A Novel Method for Measuring and Constructing Displaced Multifocal Optics

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Introduction

One of the many modern advances in specialty contact lenses today is the ability to build displaced multifocal optics[1]. This complex construction allows for the optical axis of the lens to be centered over the patient's visual axis. However, how do we determine the distance and direction (vector) the multifocal optics must be moved to center over the line of sight? Previous work on this topic has suggested a corneal topographer can determine both the visual axis and position of the multifocal optics[2]. Researchers set out to build a novel, topography based, software tool to objectively measure the vector required for displaced multifocal optics construction.

Methods

A multifocal contact lens is placed on eye and corneal topography captures are taken over the lens (Figure 1). The tangential interpretation is selected to best observe the concentric zones of the lens. The scale may need to be adjusted to refine the view of the central distance, intermediate and near zones (Figure 2).

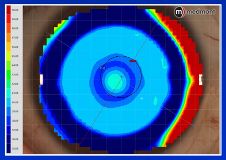

Figure 1: Corneal topography is performed over the multifocal contact lens on eye.

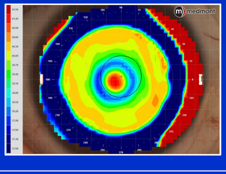

Figure 2: Select the tangential map and customize the scales to best observe the multifocal zones of the lens.

Methods (Continued)

A novel software tool is employed to define one or more zones of the multifocal lens. This circular reference attribute is placed by the user over the border between two colorized zones of the multifocal optics.

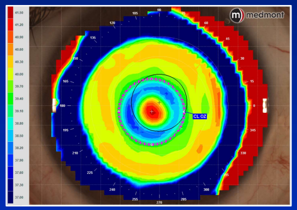

Figure 3: A concentric circle tool (purple) is used to define the outer border of the distance zone (blue). Note the displacement in relationship to the pupil margin (black circle).

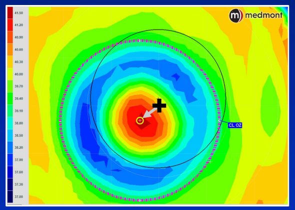

Figure 4: The software tool compares the position of the visual axis (black cross) to the center of the circular reference (yellow circle) and provides the distance and direction (below). In this case the optical center of the lens is 0.50mm towards 220° relative to the patient's visual axis.

CL Displacement	0.50 mm
CL Displacement Angle	220 °

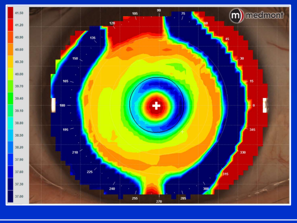

Figure 5: To position the displaced optics over the patient's visual axis, the optical center must be moved 0.50mm and 180 degrees in the opposite direction (220 – 180 = 40°). Figure 5 shows the custom ordered displaced multifocal optics lens with improved position over the pupil (black circle) and visual axis (white cross). In this case the lens was ordered with a displacement of 0.50mm towards 40°.

Discussion

This method makes it possible to assess both the visual axis and lens axis in order for displaced optics lenses to be calculated. However, there are numerous considerations related to this technique:

- Perform topography with a normal patient posture and relaxed lids to avoid influencing the lens position and the resultant measurements.
- The multifocality must be apparent on the anterior surface of the lens.
- The tool may only be effective on concentric multifocals lenses.
- The lens must be stabilized rotationally and remain on axis.

It is recommended that multiple topographies are taken over the lenses. Additionally, numerous measurements of the various zone positions should be taken and averaged to determine an accurate custom lens. Finally, this body of work has proposed a new method for analyzing and calculating displaced multifocal lenses, however, his project has not determined if the method will improve presbyopic fitting outcomes.

Conclusion

This tool provides an objective method of efficiently determining the vector required to properly position displaced multifocal lenses over the line of sight. Further study is needed to validate its accuracy and influence on patient outcomes in displaced multifocal optics lenses.

References

1 Zhang et al, Visual Effects of Centered and Decentered Multifocal Optics, Poster, Global Specialty Lens Symposium, Las Vegas, NV, January 21, 2016
2 Lampa et al, Assessing Soft Multifocal Contact Lens Centration with the Aid of Corneal Topography, Poster, Global Specialty Lens Symposium, Las Vegas, NV, January, 27, 2012