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Prognostic Indicators and Outcome Measures for Surgical Removal of Symptomatic Nonadvanced Cataract

Sofia Charalampidou, MRCPI, MRCOphth; James Loughman, PhD; John Nolan, PhD; Jim Stack, PhD; Lorraine Cassidy, FRCOphth; Konrad Pesudovs, PhD; Stephen Beatty, MD, FRCOphth

Objectives: To report changes in perceived visual functioning after surgery for symptomatic cataract with preoperative corrected distance visual acuity [CDVA] of 0.4 logMAR or better (Snellen equivalent, 20/50) and to investigate the relationship between any observed changes and preoperative physical characteristics and psychophysical consequences of the lens opacity and any changes in psychophysical findings after the procedure.

Methods: Eighty-five patients with cataract completed a validated questionnaire concerning functional vision satisfaction and a series of visual performance assessments before and 2 months after cataract surgery. The lens optical density and Lens Opacities Classification System III score of the cataract were recorded. Correlations between changes in the Rasch-analyzed questionnaire score and changes in visual performance after cataract surgery, as well as preoperative psychophysical measures, lens optical density, and Lens Opacities Classification System III score, were determined.

Results: The mean (SD) questionnaire score improved from 2.15 (0.36) to 1.54 (0.41) ($P<.001$). The preoperative questionnaire score ($r=-0.44$), preoperative mesopic glare disability [GD] (at 1.5 cycles per degree [cpd] [$r=0.34$] and 3.0 cpd [$r=0.27$]), and preoperative photopic GD (at 1.5 cpd [$r=0.24$] and 3.0 cpd [$r=0.30$]) showed statistically significant correlations with perceived improvements in visual functioning after surgery ($P<.05$). Changes in perceived visual functioning correlated significantly with changes in mesopic GD (at 1.5 cpd [$r=-0.43$] and 3.0 cpd [$r=-0.28$]; $P<.05$) and photopic GD (at 1.5 cpd [$r=-0.24$] and 3.0 cpd [$r=-0.39$]; $P<.05$). Neither preoperative CDVA nor change in CDVA after surgery correlated significantly with perceived improvement in visual functioning after the procedure ($P>.05$ for both).

Conclusion: Psychophysical tests alternative to CDVA better represent improvements in self-reported visual functioning following removal of symptomatic nonadvanced cataract.

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AGE-RELATED CATARACT IS one of the most common eye pathologies in the Western world,[1-4] and the unprecedented increase in life expectancy[5] is leading to a dramatic rise in the demand for cataract surgery.[1-3,6] To judge the holistic impact of modern cataract surgery on the life of patients undergoing this procedure—and thus its appropriateness—it is necessary to identify and quantify the preoperative visual loss and any benefits perceived by the patient.

The 2 most widely used methods for evaluating appropriateness for and benefits of cataract surgery include the measurement of corrected distance visual acuity (CDVA) and case history evaluation of patient-reported symptoms.[7-13] Visual acuity (VA) thresholds for treatment in cataract surgery have decreased dramatically in the past 15 years.[14-16] It has recently been suggested that a minimum of 1 line of improvement on the logMAR chart in cases in which the preoperative VA is 0.4 logMAR (Snellen equivalent, 20/50) and a minimum of half a line of improvement in cases in which the preoperative VA is 0.2 logMAR (20/32) are required for a benefit to be perceived by the patient.[7,17]

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However, it has also been suggested that VA is relatively unaffected by cataract and may not be the most appropriate tool for the evaluation of visual functioning in patients with cataract.[18-23] Complementary techniques that have been investigated include contrast sensitivity (CS),[22] glare disability (GD),[24] reading performance,[25] and visual functioning assessed by a questionnaire.[12,26,27] Morpho-

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logical[28,29] and optical[30-33] characteristics of lens opacification have also been used in the assessment of cataract and have the advantage of being somewhat independent of patient cooperation and ocular comorbidity.

The study reported herein used patient self-reported visual functioning (responses to a validated questionnaire) and a number of psychophysical methods for assessing visual performance in patients with symptomatic cataract and CDVA of 0.4 logMAR or better (Snellen equivalent, ≥20/50) before and after cataract surgery. The purposes of this study were to (1) investigate changes in subjective and self-reported visual functioning in patients undergoing surgery for symptomatic cataract who had high-contrast CDVA of 0.4 logMAR or better (≥20/50), (2) determine whether alternative psychophysical outcome measures are more appropriate than CDVA in reflecting any observed changes in visual functioning after surgery, and (3) investigate whether preoperative psychophysical, lens optical, or lens morphological measures are of prognostic value for surgical intervention in such cases.

In addition, we conducted a survey of all consultant ophthalmologists in the United Kingdom and the Republic of Ireland to report on the preoperative testing of visual function currently used before cataract surgery.

METHODS

PATIENTS

Eighty-five consecutive patients with nonadvanced cataract and no other ocular pathology who were scheduled to undergo phacoemulsification cataract extraction and implantation with an intraocular lens (Tecnis 1-Piece intraocular lens; Advanced Medical Optics, Inc, Santa Ana, California) were recruited from ophthalmic clinics at the Institute of Eye Surgery, Whitfield Clinic, Waterford, Ireland. *Nonadvanced cataract* was defined as a cataract for which CDVA was 0.4 logMAR or better (Snellen equivalent, 20/50). Only 1 eye of each patient (the one with the worse CDVA) was recruited. Previous contralateral cataract surgery was not an exclusion criterion. The fellow eyes of 65 of the 82 study eyes were phakic, whereas 17 were pseudophakic. Ethics committee approval was granted from the local regional ethics committee (Research Ethics Committee, Health Service Executive, South Eastern Area, Ireland), and the research was conducted in accordance with the principles of the Declaration of Helsinki.

Exclusion criteria were having CDVA worse than 0.4 logMAR, any preoperative ocular comorbidity (whether visually consequential or inconsequential), a history of ocular trauma, a history of diabetes mellitus, and any previous intraocular surgery in the proposed study eye.

Data were collected on 2 separate occasions: 1 to 4 weeks (mean [SD], 17 [16] days) before planned cataract surgery and 2 months (61 [16] days) after surgery.

SUBJECTIVE VISUAL FUNCTIONING

Subjectively perceived visual functioning in everyday life was evaluated using the Priquest questionnaire, which is part of the Nationell Indikationsmodell för Kataraktextraktion (NIKE) indication tool, a validated indication tool for cataract surgery used in Sweden since 2006.[12] Rasch analysis was applied to the questionnaire data using commercial software (WINSTEPS Rasch measurement computer program, version 3.70.0.2; Beaverton, Oregon [http://www.Winsteps.com]), thus calibrating item difficulty and patient ability on the same scale.[34,35] We found a significant gain in precision after Rasch scaling of the questionnaire (a gain of 32% and a relative precision of 1.32), thus reinforcing the current evidence with respect to the benefits of subjecting questionnaires to Rasch scaling.[27,36,37]

VISUAL PERFORMANCE TESTING

Corrected distance visual acuity was measured monocularly and with the patient's best subjective refraction using the logMAR chart provided by a letter chart (Test Chart 2000 PRO; Thomson Software Solutions, Hertfordshire, England) at a testing distance of 4 m.

Contrast sensitivity was measured using the letter chart and the sine wave grating-based Functional Acuity Contrast Test (Optec 6500 Vision Tester; Stereo Optical Co, Inc, Chicago, Illinois). Best-corrected letter CS was determined using ETDRS (Early Treatment Diabetic Retinopathy Study) letters in logMAR form (monocularly with the study eye) at a distance of 4 m. The letters were shown in isolated rows, one row at a time, and the contrast of letters of predetermined size (and therefore a predetermined set of primary spatial frequencies) was reduced systematically using the software's contrast-adjustment function (calibrated before commencement of the study) until the patient's contrast threshold was reached (ie, the patient could read no more letters). Contrast sensitivity was also determined using the Functional Acuity Contrast Test device according to a protocol previously described.[38] Testing was performed under mesopic (3 candela per square meter [cd/m^2]) and photopic (85 cd/m^2) conditions.

The Functional Acuity Contrast Test was repeated in a manner similar to that of the CS test under mesopic and photopic conditions but with additional glare light (1 lux for mesopic and 10 lux for photopic glare testing) to assess GD.

Reading speed and near VA (logRAD [log reading acuity]) were measured with an English version of the standardized Radner reading charts while adhering to a previously described protocol.[39] Stereoacuity was measured using the TNO stereo test (Lameris Instrumenten, Utrecht, the Netherlands). Retinotopic ocular sensitivity was measured by microperimetry (Microperimeter MP 1; Nidek Technologies Srl, Albignasego, Italy) while adhering to a previously described protocol.[40] Retinotopic ocular sensitivity was calculated for 4 areas: fixation (1 stimulus), within the central 5° of fixation (average of 5 stimuli), between 5° and 10° of fixation (average of 8 stimuli), and within the central 10° of fixation (average of 13 stimuli).

LENS ASSESSMENT AND CATARACT SURGERY

Lens optical density was measured using Scheimpflug images taken by an eye scanner (Pentacam Comprehensive Eye Scanner, software version 1.16; Oculus, Inc, Wetzlar, Germany) while adhering to a previously described protocol.[31] The "densitometry along a line" part of the software was used to analyze the images, and a mean lens optical density value was recorded directly from the visual axis line appearing in the Scheimpflug image. Cataracts were categorized and graded clinically at the slitlamp in terms of nuclear, cortical, and posterior subcapsular cataract by a single ophthalmologist (S.B.) using the Lens Opacities Classification System III.[28]

Phacoemulsification cataract surgery and intraocular lens implantation in the capsular bag were performed by a single surgeon (S.B.) using topical anesthesia and a standard technique.

SURVEY

A postal survey was sent to all consultant ophthalmologists listed in the databases of the Royal College of Ophthalmologists in the United Kingdom and of the Irish College of Ophthalmologists in

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the Republic of Ireland to ascertain the methods other than VA currently used in the preoperative assessment of patients with cataract. The mailing comprised an anonymous questionnaire with a stamped, addressed envelope for return of the completed survey.

STATISTICAL ANALYSIS

The sample size was determined by power analysis: thus, a sample of 82 individuals would have power in excess of 80% to detect a correlation of 0.30 at the 5% level of significance. Descriptive statistics were calculated for all measured variables, including demographic, ocular, refractive, psychophysical, cataract optical, and cataract morphological data, as well as data on subjective visual functioning (the questionnaire) and the survey responses. Visual acuity rating scores[41] were used for the statistical analysis of VA data. Statistical analysis was performed using the PASW Statistics 18.0 software package (IBM Corp, Somers, NY).

Preoperative and postoperative measures were compared using the paired-samples *t* test (for continuous variables: Rasch-scaled score, CDVA, spherical equivalent, CS, GS, logRAD, reading speed, and retinal sensitivity) or the Wilcoxon 2-related-samples signed ranks test (for stereopsis, the categorical variable). The independent-samples *t* test was used to compare Rasch-scaled scores in VA subgroups (subgroups based on having preoperative CDVA of <0.2 or ≥ 0.2 logMAR and also based on having preoperative CDVA of <0 or ≥ 0 logMAR).

Correlations between observed changes in Rasch-scaled scores and observed changes in psychophysical measures after cataract surgery, as well as correlations between observed changes in Rasch-scaled scores and preoperative psychophysical measures (lens optical density and Lens Opacities Classification System III scores), were investigated using Spearman rank correlations. Tests were 2-sided in all analyses, and $P \leq .05$ was considered statistically significant.

RESULTS

Eighty-five patients (85 eyes) met the inclusion criteria and were recruited into this study. Two patients developed transient corneal edema, and 1 patient developed self-limiting cystoid macular edema. Their data were therefore excluded from analysis, thus yielding data from 82 eyes of 82 patients for analysis.

The mean (SD) age was 66.8 (8.8) years (range, 47-85 years). The male to female ratio was 28:54, and the right eye to left eye ratio was 39:43. The mean (SD) time from preoperative assessment to surgery was 17 (16) days (range, 1-90 days), and the mean (SD) follow-up was 61 (16) days (range, 15-120 days).

The mean (SD) Rasch-scaled questionnaire score improved from 2.15 (0.36) (range, 1.37-3.13) to 1.54 (0.41) (range, 1.00-2.61; $P < .001$). All psychophysical measures tested, with the exception of CDVA of the fellow eye, exhibited statistically significant improvements after surgery (**Table 1**).

The following preoperative (baseline) psychophysical variables showed statistically significant correlations with observed changes in the Rasch-scaled questionnaire score after cataract surgery: CS by letters at 1.2 and 2.4 cycles per degree (cpd), mesopic CS by gratings at 1.5 cpd, mesopic GD at 1.5 and 3.0 cpd, and photopic GD by gratings at 1.5 and 3.0 cpd (**Table 2**). The remaining variables were not significantly correlated ($P > .05$ for all). There was no significant difference between preoperative (baseline) CDVA subgroups in terms of observed changes in Rasch-scaled questionnaire score after cataract surgery (**Figure 1**). The relationship between the preoperative Rasch-scaled questionnaire score and observed changes in the Rasch-scaled questionnaire score after cataract surgery is represented by a scatterplot (**Figure 2**), and the correlation between these variables was statistically significant ($r = -0.44$; $P < .001$).

Changes in the following psychophysical variables after cataract surgery showed statistically significant correlations with changes in the Rasch-scaled questionnaire score: CS by letters at 1.2, 2.4, and 24.0 cpd; mesopic GD at 1.5 and 3.0 cpd; photopic GD at 1.5, 3.0, and 6.0 cpd; reading acuity; and reading speed at a print size of 0.5 logRAD and at print sizes between 0.8 and 1.2 logRAD (**Table 3**). Changes in the remaining variables were not significantly correlated with changes in the Rasch-scaled questionnaire score ($P > .05$ for all).

SURVEY

The survey was mailed to all 972 members of the Royal College of Ophthalmologists and all 66 members of the Irish College of Ophthalmologists, with a 56.1% response rate (582 responses). Of the respondents, 38 (6.5%) did not perform cataract surgery, thus yielding 544 responses for analysis. Routinely used methods of preoperative visual function assessment and cataract morphological assessment are illustrated in **Figure 3**. In brief, 100.0% of consultant ophthalmic surgeons use VA (90.8% use Snellen, 9.1% use logMAR, and 9.1% use both Snellen and logMAR) in the preoperative assessment of visual function before cataract surgery, whereas 2.6% use a validated questionnaire and 2.2% test CS and/or GD.

COMMENT

To our knowledge, this study represents the first evaluation of prognostic indicators and outcome measures for surgical removal of symptomatic nonadvanced cataract in a way that relates to patients' subjectively perceived improvement in visual functioning after the procedure. We report that patients' self-reported impairment of visual functioning attributable to cataract with CDVA of 0.4 logMAR or better (Snellen equivalent, 20/50) was alleviated by surgery. Our results are consistent with previous studies investigating improvement in visual functioning after cataract surgery[18,36,43] and are consistent with guidelines published by the American Academy of Ophthalmology (http://one.aao.org/CE/PracticeGuidelines/PPP_Content.aspx?cid=a80a87ce-9042-4677-85d7-4b876deed276#section4). However, our results are not in keeping with the recommendations of some investigators,[7,11,17] who have stated that the threshold for cataract surgery should be based on preoperative CDVA of 0.3 logMAR (Snellen equivalent, 20/40) for the better eye and 0.52 logMAR (20/62) for the worse eye and who contend that *success* should be defined as at least 2 lines of gain in logMAR CDVA. Nevertheless, the authors of one of these studies[11] did concede that the ethical considerations of setting such preoperative VA limits for cataract surgery are open to criticism and that visual symptoms reported by the patient should represent an indication for operating in patients with good CDVA.

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Table 1. Changes in Psychophysical Measures After Cataract Surgery in 82 Patients

Variable	Mean (SD)		*P* Value
	Preoperative	Postoperative	
High-contrast VA, logMAR			
CDVA in study eye	0.18 (0.16)	0.02 (0.10)	<.001
CDVA in fellow eye	0.12 (0.12)	0.10 (0.14)	.10
Refractive status: SE in study eye, D	0.10 (2.80)	–0.31 (0.62)	.20
Photopic logCS by letters according to spatial frequency, cpd			
1.2 (n = 79)	1.38 (0.19)	1.70 (0.26)	<.001
2.4 (n = 79)	1.31 (0.25)	1.63 (0.24)	<.001
6.0 (n = 78)	1.00 (0.31)	1.43 (0.20)	<.001
9.6 (n = 72)	0.78 (0.29)	1.23 (0.22)	<.001
15.2 (n = 53)	0.54 (0.27)	1.00 (0.21)	<.001
24.0 (n = 13)	0.34 (0.14)	0.59 (0.31)	.03
Mesopic logCS by gratings according to spatial frequency, cpd			
1.5 (n = 79)	1.44 (0.22)	1.83 (0.16)	<.001
3.0 (n = 77)	1.51 (0.24)	1.93 (0.19)	<.001
6.0 (n = 40)[a]	1.31 (0.20)	1.63 (0.25)	<.001
12.0 (n = 2)[a]	1.11 (0.10)	1.11 (0.10)	<.001
18.0 (n = 1)[a]	0.60 (. . .)	0.90 (. . .)	. . .
Photopic logCS by gratings according to spatial frequency, cpd			
1.5 (n = 79)	1.35 (0.20)	1.71 (0.16)	<.001
3.0 (n = 79)	1.58 (0.22)	1.97 (014)	<.001
6.0 (n = 57)	1.46 (0.21)	1.90 (0.21)	<.001
12.0 (n = 24)[a]	1.16 (0.17)	1.48 (0.21)	<.001
18.0 (n = 19)[a]	0.95 (0.20)	1.19 (0.27)	<.001
Mesopic logGD by gratings according to spatial frequency, cpd			
1.5 (n = 64)	1.31 (0.23)	1.61 (0.24)	<.001
3.0 (n = 61)	1.45 (0.22)	1.78 (0.21)	<.001
6.0 (n = 22)[a]	1.36 (0.25)	1.58 (0.17)	.02
12.0 (n = 1)[a]	0.09 (. . .)	0.09 (. . .)	. . .
18.0 (n = 1)[a]	0.78 (. . .)	0.78 (. . .)	. . .
Photopic logGD by gratings according to spatial frequency, cpd			
1.5 (n = 74)	1.34 (0.20)	1.62 (0.18)	<.001
3.0 (n = 71)	1.57 (0.20)	1.91 (0.18)	<.001
6.0 (n = 47)	1.47 (0.22)	1.84 (0.23)	<.001
12.0 (n = 22)[a]	1.14 (0.15)	1.49 (0.24)	<.001
18.0 (n = 13[a])	1.01 (0.21)	1.19 (0.30)	.05
Reading performance			
logRAD (n = 80)	0.33 (0.21)	0.19 (0.09)	<.001
logRAD score (n = 80)	0.33 (0.21)	0.20 (0.09)	<.001
Reading speed, wpm, by print size, logRAD			
1.2 (n = 80)	150 (31)	170 (31)	<.001
1.1 (n = 80)	144 (31)	162 (30)	<.001
0.9 (n = 77)	149 (37)	169 (32)	<.001
0.8 (n = 77)	149 (36)	164 (30)	<.001
0.7 (n = 77)	143 (37)	166 (32)	<.001
0.6 (n = 72)	138 (39)	162 (37)	<.001
0.5 (n = 71)	136 (49)	157 (40)	<.001
0.4 (n = 68)	130 (42)	156 (42)	<.001
0.3 (n = 64)	97 (55)	142 (43)	<.001
0.2 (n = 31)	101 (41)	129 (50)	.01
0.1 (n = 2)	110 (16)	137 (22)	.10
Retinotopic ocular sensitivity, dB			
Fixation (n = 81)	14.6 (5.0)	17.4 (3.4)	<.001
Central 5° (n = 81)	15.9 (3.8)	18.6 (1.9)	<.001
Between 5° and 10° (n = 81)	16.5 (3.5)	18.8 (2.0)	<.001
Central 10° (n = 81)	16.3 (3.6)	18.7 (1.9)	<.001
Stereopsis, median, mode, min of arc (n = 80)	120, 120	120, 60	<.001

Abbreviations: CDVA, corrected distance visual acuity; cpd, cycles per degree; CS, contrast sensitivity; D, diopters; ellipses, not applicable; GD, glare disability; logRAD, log reading acuity; SE, spherical equivalent; VA, visual acuity; wpm, words per minute.

[a] Only a small number of patients achieved the minimum score during CS and GD testing by gratings. This is owing to a known floor effect when testing CS/GD with the Functional Acuity Contrast Test, in the presence of cataract.[42]

In this study, all psychophysical measures tested, with the exception of CDVA of the fellow eye, showed statistically significant improvements after surgery. All these statistically significant changes are of limited or indeterminate clinical value unless associated with improvement in subjectively perceived visual functioning after the proce-

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Table 2. Significant Correlations Between Preoperative (Baseline) Psychophysical Variables and Postoperative Changes in Rasch-Scaled Questionnaire Score

Preoperative Psychophysical Variable	Spearman Correlation With Postoperative Changes in Rasch-Scaled Questionnaire Score
Contrast sensitivity	
Photopic by letters according to spatial frequency, cpd	
1.2 (n = 79)	−0.27[a]
2.4 (n = 79)	−0.30[a]
Mesopic by gratings according to spatial frequency, cpd	
1.5 (n = 79)	0.22[a]
Glare disability	
Mesopic by gratings according to spatial frequency, cpd	
1.5 (n = 64)	0.34[b]
3.0 (n = 61)	0.27[a]
Photopic by gratings according to spatial frequency, cpd	
1.5 (n = 4)	0.24[a]
3.0 (n = 71)	0.30[b]

Abbreviation: cpd, cycles per degree.
[a] Correlation is significant at the .05 level (2-tailed).
[b] Correlation is significant at the .01 level (2-tailed).

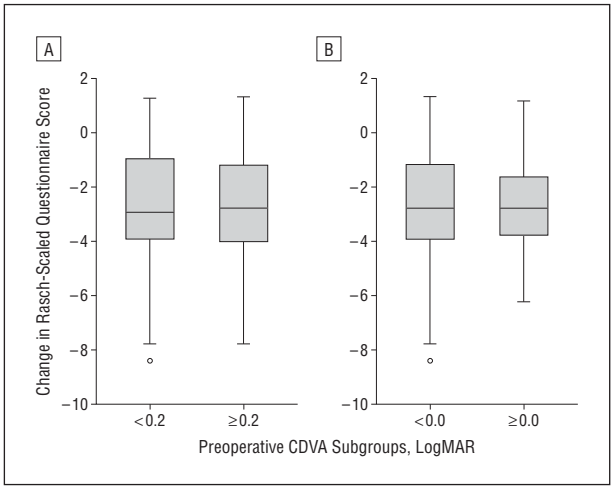

Figure 1. Change in Rasch-scaled questionnaire scores of patients in various preoperative (baseline) corrected distance visual acuity (CDVA) subgroups. A, Change in questionnaire scores of patients with preoperative CDVA of 0.2 logMAR or better (Snellen equivalent, 20/32; 46 patients) vs patients with preoperative CDVA of less than 0.2 logMAR (20/32; 36 patients; $P = .93$, paired t test). B, Change in questionnaire scores of patients with preoperative CDVA of 0.0 logMAR or better (Snellen equivalent, 20/20; 9 patients) vs patients with preoperative CDVA of less than 0.0 logMAR (20/20; 73 patients; $P = .965$, paired t test). Each box is given by the 75% percentile (top) and 25% percentile (bottom) and its length (interquartile range) by the difference between the 2 percentiles. The horizontal line inside the box represents the median (50% percentile). The whiskers represent 95% confidence intervals. The open circles represent outliers outside the 95% confidence intervals.

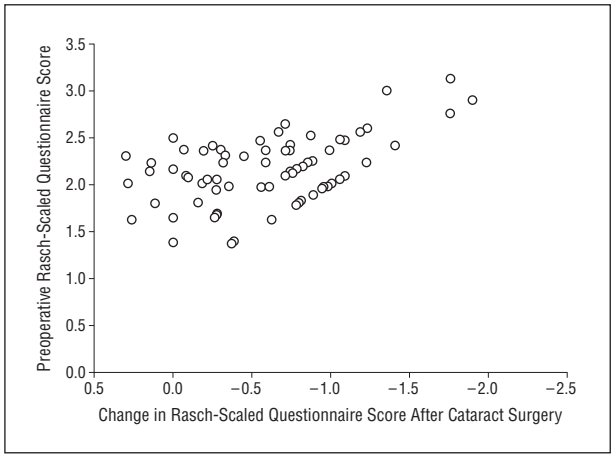

Figure 2. Preoperative (baseline) Rasch-scaled questionnaire score vs change in Rasch-scaled questionnaire score.

Table 3. Significant Correlations Between Postoperative Changes in Psychophysical Variables and Postoperative Changes in Rasch-Scaled Questionnaire Score

Psychophysical Variable (Postoperative Change)	Spearman Correlation With Postoperative Changes in Rasch-Scaled Questionnaire Score
Contrast sensitivity	
Photopic by letters according to spatial frequency, cpd	
1.2 (n = 79)	−0.32[a]
2.4 (n = 79)	−0.28[b]
24.0 (n = 13)	−0.48[b]
Glare disability	
Mesopic by gratings according to spatial frequency, cpd	
1.5 (n = 64)	−0.43[a]
3.0 (n = 61)	−0.28[b]
Photopic by gratings according to spatial frequency, cpd	
1.5 (n = 74)	−0.24[b]
3.0 (n = 71)	−0.39[b]
6.0 (n = 47)	−0.35[b]
Reading performance	
logRAD	0.26[b]
Reading speed, wpm, by print size	
1.2 (n = 80)	−0.32[a]
1.1 (n = 80)	−0.29[a]
0.9 (n = 77)	−0.35[a]
0.8 (n = 77)	−0.22[b]
0.5 (n = 71)	−0.28[b]

Abbreviations: cpd, cycles per degree; logRAD, log reading acuity; wpm, words per minute.
[a] Correlation is significant at the .01 level (2-tailed).
[b] Correlation is significant at the .05 level (2-tailed).

dure. We found that improvement in the Rasch-scaled questionnaire score correlated significantly with improvement in CS and GD at particular spatial frequencies. In addition, and of prognostic value, we found significant correlations between improvement in the questionnaire score and preoperative (baseline) GD at the same spatial frequencies. This latter finding indicates that GD not only is a useful outcome measure for cataract surgery but also may be a valuable prognostic indicator for improvement in visual functioning attributable to the lens opacity after successful surgery. We believe these findings are consistent with the clinical experience of many ophthalmic surgeons who see patients reporting decreased visual functioning de-

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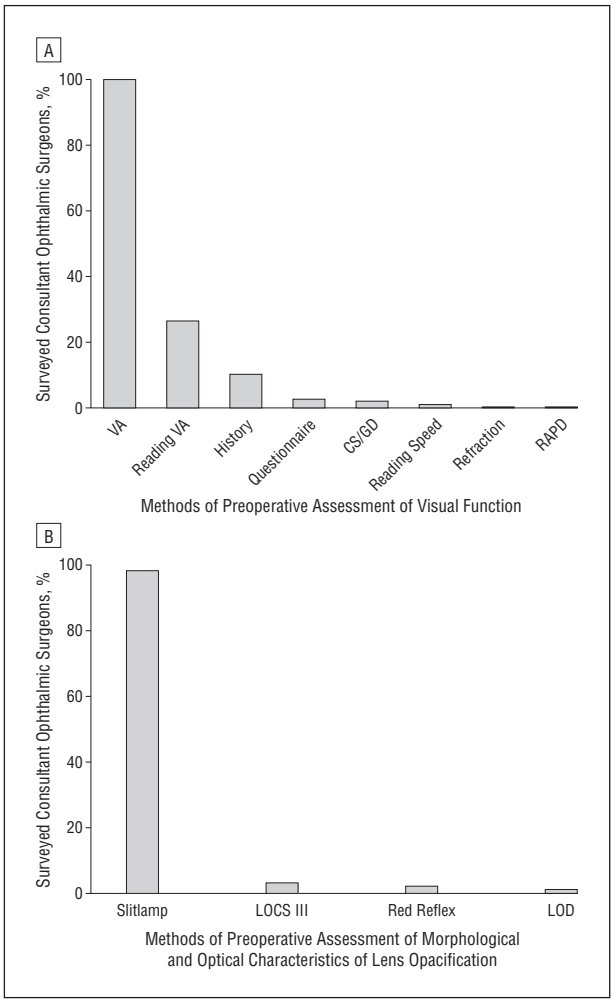

Figure 3. The relative popularity of methods used by consultant ophthalmic surgeons in the United Kingdom and the Republic of Ireland for evaluating patients before cataract surgery. A, Methods of assessment of visual function in patients being considered for cataract surgery before the procedure. B, Methods of preoperative assessment of morphological and optical characteristics of lens opacification in patients being considered for cataract surgery before the procedure. CS indicates contrast sensitivity; GD, glare disability; LOCS III, Lens Opacities Classification System III; LOD, lens optical density; RAPD, relative afferent pupillary defect; and VA, visual acuity.

spite good high-contrast CDVA preoperatively. It is likely that these patients are reporting the symptoms of loss of CS, which is further provoked under conditions of glare, leading to GD, which is known to be associated with degradation of the retinal image as a result of intraocular stray light arising at the lens opacity.[33] Our findings are consistent with those of previous investigators[18,19,21,22,24] with respect to GD and cataract and with regard to alleviation of GD after surgical removal of the lens opacity.

Improvement in visual functioning after cataract surgery was related to the preoperative questionnaire score (Figure 2); a high preoperative score was associated with the greatest improvement in visual functioning, although this finding should be interpreted with some degree of caution because the preoperative score is part of both variables. Nevertheless, this finding suggests a role for formal assessment of patients' subjective visual functioning in the preoperative setting. We make this suggestion, mindful that only 2.6% of consultant ophthalmic surgeons in the United Kingdom and Republic of Ireland routinely use a questionnaire in the preoperative evaluation of patients with cataract. This finding also has important medicolegal implications relating to documentation of visual performance and visual functioning before cataract surgery.[44] If we fail to measure and document variables that relate to the improvement of subjectively perceived visual functioning after cataract surgery and continue to measure CDVA only, we will be unable to draw on documentation demonstrating that the patient had subjectively perceived impairment of visual functioning and that he or she was likely to benefit from surgery.

Therefore, we believe that there is a rationale to support the incorporation of GD testing under mesopic and/or photopic conditions (at 1.5 and/or 3.0 cpd), as well as evaluation of functional vision by means of a validated questionnaire, into the preoperative assessment of patients with symptomatic nonadvanced cataract. These supplemental tests represent only a 5- to 10-minute extension of a typical preoperative assessment for cataract surgery, depending on whether the questionnaire is completed before that consultation.

We report no significant correlation between preoperative (baseline) VA and improvement in visual functioning and no statistically significant correlation between the observed improvement in CDVA and the observed improvement in self-reported visual functioning. Furthermore, we found that the subgroup of patients with preoperative CDVA of 0.0 logMAR or better (Snellen equivalent, ≥20/20) in the study eye did not differ significantly from the subgroup of patients with preoperative CDVA of less than 0.0 logMAR (<20/20) in terms of change in perceived visual functioning. A similar finding is reported when patients were dichotomized according to preoperative CDVA of 0.2 or better vs less than 0.2 logMAR (20/32), indicating that preoperative CDVA in this group of patients is of no prognostic value in discriminating between those who are and are not likely to experience improvement in visual functioning after the procedure. These findings are clinically important given that CDVA is the only psychophysical test used by most consultant ophthalmic surgeons and suggest that VA used in isolation is not the most appropriate test for assessing symptomatic nonadvanced cataract.

Visual acuity is a measure of the spatial resolving ability of the visual system under conditions of very high contrast. In terms of CS, VA is defined as a measure of the highest spatial frequency that can be detected at 100% contrast.[45] However, CDVA alone fails to capture the functional problems attributable to cataract because it measures only one aspect of visual impairment. Most individuals engage in few daily activities that involve visual stimuli at 100% contrast, reflected in the consensus that CS is a stronger correlate of visual function.[22]

In conclusion, this study shows that the strongest preoperative indicators for improvement in visual functioning after surgery for symptomatic nonadvanced cataract are GD (tested at low and medium spatial frequencies) and questionnaire score. Neither preoperative CDVA nor change in CDVA after the procedure relates to the observed improvement in visual functioning. These findings suggest that ophthalmologists should not select patients with symptomatic nonadvanced cataract for surgery on the basis of CDVA alone but rather should consider introducing GD testing at low and medium spatial frequencies and admin-

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istration of a validated visual functioning questionnaire into the decision-making process. These tests are simple to administer, consume very little time, and can easily be incorporated into a busy ophthalmic practice.

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