CE25 - Using Technology to Maintain Ocular Health in Scleral Lens Wear
10:05am - 12:00pm - January 20, 2024
Gloria Chiu, OD (Moderator) | Jan Bergmanson, OD, PhD, DSc | Greg DeNaeyer, OD, FAAO, FSLS | Mile Brujic, OD, FAAO

Outline for Session (4 speakers)

This session will explore the impact of solutions and materials on ocular health, fitting outcomes with profilometry and ocular health management with AS-OCT, effects of lens wear on ocular structures, and impact of ocular surface disease on technology utilization.

Greg DeNaeyer

- Scleral Lens Solutions
    - Availability
        - 0.9% Sodium Chloride
            - Addipak
            - FDA
                - Non-buffered
                - Lacripure (ampules)
                - VibrantVue (amplules)
                - Buffered (benefits)
                - ScleralFil (ampules)
                - PuriLens Plus (2 and 4 ounce bottles)
        - Physiologic solution Nutrifill
            - Purpose/philosophy
            - Benefits
                - Physiology
                - Midday fogging
        - Artificial Tears
            - Benefits
                - Viscosity
                - Midday fogging
            - Disadvantages
        - Autologous tears (advantages/disadvantages)
    - Future products
        - Physiological
        - Dk?
- Dk of material
    - Polymers
        - Modern
            - Silicone addition
            - Hyper Dk
        - Transmissibility and corneal physiology
            - Theoretical
            - Clinical
            - Rate limiting
        - The “arms race” for increased Dk

        - Unnecessary
        - At the cost of other material advancement (i.e. wetting)
- Piggybacking
    - Traditional- soft lens under scleral lens
        - Limbal cushion
        - Midday fogging
    - Soft lens over scleral
        - Power
        - Improving lens wetting
    - Hazards
        - Cost/Inconvenience
        - Transmissibility
        - Infection
- Profilometry
    - Types
        - Scheimpflug
        - Reflectance
    - Practitioner adaptation/incorporation
    - Utilization
        - Measurement profile is used for diagnostic fitting
        - Measurement profile is used to customize a branded design
        - Measurement profile is used to create free-form
    - Customization
        - Pingueculas
        - Conjunctival blebs
        - Back/Front surface toricity
        -

Jan Bergmanson

- IOP pathways with scleral lens wear
- How to measure IOP/technology used
- Health concerns
- New studies and any evidence of glaucomatous concerns

- Hypothesis: wearing a scleral gas permeable contact lens (SL) may elevate the intraocular pressure (IOP) (McMonnies, 2016).
    - If true, SL device would potentially be contraindicated
        - hypothesis for a potential side effect from SL wear has been fielded previously (Pearson, 2016).
        - anatomical structures, neurology and physiological processes dictating the IOP forms an intricate system controlling IOP.
        - presentation will analyze the effect a SL may have on the complex system determining IOP.
- Review: aqueous carrying vasculature (Johnson, 2009; Bergmanson, 2023) that an SL may compress to impede aqueous outflow and thereby elevating the IOP

    - aqueous may escape from the eye via routes not completely facilitated by canals and vessels (Costagliola et al, 2019).
- The nervous system has the potential to influence the IOP through efferent and afferent pathways (Bergmanson, 1982).
- SL studies typically are conducted on young subjects, who had not been prescribed SLs.
    - validity of IOP measurements while wearing SLs or immediately after lens removal will be discussed.
    - Can tonometers accurately record IOP when applied to the conjunctiva over the sclera, the eyelid (upper and lower) and the peripheral cornea?
        - These anatomical structures have fundamentally different morphologies, which will have an effect on the recorded IOP.
- Although at this time we do not have good, scientific data to base an opinion on whether the SL elevates IOP or not, we appear to have a diffuse aqueous drainage system that, perhaps aided by the nervous system, can accommodate an impediment along the most anterior outflow pathway

References

McMonnies CW. A hypothesis that scleral contact lenses could elevate intraocular pressure. Clin Exp Optom, 2016, 99, 594-596

Pearson RM. Letter to the Editor. Clin Exp Optom, 99, 2016,

Bergmanson JPG. Clinical Ocular Anatomy and Physiology, Edition 30, Texas Eye Research and Technology Center, University of Houston College of Optometry, Houston, Texas, 2023, ISBN # 978-1-7923-5733-6

Johnson MA. Aqueous humor outflow system overview. In Becker-Shaffer's Diagnosis and Therapy of the Glaucomas. Eds Stamper, Lieberman, Drake. Mosby, St Louis, 25-46

Costagliola C, dell'Omo R, Barollino S, Fea AM, et al. How many aqueous humor outflow pathways are there? Surv Ophthalmol, 2020, 65(2), 144-170

Bergmanson JPG. Neural control of intraocular pressure. Am J Optom, 1982, 58(1), 94-98

Mile Brujic

Anterior Segment Optical Coherence Tomography (OCT)

1) Intention for specialty lenses and scleral lenses
    a. Correct for corneal irregularities through a consistent surface
        i. Keratoconus and other ectasias
        ii. Corneal injuries, post infection scars
        iii. Irregular surfaces (epithelial membrane dystrophy, etc)
        iv. Persistent epithelial erosions
        v. High ametropia including astigmatism
    b. At times to optimize ocular surface health
        i. Persistent epithelial defects

2) Anterior segment OCT advances
    a. Anterior segment measurements
        i. Identifying the limbal region
        ii. Keratoconus risk score
        iii. Sagittal depth measurements
    b. Epithelial thickness map (ETM)
        i. Normal range is 50-59um
        ii. ETM change with various ocular conditions
            1. Dry eye, EBMD, refractive surgery, keratoconus, orthokeratology
3) Utilizing OCT to maintaining ocular health
    a. Understand the fitting characteristics
        i. Limbal region
            1. Discuss transition from corneal to conjunctival epithelium
            2. Understand the anatomical change
            3. Understand the importance of the region
        ii. Assure clearance with fit
            1. Traditionally was not accounted for
            2. Excessive pressure is to be avoided
            3. Two reverse curves on contemporary designs allow for more assurance of clearance of limbal region
    b. Understand monitoring the health of the cornea
        i. Measuring total corneal thickness
            1. Scleral lenses and fluid have a resistance to oxygen permeability
            2. Minimum clearance should be fitting goal
            3. Measuring corneal thickness pre and post wear is critical
            4. Case reports
        ii. Measuring epithelial thickness
            1. Epithelial thickness should be maintained without change during scleral lens wear
            2. Scleral lens filling solutions should be considered that minimize epithelial swelling
            3. Case reports
    c. Understanding how to monitor progression of corneal conditions
        i. Important to continue to monitor conditions that are being treated with scleral lenses
        ii. Total corneal thickness
        iii. Thinnest portion of cornea

- Epithelial

Gloria Chiu

- Scleral lens wear must consider ocular shape AND ocular surface condition
    - Techniques to optimize shape and fit for eye:
        - Profilometry (as shared by Greg)
        - Topography/tomography
        - Anterior segment OCT (as shared by Mile)
    - However, the eye is not a static structure
        - Must consider soft tissue

                - Settling over time
            - Tear film composition
            - Lid position and blink range
                - The perfect fit will not matter if not supported by ocular surface
    - May need adjunct therapies to optimize scleral lens results
        - Topical antibiotics
        - Topical steroids
        - Immunomodulators
        - Dry eye medications
        - Lid hygiene
        - Surface rinsing
        - Tx for MGD
    - Consideration for best materials and solutions for different patients with OSD
        - Materials and Dk
        - Impact of Dk on wetting and comfort
        - Thickness for handling
        - Design for best oxygen permeability
        - Best filling solutions
    - Consideration for advanced techniques to optimize daily wear
        - Scleral lens channels
        - Scleral lens fenestrations
        - Scleral lens micro-vaults and cut out notches
- Review of various systemic diseases that impact ocular surface
    - Sjogrens Syndrome
        - Pathophysiology and impact on ocular surface
        - Tips for scleral lens wear in these patients
    - Graft versus Host Disease
        - Pathophysiology and impact on ocular surface
        - Tips for scleral lens wear in these patients
    - Stevens-Johnson Syndrome
        - Pathophysiology and impact on ocular surface
        - Tips for scleral lens wear in these patients
- Must understand impact of scleral lens wear on structures within eye
    - Drainage system, trabecular meshwork
        - Impact on IOP/glaucoma? (shared by Jan)
    - Impact on optic nerve itself
        - IOP and Optic Nerve Head Morphology during Scleral Lens Wear. Walker MK, Pardon LP, Redfern R, Patel N.Optom Vis Sci. 2020 Sep;97(9):661-668. PMID: 32932395
        - Anatomical and physiological considerations in scleral lens wear: Intraocular pressure. Schornack MM, Vincent SJ, Walker MK. Cont Lens Anterior Eye. 2023 Feb;46(1):101535. Epub 2021 Nov 22. PMID: 34824016
        - Assessment by Optical Coherence Tomography of Short-Term Changes in IOP-Related Structures Caused by Wearing Scleral Lenses. Queiruga-Piñeiro J, Barros A, Lozano-Sanroma J, Fernández-Vega Cueto A, Rodríguez-Uña I, Merayo-LLoves J.J Clin Med. 2023 Jul 20;12(14):4792. PMID: 37510907

- Clinical pearls for scleral lens success utilizing technology for daily wear and insertion/removal

    - Tools available for application, removal, handling
    - Improved cleaners
    - Coatings to enhance wetting
        - Solution to maintain coatings
    - Cleaners and soaking solutions to enhance storage and conditioning
- In summary, cannot ensure the best scleral lens fit and design with technology alone
    - Must understand the ocular surface
    - Must treat each patient individually
    - AI cannot compete with our collective experience and predict ocular responses in sick eyes (yet)
    - Must use technology to monitor ocular changes over time