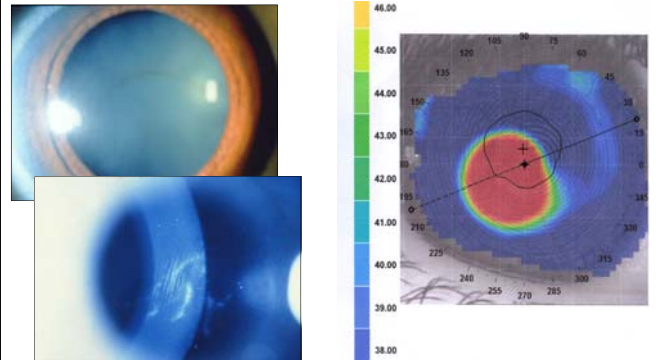


## KERATOCONUS: New Advancements in Contact Lenses & Surgical Procedures

Long D. Tran, OD  
Tim Edrington, OD, MS

## Diagnosis of Keratoconus



## Age of Onset

- Puberty
- Earlier age of onset; more severe disease
- Progressive until the third to fourth decade
- CLEK Survey
  - Mean age of diagnosis =  $27.3 \pm 9.5$  years
- The Manchester KC Study:  $n = 29$ 
  - Mean age of diagnosis =  $21 \pm 8$  years

## Gender

- Literature reports relatively equal incidence between males and females
- CLEK Study sample:
  - 56.4% male, 43.6% female
- Manchester KC Study
  - 76% male

## Asymmetric Condition

	Better Eye	Worse Eye	Difference
Flat Keratometry	$45.94 \pm 4.10D$	$49.53 \pm 5.83D$	$3.59 \pm 4.46D$
Steep Keratometry	$48.51 \pm 4.49D$	$52.86 \pm 5.75D$	$4.35 \pm 4.41D$
High Contrast Best-Corrected Visual Acuity			$7.30 \pm 6.83$ Letters

## Visual Acuity (CLEK Study)

- 88% were 20/40 or better through CLs
- 58% were 20/40 or better through manifest refraction
  - Is manifest refraction repeatable?
  - Is quality of vision adequate?
    - Depends on disease severity

### Heredity

- Autosomal dominance with variable penetrance
- CLEK Study
  - 13.5% reported a family history of keratoconus at baseline
  - 18% reported a family history at Year 7
    - Parent, sibling, child, aunt or uncle

### Common Associations

- Eye rubbing
- CLEK Study sample
  - Hay fever or allergies – 53%
  - Asthma – 15%
  - Atopic dermatitis – 8%

### Management of Keratoconus

#### Quality of Life (QOL) in KC

Kymes, Walline, Zadnik et al. *American Journal of Ophthalmology* October 2004

- Scores for CLEK subjects on all scales NEI-VFQ (Visual Function Questionnaire) were consistent with patients with category 3 and 4 (advanced AMD) age-related macular degeneration patients, except for...
  - General health was better for CLEK subjects (they're younger)
  - Ocular pain was worse for CLEK subjects (they are forced to wear GPs)

### Keratoconus Patient Education

- You will not go blind from the condition
- Have a large and wonderful family
  - Average age of Dx 27.3 years in CLEK Survey
- LASIK is not a good idea
  - Both result in corneal thinning
- Back-off on the eye rubbing
- Corneal collagen cross-linking
  - Who is a good candidate?

*I fit CLs to enhance or improve vision,  
not to alter the progression of  
keratoconus.*

### GP Fitting Philosophies

- Flat = touching the cone apex
  - Better vision? **Probably**
  - Delay the need for surgery? **NOT!**
  - Increases risk of corneal scarring? **Yes**
- Steep = vaulting the cone apex
  - Less disruption to cone apex

### Korb, Finnemore and Herman (1982)

- Results
  - Apical Bearing
    - 4 of 7 eyes developed apical scarring
  - Apical Clearance
    - 0 of 7 eyes developed apical scarring

Rigid Contact Lens Fitting Relationships in Keratoconus  
Edrington, Szczotka, Barr et al. *OVS* Oct 1999

#### How flat they're fitted...

88% fitted apical touch

- |                       |                       |
|-----------------------|-----------------------|
| • Mild kconus (<45 D) | 1.18 D flat (SD±1.84) |
| • Moderate (45-52 D)  | 2.38 D flat (SD±2.56) |
| • Severe (>52 D)      | 4.01 D flat (SD±4.11) |
| • Overall             | 2.86 D flat (SD±3.31) |

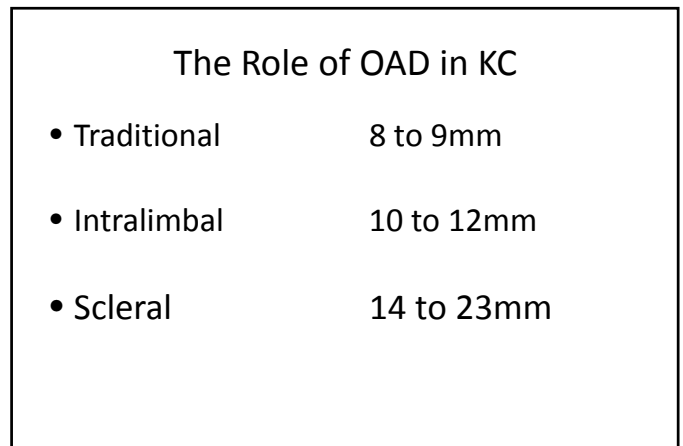
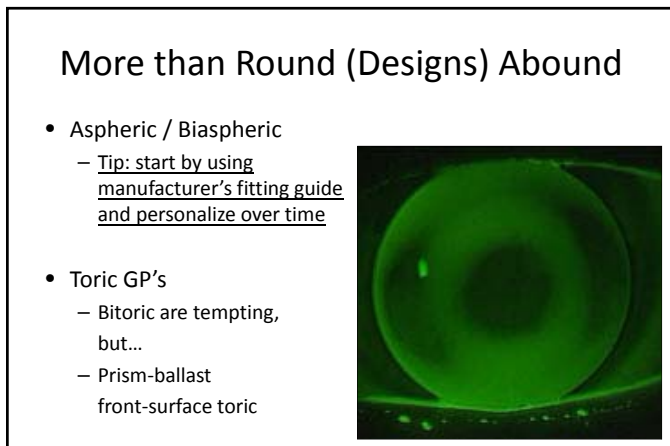
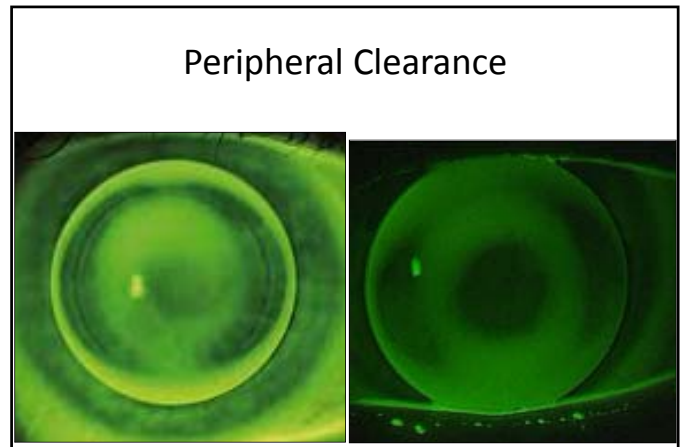
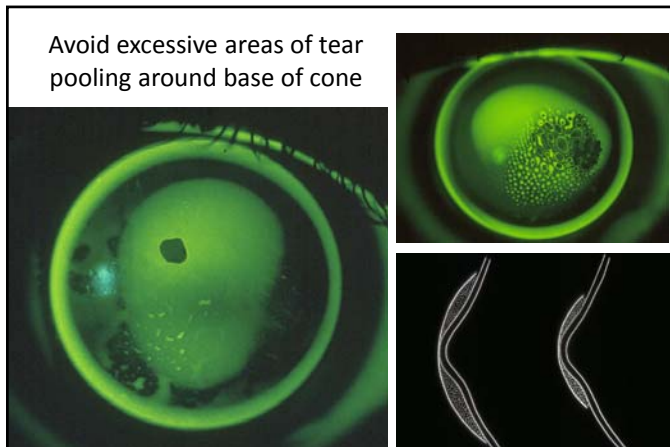
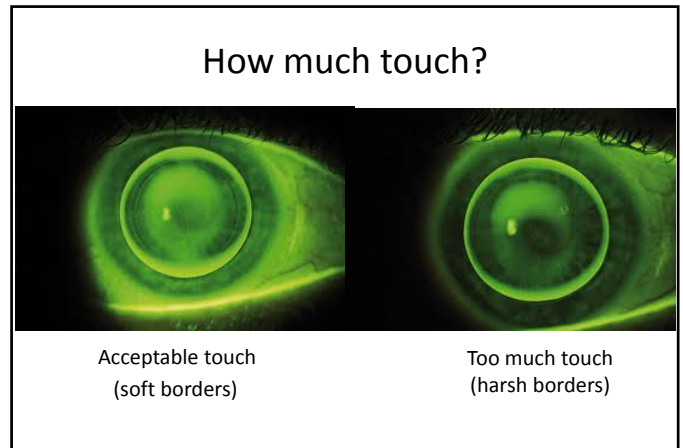
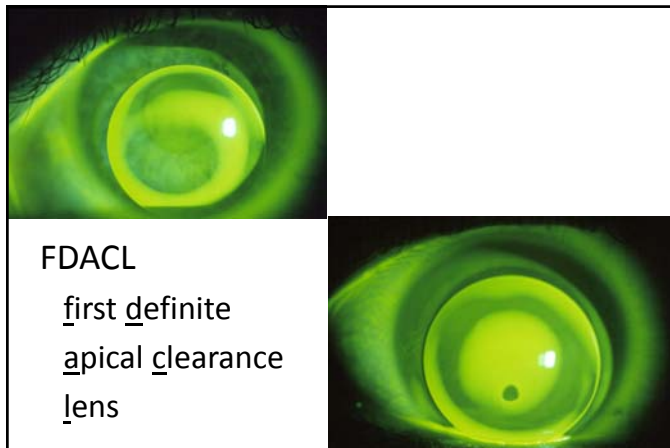
### "Ideal" RGP Keratoconus Fit

- Goal #1: **feather** "three-point" touch or slightest amount of apical clearance
- Goal #2: minimize area of tear pooling around base of cone
- Goal #3: average (to maximum) peripheral clearance to enhance tear exchange

### Keratometry / Sim K

- Extend range by using a +1.25 D spectacle trial lens and adding 8 to 9D to the drum reading
  - (+2.25 D add ~16 D to the drum reading)
- Use steep K (or slightly flatter) to select initial diagnostic contact lens
  - Dependent on OAD/OZD

Put on a lens!!!



### Large OADs for KC

- Intralimbal
  - Option for decentered cone apex
  - Option to enhance initial comfort?
- Sclerals
  - Indicated for KC patients who are intolerant of GP lens wear
  - Indicated for KC patients whose GP lenses eject or decenter often

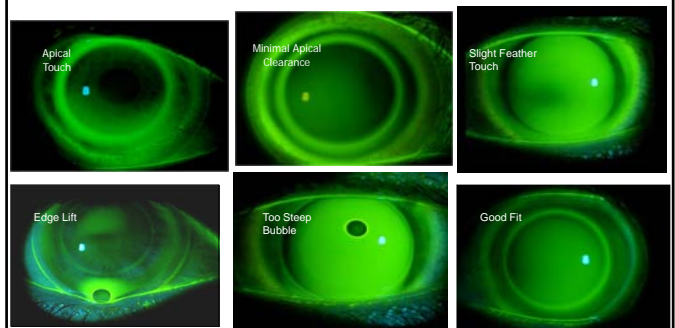
### Soft Lens Options for Keratoconus

- Available in a silicone hydrogel material
  - Kerasoft IC (Bausch + Lomb Boston Group)
    - 14.5mm OAD and 8.0mm OZD
- Made in Definitive material
  - Silicone hydrogel (Dk = 60)
  - Water content = 74%
- “Front-surface aberration control optics”

### Piggy Back

- When?
  - Comfort (initial); 3-9 staining; bandage
- How?
  - Minus, plus, how much?
  - Effect on over-refraction
  - Over-keratometry
- Materials?
  - S-H? Modulus? Daily disposable?
- Care system?

### SynergEyes Fluorescein Patterns



### 3-9 Staining

- Copious lubricants
  - Explain reason to patient
  - Explain how patient will benefit
- Piggyback with daily disposable or silicone-hydrogel SCL
- Scleral lenses

### KConus Comfort

- Initially tolerable, but wearing time is decreasing
  - “open-up” peripheral curve system
- Initial discomfort and continues throughout day
  - re-contour edge
  - piggyback with a daily disposable or silicone hydrogel CL
  - **SCLERAL**

## Sclerals

- If KC patient can not tolerate GP lens comfort
- If lens decenters or ejects frequently



## Surgical Options

## Refractive Surgery for Kconus

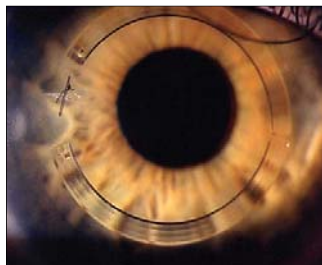
- Are you kidding? Kconus a corneal thinning condition ... and so is LASIK!
- Could perform PRK custom ablation?
- Could perform PTK to reduce central corneal scarring (raised or proud scar; nebula)

Risk Factors and Prognosis for Corneal Ectasia after LASIK - Randleman et al. (*Ophthalmology* 2003)

- Preoperative risk factors
  - forme fruste keratoconus (88%)
  - Residual stromal bed thickness of <250 microns (70%) –mean 223 microns
    - Flap thickness ~ 160 microns + 12 microns per diopter of correction
- All eventually achieved BCVA 20/30 or better
- Average time to development of ectasia = 16.3 months

## INTACS

- For mild / moderate KC patients (**K < 57 D**)
- If patient can't tolerate GP lens wear?
- Goal is to reduce K distortion and flatten K and to center apex (makes it easier to fit GP ??? I don't think so!)



## Intracorneal Ring Segments for KC Correction: Long-term Follow-up

Alio et al., J Cataract Refract Surg, June '06

	Best spectacle Corrected VA	Max K
Pre-Op	0.46 = 20/50	51.07 D
Mean 6 month Post-Op	0.66 = 20/30	47.15 D
Mean 3 year Post-Op	0.62 = 20/32	48.92 D

## Neovascularization



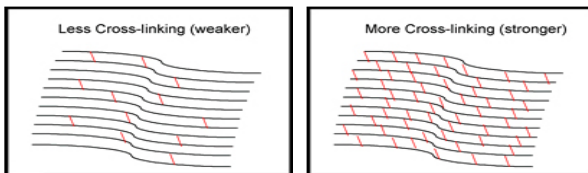
## Corneal Collagen Cross-linking

- Photo-polymerization increases the number of collagen cross-links
- Goal is to strengthen (stiffen) the cornea



## Corneal Collagen Cross-Linking (C3-R)

- **Remove corneal epithelium** (or not)
  - Corneal thickness should be 455 microns (including epithelium)
- **Apply riboflavin 0.1%** (Vitamin B2) drops
  - Every 3min for 30min pre-op; then every 5min for 30min tx
- **Expose to ultraviolet (UVA) light** (370nm)



Coskunseven et al.  
*Journal of Refractive Surgery*, April 09

	Best spectacle Corrected VA	Max K
Pre-Op	0.29 = 20/70	54.02 D
Mean 9 month Post-Op	0.40 = 20/50	52.45 D
Translation	Can patient stop wearing CL's?	Does this help you Rx CL?

Complication and failure rates after corneal crosslinking  
Koller et al., *J Cataract Refract Surg*, August 09

- 117 eyes of 99 patients
- Baseline, 6 mos, and 12 mos follow-up
- Percentage of eyes losing  $\geq 2$  lines of VA
  - 2.9% (95% CI, 0.6-8.5%)
  - **Risk factors included >35 years of age**
- Percentage of eyes exhibiting progression
  - 7.6%
  - **Risk factor of steep K >58 D**

## Alphabet Soup of Keratoplasties

- Penetrating Keratoplasty (PK)
- Selective Keratoplasties
  - Deep anterior lamellar keratoplasty (DALK)
  - Descemet stripping endothelial keratoplasty (DSEK)
  - Deep lamellar endothelial keratoplasty (DLEK)

## Penetrating Keratoplasty

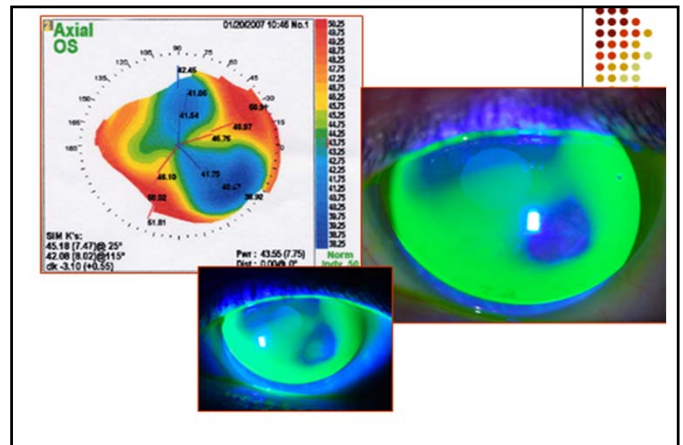
- Patient selection
- Patient education
- Surgical techniques
  - Trephine
  - Femtosecond laser

## Penetrating Keratoplasty

- Post-operative care
  - Meds
    - Topical abx
    - Topical steroid
- Post-operative complications
  - Wound dehiscence
  - Graft rejection
  - Graft failure

## Penetrating Keratoplasty

- Post-operative contact lens management
  - GP lenses
  - Lens design
    - BC, OAD, peripheral system
    - Large OAD design
    - Scleral design



## Deep Anterior Lamellar Keratoplasty

- Procedure
- Indications
- Benefits (over PK)
  - Anatomic outcomes
  - Visual outcome
- Risks
- Post-operative complications
- Post-operative contact lens management

## Descemet Stripping (automated) Endothelial Keratoplasty (DSEAK)

- Procedure
- Indications
- Benefits (over PK)
  - Anatomic outcomes
  - Visual outcome
- Risks
- Post-operative complications
- Post-operative contact lens management



Deep Lamellar Endothelial  
Keratoplasty (DLEK)

- Procedure
- Indications
- Benefits (over PK)
  - Anatomic outcomes
  - Visual outcome
- Risks
- Post-operative complications
- Post-operative contact lens management

Thank You.