Visual Function and Subjective Quality of Life Compared in Subjects with Acquired Macular Disease

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PURPOSE. To determine the objective measures of visual function that are most relevant to subjective quality of vision and perceived reading ability in patients with acquired macular disease.

METHODS. Twenty-eight patients with macular disease underwent a comprehensive assessment of visual function. The patients also completed a vision-related quality-of-life questionnaire that included a section of general questions about perceived visual performance and a section with specific questions on reading.

RESULTS. Results of all tests of vision correlated highly with reported vision-related quality-of-life impairment. Low-contrast tests explained most of the variance in self-reported problems with reading. Text-reading speed correlated highly with overall concern about vision.

CONCLUSIONS. Reading performance is strongly associated with vision-related quality of life. High-contrast distance acuity is not the only relevant measure of visual function in relation to the perceived visual performance of a patient with macular disease. The results support the importance of print contrast, even over print size, in reading performance in patients with acquired macular disease. (Invest Ophthalmol Vis Sci. 2000;41:1309–1315)

Macular degeneration is the leading cause of low vision in the Western world.1 The disease process leads to loss of central vision, which causes daily difficulties for those affected, in particular in reading. The precise measurement of visual function in patients with acquired macular disease is necessary for both the estimation of need for therapeutic and supportive interventions and for the measurement of the outcomes of such care.

High-contrast distance visual acuity (VA) is the most commonly used measurement of vision in clinical practice. It is from this measurement that many clinical and surgical decisions are made in the process of patient management and treatment. Therefore, it is assumed that the measurement of a patient’s ability to see high-contrast letters is a good indication of everyday visual function. However, a high-contrast VA measurement can actually be a poor predictor of a number of aspects of visual function.2–9 Other measures of visual function can be better predictors of visual performance. For example, contrast sensitivity (CS) has been measured in different patient groups and found to correlate well with various aspects of visual ability, including orientation and mobility,1,6,8,10 reading speed,11,12 and driving.10 Low-contrast VA has been shown to be better than high-contrast VA at predicting problems with orientation and discrimination in patients with macular degeneration.6

Reading is often the primary rehabilitation goal of the patient with low vision and central field loss (CFL).13,14 A number of studies have investigated the relationship in low-vision observers between reading speed, as a measure of reading performance, and clinical measures of visual function. High-contrast VA has been shown to be unrelated15–17 or weakly related18–22 to reading speed. However, previous investigators have found a correlation between low-vision reading speed and CS when CS was measured using gratings.12,16,25 The measurement of CS is therefore likely to be of value in the assessment of patients with acquired macular disease.

Two methods are commonly used to determine which tests of visual function are relevant to visual performance. Vision test results can be compared with performance-based measures—for example, reading speed or the time taken to complete an obstacle course. Alternatively, vision test results can be compared with self-reported visual performance measured as the score of a visual performance questionnaire. In this study we used a questionnaire-based approach to determine subjects’ perceived quality of visual performance. We chose to look specifically at the visual performance associated with reading, as well as general visual performance. This is because the subject group all have CFL, which is particularly detrimental to tasks such as reading. Individual questions about reading performance have been asked in other questionnaires,8,24–28 but in the present study a wider range of reading questions was used, the results of which were combined as a separate score. These questions were derived from patients’ comments on vision-related quality of life. There is a growing awareness of the importance of patients’ subjective assessment of their own visual performance. Subjective measures reflect perceived need for the patients and add meaning to, as well as justification for, the use or appropriateness of objective clinical tests.
In this study, we were particularly interested in the reading performance of patients with macular disease due to the detrimental effect CFL has on this visual task. Many studies have used reading speed as a measure of reading performance. However, it cannot be assumed that reading speed is necessarily the measure on which readers base their perceived performance. Therefore, the purpose of this study was to determine, without prior assumptions, which tests of visual function correlate best with perceived reading performance, as well as those that correlate with general perceived visual performance. We studied patients with acquired macular disease as representative of patients with CFL. The ability to understand and quantify the subjective visual performance of the vision impaired is important if we are to accurately determine the success or otherwise of the management of these patients.

**METHODS**

**Subjects**

The subjects for this study were all patients of Birmingham Heartlands and Solihull National Health Service Trust. They were due to undergo surgery to remove choroidal neovascular membranes that were idiopathic or associated with presumed ocular histoplasmosis syndrome (POHS) or age-related macular degeneration (ARMD). There were 12 patients (11 women and 1 man; age range, 23–46 years) with idiopathic membranes or membranes associated with POHS and 16 ARMD patients (9 women and 7 men; age range, 51 to 80 years). With subfoveal membranes, these subjects are a selective subset of all patients with maculopathies. However, they can be considered representative of patients with late-stage maculopathy, because they all have loss of central visual field. It is CFL that is the most debilitating characteristic of macular disease, and it is therefore important to be able to assess its effect on quality of life.

Aston University and Birmingham Heartlands and Solihull Hospital Ethics Committee approvals were obtained, and all patients gave informed consent. The study followed the tenets of the Declaration of Helsinki.

**Quality-of-Life Questionnaire**

The questionnaire used in this study was developed for the measurement of vision-related quality of life (VQOL). The questionnaire is specifically designed for the assessment of ophthalmic interventions and has a modular design. During the development of the questionnaire, an initial pool of 232 questions was subjected to a pretesting phase that tested the questions on individuals with a wide variety of ocular diseases, levels of visual impairment, and social backgrounds. This phase of testing enabled further refining of issues already generated and enabled modification of the questionnaire to maximize its relevance. The result of this pretesting phase was a 139-item “parent” questionnaire from which individual items or groups of items could be selected. From the parent questionnaire, a core questionnaire (the VCM1) was developed, which contains 10 broadly applicable items referring to physical, social, and psychological issues and acts as a global measure of concern about vision. It has high reliability ($\alpha = 0.93$) and validity. The VCM1 score ranges from 0.0 (no problem) to 5.0 (extreme problem) and is strongly associated with responses to questions about a wide range of quality-of-life issues including mobility, reading, and leisure activity. In addition to the VCM1, items can be selected from the parent questionnaire to meet particular needs in specific studies. Each item in the parent questionnaire is a 6-point ordinal scale that ranges from 0 (no problem) to 5 (extreme problem). In the present study, the items that were plausibly associated with reading were combined into a single scale that ranged from 0.0 (no problem) to 5.0 (extreme problem) and had acceptable psychometric properties (see the Results section) in the sample under investigation. This section of the questionnaire will be described as the reading scale. The values for each question within each section (VCM1 and reading scale) were summed for each subject to provide a total score for the VCM1 (range, 0–50) and reading scale (range, 0–75). Each total score was then divided by the number of questions in each section (i.e., 10 for the VCM1 and 15 for the reading scale), and these values (range, 0–5) were used for the regression analysis. Because these are accumulative scores, the values are very likely to be normally distributed and therefore appropriate to use within the regression analysis. Tests for skewness and kurtosis also indicate that the sample population does not deviate significantly from a normal distribution, thus ensuring appropriate use of the analyses described. If the patient was unable to read the questionnaire, it was administered by the examiner in a standardized manner. All subjects were given the same instructions and were asked to answer the questionnaire considering their eyesight during the past month, using both eyes and any habitually used spectacles, contact lenses, or low-vision aids.

**Visual Function Tests**

All tests were performed in the same room with photopic lighting conditions provided by two fluorescent strip ceiling lamps and a 60-W angle-poise lamp for near tasks. All tests were performed in the same order for each subject by the same examiner.

The following tests were completed after subjective refraction was performed for each subject:

1. **High-contrast distance VA** with best refraction was measured using a 3-m externally illuminated Bailey–Lovie logMAR chart. Acuity was measured monocularly in each eye with the fellow eye covered with a black patch. Subjects reported no problems with rivalry under these conditions. Visual acuities were recorded letter by letter, where each letter read was given the value of 0.02 log units. The chart luminance was 95 candela [$\text{cd}/\text{m}^2$], as measured with a spot photometer (CS-100; Minolta, Tokyo, Japan).

2. **Low-contrast distance VA** measured with a 3-m externally illuminated Bailey–Lovie logMAR chart. VA was measured monocularly in each eye, and acuities were recorded in the same way as for the high contrast chart. The chart luminance was 95 cd/m$^2$, and the Michelson contrast was 10%.

3. **Near word acuity** measured with a Bailey–Lovie near word chart at 25 cm with a +4.00 DS reading addition if necessary. Acuities were measured monocularly and were recorded as the smallest letter size at which at least three of the five words on the line were read correctly. The chart luminance was 120 cd/m$^2$.

4. CS using a Pelli–Robson chart at 1 m. CS was measured monocularly and scored per letter with each correctly read letter given a value of 0.05 log units. A C mistaken
oral reading speed was measured binocularly using a paragraph of justified text of 66 words in length, which was of early secondary school level. All subjects had an educational standard that exceeded this level, ensuring that reading speed measures were not compromised by difficulty in comprehension of the text. The time taken to read the passage was recorded in words per minute. The text size was at least 0.2 log units larger than the near word acuity (a conservative guideline for prescribing magnification\(^-1\)) as measured with the Bailey–Lovio near word chart. Errors were not recorded, because few were made at this level above acuity threshold. The chart luminance was 120 cd/m\(^2\).

These tests were performed after subjective refraction to facilitate eventual comparisons after surgery. Although subjects responded to the questionnaire with regard to their habitual visual performance, there was no statistically significant difference between the best corrected and habitual VA for either the better (\(r(27) = 0.45, P = 0.65\)) or worse eye (\(r(27) = 0.33, P = 0.75\)). The best corrected visual acuities were therefore used in the analysis.

**Analysis**

Monocular vision test results were obtained from right and left eyes for the 28 subjects but were separated according to whether they were from the better or worse eye, according to high-contrast distance VA (values ranged between −0.14 and 1.68 logMAR). The data were analyzed using two software programs (SPSS for Windows; SPSS, Chicago, II.; and Statistical Analysis Software; SAS, Cary, NC). The psychometric properties of the group of reading questions were evaluated by calculation of inter-item correlation coefficients (Spearman), item–total correlations, and Cronbach \(\alpha\) coefficient. Principal components analysis was also performed. The relationships between reading scale, VCM1, and vision test results were also investigated by calculating Spearman correlation coefficients. The associations between vision test results and questionnaire scores were further explored by performing stepwise forward multiple regression analysis with the vision test results as potential explanatory variables.

The variables for each subject are as follows: VCM1 score, reading scale score, high-contrast logMAR acuity in each eye, low-contrast logMAR acuity in each eye, Pelli–Robson CS in each eye, Bailey–Lovio near word acuity in each eye, and binocular text-reading speed.

**RESULTS**

The descriptive statistics for the questionnaire and each of the tests of visual function are shown in Tables 1 and 2. There was a large variation in performance among subjects. The group of reading questions showed high internal consistency. Spearman inter-item correlation coefficients ranged between 0.7 and 0.9. Corrected item–total correlations, a measure of how well each individual item correlates with the total of the remaining items (Table 1), were all higher than 0.8. The Cronbach \(\alpha\) coefficient was 0.98. Principle components analysis found a dominant first-principal accounting for 77% of the variation, one principal component accounting for 8%, one accounting for 5%, and all other components accounting for 2% or less, suggesting the presence of a single underlying factor. All reading items were evenly weighted in the first principal component.

Table 3 shows the correlations between each section of the questionnaire and each of the visual function test results. When analyzed in this univariate manner, all the tests of visual function correlated significantly with perceived visual performance. For both questionnaire scales (reading scale and VCM1) there were higher correlations for the better eye results compared with the worse eye results. Also, each of the better eye and binocular visual function test results show a slightly higher

### TABLE 1. Spread of Responses for the 15 Reading Questions of the Questionnaire

<table>
<thead>
<tr>
<th>Question Number and Content</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Item Total Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Dials</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>0.883</td>
</tr>
<tr>
<td>2 Labels</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>0.885</td>
</tr>
<tr>
<td>3 Coins</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0.884</td>
</tr>
<tr>
<td>4 Checks</td>
<td>15</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>0.881</td>
</tr>
<tr>
<td>5 Handwriting</td>
<td>16</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0.856</td>
</tr>
<tr>
<td>6 Forms</td>
<td>11</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>0.940</td>
</tr>
<tr>
<td>7 General reading</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>0.896</td>
<td></td>
</tr>
<tr>
<td>8 Ordinary print</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>0.889</td>
</tr>
<tr>
<td>9 Large print</td>
<td>12</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0.905</td>
</tr>
<tr>
<td>10 Small print</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>0.889</td>
</tr>
<tr>
<td>11 Reading mail</td>
<td>11</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>0.940</td>
</tr>
<tr>
<td>12 Medicine label</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>0.923</td>
</tr>
<tr>
<td>13 Wristwatch</td>
<td>11</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>0.853</td>
</tr>
<tr>
<td>14 Telephone</td>
<td>12</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>0.852</td>
</tr>
<tr>
<td>15 Telephone directory</td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>9</td>
<td>0.900</td>
</tr>
</tbody>
</table>

Item total correlation shown for each question. The reading questions were: How much has your eyesight interfered with the ability to 1) read numbers on dials; 2) read labels or prices on cans, packages and other containers; 3) identify coins, currency; 4) write checks and pay bills; 5) see your own handwriting; and 6) complete forms. How much has eyesight interfered with 7) reading in general; 8) reading ordinary sized print; 9) reading large print; 10) reading small print; 11) reading mail; 12) reading labels and instructions on medicines; 13) seeing numbers and hands on a wristwatch; 14) seeing numbers on a telephone dial; 15) seeing a number in the telephone directory. The response numbers indicate: 0 = not at all; 1 = hardly at all; 2 = a little; 3 = a fair amount; 4 = a lot; 5 = cannot do because of eyesight.
correlation with the reading scale than the VCM1. The worse eye measurements correlated more highly with the VCM1 than the reading scale. There are limitations to this analysis, however, because it does not show which tests of visual function explain most of the variation in perceived visual performance. For this reason, multiple regression analysis by the forward method was used to highlight the most significant visual function tests. The results of this analysis are shown in Table 4.

The visual function test that accounts for most of the variation in the VCM1 is the binocular text-reading speed (\( R^2 = 0.65, P < 0.001 \)). The high correlation between binocular text-reading speed and VCM1 score is shown in Figure 1.

The tests that account for most of the variance in the reading scale are the better eye low-contrast VA, which explains 78% of the variance (\( P < 0.001 \)) and the CS in the better eye, which explains an additional 5% of the variation (\( P < 0.001 \); Table 4). Figure 2 shows the relationships between the better eye low-contrast VA and CS in the better eye with the reading scale.

Despite the wide age range of the subject group, when age was included as a factor in the analysis, it did not correlate with any of the variables. For this reason, it was not included in the present analysis.

### Table 2. Descriptive Statistics for the Questionnaire and the Vision Tests for All Patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCM1</td>
<td>1.88 ± 0.97</td>
<td>1.70</td>
<td>0.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Reading scale</td>
<td>2.03 ± 1.68</td>
<td>1.55</td>
<td>0.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Vision Tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCVA worse eye (logMAR)</td>
<td>0.93 ± 0.36</td>
<td>0.95</td>
<td>0.20</td>
<td>1.68</td>
</tr>
<tr>
<td>HCVA better eye (logMAR)</td>
<td>0.30 ± 0.41</td>
<td>0.16</td>
<td>-0.12</td>
<td>1.46</td>
</tr>
<tr>
<td>LCVA worse eye (logMAR)</td>
<td>1.24 ± 0.35</td>
<td>1.20</td>
<td>0.54</td>
<td>1.84</td>
</tr>
<tr>
<td>LCVA better eye (logMAR)</td>
<td>0.57 ± 0.42</td>
<td>0.43</td>
<td>0.10</td>
<td>1.50</td>
</tr>
<tr>
<td>CS worse eye (log units)</td>
<td>0.96 ± 0.36</td>
<td>0.95</td>
<td>0.00</td>
<td>1.65</td>
</tr>
<tr>
<td>CS better eye (log units)</td>
<td>1.40 ± 0.36</td>
<td>1.50</td>
<td>0.45</td>
<td>1.80</td>
</tr>
<tr>
<td>Near VA worse eye (logMAR)</td>
<td>1.05 ± 0.35</td>
<td>1.00</td>
<td>0.40</td>
<td>1.60</td>
</tr>
<tr>
<td>Near VA better eye (logMAR)</td>
<td>0.44 ± 0.43</td>
<td>0.30</td>
<td>0.00</td>
<td>1.50</td>
</tr>
<tr>
<td>Binocular reading speed (words per minute)</td>
<td>141.6 ± 65.6</td>
<td>154.8</td>
<td>0.00</td>
<td>216.5</td>
</tr>
</tbody>
</table>

HC, high contrast; LC, low contrast.

### Discussion

All tests of vision correlated highly with reported vision-related quality of life, but low-contrast test results explained most of the variance in self-reported problems with reading and also correlated highly with overall concern about vision. The results show a close relationship between the VCM1 and results of clinical tests of visual function. The result that most strongly correlated with the VCM1 was the binocular text-reading speed, accounting for 65% of the variance in the data. The impact that reading ability has on these macular disease patients’ overall opinion of their vision is understandable when considering the importance of an intact central field on high-acuity tasks such as reading, and the importance of such tasks in daily life.

Low-contrast VA and CS in the better eye account for significant amounts of the variance in the reading scale. Reading is generally considered to be a high-contrast task, but the present study confirms earlier suggestions\(^5,6,8,10-12\) that CS, within the limits of spatial resolution, may be more important than previously recognized. Apart from the controlled tasks undertaken in the clinic or laboratory, reading tasks are often of less than optimal contrast. The everyday reading tasks that were asked about in the questionnaire had been raised as issues by patients and support workers. They included reading labels and dials, as well as books, papers, and magazines. All these reading materials can have less than optimum contrast and are often viewed under less than ideal conditions. Therefore, when patients are asked about reading performance, they may be considering low-contrast rather than high-contrast tasks. The relationship between contrast and reading in terms of contrast reserve has been investigated.\(^36\) It was found that for spot or
survival reading, a print contrast of three times the subject’s threshold contrast (or contrast reserve of three) was required, whereas print size need be only 1 times acuity threshold. Fluent reading requires much greater contrast and acuity reserves. People with low-vision with CFL have been shown to have a decreased tolerance to contrast reduction. The dependence of reading on contrast, however, has the same form as in normal vision if scaled appropriately. Therefore, patients with CFL are behaving the same as normal observers reading lower contrast text. These findings of an increased dependence on contrast for people with CFL and the high correlation of perceived reading function and low-contrast visual function found in this study suggest that print contrast is extremely important for reading. It is possible, however, that poor CS may be the result of a larger central scotoma, and poor reading performance may actually be related more closely to the use of more peripheral retina than to CS, per se.

Regardless of the cause, CS appears to be important in patients with CFL, and therefore these findings have implications not only for the choice of vision tests but also for the design of reading materials. For example, consideration should be given by manufacturers when labeling products so that maximum word visibility can be obtained that will enable the easiest identification of the product and the information provided. The results also reinforce the need for eye-care professionals to give advice regarding minimizing glare and using focal lighting to optimize the person’s contrast threshold.

The better eye low-contrast VA explains more of the variance in the reading scale than does the Pelli-Robson CS of the better eye. Although low-contrast VA and CS are similar, they are two distinct measurements. Low-contrast VA measures acuity at low contrast, whereas CS measures sensitivity to contrast at a fixed size target. Low-contrast VA may be more relevant in relation to reading, because everyday tasks require patients to read text much closer to their acuity thresholds than the letters on the Pelli-Robson chart.

Reading speed is often the dependent variable of reading research studies. In this study we found a relationship between reading speed and perceived reading (Table 3), but it was not the strongest relationship of the tests of visual function (Table 4). Discrepancies between self-reported visual performance and measured reading speed have been found previously. Friedman et al. found that 10% of their subjects showed a substantial discrepancy between self-reported difficulty reading a newspaper and measured reading speed. They suggested these subjects may represent a transitional state in progressing from fast to slower readers as function declines.

Discrepancies may also occur because the measured function, although related, is not exactly the same function as is reported. In this study, 10 of the 15 reading-related questions ask about spot-reading tasks such as reading labels, dials, and prices rather than fluent reading tasks. The contents of these questions were derived from patients and support workers, which therefore suggests that spot-reading tasks are considered important to patients with low-vision. The perceived reading ability measured by the questionnaire is therefore largely a subjective measure of spot-reading ability rather than fluent reading ability. It would be anticipated that reading speed is better related to fluent and continuous reading than to spot-reading tasks. Although reading speed is often used as a measure of reading performance in research studies, our results suggest that reading speed cannot be assumed to be the attribute on which readers base their perceived reading performance.

The correlation between perceived visual quality of life and visual function is, to an extent, specific to the cause of low vision and the types of visual function affected by the disease. Results similar to those found in this study would not necessarily be found for subjects with other visual problems. The patients in this study all have late-stage maculopathy and CFL. These findings may not be as applicable to those with earlier macular degeneration but can be considered to be applicable to those with actual loss of central field. Further, different tasks may depend more heavily on different aspects of visual function. For example reading tasks require different visual qualities than those required for good orientation and mobility. For these reasons, disease-specific questionnaires have been suggested to be more appropriate than generic questionnaires when considering a group of subjects with a single disease. The choice of questionnaire for the subject group (and subject group for the questionnaire) is therefore important to consider when analyzing the results. The main advantage of using the VQOL in this study is that it is modular. It contains one general section consisting of questions applicable to any group of people with visual problems and one section consisting of questions about a problem with which this group of patients have specific difficulties.

The subjects in this study were predominantly women. It is possible, but unlikely, that a predominantly male group

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**Figure 1.** Binocular text-reading speed (in words per minute) as a function of VCM1 score.

**Figure 2.** CS in the better eye (□) and low-contrast VA in the better eye (●) as a function of reading scale.
would have given different answers. In a comparison of self-reported and performance-based measures in the Beaver Dam Eye Study, gender differences were found to be small. Also, Monefert and Wachtmeister found that female patients with cataract reported more problems with distance estimation and orientation than did men with similar preoperative acuity. However, the observed gender differences were not consistent across a broader range of symptoms and did not extend to self-reported reading ability.

The results of the correlation and regression analyses agree with previous findings that subjective appreciation of self-reported reading ability. across a broader range of symptoms and did not extend to cataract reported more problems with distance estimation and experienced. Investigators have also noted that patients with anxiety can occur before the stage at which real difficulties are experienced. Investigators have also noted that patients with low vision and also the elderly can sometimes be poor at providing an accurate global description of their visual ability. Similarly, a short-term problem can be considered to be more distressing (and therefore more debilitating) to the patient than the same problem that has been evident for some time. In relation to this study, it would be expected that because of the emotional nature of the VCM1 questions, the VCM1 results would have been affected more by psychological factors than would the reading scale. This would be seen in the results as weaker correlations between the visual function test results and the VCM1 score because of increased noise. However, the correlations between subjective and objective measures of visual function are high in both the reading scale and the VCM1, explaining up to 75% of the variance in the questionnaire scores. Such high correlations suggest that in this group of subjects, the visual aspects account for most of the variance, leaving little to be explained by psychological factors.

In conclusion, our purpose was to determine, without prior assumptions, which clinical tests most closely reflect general visual quality of life and perceived reading performance in patients with acquired macular disease. All tests of vision correlated highly, but low-contrast measures (low-contrast VA and CS) explained most of the variance in self-reported problems with reading. Reading speed was most important for general visual quality of life. The results suggest valuable tests to supplement high-contrast distance VA measurement in patients with acquired macular disease.

References