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## Visual Benefit of Correcting Spherical Aberration Evaluated With an Adaptive-optics Visual Simulator

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### Abstract

**Purpose:** A controversy exists concerning the visual benefit of correcting ocular spherical aberration (SA) and its effect on depth of focus. Experiments were performed using an adaptive optics visual simulator to study the effect of SA on visual performance.

**Methods:** We used an adaptive-optics device that controls ocular aberrations while the subject performs visual testing. It uses infrared light to measure the wave-front aberration in real time with a Hartmann-Shack sensor. Higher order aberrations can be induced by a membrane deformable mirror and if required, larger amounts of SA are introduced with aspheric plates. An additional channel is used for vision through the device. Visual acuity and contrast sensitivity are tested in both monochromatic (green) and white light. Two cases are studied in four normal subjects with a 4.8 mm pupil diameter: with the SA corrected and with induced SA (SA=0.15 microns, amount normally measured in older eyes). Through focus measurements (five defocus values between -1 D and 1 D) were performed in order to better understand the impact of SA on depth of focus.

**Results:** With monochromatic light at best focus, there was an increase in visual acuity after correcting SA (on average by a factor of 1.4). For small values of defocus (between 1 and -1 D), visual acuity was still better for the case of corrected SA. In white light, similar results were obtained, although due to the influence of chromatic aberrations, the benefit of correcting SA was lower. In green light and best focus, contrast sensitivity was clearly higher without SA and remained higher even out of focus.

**Conclusions:** The correction of amounts of SA, similar to those normally found in older and pseudophakic

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eyes, increases visual performance at best focus. Contrary to what is expected from simple optical calculations, for small amounts of defocus, visual performance without SA is still higher or similar to the case with SA.

**Keywords:** refractive surgery: phakic IOL • physiological optics • aging: visual performance



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