Course categories: Keratoconus, Cornea, Contact Lenses

**Irregular Corneas: Diagnosis and Management**

Contact lens and surgical management options for keratoconus and other irregular corneal conditions will be discussed. Corneal and scleral gas permeable, soft and hybrid lens designs, and surgical procedures will be presented.

**Learning objectives**
1. To understand diagnostic features of keratoconus.
2. To understand the indications for prescribing different diameter (corneal, intralimbal, scleral) GP contact lenses for keratoconus and other irregular corneal conditions. Also, indications for soft, hybrid, and piggyback lens designs.
3. To increase the understanding of current surgical options (for example, corneal cross-linking and Intacs) for keratoconus patients.
4. To enhance patient education of keratoconus.

**Keratoconus**
A. Corneal signs
   a. Vogt’s striae
   b. Fleischer’s ring
   c. Scarring
   d. Topography
B. Patient demographics
   a. Age of onset
   b. Gender
C. Patient education
   a. Progression
   b. Eye rubbing
   c. Heredity
D. Management
   a. Prescribing spectacles
   b. Corneal GP contact lenses
c. Scleral GP contact lenses
d. Soft contact lenses
e. Piggyback contact lenses
f. Hybrid contact lenses

E. Surgical options
   a. Corneal cross-linking
   b. Intacs
   c. Full and partial-thickness keratoplasties
      i. Post-PK contact lens prescribing

F. Patient cases and problem-solving

Financial disclosure: Research funding from SynergEyes.
Complications of the Conjunctiva and Lids:

Blepharitis

SXS: Itching, Burning, Debris on lashes, Increased Lens Awareness, Decreased Wearing Time
SNS: Induration, Erythema, irregularity to lid margin, collarettes
Eti.: Infectious with Inflammatory reaction due to exotoxins
TX: Decrease Wearing Time, Deprivation, Increase Lid Cleanliness, Increase replacement cycle
Pharmacologically: Lid hygiene, Anti-Bacterial agents, Steroids

Dry Eye Syndrome

SXS: Itching, Burning, Dryness, Stinging, Increased Lens Awareness, Decreased Wearing Time
SNS: Reduced Tear Wedge, reduced tear volume (phenol red thread), Lid Wiper Epitheliopathy, conjunctival and/or corneal staining(Fluor = use barrier filter, Rose Bengal/Lissamine Green = no filter – typically lower 1/3 of open eye, (Fluor = use barrier filter, Rose Bengal/Lissamine Green = no filters)
Eti.: Auto-Immune, Nutritional
TX: Decrease Wearing Time, Deprivation, Increase Lens Cleanliness and/or Hydrophilic nature, increase replacement cycle
Pharmacologically: Steroids, Cyclosporine, Tetracyclines, Lid Hygiene, Omega 3

Contact Lens Induced Papillary Conjunctivitis (CLPC – formerly GPC)

SXS: Itching, Mucus, Blur, Increased Lens Awareness, Decreased Wearing Time
SNS: Upper Bulbar Conj. Papillae, Mucus Strands, High Riding Lens, Possible Corneal and Conjunctival Stain (Use Barrier Filter).
Eti.: Mechanical, Auto-Immune, Allergic
TX: Decrease Wearing Time, Deprivation, Increase Lens Cleanliness, Increase replacement cycle, Refit
Pharmacologically: Steroids, NSAIDs, Mast-Cell Stabilizers

Conjunctival Injection, including “Circumcorneal”

SXS: “red eyes”
SNS: Engorgement of existing circumcorneal vascular plexus. Less than 1.5 mm.
Use Red-Free filter and aperture to gauge size.
Eti.: Hypoxic, Inflammatory, Infections, Traumatic, Mechanical = many possible
TX: Decrease wearing time and/or increase DK/L – SiHy material, Increase Replacement Interval, change care system – eliminate offending agent.
Pharmacological?:

Complications of the Cornea:

Contact Lens Acute Red Eye (CLARE)

SXS: Noticed on Awakening, little symptoms prior to sleep, irritation to moderate pain, some lacrimation, “red eyes”, possible mild lid edema
SNS: Significant diffuse (pinpoint) subepithelial (or very anterior stromal) infiltration of the peripheral and/or mid-peripheral cornea (usually involving one or more quadrants), Bulbar injection usually diffuse, no significant staining (may be disrupted epithelial integrity), none to trace AC response, usually unilateral, but can be asymmetrically bilateral (patient complains of one eye, but other is mildly involved), may see small petechial sub-conjunctival hemorrhages.
Eti.: Inflammation of the peripheral cornea typically caused by bacterial over-proliferation
TX: Discontinue lens wear. Consider etiology and change lens material, replacement interval and possibly care system – eliminate offending agent.
Pharmacological:

Superior Epithelial Arcuate Lesions (SEAL)

SXS: Foreign Body Sensation, burning & itching also possible, Some Asymptomatic.
SNS: Arc-Like epithelial staining, appears as “splitting” with (usually) prominent “Edges” or “lines”
Eti. Mechanical
TX: Refit Contact Lenses – change lens/cornea relationship and/or modulus of lens, Mild Anti-Inflammatory
Corneal Hypoxia / Edema

SXS: None with mild, Spectacle blur with higher amounts, pain if SEVERE.
SNS: Striae, Microcysts, Staining, Diminished Clarity of Cornea, Km distortion
   Striae: Indicates "significant edema"
   Microcysts: Need High Mag., No stain until "erupting" at surface
   Signify diminished mitotic activity. Occur > 3 mos of wear.
   Under 50 counted is tolerated. Greater = Take Action.
   Differentiate from mucin ball indentations.

Etio. Decreased Physiological Response to diminished oxygen.
TX: Decrease wearing time, discontinue, refit: Higher DK/L - SiHy.

Corneal Vascularization

SXS: Usually None
SNS: New Growth of limbal vasculature beyond 1.5 mm.
   Use Red-Free filter and aperture to gauge size.

Etio.: Periph. Corneal Edema combined with epithelial trauma (some differing opinion).
TX: Decrease wearing time and/or increase DK/L – SiHy material. Pharmacological:?

Infiltrative Keratitis

SXS: Mild to moderate irritation/discomfort, Lacrimation, scratchiness, photophobia, redness
SNS: Mild to moderate diffuse infiltrates subepithelial or anterior stroma, moderate bulbar injection, mild to moderate epithelial staining over infiltrates (may leave scar), may be variant of SEALS and have arcuate pattern.

Etio.: Hypersensitivity, Toxicity. Rule-out Infection/Ulcer, EKC
TX: Discontinue lenses 1-2 weeks. Steroid or Combo Drug (T-Dex) qid 7 days. NO PATCH.

CLPU/CLPI: Contact Lens Induced Peripheral Ulcer (or CLPI – Infiltrates)

SXS: Irritation-Discomfort-Mild Pain (Can be described as a Foreign Body Sensation), “White Spot” sometimes noticed by patient or companion, ischarge, Lacrimation, Photophobia, Redness, Blurred Vision
SNS: Focal Epithelial Loss < Infiltrate (usually < 1mm of staining), Intact Bowman’s Membrane, Mild Watery Discharge, Localized/sectoral Conjunctival (bulbar) injection, None to Trace AC reaction

Etio.: Inflammatory reaction, typically to Bacterial Presence
TX: Discontinue lenses 1-2 weeks. Combo Drug (T-Dex) qid 7 days. NO PATCH. Antibiotic only until staining resolves more conservative approach. If true CLPU, will leave a scar.
RTO 24-48 hours = improvement should be rapid.

Microbial Keratitis

SXS: Pain (of rapid onset), Discharge, Lacrimation, Photophobia, Redness, Blurred Vision
SNS: Epithelial Loss > Infiltrate (usually > 1mm), Diffuse and deep (stroma) infiltrates surrounding lesion
   Stromal “glow” from NaFl, Lid Edema, Prominent Conjunctival (palpebral and bulbar) injection,
   A/C Reaction, Mucous Discharge, Usually Unilateral.

Etio.: Bacterial Infection
TX: NO PATCH, Fluoroquinolone + Polytrim q1h
   RTO 24 hours = min improvement, no worsening
   2-5 days = improvement noticed.

Superficial Punctate Keratitis / Staining

SXS: Variable, Greater with Acute Etiology (Ulcer)
   Consider location, depth and extent
SNS: Epi. Cell membrane disease/damage = staining – usually present in at least 3 of corneal regions

Etio. Mechanical, Toxic, Hypersensitivity, Exposure
TX: Change Lens Type, Fit, DK/L, solutions
**Lamellar corneal surgery - procedures and contact lens implications**

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Director, Contact Lens Service
University Hospitals Case Medical Center Eye Institute
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Cornea Preservation Time Study

**Disclosures:** Past consultant and investigator for B&L, Ciba, Vistakon, Menicon, SynergEyes, Allergan, Alcon, AMO, CooperVision, Inspire

**POST-KERATOPLASTY CONTACT LENS FITTING**

- Graft rejection is no longer the most common "complication"
  - KC has the lowest risk of graft failure
- Common modern day complications include:
  - High regular astigmatism (4-5 D average)
  - Irregular astigmatism
  - Anisometropia

**Indications for Post Surgical Contact Lens Use**

1. Poor surface healing
   - Bandage lens therapy
2. Irregular Astigmatism
   - 25% after PK
   - Estimated 13% after PRK
   - 1-11% after LASIK
3. High regular astigmatism
4. Anisometropia

**Indications for Post Surgical Contact Lens Use (Cont.)**

5. Residual refractive error
   - RK; PERK Study 10 year results:
     - 58% felt optical correction required
     - 23% hyperopia > 1 D; 17% myopia > 1 D
   - RK; Casebeer System 1 year results:
     - 28% wore optical correction
     - 2% hyperopia > 1 D; 3% myopia > 1 D

**Limitations of Spectacles**

1. Inability to correct irregular astigmatism
2. Distortions
   - Barrel in high minus
   - Pincushion in high plus
   - Astigmatism
   - Induced prism in peripheral gaze
3. Magnification and minification
Limitations of Spectacles (Cont.)

- Aniseikonia
  - Surgically induced refractive anisometropia
  - Relative spectacle magnification disparity
  - 1% mag per D of refractive disparity
  - 3% easily tolerated
  - >5% impaired binocular function

Indications for Corneal Transplants

1. Optical
   - Keratoconus
   - Fuch’s endothelial dystrophy
     - Most common indications
     - previous graft failure
     - aphakic/pseudophakic bullous keratopathy
     - most common indications
     - interstitial or herpes keratitis
     - corneal stromal dystrophies

2. Tectonic
   - reparative or structural purposes

3. Therapeutic
   - removes actively diseased tissue

4. Cosmetic
   - removes unsightly opacity

Types of Corneal Transplants

- Penetrating Keratoplasty (PKP or PK)
- Deep Anterior Lamellar Keratoplasty (DALK)
- Endothelial Keratoplasty (EK)
  - DSEK
  - DSAEK
  - DMEK
NIH Funded Large Scale Studies on Corneal Transplantation

- Collaborative Corneal Transplant Studies (CCTS)
- Cornea Donor Study (CDS)
- Corneal Preservation Time Study (CPTS)

Collectively explored in association with graft success:
- Tissue/histocompatibility matching (CCTS)
- ABO blood type matching (CDS)
- Donor age (CDS)
- Donor Preservation Time (CPTS)

Objectives

- To determine if the 3-year graft failure rate following EK performed with donor corneas with a preservation time of 8 to 14 days is non-inferior to the failure rate when donor corneas with a preservation time of 7 or fewer days are used.
- To determine if the central corneal endothelial cell density 3 years after EK is related to preservation time.
- To evaluate donor, operative and postoperative factors on graft failure and endothelial cell density three years following EK.

Study Participant Eligibility Criteria

- EK scheduled between 10 and 60 days from baseline visit.
- Willingness to return for follow-up study visits at 1, 6, 12, 24, and 36 months.
- Second eye will able to be entered as long as meets eligibility criteria and EK occurs no earlier than 6 weeks after first eye EK surgery performed.
- Decisional and/or cognitive impairment is an exclusion.

Study Eye Eligibility Criteria

EK for FECD

- Phakic FECD
- Phakic FECD with cataract
  - Triple procedure including EK for FECD, cataract extraction, and posterior chamber intraocular lens implantation (IOL) is allowed
- Aphakic FECD
  - Pseudophakic FECD with posterior capsule supported or suture-supported posterior chamber IOL

CPTS Clinical Sites

- Wills Jules Stein
- Mid-Atlantic Cornea Consultants
- Eye Consultants of MD
- Albany Cent Pa Eye Ctr
- Eye Assoc. Northwest
- Doheny Devers Eye Consultants of Atlanta
- Bascom Palmer Focal Point VRCC & CIARC
- Medical Eye Ctr MI
- Cornea Consultants NY Eye & Ear
- NE Ohio Eye OSU Northshor Johns Hopkins University IA Hospitals
- UM/Kellogg Univ of Illinois Hospital
- Verdier Cornea Assoc. of Texas
- Dean Eye Care of San Diego
- U of Kentucky Jaeb Center & DMAC
- UHCMC Cincinnati Eye Institute
- Mayo St. John's Clinic
- Univ of Calif, San Francisco Moran Eye Center
- Hannush
CPTS Stromal Clarity Grading Scale for Endothelial Keratoplasty

| Clear | Equivocal | Cloudy |

CPTS Donor Corneal Stroma Clarity Grading Scale for Endothelial Keratoplasty

| Clear R/Clear D | Equivocal R/Equivocal D | Cloudy R/Cloudy D |
| Clody R/Equivocal D | Cloudy R/Clear D | Equivocal R/Clear D |

Types of Clinical Rejection Episodes

- Epithelial rejection
- Subepithelial Infiltrates
- Stromal
- Endothelial

Endothelial Rejection

- Most severe
- Signs
  - Khodadoust Line
  - Diffuse
  - KPs on donor endothelium

CPTS Graft Rejection Classification

Definite: Mild

- Presence of one or more of the following signs:
  - one to five keratic precipitates,
  - increase in aqueous cells from previous visit without clinically apparent change in stromal thickness from previous visit or clinically evident stromal and/or epithelial edema.

The management of suspected graft rejection episodes will be according to the investigator prerogative, but documented in the medication history.
Presence of one or more of the following signs:
- one to five keratic precipitates,
- cells in the stroma,
- endothelial rejection line,
- moderate to severe increase in aqueous cells from previous visit; or
- any of the above with or without clinically apparent change in recipient stromal thickness associated with epithelial edema from previous visit and change in stromal clarity.

The management of suspected graft rejection episodes will be according to the investigator's prerogative, but documented in the medication history.
Definite Severe Graft rejection post EK

Probable corneal rejection episode
- Hazy graft that was previously clear
- Corneal edema
- Inflammation
  - Stromal infiltrates
  - KPs
  - AC cells
  - Ciliary injection

Surgical Management of post PK and DALK Refractive Error

1. Donor-recipient trephination techniques
2. Optimal suture placement
   - single or double running sutures
   - combination interrupted and running sutures
   - interrupted sutures alone

Surgical Management of post PK and DALK Refractive Error (Cont.)

3. Selective suture removal
   - 3 months post op if interrupted sutures alone
   - 1 month post op if combo interrupted and running sutures
   - Topography best predicts suture responsible for steepening
   - Topography changes within 3-5 weeks after suture removal
Surgical Management of post PK and DALK Refractive Error (Cont.)

4. Refractive surgical techniques
   - Astigmatism Correction:
     - relaxing incisions (RI)
       - arcuate incision along steep meridian
       - flattens the steep meridian & steepens the flat
       - corrects 4-10 D astigmatism
     - compression sutures
       - complimentary to relaxing incision
       - sutures placed 90 degrees from RI

   - wedge resection
     - angled wedge removed around graft circumference
     - sutured to create steepening
     - corrects astigmatism up to 20 D
     - induces net myopia
     - unpredictable

Wound Revisions
- LASIK
  - wait at least 1 year post op

Contact Lens Management of Post-PK and DALK Refractive Error
- ~50% of KC pts return to CLs after surgery
  - Geerards, Vreugdenhil, Khazen. Eye Contact Lens 2006
- 84% CL success rates reported after PK
- Little to no graft compromise from long term CL use:
  - normal endothelial density
  - stable & consistent topography

Time Course of CL Fitting
- as early as 3 months post-op for visual rehabilitation
- Assess sutures for potential impact on graft shape
**Post-Irregular Astigmatism Topography**

- Tight Suture Steepens Post-irregular Astigmatism
- Wound Gape Flattens Wound Tilt

**Two Basic Fitting Philosophies**

- Fit the corneal contour
- Mask the corneal contour

**Corneal Lens Fitting**

- "Fit" the corneal contour
- Graft shape dictates RGP design

**Waring’s 5 Post-PK shapes:**

- Originally Classified on Axial Data
  - Prolate 31%
  - Oblate 31%
  - Mixed (Prolate & Oblate) 17.8%
  - Asymmetric 8.7%
  - Steep to Flat 13.5%

**Lens Selection Based on Graft Contour**

- Prolate Cornea
  - Can simulate normal aspheric topography
  - Central cornea has a steeper radius surrounded by concentric flattening
  - Traditional fitting techniques may be used
  - Exception and not the rule in the CL practice
  - PRACTICE PEARL: Try KC designs

- Oblate Cornea
  - Flat Central Topography With Steep Periphery
  - Very Common, at least in one meridian
  - May have heavy central clearance to align with peripheral cornea
  - Here is where the specialty stuff comes in handy
  - PRACTICE PEARL: Start with AXIAL maps to design a reverse geometry lens
What happens if you fit an oblate cornea “on k”

Lens Selection Based on Graft Contour

- Mixed Astigmatism: By definition, relatively regular astigmatism encompasses entire graft

**PRACTICE PEARL:**
Bitoric lens needed, almost always

<table>
<thead>
<tr>
<th>Patient</th>
<th>Center</th>
<th>Donor Size</th>
<th>Recipient Size</th>
<th>Baseline Astigmatism</th>
<th>Late Stage Astigmatism</th>
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<td>-3.10 X 005</td>
<td>-12.4 X 163</td>
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<td>2</td>
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<td>7.5 mm</td>
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<td>-0.50 X 115</td>
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<td>7.5 mm</td>
<td>-2.23 X 000</td>
<td>-0.50 X 115</td>
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**PATIENT 1**
**Initial PK: 11-1985**
All sutures removed 04-1986

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<th>Date</th>
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<td>09-1988</td>
<td>-2.5 X 160</td>
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<td>04-1990</td>
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<td>-3.00 - 3.75 X 160 (20/20)</td>
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**Patient 2**

**Initial PK: 03-1989**

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<td>09-1997</td>
<td>-0.75 X 029 (20/30+)</td>
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**Lens Selection Based on Graft Contour**

- **Graft Tilt**
  - Account for approx. 22% of post graft topography
  - One portion of graft steepens, topography 180 degrees away

**Practice Pearl:**

GP lens will center over the steepest portion of the graft

**Nasal or temporal tilt**

- Often, decentered lens position unavoidable, use large lens to avoid glare
- Bitorics not indicated

**That was theory, this is reality.....**

**Masking the Corneal Contour**
Scleral Lenses

INTACS
(thanks to Buddy Russell)

Scleral lens designs
Semi-scleral, corneo-scleral

- Jupiter Lens
  - Essilor
  - 15.6 mm diameter
  - 18.2 mm diameter
  - Posterior surface:
    - Consider reverse geometry:
      - 2D or
      - 4D reverse

- SoClear (aka Macrolens)
  - Dakota Sciences
  - Diameter: 9.0-15.0 mm
  - BC: 8.8-9.0 mm

- MSD Lens
  - Blanchard Labs
  - 36 lens trial lens set
    - Saggital depth
    - Limbal clearance
    - 15.6 mm OAD
    - Custom curves
    - Available

Semi-scleral lens designs

- One Fit Cone
  - Blanchard Labs

- Rose K2 XL
Case Examples

BC 0.5-1D flat

Ideal BC
Large Diameter Corneal Lenses

- Rose KIC
  - 11.2mm diameter (Available 9.4mm – 12.0mm)
  - Posterior Aspheric Aberration Control Optics
  - Dyna-IntraLimbal: 11.3mm – 12.3mm Diameter
  - Dyna-IntraLimbal: 11.0mm Standard Diameter
  - FTP: 10.4mm – 11.4mm Diameter

- What to look for in a fitting set
  - Comprehensive BC range 6.0 to 8.6
  - Some designs automatically account for the likelihood of oblate shape in flatter corneas and incorporate reverse geometries in flatter bases
    - Eg Rose KIC: Increased reverse geometry as BC flattens
  - Large optic zone (may be aspheric) – vaults graft or irregular zone
  - OZ decreases as BC steepens

Using a Systematic Approach when Fitting Keratoconus, Irregular and Post Surgical Corneas

For keratometers:
Choose first trial lens 0.3 mm flatter than the steepest corneal meridian

Assess in order:
1. Central fit
2. Peripheral fit, particularly noting tight and loose areas
3. Diameter – should sit approx. 1mm inside the limbus
4. Location
5. Movement

Eg. 6.8mm/5.5mm First trial lens 5.5mm + 0.3 = 5.8mm
2. Peripheral fit

Very tight periphery (std steep EL)

Tight periphery (standard EL)

Ideal periphery (std flat)

EDGE LIFT (Peripheral fit)

Peripheral fit is *Singularly* the most important fitting factor for a successful comfortable fit.

EXEMPLARY LIFTS

- Standard 65%
- Increased 20%
- Decreased 10%
- Other lifts 5 to 10%

How labs specify edge lift values

Quadrant Specific Design Options

Inferior Quadrant Control

- Available from a few laboratories
- Manufacturing procedure that steepens one or more quadrants
  - Typically only need the inferior quadrant only steepened
- Creates a more personalized fit
- Provides a more comfortable and stable lens
- Improves visual acuity

Example of quadrant specific steepening which allows the steepening of the inferior quadrant only
Use Asymmetric Corneal Technology

Blanchard ACT grade 1 (0.7mm)
ACT grade 2 (1.0mm)
ACT grade 3 (1.3mm)

ROSE K2 IC

Lens Dynamics
Steepeen/flatte
n 15 steps in either
direction
1 step steep
30 μ
1 step flat
50 μ

"Using a Systematic Approach when Fitting Keratoconus, Irregular and Post Surgical Corneas"

4. Location - Tend to locate over steepest point on cornea

Remedies
• Steepen BC
• Increase diameter
• Correct edge lift
• Consider piggybacking

5. Movement
Must move sufficiently to achieve tear exchange!

Excessive movement
Increase diameter
Steepen BC
Reduce the edge lift (steepen)

Insufficient movement
Decrease diameter
Flatten BC
Increase edge lift

The best thing to come along for the post-keratoplasty patient:
THE SOFT LENS!!!

Contact Lens Selection

SOFT LENSES
PK/DALK

Bandage lens indications
• persistent epithelial defects
• epithelial filaments
• extreme height discrepancies at graft-host junction

Bandage lens selection
• Silicone hydrogels!!

Low Dk SOFT LENSES for post transplant

• Residual ametropia correction
  • Discouraged due to potential NV and graft rejection
  • NV removes immuno-privileged status of graft
Silicone Hydrogel Lenses

- **Spheres**
  - Doubtful unless used as piggyback
- **Toric**
  - Any Silicone Hydrogel Stock Toric
  - Definitive Silicone Hydrogel Custom
    - Material by Contamac
  - Lenses machined by Koel, Art Optical, plus others

Material Properties of Silicone Hydrogel Lenses
Currently Available in the United States
(nominal ortho-onset Dk)

<table>
<thead>
<tr>
<th>Material</th>
<th>Lens</th>
<th>Dk</th>
<th>Water Content</th>
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<tbody>
<tr>
<td>etafilcon A</td>
<td>Air Optix Aqua</td>
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<td>lotrafilcon B</td>
<td>Air Optix Night &amp; Day Aqua</td>
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<td>Biofinity</td>
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<td>lotrafilcon A</td>
<td>Acuvue Oasys</td>
<td>38</td>
<td>0.72</td>
</tr>
<tr>
<td>etafilcon A</td>
<td>Avaira</td>
<td>47</td>
<td>0.35</td>
</tr>
<tr>
<td>lotrafilcon B</td>
<td>Acuvue TruEye II</td>
<td>74</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Piggyback Lens Systems

- **Advantages**
  - Comfort
  - Freedom from mechanical trauma
- **Disadvantages**
  - Two lens per eye daily management
  - Optics?
  - Coatings

Piggyback lenses

PRACTICE PEARL:
- Steep BC needed for some oblate grafts

Predicted Tear Oxygen Tensions

PRACTICE PEARL:
Watch oxygen delivery in some combinations

Weissman B and Ye P.

Tear Oxygen Tension beneath piggyback lens systems

Weissman B and Ye P.
**Dk/t with low Dk and Silicone Hydrogels**

**Eye Specific Lens Material Interactions**

- Menicon Z, BXO HDS 100 and all SH lenses OD resolved temporarily with Plasma Treated lenses

**Practice Pearl**

- Use soft lens to reshape the corneal contour

- Piggyback soft lens can act as a prosthetic device

**Hybrid Lenses**

- SynergEyes
UltraHealth is available in 11 different vaults (50µ-550µ) of which each can be ordered in 3 different skirt curvatures; flat, medium and steep.

**RGP Characteristics**

<table>
<thead>
<tr>
<th>Material</th>
<th>ClearZone (CK)</th>
<th>UltraHealth (UH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus (MPa)</td>
<td>1150</td>
<td>1314</td>
</tr>
<tr>
<td>Luminous Transmittance</td>
<td>&gt;90%</td>
<td>87%</td>
</tr>
<tr>
<td>UVA Transmittance (315-380)</td>
<td>No UV Blocker</td>
<td>18%</td>
</tr>
<tr>
<td>UVB Transmittance (280-315)</td>
<td>No UV Blocker</td>
<td>3.3%</td>
</tr>
<tr>
<td>Wetting Angle</td>
<td>42°</td>
<td>34°</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.10</td>
<td>1.15</td>
</tr>
<tr>
<td>Hardness (Shore D)</td>
<td>79</td>
<td>76.0</td>
</tr>
<tr>
<td>Dk (Oxygen Permeability)</td>
<td>100</td>
<td>130</td>
</tr>
</tbody>
</table>

**Soft Skirt Characteristics**

<table>
<thead>
<tr>
<th>Material</th>
<th>ClearZone (CK)</th>
<th>UltraHealth (UH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus (MPa)</td>
<td>0.7-0.8</td>
<td>0.5-0.8</td>
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<tr>
<td>Luminous Transmittance</td>
<td>95%</td>
<td>97%</td>
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<tr>
<td>Wetting Angle</td>
<td>N/A</td>
<td>25-35°</td>
</tr>
<tr>
<td>Dk (Oxygen Permeability)</td>
<td>9.3</td>
<td>64</td>
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<tr>
<td>Water Content</td>
<td>27%</td>
<td>32%</td>
</tr>
</tbody>
</table>
**Landing Zones**

- ClearKone 200 S
- UltraHealth 200 S

- Outer Landing Zone on Soft Skirt
- Inner Landing Zone on RGP
- UltraHealth has a widened and softer landing zone

**Lens Fitting**

**Determination of**

1. Vault
2. Skirt Curve
3. Lens Power

*But first let’s talk about inserting the lens!*

**Inserting the Diagnostic Lens**

- Fill the bowl of the lens completely to the top with 1 drop of fluorescein (or use a fluorescein strip) and non-preserved saline.
  - High molecular fluorescein not required
- Have the patient lean forward and tuck their chin to chest
- Nose should be perpendicular to the floor.
- Retract the upper and lower lids and gently place the lens on the cornea.
- Check for bubbles under the lens with the blue pen light included in the diagnostic set
- Bubbles cannot be displaced by lens manipulation—remove and re-insert

**Check for Bubbles After Insertion**

- Check for bubbles under the lens with the blue pen light included in the diagnostic set
- Bubbles cannot be displaced by lens manipulation—remove and re-insert

**Vault Determination**

*Ideal fit = 100µ above the apex of the cornea*

- Start with a 250µ lens and a Flat Skirt
- Use NaFl and wait 3-4 minutes

*You will see either clearance (pooling) or touch (bearing)*

**If pooling (clearance) is seen**

- Decrease the vault in 100µ increments until the first bearing is observed (Ex. 150µ)

**Perform Final Defining Step**

- Increase the vault by 50µ (ex. 150 + 50 = 200µ)

  a. **If bearing is seen**, add an additional 100µ and order. (ex. 200 + 100 = 300µ)
  b. **If pooling is seen**, only add an additional 50µ and order. (ex. 200 + 50 = 250µ)
If touch (bearing) is seen:
- Increase the vault by 100µ increments until the first pooling is observed (ex. 450µ).
- Perform Final Defining Step
  - decrease the vault by 50µ (ex. 450 - 50 = 400µ)
  a. If bearing is seen, add an additional 100µ and order. (ex. 400 + 100 = 500µ)
  a. If pooling is seen, only add an additional 50µ and order. (ex. 400 + 50 = 450µ)
Unique designs for “regular” eyes: Myopia Control, Hybrids, Toric Lenses

By Robert L Davis OD, FAAO
I. Contact Lens Market (10 Min)
   A. World Market by modality
   B. United States Market
      1. Prevalence of Myopia
      2. Stabilizing options
         a) Corneal Reshaping
         b) Soft Bifocals
         c) Low Dose Atropine
      3. Hybrid Advantage
      4. Under served Toric lens Market
         a) Disposables
         b) Customization

II. Myopia Control (15)
   A. Ocular risk for myopia
   B. History of Corneal Reshaping
   C. Designing Reverse geometry corneal reshaping lens
   D. Important Fitting parameters
   E. Problem solving
      1. Initial Adaptation
      2. Centration
      3. Degree of myopia
      4. Induced astigmatism
   F. Myopia Control Soft Bifocal
   G. Myopia Control Atropine
   H. Case Presentation for Myopia Control

III. Hybrids (15 Minutes)
   A. History of Hybrids
   B. Patient Selection
   C. Design of hybrids - differences and similarities
   D. Parameter selection
      1. Base Curve
      2. Skirt Curve
      3. Power
   E. Case Presentation – Hybrid Modality
IV. Case Presentation for Toric (15)

A. Demographics

B. Types of Astigmatism
   1. Regular
   2. Irregular
   3. Corneal
   4. Lenticular
   5. Residual
      a) Physiological residual astigmatism
      b) Induced residual astigmatism

C. Types of Correcting Options
   1. Aspheric Spheres Lens
   2. Soft Toric Lens
   3. Front Toric Lens
   4. Back Surface Toric Lens
   5. Bitoric Lens

D. Case Presentation – Toric Lens

V. Summing Up (5)
CORNEAL DYSTROPHIES AND DEGENERATIONS: DIAGNOSIS AND TREATMENT

Louise A. Sclafani, OD, FAAO
AAO Diplomate, Cornea & Contact Lens
Associate Professor of Ophthalmology
University of Chicago Medical Center

GOALS
- Differentiate dystrophy vs. degeneration
- Normal vs. abnormal
- Classify the disease by location
  - Layers of the cornea
  - Central vs. peripheral
- Determine appropriate treatment

Review the Layers of the Cornea
- Tear film: 7-11 μm
- Epithelium: 50 μm
- Epithelial BM: <128 μm
- Bowman: 8-14 μm
- Stroma: 500 μm
- “Dua Layer”: 15 μm
- Descemet: 5-10 μm
- Endothelium: 5 μm

CORNEAL DYSTROPHY
- Rare conditions
- Slowly progressive, bilateral, central location
- Primary involvement of single corneal layer *
- Variable penetration and severity
- No associated systemic or ocular disease
- No sex predilection.
- Onset by age 20, stabilize by age 40 (except Fuchs)
- Autosomal dominant (50%)

CORNEAL DYSTROPHY
- Epithelial
  - Map/dot/fingerprint
  - Meesman’s
- Subepithelial/Bowman’s
  - Reis-Bücklers Dystrophy (CDB 1)
  - Thiel-Behnke Honeycomb Dystrophy (CDB 2)
  - Subepithelial Mucinous
- Endothelial
  - Fuchs’s dystrophy
  - CHED—congenital hereditary endothelial dystrophy
  - PPMD—posterior polymorphous dystrophy

CORNEAL DEGENERATION
- Non-familial, late onset
- Asymmetric, unilateral, central or peripheral
- Changes to the tissue caused by inflammation, age, or systemic disease.
- Characterized by a deposition of material, a thinning of tissue, or vascularization
Corneal Degenerations
From Periphery to Center (arbitrary division)

- Arcus senilis
- Lipid keratopathy
- White limbal girdle of Vogt
- Senile furrow
- Terrien’s marginal degeneration
- Hassall-Henle bodies
- Cataric band keratopathy
- Calcareous degeneration
- Spheroidal degeneration
- Iron deposition
- Coats’ white ring
- Crocodile shagreen
- Corneal farinata
- Salzmann’s corneal degeneration
- Corneal keloids
- Corneal amyloid degeneration

GENETICS

- Most corneal dystrophies are autosomal dominant:
  - Heterozygous: only one of the DNA strands affected
  - Homozygous: more severe disease and recurrence in transplanted corneas is more prevalent.
- Autosomal recessive: 25% get it
- X linked: only men
- Not much has changed in the diagnosis of corneal disease, however our increased understanding of the genetics has allowed us to classify better.

GENETICS

- Chromosomes 1, 5, 9, 10, 12, 16, 17, 20, 21
- Long arm of chromosome 5, 5q31
  - Gene codes for protein keratoepithelin which is involved in Bowman’s and stroma attached to Descemet’s layer
  - Gene codes for 683 amino acids
- Lattice, Granular, Avellino, Reis-Buckler Dystrophies
- Discovering the pathways may aid in the use of drugs to interfere with the deposition of substances
- Many chromosomes explain the phenotypic variations. Any change of sequence in the amino acid chain can cause variations of the disease

GENETICS

- 50 µm non-keratinized stratified squamous epithelium
- 5-10 layers central 8-10 peripheral
- Superficial layers have microvillae that attach tears.
- Exfoliation q 5-7 days
- Deeper layers (Basilar Columnar cells) have hemidesmosomes
  - Connect the epithelium to basement membrane which connects to Bowman’s Layer.

EPITHELIUM

- Basal cells produce abnormal finger-like projections that bend intra-epithelially and trap cells/debris that form cysts.
- MAPS: multi-lamination of BM and collagen
- DOTS: grey opacities, cysts
- FINGERPRINT: reduplication of BM
SLX of EBMD

- Negative NaFL pattern and instantaneous TBUT
- No Rose Bengal Stain
- When Microcysts surface and erupt, + NaFL
- Asymptomatic vs.
  Variable degrees of
  Blur, diplopia, photophobia,
  dryness, FBS, or pain.
  TX: Lubricants, hypertonics

TREATMENT FOR EBMD

- Indicated if vision or comfort are compromised.
- Manage co-existing ocular surface disease
- Environment/diet
- Lubricants
- Punctal occlusion
- Bandage Contact Lens (BCL)
- Surgical: PTK

LUBRICANTS

- Avoid preservatives or surfactants
- Electrolytes nourish eye
- Avoid bland ointments:
  hypo-osmotic and retain fluid
- Hyperosmotic agents
  Muro 128: Solution (2-5%) vs. ointment (5%)
  Ung: comfort, > concentration
  Treat 6 weeks Soln/3-6mo ung
- Warm Packs: QID 2-3 weeks

ALTERNATIVE DROPS

- N-ACETYL-CARNOSINE
  "inactive ingredient"
  Visual Ocuity™ A Professional Product from Longevity Science®
  Can-C, International Anti-ageing Systems, UK
  HPMC 0.3% and Glycerin 1.0%
  Anti-oxidant compound combined with CMC
  Carnosine penetrates the lipid membrane of the lens to reduce opacification
  Improves VA/glare

Autologous Serum Drops

- Utilizes patient’s own blood serum
- Blood is drawn and the serum is spun down and mixed with artificial tears. Devoid of cells and clot factors
- Replaces individualized growth factors
- Replaces individualized antibodies
- Serum contains growth factors, fibronectin, Vit. A and anti-proteases
- Requires blood donation 2-3 times year $150-$300 Hospital/Lieters
- Consider 5-10% serum albumin drops qid instead

PUNCTAL OCCLUSION: THE IDEAL PLUG

- Easy and comfortable to insert
- Negligible corneal contact, no sensation
- Visible upon inspection only
- Reversible easy to remove by a professional
- Inert material with no allergic response
- Effective in the treatment of dry eye
- Responsibility = Consent
- Increase contact time of natural or artificial tears on the eye.
Superficial Punctate Keratitis of Thygeson (SPKT)

- Chronic, usually bilateral disorder characterized by central focal epithelial lesions and no stromal involvement.
- Fine or dense Single or Multi
  Avg of 15-20 lesions (1 to 50)
- Corneal sensation not effected although occasional hypoesthesia
- Conjunctiva is not inflamed

SPKT

- NaFl/RB staining and elevated during active disease process
- Each lesion comprised of multiple lesions
- Change position over time
- Conjunctiva: usually not inflamed unless during the developmental stage:1-2 wks

Etiology of SPKT Unknown

- Possibly Viral due to latency, recurrence, lesion appearance, duration
- PCR testing proved that it is NOT HSV 1 or 2, VZV or adenovirus
- Still investigating HPV since both have minimal inflammation
- Prolonged SPKT Associated with Salzmans Nodular Deg
- Suggested association with eczema, urticaria, asthma
- HLA-DW3 and DR3 association:
  gluten sensitive, DM2, Lupus, Graves

Etiology of SPKT Unknown

- R/O etiology of
- Punctate epithelial erosions PEE vs.
- Sub-epithelial infiltrates SEI vs.
- Superficial Punctate keratitis SPK

Various Presentations of SPKT

“Pink EYE”

STANDARD TESTS
- No testing done – expensive, time consuming
- Diagnosis based on hx/exam
  Misdiagnosis = 50% of cases
- Most often, treated empirically
- Antibiotics – between 50%-90% of all cases
  Steroids – may pose risk in misdiagnosis
  • “If antibiotics are not effective, it must be viral.”
- Other bacterial infections, such as Strep, use a confirmation test.
  - FDA Cleared
  - CLIA Waived
  - 10 minute results
  - Detects all 51 serotypes of adenovirus
  - 15% - 40% of all acute
  - 85% - 90% of viral
- CPT Code 87696
  - Cost $13 Reimburse $17
SPKT

- Mean age 29 (2 to 70)
- Usually Bilateral
- Favor the central visual axis
- Long duration with remissions and exacerbations
- Asymptomatic (esp. later) vs. FBS, epiphora, photophobia
- Treat the symptoms

Treatment for SPKT

- Lubricants for comfort
- BCL to smooth surface
- Lack of response to systemic or topical AB, debridement/ cautery of tissue
- Good response to steroids however long taper and can prolong the course or worse
- Antivirals?
  - Cyclosporine
    - Reinhard showed 70% suppression with 2%

MEESMAN’S DYSTROPHY

- Diagnosed within first year of life
- A “peculiar” substance is produced which thickens BM
- Numerous epithelial vesicles that extend to limbus*
  - Contain debris, cells, GAG
- No scarring, Photophobia, Irritation
- May have slight decrease in VA.
- CLS are not contraindicated and may be therapeutic when rupturing
- LISCH: whorl-shaped clusters

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RECURRENT CORNEAL EROSION

- Traumatic erosions due to thickened BM with poor hemidesmosomal attachments.
- May result from incomplete healing following trauma
- Associated with EBMD (50%) or Lattice Dystrophy
- Onset in the am due to edema or shearing effects
- Symptoms may be more severe than it appears
- Epithelial loss surrounded by pooling and loose ends
- Prophylaxis/Treatment: lubricants/plugs/BCL

Treatment for RCE

- Prophylaxis with lubricants/hyperosmotic agents/BCL
- Treat like a corneal abrasion: heals slower
- Debridement
- Anterior Stromal Puncture
- PTK with PRK
BANDAGE CONTACT LENSES

- To aid in healing by offering protection
- To provide comfort for decompensating corneas with erupting microcysts
- To aid in dehydration
- To produce a more regular refracting surface
- To aid in drug delivery
- To reduce inflammation

INDICATIONS FOR BCLS

- ACUTE
  - Traumatic abrasion
  - Following FB removal
  - RCE
  - Chemical burns
  - Thermal Burns
  - Shield Ulcer

- CHRONIC
  - Severe dry eye
  - Bell's Palsy exposure
  - Cicatrical disease
  - Nocturnal lag
  - Conjunctival elevations that reduce wetting
  - Wholet Keratopathy

INDICATIONS FOR BCLS

- SURGICAL RESULT
  - Retinal surgery causes epithelial defects
  - PRK
  - PTK
  - Extrusion of Intacs
  - Irregular surface from filtering blebs

- DISEASE
  - Thygeson's
  - Salzmann's
  - Granular Dystrophy
  - Lattice Dystrophy
  - EBMD
  - Bullous
  - Band Keratopathy
  - Piggyback
  - RGP induce abrasions for ectasias

CONTRAINDICATIONS FOR BCL

- Non-compliant patient
- Poor Hygiene
- Socio-economic
- High risk for infection
- Non-consent

Faster Recovery with BCL

- Donnenfeld reported in A. Ophthalmology 1997
- Compared patients treated with:
  - Pressure patch /AB vs. BCL vs. BCL/Topical NSAID
  - No difference in re-epithelialization time
  - Psychometric Analysis: patients prefer BCL/NSAID
  - Return to normal activities in 1.37 days
  - Soak lens in ANTIBIOTIC
    - Caution with preservative toxicity, especially BZK
  - Other options: Collagen Shields

GOALS IN FITTING BCL

- CL should have smooth surface
- Minimal ET
- Wettability
- High dK
- High modulus when lid edema is present
- Full coverage, minimal movement

- HIGH Water = provides mechanism for dehydration and slower drug release.
- LOW Water = when evaporation is not desired.
- Minimal movement to avoid rupture of hemidesmosomal bonds.
  Complete coverage.
- Disposables / EW / low ET
FDA Approved vs. STD of CARE

- Cooper Vision PermaLens Therapeutic
  - 71% H2O dK 34
- Bausch & Lomb Plano-T
  - 38% H2O, dK 9.2
- CIBA Focus Night & Day
  - 24% H2O, dK 160
- CIBA CSI-FW
  - 38% H2O, dK 13
- B & L Purevision
  - 36% H2O dK 101
- Acuvue
  - 58% H2O dK 28
- Acuvue Advanced/Cryes
  - 47% H2O dK 60/103
- BAL SofLens
  - 68% H2O dK 32
- Cooper ProClear Compatibles
  - 62% H2O dK 34

INFECTION PROPHYLAXIS

- Erthromycin ung or Bacitracin ung q 2-4h or
- Polysporin gtt +/- qid OR
- Ciloxan/ Ocuflox qid
- Zymar/ Vigamox qid
- Submerge BCL

PAIN MANAGEMENT

- CYCLOPLEGIA
  - 5% Homatropine
  - 1-2% Cyclopentolate
  - Scopolamine
  - BID
  - NSAIDs
  - Decreases pain by 40%
  - Acular PF (Keterolac)
  - Voltaren (Diclofenac)
  - Ofloxacin
  - Nevanac (Nepafenac)
  - Xibrom
  - Ophthalmic hypocynotic agents
  - Q3-4 h DIC after 48 hours to prevent 20%/healing time

- ORAL MEDS
  - Motrin 400-600 mg AND (no PG)
  - Acetaminophen 500-1000 mg (no ETOH)
  - Ultracet (Schedule III narcotic)
  - Tramadol (ultram)
  - Xibrom Q3-4 h D/C after 48 hours to prevent 20%
  - Lortab (Schedule III narcotic)
  - Hydrocodone with acetaminophen 2.5/500, 5/500, 7.5/500

- LUBRICATION
  - Non-preserved AT
  - AT w/ Hyaluronic acid
  - Blink, Aquifil
  - RX 5% BID for AC rxn

FOLLOW-UP CARE FOR BCL

- 24 Hours
  - May note 25-50% improved
  - If improvement q 2-5 days
  - Monitor high risk patients daily
  - CL wearers
  - HSV, immuno-comp, DM
  - Monocular, children
  - Central or Large abrasion
  - Do not remove BCL too early- wait 5-7 days until after it appears to be resolved- late phase healing
  - If condition worsens or no improvement, consider referral for tarsorrhaphy or conjunctival flap

ANTERIOR STROMA MICROPUNCTURE

- Disturb Bowman’s Layer to promote tighter adhesion and stimulate cornea to produce functional BM complexes
- Topical anesthetic and a 27g cannula: use forceps to bend needle to avoid puncture
- Closely spaced (.5mm) punctures damaged/adjacent
  - Anterior Stroma: 100-150 µl
  - Apply tangential force
  - Avoid Visual axis since minimal scarring can occur
  - RR 40%

CORNEAL DEBRIDEMENT

- Soften epithelium
  - 1-2 gtt topical anesthetic q 15-30 seconds for 2-3 minutes
  - Use cotton swab, spatula, spud or jewelers forceps
  - Remove flaps by pulling edges toward center
  - Don’t pull directly up or out
  - Remove flaps down to tight, firm edges.
  - Rx abrasion (>50-100%)
  - Recurrence Rate 18%
PREVENTION OF RCE

- Patients with RCE show a chronic increased level of metallo-proteinase enzymes (MMP 2&9) which may dissolve the basement membrane and fibrils due to inadequate neutralization.
- Treatment is to inhibit metallo-proteinases
  - Doxycycline: oral, 50mg BID
    - 2 months treatment time. Reduced MMP 70%.
  - Topical Steroids
    - Pred Forte, FML, Lotemax, TID, 2-3 weeks
- No recurrences in 21 months.

Bowman’s Layer

- Acellular modified layer of anterior stroma
- Type 1 collagen fibers randomly arranged
- Pores for corneal nerves to pass
- Fxn? Not found in many species with good vision and normal epithelial-stroma junctions.
- Not replaced and when damaged, causes significant opacification which effects VA

REIS-BUCKLER DYSTROPHY

- Bilateral, symmetric, AD, by age 5
- Bowman’s layer is obliterated and replaced with randomly arranged regular collagen that thickens.
- Linear, ring-like or “Honey comb”
- Marked VA loss due to superficial stromal haze or topographical changes from elevation of tissue
- Painful if recurrent erosions occur.
- TX: PKP or LK around age 50 but may recur in grafts

ANTERIOR MOSAIC

- Dystrophy or Degeneration
- AKA: Anterior Crocodile Shagreen
- Breaks in Bowman’s that appear like central grey polygonal opacities with clear spaces.
- Blanches with limbal pressure.
- Asymptomatic

BAND KERATOPATHY DEGENERATION

- Deposition of Calcium salts in Bowman’s layer
- Located interpalpebral region
- History of uveitis, renal failure, prolonged use of miotics, syphilis, interstitial keratitis, hyperparathyroidism
- TX: Chelation with EDTA 1%
- TX: Therapeutic CL
Treatment: Cosmetic Contact Lens

- Black Underprint: color is applied to a dark background to mask and make a scar more uniform. This darkens and mutes the overlaid color.
- Store in glass vials
- 53% H2O to maintain dye

SALZMANN’S NODULAR DEGENERATION

- Bluish, superficial nodular elevations
- Inflammatory/Non-inflammatory event that exposes the cornea and results in excess collagen plaques that replace Bowman’s
- Post-chronic-keratitis
- Asymptomatic to very painful and sight threatening depending on location and severity
- TX: BCL/AB/NSAID, PTK, PKP

STROMAL DYSTROPHYS

- 90% of corneal thickness
- 22%: Comprised of collagenous lamellae (type 1) interspersed with keratocytes and ground substance (proteoglycans, glycoproteins, serum)
- GAGS: affect hydration, thickness, transparency
- 78%: rest is water
- Abnormal Substance found within the cells or fibrils that have distinct histological-stains

Name of Dystrophy
Name of Deposition
Pathology Stain

- Marilyn Monroe Always
- Gels Her Man
- Los Angeles County
- Southern California Ocean

MACULAR DYSTROPHY

- Clouding due to build-up of mucopolysaccharides
- Begins centrally & superficially then extends limbus to limbus thru all layers
- Thinning without clear spaces
- Primary involvement of the endothelium: guttata*
- Begins in 1st decade of life: aggressive causing early & severe VA loss
- Predominant in Virginia area
- Autosomal recessive*
- TX: PKP
- Macular / Mucopolysaccharide / Alcian Blue stain

GRANULAR DYSTROPHYS

- Central, anterior to mid-stromal deposits of Hyaline
- AD
- Discreet white spots (translucent) to powdery rings
- Clear areas between lesions in early years
- Erosions can break thru BM.
- Autosomal dominant w/ complete penetrance*
- Granular / Hyaline / Masson Trichrome
**Granular Dystrophy Treatment**

- Pinhole effect may maintain VA (20/20) until the lesions coalesce and reduce VA=20/200.
- PKP was only treatment and recurrences were common
- Present treatment includes PTK and BCL:
  - Smooth epithelial surface to treat monocular diplopia
  - Pain management following PTK or erosions
  - Induced anisometropia
  - Spectacle distortions of high plus lens

**Granular Dystrophy**

70 YO AAF
- 1992 VA 20/50
- 1997: 20/80 & RCE
- PKP vs. PTK
- SRX pre: +1.00
  - K: 42.00/41.00
- SP 2 mo: +8.75
  - K: 36.75/37.75
- SP 6 mo: +6.50
- TX: Acuvue +7.00

Granular Dystrophy

25 YO WF
- C/O anisometropia/haze
- RE +7.50 – 2.00 x 010 20/30
- LE +2.25 x 170 20/30
- CL FIT
  - DIL +3.00/0.50/11.2 20/25+
  - PV +1.75 x 180
- Refit OD at 4 months pg
- Hydrasoft Options
  - +8.75 -2.00 x 010 20/25

**Lattice Dystrophy**

- Branching refractile filaments of AMYLOID
- Symptoms occur early in life, age 20-30, AD
- RCE are common
- Resultant scars and late intervening haze can blur VA
- Lines thicken with age & penetrate deeper layers
- Autosomal Dom/Recessive
- TX: PKP
- Lattice / Amyloid / Congo Red

**Types of Lattice Dystrophy**

- **TYPE 1**
  - Poor VA by age 40-60
- **TYPE 2**
  - Merloja syndrome
    - Bilateral Facial palsy, skin thickens, depressed brows, prominent
    - VA loss >65y
- **TYPE 3**
  - Floppy ears, protruding lips, Auto-R
  - LGE deposits, mid stroma, no RCE
  - VA loss >60y

**Avellino Dystrophy**

- Avellino, Italy
- Typical granular dystrophy with axial anterior stromal haze and mid-stroma discreet linear opacities.
- Congo red

**Central Crystalline Dystrophy of Snyder**

- Deposits of cholesterol crystals in anterior stroma
- Premature peripheral arcus
- Vision is generally good
- Usually normal serum lipid profile: +/ hyperlipidemia
- Expressivity is variable
- B120 gene on chromosome 1 is responsible for lipid metabolism and transport
- Snyder / Cholesterol / Oil
POSTERIOR AMORPHOUS DYSTROPHY
- Rare, autosomal dominant
- Gray opacities in the posterior stroma that may extend to the limbus, central corneal thinning
- Flattening of the curvature and induced hyperopia
- Prominent Schwalbes line
- Pathology shows focal areas of endothelial disruption
- Slow progression and may not threaten vision

WHITE LIMBAL GIRDLE OF VOGT
- Effects > 50% population between 40-60
- With/Without clear zone
- Represents subepithelial degeneration and sometimes calcium deposition
- Does not affect visual acuity
- Located in the horizontal meridian

POSTERIOR EMBRYOTOXIN
- Extremely prominent ring of Schwalbe
- Eye is normal but may be associated with correctopia, aniridia, or corneal conditions that are part of systemic syndromes

ARCUS SENILIS
- Effects >60% population between 40-60 years
- Peripheral lipid deposition
- Located anterior to Descemet’s layer and in Bowman’s layer
- Juvenile form usually represents hyper-lipidemia
- Be suspicious of carotid disease if this is present to a greater degree in one eye.

FURROW DEGENERATION
- Peripheral thinning in the elderly
- Lucid interval of Arcus
- No inflammation
- Vision unaffected

DELLen
- Peripheral 50% thinning of one or more layers
- Runs along the limbus parallel to area of swelling
- Limbal elevation causes dryness which leads to further excavation
- CL, lid disease, OSD
TERRIENS MARGINAL DEGENERATION

- INTACT epithelium with progressive thinning
- Non-inflammatory
- Supero-nasal location
- Attacks young men (3:1)
- Produces AR or oblique astigmatism seen on topography
- Treat irregular astigmatism with RGP's

Peripheral Ulcerative Keratitis

- A painful, chronic, crescent-shaped peripheral ulcer
- Adjacent epithelial defect and stromal infiltrate
- Progresses circumferentially forming an overhanging edge
- Adjacent conj. and sclera are erythematosus and inflammed.

RHEUMATOID ARTHRITIS

- Marginal Furrows
- Usually Bilateral
- Due to decreased tear production
- Limbal vascular compromise
- TX: Lubricants, BCL, Tarsorrhaphy
- Alternative treatments

ALTERNATIVES TO BCL

- TARSORRHAPHY
  - Surgically close the palpebral fissure by suturing the superior and inferior lids at the lateral aspect
- STAMLER LID SPLINT
  - Adhesive on one side with enough rigidity on the other to hold the eyelid in the closed position
  - Allow for use of meds and examination

ANTI-INFLAMMATORY THERAPY

- CYCLOSPORINE
  - .05% and .1%
  - Reduction in artificial tear use
  - Increase in goblet cell density
  - Decrease in corneal staining
  - Improved Schirmer test scores
  - Improved visual

MOOREN’S ULcer DEGENERATION

- Peripheral Ulcerative Keratitis PUK
- Idiopathic or related to autoimmune disease, trauma, surgery.
- Association to Crohn’s disease and Hepatitis C
- Symptoms are mild* to severe
Mechanism of Ulceration Process

- Trauma or infection or systemic disease
- Nil corneal antigens
- Altered corneal antigens
- Cellular and humoral immune reaction
- Neutrophil degranulation or keratocyte collagenase stimulation
- Complement activation
- Corneal melting

Peripheral Ulcerative Keratitis Work-up

- Investigation for Menor’s-like ulcer
  - Thorough medical history
  - Corneal cultures
  - CBC with differential, platelet count, ESR, RF, ANA, ANCA, circulating immune complexes, LFT’s, VDRL and FTA-ABS, BUN and creatinine, serum protein electrophoresis, urinalysis, CXR
  - Additional testing based on ROS and physical exam

Treatment of Mooren’s Ulcer

- Control of underlying systemic disease
- Anti-collagenolytic – topical or oral tetracycline
- Topical steroids & oral steroids - 60-100 mg/day
  • With cycloplegia / topical antibiotic / BCL
- Topical or systemic immuno-suppressives
  • Topical Cyclosporin 1% QID or 2% BID / Methotrexate
- Conjunctival resection
- Lamellar Keratoplasty: Doughnut shaped with donor sclera, conjunctiva and peripheral cornea.
- Healing rate of 95.6% Recurrence rate of 25.6%

SUMMARY OF SURGICAL OPTIONS

- Penetrating keratoplasty PKP
  Full thickness exchange
- Lamellar keratoplasty LKP
  Exchange epithelium/partial stroma
  Less risk for rejection, glaucoma, or endophthalmitis.
- Doughnut shaped: replace sclera and limbal stem cells in the case of peripheral marginal disease.
- Epikeratophakia
  Donor lenticule to flatten cornea

Stem Cell Deficiency

- Defects in renewal and repair causes invasion of conjunctival epithelial cells onto the cornea
- SIGNS:
  • Dull corneal reflex
  • Ingrowth of thickened fibrovascular pannus
  • Keratitis
  • Scarring
  • Calcification
- SYMPTOMS:
  • Blur
  • Photophobia
  • Pain
  • Tearing
  • Eyelid retraction
  • Recurrent epithelial breakdown
  • Chronic inflammation with red eye

FUCH’s SUPERFICIAL MARGINAL KERATITIS

- Affects middle aged adults
- It is characterized by periods of relapses and remissions of irritation and redness.
- Begins as superficial marginal keratitis that advances non-uniformly sparing the central cornea.
- Advancing keratitis is demarcated from the central cornea by a gray line.
- Active keratitis is accompanied by stromal infiltrates
- Chronic disease leads to progressive circumferential peripheral corneal thinning with vascularized pseudopterygia growing over these areas.
FUCH’S SUPERFICIAL MARGINAL KERATITIS

- Histopathologic studies shown corneas to be thinned 20-25% in the periphery.
- Inflammatory cells in the cornea consisted of mostly lymphocytes and PMN but also mast cells & basophils.
- BV leaking lipids
- These studies suggest no clear cut etiology of the disease.

BROWN-McLEAN SYNDROME

- Non-vascularized peripheral edema of stroma and epithelium that occurs no sooner than 6 years after Cataract surgery - usually aphakes.
- Brown or orange pigment
- Endothelial cell density may decrease but not centrally
- Due to altered aqueous dynamics, iridodonesis
- Contact lenses require thin edges

Abnormal Changes to the Endothelium

- Endothelial cells become more irregular
- Cells secrete collagen towards Descemet’s causing multilamination = guttata
- This breaks down the barrier function and results in stromal and epithelial edema

Normal Changes to the Endothelium

- Descemet’s layer thickens from 3-17u
- There is a decrease in the # of endothelial cells
  - from 3500 cells/mm² to 1200
  - this single layer spreads out: lacks mitosis
- High density mitochondria : 90% pump
- Lenses produce reversible polymegathism

FUCH’S DYSTROPHY

- Bilateral, asymmetric, begins in 5th or 6th decade
- More predominant in women (3x)
- Initially pigment dusting
- Non-asymptomatic

Guttata represent clear, vesicular endothelial secretions that project into the potential space between the endothelium and Descemet’s I

TREATMENT FUCH’S SUPERFICIAL MARGINAL KERATITIS

- A.T., topical steroids, and topical antibiotics during acute exacerbations
- Topical Cyclosporine 1% BID
- Fit RGP contact lenses (Improve Vision)
- Lamellar Keratoplasty (reports of recurrence in the graft)
- Combined superficial keratectomy with a conjunctival autograft (Kotecha and Raber)
  Method used to retard recurrent pseudopterygium formation
FUCH’S DYSTROPHY STAGE 2
- Guttata interrupt the normal pumping mechanism = edema
- Edema begins around Descemet’s and Bowman’s layers and then spreads the entire thickness.
- Pts experience glare/hazy VA
- Bullae appear: they reduce vision and cause pain when they rupture, especially in am

FUCH’S DYSTROPHY STAGE 3
- Edema is reduced but subepithelial connective tissue grows and causes reduced vision.
- Patient is comfortable due to reduced corneal sensitivity.
- Elevated IOP, peripheral neovascularization, and corneal erosions.

FUCH’S DYSTROPHY TREATMENT
- Hypertonic solutions to draw fluid out
  - Sodium Chloride
  - Muro 128 (2% or 5%) solution, 5% ointment-PF
  - Fresh Kote
- BCL to aid in comfort for ruptured bullae
- Lubricants for comfort
- Lower IOP
- Conjunctival flap
- Corneal transplant to restore vision/ DSEK

DSEK: Descemet Stripping Endothelial Keratoplasty
- Faster visual recovery
- Less astigmatism created since there are no sutures
- Eye is much stronger and more resistant to injury since only the diseased tissue rather than the entire cornea is replaced
- Surgery time is quicker
- Chance of rejection is reduced
- Procedure can be combined with cataract surgery
- VA 20/30-20/40
- 1-2 D Hyperopic Shift, thicker

POSTERIOR POLYMORPHOUS DYSTROPHY- PPMD
- Isolated to coalescent vesicles that intervene between normal endothelial cells.
- Areas of normal or thickened Descemet’s membrane representing a collagenase material
- These vesicles can lead to stromal edema.
- Association with keratoconus

POSTERIOR POLYMORPHOUS DYSTROPHY- PPMD
- Can be present at birth
- Wide variety of expression
  - Non-symptomatic
  - Grouped vesicles cause blur
  - Stromal edema
  - Correctopia and irido-corneal adhesions resulting in glaucoma if they enter TM
**Visante™ OCT**

**Anterior Segment Imaging and Surgery**
- Refractive Surgery
  - Corneal laser refractive surgery: pre-op, enhancement options
  - Phakic IOLs
  - Corneal refractive implants: Intacs
- Anterior Segment Imaging and Surgery
  - Corneal Imaging and Measurement
  - Iris Imaging and Evaluation
  - Trauma Assessment

**OCT Applications**

**Anterior Segment Imaging and Surgery**
- Corneal Imaging and Measurement
  - Imaging and evaluation of corneal pathologies
  - Penetrating keratoplasty
  - Lamellar keratoplasty
  - Endothelial keratoplasty
  - Keratoconus imaging and assessment
  - Anterior segment imaging through opaque corneas

**KERATOCONUS**

"Keratoconus is a clinical term to describe a condition in which the cornea assumes a conical shape because of thinning and protrusion."

**Keratoconus - Keratometry**
- Initially, mires get small and then there is a lack of parallelism
- Expand perimeters by use of +1.25 SPH and add 7 D to your reading
- Steepening begins infero-temporally and progresses clockwise
- Topography - more sensitive
- Placido Rings - get closer

**RETINOSCOPY**
- Scissors Reflex
- Against motion that breaks apart
- Represents multiple refractive powers within the optic zone

**PSEUDOKERATOCONUS**
- Corneal warpage topography can mimic KC
- Repeat topography must be performed and a measurable change would indicate pseudo-KC
- Evaluation of elevation maps at steep zone:
  - Predicts the elevation or depression of the cornea if the best fit sphere was on cornea
KERATOCONUS-SLIT LAMP FINDINGS

- Fleischer ring
- Vogt’s striae
- Stromal thinning
- Stromal scars
- Swirl-like pattern
- Enlarged corneal nerves
- Acute hydrops

PELLUCID MARGINAL DEGENERATION

- 20-40yo, no gender preference, slow progression
- Thinning occurs below the steep curvature
- Stromal thinning is concentric to the lower limbus and runs from 4-8:00, 1-2mm wide
- Clear, epithelialized, and non-vascularized.
- Absence of lipid: dx from Mooren’s or Terrien’s
- Vertical stress lines and hydrops can occur
- Beer-belly cornea-

PROGNOSIS FOR PELLUCID

- Lens fitting is difficult due to inferior apex
- Central rings show AR/ Inferior rings show WR
- Fitting flat causes bearing and on K (steeple) causes too much seal off
- Larger lenses needed due to low positioning/glare
- Careful monitoring-
- Poor SX candidate

KERATOglobus

- A diffuse thinning of the cornea to 1/3-1/5 the normal thickness
- It is noted early in life and progression is minimal
- Associated with Ehlers-Danlos Syndrome and Leber’s Congenital Amaurosis
- Acute hydrops

POSTERIOR KERATOCONUS

- Rare developmental defect
- Focal indentations of the posterior cornea with overlying stromal scarring
- Anterior curve not effected
- Descemets’ membrane and endothelium are always present but may be abnormal in the area of thinning

POSTERIOR KERATOCONUS

- Associated Ocular Disease
  - Lens abnormalities, choroidal or retinal sclerosis, PPMD, retinal coloboma, optic nerve hypoplasia, ptosis, iron rings, and posterior synechia,
- Systemic Associations
  - Mental retardation, webbed neck, hypertelorism, short stature, superior placed lateral canthi, genitourinary abnormalities
Thank you

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Objective: This course will review some of the seminal basic and clinical contact lens research conducted over the last thirty years and highlight how this work has influenced contact lens development and clinical practice.

I. Introduction to the Research Diplomate Track

II. The evolution of contact lenses – from Da Vinci to silicone hydrogels

III. The cornea
   a. Anatomy
      i. The corneal epithelium
         1. Maintaining homeostasis
      ii. Stroma
      iii. Endothelium
   b. Physiology – are we there yet?
      i. Holden-Mertz – oxygen requirements for lens wear
      ii. Harvitt and Bonanno - re-evaluation of minimum Dk/t
      iii. Fonn – corneal swelling

IV. Contact lenses and lens-related adverse events
   a. Overview
   b. Past
      i. Epidemiology of infection
         1. Poggio and Schein
ii. The impact of lens-induced hypoxia

c. Present

i. Epidemiology of infection:
   1. Stapleton and Keay

ii. Corneal physiology
   1. Benefits of silicone hydrogels

iii. Role of contact lens care solutions
   1. The epithelium
   2. Mucins

iv. Compliance and daily disposables

d. Future

V. Orthokeratology

a. Past

i. Orthokeratology

b. Present

i. Corneal reshaping – contemporary orthokeratology
   1. Corneal epithelial cell/tissue changes
   2. Redistribution of corneal nerves
   3. Myopia control

c. Future

VI. Next generation contact lenses

a. Medical sensors – diabetes, glaucoma

b. Virtual reality
An overview of scleral lenses

Renée E. Reeder OD, FAAO, FBCLA
Diplomate, AAOCCCLRT

Objectives

• To discuss proper clinician and patient lens handling
• To discuss the 3 zones of lens assessment
• Guidelines for appropriate lens fitting
  – for the normal cornea
  – for the irregular cornea
  – for ocular surface diseases
• To discuss troubleshooting scleral lenses

Positioning

• Lens parallel to the floor
• Patient’s chin touching their chest
• Doctor applied
  – Adjust chair accordingly
  – Enlist patient to hold lower lid
• Patient applied
  – Mirror
  – Lighted suction cup

Position: Chin to chest head parallel to the floor

Application

• Filling the lens – COMPLETELY!
  – Preservative free (PF) is essential
  – PF Saline
    • Saline 0.9% nebulizer vials
    • Unisol 4
  – PF tears
  – Addition of a viscous PF tear to the non preserved saline
  – Fluorescein can be added to the bowl to enhance assessment
Techniques

- Fingers
  - Tripod
  - Two

- Devices
  - Intact versus with tip cut off
  - lighted
  - O-ring
  - Ring

Solid suction cup

Removal

- Most often with a suction cup
  - Large or small solid
  - Must be moistened
  - Large must be squeezed

- Apply below the line of sight
- Break suction
  - Push up on lens with lid
  - Indent globe through lid near edge of lens
- Use suction cup like a fulcrum tipping it upward

The care of scleral lenses

- GP or soft lens solution?
  - approved vs. non-approved

Advantages

Disadvantages

Water???
Preservative Free

Progent

Large case for use with clearcare

Assessment

• Three key zones
  – Cornea
  – Limbus
  – Conjunctiva

Central cornea

• Overall with fluorescein
  – Helpful to determine relative clearance in comparison to limbus
  – If bowl was filled during fit the pupil should be slightly obscured

Optic section

• When possible, the central area of the lens should align with the cornea
• Depending on the fitting sets your goal
  • Roughly 150 microns for normal corneas
  • For diseased corneas, usually 200 and 350
• Comparison
  • Many sets are around 200 microns so this is a good 1:1 ratio
  • If known corneal thickness this can also be used but is less consistent

OCT

• Many devices can now offer good OCT imaging of the clearance
  – Visante
  – Cirrus
  – Rtvue
• May use single line or raster with Cirrus and Rtvue
limbus

• The limbus must be cleared
• Compression at the limbus could damage delicate stem cells
• View with optic section and fluorescein
  – Optic
    • Should be able to perceive clearance
  – Overall
    • Fluorescein should obscure pattern

conjunctiva

• Should look like a well fit soft lens
• Vessels
  – No drag or blanch
  – High mag should so bloodflow in the conjunctival vessels
• Indirect view of edge
  – Assess for shadows that may indicate lift off
• No impingement
  – Meaning the lens should not compress or dig in to the conjunctiva
  – This is easily seen with the OCT on raw image
• It is preferable that the conjunctiva is not pulled up under the lens

Tear exchange evaluation

• A push up test should allow some movement of lens
• Indenting the globe at the edge of the lens should also create a small bubble or if using NaFl should allow it under the edge
• Applying Nafl to the surface of a settled lens should result in Nafl under the lens within 5 minutes

Lens settling

• Lenses settle 50-150 microns
• Varies with the “softness” of the conjunctiva
• Importance of follow-up visits with lenses on for 2 hours minimum

Lens selection

• Highly dependent on the prescription, shape of the eye regularity of the eye, steepness of the eye, and any ocular surface disease as well as lid tension
Irregular corneas

- Size is often based on how much irregularity there is and how delicate the cornea is.
- The larger the lens the more fluid will bathe the cornea and help rehabilitate the ocular surface.
- However with lenses that have extreme peaks and valleys very large lenses can lead to bubbles.
- Corneal diameter: in general at least 2 mm greater than HVID.

Keratoconus

- Central ectasia
  - Can try a corneoscleral in the 14.0-16.0 range
- Peripheral ectasia (15.8-18.8)
  - Larger is needed to minimize the rubbing on the cornea
- S/P hydrops
  - You may need to go larger if the break is persistent or the patient struggles with abrasions

Ectasia

- Non-keratoconic ectasia
  - Eg. Post-Lasik may need larger lenses with reverse geometry designs to aid in centration and to clear the significantly thinned ectatic zone.
  - Usually 15.6-18.8

Diseased surfaces

- The goal is to bathe the surface in fluid and to protect the ocular surface while enhancing vision.
- Therefore you must use a larger lens to create an appropriate chamber.
- 18.0-20.2

Lids

- All that is fine and good but if you have a tiny fissure, you’ll have to go smaller.
- This is very critical with patients with cicatrical diseases like Steven-Johnson Syndrome and Scleroderma when the fissure may be narrowed and the skin tough, tight, and/or scarred.
- Must select a lens that can be easily inserted between the lids.

Availability

- As large as 22mm
- Larger lenses for more severe ocular surface disease.
  - GVHD, Thyroid disease
- Designs in the 18.0-18.8 very forgiving
  - MSD
  - Jupiter
  - Custom Stable
- Materials
  - Boston XO, XO2, Equalens II
  - Optimum Extra
  - Tyro 97 and Onsi 56
  - Menicon Z
Sag/BC selection

• Ks/Topography
• Shape/Height
  – OCT
  – Corneal profile

Fitting guides

• Some fit sets will specify a given adjustment or correlation to the K readings
• In general you will make this adjustment based on the sim K readings
• More likely to find K recommendations on smaller designs
  – Eg. Perimeter, Onefit Kone

IT IS ALL ABOUT THE HEIGHT

• The sclera is actually believed to be an angle rather than a curve
• There seems to be some uniformity to this
• Options
  – OCT
  – Corneal profile

OCT

• An anterior segment OCT can be taken
• A horizontal cord can be drawn at the appropriate fitting diameter
• A perpendicular can be dropped
• And a sagittal height determined

• For fitting sets that use sag this can be helpful but is not essential

Corneal profile

• Works with any set
• May be done with or without the slit lamp

Without slit lamp

Instruct the patient to look straight ahead
Use your trans illuminator or other external light source
Notice the general shape and height of the cornea
Notice the position of the lids
Select a lens
Compare its profile to the profile of the cornea
Choose the lens that is most like the profile of the cornea
Using the slit lamp

- At the patient looks straight ahead
- Rotate both the optics and the light source of the slit lamp as close to 90° away as you can
- Be careful to hold the optics and the light source so that they do not tip forward and hit your patient in the head
- Using low mag and diffuser if available
- Evaluate the profile of the cornea

View a lens

Once you have selected a lens design with a given diameter you need to select a lens based on the profile you have seen
- Look at the individual lenses hold it up and look at it on profile with your trans illuminator or slit lamp in same manner
- Verify by looking patient again
- When you feel you have a good match begin fitting

Other options

- Always start with the middle lens.
- Arbitrarily divide the set into zones and start at the middle of each zone
  - Steep, Average, Flat
- Look at the eye in profile and try to match to the profile of a lens

Variety of Brands

- Jupiter
  - 15 and 18
- MSD
  - 15.8
  - 18.0
- Semiscleral
- EB
- Zenlens
- Rose K2 XL
- Atlantis
- So2clear
- Custom stable
  - 15.0 and 16.0
- ICD
  - 16.9
- Digiform
  - 15.0
- Onefit
  - 14.0
- Perimeter
  - 14.0

Not an exhaustive list
Design examples

Jupiter design

• Chord fitting add 250 to 15mm chord value
• Start just flatter than steep K
• Use elevation map at 10mm chord and add 2200

Irregular cornea

MSD design

• In general you want to achieve apical clearance. However, this is sometimes not possible. In these cases, you want the lightest touch

• You still would like roughly 200 µ clearance
Cases

JM

• 37 yo hispanic male
• h/o RK in Mexico
• Truck driver needs to pass his vision test to keep his CDL

• RX
• -1.75-1.00x080 20/50
• -1.75-2.00x070 20/25
• But this is very unstable and distorted

OD cornea

OS cornea

Hmmm...

Slit lamp exam

• OD
  – 24 radial slits all the way to the limbus
  – The Slit at 4 o’clock extends to the visual axis
  – There are 4 T cuts inferior and 3 Superior
  – TOTAL OF 31 incisions
  – A fleischer ring is also apparent
• OS
  – 21 radial incisions again to the limbus
  – 5 Ts inferior and 3 superior
TOPO OD

Now what?

OD
380 S
Too much central pool
370 S more aligned
acceptable periphery
OR -12.25 =20/40+

Ordered 370 S -10.50

TOPO OS

MSD fitting

OS
370 S
Touch in midperiphery
370 I
Better alignment in periphery
OR -11.25 = 20/40
Ordered 370 I -10.00

MSD cont’d

• Dispensed OD 370 S
• 20/40+
• Apical pooling
• Follow-up visit
• Impingement
• Dispensed OS 370 I
• 20/30
• Apical pooling
• Follow-up visit
• Better comfort

So what next?
370 I on both eyes

OD  OS

What’s left

• We’re in the shallowest lens
• We’re vaulting the cornea
• We’re vaulting the limbus
• Patient is aware of edge
• ........

Cut down to 15.3

MSD

• Stable in lenses for over a year
• Wear time is 16 hours
• Over RX in poly with transitions for work
• +1.25-3.00x015  20/40+ STABLE
• +0.50-2.00x180  20/30+ STABLE
• He passed his vision test and kept his job.
• Note: spectacle acuity has dropped to 20/60- and 20/50

CB

• 48 yobf with advanced keratoconus
• H/O hydrops ou
• Persistent breaks in descemets
• Surgeon says CL won’t do any good and need to wait on surgery until eye quieter

8/2/09

8-28-09
Fitting

- 460 S was missing from set
- Started with 450 S
- Acceptable center but excess pooling at limbus and impingement on conjunctiva
- 450 D improved but still a little impinged
- Order 450DD in -6.00

MSD appearance

Outcome

- Patient is 20/40 and able to wear >10 hours comfortably.
- Surgery deferred

Fitting relationship
Central troubleshooting

- If central pattern is touching or bearing you need a deeper lens
  - For each .1mm bc change you should get about a 10-15 micron change in fitting relationship of smaller diameter sclerals
  - Make a significant change
- Conversely, if the central pattern has bubbles or excessive clearance go to a shallower or lower lens
Limbus troubleshooting

- Limbus
  - IF there is touch or bearing you may deepen based on design options
    - Increase reverse geometry if available
    - Make lens larger
    - Deepen entire lens
  - IF there are bubbles in the limbal zone
    - Consider a shallower mid peripheral design if available
    - Reduce the diameter
    - Go shallower overall

Awareness

- Edge awareness especially at lower lid is often attributaable to lift off
  - A larger lens or steeper edge may help reduce this discomfort
- Overall awareness is often an indication of a tighter fit may be addressed by
  - Making the lens shallower
  - Flattening the edge
  - Reducing the diameter

Conjunctival compression

- Smaller diameter or optic zone
- Flatter peripheries
- Shallower lens overall
I. Lecture Goals: Review the basics of LASIK & PRK, Premium PCIOLs, Corneal Collagen Crosslinking, and Inlays

II. LASIK & PRK
A. History of Laser Vision Correction
B. Corneal Laser Vision Correction (LVC) candidates
C. In Office Calculation of Residual Stromal Bed Thickness-5.00 DS, 550um Pach
D. Types of Laser Ablations More likely to induce aberrations
E. Advancements in Flap Creation (Microkeratome & Femtosecond Laser)
F. Femtosecond lasers brands
G. Femtosecond Lasers
   1. History, Laser Brands FS laser, Complications, Operational Characteristics, Non LVC uses
H. Pre and Postop Protocols
   1. Medications, Exam Testing

III. Premium PCIOLs
A. IOL HISTORY
B. Types of PCIOLs
   1. Aspheric, Toric, Accommodating, Refractive, Diffractive/Refractive
C. Aberrations
   1. Low Order, High Order, and Optical Side Effects
D. Conventional Spherical Monofocal PCIOL vs Aspheric Monofocal PCIOL
   1. Popular brand names
a. Amount of Spherical Aberration Correction
b. Other Lens characteristics

E. Toric Aspheric PCIOLs
   1. Popular Brand Names
      a. Amount of Astigmatism & Spherical Aberration Correction

F. Accommodating PCIOLs
   1. Non-FDA approved and FDA approved brand names
   2. B&L Crystalens AO
      a. Lens Material and Characteristics
   3. The Bausch & Lomb TrulignToric Accommodating PCIOL
      a. Lens Material and Characteristics

G. Diffractive versus Refractive PCIOLs
   1. Definition of each type
   2. Diffractive PCIOL
      a. AMO Tecnis Multifocal
         1) Lens Material and Characteristics
   3. Refractive/Diffractive PCIOL
      a. Alcon Acrysof IQ Restor +3 Multifocal
         1) Lens Material and Characteristics
      b. Alcon Acrysof Restor Toric

IV. Corneal Inlays
   A. History of Corneal Inlays
   B. Definition
   C. History
   D. Brand Names (material, results, characteristics, complications)
1. AcuFocus Kamra™ Corneal Inlay
2. Raindrop Near Vision Inlay, ReVision Optics
3. Flexivue Microlens, Presbia

V. Corneal Collagen Crosslinking

A. Applications
   1. Corneal Ectasia Patients = Candidates
      a. Naturally occurring: (FF Konus, Konus, PMD)

B. Corneal Ectasia (incidence & prevalence)

C. Keratoconus characteristics,
   a. Associations, characteristics

D. History of Corneal Collagen Crosslinking

E. Candidates

F. Procedural Steps

G. Epi-On and Epi-Off Corneal Collagen Crosslinking

H. Adverse Effects and Postop Management