

## Specialty Contact Lenses for Irregular Corneas

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### Abstract:

Funky cornea? Lots of aberrations? Sounds like a job for specialty contact lenses! Contact lens options, including corneal GP, piggyback, soft, custom soft, hybrid, and scleral lenses, will be discussed. Additionally, we will discuss methods to choose lens type, innovations to improve vision via aberration-canceling optics, and technology to improve the fitting process via impression and scan-based design.

### Course Learning Objectives:

1. Review of contact lens options
2. Raise awareness of technologies to aid in fitting
3. Teach how to select lenses based on corneal contour

### Outline:

1. Contact Lens for Visual Rehabilitation
  - a. Traditional Glasses and Soft CL
    - i. Don't discount, still effective in some
  - b. Specialty Contact Lenses
    - i. Multiple options
    - ii. Not one size fits all
  - c. Contact Lens Options
    - i. Standard Soft
      1. Parameter limitations
      2. Consideration
        - a. Van der worp et al
          - i. Sagittal depth
            1. Stability
      - ii. Custom Soft
        1. Parameter freedom
          - a. Multicurve options
            - i. BC = cornea fit
            - ii. PC = movement
          - b. Thickness = pseudo rigidity = mask irregularity
            - i. Central thickness only vs edge to edge
              1. Location of irregularity
      - iii. Corneal GP
        1. Standard of care
          - a. 3 point touch
          - b. Bearing > epitheliopathy > scarring
            - i. NO effect on progression of keratoconus
          - c. Centration

- i. Inferior edge tuck
    - iv. Piggyback
      - 1. Soft under GP
        - a. Apply principals from soft lens sag
          - i. Cushion cornea from GP to improve comfort
    - v. Hybrid
      - 1. GP with soft skirt
        - a. GP optics with improved lens centration and edge awareness compared to GP
          - i. Designs and material matters
    - vi. Scleral
      - 1. Full corneal clearance
        - a. SCOPE Study
          - i. KC most common utilization
        - b. DeLoss et al: Scleral lens prevent PK
        - c. Koppen et al: Scleral lens prevent PK
      - 2. Common reason for failure
        - a. Lens handling
2. New technology
  - a. Optics
    - i. Wavefront-guided optics
      - 1. Principles laid out by Magnante patent from 2000
        - a. Followed by others such as:
          - i. Gemoules: 2011
          - ii. Johns et al.: 2012
      - 2. Destructive interference
        - a. Similar concept to noise-canceling headphones
          - i. Equal and opposite to cancel out distortion
      - 3. Process
        - a. ScCL fit
          - i. WF Aberrometry measured with CL worn to collect HOA Data of the entire eye
          - ii. HOA data mirrored
          - iii. Manufactured onto surface of the ScCL
      - 4. OPTICS TOTALLY CUSTOM TO INDIVIDUAL EYE
        - a. Why a scleral lens (ScCL)?
          - i. Lens stability & rigid material
      - 5. HOA Sclerals in Research
        - a. Total HOA reduction of ~43-66%
        - b. 1-2 lines of vision improvement
    - ii. Improving near vision
      - 1. Multifocal optics
        - a. Inducing aberrations

- i. Spherical aberration
          - 1. Must be centered to line of sight
            - a. Induce unwanted aberration
          - 2. Decentered pupil size optimized
            - a. Legerton: 2004
        - iii. Combination of principals
          - 1. Reduce unwanted aberration
          - 2. Induce the desired aberration in the necessary amount
      - b. Device driven design
        - i. Topography
          - 1. Corneal surface mapping
            - a. Placido disk
            - b. Scheimpflug
        - ii. Profilometry
          - 1. Understand corneal scleral shape (similar to topography)
            - a. Rasterstereography used in 2 systems
              - i. Reflection based
            - b. Scheimpflug used in 1 system
              - i. Unaffected by tear film
          - 2. Scleral shape study group
            - a. DeNaeyer et al.: 6% of scleras are spherical in shape, 30% sym toric, all other asymmetric
        - iii. Impression Mold
          - 1. PVC based
            - a. Measurement of sclera from impression
            - b. Nyguen et al.: Impression-based lens indications
        - iv. Data imported into design software
          - 1. Recommend standard parameter
          - 2. Freeform design
3. Lens selection
  - a. Sarac et al 2019
    - i. Soft and Hybrid on mild, RGP and Scleral in moderate to advanced
  - b. Zhang F. et al 2016
    - i. Elevation difference most important factor in corneal GP vs scleral
      - 1. Scleral
        - a. Corneal curvature metrics = not a significant factor
4. Considerations
  - a. Cornea edema
    - i. Scleral lenses associated edema
      - 1. Vincent et al penetrating keratoplasty
        - a. Lass et al loss of endothelial cells over 10 years
      - 2. Arnold et al radial keratotomy