Contact Lens Management of the Irregular Cornea

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Irregular Corneas in 2022

- Keratoconus / Pellucid Marginal Degeneration
- Post Corneal Transplant
- Post Radial Keratotomy (RK)
- Post LASEK/PRK
- Post Implant
- Corneal Scarring
- Post surgical
- Ocular surface disease (OSD)
- High Rx, amblyopia, myopia control, prosthetics, aphakia, and more

What IS the Prevalence of Kc??.

Incidence of Kc:
- Denmark: 1.24 per 100,000 person-years (2000) to 3.6 per 100,000 (2011)
- South Korea: 5.56 per 100,000 person-years
- Netherlands: 13.3 per 100,000 person-years
- Prevalence of Kc:
  - Denmark: 44 per 100,000 people (1 in 2000)
  - South Korea: 37.4 per 100,000 people (1 in 2600)
  - Netherlands: 265 per 100,000 people (1 per 375 cases)
What is the Prevalence of Kc??

South Korea

Prevalence and Incidence of Keratitis in South Korea: A Nationwide Population-Based Study

Incidence of Kc: 5.56 per 100,000 person-years

Prevalence of Kc: 15.4 per 100,000 people (1 in 6,600)

Saudi Arabia

Prevalence of Kc: 522 pediatric patients (1 in 21, 5%) (1 in 21, 5%)

Iran

Prevalence of Kc: 4% (1 in 25)

New Zealand

Prevalence of Kc: 1196 school aged children 1 in 191

United States

Prevalence of Kc: 0.15% of all VSP enrollees (2016)

1 in about 700 people

3x increase from prev. estimates

2019 Assessment:

Saudi Arabia: 48 in 1000

Iran: 40 in 1000

New Zealand: 5 in 1000

Netherlands: 2.5 in 1000

United States: 1.5 in 1000

South Korea: 0.38 in 1000

2019 Assessment:

101 articles assessed, 99 read

28 studies

50,358,341 subjects

15 countries

1.38 per 1000
Irregular Corneas in 2022

- Post Corneal Transplant
- Post Radial Keratotomy (RK)
- Post LASIK/PRK
- Corneal Scarring

Corneal Transplantation in the US

Deep anterior lamellar keratoplasty for the management of iatrogenic keratectasia

Paras Mehta, Varsha M Rathi, Somasheila I Murthy

https://webeye.ophth.uiowa.edu/eyeforum/tutorials/Cornea-Transplant Intro/3-DALK.htm

Specialty Contact Lens Options in 2022

- Custom Soft
- Corneal GP
- Piggyback
- Hybrid
- Scleral

The Irregular Cornea
The Irregular Cornea

Keratoconus

Pellucid Marginal Degeneration

Post-Radial Keratotomy

Scarring

Iron Deposition

Post-Transplant

Penetrating Keratoplasty

Lamellar Keratoplasty

Steps of Irregular Cornea fitting/management

- Evaluating disease state:
  - Preliminary/baseline testing
  - Slit lamp exam
  - Auxiliary testing – tomography, topography (scleral, corneal), aberration
- Selection and fitting of specialty CL
  - Using topography as a guide
- Post-fitting management of irregular corneas
  - Follow-up management, referrals
Evaluation of Disease State

- Baseline features to evaluate:
  - Scarring, staining, neovascularization (grading, photography, OCT)
  - Careful record of current medications
  - CL history
  - Cornea/scleral shape

http://www.eanw.net/medically-necessary-contact-lenses/

Evaluating Keratoplasties

- Post-infectious scar
- Post-PK irregularities
- RK incision neo

Evaluating Keratoplasties

- (+) staining
- Infiltrates
- Sutures
- Neo/edema
- Broken suture

Pertinent observations in post-transplant patients:
- Type of transplant (PK, LKP, DSEK, DMEK)
- Presence of sutures (+/-, broken or intact)
- Graft clarity (clear, folds, infiltrates, haze, scarring)
- Graft/host (G/H) interface appearance (clear, scar, decentered, elevated)
- Host rim (neo, clear, scarred, thinning)

Special Testing: When and What?

- Irregular corneal shape
- Post-surgical (transplant)
- Severe dry eye

CL for Irregular Corneas

- Where do we start?!!
  - BCVA in spectacles
  - Good – may be suitable for commercial SCL
  - Poor – will likely need custom SCL or GP
  - Topography
    - Patient characteristics
      - Dexterity
      - Eye positioning (eyelids, size of socket)
      - Occupation/Vocation
      - Personality characteristics & visual sensitivity

The Irregular Cornea

- Trauma
- Post-RK
- Post-PKP

Custom Soft Contact Lenses

- Spherical and toric
  - Very mild forms
- Custom lathe-cut soft lens designs
- Aberration-control optics
- Best candidates
  - Mild irregularities
  - Lower blur sensitivities
Custom Soft Contact Lenses for Kc

SiHy lens designs
Lens settling is needed

Corneal GP Fitting: Ectasia (e.g., keratoconus)
General Rules of Corneal GP fitting

- 30-40um apical clearance (bubble at >90um)
- Lands in the mid-periphery
- 3h 9h with a vertical channel
- Allowing "vertical unrestricted movement"
- About 90um edge lift

RGP for Kc vs normal designs

RGP designs for Kc have:
- Smaller diameters
- Greater Eccentricities

Using topography in corneal GP fitting

Axial Display
Elevation Display

Steep Meridian
22 microns INTO the cornea
68 microns

Flat Meridian
46 microns AWAY from the cornea
Using topography in corneal GP fitting

Okay Fit of RGP on Kc

But providing good vision and comfort, so O.K.

Good RGP fit on Kc Eye

Inferior decentration

Unrestricted vertical movement

Pooling over ectasia area

Corneal GP Fitting: Post-surgical (e.g., post-PKP)

- Diameters: 9.5-12.0mm
- VAULT over graft
- Reverse Geometry
- Not always necessary
- Piggyback ➔ caution with Dk

Don’t always need a reverse curve – look at the topography!
Piggy-back

- Rigid lens fits over top of soft lens
- Integrate rigid lens into soft carrier lens
- Candidates
  - People who cannot tolerate rigid lens
  - Poor lens-to-cornea fitting relationship
- Traditional piggy-back
  - SiHi lens
  - Low power (+ or - 0.50 D)
  - High power (+6.00 D) - for stability

SL are more comfortable in Kc

Corneal or Scleral lens?
Using corneal elevation as a guide

Fitting Technique: Fluorescein

Scleral Lens Application
Establish a visible target for patients
White light
Optic section
45 degree angle

Ectasia tear reservoir patterns

Apical Bearing

Ideal Clearance: 100-200um

Evaluating the Limbus

Transitional Zone (Limbal)

Appropriate Limbal Clearance

Inadequate Limbal Clearance

Epithelial breakdown
Landing Zone Assessment

The Landing Zone

Scleral Bearing

Conjunctival/Scleral Bearing

Management:
- Flatten edge
- Customized designs (toric, quad specific)
- Increase diameter

Excess Edge Lift

Using NaFl for Landing Zone

- Steepen edge (25-30um per "step")
- Usually need 3-5 steps for significant change
- Customized designs (toric, quad specific)
- Reduce diameter
Using Lissamine Green & NaFl

Scleral Shape: Beyond Torics

- 4 primary categories of shape
- Results suggest that the majority of eyes may benefit from custom back surface haptics beyond a toric design
- Measurement of the sclera allows for more efficient and accurate determination of lens design


<table>
<thead>
<tr>
<th>Group</th>
<th>Pattern Description</th>
<th>N (%)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Spherical</td>
<td>8 (5.7%)</td>
</tr>
<tr>
<td>2</td>
<td>Toric-regular</td>
<td>40 (28.6%)</td>
</tr>
<tr>
<td>3</td>
<td>Asymmetric High or Low Points</td>
<td>57 (40.7%)</td>
</tr>
<tr>
<td>4</td>
<td>Periodicity different from 180°</td>
<td>35 (25%)</td>
</tr>
</tbody>
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Groups 3 and 4 have scleral shapes that are different from commonly designed spherical or toric haptic designs!
The SL Landing Zone

Effect of Centration
- Most lenses will decenter inferior and temporal
- Observe translation of lens on eye movement to make final decision

Spherical Lens on an ATR Sclera

Effect of Centration
- Most lenses will decenter inferior and temporal
- Observe translation of lens on eye movement to make final decision

Scleral lens optics
- What is available?
  - Sphere
  - Toric
  - Multifocal
  - Distance optics
  - Alternating corrections

Presbyopia
- Front surface asphericity
  - Spherical: unreadable design
  - Small changes to the optics may be adequate enough to improve near vision in early presbyopes
- Multifocal optics
  - A scleral lens with multifocal optics was rare 10 years ago, but now mostly every lab offers at least one option

Optical metrology of a center-near multifocal design.
- Scleral lenses do not translate on the eye
- Minimal movement/rotation and are very stable
- Simultaneous vision multifocal designs are necessary
- Majority center-near designs, but some labs offer center-distance designs
- Multifocal optics come with gradual increase in add
- Some labs offer switchable zones based on patient's pupil size
- Multifocal optics are added to front surface of the lens
### Setting Expectations

- **Comfort**
  - Consider dryness and tear layer stability.

- **Patient selection**
  - Dry eye disease and high/hypermeter astigmatism - poor candidates?
  - Should have less than +0.75D of residual astigmatism for the lenses to work as effectively as possible.

- **Must see realistic expectations**
  - Not necessarily perfect at all distances.

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### Advanced Optics for scleral lenses

- **Multifocal Lenses**
  - **Aberration control**

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### Residual Aberrations

> “I can see it, but it’s not clear.”

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### WFG Scleral Lenses

- **Exciting time to be fitting scleral lenses**
- **Technology has changed the way we fit scleral lenses**
- **Today, technology will improve patient’s vision.**

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### Specialty CL exam sequence

- **Initial fitting (1)**
  - Baseline/disease data collection
  - CL fitting
- **Dispense visit (2)**
  - Dispense lens - handling and care training
  - Any additional baseline data that was not obtained at visit 1
- **1-week (3) or visit (3)**
  - Follow-up on handling, comfort, vision, etc.
  - Measure KPF most testing if indicated
  - Monitor corneal edema
- **1-month final (4)**
  - Measure KPF most testing if indicated
  - Measure corneal edema
- **6-12-month visits**
  - Annual visit, or more to monitor disease

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### Assessing the Presenting Scleral Lenses

- **Prior to lens removal**
  1. Add NaFl to several areas at the lens edge
  2. Watch for NaFl in tear reservoir

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Tear Exchange with SL

- Variable tear exchange rates
- Some patients do better with more exchange, some with less
- Clinically...
  - zero exchange (seal-off) can cause metabolic toxicity
  - excess exchange causes debris buildup and discomfort

Slow, moderate exchange is ideal for most patients

Different Patterns of Tear Exchange

Monitor the Cornea

Scleral Lens Complications

- Lens management complications
  - Trouble with application, removal
  - Lens deposits, non-wetting, solution sensitivities
- Fitting Complications
  - Corneal, limbal, conjunctival bearing or excess lift
- Midday fogging, tear reservoir stagnation
- Corneal complications
  - Solution & freelanced epitheliopathies
  - Epithelial boggling
  - Corneal edema
- Limbal bearing, edema, infiltrates, neovascularization
- Conjunctival/scleral complications
  - Impression, compression, staining, edema, prolapse

Easy and Common Complications
**Easy and Common Complications**

- Lens deposits
- Use of Progent cleaner

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**Scleral Lens Application**

Establish a visible target for patients

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**Application Considerations**

- Dexterity (Parkinson’s/tremors)
- Eyelid apertures
- Visual Status

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**Removal**

Proper placement of plunger is key

Wet the tip of the plunger for greater suction

Slow and steady wins the race

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**Corneal Staining**

- Causes:
  - Lens touch (focal)
  - Lens seal-off (diffuse)
  - Disease state (remember to compare to baseline!)

- Management:
  - Determine cause
  - Manage lens fit
  - Increase clearance
  - Loosen haptic
  - Change application solution
  - Monitor!

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**Corneal Epitheliopathy**

- Treatment:
  - Change application solution
  - Change fit to decrease vault
  - Educate patients taking medicated drops
  - Educate patients on proper use of solutions

Patient education is the key to SL success
Epithelial “Bogging”

- Potential etiologies:
  - Loss of glycocalyx layer
  - Epithelial edema
  - Osmotic imbalance

- Cause unknown. Patients asymptomatic.
- Does not appear to be long-term effect

3 and 9 o’clock staining

- Patients may be asymptomatic.
- Itchy sensation usually increasing with wearing time.
- Increasing lens awareness.
- Dry eye symptoms.
- Can occur after any duration of lens wear.

Vascularized Limbal Keratitis (VLK)

- Complicated Corneal Touch

- Corneal hypoxia
Non-Infectious Corneal Infiltrates
- Sub-epithelial generally, no overlying staining
- Sterile
- Up to 44% in EW of HEMA lenses
- Risk approximately DOUBLES for SiHy

Why?

Midday Fogging (MDF)

Conjunctiva
- Pinguecula
- Pterygium
- Symblepharon
- Surgical interventions
  - Ahmed valve
  - Trabeculectomy
  - Scleral buckle

Conjunctival Roadblocks

Special needs for Customization:
Pingueculae, Pterygium, Blebs, Cysts
- Scleral lens interaction may lead to
  - Inflammation
  - Discomfort
  - Infection
- Goal:
  - Pterygium/pinguecula: avoid or vault over
  - Bleb: Avoid interaction
Vaulting Technology Basics

- Lens must be rotationally stable
  - Toric PCs
  - Front Toric and Dual Elliptical Stabilization
  - Toric PCs and Front Toric Optics
- Speak with the consultants!

Different Vaults, Same Idea

- Creates a channel (or ripple) in the lens edge to vault the lens over the peripheral obstruction
- Precise and reproducible compared to hand-notching
- Used for pingueculae or peripheral elevations that can interfere with a proper landing on the sclera

Customized lens designs

- Without custom edge
- With custom edge

Impression Rings

- Are they always bad? No
- Can we eliminate them? Not entirely

Questions?

Feel free to email me with questions:
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