The Fundamentals of Corneal Topography and Tomography for Myopia Management Orthokeratology

Melanie Frogozo, OD FAAO, FSLS
Alamo Eye Care and Contact Lens Institute of San Antonio
1742 N Loop 1604 E
San Antonio, TX 78232
mfrogozood@gmail.com
Office: 210-403-9050

Anthony Mac, OD, MPH FAAO
Alamo Eye Care and Contact Lens Institute of San Antonio
1742 N Loop 1604 E
San Antonio, TX 78232
Anthonymacod@gmail.com
Office: 210-403-9050

Course Description:

ARBO CL

This case driven, 1-hour course focuses on how to prescribe and troubleshoot orthokeratology fitting with respect to myopia management. It explains the how to approach orthokeratology fitting based on corneal topography and tomography. This will also include how to select appropriate patients and approach troubleshooting common fitting adjustments using corneal mapping technologies.

Learning Objectives (3):

1) Understand when to start fitting orthokeratology contact lens for myopia management and whom to fit based on patient history and corneal mapping.
2) Understanding corneal shape as it is described through different topography and tomography maps such as axial, tangential, refractive, elevation, pachymetry, and ectasia screening.
3) Learn how to implement follow-up care and modify common troubleshooting adjustments in orthokeratology care.

Outline

I. Introduction
   a. Goals of the lecture
II. Corneal Shape
   a. Description of Corneal Shapes
      i. Eccentricity
         1. Derivative of Shape Factor
         2. Derivative of Asphericity
         3. Understanding Normative Values
            a. Prolate Ellipse
            b. Irregular Cornea
               i. Prolate
               ii. Oblate
   b. Corneal Mapping
      i. The Difference in Tomography vs. Topography
      ii. Map Type
         1. Axial
         2. Tangential
         3. Elevation
         4. Refractive
         5. Tomography
            a. Pachymetry Maps
            b. Ectasia Screening
   c. Discuss why do we fit myopia management contact lens
      i. Myopia epidemic and worldwide prevalence
      ii. Increase risk for several sight-threatening ocular diseases
   d. The Orthokeratology for myopia control
      i. Contact lenses for myopia control simultaneously focus light onto and in front of the retina
         1. This creates a retinal image shell and defocus that slows axial growth
         2. Reduction of myopia by at least 40% is considered clinically significant
III. Understanding Good Candidates Based of History and Corneal Mapping
   a. When to implement treatment
      i. Age is a critical factor on deciding when to implement treatment

                1. Earlier onset correlates with faster progression
                    a. Consider further evaluation and possibly genetic testing for high myopia that onsets before the age of 5
                    b. Analyzing Risk for Corneal Ectasia
                        i. Pachymetry Maps
                        ii. Keratometry Readings
                        iii. Eccentricity
                        iv. Family History
                        v. Genetic Saliva Testing
    b. Which children to treat
        i. Discuss risk factors for faster rates of progression
            1. Race and ethnicity
            2. Family history

IV. Orthokeratology for myopia control
    a. Orthokeratology lenses
        i. Lens anatomy- reverse geometry design
        ii. Required measurements to create a lens
        iii. Centration is key to properly fit an Ortho-K lens for myopia management
        iv. How to assess if the Ortho-K lens is effective with topography
        v. Assessing cornea health when using OrthoK lens

V. Troubleshooting orthokeratology lenses through case presentations
    a. Smiley Face Response
        i. ***Smiley Face Response*** In the smiley face topographical response, the red ring decenters superior-temporally with respect to the pupil
            1. Centration
            2. This is caused by a flat-fitting lens.
            3. less-than-expected myopia reduction, an increase in with-the-rule astigmatism, or associated ghosting, glare, and flare
            4. A flat, superior-riding lens has too little sagittal depth either from underestimating the corneal sagittal depth or overestimating the corneal eccentricity
            5. To correct for this, increase the sagittal depth of the lens. Depending on the lens design, practitioners can accomplish this in a number of ways that include steepening the alignment curve, the BOZR, or the reverse curve zone. Additionally, widening these curves can also increase the sagittal depth of the lens and fix the problem of a smiley face topography
            6.
    b. Frowny Face Response

i. With a frowny face response, the red ring decenters inferiorly with respect to the pupil
    1. Centration
    2. This is caused by a steep-fitting lens.
    3. A patient who presents with this topography pattern may have less myopia reduction than expected, an increasing amount of astigmatism, or associated ghosting, glare, and flare.
    4. A frowny face topography is caused by the lens having too much sagittal depth from either overestimating the corneal sagittal depth or underestimating the corneal eccentricity. A smaller overall lens diameter may cause this as well.
    5. Remedy this topographical response by reducing the lens sagittal depth. This can be accomplished by flattening the alignment curve, the reverse curve, or the BOZR. Decreasing the width of these curves will also decrease the overall sagittal depth of the lens. If a small diameter is causing decentration of the lens, increasing the diameter will help achieve a proper fit.

c. Lateral Displacement
    i. A topographic red ring that decenters nasally or temporally with respect to the pupil indicates lateral displacement of the lens
        1. Centration
        2. A patient whose ortho-k lens is laterally displaced may exhibit associated ghosting, glare, or flare; have induced astigmatism; or have vision that is reduced in the paracentral region of the pupil. Possible causes of lateral decentration are a lens that is too steep or too flat, a lens that is not large enough, an asymmetrical corneal curvature, or a decentered corneal apex.
        3. Increasing or decreasing the sagittal depth of a lens can help remedy a flat- or steep-fitting lens, respectively. If a small lens is causing lateral decentration, increasing the lens diameter will help improve the fit. If an asymmetrical corneal curvature or decentered apex is causing decentration, altering the alignment curves or changing to a toric design lens may help with this concern.

d. True Central Island
    1. ***True Central Island*** In a true central island, the red ring centers perfectly; however, there is also a central area of steepening on topography.
    2. This area of central corneal steepening relative to the rest of the treatment zone is caused by a steep-fitting lens. A true central island has no sign of epithelial damage upon lens removal, and the central peak is > 0.00D on corneal topography. The steeper the lens, the steeper the central island.

3. Patients who present with a true central island may have an over-refraction with no clear end-point, reduced best-corrected visual acuity of more than one line on the Snellen acuity chart, or unaided acuity that is worse compared to the pre-fit acuity if the cornea becomes steeper than baseline. Possible causes of a true central island include a lens sagittal depth that is too high because of overestimated corneal sagittal depth or underestimated corneal eccentricity. True central islands can be resolved by reducing the sagittal depth of the lens (similar to the changes needed to resolve a frowny face topography).

e. False Central Island

1. A false central island appears as a central peak within the treatment zone that has a topographical value of < 0.00D
2. This is caused by a flat-fitting lens and often is accompanied by a smiley face topography pattern of superior lens displacement. Patients who have a false central island will often have corneal staining upon lens removal from epithelial damage. Additionally, distortion of the placido disc mires may appear with topography. In these cases, patients may have associated ghosting, glare, and flare or have poor best-corrected vision if the staining is central in location.
3. A false central island is caused by heavy bearing of the lens on the corneal surface; the topographer interprets the induced epithelial damage as an area of steepening. This may be remedied by increasing the lens sagittal depth (similar to the changes needed to resolve a smiley face topography response).

VI. Conclusions and summary