Orthokeratology - Reshaping Vision

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Evolutionary Eye Care

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Financial Disclosures

I have consulted for and/or received honorarium from the following companies

- Bausch & Lomb
- Carl Zeiss
- Sun Pharmaceuticals
- PRN Nutriceuticals

Will have no impact on the contents of this Lecture

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Why Myopia Management/Control Matters

- "1-diopter increase in myopia is associated with a 67% increase in the prevalence of myopic maculopathy."

- High Myopia → Increased risk
- There are options to help with progression

"Myopia Control: Why Each Diopter Matters". Mark A. Bullimore, MCOptom, PhD, FAAO1, * and Noel A. Brennan, MScOptom, PhD, FAAO2

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What we will cover

1. How Orthokeratology works
1. Defining Orthokeratology architecture
1. Understanding Topography
1. Troubleshooting

4

Orthokeratology

- Temporary reshaping of anterior corneal surface with the use of rigid gas-permeable lenses

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How it works

- Hydraulic forces
  - Uses tear film forces to reshape corneal epithelium
  - Mid-peripheral steepening with central flattening

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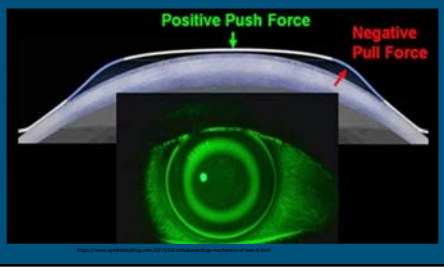
How it works



https://www.eyedoctorsblog.com/2015/04/orthokeratology-mechanics-of-how-it.html

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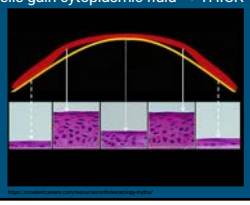
How it works

- Fluid reservoir created
- Less fluid centrally → More fluid mid-peripherally
- Central Cells lose cytoplasmic fluid → THIN
- Mid-peripheral cells gain cytoplasmic fluid → THICK



https://coastlenscare.com/resources/orthokeratology-myths/

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Anatomy

- Orthokeratology effects corneal epithelium
  - Central epithelial THINning
  - Mid-Peripheral epithelial THICKening
  - Stromal changes?

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Anatomy

- Central thinning -> epithelium
- Mid-peripheral thickening -> epithelium and stroma
- Conclusion:

"OK lenses caused the central corneal epithelium to thin while the mid-peripheral epithelium and stroma became thicker. Refractive changes during OK are associated with changes in central epithelial thickness, while stromal changes did not contribute significantly"[1]

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Anatomy - Endothelium

- 1 year study Conclusion: "Overnight orthokeratology for 1 year did not influence the density or morphology of corneal endothelial cells."[2]
- 2 year study Conclusion: Orthokeratology lens wear had minimal effect on the developmental changes in endothelial morphology.
- 7 year study Conclusion: There was also no statistics significance between moderate-low and high myopia of the endothelial cell and the corneal thickness change with long-term OK lens wearing"[3]

2) https://pubmed.ncbi.nlm.nih.gov/27266953/
3) https://pubmed.ncbi.nlm.nih.gov/29090016/
4) https://pubmed.ncbi.nlm.nih.gov/24709127/

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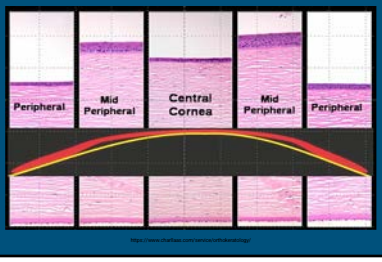
Anatomy



https://www.charlilaw.com/service/orthokeratology/

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Defining the architecture

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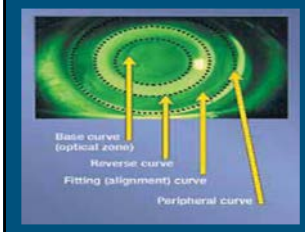
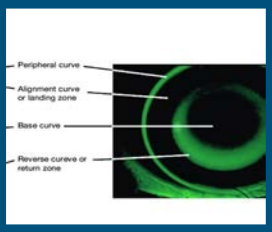
Defining the Architecture





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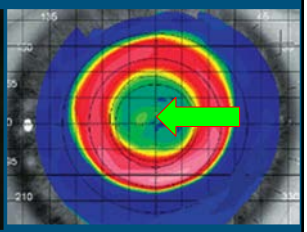
Base Curve



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Base Curve

- Central zone
- Responsible for treatment effect
- Corneal touch/Mechanical compression?

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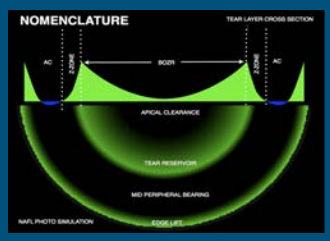
Base Curve



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Base Curve

- Not touching cornea - no mechanical compression
- Need about 20-25um of fluorescein to visualize at slit lamp
- Hydraulic forces cause central flattening and mid-peripheral steepening -> not mechanical compression
- Should not expect significant SPK

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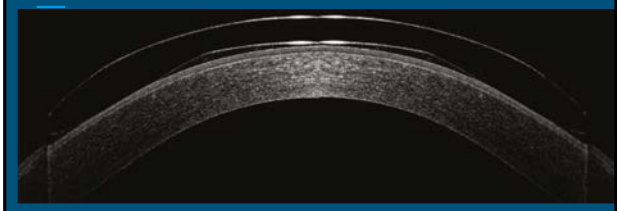
Base Curve



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Base Curve

- Purpose - Control treatment effect
  - Refractive error correction

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Base Curve

- When to modify - Only for refractive error correction!
  - Not involved with fitting!
  - Do not change to improve centration, overall fit
  - Changes made only if over/under correction of refractive error

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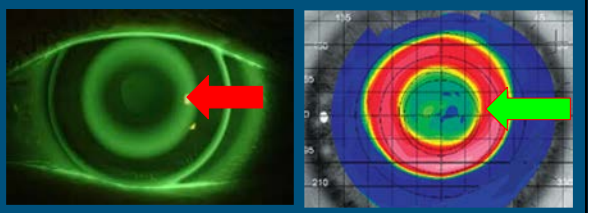
Reverse Curve



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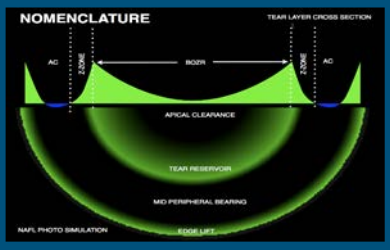
Reverse Curve



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Reverse Curve

- Used to raise and lower sagittal height
  - Determines amount of apical clearance
- Creates zone of "peripheral plus" needed for peripheral myopic defocus
- Creates negative hydraulic force to create central flattening and mid-peripheral steepening

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Reverse Curve

- When to modify - when need to increase/decrease sagittal depth
  - When lens is decentering superiorly/inferiorly
  - Modify Reverse Curve, NOT Base Curve

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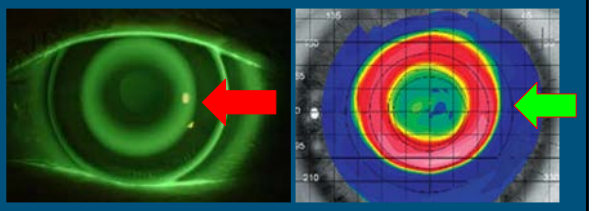
Alignment Curve



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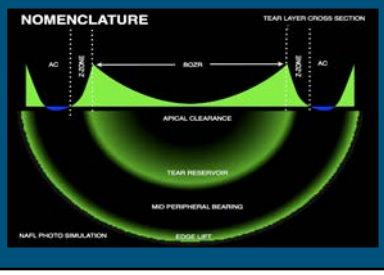
Alignment Curve



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Alignment Curve

- Alignment with mid-peripheral cornea
- Aids in proper centration
- Lower the eccentricity the steeper the AC needs to be
- Higher the eccentricity the flatter the AC needs to be

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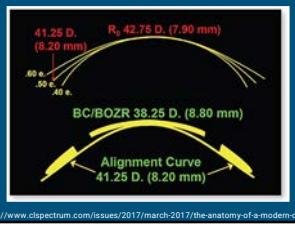
Alignment Curve

- Corneal Eccentricity - rate of flattening from center to periphery



https://www.clspectrum.com/issues/2017/march-2017/the-anatomy-of-a-modern-orthokeratology-lens

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Alignment Curve

- Lower the eccentricity → Steeper the AC
- Higher the eccentricity → Flatter the AC

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Alignment Curve

- When to modify - when lens is not centering properly
  - Modify this curve for centration as well - NOT Base Curve
  - Want 360 degrees of mid-peripheral alignment

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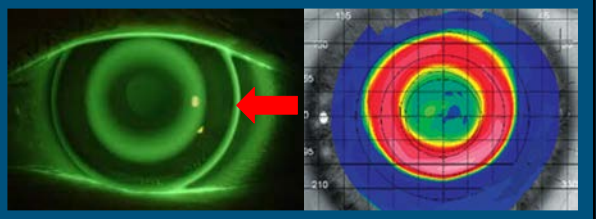
Peripheral Curve



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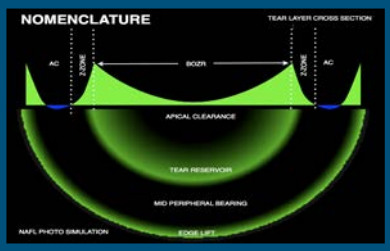
Peripheral Curve



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Peripheral Curve

- Edge lift provides tear exchange
  - Maintain health of corneal environment
  - Do not want seal off
  - 360 degrees of edge lift to ensure proper tear exchange

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Peripheral Curve

- When to modify - when inadequate tear exchange
  - Corneal compromise - need to increase edge lift
  - Debris - excessive edge lift
  - Can be adjusted to aid in centration as well
- When to modify - Patient discomfort
  - Excessive edge lift, need to reduce

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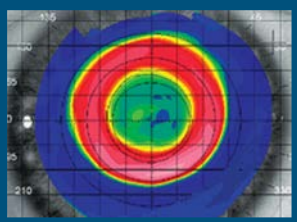
Topography



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Topography

- Do you need it
  - Can order from K's refraction
  - Can monitor VAs and SOR over retainers
  - Can assess at slit lamp

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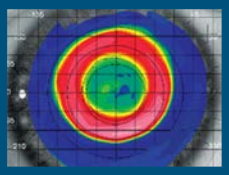
Topography

YES YOU NEED IT!!!



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Topography

- Types of Maps
  - Axial
  - Tangential
  - Refractive
  - Elevation
- Subtractive Maps

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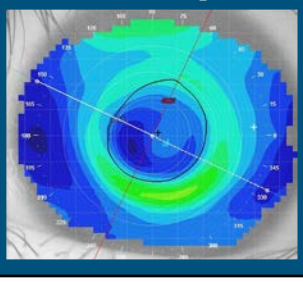
Axial Maps



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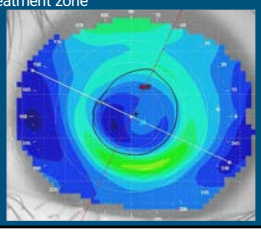
Axial Map

- Use to visualize treatment zone



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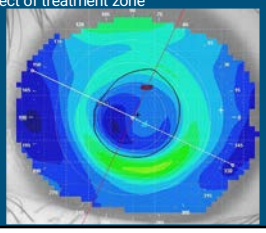
Axial Map

- Shows size and effect of treatment zone



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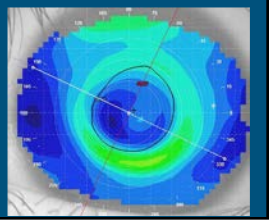
Axial Map

- Modifications - when inadequate treatment zone
  - If not enough treatment area in pupil zone
    - Halos
  - If too large treatment zone
    - Not enough peripheral myopic defocus



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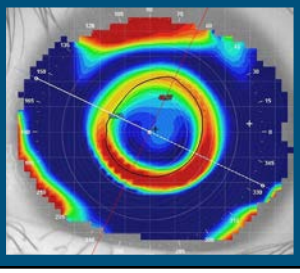
Tangential Maps



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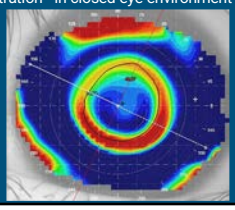
Tangential Map

- Use to visualize shape
- Use to visualize centration - in closed eye environment



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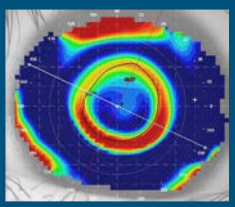
Tangential Map

- Use to modify Reverse Curve
- Use to modify Alignment Curve
- Use to modify centration issues
  - Superior decentration
  - Inferior decentration
  - Lateral decentration



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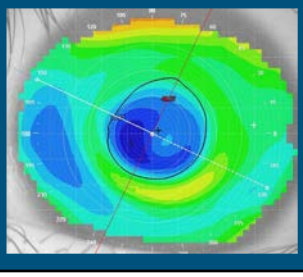
Refractive Map



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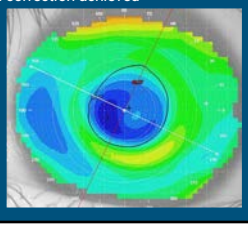
Refractive Map

- Use to visualize how much correction achieved
  - Subtractive map



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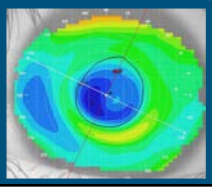
Refractive map

- Use to visualize amount of refractive error correction
  - Under/over correction over pupil area
  - Shows amount of treatment zone as well, similar to axial map



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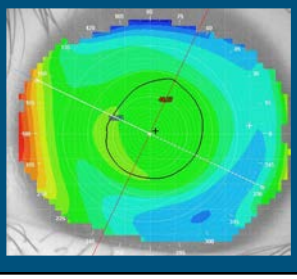
Elevation Map



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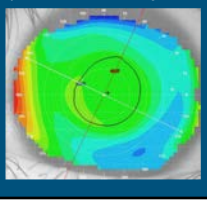
Elevation Map

- Use to determine elevation difference in different meridians
- Use to determine if spherical or toric design needed



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Elevation Map

- If < 30um of elevation difference → Spherical design
- If > 30um of elevation difference → Toric design
- Check at chord where lens lands
  - Typically at 8mm chord

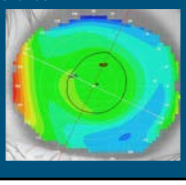

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Image Capture

- Topography guides your decision making
  - Need reliable maps
  - Get lashes out of the way
  - Good tear film
    - Use artificial tears
- Only one first impression
  - Only one shot at good baseline topos
    - Take multiple baseline topos

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Image Capture

- Good vs poor capture

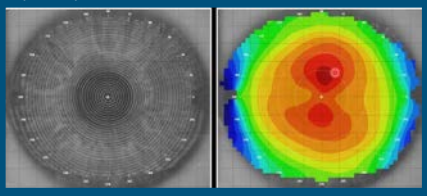

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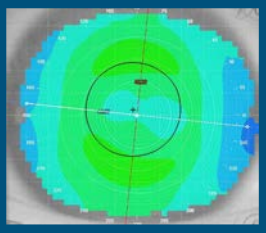
Image Capture

- Good capture



55

Image Capture

- Poor Capture

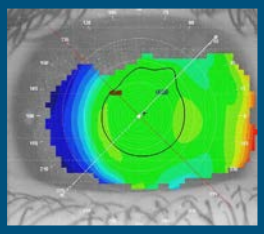


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Image Capture

- Poor Capture

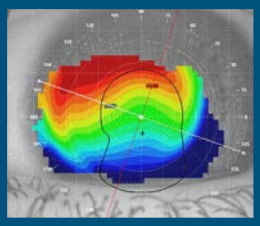

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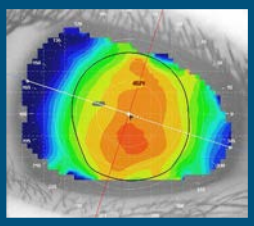
Image Capture

- Poor Capture



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Troubleshooting

- Smiley Face
- Frowny Face
- Lateral decentration
- Central Island
- False Central Island
- Toric Designs

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Smiley Face

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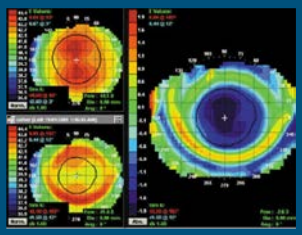
Smiley Face

- "Riding high"
- Lens decentering superiorly



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Smiley Face

- What causes this?
- Too little sagittal depth

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Smiley Face

- How do we fix?
- Increase sagittal depth
  - Steepen Reverse Curve
  - Steepen Alignment Curve

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Frowny Face

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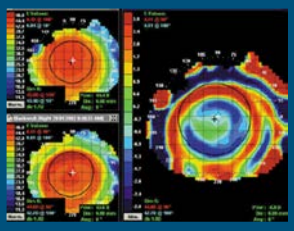
Frowny Face

- "Riding Low"
- Inferior decentration



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Frowny Face

- What causes this?
- Too much sagittal depth

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Frowny Face

- How do we fix it?
- Decrease sagittal depth
  - Flatten Reverse Curve
  - Flatten Alignment Curve
  - Increase OAD (Overall Diameter)

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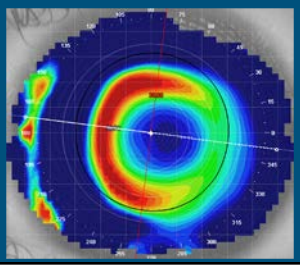
Lateral Decentration



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Lateral Decentration

- Can be toughest to deal with
- Can be due to too much sagittal depth
- Can be due to too little sagittal depth
- Can be due to improper OAD selection

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Lateral Decentration

- Increase OAD
- Look at slit lamp
  - Too Flat → Steepen Alignment Curves
    - May see SPK if too flat
  - Too Steep → Flatten Alignment Curves

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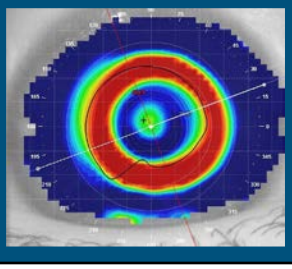
Central Island



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Central Island

- What causes this
  - Too much sagittal depth

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Central Island

- How do we fix it?
- Reduced sagittal depth
  - Similar to Frowny face
- Flatten Reverse Curve

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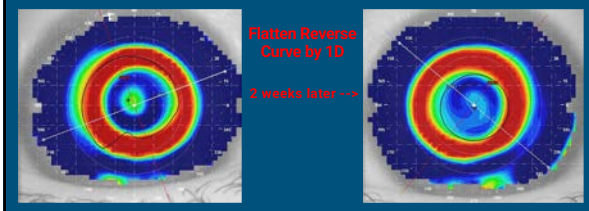
Central Island



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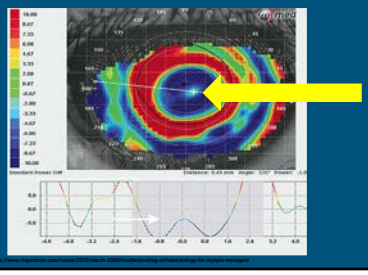
False Central Island



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False Central Island

- What causes this?
- Similar appearance to Central Island
- Caused by mechanical compression/rubbing
- Central SPK
  - Topography misinterprets epithelial disruption as steepening

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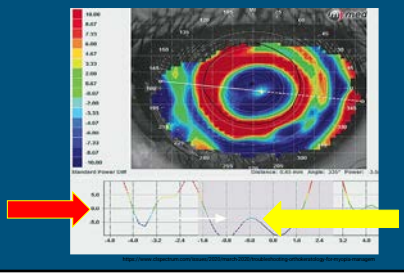
False Central Island



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False Central Island

- How do we fix it?
- Increase sagittal depth
  - Similar to Smiley Face
- Steepen Reverse Curve

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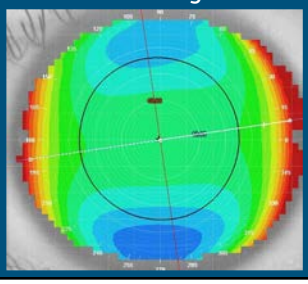
Toric Designs



79

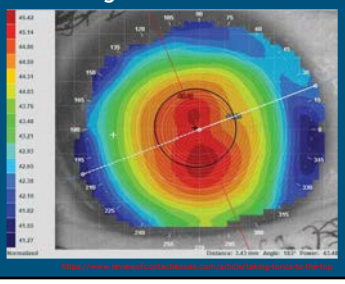
Toric Designs

- Apical Astigmatism
- Limbus to Limbus

80

Toric Designs

- Apical Astigmatism



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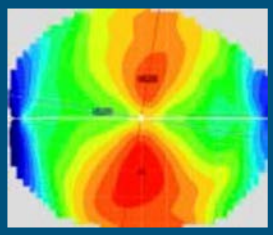
Toric Designs

- Limbus to Limbus Astigmatism



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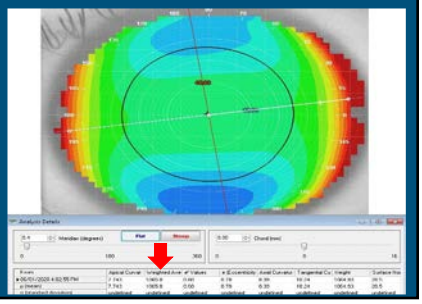
Toric Designs

- **Elevation Maps**

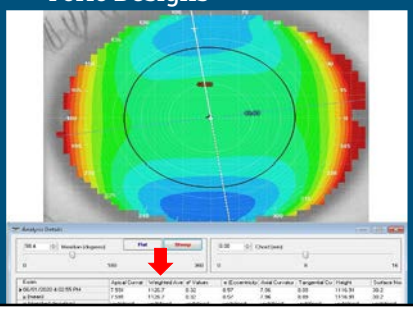


Flat:1065.8

83

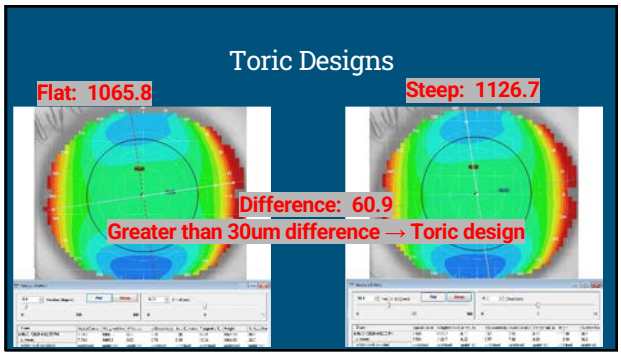
Toric Designs

- **Elevation Maps**



Steep: 1126.7

84


Toric Designs
Flat: 1065.8
Steep: 1126.7
Difference: 60.9
Greater than 30um difference → Toric design

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Resources
GPLI - GP Lens Institute
https://www.gpli.info/
AAOMC - American Academy of Orthokeratology and Myopia Control
https://aaomc.site-ym.com/
AAOMC

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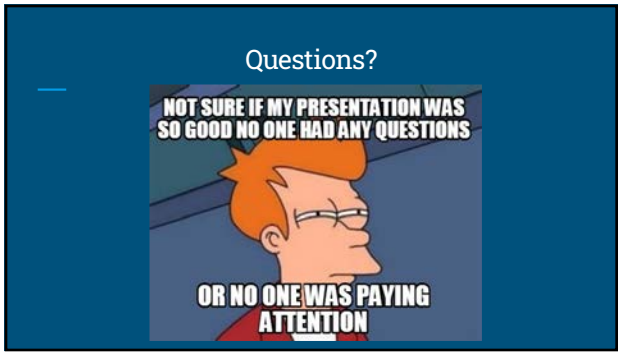
Questions?
NOT SURE IF MY PRESENTATION WAS SO GOOD NO ONE HAD ANY QUESTIONS
OR NO ONE WAS PAYING ATTENTION

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