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## ABERRATIONS PRODUCED BY MISALIGNMENTS OF INTRAOCULAR LENSES IN PSEUDOPHAKIC EYES

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### Abstract

**Purpose:** To determine the relative contribution of misalignments of implanted intraocular lenses (IOLs) to the ocular aberrations in pseudophakic eyes.

**Methods:** Both ocular and corneal wave–aberrations were measured in four patients implanted with two types of foldable IOLs: CeeOn 911 (Pfizer), a spherical biconvex lens, and Tecnis Z9000 (Pfizer) with aspheric surfaces. Corneal wave aberrations were calculated from elevations provided by videokeratography and ocular aberrations were measured using our own high–dynamic range Hartmann–Shack sensor. Misalignments of the implanted IOLs were measured using a new instrument we developed. The eye was illuminated with a semicircular set of infrared LEDs and the Purkinje images were recorded. An analysis of the position each Purkinje images with respect to the pupil center for nine controlled eye fixations allowed us to determine misalignments of the implanted IOLs. The aberrations of the IOLs were estimated by subtracting measured ocular and corneal aberrations in each eye and calculated from the experimental data.

**Results:** IOLs tilts ranged from 0.9° to 4.3° nasal (average: 2.3° ± 1.6° nasal) and 1.2° inferior to 2.9° superior (average 1.6° ± 1.9° superior) and decentrations were 0.2 ± 0.1 mm horizontally and –0.1 ± 0.3 mm vertically. The measured wave–aberrations of the implanted IOLs were similar to those calculated

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using actual IOL misalignments and design parameters of the lenses. The amount of the aberrations found in the implanted IOLs represents a fraction smaller than 20% of the total ocular aberrations. Beyond spherical aberration, present in the lenses, coma and astigmatism are the main aberration terms induced by misalignments. IOL tilts induce similar amount of aberrations for both lenses: as an example, 5° of tilt (well beyond the measured range) produces 0.12 microns of coma. IOL decentrations induce more aberrations for the aspheric lens: for a 0.2 mm detrementation -0.03 and 0.09 microns of coma were induced for each lens.

**Conclusions:** A robust new method to measure tilt and decentration of implanted IOLs has been developed. By using misalignment data we estimated the amount of aberrations induced by two types of IOLs. The cornea is the main source of aberrations in pseudophakic eyes, while the aberrations induced by the implanted IOLs represents a small fraction for both types of lenses. These results further supports the optical advantages of correcting corneal aberrations with IOLs.

**Keywords:** refractive surgery: phakic IOL • cataract • optical properties



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