Understanding the basic and not so-basic essential tips in fitting scleral lenses.

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Dr Michaud  
• Honorarium /Speaker fees /Research Grants
  - Alcon /Ciba
  - B&Lomb (Valeant)
  - Cooper Vision
  - Blanchard Labs
  - Genzyme Canada

Dr Brazeau  
• Honorarium /Speaker fees
  - Blanchard Labs

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Disclosure

For which of the following patients would you recommend scleral lenses for?
• Keratoconus patient
• Oblate post-RK patient
• Highly myopic asian teenager
• Emmetropic, presbyopic manager (1st time wearer)
• Soccer dad complaining about CLD
• Astigmat patient complaining about fluctuent vision
• All of them
• None of them

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THE TRAIN IS COMING… .... ARE YOU READY ?

Scleral lenses are booming

Source: DeNayer, G. http://www.revoptom.com/continuing_education/tabviewtest/lessonid/108308/
RGP lenses: where are we?

A look in the past

- The concept of optically neutralizing the cornea with an enclosed liquid reservoir over the eye’s surface was first proposed by Leonardo da Vinci in 1508.

- Thomas Young was the first to experiment visual correction through a glass tube filled in with water. His work was based on René Descartes’ papers.

- Among the first lenses manufactured
  - Adolf Eugen Fick (1888), lenses in glass
  - Failure: poor design, physiological complications, suction
- Re-birth in 1983
  - Ezekiel – used of gas permeable material
  - Haptic design, fenestration

- In the last 10 years, improved technology allowed for the production of scleral and mini-scleral lenses

A look in the future of RGP lenses

- To fit larger diameter gas permeable lenses
- OR.....

Definitions

- Large diameter lenses (>14.0 mm) are NOT contact lenses because they do not lie, nor touch the cornea
- Their resting point are located beyond the corneal borders
SLES classification

<table>
<thead>
<tr>
<th>Lens Type</th>
<th>Description</th>
<th>Definition of Wearing Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corneal</td>
<td></td>
<td>Lens rests entirely on the cornea</td>
</tr>
<tr>
<td>Corneoscleral</td>
<td></td>
<td>Lens rests partly on the cornea, partly on the sclera</td>
</tr>
<tr>
<td>Scleral</td>
<td>Mini/Scleral</td>
<td>Lens is up to 3mm larger than BVD</td>
</tr>
<tr>
<td>Scleral</td>
<td>Large Scleral</td>
<td>Lens is more than 3mm larger than BVD</td>
</tr>
</tbody>
</table>

Large diameter lens indications

1. Vision improvement
   - Irregular corneas
   - Corneal ectasia
   - Post-surgery (graft, refractive surgery)
   - Current / High refractive errors
   - Fluctuating vision with current contact lenses (astigmatism)

2. Ocular dryness / diseases
   - Severe dry eye (Sjogren) - Exposure keratitis
   - Ocular Surface Diseases - Neurotrophic corneas
   - CLIDE - Systemic diseases with ocular manifestations

3. Intolerance to regular gas permeable lenses (smaller diameter)

4. Prosthesis/Cosmesis /sports

Significant impact on wearers

This photo shows a sports-related injury of a OneFit™ PVA mini-scleral contact lens wearer. This 13 year-old girl was poked in the eye with a finger and fingernail during a basketball event. The force of the trauma broke the lens. One half immediately came out of the eye. The other half rested nicely in place, superiorly. The player noted that the finger poked the center of the eye and slid towards the outside corner. As seen in the photo, the cornea was completely unaffected. The trauma occurred where the nail came in contact with the eye, but the cornea was protected.

What is known:
Clinical advantages of large diameter RGP lenses

- Initial and long term comfort
- Stability
- No lid interaction
- Oxygen transmissibility *
- Fluid reservoir
- Improved visual acuity
- Customized design

What is not known:
Natural evolution of large diameter RGP lenses

Clinical applications for normal corneas

- High refractive errors
- Presence of HOA, glare, haloes symptoms
- Fluctuant vision
- Contact lens induced discomfort
- Presbyopia
- Sports / allergy/ challenging environment
Modern reality
Decentered small RGP with swirl staining

OR
Perfectly centered mini-scleral lens

Sclerals vs Small RGPs

<table>
<thead>
<tr>
<th></th>
<th>SMALL RGPs</th>
<th>SCLERALS</th>
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<tbody>
<tr>
<td>Initial comfort</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Long term comfort</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Visual acuity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corneal astigmatism</td>
<td>Up to 3 D</td>
<td>Up to 3.5 D</td>
</tr>
<tr>
<td>(spherical lens)</td>
<td>3.9 o’clock sig?</td>
<td>No corneal sig</td>
</tr>
<tr>
<td>Fitting /Learning curve</td>
<td>Easier</td>
<td>Longer</td>
</tr>
<tr>
<td>Handling</td>
<td>Easier</td>
<td></td>
</tr>
<tr>
<td>Designs (toric)</td>
<td>Front/ b-toric</td>
<td>Front</td>
</tr>
<tr>
<td>Designs (MF)</td>
<td>Corneal warpage</td>
<td>Lens is stable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>better outcome for high ametropia</td>
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Sclerals vs Hybrids

<table>
<thead>
<tr>
<th></th>
<th>DUETTE</th>
<th>Clear Kone</th>
<th>Ultra Health</th>
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<tr>
<td>Initial comfort</td>
<td>=</td>
<td>Could be an issue</td>
<td>=</td>
<td>=</td>
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<tr>
<td>Long term comfort</td>
<td>=</td>
<td>Could be an issue</td>
<td>=</td>
<td>=</td>
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<tr>
<td>Visual acuity</td>
<td>For regular corneas only</td>
<td>Could be an issue with high irregularity</td>
<td>Overall, it is better</td>
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<tr>
<td>Corneal astigmatism</td>
<td>No ectasia</td>
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<td>=</td>
<td>Up to 3.5 D</td>
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<tr>
<td>(spherical lens)</td>
<td>= scleral</td>
<td>= scleral</td>
<td>More complicated</td>
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<td>Fitting /Learning curve</td>
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<td>= scleral</td>
<td>= scleral</td>
<td>Lens is &lt; 15 mm are preferable</td>
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<tr>
<td>Handling</td>
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<td>= scleral</td>
<td>= scleral</td>
<td>= scleral</td>
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<tr>
<td>Cost</td>
<td>Affordable</td>
<td>Costly</td>
<td>More affordable</td>
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<tr>
<td>Clinical application</td>
<td>Limited</td>
<td>Limited to KC</td>
<td>Limited To KC</td>
<td>Fully customizable</td>
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Sclerals vs Piggy backs

<table>
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<tr>
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<th>Piggy backs</th>
<th>SCLERALS</th>
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<tbody>
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<tr>
<td>Long term comfort</td>
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<tr>
<td>Visual acuity</td>
<td>RGP can decenter</td>
<td>Stable, better v.a.</td>
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<tr>
<td>Clinical application</td>
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<tr>
<td>Designs (MF)</td>
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<td>Better outcome</td>
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<tr>
<td>Cost /convenience</td>
<td>Higher /less</td>
<td>Lower / More</td>
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Limiting factors

- Oxygen permeability
- Corneal physiology
- Conjunctival anatomy
- Rate/ nature of complications
- Ease of fit / troubleshooting
- Learning curve
- Handling

A theoretical approach
- Considering available materials
  - DK of 100 to 170
- Various lens thicknesses
  - 250-500 um
- Post-lens tear thickness
  - 100-400 um
Maximal central thickness of a lens

<table>
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<tr>
<th>Lens Dk</th>
<th>100</th>
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<th>229</th>
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<td>875</td>
<td>781</td>
<td>687</td>
<td>500</td>
<td>312</td>
<td>125</td>
<td>60</td>
<td>240</td>
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</tbody>
</table>


A clinical model

- Corneal edema is not associated with scleral lens wear except if endothelial cell layer is compromised
- Replenishment of the oxygen should come from other sources
  - Limited tear exchange
  - Larger lenses vs smaller lenses vs conjunctival toricity

Transient hypoxia

- First 2h00 of wear
  - Affects central cornea

Rule no.1

- To vault over the cornea
  - SAG of an eye vs sag of the lens
  - Base curve ??

Ocular surface sagitta
**Base curve vs sag**

**Factors to consider**
- Base curve
- Intermediate (reverse curve)
- Diameter (zones, overall)

**Rule no.2**
- To land nicely on the conjunctiva
  - Without compression
  - Without edge lift

**Conjunctival anatomy**
- Conjunctiva is toric in nature
  - > 15 mm
  - Insertion of the right muscles
- Needs of designing toric peripheries to align in all meridians
  - If significant edge lift: discomfort
  - However, allows tear exchange

**OCT can help**

**Support for the lenses**
- Conjunctival Support
  - While settling lenses will sink into the conjunctiva
    - Depending on lens design and other factors
    - Loss of fluid over the day
- Fluid layer support
  - Like a water bed
    - Larger lenses need greater vault higher clearance
    - Designs
      - Optimum design should create a wedge profile vault from lens center to lens edge creating a fluid layer supporting the lens
Support for the lenses

• Never allow corneal touch to support the lens
  – Corneo-scleral lenses lead to increased discomfort and higher risk of distortion, scarring, etc.

Fitting Process

Step no.1

• Select the diameter of the lens
  – Based on the corneal diameter
  – Mini vs Full scleral lenses
    • Patient condition
    • Visual needs
    • Easiness to fit

Modern consensus

• Mini-scleral lenses are ideal for:
  – Day-to-day visual needs
  – Regular refractive errors
  – Presbyopia
  – Corneal irregularity and ectasia
  – Sports, environmental challenges
  – Allergic conditions

• Larger diameter lenses are ideal for
  – Corneal grafts (reverse geom), severe ectasia
  – Ocular surface disorders treatment
  – Megalocornea
  – Pellucid Marginal Degeneration

Step no 2 Selection of the BC/SAG

• Sag mapping /calculation
• Empirical
  – Always follow manufacturer’s fitting guides

• Goal
  – Lenses < 15 mm: to vault by 200 um
  – BC: 0.3 to 0.4 steeper than K
  – Sag: 4.4 to 4.5 for a normal cornea;
  – Lenses > 15 mm: to vault by 400 um
  – Sag value: 4.5 to 4.8 mm
  – Higher for KC;
  – lower for oblate pattern (post-graft)

Sag evaluation

• Direct observation : not reliable
• Empirical : trial and error
• Topographic maps: specific software (Medmont)
• Eaglet Eye Profiler : quadrant specific and overall sag evaluation (up to 18 mm of chord)
• OCT : takes chair time
**Sag mapping**

**BC selection**

Use of elevation map (Medmont)
- Highly irregular corneas
- Very limited nipple cones (most of the cornea is normal)

**PROCESS**
- Select the elevation map
  - Provides elevation in microns
  - Provides Corneal Best Fit Sphere

**Target:**
- To vault by 180-200 um (0.6 to 0.7 mm) over BFS.

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**Topo maps**

- Regular map showing a nipple cone
- Elevation map of the same eye: The inferior cornea, where the cone sits, is LOWER than the Best Fit Sphere!!!
- BFS already vaults the cornea

**Trial lenses**

- From regular map
  - Sim K: 48.5 x 54 @73
  - Flat K: 48.5 = 6.96 mm
  - 0.3 mm steeper than K
  - Initial BC for trial lens: 6.7 mm

- From elevation map
  - Elevation: -23 um
  - Target 180 um
  - Real vault = 180 - 23 = 157 um
  - Every 30 um = 0.1 mm
  - BFS = 7.16 mm
  - Initial lens: 6.7 mm

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**Step no.3 : Lens insertion**

- Look for bubbles
- Look for initial clearance (too few, too much)
- Once optimal, let the lens to stabilize
  - 30 minutes to 1h00: mini-sclerals
  - > 1h00 for larger lenses
  - DD piggybacks (patient can see)
- Ask the patient about comfort once lens is stabilized

**Lens evaluation**

- Under the slit lamp, using white light
- Compare tear fluid thickness vs lens thickness (average 300 um)
  - 1:2 to 2:3 ration for mini-sclerals
  - 1:1 ration for full sclerals.
- Push-in test
Evaluate clearance

- Optimal clearance: 170 µm
- Shallow clearance: 119 µm
- Excessive clearance: 360 µm

Possible complications

- Smaller diameter:
  - Handling
  - Imprints / Indentation
  - Tight lens syndrome
  - Physiological response
- Larger diameter:
  - Handling
  - Post-lens clouding
  - Lens fitting ( conjunctival tenacity)
  - Conjunctival prolapse
  - Imprints / Indentation

Specific clinical complications

- Lens decentration
  - Go smaller
- Haptic Misalignment
  - Induced HOA
  - Reduced V.A
  - Lens Bearing
  - NEED toric pc’s

Conclusion

- Sclerals offer a lot of clinical advantages
- They are not for everyone but are becoming mainstream
  - Some patients are too sensitive
    - Also true for other modalities
  - Address ocular surface inflammation first then fit the patient
Conclusion

• To start
  – Easier cases, normal profiles
  – Mini-sclerals
  – When you are comfortable, incorporate fitting of larger lenses

• Practitioners need mini and full scleral lens trial sets
  – Like soft toric lenses: there is not a single design able to meet all patient’s needs

• Scleral lenses are the future of RGP and contact lenses in general… Be prepared.

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