Corneal Infiltrative Events (CIE) and Contact Lenses: Avoidable or Not?

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Over the past three years, members of CORE have received research funding and/or honoraria from the following 15 companies & 3 funding agencies:

- Alcon
- Allergan
- Contamac
- CooperVision
- GL Chemtec
- Inflamax Research
- Johnson & Johnson Vision
- Menicon
- Nature’s Way
- Novartis
- Safilens
- Santen
- Shire
- SightGlass
- Visioneering
Corneal Infiltrates vs Microbial Keratitis
An infiltrate is a collection of inflammatory cells (usually polymorphonuclear leucocytes) located within the cornea

- located within the epithelium or subepithelial layers
- Self-limiting inflammatory response

**Definition**

Appearance

- Infiltrates appear as small, hazy whitish areas often surrounded by edema
- Can be single or diffuse

2. Sweeney et al.: Clinical characterization of corneal infiltrative events observed with soft contact lens wear. Cornea 2003; 22;5: 435-42.
Contact Lens Peripheral Ulcer (CLPU)

Microbial Keratitis
Infection of the cornea with pathogenic organism
• most typically bacteria
• associated inflammation and destruction of the cornea

Sight-threatening ocular emergency

Variety of terms
• corneal ulcer
• infectious keratitis
• ulcerative keratitis
• bacterial keratitis
Major microbial types in MK

- **CL Wearers**
  - 70% Pseudomonas aeruginosa (gram –ve)
- **Non CL wearers**
  - 50% Staph aureus (gram +ve)
- **Emerging gram –ve pathogens** \(^1,^2\)
  - Achromobacter xylosoxidans
  - Delftia acidovorans
  - Stenotrophomonas maltophilia

Symptoms of MK

- Acutely painful
  - increasing pain despite CL removal
- Patient may notice “white spot” on cornea
- Redness
- Discharge / tearing
- Photophobia
- Reduced vision
- Swollen lid

Sweeney et al.: Clinical characterization of corneal infiltrative events observed with soft contact lens wear. Cornea 2003; 22;5: 435-42.
My 1st MK Case: 1986

- 23 year-old male
- SCL wearer
- Non compliant with care regimen
- Red eye (OD) for 1 day
- Significant pain & photophobia
- Significant epiphora
- Significant hyperemia
- VA 6/12 OD, 6/5 OS
Slit Lamp Appearance: 1986
My Last MK Case: 2016
Management: Scleral Lens Fit
Acanthamoeba & Fungal Keratitis

- Lower risk than bacterial keratitis
  - 5-10% of all CL-related MK
- Acanthamoeba ¹-⁴
  - Non-sterile water exposure (including swimming in CLs)
  - Poor compliance
  - CL solutions (US 2007; UK 2018)
- Fungal keratitis (mainly Fusarium) ⁵-⁷
  - Poor compliance
  - CL solution (global 2004-2006)
    - formulation and storage conditions

Incidence
MK Rates for All CL Types
(modern lenses)

- Lowest for RGP
- Highest for EW

Severe keratitis and MK

Annual Incidence (per 10,000)

- DW RGP: 2.9
- DW SCL: 1.2
- DD SCL: 6.4
- DW SH: 1.9
- EW SCL: 4.9
- EW SH: 2
- Morgan 2005: 0
- Stapleton, 2008: 11.9
- EW SCL: 96.4
- EW SH: 19.5
- Morgan 2005: 19.8
- Stapleton, 2008: 25.4
MK Rates for EW SCL

Hydrogel ~ SiHy

Annual Incidence (per 10,000)

- Hydrogel
- Si Hydogel

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poggio USA</td>
<td>1989</td>
<td>20.9</td>
</tr>
<tr>
<td>Nilsson Sweden</td>
<td>1994</td>
<td>13.3</td>
</tr>
<tr>
<td>Cheng Netherlands</td>
<td>1999</td>
<td>20</td>
</tr>
<tr>
<td>Lam Hong Kong</td>
<td>2002</td>
<td>9.3</td>
</tr>
<tr>
<td>Morgan UK</td>
<td>2005</td>
<td>96.4</td>
</tr>
<tr>
<td>Schein USA</td>
<td>2005</td>
<td>19.8</td>
</tr>
<tr>
<td>Stapleton Australia</td>
<td>2008</td>
<td>19.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.4</td>
</tr>
</tbody>
</table>
MK Rates for DW SCL

No change over 25 years!

Figure 1. Rates of MK with daily wear lenses and key dates relating to lenses and solutions.

Willcox: Microbiology and CL wear. CL Spectrum April 2011
Incidences of MK with OK in Children

- 1317 patients
- 640 adults (49%) and 677 children (51%)
- 2599 patient-years of wear
- Incidence
  - 13.9 per 10,000 px years

Risk of MK with overnight corneal reshaping contact lenses is similar to that with other overnight modalities

Annualised Incidence for IK

- Difficult
  - depends upon criteria used for classification, lens type worn, frequency of visits and quality of the observers in the study
- Daily wear
  - symptomatic
    - 0.5-3%
  - asymptomatic
    - 3-5%
- Extended wear
  - symptomatic
    - 2-6%
  - asymptomatic
    - 20-25%
Risk Factors
### Relative Risk Factors For CIE

<table>
<thead>
<tr>
<th>Factor</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-modifiable</strong></td>
<td></td>
</tr>
<tr>
<td>Age (18-29)</td>
<td>2.2x</td>
</tr>
<tr>
<td>Young age (&lt;25)</td>
<td>1.75 – 2.6x</td>
</tr>
<tr>
<td>Older age (&gt;50)</td>
<td>2x</td>
</tr>
<tr>
<td>Males</td>
<td>1.4x</td>
</tr>
<tr>
<td>Refractive error &gt; ± 5 D</td>
<td>1.2-1.6x</td>
</tr>
<tr>
<td>Previous history of CIE</td>
<td>2.5-6.1x</td>
</tr>
<tr>
<td><strong>Modifiable</strong></td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>1.4-2.7x</td>
</tr>
<tr>
<td>Overnight wear</td>
<td>2.4-7x</td>
</tr>
<tr>
<td>Multipurpose solutions</td>
<td>2.9-3.8x</td>
</tr>
<tr>
<td>Bacterial bioburden</td>
<td>5x (lids); 8x (lens)</td>
</tr>
</tbody>
</table>

Question

• Which soft lens material has been shown to provide the **lowest risk** for the development of corneal infiltrates in reusable lenses?

  a) Hydrogels
  b) Silicone hydrogels
  c) No difference
Infiltrative Keratitis: Reusable CL

• Consistently ~2X higher rate with reusable SiHy

<table>
<thead>
<tr>
<th>Study</th>
<th>Rate with SiHy compared with hydrogel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Szczotka-Flynn &amp; Diaz 2007</td>
<td>2.18 – 2.23x</td>
</tr>
<tr>
<td>2. Radford et al 2009</td>
<td>2x</td>
</tr>
<tr>
<td>3. Chalmers et al 2011</td>
<td>1.85x</td>
</tr>
<tr>
<td>4. Chalmers et al 2012</td>
<td>1.84x</td>
</tr>
</tbody>
</table>

Reducing CIE risk
Question

• How much **lower** is the risk of developing corneal infiltrates if a patient switches to daily disposable lenses from reusable lenses?

  a) 2x
  b) 6x
  c) 12x
Infiltrative Keratitis & DD Contact Lenses

**Age and Other Risk Factors for Corneal Infiltrative and Inflammatory Events in Young Soft Contact Lens Wearers from the Contact Lens Assessment in Youth (CLAY) Study**

Robin L. Chalmers, Heidi Wagner, G. Lynn Mitchell, Dawn Y. Lam, Beth C. Meredith E. Jansen, Kathryn Ricdbale, Luigina Sorbara, and Timothy T. McMabon

**Purpose:** To describe age and other risk factors for corneal infiltrative and inflammatory events (CLEs) in young, soft contact lens (SCL) wearers and to model the age-related risk.

**Methods:** A multicenter, retrospective chart review of 3549 SCL wearers (8-33 years at first observed visit, +8.00 to −15.00, astigmatism ≤ 1.00) contact 288 for young adults. In terms of safety outcome acceptable method of delivering optic myopia progression in children and you (Invest Ophthalmol Vis Sci. 2011; 10.1167/jovs.10-7018)

**Multicenter Case-Control Study of the Role of Lens Materials and Care Products on the Development of Corneal Infiltrates**

Robin L. Chalmers, Lisa Keay, John McNally, and Jami Kern

“12x lower risk of IK with DD lenses”

Infiltrative Keratitis & DD: Hydrogel vs SiHy

• 1171 subjects (960 years of wear)
  – 489 years of SiHyDD (1-Day Acuvue TruEye)
  – 471 years of HydDD (1-Day Acuvue Moist)
• Adverse events recorded and practice records reviewed
• Only 1% had SCL complications that prompted visits to ECP
• SiHy DD = HydDD
• Risk factors associated with recorded events
  – overnight wear = 30%
  – storage & reuse = 21%
  – >5.0D = 22%
  – Age <25 years = 31%

Summary
Hydrogels vs SiHy

- CIEs are a potential issue for CL wearers
- Need to be able to differentiate between MK & IK
  - careful slit lamp examination required
- Be aware of the risk factors
  - be careful of lens choice and modality with those who have higher risk factors
- Infiltrates lower with reusable hydrogels compared with reusable SiHy
- Infiltrates lowest with DD lenses
Reducing CIE Risk

- **Stop sleeping** in lenses
- Be wary of
  - smokers
  - those in the age group **18-29**
  - non-compliant **males**
  - previous inflammatory response
  - those exhibiting **blepharitis** or **meibomian gland dysfunction**
    - higher levels of gram +ve bioburden on the lids
- Switch to **peroxide**
- Switch to **daily disposables**
- **Improve compliance** with respect to
  - Water exposure
  - hand washing
  - case replacement & case cleaning

THANK YOU