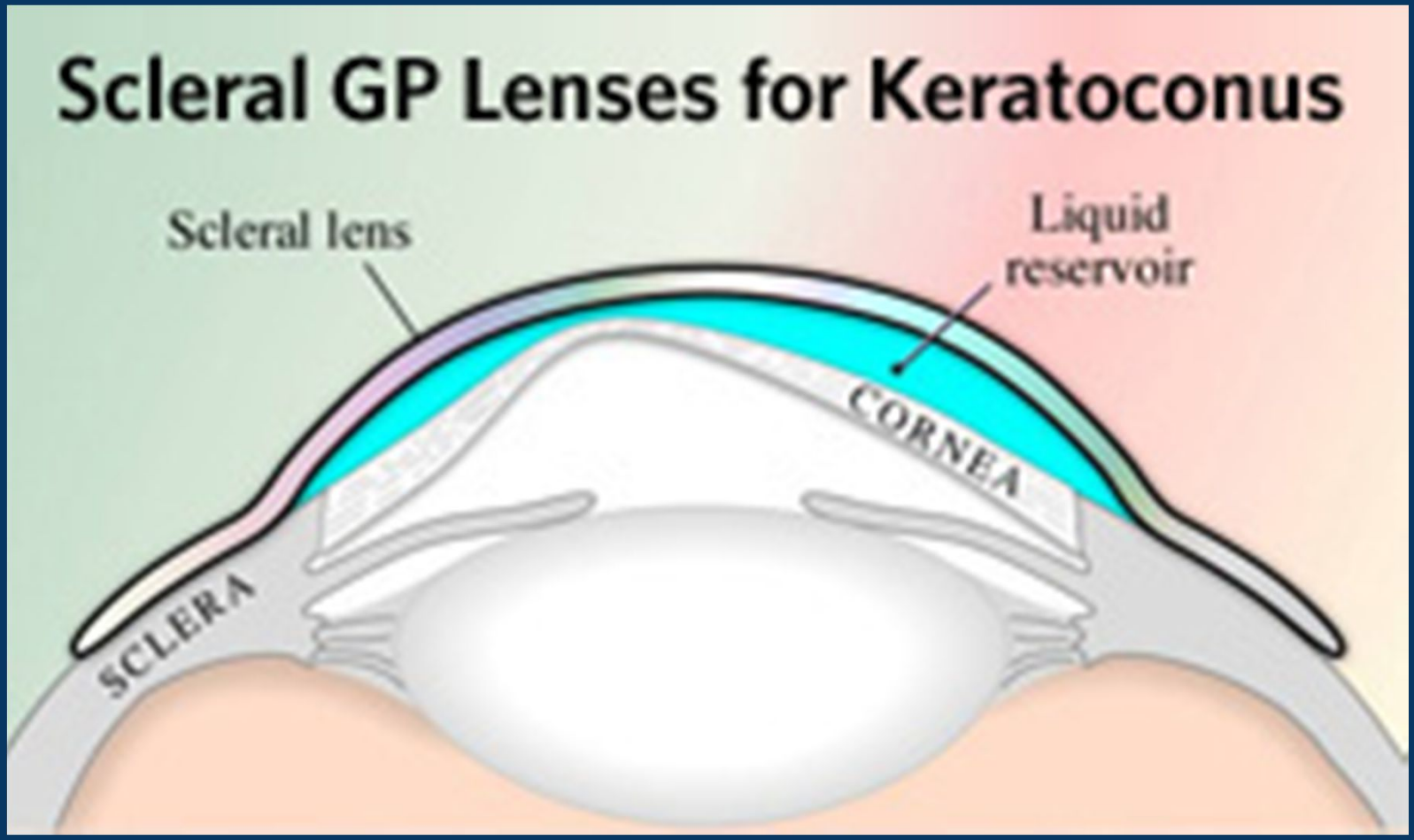
Pros of scleral lenses

- Very comfortable
- Good centration
- Often the only option for irregular corneas
- Often better vision than corneal GPs

Cons of scleral lenses

- Expensive
- More difficult to apply and remove
- Fogging issues

Scleral GP Lenses for Keratoconus



Scleral Lens Indications

Corneal irregularities

- Keratoconus, pellucid, scars, corneal transplants, RK surgery, etc

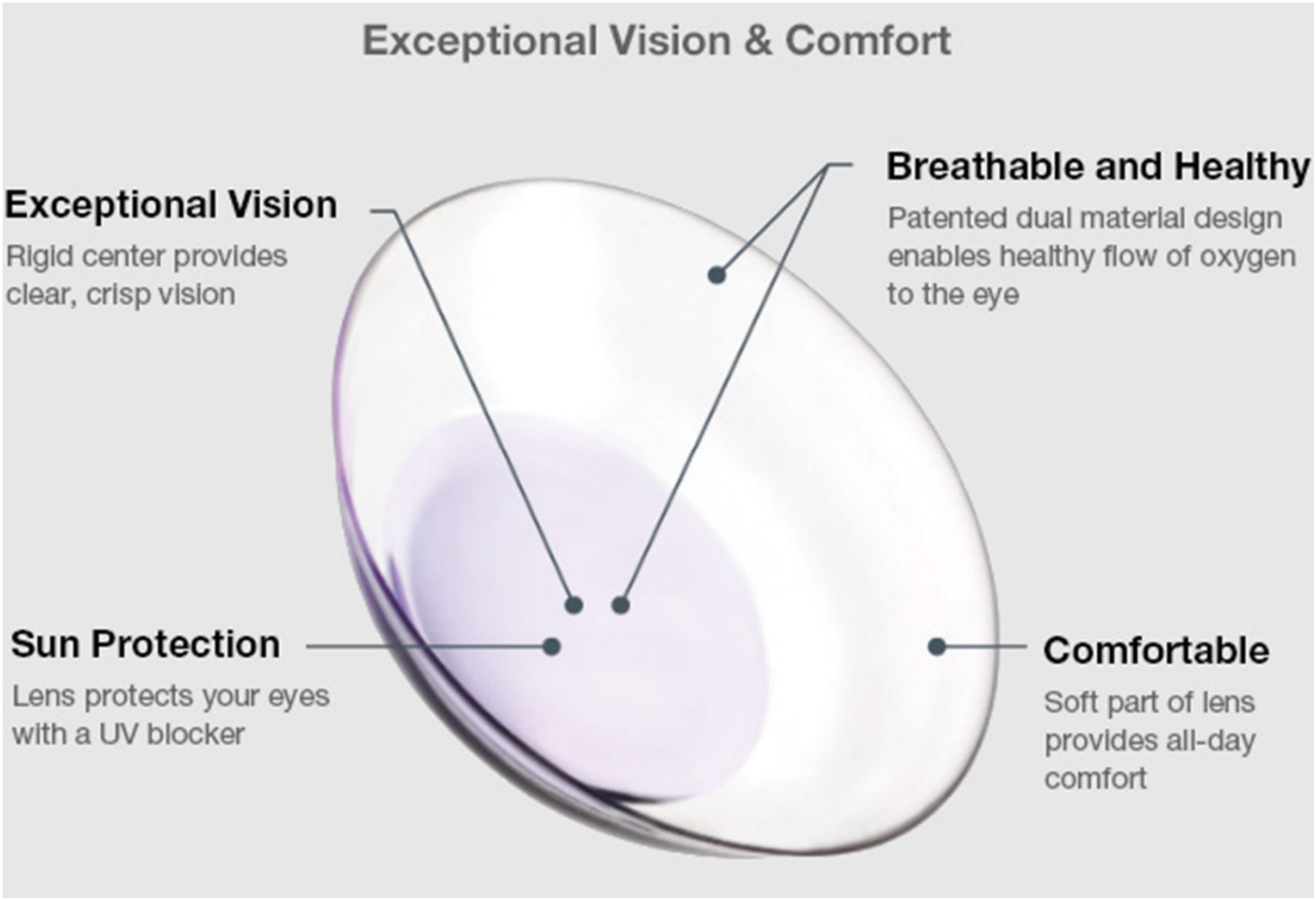
Ocular surface disease

- Severe dry eye, Stevens Johnsons Syndrome, Graft vs Host disease, etc.

Hybrid Contact Lenses

Best of both worlds?

- Rigid gas-permeable center
- Soft outer “skirt”
- “The vision of a GP with the comfort of a soft lens”
- Synergeyes, Ultrahealth, Duette, Clear Kone, Soft Perm


Exceptional Vision & Comfort
Exceptional Vision
Rigid center provides clear, crisp vision
Breathable and Healthy
Patented dual material design enables healthy flow of oxygen to the eye
Sun Protection
Lens protects your eyes with a UV blocker
Comfortable
Soft part of lens provides all-day comfort

Hybrid Contact Lenses

Pros:

- Usually good comfort/adaptation
- Good option for those intolerant to corneal GPs
- Good breathability (now)

Cons:

- Expensive
- Difficult/inconsistent fit
- Sealing/suction problems
- End-of-day dryness

Fitting Toric Soft Contact Lenses

Consider fitting toric soft contact lenses for those with 0.75 or more astigmatism

- You must evaluate lens rotation
  - Markings are typically at 6:00

Remember LARS

- Left add; right subtract from the SPECTACLE refraction
- Each clock hour is approximately 30 degrees
- Let’s do an example…

Toric Soft Contact Lens Fit Example

Dustin has the following Rx: -2.75 +1.75 x 080.

You place a lens on the right eye which rotates 10 degrees temporal (L)

What should you Rx?

Convert to minus cyl: -1.00 -1.75 x 170

LEFT rotation (LARS) - add 10 degrees to the cylinder of the refraction

170 + 10 = 180

Order: -1.00 -1.75 x 180

Toric Soft Contact Lens Fit Example

Tracy has the following Rx: -1.00 +2.25 x 062

You place a lens on the right eye which rotates 15 degrees nasal (R)

What should you Rx?

Convert to minus cyl: +1.25 -2.25 x 152

RIGHT rotation (LARS) - subtract 15 degrees to the cylinder of the refraction

152 - 15 = 137

Order: +1.25 -2.25 x 140

Questions?