Scleral Lenses 101
-the basics

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Overview
• Clinical Indications
• Advantages and Challenges
• Terminology
• Anterior eye anatomy
• Basic design features
• Instrumentation
• Fitting basics – lens selection, fitting, evaluation, follow-up
• Tips and troubleshooting

Clinical Indications
• Vision Improvement
  – Correcting the irregular cornea
    • Corneal Ectasia
      – Primary – Keratoconus, Keratoglobus, Pellucid marginal degeneration (INTACS, CXL)
      – Secondary – post-refractive surgery, corneal trauma
    • Corneal Transplant
    • Corneal Degenerations
      – Normal Cornea
        • Presbyopia, moderate to high corneal astigmatism

Clinical Indications
• Ocular surface protection
  – Dry eye
  – Incomplete lid closure
  – Sjogren’s Syndrome
  – Stevens-Johnson Syndrome
  – RCE / corneal abrasions
  – Graft host disease
  – Infiltrative keratitis

Persistent corneal epithelial defects
• 8/7/17 – epi-off CXL (16 year old male)
  – Being treated for a constant epi defect until 10/6
  – Neomycin/dexamethasone, Zirgan, Ofloxacin, doxycycline, acyclovir, AT, BCL
  – Applied a scleral contact (15.6 diameter)
  – Wore extended wear for 6 days
  – Cont Maxitrol and ofloxacin drops
  – 10/12 – lens removed, epi defect healed with overlying corneal haze

Corneal Abrasion
• Healing response attributed:
  – Oxygenation
  – Moisture
    • Constant tear film
  – Protection of the corneal epithelium
    • Minimal abrasion
  – Allows epithelium to migrate, adhere, and proliferate over the persistent epithelial defect.
Clinical Indications

- Cosmetic/Sports
  - Hand-painted scleral lenses
  - Ptosis
  - Water sports
- Lens failure in other designs

Advantages of Scleral GPs vs Corneal GP

- Centration
  - Fitting a “regular” part of the eye
- Lens Retention
  - Minimal chance of inferior standoff
- Comfort
  - Reduced lid interaction; no corneal interaction
- Vision
  - Masking severe corneal irregularity

Challenges associated with scleral lenses

- Handling
  - Difficult I and R (initially)
  - Apprehensive patients
- Fitting
  - Subtle fit indications
  - Increased chair time
- Physiology
  - Dk/L – Oxygen must diffuse over great distance
  - Long-term effects of scleral lens wear are unknown

Terminology

- Classification
  - Corneo-scleral 12.9mm to 13.5mm
  - Semi-Scleral 13.6 mm to 14.9mm
  - Mini-Scleral 15.0mm to 18.00mm
  - Full-Scleral 18.1mm to 24+

Terminology

<table>
<thead>
<tr>
<th>Lens Type</th>
<th>Description</th>
<th>Definition of seating area</th>
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<tbody>
<tr>
<td>Corneal</td>
<td></td>
<td>Less rests entirely on cornea</td>
</tr>
<tr>
<td>Corneo-scleral</td>
<td></td>
<td>Less rests partly on the cornea, partly on the sclera</td>
</tr>
<tr>
<td>Scleral</td>
<td>Mini-Scleral (Len &lt; HBD)</td>
<td>Less rests entirely on the sclera</td>
</tr>
<tr>
<td></td>
<td>Large-Scleral (Len &gt; HBD)</td>
<td></td>
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Anatomy and Shape of the Anterior Ocular Surface

- Maximum scleral lens size for normal eye: 24mm
- Scleral Shape Study

Scleral Lens Education Society
June 2013
www.sclerallens.org
Anatomy and Shape of the Anterior Ocular Surface

- Corneal Toricity does not typically extend to sclera
- The ocular surface beyond the cornea is nonrotationally symmetrical
  - Asymmetrical
  - The entire nasal portion typically flatter compared to the rest

Clinical Consequences
- Temporal-Inferior decentration of scleral lenses
  - Inferior decentration
    - Weight/gravity
    - Eyelid pressure
  - Temporal
    - Flatter nasal elevation
- Conjunctival Prolapse

Basic Design Features

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
- Optic Zone
  - Centermost zone
  - Optics/Lens power
    - Anterior surface
  - Back surface
    - Ideally mimics corneal shape
    - Completely vaults cornea

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
- Transition Zone
  - Mid-periphery or limbal zone
  - Creates the sagittal height
  - Can be reserve geometry
  - Completely vaults limbus

- Spherical Design
  - Concentric symmetrical (spherical) scleral lens
  - Non-toric back surface
- Landing Zone
  - Area of the lens that rests on anterior ocular surface
  - Scleral zone or haptic
  - Alignment to provide even pressure distribution is key

- Toric Lens Designs
  - Front Surface Toric
    - Anterior surface front toric optics to improve vision
    - Located on the front surface of the central optical zone
    - Indicated when residual cylinder over-refraction is found
    - Needs stabilization
      - Dynamic stabilization zones or prism ballast
      - LARS
Basic Design Features

• Toric Lens Designs
  — Back Toric Haptics
  • Landing zone is made toric to improve lens fit
  • Does not interfere with central zone of scleral lens
  • Better ocular health
    — Fewer areas of localized pressure
    — Decreased bubble formation
    — Longer wearing time and better patient comfort
  • More frequently needed in larger diameter sclerals

Basic Design Features

• Toric Lens Designs
  — Bitoric both anterior optics and back toric haptics
  • Front surface toric optical power
  • Back surface toric periphery
  • No need for lens stabilization

Basic Design Features

• Multifocal Scleral lens design
  — Simultaneous Multifocal Lens Design
    • Aspheric or concentric
    • Center Near and Center Distance Designs
      — Can adjust near powers
      — Can adjust zone size
    • Not all scleral lens designs have a MF option

Basic Design Features

• Lens Material
  — High(est) Dk lens material; plasma or hydra-PEG
    • Considerably thicker when compared to corneal GP
      — 250 microns to 500 microns
    • Optimum Extreme, Menicon Z
  • Increasing Oxygen transmissibility
    1. high Dk material (Dk > 125)
    2. minimal tear clearance behind the lens (<200)
    3. Reduced center thickness of the lens (<.250)
Basic Design Features

Fitting Basics
• Completely vault the cornea and limbus while aligning to the bulbar conjunctiva.

Fitting Basics
• 1. Diameter
  • HVID
    • <12mm
      – Start with a 16.0 mm or smaller lens
    • >12mm
      – Start with a 16.0 mm or larger lens
  • Diameter of the optical zone and the transition zone chosen roughly 0.2mm larger than the corneal diameter

Fitting Basics
• 1. Diameter
  • Choose a Fitting Set
    • Direct vs Indirect control
  • Laboratory warranty/exchange policy
  • Overall Diameter
    • Larger – more clearance needed, ectasias
    • Smaller – easier to handle, less clearance

Fitting Basics
• 2. Clearance
• 3. Landing Zone Fit
• 4. Lens Edge
• 5. Asymmetrical Back Surface Design
  • Some trial sets are toric back surface
• 6. Lens Power

Fitting Basics
• How can I vault a steep cornea with a flat lens?
  BC much flatter than "K"
  Very steep cornea
Fitting Basics

• 2. Clearance
  – Minimum of ~100 microns
  – Typically aim for 200-300 microns after settling
  – Maximum of 600 (if desired)

  – Base Curve Determination
    • Select an initial base curve that is flatter than the flat k value
    • Use 14 mm chord OCT, measure sagittal depth

Fitting Basics

• Evaluate overall corneal chamber appearance
  – Diffuse beam, low mag, medium illumination
  – Observe centration, areas of bearing, tear lens appearance, look for bubbles

Fitting Basics

Estimate Corneal Clearance

- Lens
- Tear Lens
- Cornea

Fitting Basics

• Evaluate central clearance
  *Compare lens thickness to tear lens thickness and estimate central clearance in microns

Fitting Basics

Look for continuity of the tear lens…

Acceptable clearance: 
Too little clearance:

Fitting Basics

Look for continuity of the tear lens…
Fitting Basics

• Change lens base curve/sagittal depth until desired central clearance is reached
  — Considerations:
  • All scleral lenses will settle over a period of hours
  • Expect ~90 to 150 microns settling
  • Aim for 150 to 300 microns after settling
  • Build-in settling time into fitting session ~30 min

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Fitting Basics

• UMSL Study:
  — No significant settling after 4 hours of wear
  — Most settling within the 1st hour
  — Large Diameter Scleral settle ~90 microns, slower
  — Mini Scleral ~130 microns, faster

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Fitting Basics

• Evaluate remaining corneal chamber
  — Optic Section
  — Sweep limbus to limbus noting tear lens thickness
  — Looking for tears in optic section beyond the limbus and should increase in thickness toward the central cornea
  ** Adequate limbal clearance is critical for an acceptable fit and good tear exchange**

UMSL Optometry

Fitting Basics

• Anterior Segment OCT

Anterior Seg OCT

UMSL Optometry
Fitting Basics

- 3/4. Landing Zone Fit/Edge
- Bulbar conjunctival vessels
- Look for blanching
  - Inappropriate scleral curve alignment
  - Typically indicates PC is too tight
  - Or new toric back surface haptics
- Confirm no lens movement
- Ideal alignment when vessels course unobstructed under the scleral curves

Fitting Basics

- Properly fitted scleral curves
  - Vessels course unobstructed
  - No blanching seen
  - No movement
- Improperly fitted scleral curves
  - Blanching seen in primary gaze
  - Patient discomfort likely
  - Difficult removal
  - Redness after removal

Fitting Basics

- 5. Asymmetrical Back Surface Design
  - Allows for more equal pressure distribution
  - Can help center a inferiorly decentered lens
  - Flat and steep meridian
    - Can adjust either independently
    - Flat meridian is typically marked
    - Will lock into place
    - Usually has a dot for correct insertion
  - Other meridian
    - Can adjust independently
    - Usually has a dot for correct insertion
  - Flat meridian is typically marked
  - Will lock into place
  - Usually has a dot for correct insertion

Fitting Basics

- 6. Lens Power/Over-Refraction
  - Expect close to spherical OR
  - If OR yields significant cylinder check - flexure
    - Do over-keratometry or over-topography
  - Residual Cylinder
    - Front surface toric
    - Usually has a great visual outcome
Fitting Basics

• Design and Order
  – Often lens modifications will need to be made from the best trial lens fit
  – Lab Consultants are helpful
    • Some warranties require consultation when re-ordering

Fitting Basics

Scleral Lens Handling

• Insertion
  – Prepare Lens
    • Large DMV
    • Clean lens, rinse
  – Fill with non-preserved sol
    • 0.9% NaCl inhalation sol
    • Off label: Addipak, Modudose
    • Lacripure, ScleralFil (buffered)
    • Refresh Optive single vials
    • Celluvisc

Is buffered better??

<table>
<thead>
<tr>
<th>Product</th>
<th>Average</th>
<th>Range</th>
<th>Difference</th>
<th>Std. Deviation</th>
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<tr>
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<td>7.43</td>
<td>7.32-7.52</td>
<td>0.20</td>
<td>0.053</td>
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<td>0.021</td>
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<td>Lacripure</td>
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<td>5.21-5.45</td>
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<tr>
<td>Modudose</td>
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<td>4.78-5.38</td>
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<td>0.256</td>
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<tr>
<td>Additex</td>
<td>4.67</td>
<td>4.50-4.82</td>
<td>0.32</td>
<td>0.107</td>
</tr>
</tbody>
</table>

Current accepted pH range of 6.60 to 7.80 for ocular comfort

Fitting Basics

Lens Insertion

• Place paper towels on patient’s lap
• Have patient tuck chin to chest and look straight down
• Have patient hold lower lid
• Clinician hold upper lid
• Insert lens straight onto cornea

Fitting Basics

Scleral Lens Handling
Fitting Basics
Scleral Lens Handling

- Removal
  - Loosen Lens – gently nudge lens
  - Medium DMV
    - placed on inferior portion of lens
  - Hold both lids

Parameter Considerations

- Common Parameter Changes:
  - Sagittal Height
  - Overall diameter (OAD)
  - Optic Zone Diameter (OZD)
  - Base Curve (BC)
  - PC width
  - PC radius of curvature
  - Center Thickness

Parameter Considerations

- Common Parameter Changes:
  - Adjustable to the transition zone
  - Allows clinician to increase or decrease central lens clearance without adjusting base curve or peripheral lens curves
  - Indicate to lab the amount of clearance you want to gain or lose

Patient GH

- Fit in 2013
- OD: 7.50 / -7.00 / 14.5 20/50
- OS: 7.5 / -7.50 / 14.5 20/40
- SLE: central touch in both eyes
  - Increase diameter; increase sagittal height; steepen lens
Patient GH

- New Scleral Lens
  - OD: 7.5 / 14.8 / -7.50 / -1.25 x 013 20/30
    - 1.5 steep limbal zone
  - OS: 7.18 / 14.8 / -8.25 / -0.75 x 162 20/40+
    - 1 step flat limbal zone; 1 step flat scleral zone

Parameter Considerations

- Common Parameter Changes:
  - Overall diameter (OAD) / Optic Zone Diameter (OZD)
    - Can increase or decrease
      - More likely to increase
    - If you need additional central clearance
      - Can increase OZD which will increase OAD
    - If you need more clearance at limbus
      - Can increase OZD which will increase OAD

Parameter Considerations

- OZD changes: often done to improve fit
  - OZD increase without BC compensation
    - OZD: 8.2 mm BC: 7.5 mm
    - OZD: 9.0 mm BC: 7.5 mm

Parameter Considerations

- Increase OZD with BC compensation
  - OZD: 8.2 mm BC: 7.5 mm
  - OZD: 9.0 mm BC: 8.25 mm
  - Increased OZD without increasing sagittal height of lens

Parameter Considerations

- Common Parameter Changes:
  - Base Curve (BC)
    - Typically adjusted during initial fit
    - Flatter base curve to address peripheral lens tightness or excessive central clearance
    - Steeper base curve to increase central clearance or loose periphery
    - If you need to adjust the central clearance, but you are happy with peripheral alignment
      - Adjust sagittal height NOT base curve

Parameter Considerations

- Common Parameter Changes:
  - PC width / PC radius of curvature
    - Make wider or smaller
    - Steeper or flatter
    - Toric Haptics
  - Center Thickness
    - Can increase or decrease
      - Considerations: flexure and edema
Parameter Considerations

• Scleral Curve Changes

Steeper PCs
100 mic
Flatter PCs

Sag: 2.8 mm
Sag: 2.7 mm

Tips for Fitting

• 1. Go flatter than flat K value for initial lens selection
• 2. Use Fluorescein for initial lens selection
  – Use BLUE Light – GET THE BIG PICTURE
  – Use WHITE Light – to evaluate everything else
• 3. Analyze Superior and Inferior lens edges in Primary Gaze
• 4. Try not to make parameter changes at dispensing
• 5. Toric Haptics – spin lens and watch for quick return

Tips for Follow-up

• 1. Ask patient: “How do you take care of your lenses”
• 2. Follow-up should be at least 2 hours after lens insertion
• 3. Paint the front of the lens to look for fluid exchange
• 4. Remove lens and evaluate cornea

Troubleshooting

• Problem: Decreased vision after insertion
  – Often caused by mucin build-up in tear lens
  – Begins ~30min to 4 hrs after insertion

• Possible Solutions
  – Reinsert lens with fresh solution/ use solution mixture
  – Rx lid hygiene
  – Rinse eye prior to insertion
  – Refit with decreased central clearance/better peripheral alignment
  – Change lens material or Lens coating – Hydra-PEG

Troubleshooting

• Decreased Vision after Insertion
  – Patient states vision gets foggy after 2 hours of wear and gradual decreases in clarity over time
  – ~200 microns clearance OD/OS
  – NaFL seeps under lens superiorly OD and 360 OS

Re-order: steeper PC OU

Troubleshooting

• Conjunctival Prolapse

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Troubleshooting

Conjunctival Prolapse

- Caused by negative pressure under the lens
- More prominent in patients with loose conjunctival tissue or elderly patients

• Check for neovascularization
• Solution
  - 1. Fit a asymmetrical back surface scleral lens to help alleviate the problem
  - 2. Decrease limbal clearance

Troubleshooting

Conjunctival Prolapse

- Prolapse with tight PC
  - Flatten the PC

Troubleshooting

Conjunctival Prolapse

- Prolapse with peripheral alignment
  - Decrease the limbal clearance
  - 2 ways:
    • Flatten the BC
    • Decrease the reverse curve

Troubleshooting

Problem: Diffuse Corneal Staining on follow-up

- Due to fill media, care systems, AT’s or meds
- Can be difficult to isolate cause
- Can be more significant if tear exchange is low

• Possible solutions:
  - Switch Care systems
  - Rx 0.9%NaCl inhalation solution
  - Completely rinse MPS off lens
  - Confirm compliance with prescribed care

Troubleshooting

A severe case of stain

- 27 yo patient with Keratoconus OU
  • Wearing scleral lens OU – 2014
  • Hx of Corneal Crosslinking OU ('09)

- Presents 7/2017
  • Cc: blurred vision OS> OD
  • using clear care to clean lenses
  • sometimes sleeps in lenses
  • uses Boston Advance to fill lenses prior to insertion

A severe case of stain

- 27 yo patient with Keratoconus OU
  • VA 20/30– OD 20/125 OS
  • SLE: Punctate staining OU, mild corneal edema OS
  • 150 microns clearance OU
  • Adequate limbal clearance
  • No peripheral blanching or impingement

• Plan: educated patient about proper lens care; RTC 1 week fitting
Troubleshooting

- **Problem: Poor surface wetting**
  - MGD can contribute / cause problem
  - Multipurpose Solution (MPS) may cause problems
  - Lens Material

- **Possible Solutions:**
  - Evaluate lid margins/ tear film
  - Prescribe lid hygiene if necessary
  - Change MPS / Lens material
  - Lens Coating – hydra-PEG

39 yo female
PKP OD / KCN OS
Jupiter scleral OU – Tyra 97
Issues with surface wettability
Re-order OD with hydra-PEG
Patient LOVES hydra-PEG – has significantly decreased surface deposits and she does not have to remove to clean during the day.

Case TS: KCN and Fuchs

- **Initial FITTING**
  - HVID 12mm; Pingecula T/N OU
    - 8.4 base curve
    - 4.6 sagittal height
    - 17.0 diameter
    - OR: +3.75 -0.75 x 180 20/25—
    - +4.00 -0.75 x 180 20/30

- **Options to Troubleshoot Pingecula:**
  - Microvault
  - Toric PC

Breathing Easy, for the Patient and Yourself: Contact Lens Vision Rehabilitation for Thirty-six year old Corneal Graft with Edema

Jonathan Chen, OD; Julie DeKinder, OD, FAAO, FSLS
Diplomate AAO, CLCFT
Breathing Easy, for the Patient and Yourself: Contact Lens Vision Rehabilitation for Thirty-six year old Corneal Graft with Edema

Introduction

- Scleral Lens (ScCL)
- Grafts with significantly reduced endothelium cell counts
- Corneal grafts with significantly reduced endothelium cell counts

Differential Diagnoses

- Late graft endothelium failure OD
- Chronic corneal edema OD

Diagnosis:

- SynergEyes
- SynergEyes
- SynergEyes

Rest of series A (2 D) reverse

Results

- Patient reported AWT 5
- OD: unable to obtain reliable scan secondary to edema in clinic
- Specular Microscopy (cells/mm

Testing

- Comparison Pachymetry OS to monitor for edema

Conclusion

- Hypoxia, but this case shows to also be cognizant on elevated changes.
- IOP.
- Tear exchange
- Health, IOP, and edema.

http://www.reviewofcontactlenses.com/article/postkeratoplasty


2/10/2019
Case TS: KCN and Fuchs

• Toric Haptics/Peripheral Curves
  – Steepen the Vertical meridian to relieve pressure in the horizontal
  – Flatten the horizontal meridian
  – Always evaluate the location of the flat meridian markings

• MicroVault
  – Confirm lens design can incorporate microvaults
  – Measure location and size

Troubleshooting

• Problem: Discomfort immediately after insertion
  – Ask patient where discomfort is located
  – Poor peripheral fit – too flat
  – Base curve too flat- central bearing or touch
  – Mucus adhered to back surface of lens

• Possible solutions:
  – Adjust peripheral systems for proper alignment
  – Select steeper base curve
  – Clean inside of bowl daily; prescribe Progent (Menicon) to remove mucus

Case TS: KCN and Fuchs

• Keratoconus and Fuchs! Oh My!
  – At one year follow-up

Troubleshooting

• Problem: Discomfort after several hours of wear
  – Follow-up patient questions
    – Does your eye become red while wearing the lens?
    – Does your eye become red after lens removal?
    – Where is the irritation located?
    – Do you notice any changes in your vision?
    – What solution(s) are you using for lens application?
Troubleshooting

• Problem: Discomfort after several hours of wear
  – Poor peripheral fit (too steep)
  – Lens is too small to support its weight
  – Corneal chamber too small

• Possible solutions:
  – Adjust peripheral systems for proper alignment
  – Increase surface area of scleral curves
  – Increase OAD or corneal chamber size if appropriate

• Problem: Lens hurts upon removal with subsequent difficulty wearing it the next day
  – Poor peripheral fit — scleral compression
    • Causing rebound hyperemia and inflammation

• Possible solutions:
  – Changing Diameter
  – Changing peripheral curves

Patient AB

• History: KCN OU; crosslinking OU
• Lens history: soft toric lenses

Patient AB

• Examination findings
  – MR:
    • OD +0.75 -3.50 x 060  20/70+
    • OS -0.25 -0.75 x 142  20/100+
  – Lens options
    • Specialty Corneal lens
      – Patient attempted to wear and could not adapt
    • Intralimbal design
      – Patient attempted to wear and could not adapt
    • Scleral Lens

Patient AB
Final Thoughts

• Consider mini-scleral / scleral for appropriate patients
  – Select one lab, one design
• First couple fits are the most challenging
• Scleral lenses are not going away
• Consultants are a great resource
• Huge practice building opportunity

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