Defocus Curve of Multifocal Intraocular Lenses Measured With a New Asymmetric Focus Double Pass System

Program Number
5743

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Purpose:

The aim of this work was to develop a new objective system to measure the Modulation Transfer Function (MTF) of multifocal intraocular lenses (MIOL's) that can be used in vitro and in vivo conditions. It is based in an asymmetric foci double pass system (DP) with independent first and second pass focus control.

Methods:

The developed system allows to control independently the focus correction for both first and second pass by means of two different Badal's systems **(Fig. 1).** Symmetric and asymmetric pupil configuration can be used. The employed wavelength was 780nm. The best far vision correction was obtained by changing simultaneously both Badal's systems. Far and near vision were measured by moving both Badals. DP images were recorded while increasing defocus from far vision, in steps of 0.25D, up to 4D. Measurements were performed in vitro using an artificial eye **(Fig. 2),** limited for diffraction **(Fig. 3),** in five different designs of MIOL's: A refractive (Amo NGX1), some diffractives (AcrySof ReSTOR SN60D3, TecnisTM *ZM900*) and the aspheric diffractives (AcrySof ReSTOR SN6AD3 and AcrySof ReSTOR SN6AD1). Exit pupil diameter was 4mm and entrance pupil diameters were 2mm and 4mm.

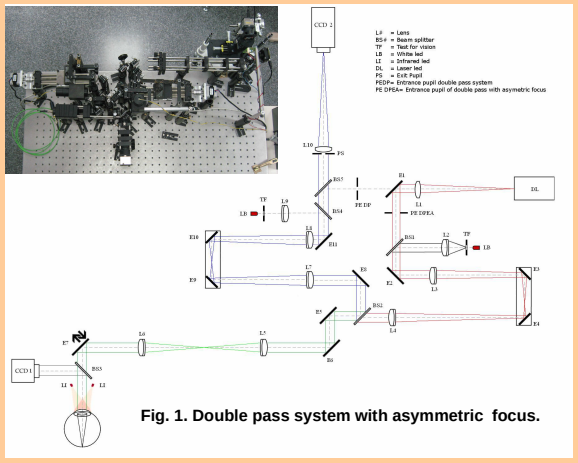


Fig. 1. Double pass system with asymmetric focus.

Results:

We measured the MTF of each multifocal intraocular lens using the double pass with asymmetric focus with 2mm **(Fig. 4)** and 4mm **(Fig. 5)** of diameter of entrance pupil and 4mm diameter of exit pupil for both cases. When both the first and second pass position were near focus, the MTFs (Fig. 4a, Fig 5a) were better than when the first pass position was in near focus and second pass position was in far focus (Fig. 4b, Fig 5b). Likewise, when the first and second pass position were in far focus, the MTFs (Fig. 4c, Fig 5c) were better than when the first pass position was in far focus and second pass position was in near focus (Fig. 4d, Fig 5d).
We measured the transversal intensity of the light of the multifocal intraocular lenses in simple pass configuration, the it is possible observe the different foci of the each multifocal intraocular lenses (**Fig 6**).

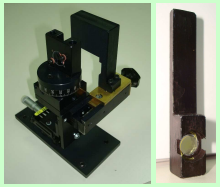


Fig 2. Artificial eye and lens holder .

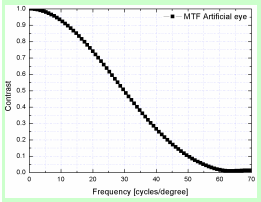


Fig 3. MTF Artificial eye.

Measurements of MTF in double pass with asymmetric focus of five MIOLs with entrance pupil size of 2mm and 4mm and exit pupil always of 4mm:

Entrance pupil diameter 2mm

Fig. 4a - First pass **near** focus - Second pass **near** focus

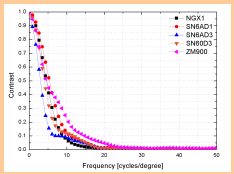


Fig. 4b - First pass **near** focus - Second pass **far** focus

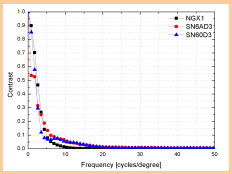


Fig. 4c - First pass **far** focus - Second pass **far** focus

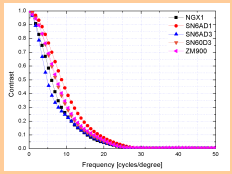
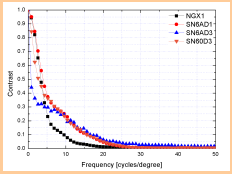


Fig. 4d - First pass **far** focus - Second pass **near** focus



Entrance pupil diameter 4mm

Fig. 5a - First pass **near** focus - Second pass **near** focus

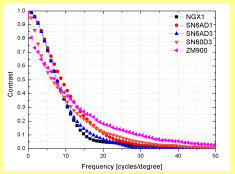


Fig. 5b - First pass **near** focus - Second pass **far** focus

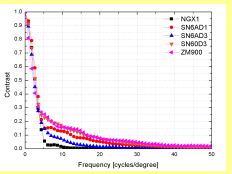


Fig. 5c - First pass **far** focus - Second pass **far** focus

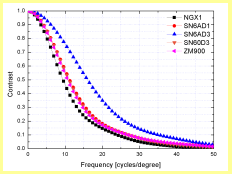
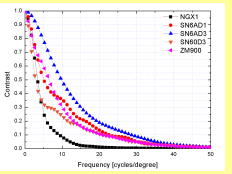


Fig. 5d - First pass **far** focus - Second pass **near** focus



Images obtained from the experimetal measurements in simple pass configuration:

Fig 6a - NGX1

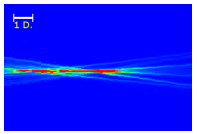


Fig 6b - SN60D3

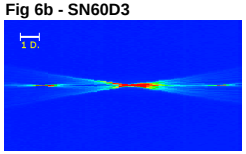


Fig 6c - ZM900

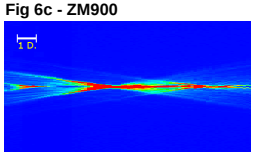


Fig 6d - SN6AD3

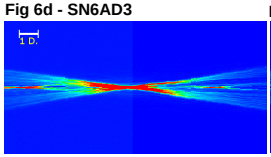
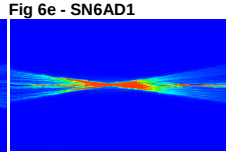


Fig 6e - SN6AD1



Conclusions:

A new robust and objective optical method to measure the MTF of MIOLs has been developed. It is based on the DP image evaluation along different foci of the MIOL and it has been applied for in vitro measurements of five different lens designs. We was observed different behavior among different focus. This method also could be applied in vivo for testing the optical behavior of intraocular lenses.

Bibliography

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M. Orchowsky and M. Simpson. Multifocal Intraocular lenses. Lentes intraoculares Bifocales, 2007.
H. Zuluaga, S.O. Luque, M. Vilaseca, M. Arjona, J. Pujol, A. de la Torre, T. Salvador. "Measurements of optical quality in multifocal intraocular lenses by means of a double pass system". 4th European Meeting in Visual & Physiological Optics, Creta-Grecia. (2008)

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