

Advanced Optics of Scleral Lenses: Beyond 20/20

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Course Length: 1 Hours

Abstract:

You spend weeks on achieving the perfect scleral lens fit. The patient reads 20/20, you ask, "How's the vision?" expecting the patient to be elated, only to have the patient say, "The vision is still blurry." How can that be?? How can you improve the quality of vision for scleral lens-wearing patients? This course will teach you everything you need to know about wavefront aberrometry, wavefront-guided scleral lenses, and how this technology is used to improve the vision of patients wearing scleral lenses.

Learning Objectives:

1. Understand higher-order aberrations (HOA)
2. Learn how HOA affects vision in scleral lenses
3. Learn what is true and not true regarding HOA
4. Learn misconceptions of HOA and scleral lenses

Outline:

1. Scleral lens use (1 min)
 - a. SCOPE Study: 74% used for irregular cornea
2. Irregular cornea diseases affecting visual quality (2 mins)
 - a. Keratoconus (number 1 indication for scleral lenses)
 - b. Pellucid marginal degeneration
 - c. Iatrogenic ectasia
 - d. Post keratoplasty
 - e. Cornea scars
3. Evaluation of visual quality (12 mins)
 - a. Concept of visual quantity vs visual quality
 - i. Aberration vs scatter
 - b. Scatter
 - i. Remove opacity to clear media
 1. Cornea scar
 2. Cataract
 3. Fluid reservoir fogging
 - c. Diagnostics
 - i. Optical scatter
 1. How it works: spot quality
 - ii. Desitometry

1. How it works: media clarity
 - d. Aberrations
 - i. Aberration = optical
 1. Improve focus
 - ii. Low order aberrations
 1. Piston, tilt, defocus, astigmatism
 - iii. High order aberrations
 1. Coma, trefoil, spherical aberration
 - iv. Dependant factors
 1. Applegate et al
 - a. Pupil size
 - b. Age
 - e. Diagnostics
 - i. Auto refraction
 1. Low order aberrations only
 - ii. Wavefront aberrometry
 1. All aberrations
 - a. How it works: spot diagram, spacing and defocus
 - b. Optical simulations
 - i. Model eye
 - ii. Normal eye
 - iii. Keratoconus
 - iv. Glasses over keratoconus
 - v. Scleral lens over keratoconus
 2. Not specific to any part of the eye
 - a. Measurement of the fully optical system of the eye
 - f. Does topography = aberrometry?
 - i. NO
 1. Topography can be used to matically calculate aberrations of the cornea based on its shape but this is not true optical aberration
 - ii. If topography is added to aberrometry the source of aberrations can be located
 1. Topography + aberrometry = cornea surface can be isolated
 2. Tomography + aberrometry = total cornea can be isolated
 3. Extended depth tomography + aberrometry = total cornea and total lens can be isolated
4. Scleral lens optics (35 mins)
 - a. Traditional optics
 - i. Sphere
 - ii. Cylinder
 - b. Poor visual quality with scleral lenses?
 - i. Lens decentration
 - ii. Posterior corneal contribution
 - c. Advanced optics

- i. Aspheric optics
 - 1. Spherical aberration only
 - a. Not customized
 - i. Optimized
 - ii. Wavefront guided optics
 - 1. Correct higher order aberation
 - a. All aberrations
 - i. Fully customized to the individual
 - 2. How do they work?
 - a. Destructive interference
 - i. Similar concept to noise cancelling headphone but with light instead of sound
 - 3. Process
 - a. Capture aberration profile
 - i. Wavefront aberrometry over scleral lens
 - b. Mirror aberration profile
 - i. Destructive interference
 - c. Manufacturer mirrored profile onto the scleral lens
 - i. Aberrations cancel out = improved visual quality
 - 4. Literature review
 - a. 44 to 64% improvement in HORMS
 - i. 1-2 line VA improvement
 - b. Marsack et al
 - c. Johns et al
 - d. Magnete patent
 - e. Gelles et al
 - i. Case study
 - ii. Retrospecitve
 - iii. Prospective
 - iv. Neural adaption
- d. Presbyopia correction
 - i. Over spectacles
 - ii. Blended vision (monovision)
 - 1. Neural adaption
 - iii. Multifocal
 - 1. Induce aberration for increased depth of focus
 - a. Optics placed in the center
 - b. Lens must be centered
 - i. Lens centered = spherical aberration = good outcomes
 - ii. Lens decentration = induced coma = poor outcomes
 - 2. Decentered multifocal optics
 - a. Optics moved on the lens to align with line of sight

3. Wavefront guided
 - a. Custom placement, pupil size optimization
4. Shortcomings
 - a. Static solutions to dynamic problems
 - i. Aberration induction not the same as accommodation