Optical evaluation of new design multifocal IOLs with advanced diffractive optics, enhancing the range of intermediate to near vision.

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Aims &

The aim of this study was to investigate in vitro the optical performance of two new complementary IOLs with continuous phase design (Artis Symbiose, Cristalens Industrie, France).

Three IOLs, two complimentary IOLs with continuous phase design (Artis Symbiose MID and PLUS) and a traditional bifocal (Artis PL M) were tested, all same hydrophobic acrylic material, dioptric power (+24.0D) and manufacturer (Cristalens Industrie, Lannion, France). IOLs were mounted in a lens holder aligned on the optical axis of our bench system. Images were captured with a CCD camera, at several distances and pupil sizes.

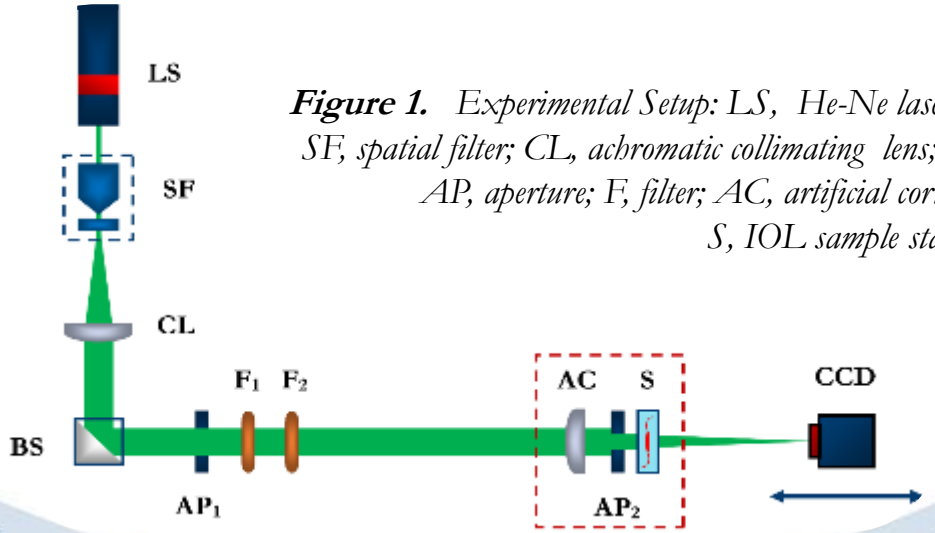

Figure 1. *Experimental Setup: LS, He-Ne laser source 563.2nm; SF, spatial filter; CL, achromatic collimating lens; BS, beam splitter; AP, aperture; F, filter; AC, artificial cornea (0.20μm SA); S, IOL sample stage; CCD, detector;*

Results I

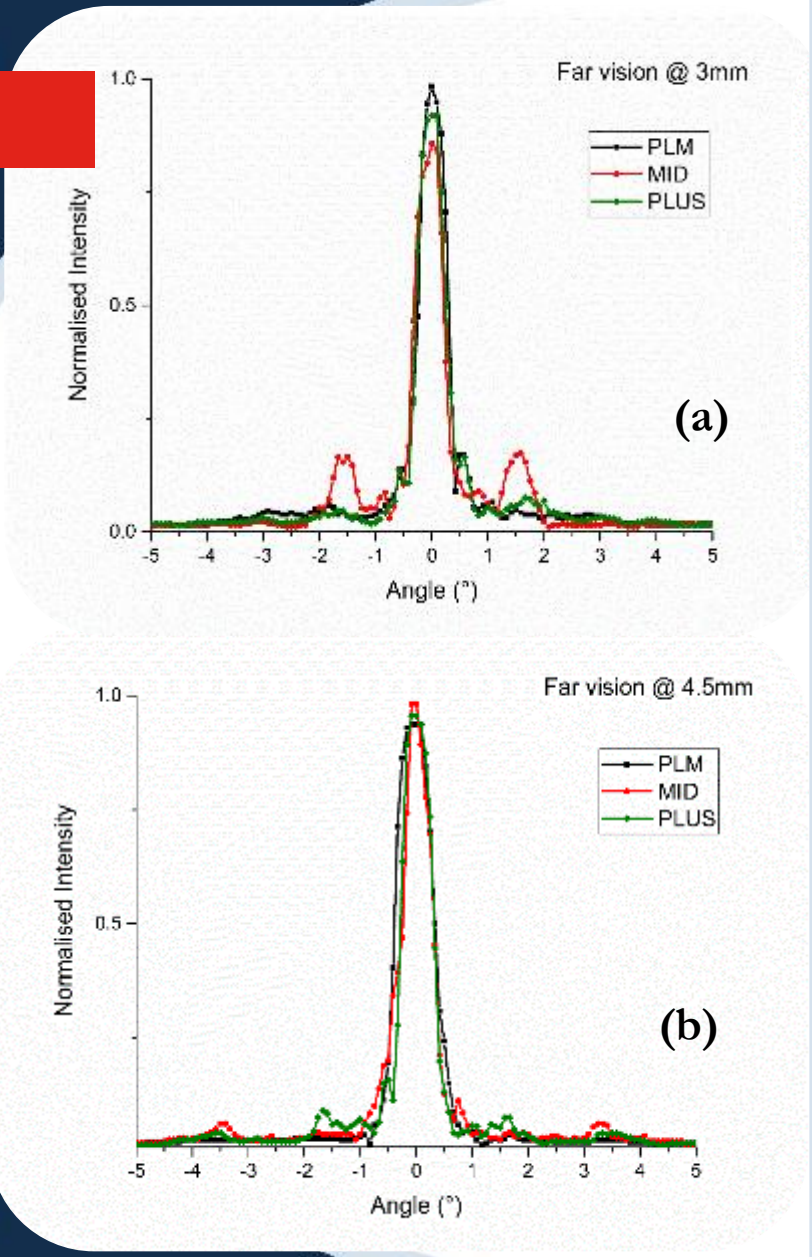

Figure 2. *Far Vision PSF profiles for the MID, PLUS and PLM IOLs at a) 3mm and b) 4.5 mm pupil size*

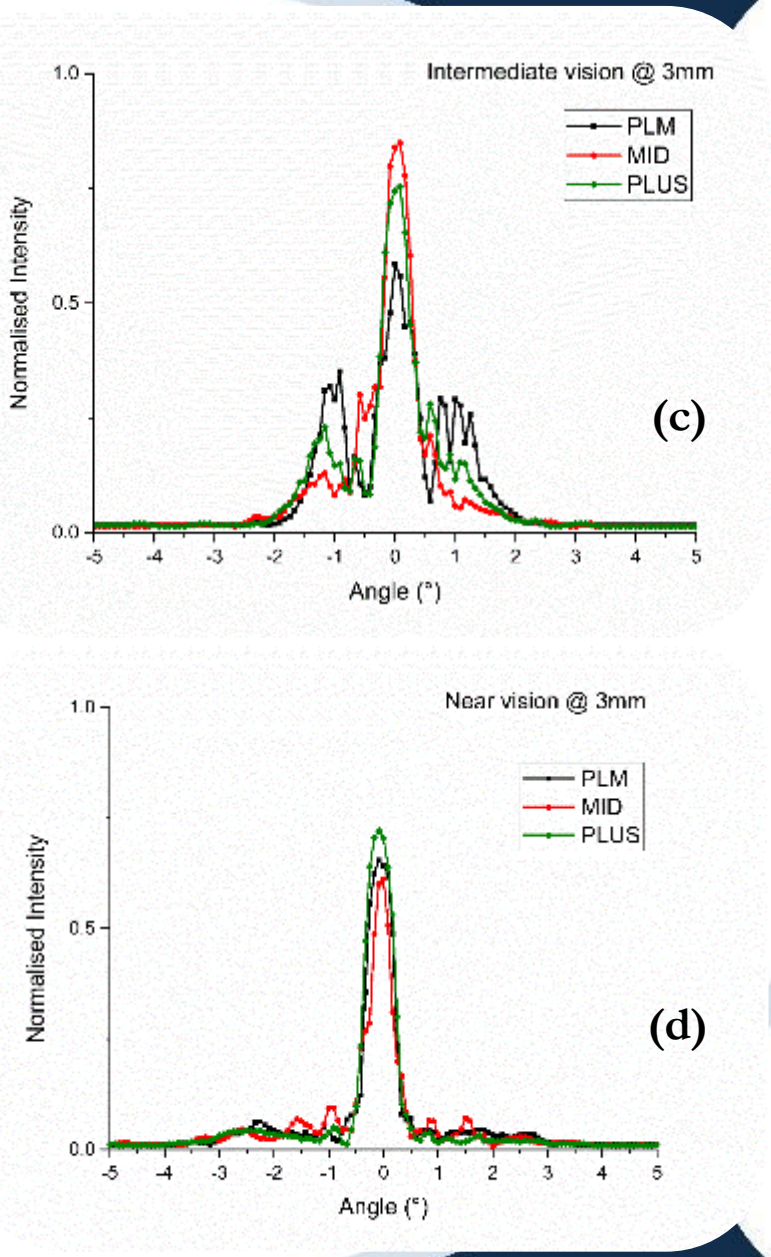

Figure 3. *PSF profiles for the MID, PLUS and PLM IOLs at 3mm pupil size for c) Intermediate and d) Near Vision*

Results II

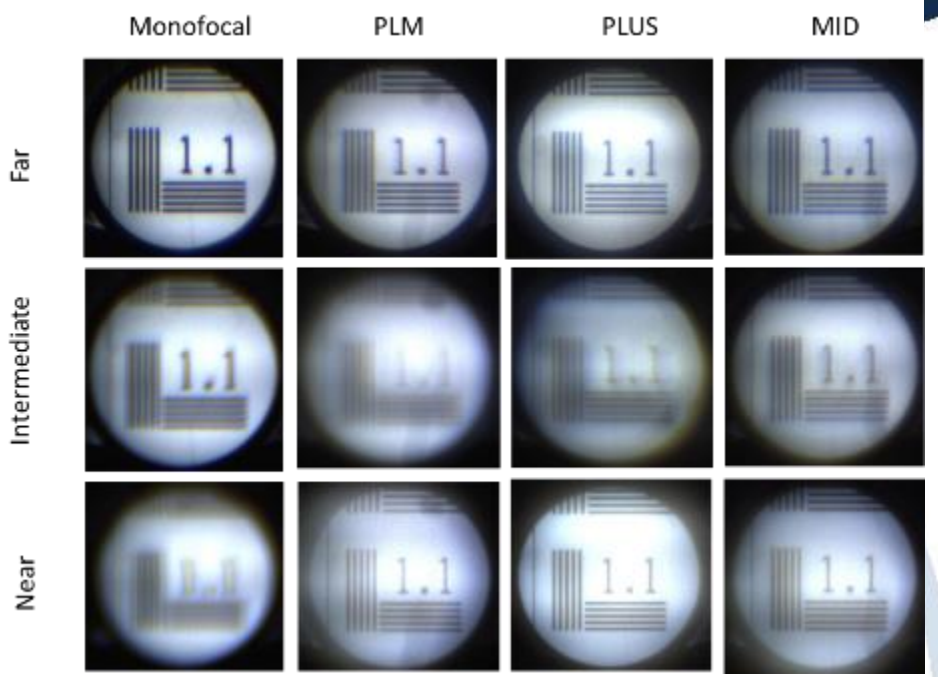

Figure 4. *Microscopy Resolution chart for a 1.1 cycle/mm element projected at retinal plane with the different IOLs (A monofocal ARTIS IOL is set as a reference). The upper line is for distance vision, the second line for intermediate vision and the third line for near vision.*

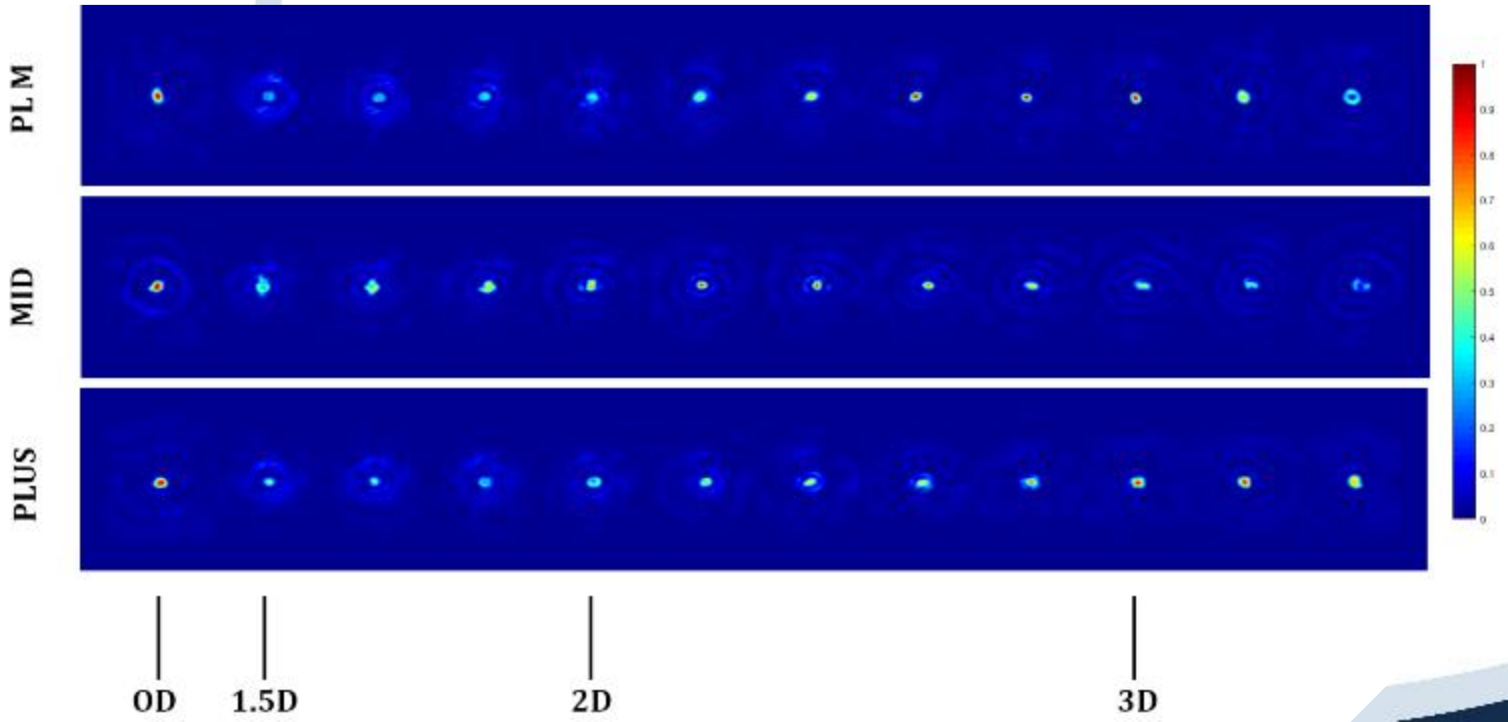

Figure 5. *Though focus PSF-profile comparison for a 3mm pupil size between PL M, Symbiose PLUS and Symbiose MID as propagating from far (+0D) to near vision (+3.2D). The MID seems to offer an enhanced intermediate vision zone while PLUS an extended depth of focus in near vision zone.*

Discussion

Symbiose MID demonstrated the same distance vision as the bifocal IOL. Symbiose PLUS showed a lower peak with the same spreading peak, demonstrating that lower energy but same resolution is allocated for distance vision.

As expected, the bifocal IOL illustrated a lack of good intermediate vision while both Symbiose MID and PLUS demonstrated narrow and higher PSF in the intermediate range, with Symbiose MID demonstrating the higher energy.

The through focus PSF measurements show the enhanced depth of focus of both the Artis Symbiose MID and PLUS profiles with a progressive complementarity between them. Our results demonstrate the innovative technology of Artis Symbiose: the "phase continuity" to keep a sharp vision through a wide distance continuum and the "complementarity" of both IOLs to optimize the binocular contrast repartition.

Our results may suggest that the new design ARTIS Symbiose IOLs, when implanted together, could possibly offer sharp vision at all distances.

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