The effect of binocular summation on visual acuity and reading performance with single vision and multifocal contact lenses: an eye-fixation based analysis.

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Purpose: Simultaneous-image correction with aspheric multifocal contact lenses (CLs) usually requires perceptual processes, such as binocular summation, to help the interpretation of "in-focus", while suppressing out-of-focus images. Here, the effect of binocular summation on reading performance is evaluated using a new method, based on eye fixation analysis.

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 – uncorrected for near (b) aspheric multifocal (MF) lenses. Visual acuity (VA) at near was measured with ETDRS charts. Reading performance was evaluated using standard IReST paragraphs displayed on a screen (0.4 logMAR print size at 40cm distance). 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: Average binocular summation in VA at near was 0.12±0.10 and 0.11±0.10 logMAR with SV and MF CLs, respectively (p<0.001). Average monocular reading speed with SV lenses was 231±75 wpm, improving to 247±67 wpm, binocularly (p=0.04). A statistically significant improvement in reading speed with binocular viewing (19±39ms) was also found with MF CLs (p<0.02). Binocular summation was mainly due to the faster average fixation duration in binocular viewing in both SV (21±42ms, p=0.004) and MF CLs (14±28ms, p=0.045). Number of forward fixations and percentage of regressions did not differ between the binocular / monocular conditions.

Conclusion: Binocular summation increases reading speed by the same amount in a presbyopic population when corrected with SV or MF CLs. Fixation duration was the only parameter improved in both conditions (visuo-motor component), while no difference was found for the number of fixations and regressions (cognitive component). Evaluating reading performance using eye fixation analysis could offer a reliable outcome of functional vision.