Keratoconus: To cross-link OR not to cross-link

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Disclosure slide

Case 1: LASIK consult
- Drove himself here from Kerrville (1hr away)
- Interested in getting LASIK because he can’t see with any glasses, WAS NOT WEARING Glasses
- UCVA OD 20/60 OS 20/70
- AR OD: -6.00 -3.00 x 038
- AR OS: -10.25 -9.00 x 116

Overview of Keratoconus
- Keratoconus is a bilateral, progressive corneal ectasia resulting in irregular astigmatism and loss of visual function, with onset in teenage years
- Affects 1 in 2000 people in the US
- As of 2016, keratoconus was the most common indication for penetrating keratoplasty in the United States
- Eye Bank Association of America noted ~6,195 transplants/year in patients with keratoconus
- Predicted 73% of grafts fail within 20 years; 98% at 30 years
  - Potential for multiple transplants

**Why does it happen?**

- **Hereditary**
- **Eye Rubbing**
  - Only Significant Predictor of the disease
  - Asymmetric KCN = Eye Rubbing? Dominant eye?
- **Atopy**

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**Keratoconus Signs**

- Look out for warning signs:
  - Medical history
  - Family & genetic predispositions
  - Look out for visual complaints:
    - Blurred vision
    - Distortion of images
    - Decreased or deteriorating vision
  - Presence of striae or Fleisher's ring
  - Slit-lamp biomicroscopy
  - Cornea Transplant
  - Cross-linking
  - Correct vision

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**RISK FACTORS**

- Atopic Dz
- Sleep Apnea
- Family Hx

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**Corneal Scars**

- Look out for warning signs in medical history:
  - History of eye rubbing
  - Family & genetic predispositions
  - Look out for visual complaints:
    - Blurred vision
    - Distortion of images
    - Decreased or deteriorating vision
  - Slit-lamp biomicroscopy
  - Vogt's Striae
  - Fleisher's Ring
  - Scarring

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**DIAGNOSE EARLY**

- No Cornea Transplant

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**CROSS-LINKING**

- CORRECT VISION
Despite advances in diagnostic tools, keratoconus is often diagnosed at a relatively late stage.

Be Suspicious – Easy as 1,2,3

- 1 line of decreased vision
  - Not correctable to 20/20
- 2 lines on the back of the cornea
  - Vogt's Striae
- >3 diopters of astigmatism
  - PI -4.00 x 180
  - Asymmetric Astigmatism

EARLI DIAGNOSIS

Epithelial Thickness Mapping

**KCN: YES!**

Case 2: KCN? Yes or No?

**Corneal Epithelial Thickness Profile in the Diagnosis of Keratoconus**

CONCLUSIONS: An epithelial doughnut pattern appears to indicate the presence of an underlying stromal cone; the lack of an epithelial doughnut pattern would indicate that an abnormal topography was not due to keratoconus. In very early keratoconus, epithelial compensation can mask the presence of an underlying cone or front surface topography, i.e., a diagnosis of keratoconus might be missed. ([Ref: Acta Ophthalmol 2009;87:300-306])

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Conclusions

The epithelial thickness in the thinnest corneal zone and its location provided by the OCT epithelial mapping might be useful for the early diagnosis of forme fruste keratoconus.

Case 3 – Why else is it important to diagnose KCN early?

21 year old male: UCVA = 20/80 OD, 20/25 OS
MR OD = -0.50 +1.00 x 80° = 20/20 (stable for 5 years)

19 years after AK (now age 40): Ectasia OD (Pellucid Pattern)
UCVA OD = 20/80; MR = -1.75 +2.50 x 025 = 20/25.

19 years later OS (Now age 40): No previous Corneal Surgery
Contralateral eye (OS): UCVA = 20/25

Nationwide reduction in the number of corneal transplantations for keratoconus following the implementation of cross-linking

Significantly fewer corneal transplants were performed. This reduction suggests corneal cross-linking can significantly reduce the need for corneal transplants.
Overview of Procedure

**FDA Approved Treatment**

1. Remove thin epithelium using aseptic techniques.
2. Apply 1 drop of PHOTREXA® VISCOUS (riboflavin 5'-phosphate in 20% dextran ophthalmic solution) 0.146% every 2 minutes.
3. Check for flare:
   a) If none, continue with PHOTREXA® VISCOUS 1 drop every 2 minutes for an additional 2-3 drops and check again for flare.
   b) Repeat until flare is detected.
4. Measure corneal thickness:
   a) If less than 400 μm, add 1 drop of PHOTREXA® (riboflavin 5'-phosphate ophthalmic solution) 0.146% every 5 – 10 seconds and check pachymetry at 2 minute intervals.
   b) Repeat until 400 μm thickness is reached.
5. Apply UV for 30 minutes at 3 mW/cm² while continuing with PHOTREXA® VISCOUS drop every 2 minutes.

Efficacy Analysis: Progressive Keratoconus

- In clinical studies, the CXL-treated eyes showed increasing improvement in Kmax from month 3-12, while in untreated, Sham eyes, Kmax demonstrated steepening.
- Progressive keratoconus patients had an average Kmax reduction of 0.6 degrees in Study 1 and 1.5 degrees in Study 2 at Month 12 in the CXL-treated eyes while the Sham eyes had an average increase of 0.5 degrees in Study 1 and 0.6 degree in Study 2 at Month 12.
The most common ocular adverse reactions reported in the CXL-treated eye were:

**Progressive Keratoconus**
- corneal opacity (haze)
- corneal edema
- corneal epithelium defect
- eye pain
- reduced visual acuity
- blurred vision
- corneal scarring

**Corneal Ectasia**
- corneal opacity (haze)
- corneal edema
- corneal epithelium defect
- dry eye
- eye pain
- punctate keratitis
- photophobia
- reduced visual acuity
- blurred vision

The majority of adverse events reported resolved during the first month. Some observations (corneal opacity or haze) took up to 12 months to resolve. In 1-2% of patients, corneal epithelium defect, corneal edema, corneal opacity, and corneal scar continued to be observed at 12 months.

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Case 4: Inferior steepening OU

13 year old KCN eval

- Last year had a lot of astigmatism
- This year doctor noticed lines on cornea and scarring and can’t see really well out of left eye

Case 5: Impact of COVID on KCN

Can you cross link someone less than 14 years of age?
Would you cross link a patient who is 20/20?

Would you cross link the right eye of this 13 year old?

Do you have to wait for progression to treat?

88% of pediatric patients progressed over a 3 year period.

Young patients with KCN – No brainer

How long do you wait between cross-linking treatments?

What about Intacs?

Progression of Keratoconus and Efficacy of Corneal Collagen Cross-linking in Children and Adolescents

Progression of Keratoconus in Patients While Awaiting Corneal Cross-linking: A Prospective Clinical Study

Abstract

Purpose: To assess topographical changes in patients with keratoconus while awaiting corneal cross-linking treatment.

Methods: A prospective, double-center, observational clinical study, patients with keratoconus were enrolled. Progression was defined as a change in the corneal topography defined as ≥0.50 diopter (D) change in curvature and ≥0.50 microns (µm) at the thinnest point. The patients were treated with cross-linking treatment for keratoconus using the Visante (Carl Zeiss Meditec, Inc., Dublin, CA) device. The patients were monitored at baseline, 3, 6, 9, and 12 months postoperatively. The mean spherical equivalent, keratometry, topography, and corneal hysteresis were assessed at baseline and 12 months postoperatively.

Results: One hundred forty-six patients were included. The mean age of the patients was 42.8 ± 12.8 years. The mean values of topographical variables in the preoperative and postoperative periods are shown in Table 1. The mean spherical equivalent and keratometry decreased significantly from baseline to 12 months, while the mean corneal hysteresis increased significantly at 12 months compared to baseline. The mean value of keratoconus progression was -0.47 ± 0.72 D at 12 months, indicating a decrease in the progression of keratoconus.

Discussion: The results of this study suggest that corneal cross-linking treatment is effective in reducing the progression of keratoconus in patients awaiting treatment. Further studies are needed to evaluate the long-term outcomes and efficacy of corneal cross-linking treatment for keratoconus.
UPCOMING IN CXL – Accelerated CXL

Effectiveness and safety of accelerated (9 mW/cm²) corneal collagen cross-linking for progressive keratoconus: a 24-month follow-up

Damee P. Loo, MD, Ramanathan Rathinam, Yunsung Lee, Douglas Rith, John Pierre Durigon, Sheela T. Joseph, Solomon R. Margolis, Ellis H. Schiff

Modern Optometry: Which comes first: CXL or scleral lenses? Saenz and Mueller

Remember:
- Diagnose KCN Early
- Treat with CXL Early (CURE PROGRESSION)
- Don’t let these patients slip through the cracks if they get good vision with specialty lenses
- Feel the need for speed
- Send all prior topographies, manual K’s, glasses or contact Rx’s to demonstrate change – prior to apt
- Young Pts progress FAST
- Pts wear in age still progress
- Watch KCN like glc pts

Advantage: ODs

Questions/Comments?
- Anything different than when you first started doing cross-linking?
- No global period
- PKs can still get KCN?

UPCOMING IN CXL – PRK

Visual and Keratometric Outcomes of Keratoconus Patients After Sequential Corneal Collagen Cross-Linking and Topography-Guided Surface Ablation: Early United States Experience

Long-Term Comparison of DirectVision Topographically-Guided Keratectomy and Intentional Flapless Epithelial Abrasion

TABLE 2. WHICH COMES FIRST: SCLERAL LENSES OR CXL?

CATEGORIZE PATIENTS BASED ON AGE AND RISK OF KERATOCONUS PROGRESSION

<table>
<thead>
<tr>
<th>CXL 1st</th>
<th>Scleral Lenses 1st</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better than 20/40</td>
<td>Better than 20/40</td>
</tr>
<tr>
<td>Worse than 20/40</td>
<td>Worse than 20/40</td>
</tr>
</tbody>
</table>

Specialty Contact Lenses 1st
- Must have good vision to continue contact lens wear
- Specialty lenses have shown to slow progression
- Young Pts progress FAST
- Pts wear in age still progress
- Watch KCN like glc pts

Scleral Lenses 1st
- Must have good vision to continue contact lens wear

CXL 2nd
- Must have good vision to continue contact lens wear
- CXL can be delayed until the patient is ready

CXL Better Eye
- Only the better eye will receive CXL

Questions/Comments?
- Anything different than when you first started doing cross-linking?
- No global period
- PKs can still get KCN?