

Evaluating visual performance in presbyopia correction with multifocal contact lenses: visual acuity vs. reading speed

Plainis S¹, Ktistakis E¹, Tsilimbaris MK^{1,2}

¹ *Laboratory of Optics and Vision (LOV), School of Medicine, University of Crete, Greece*

² *Ophthalmology Department, University Hospital of Heraklion, Greece*

Purpose: Standard tests of visual acuity (VA) provide only a partial indication of functional vision and usually overestimate near visual performance. Many complaints from presbyopes originate when reading a book or a passage in a tablet, although VA is fine. Here the effectiveness of presbyopia correction with multifocal contact lenses (CLs) is evaluated using both standard near VA testing and an eye-fixation based analysis of reading speed.

Methods: Visual performance of thirty presbyopic volunteers (age: 50±5 yrs) was assessed monocularly and binocularly using monthly disposable CLs (Air Optix Plus Hydraglyde, Alcon Laboratories) with: (a) single vision (SV) lenses offering correction for far and (b) aspheric multifocal (MF) CLs. Near performance was evaluated using 0.4 logMAR print size at 40cm distance. LogMAR acuity was measured with ETDRS charts. Reading performance was evaluated using the standard Greek IReST paragraphs, displayed on a screen. Eye movements were monitored with an infrared eyetracker (Eye-Link II, SR Research Ltd). Data analysis included computation of reading speed, fixation duration, fixations per word and percentage of regressions.

Results: Near VA with MF CLs improved on average by 0.20±0.20 logMAR ($p<0.001$). In addition, a statistically significant advantage of 0.12±0.10 logMAR with binocular over monocular viewing was observed ($p<0.001$). Average binocular passage reading speed showed a statistically significant improvement from 250±68 to 280±67 wpm ($p=0.002$). Average binocular advantage in reading speed (21±46 wpm) with MF CLs was also found statistically significant ($p=0.002$). Regarding the eye fixation parameters, fixation duration showed a statistically significant improvement, by 13±33 ms, with MF CLs ($p=0.048$), while the improvement in the number of fixations per word (0.04±0.12) was marginally statistically insignificant ($p=0.053$). Finally, a small correlation was found between the improvement in reading speed and VA ($r=-0.36$). Improvement in reading speed was strongly correlated with fixation duration ($r=0.79$, $p<0.001$) and the difference in the number of fixations per word ($r=-0.69$, $p<0.001$).

Conclusion: VA tests may overestimate the improvement in functional vision performance and cannot predict the enhancement in reading speed in presbyopes with simultaneous-image correction, probably because reading is facilitated by parafoveal visual information. Evaluating reading performance and eye fixation parameters in reading tasks with standardized passages may provide crucial information regarding the effectiveness of various approaches in presbyopia correction.

Financial Disclosure: The study was supported by an investigator-initiated study grant from Alcon (IIT# 52977371).