

Corneal catastrophes and casualties

Causes of Irregular Cornea

Puberty Onset Keratoconus

- *Begins in early adolescence approx. age 12 to 16.*
- *Usually bilateral with one eye affected worse than the other.*
- *The younger the patient, the more severe the condition.*

Late Onset Keratoconus

- *Usually begins in late 20's or early 30's*
- *Both eyes can be affected the same.*
- *The incidence of progression reduces greatly with the age of onset.*

Biochemical influences

The Cascade Hypothesis of KC

Cristina Kenney MD Ph.D.

- *Stromal collagen fibers are degraded due to exposure to UV light, mechanical trauma (poorly fitted contact lenses, eye rubbing) and atopic disease.*

Keratoconus Fruste

- *A mild non-progressive form KC*
- *Can occur anytime throughout life.*
- *No positive slit lamp findings associated with KC.*
- *Normal corneal thickness.*

Keratoconus

- *75% have peripheral (sagging) cones with steepenings extending to the limbus*
- *25% have corneal (nipple) steepening cones*

Curvature versus Elevation

Custom Soft Lens Designs & Silicone Hydrogel Materials ?

KCN fitting with Soft CLs

- *Relatively steep base curves*
- *Thicker than std soft CLs (0.3-0.6mm) and therefore masks some astig*
- *Reverse geometry configurations available*

Soft KCN CL pearls

- *Fit empirically or with a fitting set*
- *Center lens for best vision*
- *Use high molecular weight Nafl with a cobalt blue light and Wratten*

filter to check for excess bearing or vault

- *Edge fluting – lens is too flat*
- *Sph – cyl OR – use topo to measure the amount of residual irregularity and increase thickness of lens*

Piggyback in Keratoconus

- *Improved comfort*
- *Better centration – higher plus powers*
- *Lower oxygen*
- *Inconvenience*
- *Need lenses with lower modulus to decrease edge fluting*
- *Recessed soft lenses – Flexlens piggyback by Xcel and the Recessed Pillow by Fusion Technologies and Eye Vis Vision Research*
- *Low powers -1.50 to -3.00D*
- *20% lens of soft lens power manifests in the piggyback system >-3.00D but does not impact the VA in patients with KCN*

• Only 10% of People with KCN Undergo Corneal Transplant

Surgery

GPs- 1/3 the risk of PK

Sclerals – 1/5 the risk of PK

CROSSLINKING

CANDIDATES

PROCEDURE AND FOLLOW UP

- *RIBOFLAVIN – PHOTSENSITIZER WITH AND ABSORPTION*
- *PEEK 366NM INSTILLED Q2MINS FOR 30 MINS*
- *MINIMUM THICKNESS 400UM*
- *UV-A RADIATION TX FOR 30 MINS*
- *LIMBUS IS PROTECTED*
- *BANDAGED LENS 3-5 DAYS*
- *ANTIBIOTICS – 1 WEEK*
- *STEROIDS 2-3 WEEKS*

COMPLICATIONS

- *CORNEAL HAZE – DECREASES 3-12 MONTHS*
- *MICROBIAL KERATITIS*
- *STERILE INFILTRATES*
- *PERSISTENT CORNEAL EDEMA OR CORNEALDECOMPENSATION*
- *PERSISTENT EPITHELIAL DEFECTS EPI-ON VS EPI-OFF*
- *HIGHER DOSE OF UV WITH LESS EXPOSURE TIME*
- *FASTER HEALING*

- *BETTER VA*
- *LESS HOA*
- *LESS COMPLICATIONS*

CONTACT LENSES

- *SOFT, GPS AND HYBRIDS- AFTER 3 MONTHS EPI-OFF*
- *PIGGYBACK WITH HIGH DK LENS, STEEPER BC, AND LARGE*
- *SOFT LENS WILL MODIFY POWER BY 22%*
- *+1.00 WILL MODIFY BY +0.25D*

SCLERAL LENSES

- *PREVIOUS WEARER- NO CHANGE BUT TO CORNEAL PROFILE*
- *200UM CENTRAL CLEARANCE TO REDUCE HYPOXIC STRESS*
- *CT 250UM MAX*
- *SMALLEST LENS POSSIBLE*
- *1 MONTH AFTER CXL*

CLEANING REGIMEN HYDROGEN PEROXIDE WITHOUT A MOISTURE MATRIX COMPONENT??

Pellucid Marginal Degeneration

Treatment

- *Toric SCL/ custom lenses in the early stages*
- *GP lenses in the later stages but tend to decenter inferiorly to the steepest portion*
- *Piggy back lenses*
- *Scleral lenses- best option vs having a large, decentered graft*

Severe OSD Corneal Topography and Corneal Trauma Viral Keratitis

Corneal Topography Post Trauma and RK

The flattening effect increases as the laceration approaches the visual axis

How Do You Select the Initial Base Curve (BOZR) of the Initial Diagnostic Lens???

Classification System (SLS)

- *Scleral Lens (SL)*
- *Not a 'contact' lens*
- *The New Terminology removes the distinction between 'mini' and 'large' scleral lenses*
- *All Scleral Lenses – regardless of size - are fitted to completely vault over the cornea and land on the conjunctiva*

- *'Application' of scleral lenses is used instead of 'Insertion'*
 - *To describe the difference in shape and height of the ocular surface the term 'asymmetry' is used*
- Some eyes can not be optimally fitted with corneal lenses*

SCLERAL LENS INDICATIONS

Ocular Surface Disease

Corneal Irregularity Ectasia/Scar/Post Surgery

Better VA and fitting

Irregular Astigmatism

- *Keratoconus*
- *Pellucid Marginal Degeneration*
- *Post Corneal Trauma*
- *Post keratoplasty*
- *Post Refractive Surgery*

RK, PRK and LASIK

- *Post HSV and HZV*

GP centration problems

GP stability (rocking) problems

—

Pathologic Ocular Surface Disease

Protection of the Cornea

- *Chemical Burns*
- *Ocular Pemphigoid*
- *Stevens-Johnson Syndrome*
- *Symblepharon formation*
- *Graft vs Host Disease*
- *Persistent Epithelial Defect*
- *Exposure Keratitis*
- *Neurotrophic Keratopathy*
- *Severe Dry Eye*
- *Neurotrophic Keratopathy*
- *Severe Dry Eye*

—*Sjogren's Syndrome,*

—*Filamentary Keratitis*

—*Limbal Stem Cell Deficiency*

—

•

Indications for Scleral Lenses

- *Normal eyes*
- past RGP wearers*
- high astigmats*

windy, dusty environments
athletes
presbyopes
orthokeratology

*Laboratories Currently Manufacturing
Scleral Lens Designs*

- 1. ABB Optical Group
- 2. AccuLens
- 3. Advanced Vision Technology
- 4. Alden Optical
- 5. Art Optical
- 6. Blanchard CL
- 7. C&H Contact Lens
- 8. Contax
- 9. Essilor
- 10. Firestone Optics

High DK Scleral Materials

Oxygen- min requirements according to Michaud et al.

6 Subjects wore .35 mm (350 micron),

100 DK scleral lenses for 8 hours

Habitual DW SCL for 8 hours

100 DK scleral lenses for 8 hours

Habitual DW SCL for 8 hours

Cell count of 800 or less results in hypoxia/edema or neovascularization

SCLERAL LENS DESIGNS

Complications

Traditional Corneal / Scleral Shape

VERTICAL RESULTS

HORIZONTAL RESULTS

GSLs Poster 2015

Scleral Height Differential N =80 Eyes

CONCLUSION

Limbal / Scleral Angles

Scleral Shape

- *Corneo-scleral junction and the anterior sclera is frequently tangential than curved*
- *Nasal portion of sclera is flatter causing temporal scleral decentration beyond 15mm mark.*
- *Many eyes are asymmetrical in nature and beyond corneal borders.*

DeNayer et al.

N= 140 eyes

- *6% spherical*
- *30% toric*
- *40.7% had asymmetric depressions (or steep areas) or asymmetric elevations (or flat areas). 26% had a recognizable toric pattern with*
175
176
177
- *40.7% had asymmetric depressions (or steep areas) or asymmetric elevations (or flat areas). 26% had a recognizable toric pattern with elevations and depressions but they were irregularly spaced*

- *Nafl pattern (Wratten filter)*
- *Scan the entire lens esp the area of disease*

In Fitting Scleral CL...

What is the appropriate amount of Apical clearance?

Scleral Lens Corneal Settling

11 subjects, 22 eyes

At lens application and 8 hours post lens wear

- *Average apical clearance on insertion: 393um*
- *Average apical clearance after 8 hours: 265um*
- *Average drop in sag between insertion and 8*
- *Average drop in sag between insertion and 8*
hours (22 eyes): 127um

Scleral Lens Settling

Matthew Kaufmann, University of Missouri, St. Louis

American Academy of Optometry Meeting Seattle WA 2013

- *Nine subjects were fitted the 3 different scleral designs*
- *Central clearance was measured at 0 min., 15 min., 30 min., 45 min., 1 hr., 2 hr., 4 hr., 6 hr. and 8 hr.*
- *On average, the lenses settled a total of:*
-127 microns
-111 microns
-91 microns.
- *Approximately 70% of the total lens settling occurred within the first two hours of wear.*
- *The amount of settling was not directly related to lens diameter.*

Lens settling

- *John Mountford - Average 146 microns with a range from 106-186*

microns

- *Settling depends on the size of the lens used:*
 - *larger lenses 15.5 mm or more settle more*
 - *smaller lenses 15.0 mm or less settle less*

Time (Barnett et al, 2021)

- *1 hour – 50% settled*
- *2-4 hours – 80% settled*

Amount of clearance?

- *Clearance varies with the condition*
 - *KCN / keratoglobus – large sag*
 - *post corneal grafts/ scars – less sag*
- *Too little clearance – lens will move and feel uncomfortable*

Excess apical clearance

- *Decreased optics*
- *Excess negative pressure resulting in a tight periphery and neovascularization*
- *Difficulty with insertion of lens*
- *What really matters is how much the lens really settles*
- *Increased mucus*

Mucus production

- *From lenses with a lot of apical clearance*
- *Depends on the patient's health:*
 - *severity of dryness – viscosity of tears*
 - *thyroid disease*
 - *post-surgical eyes make mucus*
 - *Steven's Johnson*
- *Mucus fishing syndrome*
- *The longer the lens is worn, the less mucus production there is later*

Central Clearance Zone

300 to 400 microns of Apical Clearance

300- 400 microns???

Traditional Corneal / Scleral Shape

SCLERAL LENS DESIGNS

Limbal Vault Zone (LZ2)

Inadequate limbal clearance

- *Larger diameter*
- *Steeper*
- *Deep circumlimbal conjunctival compression with rebound hyperemia- increase landing zone width*

Scleral Landing Zone (SLZ)

Conjunctival Impingement

- *Decrease sagittal depth*
- *Flatten peripheral curves – if it occurs at the outer edge of lens*
- *Steepen peripheral curves – if it occurs at the inner edge of the peripheral curve*
- *Increase the center or junction thickness – flexure*
- *Larger diameter – stiletto heels vs snowshoes*
- *Get rebound hyperemia and neo – impression ring*

Conjunctival Blanching

- *Partial or full 360?*
- *Partial: Need quadrant specific periphery*
- *Plan: circumferential flatten scleral zone but check to see if sagittal depth is affected*

Conjunctival “Blanching” Sxs

Post 2-4 Hour Evaluation

Compression Rings

- *Document pt’s wear time – if decreased, change the landing area in the scleral zone*
- *Nasal > temporal*
- *Use more viscous solution*
- *360 degrees is unacceptable – adjust with a larger landing zone*

Pinguecula

- *Remove it – mitomycin C to prevent reoccurrence*
- *Fit over it*
- *B complex vitamins*
- *Notch*
-

Fenestration??

- *1.0mm diameter*
- *Should be in deepest limbal pooling area but weakens the lens*
- *Conjunctival chalasis*
- *Corneal abrasions*
- *Induces bubbles*
- *Helps with oxygen exchange ?????*
- **** relieves lens suction, reduces edema*

If no OCT nor topographer?

Initial Diagnostic Lens

APPLICATION AND REMOVAL

Ø Aperture of lids

- Ø Depth of eye socket*
- Ø Tight lids*
- Ø Blepharospasm tendencies*
- Ø Dexterity*
- Ø Large fingers*

Applicators and removal

Applicators- Dalsey Adaptives, LLC (case 24mm lens)

Lens Application

*Preservative Free Saline Options
(in the USA)*

The unit dosed 5 or 10 ml Inhalation PF saline.... 0.9% Sodium Chloride Solution by Rx only

The 12 OZ aerosol saline... Simply Saline by Arm and Hammer OTC

The 4 OZ bottle Purilens Plus Ultra PF Saline from Purilens OTC

LacriPure Saline from Menicon

Preservative-Free Saline

- Calcium, Magnesium, Phosphate, Potassium, Sodium*
- Sterile, buffered, isotonic solution*

I and R videos

- Scleral lens society video*
- [Http://www.sclerallens.org/how-use-scleral-lenses](http://www.sclerallens.org/how-use-scleral-lenses)*
- You tube videos*
- Search “Scleral Contact Lens”*

Drape the patient with the lap towel or paper towels so that solution does not get on their clothing

Lens Application

Have the patient look down....patient holds their upper and lower lids & the lens is applied

Patient needs to look downward and tuck their chin towards the chest

Hold the upper and lower lid where the eyelashes meet and hold the plunger at a 45 degree angle aimed at the bottom of the lens

Application Bubble

Bubble formation

- If lens is placed off center on insertion*
- If lens is does not have enough fluid in the bowl of the lens*
- If the patient does not bend over parallel with the floor to insert the lens*

- Consider Refresh Celluvisc (Allergan)
- Lens flexure
- Dellen formation if worn for a while

Lens Removal

Lens Removal with a DMV

- What if a DMV or other lens removal appliance is not available?

Removal of lenses on bulging graft

Follow up Evaluation

- Pt wears lenses to exam after wearing for at least 4 hours
- Apply Nafl as soon as patient arrives
- Takes 10-15 mins for Nafl to get behind the lens
- If no Nafl present, lens is too steep. Adjust by flattening scleral zone
- Typical follow up: 1 day, 1 week, 1 month, 6 months

Troubleshooting

- Blurred VA
 - too much clearance (flatten central zone)
 - poor wetting or deposits on lens - (clean lens, MGD)
 - sphero-cyl overrefraction
(increase lens thickness)
 - internal astig – front toric
(increase lens thickness)
 - internal astig – front toric
or use glasses
 - bubbles
 - “foggy vision” caused by chamber debris
 - Corneal edema

Reservoir/chamber debris

- 49% of scleral lens patients have to remove their lenses one or more times a day
 - study by Visser, Visser, Van Ier, Otter HM. Modern scleral lenses part II: Patient satisfaction, Eye Contact Lens 2007 Jan;33(1):21-25

- If excess debris:
 - Antihistamine gtt
 - Less sagittal depth – reservoir holds less debris
 - Corneal edema
- Material Dk
- Lens thickness
- Fenestrations

- Channels
 - Corneal clearance
- Poor wetting
- Face cream
 - Hand sanitizer
 - MGD
 - Manufacturing
 - DMV “Squeegee method”

Solution:

Remake the lens

Alcohol based cleaner

Rub lens with lens conditioner prior to insertion

Change lotion free soap

Change lens material

Plasma tx

Cleaners

• Protein removal Boston daily cleaner are abrasive cleaners
Oil and organic removals - Lobob, Menicare GP CDS, Menicon are non abrasive cleaners

•

Extra strength cleaners

- *Miraflow (no longer available)*
- *Optikem International*
- *Sereine Extra Strength Daily Cleaner*

Peroxide systems

Lab Cleaner

Plasma tx

- *Effective cleaning method to remove any remaining residues (oils and waxes) from the lens manufacturing process*
- *Contact lens plasma treatment is a common functionalization application where the lens surface is oxidized to create a hydrophilic lens surface that is resistant to protein deposition.*
- *Better comfort and can wear for a longer time*
- *Enhances the wetting angle*
- *Ionization does not last forever*

Hydra-PEG

- *90% water*
- *PEG (polyethyleneglycol)*
- *Creates a wettable surface over the lens and separates it from the*

ocular surface and tear film

- *40um mucin-like hydrophilic shell*
- *Applied to SiHy, hydrogel, GPs, sclerals,*
- *Approved materials:*

Optimum, Paragon, Boston, Acuity 200, and Synergeyes-Simplifeyes 1 day hydrogel daily disposable

Hydra-PEG

- *OSD pts study by Mickles CV, Harthan JS, Barnett M. Assessment of a novel lens surface treatment for scleral lens wearers with dry*
- *Improved dry eye sxs*
- *Reduction in ocular surface changes*
- *Less complaints of foggy vision*

--

Boston Simplus, Unique pH, Clear care, Tangible Clean can be used with it

-

Tangible Boost

Conditioning solution to be used by patients monthly to restore and maintain the coating 2021

Central fit evaluation

Preservative Free Tears

Lens adhesion

- *Insufficient corneal clearance*
- *Insufficient limbal clearance*
- *Lens flexure – increase lens thickness*
- *Dry eye patients – Sjogren's pts*
- *PFree rewetting gtt's and one extra cleaning per day*