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Is There Neural Adaptation to the Aberrations in Progressive Power Lenses?

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Abstract

Purpose: We previously suggested (Artal et al., Journal of Vision, 2004) that the eye is adapted to its particular aberrations, because subjective blur when viewing a scene through one's own aberrations was less than that when the aberrations were rotated using an adaptive optics system. The extent to which neural adaptation influences visual performance following the introduction of new spectacle corrections has not been explored. Progressive power lenses (PPLs) commonly used to correct presbyopia introduce small amounts of coma and trefoil, in addition to astigmatism (Villegas & Artal, OVS 2003), and these aberrations vary across the lens. We studied whether neural adaptation to aberrations plays any role when patients adjust to PPLs. **Methods:** We measured visual acuity (VA) through different controlled areas of PPLs after subjects were adapted to the lenses during a period of up to one week. Four presbyopic subjects, who never previously had used PPLs participated in the study (power additions: one of 2.25 D, two of 2.00 D and one of 1.00 D). VA of the left eyes was measured through three zones for intermediate vision of the PPL, all of them located 6–mm below the fitting cross (within the corridor, 3 mm toward the nasal side, and 6mm toward the temporal side). VA was measured using a forced–choice procedure during the first week wearing the lenses: in the first day just before ever wearing the PPLs and after 2 and 7 hours, and 2, 4 and 7 days later. The optical aberrations of both the eye and the PPLs were measured using a Hartmann–Shack wave–front sensor.

Results: Wavefront sensor measurements revealed the systematic changes in the wave aberration with gaze position expected with PPLs, which were stable throughout the week of testing. However we did not find significant changes in VA in any of the selected zones of the PPL after a week of adaptation to the

new lenses.

Conclusions: We did not find an improvement in VA after wearing PPL during a week that could be attributed to neural adaptation. While our previous work has demonstrated neural adaptation to the particular pattern of aberrations, patients apparently do not adapt during the first week of exposure to a multiplicity of new aberration patterns, one for each direction of gaze. These results suggest that the neural adaptation to aberrations probably plays a minor role in how patients adjust to PPLs. This adjustment during the first week may be mainly driven by compensatory eye–head movements and perhaps gaze–contingent adaptation to the distortion rather than the blur introduced by the lenses.

Keywords: adaptation: blur • visual acuity • optical properties