

## **Keratoconus 1, 2, 3: Keratoconus Management Made Simple**

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### **Abstract:**

The management of keratoconus is ever-evolving. This course aims to address the comprehensive visual needs of the keratoconus patient and the importance of both surgical procedures and contact lenses in a very simple 1,2,3 step process. It will review the management and treatment of patients with keratoconus with new and innovative therapies by stopping progression, improving curvature, and correcting vision.

### **Course Learning Objectives:**

1. Learn about new surgical and contact lens management for keratoconus
2. Understand that contact lens vision is only one part of the patient's visual needs
3. To show the importance of MD and OD collaboration in the comprehensive management of keratoconus

### **Outline:**

1. Brief Keratoconus Background
  2. Core Concepts in Modern Keratoconus Management
    - a. Diagnose early, Stop progression, Rehabilitate vision.
      - i. Diagnose early
        1. Modern devices
          - a. Refractions in early KC
            - i. Present CLEI Study on KC and Refractive Axis
    - b. Keratoconus 1,2,3
      - i. Stabilize
        1. CXL
      - ii. Enhance
        1. Surgical interventions
          - a. Inlay
          - b. Excimer
            - i. Corneal curvature
            - ii. UCVA and BSCVA
      - iii. Correct
        1. Specialty contact lenses
          - a. BCLVA
        2. Glasses
        3. Lens-based surgery
3. Stabilize
  - a. CXL
    - i. CXL origins
      1. Spoerl et

- a. ex-vivo tissue strain
      - i. Ribo, 365 nm, 45 mins best result
  - 2. Meek et al and Wollensack et al
    - a. Collagen molecules at the surface of fibrils
      - i. Within/between proteoglycans in individual fibril or adjacent fibrils
        - 1. Collagen-proteoglycan matrix
  - 3. Wollensack et al
    - a. Prospective study
      - i. Pre-op: Progressive
      - ii. Post-op: Regressive
- b. Tradition KC Management in the US
  - i. Review
  - ii. CXL is a paradigm shift in KC Management
  - iii. Review FDA approval
- c. CXL for KC benefits
  - i. Stop progression
  - ii. Cost-Benefit
    - 1. Lindstrom RL et al
      - a. Lifetime economic model
- d. Review FDA clinical trial data
  - i. Hersh PS, et al
    - 1. United States Multicenter Clinical Trial of Corneal Collagen Crosslinking for Keratoconus Treatment
      - a. Expected corneal changes
        - i. Kmax
          - 1. Greenstein SA et al
            - a. Flattening by 1.7D
        - ii. VA
          - 1. Improvement by approximately 1 line UCVA and BCSVA
          - 2. Brooks NO et al,
            - a. Patient subjective visual function
        - iii. Haze
          - 1. Transient
            - a. Back to baseline by month 6
          - 2. Demarcation line
            - a. Depth of effect
          - 3. Greenstein SA et al
            - a. Natural history of corneal haze
        - iv. Corneal Thickness
          - 1. Thinner initially then back to baseline
        - v. Endothelial Cell

- 1. No change
    - b. 10 year FDA CXL Trial Follow Up
      - i. KC stable over 10 years
      - ii. Ectasia has less progression than untreated
        - 1. More unstable
          - a. More frequent follow up
4. Enhance
  - a. Goals
    - i. Improve corneal symmetry
    - ii. Improve non CL vision = more functional when not wearing CL
      - 1. Improve BCSVA
      - 2. Improved UCVA
    - iii. Options
      - 1. Intacs
        - a. PMMA arc segment implant
          - i. Hersh et al
            - 1. CXL and Intacs
              - a. Sequential vs concurrent
                - i. No difference
          - ii. Limitations
            - 1. Fixed parameters
            - 2. Gross change
            - 3. Biocompatibility
              - a. Nyguyen et al
                - i. Explantation rates
        - iii. Role is changing
          - 1. Seldomly used
          - 2. Poor outcomes with stability
            - a. Newer options
  - 2. PRK
    - a. TGPRK
      - i. Ablation based on topography
        - 1. Corneal curvature
          - a. Kanellopolous et al
          - b. Nattis et al
      - ii. Precise
        - 1. Limited by corneal thickness/removal of corneal tissue
      - iii. Present CLEI study on TGPRK
  - 3. Allogeneic Inlays
    - a. The use of corneal tissue inlays have been explored
      - i. Sun et al
        - 1. SMILE Lenticule implantation

- ii. Jacob et al
        - 1. Fresh tissue
          - a. Manual cut
          - b. Intacs segment shape
        - b. Limitation in the US due to tissue bank regulations
          - i. Greenstein et al
            - 1. CTAK
              - a. Sterilized Tissue
              - b. Fully customized
          - c. Sterilized allograft corneal tissue inlay
            - i. Biocompatibility
          - d. Massive change
            - i. Precise/Gross
5. Correct
  - a. Contact lenses
    - i. Goals
      - 1. Improve vision while wearing
    - ii. Options
      - 1. Soft
      - 2. Hybrid
      - 3. GP
      - 4. PB
      - 5. Scleral
    - iii. CLEI Study on corneal factors in lens selection
      - 1.  $>10D$  IS,  $>55K_{max}$ ,  $>50K_{mean}$ 
        - a. Scleral and PB
      - 2.  $<10D$  IS,  $<55K_{max}$ ,  $<50K_{mean}$ 
        - a. BCVA better than 20/30
          - i. Soft and Custom Soft
        - b. BCVA 20/30 or worse
          - i. GP and Hybrid
      - 3. Predominantly used lenses
        - a. Scleral and Custom Soft
- b. Cataract Surgery/ICL in KC
  - i. Goals are important
  - ii. Potential to significantly reduce RX
  - iii. Sequential procedures
    - 1. Performed after TGPRK/Intacs/CTAK
      - a. More symmetry = more accurate K's = better outcomes
6. Impact of 1,2,3 approach on CL fitting
  - a. CLEI Study on corneal surgery
    - i. Intacs 7D Max Flattening
    - ii. TGPRK 4D Max Flattening

- iii. CTAK up to 20D Max Flattening
        - 1. Opportunity to move to a less complex lens
    - b. Surgery Influence on Lens Selection
      - i. Intacs
        - 1. Soft and Vaulting Designs
          - a. Avoid “plastic sandwich” = CL rub tissue over segment
            - i. PS leads to tissue disruption, inflammation, neo, extrusion
      - ii. TGPRK
        - 1. More symmetry = lower IS, Kmax, Kmean
          - a. Present CLEI data on lenses before and after
      - iii. CTAK
        - 1. More symmetry = lower IS, Kmax, Kmean
          - a. Current CLEI data on lenses before and after
7. CASES:
- a. Hx 30 yo M with Moderate Keratoconus + Scleral Lens
    - i. Progressive KC
      - 1. Intacs + CXL
        - a. Improved symmetry & stop progression
          - i. Improved BCSVA and balanced
      - 2. Post Sx = Scleral lenses still the best choice
        - a. BCLVA = 20/30
          - i. +HOA Scleral
            - 1. BCLVA = 20/20
              - a. Pt experience
                - i. Improved QoL
    - ii. Take away:
      - 1. Yes, it still needs a scleral; the goal of Sx is not to eliminate CL, rather VA improved and balanced with glasses
        - a. More functional
  - b. Hx 32 yo M with Severe KC + Intacs
    - i. Pt unhappy with VA after Intacs hates CL
      - 1. TGPRK
        - a. UCVA 20/100 and BCVA 20/40
      - 2. Custom soft
        - a. BCLVA 20/25
          - i. Pt experience
            - 1. Thrilled, glasses or CL
    - ii. Take away:
      - 1. Can improve VA after Intacs
        - a. More functional
  - c. Hx 70 yo F with Moderate Keratoconus + Cataract + Scleral
    - i. No improvement with CL and very unhappy with Scleral

1. Refer for CE
    - a. Sequential procedure
      - i. TGPRK = improved symmetry
      - ii. CE = 20/60 UCVA
        1. BCSVA = 20/30-
    - b. Custom Soft now possible
      - i. BCLVA = 20/25+
        - a. Pt experience
          - i. Functional all the time
          - ii. Improved QoL
  - ii. Take away:
    1. Sequential procedures can improve symmetry allowing for improved IOL calc = better out comes and less complex CL
- d. Hx 35 yo M with Severe Keratoconus + TECXL (C3R) + CXL
  - i. Progressive
    1. Refer for CXL
      - a. Repeat TECXL
        - i. Too thin for other intervention
    2. Scleral lens
      - a. BCLVA = 20/50
        - i. +HOA = 20/30
          1. Pt experience
            - a. Less stress about vision
              - i. Improved QoL
- e. Hx 22 yo M with Aysmetric Severe Keratoconus and FF Keratoconus + Scleral
  - i. Scleral lens OD and Soft OS
    1. BCLVA OD 20/20 and OS 20/40
      - a. Unhappy when not wearing Scleral
        - i. CTAK
          1. Massive curvature change 25D
            - a. UCVA 20/60 from CF
      - ii. Custom soft
        1. 20/30
8. Conclusion
  - a. Diagnose early, Stop progression, Rehabilitate vision.
    - i. Stop Progression
      1. CXL
    - ii. Rehabilitate Vision
      1. Specialty contact lenses
      2. Refractive/Surgical interventions
        - a. BETTER TOGETHER
    - iii. Don't Fear Corneal Transplantation
      1. Modern transplantation