Specialty Lens Fitting

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Affiliations

• Chief, Cornea Contact Lens Service, TEC, SCO
• Founding Supervisor, Cornea Contact Lens Refractive Surgery Residency, SCO and ESG
• Chair, Public Education Committee Scleral Lens Education Society
• Candidate, Diplomate Cornea Contact Lens Refractive Surgery, AAO

Objectives

• Increase awareness of indications for specialty contact lenses
• Develop a methodical approach to selecting lens designs
• Discuss fitting considerations in complex cases
• Diagnose and manage associated complications
What constitutes a specialty lens?

- Underlying cornea
- Purpose of the lens
- Lack of familiarity with design

Common Indications for Specialty Designs

Abnormal corneas
- Corneal ectasia
- Post-surgical
- Ocular surface disease
- Complications of systemic disease
- Post-infection or trauma
- Prosthetics

Normal corneas
- Myopia control
- Torics
- Multifocals
- Anisometropia correction

Recent Survey from Contact Lens Spectrum

2. If you answered yes, what specialty custom contact lenses do you prescribe? Please check all that apply.
- Custom soft multifocal or toric contact lenses
- Gas permeable (rigid) multifocal or toric contact lenses
- Scleral contact lenses for irregular or normal corneas
- Scleral contact lenses for dry eye patients
- Contact lenses for orthokeratology (corneal reshaping)
- Contact lenses for myopia control (multifocal or orthokeratology contact lenses)
Common Indications for Specialty Designs

- Ocular surface disease
  - K.sicca
  - Sjogren’s
  - Rheumatological disorders
  - Thyroid dysfunction
  - GVHD
  - Limbal stem cell deficiency (LSD)
  - Preservative toxicity

Common Indications for Specialty Designs

- Complications of systemic dz
  - Steven’s-Johnson
  - Cicatricial pemphigoid
- Post-infection or trauma
  - Neurotrophic keratitis
  - Persistent epithelial defects
  - Any cause of corneal scarring

Common Indications for Specialty Designs

- Prosthetics
  - Tints
  - Artificial apertures
- Myopia control
  - Bifocal or dual focus designs
  - Overnight orthokeratology

Design Selection: A Systematic Approach – Know your destination
Rehabilitation Goals

- **Preservation of function**
  - Improve vision
  - Return to productive life
  - Work
  - Family
  - Reduce depression or anxiety

- **Palliative management**
  - Vision improvement less likely
  - Improve comfort
  - Stabilize tear film
  - Stabilize disease process
  - Prevent further scarring

Interprofessional Care & Communication

- Clearly understand each provider’s role
- Sub-Specialties in Medicine
  - Cornea
  - Retina
  - Glaucoma
  - PCP
  - Internist
  - Endocrinologist
  - Rheumatologist
- Optometrists
  - Primary
  - Secondary
  - Low Vision
  - Rehabilitation
  - Vision Therapy
- Others
  - Social workers
  - Occupational therapists
  - Disability counselors

Essential Equipment – Ridiculous to Sublime

- $30K
- $5K
- $19K
- $30K
- $100K

OK… Now I am just bragging….
Measurement of Corneal Shape

• Keratometry / Auto-Keratometry—Curvature data
  • Reflected mires
  • Central 3mm
  • Quality of mire patterns

Essential Equipment

Fuller 2019, COPE #59312-CL

Measurement of Corneal Shape

• Topography – Curvature data
  • Placido’s disk – dependent on reflection
  • References btw. fixation target and center of ring pattern on the eye (VK axis) which should coincide with line of sight
  • Calculated height data
  • Covers 6mm (10mm chord with composite images)

Measurement of Corneal Shape

• Tomography
  • Ant. Seg. OCT
  • Scheimpflug
  • Not dependent of reflection
  • True height data & more
  • Not referenced to axis of device
  • 18mm to 20mm chord
Measurement of Corneal Shape

- Variety of measures
  - Profilimetry – true height data (sMap3D & Eaglet Eye Surface Profiler)
  - Fluorescence based structured light topographer
  - 20mm to 22mm range and 360° scleral coverage
  - True height data

Interpreting the data

- **Axial (Sagittal) Maps**
  - Values are referenced to the central keratoscopic axis
  - Represents best the optical characteristics of the eye
  - Can compare btw. pts. makes it useful in refractive surgery

Interpreting the data

- **Tangential (Instantaneous) Maps**
  - Curvature relative to a particular point not a central axis
  - More detailed curvature representation, esp. in periphery
  - More useful in CL fitting

Interpreting the data

- **Refractive Power Maps**
  - True refractive power of the cornea in Diopters
Interpreting the data

- **Elevation Map**
  - Referenced to a BFS
  - Used to simulate fluorescein patterns under a rigid CL
- **Height Map**
  - Dist. along the axis of the eye to the surface in microns
  - Visualize corneal shape
  - Critical to fitting CL's

Interpreting the data

- **Difference Map** – assess change over time

Interpreting the data

- **Scales**
  - Absolute (Standard) – scale to all eyes
  - Compare btw.Pts.
  - Relative (Normalized) – scale to that eye
  - More detail
  - More useful for CL fitting
  - Universal Standard Scale (Smolek, 2002)

Indicies

- **SRAX** – couples IS with axis. If axis is more than 2° different it is suspect
- **IS** – Inferior/Superior asymmetry index is the difference btw. averages
  - Moderate 1.4D to 1.9D
  - Suspect >1.9D
- **SAI** – surface asymmetry index is the centrally weighted ave. btw. corresponding pts. 180° apart
- **SRI** – surface regularity index within 4.0mm pupil
  - <1.0 normal
  - Correlates with VA
Shape Descriptors

- **e (Eccentricity)** –
  - Circle: 0
  - Ellipse: 1
  - Cannot differentiate prolate from oblate
  - $>0.8$ is likely keratoconus
  - Normal: 0.43 (range 0.40 to 0.57)
- **p-value**
  - Circle: 1
  - Ellipse: 0
  - Prolate: <1
  - Oblate: >1
- **Q (Asphericity) – (Q = p-1)**
  - Prolate is negative
  - Sphere: 0
  - Oblate is positive

Prolate v. Oblate Shapes

- Severe Keratoconus
- PK #3 Chronic GVHD

Regular v. Irregular Corneas

- Normal WTR Astig. (-2.20x017)
- Post PK Irregular Astigmatism

Not Always Clear Cut
Grading Severity e.g. Keratoconus

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Required Features</th>
<th>ACP</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
<td>No corneal scarring; No slit lamp findings; Typical axial pattern &lt;47.75D</td>
<td>&lt;0.65</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>Atypical</td>
<td>No corneal scarring; No slit lamp findings; Atypical axial pattern/Irregular/Asymmetric superior bowtie/Asymmetric inferior bowtie/Inf or Sup steepening no more than 3.00D &gt; than ACP</td>
<td>&lt;48.00D</td>
<td>&lt;1.00</td>
</tr>
<tr>
<td>2</td>
<td>Suspect</td>
<td>No corneal scarring; No slit lamp findings; Axial pattern with isolated area of steepening; Inf seteep pattern/Sup steep pattern/Central steep</td>
<td>&lt;49.00D</td>
<td>&gt;1.00 but &lt;1.50</td>
</tr>
<tr>
<td>3</td>
<td>Mild</td>
<td>Axial pattern consistent with KCN; May have positive slit lamp findings; No corneal scarring</td>
<td>&lt;52.00D</td>
<td>&gt;1.50 but &lt;3.50</td>
</tr>
<tr>
<td>4</td>
<td>Moderate</td>
<td>Axial pattern consistent with KCN; Must have positive slit lamp signs; Corneal scarring and overall CLEK grade up to 3.00D</td>
<td>&gt;52.00 but &lt;56.00</td>
<td>&gt;3.50 but &lt;5.75</td>
</tr>
<tr>
<td>5</td>
<td>Severe</td>
<td>Axial pattern consistent with KCN; Must have positive slit lamp signs; Corneal scarring &gt;CLEK grade 3.5</td>
<td>&gt;56.00D</td>
<td>&gt;5.75</td>
</tr>
</tbody>
</table>

McMahan TT et al. Cornea 2006;25:794–800

Not Always Clear Cut

Corneal Center v. Apex

Soft Lens Designs for Irregular Corneas

- **Indications**
  - Keratoconus
  - Post-op PRK/LASIK/RK/PK/ICRS
- **Pros**
  - +20.00D and Astigmatic options to -12.00 at 1º
  - Handling
  - Comfort
  - Care
- **Cons**
  - Thicker lens = hypoxia (Dk/t)
  - More HOAs due to draping
  - Conventional replacement
  - Peroxide best option
  - May need enzyme
**Soft Lens Designs for Irregular Corneas**

- Tips for fitting
  - Transition soft to rigid or large asymmetry in KCN
  - Coverage with equal overlap (centration)
  - Move enough to produce tear exchange (+ push up test)
  - Consider over-K's/-topos
    - Aberration control on front (asph.)
    - BST

**Rigid Lens Designs for Irregular Corneas**

- Indications
  - Keratoconus
  - Post-op PRK/LASIK/RK/PK/ICRS

- Pro’s
  - Corrects HOA’s better
  - More stable VA
  - Less hypoxia
  - Corrects irregular cylinder

- Con’s
  - Comfort +/-
  - Condition may limit diameter
  - Flare, glare and halos
  - Staining

**Soft Lens Complications**

- Contact Lens papillary conjunctivitis (CLPC)
- Deposits
- Lens damage
- Neovascularization
  - Hypoxia risks (open-eye)
    - Holden-Mertz criteria $Dk/t = 24$
    - Harvitt-Bonnano criteria $Dk/t = 35$
    - G-H junctions, RK with NVZ
  - Endothelial health?
  - Superior arcuate defects (SEAL) & Smile Mucin balls

**Rigid Lens Designs for Irregular Corneas**

- Designs
  - Spheres
  - Aspheric
    - Improves centration
    - BC v. PC’s
    - Small (8.5-8.8mm)
    - Large diameters (10.0-11.0mm)
    - Adjustable edges and quadrants

- Torics
  - Not commonly used due to irregular cylinder
  - May only have toric peripheral curves on some aspheric designs
Rigid Lens Designs for Irregular Corneas

- Tips for fitting
  - Keys to centration
    - Central apex – small diameters, intrapalpebral
    - Para-central and peripheral apex – large diameters, lid-attached
  - Judge fit on center not where it decenters
  - Adjust PC’s to keep it centered
  - Three-point touch is best

Rigid Lens Complications

- 3-9 staining – approx. 80% (van der Worp, 2003; Fonn, 2010)
  - Bridge v. meniscus theory
  - Intrapalperbral – goal is to align curves with cornea (asph)
  - Lid-attached – keep lenses thin if using a larger diameter
  - Solution-induce corneal staining (SICS) (Fonn, 2010)
    - Unique to lens-solution combination
    - 50:50 association with sx
  - Adhesion

Rigid Lens Complications

- Vascularized Limbal Keratitis
  - Extension of 3-9 staining
  - Dellen
  - Change diameters
  - Lower edge clearances
  - Lubricants

- Materials
  - Silicone acrylates
  - Fluoro-silicone acrylates
  - Flexure – over-K’s/-topos
  - Deposits
Piggy-backing

• Indications
  • Intolerance of rigid lens
  • Central, para-central and peripheral apices
  • Lens ejection

• Pro’s
  • Improve comfort
  • Improve centration
  • Optics possibly better (Kumar, 2016)

• Con’s
  • Two lenses require more care
  • Lowers Dk/t (Michaud, 2012; Florkey, 2007; O’Donnel, 2004)

Tips for fitting

• Use high Dk carrier and GP
• Assess fit with fluorescein
• Staining of the trial (high MW or not)
• Soft lens fit
• GP fit
• Centration of both lenses is key
• Consider specialty carriers (e.g. Flexlens piggyback, Xcel Specialty Contacts)
• Soft lens contributes on 20% to power; plus v. minus (Michaud, 2013; Romero-Jiménez, 2015)

Complications (Yeung, 1995)

• Corneal edema
• Neovascularization
• CLPC
• Overall, very safe and efficacious

Hybrids

• Indications
  • Intolerance of rigid lens
  • Central, para-central and peripheral apices
  • Lens ejection

• Pro’s
  • Improve comfort & centration over GP but similar to PB (Acar, 2012)
  • Dk/t optimal at 100µ vault (Lee, 2015)
  • Single lens system
  • Reverse geometry designs

• Con’s
  • Bi-annual replacement
  • No torics
  • Durability issues much improved
  • Handling challenging with HydraPEG
Hybrids

• Indications
  - Intolerance of rigid lens (Nau, 2012)
  - Central, para-central and peripheral apices – centration (Guzik, 2002)
  - VLK (Cressy, 2012)
• Pro’s
  - 79.5% of subjects (N=54) with intolerance to their rigid lenses preferred comfort of hybrid (Nau, 2008)
• Outcomes may be similar to PB (Nau, 2009)
• VA’s may be same or better than GP with improved quality of life (Nau, 2012; Pinero, 2015; Hassani, 2015)

<table>
<thead>
<tr>
<th>Indication</th>
<th>% of Sample (N=79 eyes/54 pts.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keratoconus</td>
<td>57%</td>
</tr>
<tr>
<td>PK</td>
<td>15%</td>
</tr>
<tr>
<td>Scarring</td>
<td>1%</td>
</tr>
<tr>
<td>Globe rupture/trauma</td>
<td>6%</td>
</tr>
<tr>
<td>RK-induced ectasia</td>
<td>5%</td>
</tr>
<tr>
<td>LASK-induced ectasia</td>
<td>4%</td>
</tr>
<tr>
<td>PMD</td>
<td>2%</td>
</tr>
<tr>
<td>High astigmatism</td>
<td>2%</td>
</tr>
<tr>
<td>DSEK</td>
<td>1%</td>
</tr>
<tr>
<td>Alpha Cor Prosthesis</td>
<td>1%</td>
</tr>
</tbody>
</table>


Hybrids

• Pro’s (cont.)
  - Dk/t improved over PB
  - Single lens system
  - Reverse geometry designs
• Con’s
  - Bi-annual replacement
  - No torics
• Fitting tips (Lee, 2015; Downie, 2013)
  - Optimal vault increases with apical height (range 100µ-300µ); varies by design
  - Fit steeper avoids lens tightening
  - More eccentric apices correlated with steeper skirts

Scleral Contact Lenses

• Indications (Bennett, 2018)
  - When all else fails & normal corneas?
  - Moderate to severe presentations of the aforementioned conditions
  - Fails at other options/intolerance
  - Some insights do exist

[Images and tables are replaced with text descriptions due to the nature of the task.]
Scleral Contact Lenses

**Pro's** (Bennett, 2018; Barnett & Johns, 2017)
- Comfort
- Tear reservoir as a liquid bandage
- Precise control of curvatures
- Customization

**Con's** (Bennett, 2018; Barnett & Johns, 2017)
- Steeper learning curve
- More visits required
- Expense +/-
- Handling

17 yo progressed to PK within 12mos. (20/20 s/p)

Still wearing Oasys toric (20/20)
Scleral Contact Lenses

• Fitting tips
  • Diameter – No consensus [Bergmanson, 2017]
    • Anatomical limbus is approx. 1.2mm > HVID or ≥14.0mm in the average eye
    • >16.0mm suggested
    • Clear the limbus
    • Look for diffusion outside limbus without touch in midperiphery
    • Double check with AS OCT (Hall, 2011)
    • Larger diameter clears limbus more and increases sag

Scleral Contact Lenses

• Fitting tips (cont)
  • Larger diam. rests on increasingly asymmetric sclera
    [Fadel, 2018; Macedo-de-Araújo, 2018; deNaeyer, 2017]
    • Toric PC’s may be required
    • Flexure offset as diam. inc. by inc. in CT (Fadel, 2017)
    • Sclera higher and flatter N side
      [Ritzman, 2015; Morrison, 2015]
    • Avoid obstacles

Scleral Contact Lenses

• Sagittal depth v. BC [Andre, 2011]
  • Sagittal depth varies with chord; Better predictor of fit
  • Determines reservoir thickness;
  • Dk/t [Kim, 2018; Essen, 2017; Gascon, 2017; Compan, 2018; Viven, 2016; Jayme, 2015; Michaud, 2012]
  • Suggested CT - 250microns, 200microns CCC, 150 Dk;
  • Others suggest 200-300microns CCC with 100microns LZC; [Gascon, 2017]
  • Oblate and RG designs reduce CCC. RK patients may have moderate (+) Rx with thicker centers
  • Optics of sag do not follow SAMFAP

Scleral Contact Lenses

• Lens settling [Kim, 2018; Essen, 2017; Gascon, 2017; Compan, 2018; Viven, 2016; Michaud, 2012; Jayme, 2015; Stoffman, 2014; Caroline, 2015; Fuller, 2014]
  • No agreement; small studies; limited lens designs
  • Maybe smaller settle more if you believe P=F/A
  • Non-linear, most occurs in first few hours but can continue for many hours
  • Lens & eye dependent
  • Relates to impingement and compression
Scleral Contact Lenses

• Complications
  - N=517 eyes wearing low Dk ScCL (primarily PMMA) btw. 1988 and 1993 (Tan, 1995)
    - neovascularization (13.3%)
    - corneal edema (7.4%) secondary to corneal hypoxia
    - corneal abrasion (3.1%)
    - giant papillary conjunctivitis (1.7%)

Scleral Contact Lenses

• No contemporary prospective studies (Walker, 2015)
  - MK (same as GP?)
  - Inflammatory events
  - Hypoxia

Scleral Contact Lenses

• No contemporary prospective studies (Walker, 2015)
  - Conjunctival prolapse
  - Limbal bearing

Scleral Contact Lenses

• No contemporary prospective studies (Walker, 2015)
  - Epithelial bogging
  - Solution reactions
Scleral Contact Lenses

- No contemporary prospective studies (Walker, 2015)
- Mid-day fogging

Thank you!