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## Retinal Image Quality in Subjects With High Visual Acuity

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### Abstract

**Purpose:** We recently reported (Artal et al., ARVO, 2005) that most subjects with exceptional natural visual acuity (VA) had normal amounts of ocular aberrations. Since this was somehow against conventional wisdom, we further explored here this issue by performing new experiments under natural viewing conditions and using retinal image quality parameters to be compared with acuity.

**Methods:** We selected a group of 40 young subjects having excellent VA (better than 20/15). Subjects were in a refractive range between –1D to 1D and had astigmatism smaller than 0.5 D. A custom procedure was used to estimate VA under carefully controlled experimental conditions. Best focus was determined by each subject subjectively with a Badal optometer. Small amounts of astigmatism were corrected using a crossed–cylinder device with a precision better than 0.07 D. Natural pupil was used during the VA measurements. For each subject, pupil diameter and centration were controlled during the experiment by an auxiliary camera. Both high and low contrast letter acuity were measured by using a forced choice procedure. The setup allowed measuring acuity as high as 30/10 with good accuracy, although the highest measured value was around 20/10. For a fixed luminance level, there was a large range of pupil diameters (from 5 to 7.5 mm). For each eye, we measured the wave–front aberrations for the same pupil diameter as that used for the acuity measurements.

**Results:** Subjects had a high contrast VA under the best conditions uniformly distributed from 20/15 to 20/10. In each eye, a retinal image quality parameter, the logarithm of the Strehl ratio (*lnSR*), was determined from the wave–front aberrations at the appropriate pupil diameter. This parameter (*lnSR*) was maximized in each case by adding the necessary defocus. This would mimic the experimental condition

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where subjects adjusted subjectively for the best focus. The optical parameter ( $\ln SR$ ) and VA showed no correlation in our group of subjects. This further confirms our previous finding: subjects with the highest VA had good, but not diffraction-limited, retinal image quality.

**Conclusions:** In subjects with excellent spatial vision, retinal image quality was not correlated with visual acuity. This could be explained by the combined effect of other factors that set the limit to visual resolution beyond the eye's optics and also in relation with the neural adaptation to the aberrations (Artal et al, Journal of Vision, 2004).

**Keywords:** visual acuity • adaptation: blur • optical properties



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