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Spatially Resolved Wave-front Aberrations In Progressive Power Lenses

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Abstract

Purpose: To measure the wave-front aberrations (WA) at different locations in progressive power lenses (PPL) at optical conditions resembling those in real viewing. To evaluate how aberrations in PPL and the older eye combine together and how this is related to vision. **Methods:** A Hartman-Shack wave-front sensor, specially designed in our laboratory, was used to measure ophthalmic lenses and human eyes either independently or in combination. A micrometric positioner allows to select the precise location and tilt of the PPL to simulate the real angles between visual axis and lens. A variable prism compensator was incorporated to the system to remove prismatic effects of the progressive lens. We obtained WA maps at 20 relevant locations across the PPL. Plano lenses with a power addition of 2 D were studied. The PPLs aberrations were combined with the aberrations in presbyopic subjects (around 50 years old). A number of parameters for each location were obtained: RMS (root mean square) of the WA, Strehl ratio, astigmatism, coma and values of individual higher aberration terms. Complete results were obtained for two pupil diameters: 6 mm and 4 mm. **Results:** For a 4 mm pupil, the typical RMS values of the PPL were 0.05 and 0.07 microns for the far and near centered zones. In the central part of the corridor, the RMS increases to around 0.1 microns. In these areas of the PPL, third order coma is the dominant aberration. As a comparison, the typical RMS of the aberrations in a 50-years presbyopic eye for this pupil is around 0.25 microns. In areas of the PPL outside the corridor, astigmatism largely increases, while other higher other aberrations remains similar than in the center. As an example, the RMS at locations 3 and 6 mm from the corridor line is around 0.4 and 0.7 microns respectively. Two-dimensional maps of different image quality parameters will be presented. **Conclusion:** We developed a method to carefully inspect the aberrations of PPL at relevant locations across the lenses for realistic optical conditions. These spatially-resolved aberration maps were combined with the aberrations in presbyopic subjects.

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