

Continuum of Care in Keratoconus: From Spectacles to Contact Lenses to Surgery  
Jeffrey Sonsino, O.D., FAAO

Introduction

Care for the keratoconic patient has evolved incredibly rapidly over the past 10 years. With vastly more options for spectacles, contact lenses, and surgery, many practitioners are finding themselves puzzled over which strategies to employ at which stage of disease. The author first presents a literature-supported and clinically-based staging classification. Then, spectacle, contact lens, and surgical considerations for each stage are discussed with case-based examples. Following this discussion, attendees should understand a clear model for providing state of the art care to their keratoconic patients.

Learning Objectives

1. Understand which equipment is necessary for diagnosing and staging keratoconus
2. Differentiate between forme fruste, mild, moderate, and severe keratoconus
3. Understand the role of spectacles, which has traditionally been ignored, in the treatment of keratoconus
4. Form an opinion on which contact lenses are appropriate for which stage of the disease
5. Be able to help guide patients into surgical procedures such as collagen-crosslinking, INTACS, partial-thickness keratoplasty, and full-thickness penetrating keratoplasty at the right time in the progression of their disease

Outline

- I. Introduction with disclosures
- II. Keratoconus staging
  - a. Evidence for classification
    - i. Amsler- Krumeich system
    - ii. Alio & Shabeyek grading
    - iii. Wang description of cone location
  - b. Necessary equipment
    - i. Topographer
    - ii. Scheimpflug or scanning slit tomographer
    - iii. Pachymeter
    - iv. Biomicroscope
  - c. Special equipment
    - i. OCT- for imaging, global pachymetry and epithelial mapping
    - ii. Corneal hystrometer for corneal biomechanics
  - d. Forme Fruste (Sub-clinical)
    - i. Topography shows eccentric steepening
    - ii. Pachymetry is normal (500u or greater)
    - iii. myopia and astigmatism < 5.00D
    - iv. mean central K < 48.00D
  - e. Mild
    - i. Topography shows inferior steepening
    - ii. Pachymetry is greater than 2 standard deviations from normal 550u (less than 500u)
    - iii. Myopia and astigmatism 5.00-8.00D

- iv. mean k ranges from 40.00D to 48.00D
    - v. Eccentricity of cone apex
  - f. Moderate
    - i. Topography shows significant steepening
    - ii. mean k ranges from 48.00D to 52.00D
    - iii. Corneal thickness 300-400u
    - iv. Eccentricity of cone apex
  - g. Severe
    - i. mean k greater than 52.00D
    - ii. Corneal thickness 200u-300u
    - iii. Eccentricity of cone apex
  - h. Surgical Keratoconus
    - i. central scarring
    - ii. Corneal thickness <200u
    - iii. Refraction not measurable
- III. Surgical and Vision correction at each stage
  - a. Forme Fruste / Pre-clinical
    - i. Spectacles
    - ii. Off-the-shelf soft toric
    - iii. Custom soft toric
    - iv. Hybrid
    - v. Collagen Crosslinking
  - b. Mild
    - i. Keratoconic-design corneal GP
    - ii. Hybrid
    - iii. Keratoconic design thick soft
    - iv. Scleral
    - v. Collagen Crosslinking
  - c. Moderate
    - i. Hybrid
    - ii. Scleral
    - iii. Collagen Crosslinking
    - iv. INTACS
  - d. Severe
    - i. Scleral
    - ii. Custom scleral
  - e. Surgical Keratoconus
    - i. Partial-thickness corneal transplant
    - ii. Full-thickness corneal transplant
- IV. Description of each strategy
  - a. Spectacles
    - i. Cut the cylinder
    - ii. Maximize one eye if significant anisometropia
    - iii. Digital progressive
  - b. Contact Lenses
    - i. Off-The-Shelf Toric Soft Lenses
      - 1. Pros
        - a. Easy to fit

- b. Trial lenses readily available
    - c. Relatively inexpensive
    - d. Daily, monthly or 2 week replacement
  - 2. Cons
    - a. Does not correct for irregular astigmatism
    - b. Rotational instability when cornea is irregular
    - c. Keratocones are prone to contact lens papillary conjunctivitis due to ocular allergies and eye rubbing- monthly and 2 week replacement soft torics tend to attract deposits
  - 3. Ideal patient types and patient parameters
    - a. Regular astigmatism
  - 4. When to choose this lens
    - a. Good option for patient who does not have critical vision needs and does not wish to wear glasses
- ii. Custom Soft Toric Lenses
  - 1. Pros
    - a. Ultimate customizability in material, base curve, diameter, power, cylinder, and axis correction
  - 2. Cons
    - a. With ultimate customizability, there may be too many parameters to change, resulting in many visits with variable results
    - b. Quarterly replacement
    - c. Comfort is worse with most commercially available lathe cut lenses
- iii. Hybrid
  - 1. Pros
    - a. Very comfortable
    - b. Better centration
    - c. GP optics
    - d. tear exchange mechanism
    - e. Vaulting the cornea
    - f. Visits required for optimal fit
    - g. Excellent consultation and doctor support by manufacturer
    - h. Use of regular fluorescein for evaluation of fit
  - 2. Cons
    - a. If the corneal condition is beyond the available lens parameters or the condition is exhibited in the far peripheral cornea, the lens may not be successful.
    - b. Since this lens type is much more modern, there are fewer practitioners familiar with the nuances of fitting, evaluating, and troubleshooting.
  - 3. Ideal Patient Types and patient parameters
    - a. Mild or moderate keratoconus
    - b. Those with comfort complaints with corneal GPs

- c. Those requesting better vision than in soft toric lenses
  - d. Newly diagnosed keratocones
  - e. Keratoconic patients with pterygium, pinguecula or surgical blebs/stents for glaucoma
  - f. Current GP wearer-lens no longer stays centered or pops out; environmental changes
- iv. Keratoconic-design corneal GP
1. Pros
    - a. A high degree of precision can be built into the fit and the optics
    - b. When fit well, are very safe and effective at providing excellent vision, above what glasses or soft contact lenses can provide
    - c. Relatively inexpensive
    - d. Have been around for a long time
    - e. Due to the life of a GP lens it can be successfully worn for many years.
  2. Cons
    - a. Require expertise to fit
    - b. Comfort is always a challenge
    - c. Movement
    - d. GP lenses rest on the cornea and have the potential to touch the apex of the cone
  3. Ideal Patient Types and patient parameters
    - a. Mild keratoconus
    - b. Habitual GP wearers
    - c. Patients with scleral elevations, such as pingueculae or glaucoma filtering blebs
- v. Keratoconic Design Thick Soft
1. Pros
    - a. Comfort
    - b. Fitting familiarity, ease
  2. Cons
    - a. Poor vision
    - b. Thick, Dk/t values VERY low
    - c. Lens stains with regular sodium fluorescein, a staff/office issue
    - d. Expensive
    - e. Tight lens syndromes common when not properly fit
    - f. Rotation
  3. Ideal Patient Types and patient parameters
    - a. Mild keratoconus
    - b. Contact lens intolerant patients
- vi. Scleral
1. Pros
    - a. Comfort
    - b. The power of the tear reservoir
    - c. A high degree of precision

- d. The ultimate in customization
    - e. Dry eye concomitant with keratoconus
  - 2. Cons
    - a. Doctor experience
    - b. Number of visits required for proper fit
    - c. Expense
  - 3. Ideal Patient Types and patient parameters
    - a. Mild, moderate, severe keratoconus
    - b. Patients who exhibit very low hysteresis and have vault settling problems with corneal lenses
- vii. Custom Scleral
  - 1. Pros
    - a. The best comfort
    - b. The best optics
    - c. Ease of fit
  - 2. Cons
    - a. Cost
  - 3. Ideal Patient Types and patient parameters
    - a. Patients with extremely thin corneas and very advanced keratoconus
    - b. Patients with severe keratoconus with scleral elevations
      - i. Pingueculae
      - ii. glaucoma filtering blebs
- c. Medical Therapy
  - i. Corneal Cross linking - CXL (for any case of documented or high risk category for progression of disease)
    - 1. Epi-Off vs. Epi-On
    - 2. Advanced and future technologies re CXL
- d. Surgical
  - i. Mild to moderate
    - 1. INTACS –for potential improvement of refractive error, UCVA, BCVA and contact lens “tolerance”
    - 2. Topography guided PRK
    - 3. Combination procedures
  - ii. Severe
    - 1. INTACS (within limits of procedure)
    - 2. Keratoplasty – for cases of contact lens intolerance or corneal scar that limits vision.
      - a. Partial-thickness corneal transplant
      - b. Full-thickness corneal transplant

## V. Conclusions