Advanced Optics on Scleral Lenses
Category: CL
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Abstract:
Scleral lens patient: “It’s still so blurry. Can’t you make it any better?”
Sound familiar? This lecture will teach you why this happens, what technology evaluates visual quality, and how advanced scleral lens optics can improve the quality of vision for your patients.

Course Objectives:
1. Review corneal diseases that affect the optics of the eye
2. Teach about standard scleral lens optics and their short comings
3. Teach why scleral lenses correct some but not all aberrations
4. Review diagnostics relevant to evaluating visual quality with scleral lenses
5. Teach how to use this data to select optics
6. Discuss advanced scleral lens optics and their outcomes

Course 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 indiciation 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. Short comings

            a. Static solutions to dynamic problems
                i. Aberration induction not the same as accommodation
    iv. Future
        1. Accomodating optics
            a. Liquid crystal optic with proximity detection