The Art & Science of Scleral Lens Fitting
CE04

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Course description

- Scleral lens fitting has become very popular, although differences between different parts of the world exists. This session covers the latest research from an evidence-based perspective, to see what is says about scleral lenses: its efficacy and safety (the science). It furthermore covers basic scleral lens fitting considerations.

Course Objectives

- To understand what the latest research says about scleral lenses: its efficacy and safety (the science)
- To understand the basic fitting considerations for scleral lenses (the art)
- How to apply scleral lenses in specialty contact lens practice

Course outline

Introduction

The last decade or so has shown a surge in scleral lens publications and in the wake of that, scleral lens fitting has become very popular within the specialty lens arena. All major journals in the field covered a 'special edition' on scleral lenes in the past year. It may not be a surprise that several studies show that scleral lenses have an impact on the (lower) rate of corneal transplantation: clinical evidence reveals that patients' access to scleral lenses reduces the risk of having to undergo a keratoplasty for patients with keratoconus for instance. Scleral lenses can delay and/or prevent corneal surgery in keratoconus patients, with huge economic and lifestyle benefits.

So, while scleral lens fitting has become almost mainstream in many specialty lens clinics, a few questions remain. What is the latest about sclerals: what do we know from a research perspective? And how can we do even better with scleral lenses in practice? Both aspects will be highlighted and are the two main pillars of this session.

This session is divided into two main sections:

1. RESEARCH UPDATE
2. CLINICAL PRACTICE

RESEARCH UPDATE

This session is to better:

1. Understand the benefits of scleral lenses
2. Understand the limitations scleral lenses
3. To understand physiological processes involved in scleral lens wear
4. To fully be updated on the latest developments in the research field

MAIN TOPICS:

- Understanding variation in fluid reservoir thickness and its consequences
- To understand corneal physiological changes underneath a scleral lens
- Understand oxygen demands and delivery during scleral lens wear
- Understand 'mid-day fogging', its potential cause – and its management options
- What is the potential role of the fluid reservoir in inflammation and infection?

1. UNDERSTANDING FLUID RESERVOIR THICKNESSES AND THEIR CONSEQUENCES

- When trying to stay clear of the cornea - what is the suggested space behind the lens?
- The optimal initial central post-lens fluid reservoir thickness is one that does not adversely affect corneal physiology or optical performance throughout long-term lens wear.
- That is, the lens has sufficient clearance that the posterior lens surface does not bear on the corneal epithelium toward the end of the day or in the long-term but not an excessive amount that results in lens tilt or decentration.
- The recommended target central fluid reservoir thickness varies among lens manufacturers, ranging from approximately 300–500µm immediately after application to 100–300µm after settling.
- For modern sealed scleral lens designs, the central fluid reservoir decreases by ~100-200µm over 8h as the lens settles into the conjunctiva.
- The reduction in central vault follows an exponential decay, with ~50% of the total settling observed after 30 min of lens wear, which stabilizes after ~2−4h.
- The magnitude and time course of lens settling does not vary with the fluid used to fill the scleral bowl (e.g., preservative-free saline or a viscous gel). Similarly, the posterior lens surface must vault the limbus during lens wear to avoid mechanical insult.

- Limbal settling of ~50-120µm (70–84%) has been reported after 3h of lens wear for a range of initial central and limbal reservoir thickness values, which resulted in a settled limbal vault of 10−50µm in the end.
- Limbal settling was found to be similar for lenses fitted with low (~160µm) or high (~200µm) initial limbal vault after 2h of wear (both ~34µm or a 20% reduction on average in absolute terms), and greater comfort was reported for lenses fitted with greater limbal vault.

2) UNDERSTAND OXYGEN DEMANDS, AND DELIVERY DURING SCLERAL LENS WEAR

- One of the biggest challenges and subjects for debate since the early days of scleral lens fitting has been 'oxygen'.
- It seems that the evidence is settling on that topic.
- In essence: the ideal lens material will have a high Dk and a low wetting angle to optimize wettability and oxygenation to the cornea.
- New insights show that increasing the Dk of a sealed scleral lens beyond 100 has minimal effect on edema in young healthy eyes, although it may improve comfort.
- Scleral lens materials range in Dk value from approximately 88–180, with center thickness from 250µm to greater than 500µm.
- Total oxygen delivery through the lens system is dependent on the balance between lens thickness, Dk and fluid reservoir thickness behind the lens.
- Regarding the lens thickness, it should be noted that the actual center thickness of a scleral lens can vary by ±100µm from the ordered thickness and still be within the manufacturing tolerance.
- Highly oxygen-permeable rigid materials provide increased oxygen transmission and result in less bacterial adhesion to the corneal epithelium following overnight lens wear, but higher-Dk materials are less scratch resistant and therefore may require more frequent replacement.
- Small variations in optical quality with high- versus low-Dk materials have been measured in-vitro, although the magnitude of these variations in higher-order aberrations would have minimal impact on visual performance compared to other factors during lens wear such as lens centration or wettability.
- Studies have shown that corneal edema is primarily stromal in nature, and on average modern scleral lenses induce ~2% (0.7-2.1% according to Fisher et al) corneal edema in healthy or keratoconic eyes and approximately double in post-graft corneas.

3) UNDERSTANDING 'MID-DAY FOGGING'
- **ITS CONTENT, ITS POTENTIAL CAUSE – AND ITS MANAGEMENT OPTIONS**

- Fluid reservoir debris (midday fogging) is commonly encountered in 26–46% of patients.
- The exact etiology and composition of this particulate matter is unknown, but it has been linked to the accumulation of leukocytes, lipids and external tear film debris.
- Midday fogging must be diagnosed through biomicroscopy, OCT, or Scheimpflug imaging rather than through symptoms alone, since corneal edema or a non-wetting anterior lens surface can also cause visual symptoms.
- The condition is currently managed by lens removal and reapplication, fitting modifications (improving landing zone alignment or reducing reservoir thickness – as only 5% of eyes seem to have a spherical landing zone),

using a more viscous application fluid and treating underlying ocular surface disease including allergies and dry eye disease.

- Filling solutions that closely mimic the composition of the natural tears can result in improvements in comfort and subjective visual quality, but no significant change in visual acuity or particulate matter in the post-lens fluid reservoir has been found.

4) WHAT IS THE POTENTIAL ROLE OF THE POST-LENS FLUID IN INFLAMMATION AND INFECTION AND OTHER HEALTH ISSUES?

- A small number of case series suggest that microbial keratitis (MK) does occur with scleral lens wear.
- But the overall MK frequency may be low due to the relatively small but growing population of scleral lens wearers.
- The most significant risk factors for MK may be poor hygiene, overnight lens wear, and exposure to tap water.
- The true change in IOP during scleral lens wear and especially its clinical significance still requires further investigation. The best way to measure intra-ocular pressure during scleral lens wear is probably using something like optic nerve head morphology.

CLINICAL PRACTICE

- **4 basic fitting steps**
    - Choose a diagnostic lens
        - Design
            - Oblate – post refractive surgery, post-graft
            - Prolate – normal cornea, KCN, ectasia
        - Diameter
            - Measure HVID – discuss different methods
            - Use manufacturer's recommendations for appropriate lens based on HVID
    - Assess the fit
        - Instill fluorescein in the bowl before insertion
        - Evaluate with wide diffuse beam with **blue light**
        - Evaluate with optic section - **white light**
        - At insertion estimate lens thickness to tear thickness ratio
        - *Important to know the trial lens center thickness*
        - Re-evaluate after 30 minutes
        - Assess central clearance

            - Varying opinions for ideal amount
            - Most agree 100-250 microns
        - Assess limbal clearance
            - Ideal 50-100 microns
        - Assess landing zone
            - No blanching, impingement or edge lift
    - Add in power
        - Recommend adding in spherical over-refraction first then cylindrical over-refraction later
    - Order final lens
        - Combine any fit changes and power
        - Speak to consultant for reassurance if needed
- **Troubleshooting Tips**
    - Poor surface wetting
        - Don't skip physical rubbing step
        - Hydrogen peroxide based solution
            - *If larger lens (>16.5mm) recommend PROSE disinfection case*
        - Protein removers
        - Plasma treatment
        - HydraPeg
    - Fogging/Debris
        - Assess and treat any ocular surface disease
        - Very common especially in patients with atopic disease, ocular surface disease, and post-surgical eyes
        - Modify peripheral curves or reduce lens diameter
        - Flatten curves to minimize impact on the conjunctiva
        - Modify curves to reduce limbal clearance
        - Mix of viscous artificial tears and saline in the bowl
        - Saline flush: Ask the patient to replenish solution from the side, without removing the lens
        - Remove lenses and replenish with fresh saline mid-day
    - Conjunctival vessel blanching
        - Caused by local pressure on the conjunctiva

    - *Presence of pinguecula/peripheral obstruction*
    - *Irregular scleral shape (sectoral)*
    - *Poor-fitting landing zone (meridional, quadrant, or 360)*
    - If long-term, can cause staining and conjunctival hypertrophy.
    - Flatten the PC either 360, meridionally or quadrant specific
- Edge Lift
    - Patient will reports awareness/discomfort
    - Recommend steepening/tightening peripheral curve(s)-may need toric haptics or quadrant specific design
- Limbal compression
    - Blanching near the limbus
    - Lands too quickly
    - Will likely also see staining after lens removal
    - Known as the "heel effect"
    - *Modify the limbal curves*
    - *Steepen the base curve*
    - *Increase OAD of the lens*
- Mid-peripheral bearing
    - High vault over the central cornea
    - Lower vault / bearing over the mid-periphery
    - Often seen on an oblate cornea fit with prolate design
    - Evaluate lens centration
    - Modify mid-peripheral curves
    - Consider the use of a reverse geometry or oblate design
    - Increase the size of the lens (if possible)
- Peripheral obstructions
    - Flatten peripheral curves
    - Notch
    - Micro-vault
    - Reduce the diameter
    - Profilometry or molded design

Q&A – DISCUSSION – CLOSING REMARKS