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Estimating Retinal Image Quality: Double-pass Provides Information Where Wave-front Sensors Might Fail

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Abstract

Purpose: Wave-front sensors provide quite useful information on the optical quality of the eye. However, in eyes where very high order aberrations and scattered light are prominent, wave-front sensors may overestimate retinal image quality. We show here how in those cases, the double-pass technique is a complementary tool to better estimate ocular optical quality.

Methods: We used a double-pass instrument (OQAS, Visiometrics S.L). This apparatus is based on recording images of a point source in near infrared light after reflection in the retina and double-pass through the ocular media. The aberrations were measured using a prototype of near-infrared Hartmann-Shack wave-front sensor adapted to the clinical environment. This system has a high-dynamic range and more than 220 microlenses over a 5 mm pupil area permitting measuring relatively high order aberrations. From the wave aberrations, the point spread function (PSF) and the modulation transfer function (MTF) were calculated. On the other hand, the MTF was also obtained from the double-pass images. We applied both techniques in normal subjects of different ages and in patients that underwent different type of surgeries: IOL implantation, LASIK, PRK. The comparison was performed for 5 mm pupil diameter.

Results: We compared the MTFs obtained from double-pass and Hartmann-Shack techniques. In the group of normal eyes with low level of intraocular scattering, these estimates were quite similar, indicating that both techniques captured well most of the optical degradation. However, in eyes where

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scatter was more predominant, i.e.; in early cataract eyes, patients after IOL implantation with posterior capsular opacification, etc...; the MTF provided by the Hartmann-Shack sensor was always higher than the MTF obtained from double-pass. We found differences in modulation two to three-fold depending the level of scatter.

Conclusions: In eyes with low scattering, double-pass and Hartmann-Shack techniques provided similar estimates of the retinal image quality. However, in patient's eye with mild to severe amount of scatter, wave-front sensors might overestimate image quality while the double pass technique produces a more accurate description of the optical quality.

Keywords: refractive surgery: optical quality • physiological optics • refractive surgery: other technologies



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