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SCIENTIFIC LETTER

On the power profiles of contact lenses measured with NIMO TR1504

Perfiles de potencia de las lentes de contacto medidas con NIMO TR1504

Manuel Rodríguez-Vallejo[a,*], **Diego Montagud**[c], **Juan A. Monsoriu**[b], **Walter D. Furlan**[c]

[a] *Qvision, Unidad de Oftalmología Vithas Hospital Virgen del Mar, 04120 Almería, Spain*
[b] *Centro de Tecnologías Físicas, Universitat Politècnica de València, 46022 Valencia, Spain*
[c] *Departamento de Óptica, Universitat de València, 46100 Burjassot, Spain*

In the last decade, new commercial devices have been proposed to assess the power profile of multifocal contact lenses (MCLs). These devices are based on different methods, including: Shack—Hartmann wavefront sensing,[1] ptychographic imaging,[2] and phase-shifting Schlieren technique.[3] In the scientific literature, most of the studies on MCLs were performed using the NIMO TR1504 instrument (Lambda-X, Nivelles, Belgium).[1–6] After reading some published results obtained with this instrument, and according to our experience with it, we found that there are some issues that need attention.

The NIMO software (version 4.2.6.0) allows obtaining valuable information about the MCL characteristics, as, for instance, the mean power of different radial zones of the MCLs up to five zones defined by the operator. A display of radial power profiles can also be readily obtained, as well as the average of the power in a circle as a function of the distance to the centre. The profile data can be exported as .CSV files for post-processing. We found that this option can furnish additional useful information of the lens allowing to avoid some common misinterpretations. For instance, the main drawback attributed to the Nimo is its lack of reliability in power measurements in the central *1 mm* lens diameter.[4] However, from a physical point of view, there is no reason that supports any failure of the instrument in the centre of the field. On the contrary, the method is capable to detect singular regions of the lens in which the phase has abrupt changes like those originated in the lens defects (often clearly visible in the wavefront map). Thus it is more likely that errors in the central power originated in the manufacturing process of MCLs which is often conducted with a precision lathe from the periphery to the centre of the lens, and it is very frequent that the end point of the lathe did not coincide with lens geometrical centre, producing a central tip. Thus the power profile measurements in the central zone of MCLs are affected by this type of defects which are highly variable. However, in many of the above mentioned works these defects were attributed to the NIMO. On the other hand, the software of the instrument provides the values for the near (N) and distance (D) powers of a MCL which are computed as the mean power values of different zones. However, these values are affected by the eventual asphericity of the lens, which is reflected in the parabolic variation of the N and D power profiles in each zone; and also, by the limits of the zones defined by the operator, which can include some transition values in which the power did not correspond to the labelled powers of the lens. Then, it is difficult to extract the effective powers in each zone from the measured profiles given directly by the instrument. Therefore, fully automated measurement procedure with the NIMO could be a limitation in some situations. To overcome these constraints, instead of using the instrument software, we have developed a custom software in Matlab to process the exported profile power data (Appendix A).

* Corresponding author: Qvision, Vithas Virgen del Mar Hospital Almería, Spain.
E-mail address: manuelrodriguezid@qvision.es (M. Rodríguez-Vallejo).

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To test our approach, some prototypes of MCLs with an aperiodic distribution of 7 zones were especially constructed.[7] No polishing was considered in the lens production to avoid smoothness of the abrupt discontinuities in power that suppose a greatest challenge to the measuring instrument. After measurement, the exported profile data was assessed using our Matlab script. The programme first defines the transition zones in the power function by finding the local extrema of the radial power function that differ in more than 0.25 D. These changes represent the maxima and minima at D and N zones respectively, whereas the location of the half values between each minimum and the consecutive maximum (or vice versa) was assumed as the transition radius between zones. Then, in each zone, a single representative power value is computed as the median of the power values in there; in fact, the median is more representative than the mean, because each zone still includes powers values near transition and the mean is particularly susceptible to the influence of outliers. Another parameter that can be obtained from a power profile is the lens spherical aberration. In fact, smooth and continuous variations in power in corresponding zones (N or D) could be fitted to a parabolic curve from which the fourth order spherical aberration can be computed (See Ref.2 Appendix A).

A custom-made algorithm for power zone recognition is useful to detect differences between labelled powers lenses either in zone diameters and powers; and to obtain information about the spherical aberration of the lens which is normally not available. This idea could be extended to other instruments which allow to export power profiles data.[8] Reliable depictions of power profiles of lenses, avoiding the limitations of the commercial software, provide to practitioners information that can be used to correlate design features with visual performance.

Conflict of interests

No conflicting relationship exists for any author.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.optom.2016.10.002.

References

1. Wagner S, Conrad F, Bakaraju RC, Fedtke C, Ehrmann K, Holden BA. Power profiles of single vision and multifocal soft contact lenses. *Cont Lens Anterior Eye*. 2014;38:2–14.
2. Plainis S, Atchison DA, Charman WN. Power profiles of multifocal contact lenses and their interpretation. *Optom Vis Sci*. 2013;90:1066–1077.
3. Joannes L, Hough T, Hutsebaut X, et al. The reproducibility of a new power mapping instrument based on the phase shifting Schlieren method for the measurement of spherical and toric contact lenses. *Cont Lens Anterior Eye*. 2010;33:3–8.
4. Kim E, Bakaraju RC, Ehrmann K. Reliability of power profiles measured on NIMO TR1504 (Lambda-X) and effects of lens decentration for single vision, bifocal and multifocal contact lenses. *J Optom*. 2015;9:126–136.
5. Domínguez-Vicent A, Marín-Franch I, Esteve-Taboada JJ, Madrid-Costa D, Montés-Micó R. Repeatability of in vitro power profile measurements for multifocal contact lenses. *Cont Lens Anterior Eye*. 2015;38:168–172.
6. Kim E, Bakaraju RC, Ehrmann K. Power profiles of commercial multifocal soft contact lenses. *Optom Vis Sci*. 2016. Post Author Corrections: September 29, 2016.
7. Rodríguez-Vallejo M, Benlloch J, Pons A, Monsoriu JA, Furlan WD. The effect of Fractal Contact Lenses on peripheral refraction in myopic model eyes. *Curr Eye Res*. 2014;39:1151–1160.
8. Furlan WD, Remón L, Llorens C, Rodríguez-Vallejo M, Monsoriu JA. Comparison of two different devices to assess intraocular lenses. *Optik (Stuttg)*. 2016;127:10108–10114.