Reading performance of monofocal pseudophakic patients with and without glasses under normal and dim light conditions

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PURPOSE: To evaluate reading performance of patients with monofocal intraocular lenses (IOLs) (Acrysof SN60WF) with or without reading glasses under bright and dim light conditions.

SETTING: Austrian Academy of Ophthalmology, Vienna, Austria.

DESIGN: Evaluation of a diagnostic test or technology.

METHODS: In pseudophakic patients, the spherical refractive error was limited to between +0.50 diopter (D) and −0.75 D with astigmatism of 0.75 D (mean spherical equivalent: right eye, −0.08 ± 0.43 [SD]; left eye, −0.15 ± 0.35). Near addition was +2.75 D. Reading performance was assessed binocularly with or without reading glasses at an illumination of 100 candelas (cd)/m^2 and 4 cd/m^2 using the Radner Reading Charts.

RESULTS: In the 25 patients evaluated, binocularly, the mean corrected distance visual acuity was −0.07 ± 0.06 logMAR and the mean uncorrected distance visual acuity was 0.01 ± 0.11 logMAR. The mean reading acuity with reading glasses was 0.02 ± 0.10 logRAD at 100 cd/m^2 and 0.12 ± 0.14 logRAD at 4 cd/m^2. Without reading glasses, it was 0.44 ± 0.13 logRAD and 0.56 ± 0.16 logRAD, respectively ($P < .05$). Without reading glasses and at 100 cd/m^2, 40% of patients read 0.4 logRAD at more than 80 words per minute (wpm), 68% exceeded this limit at 0.5 logRAD, and 92% exceeded it at 0.6 logRAD. The mean reading speed at 0.5 logRAD was 134.76 ± 48.22 wpm; with reading glasses it was 167.65 ± 32.77 wpm ($P < .05$).

CONCLUSION: A considerable percentage of patients with monofocal IOLs read newspaper print size without glasses under good light conditions.

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In addition to their limited distance acuity, most cataract patients have reduced reading ability. Because the ability to read is an important visual task in our modern information-based society, cataract patients have the desire to regain comfortable reading performance. After cataract surgery, sufficient near visual acuity can be achieved with monofocal intraocular lenses (IOLs) and reading glasses, with multifocal IOLs,[1–4] or by pseudophakic monovision.[5] The accommodative potential of accommodating IOLs, however, is still equivocal.[6,7]

For monofocal IOLs, a pseudoaccommodative amplitude of up to approximately 1.0 diopter (D) has been shown in defocus-curve analyses.[8,9] This amplitude was independent of pharmacologically induced shifts in anterior chamber depth. Thus, pseudoaccommodation with monofocal IOLs is most likely caused by the depth of focus of the optic system and a slight myopia that is usually the target refraction in modern cataract surgery. Accordingly, a considerable number of cataract patients with monofocal IOLs report that they have excellent distance vision and are also able to read newspapers without reading glasses when the light conditions are good.

Such pseudophakic reading abilities have not been scientifically quantified to date, and this lack of quantification sparked our interest in answering the following 4 related research questions: (1) What reading performance, with or without refractive correction, do patients with monofocal IOLs have

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when it is measured with a standardized reading test? (2) What is the smallest print size (logRAD reading acuity) that they can read without glasses? (3) How does reading speed, with or without glasses, change with smaller print sizes? (4) Because for patients with multifocal IOLs, "reading a menu under dim light conditions" is said to be a considerable visual ability, what is their reading performance under dim light conditions?

Answering these questions should provide a baseline for future studies of reading performance in pseudophakic patients. It is also of clinical interest to quantify reading performance after monofocal cataract surgery with a reading test that is in accordance with international standards.[10–12] Jaeger cards and other historic reading cards lack standardization[A] and thus do not meet the requirements for modern research; therefore, new concepts of reading chart standardization have been developed for measuring reading acuity and speed that allow reading performance analyses on the level of international standards.[13–15] Among these are the Radner Reading Charts,[14,15] which are based on a concept of sentence optotypes[14–17] that has been applied to a variety of languages (German, Spanish, English, French, Dutch, Swedish, Italian, Hungarian, Danish; further languages in progress).

For the preparation of Radner Reading Charts in a given language, a series of test sentences was generated and statistically selected, all of which had to be highly comparable in the number of words (14), number of characters, number of syllables, word length, position of words, lexical difficulty, and syntactic complexity. After test–item standardization, the reliability and validity of these charts were evaluated through test–retest analysis, interchart analysis, and variance component analysis.[16] In addition to their advantage as standardized reading tests for routine clinical use, the Radner Reading Charts not only allow simultaneous examination of reading acuity and speed but also make it possible to calculate several reading parameters from a single examination, including reading acuity, maximum and mean reading speed, reading score, critical print size (CPS), and the logMAR–logRAD difference.

In the present study, we used this reading test system to assess the reading performance of patients with monofocal IOLs (Acrysof SN60WF, Alcon Surgical, Inc.). Reading parameters such as reading acuity, mean and maximum reading speed, reading score, and CPS were evaluated with and without reading glasses under bright light illumination and dim light conditions.

PATIENTS AND METHODS

The study population consisted of native German-speaking persons who received a monofocal IOL (Acrysof SN60WF) in both eyes. None of the patients had a disease or received medication that could influence the results of the study. Patients were asked to participate in the study during a routine follow-up. All study procedures adhered to the Declaration of Helsinki for research involving human subjects. All patients gave informed consent to participate.

Refractive Eligibility Criteria

To be eligible for the study, the patients' refractive errors had to be limited to a spherical refraction error between +0.50 D and −0.75 D. Astigmatism was limited to +0.75 D. The logMAR corrected distance visual acuity (CDVA) was measured before all testing sessions with the Early Treatment Diabetic Retinopathy Study charts (Precision Vision) and was viewed at 4 m. Patients were only included when the refraction to achieve best visual acuity was equal to that of their own glasses. Near addition was +2.75 D in all patients.

Reading Performance Analyses

The patients' reading performance was assessed under 4 reading conditions: (1) bright light (luminance: 100 candelas [cd]/m^2) with their own reading glasses, (2) bright light (luminance: 100 cd/m^2) without glasses, (3) dim light (luminance: 4 cd/m^2) with their own reading glasses, and (4) dim light (luminance: 4 cd/m^2) without glasses. Luminance was confirmed before every testing session. Before reading under dim light conditions, patients were dark adapted for 5 minutes.

Reading parameters were evaluated with the 4 German Radner Reading Charts. The charts were presented in random order, and the tests were performed binocularly. Before the test began, the patients were asked to find their best reading distance, which was generally at or close to 40 cm. Then, the patients were asked to read at 40 cm. Reading distance was measured with a ruler and was reevaluated several times during the testing procedure. In all patients, the distance remained unchanged within ±1 cm (corresponding to a logarithm of the reading acuity determination [logRAD] correction of ±0.01).

The sentences were covered with a piece of paper, and the patients were asked to uncover sentence after sentence, reading each one aloud as quickly and accurately as possible. Reading time was measured with a stopwatch. Reading speed in words per minute (wpm) was calculated based on the number of words in a sentence and the time needed to read the sentence (14 words × 60 seconds divided by the reading time). The reading length limit was set at 25 seconds.

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