Rapid Fire:
Combatting Common Scleral Lens Problems

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Disclosure Statement:


- **Harthan**: Allergan, Contamac, Metro Optics, Shire

- **Johns**: Clinical and Educational Consultant to Bausch+Lomb

- **Shorter**: None
Scleral Lens Fitting Indications

Jennifer S. Harthan OD, FAAO, FSLS
Illinois College of Optometry
SCOPe: Scleral Lenses in Current Ophthalmic Practice Evaluation

• SCOPE I
  – Purpose:
    • Describe international scleral lens prescription and management practices
  – Method:
    • Fitters were asked to report their current scleral lens prescribing practices
SCOPE I Results: 989 Respondents >84,000 fits

n=723 have fit ≥5 scleral lenses (73%)
n=266 < 5 scleral lenses (27%)

SCOPE I Results: Indications for Scleral Lens Fitting

corneal irregularity 74%
ocular surface disease 16%
refractive error 10%

**Prevalence of Corneal Irregularity**

- Olmsted county, MN (Kennedy et al, 1986)
  - Frequency of KC = 1:2,000
  - Prevalence: 54.5 per 100,000
  - Diagnosis based on:
    - Scissors reflex
    - Keratometry
    - M = F

- Netherlands (Godefrooij 2016)
  - Data extraction from largest health insurance provider
  - Annual incidence: 13.3 per 100,000
  - Prevalence: 265 per 100,000
  - 5- to 10-fold higher than previous studies

- Highly prevalent in Middle East, India, China
  - 4:1 Asians to Caucasian
  - present at earlier age
  - require corneal graft at earlier age

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Eiden SB, Matz M. Research review - keratoconus is more prevalent than we thought. Contact Lens Spectrum. 2017 Apr; 14:15.
Prevalence of Dry Eye – DEWS II

- Higher in Asian populations
- DES increases linearly with age
- Rate of MGD increases linearly with age
- High rates reported in:
  - Younger subjects
  - School children
- Differences in prevalence rate by sex become significant only with age.
- Limited studies evaluating disease incidence.

Dry Eye Disease Management

Step 1
Step 2
Step 3
Step 4
Well-Fitting Scleral Lens
SCOPE I: Reported Complications

![Graph showing reported complications]


Common Scleral Lens Patient Complaints

Ellen Shorter OD, FAAO
University of Illinois at Chicago College of Medicine
Common Scleral Lens Patient Complaints

- Discomfort
  - Loose Lens
  - Tight Lens
  - Inappropriate Solutions

- Blurred Vision
  - Air Bubbles
  - Lens Flexure
  - Surface Debris
  - Tear Layer Debris
Discomfort...When?
Immediate Discomfort

• Initial adaptation
  – Reassure and redirect patient to focus on treatment goals
    • Improved comfort
    • Improved vision
• Poor haptic alignment / too loose
  • Check for immediate NaFl exchange
  • “Test” by holding lids out of the way
Discomfort Late in The Day

• Corneal Touch
  – Check for settling mid/late day

• Tight Lens
  – Access haptic
  – Evaluate conjunctival tissue after removing lens
    • Ideally after ½ day of CW

• Tips:
  – Evaluate fit without NaFl first
  – Have patient look to extreme gazes to exaggerate
  – May have symptoms of “itching” after removal
Discomfort Months/Years Later

- Review cleaning routine and filling solutions
- Check fit
  - Progression of ectasia, corneal touch, epitheliopathy
  - Watch for pinguecula irritation
    - If staining/redness/local tenderness, make design changes
      - Flatten haptic landing or add back surface toricity
      - Consider decreasing/increasing OAD
      - Consider trial notching by lab or microvault design
Case: JK

- 62 y/o male referred for severe dry eye
  - h/o leukemia s/p BMT with ocular GVHD
  - c/o constant eye pain and light sensitivity
  - Previous treatment
    - ATs q15 min
    - Lubricating ointment
    - BCLs
    - Punctal cauterization
    - Restasis®
    - Serum tears
    - Moisture goggles
Case JK - Slit Lamp Exam

• SLE
  – Lids/Lashes: irregular margins, (+) telangectasia, inpissated glands
  – Puncta: cauterized upper and lower
  – Conj: 1+ diffuse injection with staining, elevated pinguecula temp OS
  – Cornea: 1-2+ diffuse PEE
  – AC: d&q
  – Iris: clear
  – Lens: tr NS c small central PSC OD, OS

• Schirmer results: 2mm OD, 3mm OS
Case JK

- Initially fit 18.2mm commercial scleral OU
  
  - Follow up visit
    - Redness left eye temp
    - Worse at the end of the day
Case JK

• Trial
  – Smaller OAD (15.6)

• Final lens
  – Increased OAD (18.8)
  – Flattened haptic

• “Doctor, I love these lenses.”
Additional Examples: Pinguecula

• Watch for staining
What Solutions Are They Using?
What Solutions Are They Using?

• Ideally the cornea should be clear
  – If diffuse corneal staining rule out medicamentosa
• Only PF solutions to fill
• Consider other eye drops - both Rx and OTC
  – Frequency of AT use? Preserved with BAK?
    » May see delayed response to BAK
  – Glaucoma medications?
    » Consider PF of less irritating preservative
Filling Solutions

- LacriPure
- ScleralFil
- 0.9% inhalation sodium chloride solution
- PuriLens Plus Saline
- Preservative-free artificial tears
Complaints of Blurry Vision
Bubbles

insertion bubble
Bubbles During Lens Application

• Application error
  – Review application in office
    • Common early on
  – Train patients to check for bubbles
    • Magnified makeup mirror
    • Penlight
    • Cover one eye, check clarity
  – Recommend stand

https://dalseyadaptes.net/store/
Bubbles Later In The Day

– Acquired bubble later in day
  • Carefully evaluate the lens fit
    – Minimize vault when possible
    – Check for excessive edge lift
      » Utilize toric haptics if not already

– Fenestrated design
  • Try larger/looser/high dk first
  • If central bubble adjust further
Poor Vision

• Careful over-refraction
  – Achieve BCVA with sphere first while refining fit
  – Add optical toricity if needed

• Rule out flexure
  – Be suspicious if unexpected cylinder in over-refraction
  – Check K’s over the lens
  – Can try toric haptic or increased CT
Poor Vision

• Patient education
  – Transition period when moving out of corneal GP

• Consider utilizing different eccentricity if available
  – Helpful for corneal irregularity
Common Lens Problems

Melissa Barnett OD, FAAO, FSLS, FBCLA
UC Davis Health System
Conjunctival Compression
Ideal Scleral Alignment

- No blanching of blood vessels
- No impingement
- No edge lift

Photos Greg DeNaeyer, OD
Conjunctival Compression

• Can occur in one or more quadrants
  • More often horizontal meridian
  • Blanching due to excessive bearing of the peripheral curve
  • Can occur at the outer edge of the lens or at the inner aspect of the landing zone

• Related to a spherical lens on a toric conjunctival surface

Conjunctival Misaligment

• Conjunctiva is toric in nature
  • Non-symmetrical surface
  • Nasal side is flatter and higher
  • Temporal side is steeper but lower
• Over 15 mm, it may not be possible to align scleral peripheral curves in every quadrant
• May require toric peripheral curves

van der worp et al. 2010
Average Conj Curve @ 15mm

Average 38.3
Average Conj Curve @ 20mm

Average 39.8
OCT to Assess Landing Zone and Edge Profiles

GOOD

TIGHT

Image from Critical Measurements to Improve Scleral Lens Fitting. Jason Jedlicka, OD and Greg DeNaeyer, OD. Contact Lens Spectrum, September 2015
Lens Adherence
Lens Adherence

• Tight lens
• Steep lens can cause seal off
• Minimal clearance

Photo Lynette Johns, OD
Lens Adherence Management

- Alter peripheral curves
- Increase clearance
- Remove lens from periphery
- Artificial tears prior to removal
- Manually move lens
- Break suction
Lens Fogging/Non-Wetting
Fogging vs. Edema

- Rainbows around lights?
- Corneal microcystic edema?
- Does lens removal / reapplication solve issue?

Image: University of Iowa
Reservoir Debris

• Potential to impact visual acuity
• Potential to impact convenience
  • Remove and reinsert lenses 2-3 times /day
• Etiology
  • Ocular surface disease
  • Scleral lenses disrupt transmembranal mucin of the goblet cells; may alter cell membranes (lipids) (Caroline, GSLS, 2014)
  • Fluid dynamics under a scleral lens
    • Attracts deposits in reservoir if clearance over the limbus is high enough
    • No tear exchange – debris accumulation over time
Types of Debris

• Mucin debris – opaque, white, fluffy, small debris
  • Evaluate for GPC
  • Tighten/toric peripheries

• Evaluate for GPC

• Diluted milky fogging – associated with atopic keratoconus
  • Consider soft steroids

• Meibomian debris – semi-transparent or yellow floating on water
  • Treat MGD or blepharitis

Remove/reapply
  Evaluate fit
  Add toric/flatter peripheries
  Decrease diameter
Additional Fogging Strategies

• Mix of viscous artificial tears and saline in the bowl
• Ask the patient to replenish solution from the side, without removing the lens
  • frequent insertion /removal will promote more disruption of the ocular surface, and more debris (Sindt, AAO, 2014)
• Last resort
  • soft lens piggyback under scleral
Case: Suzanne

• 50 year old Caucasian female
• Interested in contact lenses for full time wear

• History of Sjögren’s Syndrome
  • Diagnosed 4 years ago
    – Dry mouth
    – Ocular foreign body sensation
    – Intermittent red eyes
Case: Suzanne

• Medical history: Sjögren’s Syndrome
• Medications: Plaquenil 200 mg bid po (x 4 years)
• Ocular history: keratoconjunctivitis sicca OU
• Family history: (+) rheumatoid arthritis - mother
• Ocular medications:
  – Cyclosporine 0.05% bid OU
  – Preservative free artificial tears PRN (3x in past week)
  – Visine PRN (2x in past week)
<table>
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<tbody>
<tr>
<td>VA</td>
<td>20/20 (glasses)</td>
<td>20/20-2</td>
</tr>
<tr>
<td>Pentacam</td>
<td>43.10 / 44.00 / 106</td>
<td>43.10 / 44.00 / 083</td>
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<td>Sim Ks</td>
<td>Refraction</td>
<td>-5.50 20/20</td>
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<tr>
<td>Pachymetry</td>
<td>542</td>
<td>532</td>
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<tr>
<td>IOP</td>
<td>18 mmHg</td>
<td>18 mmHg</td>
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Tonopen @ 3:42pm
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<td>2+ mgd, irregular lid margins</td>
<td>L/L</td>
<td>2+ mgd, irregular lid margins</td>
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<tr>
<td>Trace hyperemia, 2+ NaF stain nasal and temp 1+ nasal and temp LG stain</td>
<td>Conj</td>
<td>Trace hyperemia, 3+ NaF stain nasal and temp 3+ nasal and temp LG stain</td>
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<tr>
<td>1+ inferior PEK</td>
<td>Cornea</td>
<td>3+ inferior PEK</td>
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<tr>
<td>Deep and Quiet</td>
<td>A/C</td>
<td>Deep and Quiet</td>
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<tr>
<td>Clear</td>
<td>Lens</td>
<td>Clear</td>
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<tr>
<td>0.15</td>
<td>C/D</td>
<td>0.15</td>
</tr>
<tr>
<td>Normal</td>
<td>Macula</td>
<td>Normal</td>
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**OD**

- **Cornea**: 3+ inferior PEK
- **A/C**: Deep and Quiet
- **Lens**: Clear
- **C/D**: 0.15
- **Macula**: Normal
- **Peripheral Retina**

**OS**

- **Cornea**: 3+ inferior PEK
- **A/C**: Deep and Quiet
- **Lens**: Clear
- **C/D**: 0.15
- **Macula**: Normal
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<td><strong>Lenses</strong></td>
<td>Aspheric Multifocal Scleral Lens 41.00 / -2.00 / 16.4 / 9.2 Flattter PCs Sag 4.55</td>
<td>Aspheric Multifocal Scleral Lens 42.00 / -3.25 / 16.4 / 9.2 Flattter PCs Sag 4.59</td>
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<td>20/20-2 J2</td>
<td>VA Binoc 20/15+1 J1</td>
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<td><strong>Visual Acuity</strong></td>
<td>Plano</td>
<td>20/20 J1</td>
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<tr>
<td><strong>SOR</strong></td>
<td>Good central apical clearance Good peripheral fit No blanching</td>
<td>Plano</td>
</tr>
<tr>
<td><strong>Fit</strong></td>
<td>Good central apical clearance Good peripheral fit No blanching</td>
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Poor Surface Wettability

- Decreases vision
- Diminishes lens comfort
- Increases chair time
- Increases patient costs

Photo Credit: Karen Lee, OD
Patients at Risk

- Ocular surface disease
  - Ocular rosacea
  - MGD
  - Filamentary keratitis
- Excessive lipids in the tear film create a foggy, hydrophobic lens surface
- Exposure
  - Ptosis
  - Stroke / nerve palsy
  - Eyelid repair
External Causes

- Poor plunger hygiene
- Makeup/Skincare regime (oil-based products)
- Hand soaps with moisturizing agents
- Older blocking compounds such as pitch
Preventing and Managing Poor Surface Wettability
Treatment Strategies

• Increased lubrication with preservative-free artificial tears over the lens throughout the day
• Physical removal
• Remove, manually clean, rinse and reapply
• Squeegee technique
• Polish front surface of lenses BUT remove plasma surface
First and Foremost

- Treat and manage ocular surface disease!
- Lipids and mucins are attracted to hydrophobic GP material
• Polymer encapsulates lens
• Improves wettability
• Increases surface water retention
• Increases lubricity
• Reduces deposits
Protein and Lipid Deposition

Protein Deposition

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<th>Material</th>
<th>Protein (μg/lens)</th>
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<td>HydraPEG</td>
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Lipid Deposition

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<th>Lipid (μg/lens)</th>
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<tbody>
<tr>
<td>SiHy</td>
<td>10</td>
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<tr>
<td>SiHy HydraPEG</td>
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Partner Lab
End of Day Comfort Study

All Patients
n = 34 eyes

Dry Eye Patients
n = 11 eyes

Falco Linsen, Switzerland
Partner Lab
Wear Time and Preference

**Comfortable Wear Time**

<table>
<thead>
<tr>
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<tr>
<td>Uncoated</td>
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<tr>
<td>Hydra-PEG</td>
<td>10</td>
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**Lens Preference**

<table>
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<tr>
<td>Hydra-PEG</td>
<td>4</td>
</tr>
<tr>
<td>No Preference</td>
<td>1</td>
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WHICH LENS DO YOU PREFER?
Problematic Ocular Findings in a Scleral Lens Patient

- Corneal Edema
- Corneal Neovascularization
- Corneal & Limbal Staining
- Conjunctival Staining
- Hyperemia
- Conjunctival Prolapse
Corneal Edema
Oxygen

Physiological Corneal Edema 4%
Oxygen in Theory and in Practice

  – Dk > 150, c.t. 250 mm, clearance 100-250 mm
  – Dk 140, c.t. 300 mm, clearance 50 mm yields oxygen tension of 100 mmHg
  – 55 mmHg needs Dk 125, c.t. 200 mm, clearance <150 mm
  – n = 8 15.5 corneo-scleral (Dk 100, 300 c.t. 300 mm c.t) 150 and 300 mm clearance
  – 1.59% and 3.86% swelling
Corneal Hypoxia

- PMMA taught us a lot!
  - Reduced corneal sensitivity
  - Increased epithelial fragility
    - Increased thinning
    - Increased cell size
  - Epithelial microcystic edema
  - Stromal Edema
  - Polymegathism
  - Hyperemia
  - Corneal neovascularization
Corneal Bullae
Troubleshooting

- Obtain pre- and post-wear pachymetry
- Obtain endothelial cell count
- Optimize Dk of material
- Reduce clearance
- Consider fenestration
- Hypertonic sodium chloride ointment after removal
- Challenge transplants prior to fitting or dispensing
Corneal Neovascularization
Neovascularization
Novel Applications: Drug Delivery

Troubleshooting

- Measure extent, location and depth at baseline
- Photodocument
- Optimize Dk
- Reduce wearing time
- Increase diameter of lens
- Increase limbal clearance
- Refit to loosen adjacent landing zone and reduce compression
Corneal and Limbal Staining
Absence of Corneal Staining After Wear

OD pre-lens

OS pre-lens

OD after 6 hours

OS after 6 hours
Corneal Staining after Lens Removal

- Focal staining: suspect apical contact
- Diffuse staining: solution toxicity
- Herpetic etiology
Changes to the Peripheral Cornea

- 15 patients, 14.6 diameter 300 micron clearance; 6 hr WT 14 with bullae
- Epithelial bullae likely mechanical
Troubleshooting

- Increase apical clearance
- Increase limbal clearance
- Increase diameter
- Bubble identification instruction
- Ensure preservative free filling solution
- Change to preservative free care system
Conjunctival Staining
Conjunctival Staining

- Arcuate conjunctival staining is likely caused from scleral lens impingement
- Impingement that is very focal can lead to lacerated conjunctiva
- Sometimes a scleral lens can reduce conjunctival staining
Troubleshooting

• Loosen peripheral curves; if meridional loosen one meridian – make lens toric
• Refit-smaller or larger but avoid hypertrophic ridge or nodule
• Lubrication ointment at nighttime
• Reduce wearing time
Conjunctival Hyperemia
Conjunctival Hyperemia

- When does the redness occur?
  - Before application
    - Nocturnal lagophthalmos
  - Immediately after lens application
    - Mechanical
    - Solutions
    - Bubble
  - End of wearing
    - Compression
    - Impingement
  - After removal
    - Rebound hyperemia
    - Mechanical

- Where is it?
  - Outside the lens vs Inside the lens

- Changes in solutions?

- Changes in systemic medications?
  - Systemic condition flare-up
Troubleshooting

• Ensure preservative-free filling solution or care regimen
• Eliminate compression and impingement by loosening peripheral curves
• Change face creams, make-up
• Re-instruct proper removal technique
• Instruct bubble identification
Conjunctival Prolapse
Conjunctival Prolapse

- Excessive conjunctival tissue drawn underneath the clearance zone of a scleral lens
- Often associated with an area of extreme clearance
- Neovascularization may occur to leading edge of prolapse
- Prolapse may adhere
Troubleshooting

- Align clearance as close to corneal topography as possible
- Align scleral landing zone in quadrant or meridian of prolapse
- Decrease the diameter
- Decrease limbal clearance
Thank you for your attention!

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