Cones and Cross Linking

1 hour

Mitch Ibach, OD, FAAO

Description

Keratoconus is a corneal degeneration that leads to progressive corneal thinning, corneal warping, and a resultant irregular astigmatism. In 2026, the goal in keratoconus management should be interventional, preventing keratometric progression, ultimately saving visual acuity and quality. This lecture aims to review tips and diagnostic tools for earlier diagnosis, discuss the staple of halting disease progression with corneal crosslinking, and finally review optical and surgical tools for visual rehabilitation.

Learning Objectives

- Outline characteristics of progressive keratoconus, and when to refer.
- Review the data on the effectiveness of corneal cross-linking both short and long-term
- Define keratoconus and discuss the epidemiology and risk factors

I. Keratoconus (KCN) Background

a. Definition: progressive corneal steepening and thinning which results in disruption of the stromal architecture while increasing corneal astigmatism.

b. Epidemiology- Incidence Less than 1 in 1000 (National eye institute

i. Keratoconus Natural Progression: A Systematic Review and Meta-analysis of 11 529 Eyes

c. Most common age of diagnosis age 29 and under: *Keratoconus group.org*

d. Risk Factors: Eye-rubbing, allergies, atopic dermatitis, sleep apnea, floppy eyelids, Ehler's Danlos, Down's syndrome.

e. Define refractive surgery ectasia

ii. Risk factors for ectasia

II. Paradigm Shift in Keratoconus Management

a. Old Mantra diagnose, monitor, specialty contact lenses, monitor, monitor, penetrating keratoplasty as needed.

b. New Mantra diagnose early, halt the disease progression, rehabilitee the vision.

i. Importance of early diagnosis: *Keratoconus Natural Progression: A Systematic Review and Meta-analysis of 11 529 Eyes*

III. Tools for corneal ectasia/KCN diagnosis and referral

a. Gold standard- corneal topography/corneal tomography.
    a. Use examples of each.
    b. Show a case with Pentacam progression.
        i. Discuss the I>S ratio. >2 is red flag, 1.5 monitor
b. Refraction/phoropter
    a. Red flags: >1 D increase in astigmatism or >0.5D in myopia
    b. A young patient who can't be corrected to 20/20 in phoropter.
c. Amblyopia is a diagnosis of exclusion.
d. Manual Keratometry
e. Retinoscopy
f. Slit Lamp exam: apical steepening, Munson's sign, Fleischer's ring
g. Referral for corneal collagen cross-linking
    i. Communicate progressive characteristics
    ii. Educate patients on cross-linking goals stability, not a refractive procedure

IV. Corneal cross-linking (CXL) defined and the procedure.

a. Utilization of riboflavin (Vit. B2) plus ultraviolet light (UVA) to create corneal cross-links to strengthen the cornea with covalent bonds. (picture of 3 components)
b. First studied in 1997 by Dr. Theo Seiler (Dresden protocol)
c. Two options- Epithelium On vs. Epithelium Off. (Discuss FDA approved CXL and on-label)
d. Procedural slide
e. Procedure video
f. Relative contra-indications: Age, corneal scar, pachymetry<400 (photos)

V. CXL data and support

a. FDA approval trial data published for progressive KCN.
    i. *Hersh et al published in Ophthalmology*
b. FDA approval trial data published for progressive post-refractive surgery ectasia.
    i. *Hersh et al published in Ophthalmology*

c. Seven-year follow-up of CXL. Show Kmax line-graph

i. *Corneal Cross-linking to Halt the Progression of Keratoconus and Corneal Ectasia: Seven-Year Follow-up*

d. Current Insurance and cost of CXL. Adolescent phase.

a. Show picture of progressive inclusion criteria.

e. Review cost of penetrating keratoplasty versus CXL.

VI. Post-operative care – very similar to Photorefractive keratectomy

a. Bandage contact lens placed for comfort and healing
b. No global period, co-management billed as office visits.
    a. Bill corneal topography and optical correction.
c. Post-op day (POD) 1 or (POD) (surgical practice or referring OD) : BCL removal or replace?
    a. Show epithelial defect vs. epi-ridge.
d. POD 1 month (primary OD): visual rehabilitation with glasses vs. SCL.
    a. May see start of corneal haze
e. POD 3 months (primary OD): Corneal haze check.
    a. Refraction can be variable.
    b. Time for a new fit in specialty contact lens.
f. POD 6 and 12 months: Repeat topography/tomography.
    a. May see surgical practice for stability check.
g. Very common to see pachymetry thin after CXL.
    a. Also common to see mild steepening of K's in the first 3 months, before plateauing in stability, followed by possible flattening at 12 months.

VII. Conclusion / Q&A

a. CXL provides a previously unmet need.
    a. Unfortunately PKP's have high failure rate (*Australian graft registry study)*.
b. CXL decision making flow chart
c. Collaboration in KCN matches the new management mantra.
d. Questions