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Assessing the optical quality of commercially available intraocular lenses by means of modulation transfer function and straylight

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Abstract

Purpose : In vitro evaluation of intraocular lenses (IOLs) is used for evaluation of optical quality. Diffractive IOLs, designed to concentrate light at different vergences, can generate visual artifacts due to diffractive effects. This work aimed at evaluating the optical performance of five commercially available diffractive multifocal IOLs compared to one monofocal. The through focus modulation transfer function (MTF) at 50 cycles per mm (c/mm) and the straylight (expressed by the straylight parameter, s) were used to assess optical quality.

Methods : The multifocal IOLs studied were the AT LISA 809M (Zeiss), the AT LISA 839MP (Zeiss), the FineVision Micro F (PhysIOL), the Technis Symphony (Abbott) and the Acrysof Restor +3 D (Alcon). The monofocal IOL was the Acrysof IQ (Alcon). All IOLs were fresh, free of glistenings or other defects. Through focus MTF from +1 D to -5 D vergence, at two pupil diameters (3mm and 4.5 mm), was obtained with the PMTF instrument (Lambda-X). Straylight of the IOLs was recorded using the C-Quant device (Oculus) with modification proposed by Labuz et al., (Biomed Opt Express, 2015) that allows for in vitro IOL straylight assessment.

Results : For the 0 D vergence Acrysof IQ yielded the highest MTF value (0.78 at 3mm) comparing to the multifocal IOLs (0.37 to 0.51 at 0 D vergence at 3 mm). The through focus MTF of the IOLs decreased for 4.5 mm pupil size. The highest decay was found for the Acrysof IQ (26% at 0 D vergence). According to their addition powers, multifocal IOLs showed one or two extra peaks located at different vergences (from -1.5 D to -4.5 D).

D). The MTF values of those peaks decreased for 4.5 mm by 0.5% to 14%. All multifocal IOLs showed low s values ranging from $0.50 \pm 0.13 \text{ deg}^2/\text{sr}$ to $1.40 \pm 0.65 \text{ deg}^2/\text{sr}$. The monofocal IOL had an s value of $0.63 \pm 0.17 \text{ deg}^2/\text{sr}$.

Conclusions : The monofocal IOL showed the highest MTF value (at 0 D vergence), but the multifocal IOLs were found to be affected less by pupil size at all vergences. As expected, multifocal IOLs are better at some other vergence. In the present study, straylight from the IOLs was rather low. The multifocal IOLs had values similar to the monofocal IOL, thus diffractive effects *per se* of these IOLs are not expected to elevate postoperative straylight. Ex vivo study of explanted IOLs is needed.

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