Learning Objectives

- Treatment and management of common SCL associated complications
- Describe basic corneal physiology and its relationship to SCL complications
- Current research in the area complications
- Relationship of lens modality and replacement schedules to complication rates
- Signs and symptoms of serious & significant complications and their incidence rates

Interactions with a Contact Lens

Lids / Lashes

Conjunctiva
- Palpebral
  - Bulbar

Cornea
- Epithelium
- Basement Membrane
- Stroma
- Descemet’s Membrane
- Endothelium

Meibomian Glands

- Meibomian gland structure changes with age
- Arita et al studied the relationship between CL wear & M-gland function
  - 121 SCL and GP wearers and 137 controls
  - Meiboscore
    - Grade 0 – no loss of M-glands
    - Grade 1 – 33% or less affected area
    - Grade 2 – 33-66% affected area
    - Grade 3 – 66% or greater affected area
Results

- Correlation between length of wear and decrease in function of functional M-glands.
  - 30 year old CL wearer had a Meiboscore of ~65 year old non-CL wearer
  - Upper lid more affected than lower lid
    - Longer pathway with blink?
  - No significant difference between lens materials

Treatment

- Warm Compresses
- Lid Hygiene
- Therapeutics?
  - Omega-3 – Fish Oil, Flax Seed Oil
  - Doxycycline
    - 50mg QD PO x 1-6 months
  - Azithromycin Ophthalmic Solution
    - 1 gtt BID x 2 days, QD x 4 weeks
    - Off-Label Use
  - Lipiflow® Thermal Pulsation

Tear Film

- Dry Eye
- Mucin Balls

Dry Eye Disease

- Nearly 40% of Americans experience Dry Eyes in the US
- Approximately 8% of women ages 45 to 84 have a clinical diagnosis of Dry Eye

Dry Eye Disease

- Evaporative Dry Eye
  - Lipid Layer
- Aqueous Deficient Dry Eye
  - Aqueous Layer

- Contact lens dropout
  - Dryness cited as a reason for discontinued wear in 50% of wearer
- "Successful" wearers report similar comfort issues
Dry Eye Disease

- Contact lenses split the tear film into two sections
  - Pre-lens and pre-corneal
    - Pre-lens tear film evaporates faster
    - Reduced tear volume
- Considerations
  - Allergies
  - Age
  - Sex
  - Medications

Ocular Surface Disease

- Subjective
  - FBS
  - Burning
  - Gritty
  - Itchy
  - Light sensitivity
  - Tearing
- Objective
  - Hyperemia
  - Chemosis
  - Lid involvement
  - Corneal involvement

Moderate to Severe DES may be a relative contraindication to CL wear

Dry Eye Questionnaire (DEQ – 5)

- Validated questionnaire – 5 questions

Dry Eye Disease

- CL parameter changes / Lens Care Product
- Lid interventions
  - Warm compresses, lid massage, hygiene
  - Punctal occlusion
- Ophthalmic
  - Artificial tears
  - Steroid
  - Cyclosporine ophthalmic emulsion
- Oral
  - Doxycycline 50mg
  - Omega-3 – Fish Oil, Flax Seed Oil
- Supplements
- Management of associated disease

Dry Eye Disease

- Scleral Contact Lenses

Tear Film

- Dry Eye
- Mucin Balls
**Mucin Balls**

- Approx. 10-100 um discrete particles of naturally occurring tear film mucins
  - Tear film collapses → interaction between lens surface and corneal epithelium → mucin rolls up following lens / eye movement
- The immovable "deposits" that appear trapped against the corneal surface
  - Indentation in epithelium following lens removal

**Mucin Balls**

- No effect on symptoms, vision or biomicroscopy
- Not related to age, gender or prescription
- Higher incidence found if:
  - Steep cornea
  - High modulus lens material
  - 60-100% of eyes exhibiting after 1-3 weeks of CW
  - No use of re-wetting drops (3x higher)
- Association with adverse events
  - Protective against inflammatory events?
  - 3.6x increased risk of inflammatory event
  - Microstructure changes

**Conjunctiva**

- Limbal Epithelial Hypertrophy
- Contact Lens Papillary Conjunctivitis
- Contact Lens Acute Red Eye (CLARE)
- Superior Limbic Keratoconjunctivitis

**Limbal Epithelial Hypertrophy**

- Asymptomatic
- Observed in some long term extended wear HEMA wearers
- Appears as a possible precursor to corneal neovascularization
- Must be viewed with Nafl
  - Not detectable with white light alone

**Conjunctiva**

- Limbal Epithelial Hypertrophy
- Contact Lens Papillary Conjunctivitis
- Contact Lens Acute Red Eye (CLARE)
- Superior Limbic Keratoconjunctivitis

**Limbal Epithelial Hypertrophy**

- The condition resolves in 3 to 5 days after discontinuing lens wear
- Decrease wearing time from EW to DW
- Keratometry
  - Suspect a steep fitting lens
    - Mires will distort on blink and re-clear following
CL Papillary Conjunctivitis

- Remove SCL
  - Lids, Lashes, Lacrimal
    - Blepharitis
    - Papillae - lid eversion
- Contact Lens Papillary Conjunctivitis (CLPC) or Giant Papillary Conjunctivitis (GPC)

CLPC

- Mucus discharge in the nasal corner of the eye upon awakening
- Itching immediately after lens removal
- Decreased wearing time

CLPC

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
<td><img src="image3.png" alt="Image 3" /></td>
<td><img src="image4.png" alt="Image 4" /></td>
</tr>
</tbody>
</table>

Mechanical GPC

GPC from Ocular Prosthesis
The Average Eyelid

- Blinks per Minute: 12.55
- Blinks per Year: 4,397,520
- Distance Traveled per Blink: 8.5 mm
- Distance Traveled per Year: 46.5 miles

Portland, OR ➔ Welches, OR

CLPC

- Rule out mechanical GPC
- Manage lens deposits
  - More frequent lens replacement (DD)
  - Enzyme cleaners
- Change to a preservative-free lens care system
- Artificial tears
- Pharmacologic intervention (mast call stabilizer)
- Topical steroids
- Consider GPs

Conjunctiva

- Limbal Epithelial Hypertrophy
- Contact Lens Papillary Conjunctivitis
- Contact Lens Acute Red Eye (CLARE)
- Superior Limbic Keratoconjunctivitis

Contact Lens Acute Red Eye

- Appears as a response to endotoxins from gram-negative bacteria on lens
- Resolution is rapid and complete, with no known association with propensity to MK

CLARE

- Bulbar Hyperemia
  - Moderate to severe
  - Circumferential or sectoral
- Infiltration
  - Peripheral to mid-peripheral
  - Diffuse
  - Focal - low to moderate number
- None to mild VA reduction
- Uncommon
  - Bilateral
  - A/C reaction
  - Lid edema
  - Epithelial involvement

Contact Lens Acute Red Eye

- D/C CL Wear
- Lubricants & Cycloplege
- Steroids?
  - severe symptoms
  - significant infiltration
- Re-establish successful DW first
- Recurrence possible
Conjunctiva

- Limbal Epithelial Hypertrophy
- Contact Lens Papillary Conjunctivitis
- Contact Lens Acute Red Eye (CLARE)
- Superior Limbic Keratoconjunctivitis

Contact Lens-Induced Superior Limbic Keratoconjunctivitis (CLSLK)

- AKA thimerosal keratoconjunctivitis or thimerosal keratopathy
  - Strong association with lens care products that contained the preservative thimerosal
    - Discontinued in LCP in the mid-1980s
    - All CL manufacturers have discontinued use of noxious preservatives – No more CLSLK!
- Not to be confused with Theodore’s SLK (unrelated to CL wear)
  - Over 40 years old
  - More in females
  - Linked to thyroid disease

CLSLK

- Bilateral with symmetry
- Variable onset
  - 2 months to 2 years
- Thimerosal hypersensitivity
  - Organic mercury compound that interacts with tissue with good anti-fungal potency
- Clinical studies linked thimerosal to CLSLK
- Mechanical effects may play a role
- Treatment
  - D/C SCL wear, eliminate exposure, scraping, steroid
  - Resolution is slow (3-9 months)

Cornea - Epithelium

- Superior Epithelial Arcuate Lesion (SEAL)
- Inferior Epithelial Arcuate Lesion
- Solution-Induced Corneal Staining (SICS)
- Preservative-Associated Transient Hyperfluorescence (PATH)
- Microcysts

Superior Epithelial Arcuate Lesion (SEAL)

- Linear breaks seen in the superior corneal epithelium of soft lens wearers
  - In most cases the epithelium is eroded down to the basement membrane
- Usually unilateral, located beneath the upper lid
- Normal corneal epithelium separates the lesion from the limbus
- Lesion 0.5mm wide and 2-5 mm in length
- Little or no injection of the superior bulbar conjunctiva

Epithelial Splitting

- Linear breaks seen in the superior corneal epithelium of soft lens wearers
  - In most cases the epithelium is eroded down to the basement membrane
- Usually unilateral, located beneath the upper lid
- Normal corneal epithelium separates the lesion from the limbus
- Lesion 0.5mm wide and 2-5 mm in length
- Little or no injection of the superior bulbar conjunctiva
Epithelial Split

- Initial therapy
  - D/C CL wear
  - lubricants
  - topical antibiotics?
- Long term management
  - change base curve
    - Change OAD
    - Change material

SEAL

Cornea - Epithelium

- Superior Epithelial Arcuate Lesion (SEAL)
- Inferior Epithelial Arcuate Lesion
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Inferior Arcuate Corneal Staining

- Coarse punctate epithelial disruption in the inferior cornea
- Seen in patients with clean, well-fitted wet lenses, in DW and EW
- Appears independent of water content or lens thickness, occurs with hyperopic as well as myopic lenses
- Toxicity to debris accumulation under lens
- Modulus dependent?

Lens Removal Abrasion

Cornea - Epithelium

- Superior Epithelial Arcuate Lesion (SEAL)
- Inferior Epithelial Arcuate Lesion
- Solution-Induced Corneal Staining (SICS)
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- Microcysts
Solution Sensitivities

Solution Sensitivity and Ocular Inflammation

Solution related Non-Keratitis Palpebral Hyperemia

Treatment Options

• Hydrogen Peroxide
• PuriLens System
• Daily Disposable
• Continuous Wear

Solution Study

• Compared the overall comfort of SCL – MPS vs. Hydrogen Peroxide

Chemical Properties

• Tonicity
• pH
• Buffers
• Viscosity Agents (lubricants) – Hyaluronic acid, sodium hyaluronate
• Surfactants
• Stabilizers
• Preservatives – Keep the solution sterile – Disinfect the contact lens
Solution Recalls

- 66 incidents of Fusarium infections from March 2005 to May 2006
- 62 were using Renu brand solutions
  - 42 MoistureLoc
  - 6 MultiPlus
  - 11 unspecific Renu solution
  - 3 reported using more than one brand JAMA (June 2006)
- Complete Moisture Plus
  - Higher incidence of Acanthamoeba keratitis

Topping Off

- Fusarium keratitis
  - Renu MoistureLoc 13x increase risk
  - Global recall in 2006
  - Alexidine sequested
  - Tropical and subtropical climates
  - Candida - Cooler climates & associated with trauma
- Loss of efficacy
  - Water loss / evaporation
    - 2-4x concentration
    - Storage at 60°C (140°F) x 4 weeks

Rub vs. No Rub

- Rub
  - Decrease the amount of microbes on a CL
  - Most effective at removing surface deposits and pathogens
    - Reduce staining on the front of the eyes
- No Rub
  - Will not remove even loosely bound deposits
  - Potency of disinfection is reduced

SCL Care Products

- Private Labels
  - All changed the formula of their private label multi-purpose solution at least 2 times in the past 5 years.
  - No change in packaging
  - Patent number

Staining Protocol

- Type
  - None
  - Micropunctate
  - Macropunctate
  - Coalesced Macropunctate
  - Patch (1 mm)
- Area
  - 0% of region covered to 100%
- Depth
  - Superficial epithelial
  - Full epithelial
  - Stromal glow

IER Study vs Andrasko Study

<table>
<thead>
<tr>
<th></th>
<th>Andrasko Staining Grid</th>
<th>IER Matrix Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>patients per</td>
<td></td>
<td></td>
</tr>
<tr>
<td>combination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>2 hours</td>
<td>3 months</td>
</tr>
<tr>
<td>Method</td>
<td>Lenses and cases</td>
<td>Daily wear</td>
</tr>
<tr>
<td></td>
<td>soaked before wear</td>
<td></td>
</tr>
<tr>
<td>Assessment</td>
<td>1x</td>
<td>3x</td>
</tr>
<tr>
<td>Scale and</td>
<td>Average % cornea</td>
<td></td>
</tr>
<tr>
<td>colouring of</td>
<td>% cornea</td>
<td>% of patients</td>
</tr>
<tr>
<td>grid</td>
<td>&lt; 10%</td>
<td>per month</td>
</tr>
<tr>
<td></td>
<td>10-30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 20%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower quartile</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inner two quartiles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upper quartile</td>
<td></td>
</tr>
</tbody>
</table>

CL Spectrum 09.2007
% Corneal Staining at Two Hours

Institute for Eye Research
Matrix Study: Corneal Staining
% of patients

<table>
<thead>
<tr>
<th>Solution - Induced Corneal Staining per month with the combination*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lens / Solution</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>H₂O₂</td>
</tr>
<tr>
<td>PHMB</td>
</tr>
<tr>
<td>POLYQUA® &amp; ALDOXX®</td>
</tr>
<tr>
<td>POLYQUA® &amp; ALDOXX®</td>
</tr>
<tr>
<td>OQOPTIXᵀᴹ</td>
</tr>
<tr>
<td>PureVisionᵀᴹ</td>
</tr>
<tr>
<td>PureVis*</td>
</tr>
</tbody>
</table>

IER Matrix Grid vs Andrasko Grid

Cornea - Epithelium
• Superior Epithelial Arcuate Lesion (SEAL)
• Inferior Epithelial Arcuate Lesion
• Solution-Induced Corneal Staining (SICS)
• Preservative-Associated Transient Hyperfluorescence (PATH)
• Microcysts

Preservative
• Aldox / Polquad
  – Opti-Free Express / RepleniSH, PureMoist
• Alexidine
  – RevitaLens (Alexidine & Polquad)
• PHMB
  – Aquify (PHMB & EDTA)
  – Biotrue (PHMB & Polquad)
  – Complete Easy Rub (PHMB & EDTA)
  – RevitaLens Ocutec (PHMB & EDTA)
• Dymed
  – Renu Fresh / Sensitive

Preservative-Associated Transient Hyperfluorescence (PATH)
• Staining is thought to be binding of the Nafl to preservatives on the epithelium
• Preservatives have different peaks incidence of binding
  – PolyQuad and Aldox – 30 minutes
  – PHMB – 2 hours
PATH

- Noted after lens application
- Diffuse corneal staining
  - Epithelium unaffected
- Generally bilateral
- Asymptomatic
- Non-pathological
- Resolution is 6-8 hours post lens removal
- PATH vs. SICS

Cornea - Epithelium

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- Inferior Epithelial Arcuate Lesion
- Solution-Induced Corneal Staining (SICS)
- Preservative-Associated Transient Hyperfluorescence (PATH)
- Microcysts

Microcysts

- Vision – asymptomatic
- Comfort – asymptomatic
  - If symptomatic consider concurrent pathology

<table>
<thead>
<tr>
<th>Lens Type</th>
<th>Lens Wear</th>
<th>Dk</th>
<th>Prev. of Microcysts</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
<td>26%</td>
</tr>
<tr>
<td>PMMA</td>
<td>DW</td>
<td>0</td>
<td>29%</td>
</tr>
<tr>
<td>GP</td>
<td>DW</td>
<td>Low / High</td>
<td>29% / 0.7%</td>
</tr>
<tr>
<td>GP</td>
<td>EW</td>
<td>Low / Med / High</td>
<td>84% / 29% / 1.6%</td>
</tr>
<tr>
<td>SCL – HEMA</td>
<td>DW</td>
<td>Very Low</td>
<td>0.9% – 34%</td>
</tr>
<tr>
<td>SCL – HEMA</td>
<td>EW</td>
<td>Low</td>
<td>7%–100%</td>
</tr>
<tr>
<td>SCL – SiHy</td>
<td>CW</td>
<td>Low</td>
<td>41%</td>
</tr>
</tbody>
</table>

Microcysts

- Consist of accumulated cellular debris
- Chronic metabolic stress
  - Response to high levels of corneal hypoxia
- Does not affect vision and do not appear to have any direct clinical consequences
- Number correlates with length of lens wear and lens Dk/t
- Treatment
  - ↓ wearing time
  - Higher Dk material

Microcysts

- Small (~15-50 microns) translucent or grey
- Irregular-shaped or ovoid inter-epithelial cysts
- Form near the basement layer and move toward the anterior surface
- Do not stain until they break through the surface epithelium
- Reversed illumination
  - Distribution of light within the microcyst is opposite to the light distribution of the background.

Microcysts

Differential Diagnosis

<table>
<thead>
<tr>
<th>Size (um)</th>
<th>Shape</th>
<th>Color</th>
<th>Distribution</th>
<th>N</th>
<th>Optical appearance</th>
<th>Naft</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucin ball</td>
<td>Spherical</td>
<td>Grey</td>
<td>Superior cornea</td>
<td>H</td>
<td>Unreversed Fluorescence</td>
<td>Y</td>
<td>Silh</td>
</tr>
<tr>
<td>Epithelial Pits</td>
<td>Spherical</td>
<td>Clear</td>
<td>Superior cornea</td>
<td>Lo</td>
<td>Unreversed Fluorescence</td>
<td>Y</td>
<td>Silh</td>
</tr>
<tr>
<td>Microcysts</td>
<td>Spherical</td>
<td>Grey</td>
<td>Pan-corneal</td>
<td>H</td>
<td>Unreversed Fluorescence</td>
<td>N</td>
<td>Lo Dk</td>
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<tr>
<td>Vacuoles</td>
<td>Spherical</td>
<td>Clear</td>
<td>Mid-periphery</td>
<td>Lo</td>
<td>Unreversed Fluorescence</td>
<td>N</td>
<td>Lo Dk</td>
</tr>
<tr>
<td>Bullae</td>
<td>Angular</td>
<td>Clear</td>
<td>Pan-corneal / central</td>
<td>Lo</td>
<td>Unreversed Fluorescence</td>
<td>N</td>
<td>GP</td>
</tr>
<tr>
<td>Dimple Veiling</td>
<td>Spherical</td>
<td>Clear</td>
<td>Variable</td>
<td>Lo</td>
<td>Unreversed Fluorescence</td>
<td>Y</td>
<td>GP</td>
</tr>
</tbody>
</table>

Table 17.1 – CL Complications 3rd Ed.; Efron 2012

Table 9.1 – CL Complications 3rd Ed.; Efron 2012
Cornea - Stroma

- Vascularization

Limbal Hyperemia

Increase in blood flow at the limbal arcades resulting in dilation and distention of limbal blood vessels.

Neovascularization

Lipid Leakage

Corneal Vascularization

Etiology

Vasostimulation Theory
- Contact lens induced epithelial trauma results in a release of enzymes.
- Inflammatory cells migrate to this site and release vasostimulating agents that cause vessels to grow in the direction.

Hypoxia Theory
- Tissue hypoxia results in an increased production of lactic acid which may result in venous drainage
- Chronic edema results in stromal softening or loss of compactness reducing the physical barrier to vessel penetration
Corneal Edema

- Epithelial Vacuoles
  - 10% of non-lens wearers
  - Unknown etiology
  - 5-30 microns, spherical fluid or gas filled vacuoles, unreversed illumination in the periphery
  - Occur in areas overlying a corneal opacity in aphakic patients
  - Generally asymptomatic
- Prognosis
  - Epithelium has a high turnover rate

Corneal Edema

- Epithelial Bullae
  - Low prevalence in CL wearers
  - Indicates the presence of chronic epithelial edema
  - 5-30 microns, irregular shaped (typically oval) that may coalesce in the central cornea
  - Fluid filled formations
  - Generally asymptomatic
- Prognosis
  - Identify the cause
  - In severe cases the bullae may break through the epithelial surface – ouch!

Water Content and Dk

An increased Dk is linked with a decrease in water content

Corneal Vascularization

- Discontinue lens wear if needed
- Treat any underlying external pathology
- Minimize physiologic insult
  - A higher Dk lens material
  - Minimize mechanical pressure
  - Avoid preserved lens care products
**Cornea – Keratitis**
(Involves multiple layers of the cornea as well as multiple structures)
- Infiltrative Keratitis
- Contact Lens Peripheral Ulcer (CLPU)
- Microbial Keratitis
  - Bacterial
  - Protozoa
  - Fungal
  - Viral

**What is an Infiltrate?**
- A focal accumulation of cells or tissue within the anterior stroma
  - Polymorphonuclear (PMN) leukocytes
  - Mononuclear cells
  - May be infectious or non-infectious (sterile)
  - May occur anytime 1 week to 20 years following initial fitting
- Physiological factors
  - Limbal redness
  - Prior inflammatory event
  - Corneal staining

**What is an Infiltrate?**
- Response to:
  - Reaction to topical or systemic meds
  - Preserved lens care solutions
  - Immune reaction (debris entrapment)
  - Bacterial infection
  - Viral infection Staph hypersensitivity
  - Corneal hypoxia
  - Dystrophy
  - Exposure

**Bottom Line**
Infiltrates will appear with almost any chronic irritation to the cornea

**Cornea - Keratitis**
- Infiltrative Keratitis
- Contact Lens Peripheral Ulcer (CLPU)
- Microbial Keratitis
  - Bacterial
  - Protozoa
  - Fungal
  - Viral

**Infiltrative Keratitis**
- Inflammatory reaction of cornea
- Mild to moderate irritation
- Redness
- Occasional discharge
Infiltrative Keratitis

• Anterior stromal infiltration
• With or without epithelial involvement
• A/C reaction rare
• Can be bilateral
• No lid edema
• Moderate redness
• VA may or may not be affected

Infiltrative Keratitis

• Etiology - multifactorial
  – FB entrapment
  – mechanical trauma
  – Bacterial toxins
  – MPS reaction
    • SICS
• Risk factor
  – CL wear (DW or EW)
• DDx: Viral KC, CLARE, CLPU

Infiltrative Keratitis

• D/C CL wear temporarily
• Steroids if moderate symptoms or VA ↓
  – i.e. Lotemax QID X 5-7 days +/- taper
  – resolution quick vs. Viral KC
• Ocular lubricants
• Rarely scars vs. CLPU (Bull’s eye scar)
• Recurrence possible - esp. if toxic reaction
• Switch to Single Use lenses or Preservative Free system if in DW

Contact Lens Peripheral Ulcer (CLPU)

• Compared with microbial keratitis:
  – Peripheral location
  – Regularity of lesion
  – Absence of photophobia
  – No visual involvement
  – No AC reaction
  – Rapid resolution (2 to 3 days)

Cornea - Keratitis

• Infiltrative Keratitis
• Contact Lens Peripheral Ulcer (CLPU)
• Microbial Keratitis
  – Bacterial
  – Protozoa
  – Fungal
  – Viral

CLPU

• Discomfort
  – moderate to severe
  – FB sensation
  – slight irritation
  – asymptomatic
• Redness - slight
• Tearing
Contact Lens Peripheral Ulcer (CLPU)

- Infiltrate
- No lid edema
- Moderate redness
- Unilateral
- No A/C reaction
- Peripheral or mid-peripheral

CLPU

- Inflammatory reaction to G+ Exotoxins
- Toxins released by S. aureus colonizing on lens surface
- Bacteria rare in cultures of corneal scraping

Infiltrative Keratitis

- Anti-infective agent
  - 4th generation
- Cycloplege
- Steroids after re-epithelialization?
- Monitor closely

Cornea - Keratitis

- Infiltrative Keratitis
- Contact Lens Peripheral Ulcer (CLPU)
- Microbial Keratitis
  - Bacterial
  - Protozoa
  - Fungal
  - Viral

Microbial Keratitis

- Focal defect or excavation of the subepithelial corneal surface
- Produced by sloughing of necrotic inflammatory tissue (loss of stromal substance)

Microbial Keratitis

- Microbial invasion & infection
  - Bacteria (Pseudomonas, Serratia, Staph, Strep)
  - Protozoan (Acanthamoeba)
  - Fungal (Aspergillus, Candida, Fusarium)
  - Viral
Microbial Keratitis: Subjective

Symptoms may be mild to severe
Patient may experience
- Pain
- Photophobia
- Tearing
- Blepharospasm
- Red Eye
- Floaters
- AM lid crusting
- Purulent discharge

Microbial Keratitis

- Must have an acute inflammatory infiltrate of the epithelium & stroma in the presence of an infectious microorganisms
- Infection of the corneal surface cannot occur without initial bacterial attachment or binding to epithelial cells
  - The normal cornea binds few bacteria
  - Spontaneous infection is rare

Microbial Keratitis With Traditional EW

- With traditional EW the epithelium becomes edematous
- Increased attachment of microorganisms to the epithelium
- Compromised epithelium unable to defend against microbial invasion

Microbial Keratitis

- Infiltrate
  - Central or paracentral, sometimes peripheral
  - Large, irregular, focal >1mm
  - Satellite lesions common
  - Anterior stromal to full thickness
  - Corneal Edema
  - Full thickness epithelial loss
  - Anterior chamber reaction
  - Lid edema
  - Severe bulbar & limbal redness
  - Unilateral
  - Hypopyon

Risk Factors

- Trauma
- Surface Disease
- Smoking
- Age
- High Ametropia
- Lens Replacement
- Years of Wear
- CL Material
- CL Case Care
- Water Exposure
- Illness
- Extended Wear

Extended Wear

- 1989 Schein & Poggio (N Engl J Med) data suggest MK:
  - 1/500 in EW (low Dk)
  - 1/2500 in DW (5x less risk)
- 1999 Cheng (Lancet) – Planned Replacement
  - 1/500 or 20 per 10,000 EW
  - 1/2857 or 3.5 per 10,000 DW
  - Frequent replacement did not minimize complications
- What about Silicone Hydrogels?
**Extended Wear**

- 2005 Schein, McNally et al. (Ophthalmology)
  - The incidence of loss of visual acuity due to MK among users of SiHy contact lenses was low
    - 0.3 to 3.6 per 10,000
  - Higher incidence of SK in EW compared with DW
  - EW in SiHy carry 5x less risk of SK
  - Principal risk factor of MK is EW

**LASIK**

- Vision loss of two or more lines
  - 0.5 to 1.4% of individuals during the intra-operative and early post-operative
  - 1 per 2500 late post-operative
  - Primarily from post surgical ectasia
- Comparing Risk
  - “…equivalent to the risk following 20 years of EW hydrogel wear where lenses are used for 6 nights continuously or silicone hydrogel contact lens use where lenses are used for 30 nights continuously.” (Stapleton et al OVS 2007)

**Antibiotics**

- **Pharmacodynamic**
  - **Fluorometholone**: postoperative 0.1% (ocular, 5% w/v, tear film)
  - **Ciclosporin**: oral, 2mg / kg
  - **Moxifloxacin**: 0.5% (ocular, 3mg / ml)
  - **Cefazolin**: 1g / 100mg / 10mL
  - **Piperacillin / Tazobactam**: 1g / 0.125g
  - **Vancomycin**: 1g / ml

- **Pharmacokinetic**
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  - **Vancomycin**: 1g / ml

- **Other Antibiotics**
  - **Topiramate**: oral, 25mg / day
  - **Minocycline**: oral, 100mg / 25mg

**Bacterial Keratitis**

- **Pseudomonas**
  - (P. aeruginosa 70% of CL wearers, S. Aureus 50% of non-CL wearers)
  - One of the most common isolates in CL related MK
  - Liquefactive necrosis
  - Perforation in 48 hours
  - Semi-opaque ground glass appearance
- **Intact epithelium**
  - Corynebacterium diphtheriae
  - Listeria
  - Haemophilus
- **Treatment**
  - Culture (1:2:3 rule)
  - Broad spectrum antibiotic

**Protozoa Keratitis**

- **Appearance**
  - Dendritic or patchy stromal infiltrates
- **Symptoms**
  - Disproportionate to signs
- **Risk factors**
  - CL wear – 90% of cases
  - 3 per 100,000 / year vs. 1 per 1,000,000
  - Injuries from vegetative matter
  - Hot tub exposure
- **Treatment**
  - Brolene 1% q1h, Neosporin q1h, Chlorhexidine 0.02% q1h, and oral itraconazole 100-200mg
  - PKP

**2008 Stapleton et al. - Microbial Keratitis**

<table>
<thead>
<tr>
<th>Lens Type</th>
<th>Overnight Wear</th>
<th>Microbial Keratitis</th>
<th>&gt; 2 Lines Vision Loss</th>
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<tbody>
<tr>
<td>GP</td>
<td>No</td>
<td>1.2</td>
<td>0</td>
</tr>
<tr>
<td>SCL-DD</td>
<td>No</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>SCL-DD</td>
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<td>4.2</td>
<td>0</td>
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<tr>
<td>SCL-Hy</td>
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<td>1.9</td>
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<td>0.2</td>
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<tr>
<td>SCL-Hy</td>
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<td>19.5</td>
<td>4.0</td>
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<tr>
<td>SCL Shy</td>
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<td>11.9</td>
<td>1.1</td>
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<tr>
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<td>1.6</td>
</tr>
<tr>
<td>SCL Shy</td>
<td>Yes</td>
<td>25.4</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Fungal Keratitis
- Large white infiltrate with fluffy or branching margins
- Significant edema
- Fusarium
  - found in soil, vegetation & water
- Recent outbreaks
  - associated risks
- High risk of loss of BCVA
- Treatment (No Steroids)
  - Natamycin 5% and/or Amphotericin B 0.15% q1h around the clock, oral Itracanrozol 200-400mg loading dose followed by 100-200mg QD, and cycloplege

Viral Keratitis
- Simplex (HSV-1)
  - course punctate staining
  - linear branching w/ terminal end bulbs
  - geographic appearance
  - pseudodendrite (epithelial healing)
  - Treatment
    - anti-viral: Zirgan gel 5x/day, Vira-A ung, Viroptic 1% q2h, acyclovir 400mg 5x/day x 7-10days (consider famciclovir 250mg or valacyclovir 500mg TID)
- Zoster (HHV-3)
  - no terminal end bulb on pseudodendrites (raised mucous plaques)
  - Treatment (most effective w/in first 3 days)
    - lubrication, topical steroid (i.e. Durezol), cycloplege, acyclovir 800mg 5x/day x 7-10 days (consider famciclovir 500mg TID or valacyclovir 1000mg TID)

Microbial Keratitis
- Treatment Options
  - Progressively worsens without treatment
  - D/C CL wear immediately
  - Corneal scrapings & antimicrobial therapy
    - Which therapeutics?
    - Referral to cornea specialist if in visual axis

Wearing Modality & Material
- Daily Disposable
  - Benefits
    - Convenience, No CL storage case
    - Decrease deposit formation
  - Decrease in incidence severity of MK
- Silicone Hydrogel
  - Benefits
    - Increase oxygen permeability
    - Equal risk but wearing SiHy for longer periods of overnight wear (continuous wear)
    - Other factors contributing to complications

Summary of CL Associated Serious & Significant Events
- Rare
- Absolute risk has remained constant for DW and EW SCL
- Occurrence
  - 1 in 10,000 for GP
  - 3-4 in 10,000 for DW SCL
  - 10-20 in 10,000 for EW SCL
- Vision loss with CL related MK
  - 0.3 to 3.6 in 10,000
- Sterile keratitis – 1% to 7% of SCL wearers
  - Principle risk factor for MK is overnight wear

Some Topographical changes Associated with Silicone Hydrogel Contact Lenses May be Due to Everted Lenses
Williams, Westburge, Popowski, Popowski, Bergenske, Caroline, Smythe Presented at AAO, Tampa, FL 12/2004
Orthokeratology

- Controlled reshaping of the cornea with reverse geometry GP CL
  - Correct myopia
  - Centration is the primary goal
  - Central applanation (3 - 4mm)

Patient: JS    Age: 24    Male

- History:
  - Right Eye: -0.75 DS    20/20
  - Left Eye: -0.75 DS    20/20

- Interested in orthokeratology

Right Eye

Uncorrected VA
20/20

Left Eye

Uncorrected VA
20/20

Cornea - Endothelium

- Endothelial Bedewing
- Endothelial Blebs
- Polymegathism
- Pleomorphism

Endothelial Bedewing

- Endothelial deposits of unknown etiology in patients who are contact lens intolerant
  - Associated with CL wear but not necessarily induced by CL
- Fine white precipitates or pigmented dusting of cells
  - Best seen with reversed illumination
- Often benign and associated with intolerance to CL, injection, stinging & blurred vision
- Idiopathic
  - 20% occurrence in non-CL wearers
**Cornea - Endothelium**
- Endothelial Bedewing
- Endothelial Blebs
- Polymegathism
- Pleomorphism

**Endothelial Blebs**
- Black, non-reflecting areas
- Prevalence is 100% among CL wearers
- Rapid onset – 10 minutes after application
- Rapid resolution – 2 minutes post removal
- Adaptation of the endothelium
  - Blebs peak at 20-30 minutes then decrease after 45-60 minutes
  - Diurnal fluctuations & decrease over length of wear
- Asymptomatic
- Relatively minimal clinical significance

**Cornea - Endothelium**
- Endothelial Bedewing
- Endothelial Blebs
- Polymegathism
- Pleomorphism

**Endothelial Response**
- Polymegathism
  (changes in cell size)
- Pleomorphism
  (changes in cell shape)

**Put it into Practice**
- Evidence based care
- Identifying those patients at higher risk
  - 15-25 year olds
  - Extended wear
  - Living environment
  - Stress level
- Customize prescribing habits to decrease risk
- Customize patient education to decrease risk
SCL Complications

Differential diagnosis
- MGD
- Dry Eye
- Mucin Balls
- LEH
- CLPC
- CLARE
- CLSLK
- SEAL
- IEAL
- SICS
- PATH
- Vascularization
- IK
- CLPU
- MK
- Endothelial Bedewing
- Endothelial Blebs
- Polymegathism
- Pleomorphism

Practitioner Resources
- Grading Scales

Patient Resources
- Association of Contact Lens Educators
- Food and Drug Administration
- Institute for Eye Research (Brien Holden Vision Institute)
- Industry

Thank You!

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