Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Scleral lenses

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Barnett M, Courey C, Fadel D, et al. CLEAR – Scleral lenses. Cont Lens Anterior Eye 2021;44:270-88

The CLEAR Scleral Lens paper covers the history and evolution of scleral lenses from initial manufacture in glass, on to PMMA and then to modern gas permeable materials that overcome the oxygen limitations of the previous materials.[1] Modern scleral lens designs are divided into three distinct zones consisting of the optic; transition; and landing zones, each of which, in response to continual advances in manufacturing technology, can now be constructed in innumerable ways. Complimenting advances in the manufacture of lenses, advances in ocular imaging using optical coherence tomography (OCT) and specular microscopy, have considerably improved the understanding of ocular shape and response to lens wear.

The scleral lens report details how ocular shape differs across populations, and that in most eyes the scleral elevation profile is not spherical. Ability to now manufacturer complex scleral lens shapes that more closely conform with measured scleral surface topography has been shown to reduce lens decentration and flexure, post-lens debris and air-bubbles, conjunctival prolapse, localised vessel blanching and lens impingement. However, diurnal changes to ocular physiology as well as accommodation induced changes to ocular shape challenge the ability to achieve a perfect lens fit by introducing variability that a rigid lens design cannot overcome. Central lens thickness, typically 200-500µm, introduces a further consideration, balancing the needs of using a sufficiently thick lens to prevent warping and on-eye flexure, whilst ensuring adequate oxygen transmissibility is maintained.

Technology improvements are revealed in the report to have also influenced lens fitting, resulting in a shift away from using diagnostic lenses at initial fit towards the first lens on eye being designed empirically based on corneal topography measurement. Impression lens fitting retains a place in clinical practice, particularly for highly irregular corneas that can result in inaccurate topographic measurements, with better fitting resulting from scanning the impression mold instead. When it comes to assessing lens fit, the report summarises the latest research and clinical understanding on assessing optimal sagittal lens depth, back surface profile, fluid reservoir thickness, oxygen permeability, lens centration, movement and wettability.

Various challenges to successful scleral lens wear are outlined in the report:

- Optical performance from scleral lenses is typically similar to rigid corneal lenses but suffers potential for decentration that can induce prism and flexure leading to residual astigmatism.
- The literature on risk of microbial keratitis infection in scleral lens wear is sparce, but suggests risk to be low, possibly as a result of the relatively slow but growing population of scleral lens wearers.

- Lens induced oedema has been somewhat reduced in response to adopting high oxygen permeable materials and improvement in lens design capabilities to minimise lens and fluid reservoir thickness, but still remains an issue that needs to be managed.
- Fluid reservoir debris, known as midday fogging, remains a problem of unclear aetiology that is reported in 26-46% patients, with lens removal and reapplication, lens fit modification, instilling a more viscous application fluid, and treating underlying ocular surface disease, dry eye and allergy indicated as current management techniques.
- Compression forces induced by scleral lenses can cause conjunctival prolapse, which in some cases can make the lenses very difficult to remove, and hypothetically increase intra-ocular pressure (IOP). The conjecture around the influence of scleral lenses on IOP remains, in part due to difficulties in measuring IOP with lenses in-situ.
- Scleral lens handling and removal is reported to be more difficult than rigid corneal lenses and is the primary reason for scleral lens drop-out. Discontinuation of scleral lens wear being reported in a quarter of wearers.

The CLEAR scleral lens review concludes in identifying several avenues where collaboration in patient care can improve outcomes, particularly in penetrating keratoplasty. Also covered is the use of scleral lenses as a platform for wavefront guided vision correction, largely due to the stability that scleral lenses provide, and for smart devices including biometric readers, providing a simulated iris and augmented reality.

REFERENCES:

1. Barnett M, Courey C, Fadel D, *et al.* CLEAR – Scleral lenses. *Cont Lens Anterior Eye* 2021;44:270-88.