Optical Challenges When Fitting Scleral Lenses

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When fitting scleral lenses, optical issues may arise causing disruption in visual quality. This session describes five important optical challenges that may be encountered during scleral contact lens evaluations. Illustrations through case examples will be given to provide insights on how to troubleshoot and manage these optical challenges effectively.

1- Introduction
2- Optical challenges
    a. Retinal image size
        i. Thickness of the lens and post-lens fluid reservoir.
        ii. The difference in retinal image magnitude (shape factor) between the two eyes:
            1. Difficulty in fusion
            2. Non-comfortable binocular vision in monocular patients wearers.
            3. To minimize interocular imbalance in retinal images in patients wearing the scleral lens in only one eye, the lens thickness and clearance should be as minimum as possible.
        iii. Anisometropia
            1. the retinal image size may not be equal. This is associated to three factors,
                a. Lens thickness
                b. Post-lens fluid reservoir thickness
                c. Significant difference of the mean corneal curvature between two eyes:
                    i. A different back optic zone radius (BOZR) is necessary.
                d. Among these factors, lens thickness has the greater influence in the interocular difference in image magnification, followed respectively by the post-lens fluid layer and ultimately the BOZR.
                e. This means, that in cases with significant anisometropia, to minimize the shape factor between eyes, it is recommended to fit both lenses with same thickness and clearance and eventually alter the BOZR to optimize lens alignment.
    b. Residual Astigmatism
        i. Lens Decentration
            1. Scleral lenses generally decenter inferiorly due to gravitational and eyelid forces, and temporally due to the flatter and elevated nasal area compared to the temporal area.
            2. Lens decentration induces residual astigmatism, HOAs' (horizontal or vertical coma), and prismatic effect.

3. To reduce lens decentration, it is suggested to reduce lens thickness, or total lens diameter. These changes will consequently reduce lens mass.
4. Other modifications include customization of lens periphery for a better alignment; decentering lens optics
5. When decentration persist,
    a. Modify the BOZR to create a plano post-lens fluid layer
    b. In patients corrected unilaterally, fit the fellow eye with a scleral lens to create the same prismatic effect, which may eliminate or reduce the interocular difference
    c. Including a prism into the scleral lens or spectacles.
6. Decentration tip:
    a. Center the lens with a finger and verify clearance, lens alignment, and refraction

ii. Lens Flexure
1. May also cause lens suction
2. materials with greater Dk generally flex more than materials of low permeability
3. Thin lenses flex more than thick lenses.
4. The amount of lens flexure is associated to various other factors such as ocular surface shape (greater is the toricity, greater is the lens flexure), the fitting relationship between the back optic radius and the anterior corneal curvature (steeper fitting lead to more flexure), and the optic zone diameter (larger diameters cause more flexure).
5. Rigid lenses are assumed to flex to the meridian of the steepest curvature. Scleral lenses prescribed in the last years are made with high Dk materials and designed thin to promote corneal health and provide greater comfort
6. Investigate for a residual astigmatism with over-refraction.
7. Investigate for lens flexure by:
    a. performing keratometry or topography with a scleral lens on the eye to detect any warpage or the presence of toricity on the lens front surface.
    b. Radiuscope measurement to identify an atypical cylinder specific of lens warpage.
8. Management:
    a. Verify and optimize lens alignment
    b. Reduce lens diameter
    c. Increase lens thickness
    d. Add front surface toricity
    e. The lens should be rotationally stable on the eye

iii. Internal astigmatism
    a. Add front surface toricity
    b. The lens should be rotationally stable on the eye

c. Presbyopia and multifocal lenses
    i. Many lenses are available in either center and near distance design.

1. Lens geometry selection based on patients' needs and work

ii. It is important to work closely with the manufacturer to understand each lens design and optimize visual outcomes.

iii. When fitting scleral multifocal lenses, different factors need to be taken into consideration, such as:

1. visual demands over a range of working distances,
2. binocularity requirements,
3. the pupil size over a range of lighting conditions,
4. patient expectations

iv. if optical problems occur with multifocal lenses, decenter the lens optic zone to ameliorate visual acuity for distance and near

d. High Order Aberrations

i. Front surface or back surface asphericity is helpful

1. It changes the sign and magnitude of spherical aberration introduced during lens wear
2. Correcting spherical aberration may ameliorate visual outcomes.
3. Front surface asphericity may also improve visual acuity in residual astigmatism, although it does not correct the astigmatism itself, this may be due to the reduction in spherical aberration.
4. Visual outcomes with front surface asphericity of scleral lenses dependent on the unique HOA profile of each individual eye, so, the optimal front surface correction may vary between patients and probably between the fellow eyes of the same individual.
5. To correct other HOAs, such as coma, front surface wavefront guided scleral lens are needed. In this field several manufacturers are moving. The challenge here is the lens stabilization on the eye.

e. Binocular issues and prismatic scleral lenses.

i. Scleral lenses are capable of correcting up to 10 Δ, 5 Δ in each eye, either vertically and horizontally.

ii. Presentation of case reports

1. Thus, incorporating an optical prism in scleral lenses may be an optimal option in irregular and regular corneas with tropia.

iii. In some cases, the scleral lens may correct binocularity without the inclusion of any prism, since scleral lenses improve VA in patients with long-standing asymmetric corneal disease who may have developed binocular anomalies.

1. Therefore, it is crucial to verify the binocularity with standard scleral lenses before including a prism.

3- Conclusion