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Prediction of Visual Function After Cataract Surgery

A Prospectively Validated Model

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Objective: To develop a model to predict visual functional improvement after cataract extraction with intraocular lens implantation based on preoperative data.

Design: A prospective study with serial evaluations of visual function preoperatively and at 3 and 12 months after surgery.

Setting: The General Eye Service of the Massachusetts Eye and Ear Infirmary, Boston, Mass, and 33 ophthalmology practices in Boston.

Patients: Patients (N=426; ages, ≥ 65 years) who were undergoing cataract surgery.

Methods: Twelve-month improvement in visual function was measured by using the Activities of Daily Vision Scale (ADVS). Ordinal logistic regression was used to identify correlates of improved ADVS scores in 281 patients (derivative set). Potential factors included the preoperative visual acuity, preoperative ADVS score, four chronic ocular diseases, eight medical conditions, and demographic characteristics. Five predictors were identi-

fied and used to construct a prediction rule. The accuracy of the prediction rule was evaluated in an independent group of 145 patients (validation set).

Results: Postoperatively, 40% of the 281 patients in the derivative set had substantial improvement in their ADVS scores, and 53 (19%) had some improvement. Predictors of improvement included younger age ($P<.001$), a poorer preoperative ADVS score ($P<.001$), posterior subcapsular cataract ($P=.09$), and absence of age-related macular degeneration ($P=.07$) and/or diabetes ($P=.006$). When applied to the independent sample of 145 patients, these five characteristics classified the patients into three groups in which the probabilities of substantial improvement were 85%, 34%, and 3%, thus verifying the discriminatory power of the prediction rule.

Conclusions: Preoperative data can identify patients who are likely to have improvements in visual function after cataract surgery. Such findings may be useful in the selection of patients for this high-volume procedure.

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CATARACTS ARE the second leading cause of blindness in the United States. It is estimated that 18% of persons ages 65 to 74 years and 46% of those ages 75 to 84 years have cataracts,¹ and that cataracts are responsible for one third of severe visual impairment in elderly persons.² The resulting loss of visual acuity has important implications for physical function,³ potentially for cognitive function,⁴ and for independent living. Therefore, cataracts may be one of the most important causes of reversible disability in elderly persons.

Cataract extraction is the most frequent surgical procedure that is performed on beneficiaries of Medicare, at a cost of \$3.4 billion for the 1991 Medicare program.⁵ There is a consensus that the most appropriate indication for this surgical procedure is patient-reported visual functional disability that is attributable to the presence of a cataract.⁵ At the same time, there is conflicting evidence about how

much cataract extraction is inappropriate, with estimates ranging from 2%⁶ to 16%.⁷ Some of this discrepancy is owing to the lack of a consistent definition of what is considered appropriate. Because of a limited sample size or because patients with other eye diseases were excluded, most previous investigations of the appropriateness of cataract extraction have not simultaneously identified the relative importance of specific ophthalmologic and medical conditions that are associated with improvements in visual functioning after surgery.⁸⁻¹⁰ Therefore, a clinical decision rule that incorporates the preoperative characteristics that are associated with the greater likelihood of improvement in visual function after surgery may improve the selection of patients for cataract extraction. We

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on next page*

For list of author affiliations
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PATIENTS AND METHODS

PATIENT POPULATION

As permitted by the available research staff, we prospectively enrolled consecutive patients who were 65 years or older; these patients were scheduled for their first or second eye cataract extraction in the General Eye Service of the Massachusetts Eye and Ear Infirmary, Boston, Mass, or in one of 33 ophthalmology practices in Boston. The participating ophthalmologists gave consent to approach all preoperative patients and played no role in the selection of participants. Exclusion criteria based on judgments of the research staff included a patient's inability to speak English, a patient's decreased hearing or cognitive function such that the patient would be unable to understand a telephone interview, or a planned procedure for the simultaneous treatment of glaucoma. Of 690 patients who underwent a screening, 145 met at least one exclusion criterion. Of the remaining 545 persons who were eligible for enrollment, 451 (83%) gave informed consent. Major reasons for refusal were a lack of interest in 50 patients (53%) and personal or family illnesses in 23 patients (24%). After enrollment, surgery was canceled for 25 patients (6%); this left 426 patients for analyses.

DATA COLLECTION

Measurement of Visual Difficulties

Before surgery and at 3 and 12 months after surgery, patients were evaluated by telephone using the ADVS,¹¹ which consists of 20 common visual activities that are categorized into five subscales: night driving, daytime driving, distance vision activities that do not require driving, near vision activities, and activities that are subject to glare. The subscales are combined to give an overall visual function score that ranges from 0 to 100 points, where 100 represents no difficulty and 0 means that the activities are no longer performed because of visual impairment. Patients also rated their best corrected vision as excellent, good, fair, poor, or blind.³

Clinical Ophthalmologic Data

Best corrected visual acuity (as determined by Snellen's chart test types) and ocular conditions were obtained preoperatively, at 3 months, and at 1 year after surgery by chart reviewers who were masked to the questionnaire data. Because few patients

had only a posterior subcapsular cataract, evidence of a posterior subcapsular cataract alone or in combination with nuclear and/or cortical changes was classified as a posterior subcapsular cataract. For age-related macular degeneration (AMD), the examining ophthalmologist had to note pigment change or drusen, and the diagnosis had to be documented in the outpatient preoperative medical record. Glaucoma was defined by the use of medications or past surgical or laser treatments of glaucoma and documentation of this diagnosis in the ophthalmology medical record. Data on eye conditions (eg, corneal disease, pseudoexfoliation, previous retinal detachment, amblyopia, previous cystoid macular edema, and diabetic retinopathy) were collected. Preoperative visual acuities in the eye scheduled for cataract extraction and the companion eye were both considered in the analyses of visual functional improvement after surgery. Visual acuity measurements were converted into the logarithmic-transformed minimum angle of resolution since this created an equal-discriminability scale and has been recommended as the analytic standard.¹² Five percent of the medical records were randomly rereviewed by one of us (M.G.L.) to assess the reliability of other diagnoses; the agreement between reviewers was perfect.

Chronic Medical Conditions

Before surgery, patients reported the use of medications and their chronic medical conditions (eg, hypertension, diabetes mellitus, congestive heart failure, chronic obstructive lung disease, previous stroke, myocardial infarction, hip fracture, or previous malignant neoplasms other than non-melanoma skin cancer). Diabetes mellitus was defined by the current use of insulin or oral hypoglycemic agents.

STATISTICAL ANALYSIS

Definition of Improvement in Visual Function

The end point was improvement in the ADVS score at 12 months; this improved score was categorized into three groups based on the test-retest variability of the ADVS as measured from interviews of an independent convenience sample of 52 elderly visually impaired adults with either cataracts (n=19) or AMD (n=33). The mean ADVS score for the group overall was 78 points (interquartile range of scores, 62 to 95 points), and 61% of those with AMD had binocular involvement. The improvement in patients' scores was classified as "substantial" if the 12-month change in a score was greater than 2 SDs as defined by the difference

used the Activities of Daily Vision Scale (ADVS), which assesses the impact of visual loss on the ability to perform vision-specific tasks¹¹; preoperative clinical data were used to develop a model for predicting visual functional improvement after cataract extraction.

RESULTS

IMPROVEMENT IN VISUAL FUNCTION AFTER CATARACT EXTRACTION

For the patients in whom visual acuity was measured after they underwent the surgical procedure, 80% had a best corrected visual acuity of 20/40 or better in the eye

that had surgery. Of the 426 patients, 165 (39%) had substantial improvement, 85 (20%) had some improvement, and 176 (41%) had minimal or no improvement in the ADVS score after they underwent the surgical procedure (**Figure 1**). Alternatively, if any positive change in the ADVS score from the preoperative time point to 12 months is considered to be improvement without adjusting for possible misclassification owing to chance, then 328 patients (77%) had some improvement.

CHARACTERISTICS OF THE DERIVATION SET

The 281 patients with serial ADVS data in the derivation set had a mean \pm SD age of 76 \pm 6 years, and 194 (69%) were

in the test-retest variability. Because variability was less for higher ADVS scores, the test-retest cohort was divided into patients with initial ADVS scores at or above the median of 73 points (SD for the test-retest difference of eight points for these patients), and patients with ADVS scores below the median (SD for the test-retest difference of 12 points). Patients with preoperative scores at or above 73 points were classified as having substantial improvement if the ADVS score was improved by 16 points or more, while those patients with scores below the median needed at least 24 points. Patients with scores above or below the median were classified as having "some improvement" if their ADVS score was improved by less than 2 SDs but greater than 1 SD as defined by the test-retest variability on the ADVS. Other patients were classified as having "minimal or no improvement." The creation of improvement categories enhanced the feasibility of applying the decision rule in the clinical setting.

Validity of the ADVS as the End Point for Improvement

Since patients with monocular vision can perform most visual activities with ease, we expected preoperative ADVS scores to be significantly correlated with visual acuity in the better eye before surgery. To examine this association, the mean preoperative ADVS scores were classified according to Snellen's chart visual acuity in the better and worse eye before surgery, and linear regression models were used to estimate the magnitude and significance of the observed correlations. To extend our previous analyses¹³ of the validity of the ADVS for longitudinal assessments, we compared the mean changes in the ADVS scores with the change in a previously tested five-category global visual rating question after cataract extraction.³

Prediction Rule Development

A random two thirds of the cohort was used to derive the prediction rule (derivation set). The accuracy of the scoring system and predictive categories were then validated on the remaining one third (validation set). In the derivation set, univariate correlates of improvement in the ADVS were identified by using Student's *t* tests, Wilcoxon's rank sum tests, χ^2 tests, or Fisher's exact tests. All ophthalmologic and medical variables that were found in more than 2% of the derivation set were entered into a backward-stepwise ordinal logistic regression model by using $P \leq .10$ as an inclusion level for vision-related variables and $P \leq .05$

for all other variables. A less rigorous *P* value was used for vision-specific variables to decrease the probability of excluding important clinical characteristics from the model. Candidate variables were the preoperative visual acuity, preoperative ADVS score, age, gender, type of cataract, presence of other chronic eye diseases, prior cataract extraction, and medical comorbidities. Previous retinal detachment, cystoid macular edema, and amblyopia were present in less than 2% of the cohort and were not included.

To increase the ease and feasibility of applying the prediction rule in the preoperative clinical setting, the β coefficients from the final logistic model were rounded to integers and added to calculate a score for which cut-points were ascertained that matched the observed improvements for the patients' scores in the derivation set. Use of the β coefficients, rather than rounded integers, did not change the predictive accuracy of the decision rule. The accuracy of the prediction rule was then tested on the 145 patients in the validation set.

For 41 patients, the 12-month ADVS scores were missing, but the 3-month values were available. To minimize the influence of nonrandom loss to follow-up, linear regression analysis was used to impute 12-month data based on the available preoperative and 3-month follow-up data in these patients. Another 15 patients who had died or were too ill to be interviewed were classified as having minimal or no improvement at 12 months. Only six patients were excluded from the analyses because no follow-up data were available for these six patients at 3 or 12 months. In addition, 33 patients (12%) in the derivation set had undergone a cataract extraction on their other eye during the 1-year follow-up interval. Since our goal was to develop a prediction rule that was based solely on readily available preoperative characteristics, postoperative factors (eg, subsequent cataract extraction in the companion eye) were not initially included as a candidate variable. The logistic regression analyses were repeated to assess whether either the exclusion of persons who had undergone a subsequent surgical procedure on the second eye, or who had imputed data at 12 months, or who had died or were too ill to be interviewed from the model influenced the content of the prediction rule. Since the prognostic factors that were selected in the model remained the same when these persons were excluded, we do not report further on these sensitivity analyses. The data management strategy that was used permitted 426 (99%) of the original 432 patients to remain in the analyses. Data are reported as the mean \pm SD, and all *P* values are from two-sided tests.

women. According to Snellen's chart, the median visual acuity in the eye scheduled for surgery was 20/70 (interquartile range, 20/50 to 20/200). In the derivation set, 112 patients (40%) had substantial improvement, 53 (19%) had some improvement, and 16 (41%) had minimal or no improvement (**Table 1**). In the derivation set before surgery, 66 patients (23%) had AMD, and 28 (10%) had glaucoma (**Table 2**). Thirty-seven patients (12%) had two or more other eye conditions in addition to cataracts.

VALIDITY OF THE ADVS

For the cohort overall, poorer preoperative visual acuity in both the better and worse eye was correlated with

lower (poorer) ADVS scores before surgery ($P = .001$ and $P = .04$, respectively). By using linear regression to adjust for logarithmic-transformed visual acuity in the other eye, the relationship between the preoperative measured visual acuity and ADVS score was stronger for the better eye (**Figure 2**). The mean changes in the ADVS scores among those patients who, on the global rating question reported that their vision was improved, the same, or worse, were 24, 8, and -11 points, respectively ($P < .001$). The mean eight-point change in the ADVS score for those patients who rated themselves the same at 12 months after surgery was within 1 SD of the reliability of the ADVS; therefore, this change would be classified in the category of minimal or no improvement. The cor-

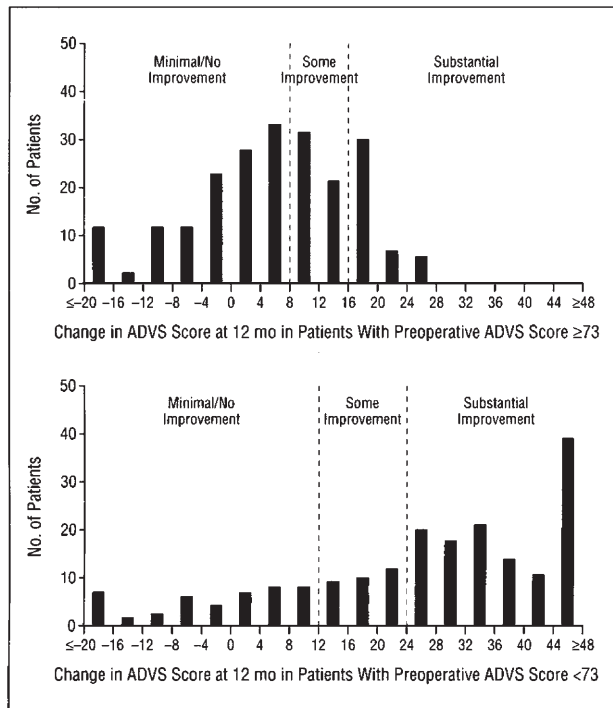


Figure 1. Distribution of change in the Activities of Daily Vision Scale (ADVS) scores by whether the patients' preoperative scores were above (top) or below (bottom) the median score in the test-retest cohort.

relation between the changes in the ADVS score and in visual acuity in the eye that had surgery was $r = -.29$ ($P < .001$).

CLINICAL PREDICTION RULE DEVELOPMENT

Bivariate Tests of Association With Improvement in ADVS Scores in the Derivation Set

There was a significant trend toward younger age and lower (worse) preoperative ADVS scores for those patients with substantial improvement after surgery. Patients with substantial improvement also had a statistically significant poorer preoperative visual acuity in the eye that had surgery according to Snellen's chart (Table 2). With the exception of AMD, where there was a trend toward fewer patients with substantial improvement ($P = .07$), none of the other chronic ocular or medical conditions that were tested were statistically significant correlates of improvement in the ADVS scores.

Multivariate Tests of Association With Improved ADVS Scores

Significant multivariate correlates of improvement in the ADVS scores after cataract extraction included younger age (odds ratio [OR] of 2.0, when comparing patients who differed in age by 10 years) and a lower preoperative ADVS score (OR of 1.6 when comparing patients whose preoperative ADVS scores differ by 10 points). Although the following characteristics were not significant bivariate correlates of change in the ADVS scores, in the multivariate model, patients who had evidence of a posterior subcapsular cataract were 1.5 times as likely to have improve-

Table 1. Three Levels of Improvement in Visual Functioning Based on the Test-Retest Variability of the ADVS*

	No. (%) of Patients		
	Substantial Improvement	Some Improvement	Minimal or No Improvement
Derivation set (n=281)	112 (40)	53 (19)	116 (41)
Validation set (n=145)	53 (37)	32 (22)	60 (41)

*ADVS indicates Activities of Daily Vision Scale; substantial improvement, a change from preoperative to postoperative levels of at least 2 SDs of test-retest differences; some improvement, a change from preoperative to postoperative levels of at least 1 SD of test-retest differences; and minimal or no improvement, a change from preoperative to postoperative levels 1 SD or less from the test-retest differences.

ment in their ADVS scores, those without AMD were 1.6 times as likely to have improved ADVS scores, and those without diabetes mellitus were 2.7 times as likely to have improved ADVS scores (Table 3).

A multivariate model with a change in the ADVS score at 3 months after surgery as the dependent variable identified four of the same five significant factors as did the 12-month model. In the 3-month model, age was no longer a statistically significant correlate, and better preoperative visual acuity (as determined with Snellen's chart test types) in the eye that had surgery and previous stroke became significant correlates of less improvement. However, the overall fit as estimated by the percent concordance between predicted probabilities and observed responses was 79% and 77% for the 3- and 12-month models, respectively, indicating that the two additional factors did not substantially affect the overall accuracy of the prediction rule.

Based on the magnitude of the β coefficients for the five significant clinical factors from the 12-month model (Table 3), patients with a higher point score were less likely to have improved ADVS scores. In the derivation set, 71% of those patients with six or fewer points had substantial improvement in their ADVS scores after surgery compared with 45% of those patients with seven to 10 points and 4% of patients with more than 10 points (Figure 3, top).

Evaluation of the Clinical Prediction Rule

The 145 members in the validation set had a similar mean age, preoperative ADVS scores, preoperative visual acuities (as determined with Snellen's chart test types), and frequencies of chronic ocular and medical conditions as found in the patients in the derivation set. The validation set also had a similar proportion of patients who were classified into each of the improvement groups: 53 (37%) had substantial improvement, 32 (22%) had some improvement, and 60 (41%) had minimal or no improvement in their ADVS scores after surgery (Table 1).

When the clinical prediction model was prospectively applied to the validation set, it successfully stratified patients according to their likelihood of improvement in the ADVS scores. In the validation set, 85% of those patients with scores of six or less points had substantial improvement compared with 34% of those pa-

Table 2. Continuous and Bivariate Correlates of Visual Functional Improvement After Cataract Extraction in the Derivation Set

Variable	Substantial Improvement (n=112)	Some Improvement (n=53)	Minimal to No Improvement (n=116)	P
Continuous variables*				
Mean±SD age, y	74.1±5.9	76.1±6.5	76.8±6.6	.004
Mean preoperative ADVS score (interquartile range)	57 (46-72)	75 (66-85)	78 (71-93)	<.001
Dichotomous variables†				
% with preoperative visual acuity of ≥20/80				
Operative eye	50	74	65	.03
Nonoperative eye	50	60	67	.01
No. (%) of patients				
Gender, F	83 (74)	32 (60)	79 (68)	.33
Prior cataract extraction	39 (35)	20 (38)	52 (45)	.12
Extracapsular extraction	93 (83)	42 (79)	99 (85)	.64
Phacoemulsification	17 (15)	10 (19)	15 (13)	.63
Nuclear sclerotic and cortical changes	101 (90)	48 (91)	105 (91)	.93
Posterior subcapsular changes‡	55 (49)	22 (42)	45 (39)	.12
Chronic eye diseases in the operative eye, No. (%) of patients				
Macular degeneration§	19 (17)	15 (28)	32 (28)	.06
Glaucoma	12 (11)	8 (15)	8 (7)	.33
Pseudoexfoliation	7 (6)	3 (6)	6 (5)	.73
Corneal disease	9 (8)	5 (9)	7 (6)	.56
Diabetic retinopathy	4 (4)	1 (2)	4 (3)	.96
Previous retinal detachment	1 (1)	0	4 (3)	.14
Amblyopia	1 (1)	2 (4)	1 (1)	.98
Medical comorbidities, No. (%) of patients				
Hypertension	57 (51)	23 (43)	60 (52)	.89
Diabetes mellitus¶	13 (12)	7 (13)	20 (17)	.22
Past cerebrovascular accident	7 (6)	5 (9)	9 (8)	.67
Myocardial infarction	14 (13)	8 (15)	16 (14)	.78
Congestive heart failure	9 (8)	6 (11)	11 (9)	.71
Chronic obstructive lung disease	19 (17)	0	21 (18)	.79
Previous hip fracture	4 (4)	2 (4)	9 (8)	.16
Previous malignant neoplasm	18 (16)	9 (17)	13 (11)	.29

*Analysis of variance test for comparison of mean age and Activities of Daily Vision Scale.

†P value is based on Mantel-Haenszel trend test (test for linear trend in proportions) and, when appropriate, Fisher's exact test.

‡Posterior subcapsular cataract alone or in combination with nuclear sclerotic and cortical changes.

§Age-related macular degeneration was considered present if the patient had pigment changes and drusen that were noted in combination with a diagnosis from the examining ophthalmologist.

|| Glaucoma was considered present if the patient was receiving medication or had undergone a previous filtration procedure.

¶Included all patients who were being treated with oral hypoglycemic agents or insulin.

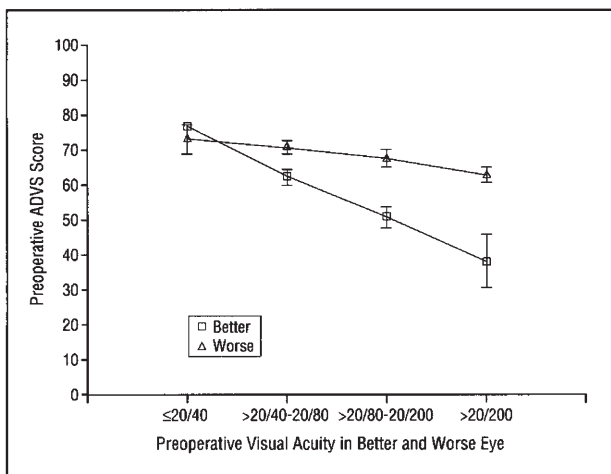


Figure 2. For each of the models presented, linear regression was used to adjust for logMAR-transformed visual acuity (as determined with Snellen's chart test types) in the other eye. Poorer preoperative visual acuity in both the better and worse eye was significantly correlated with poorer ADVS scores before surgery ($P=.001$ for the better eye and $P=.04$ for the worse eye). ADVS indicates Activities of Daily Vision Scale; squares indicate eye with better visual acuity ($P=.001$); triangles, eye with worse visual acuity ($P=.04$).

tients with scores from seven to 10 points and 3% of those patients with scores greater than 10 points (Figure 3, bottom). The proportion of patients who were classified with improvement in these three groups was similar to that found in the derivation set; this finding verified the discriminatory power of the decision rule.

COMMENT

With the exception of a standardized assessment of the patients' perception of visual function (ie, an assessment that takes about 10 minutes to administer), all other factors that were needed to use our decision rule were collected in the usual preoperative evaluation. Therefore, this clinical tool could be incorporated into the preoperative assessment of patients who are considering cataract extraction.

Traditionally, investigators have estimated improvement in visual function after cataract extraction and lens implantation by measuring the change in visual acuity with the use of Snellen's chart test types. Like previous investigations,^{14,15} we found that 80% of our cohort with a measured visual acuity at 12 months had 20/40 or bet-

Table 3. Multivariate Correlates of Visual Functional Improvement 12 Months After Cataract Extraction*

Variable	β	OR	95% CI	Points†
Intercept				
1	-9.6
2	-8.6
Age (10-y decrease)	0.7	2.0	1.4-3.0	1 per decade >65 y
Preoperative ADVS score (10% difference)	0.5	1.6	1.4-1.9	0.1×preoperative ADVS score
Posterior subcapsular changes	0.4	1.5	0.9-2.5	-1 if present
No macular degeneration	0.5	1.6	1.0-3.1	1 if present‡
No diabetes mellitus§	1.0	2.7	1.3-5.7	2 if present

*OR indicates odds ratio; CI, confidence interval; and ADVS, Activities of Daily Vision Scale.

†Calculated by rounding β coefficient from the ordinal logistic regression. The point scheme for predicting improvement in visual function is derived from the five significant factors. For the ages 65 to 74 years, patients receive one point, two points are assigned if the person's age is between 75 and 84 years, three points are assigned if the person's age is between 85 and 94 years, etc; the preoperative ADVS score is multiplied by 0.1 and added to the total score; a point is added if there is evidence of macular degeneration; and two points are added if the patient has diabetes mellitus regardless of whether retinopathy is present. One point is subtracted if patients have preoperative evidence of posterior subcapsular cataract. A higher score is equal to less improvement as follows: Score=(Points for Age+0.1 [preop ADVS]+1 [Macular Degeneration]+2 [Diabetes Mellitus]-1 [Posterior Subcapsular]).

‡Patients with diabetes mellitus or macular degeneration had poorer outcomes; therefore, points are added if these conditions are present.

§Diabetes mellitus was correlated with poorer functional outcome independent of the presence of retinopathy.

ter visual acuity in the eye that had surgery. Recently, investigators have broadened the definition of improvement by incorporating questionnaires that assess patients' perception of visual functioning and global health-related quality of life.^{3,7,9,10,15-19}

By using a variety of questions designed to estimate visual functioning, previous research has demonstrated a similar proportion of patients with improvements after cataract extraction.^{3,7,9,15,19} Recently, among patients without other eye diseases, Javitt et al¹⁵ reported that 75% of those with cataract extraction and intraocular lens implantation in one eye and 92% of those with surgery in both eyes improved in self-reported visual function after surgery. Another study based on a retrospective recall of preoperative functioning reported that 74% of patients had improvement in one or more visual functions after cataract extraction.⁷ Most investigations have classified any positive change on a questionnaire as improvement without accounting for inpatient response variation.^{15,19,20} By using this method that may overestimate true improvement, a multicenter study found that 89% of patients reported improvements in visual functioning on a 14-item questionnaire (ie, the VF-14).¹⁹ Even though the ADVS and VF-14 cover a similar content area,^{11,18} only 77% of our patients had any positive change on the ADVS. Our percentage may have been lower because a greater proportion of our patients had other coexistent eye diseases. Similar to the findings in this study, Steinberg et al¹⁹ found that only 61% of the patients with preoperative VF-14 scores above the 90th percentile reported improved scores after surgery. These findings may be owing to a lack of preoperative difficulty with the vi-

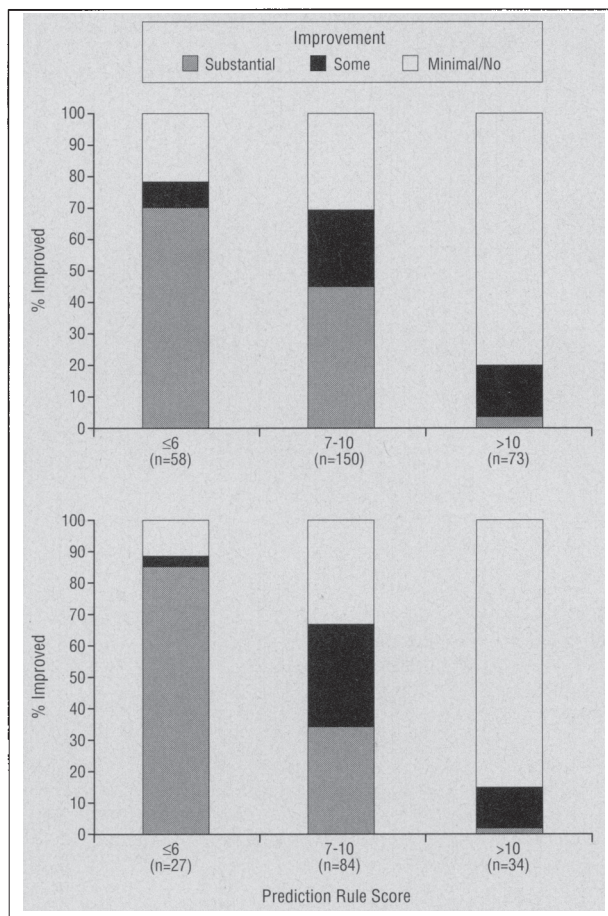


Figure 3. Percentage of patients with improved visual function. Top, Derivation set. Bottom, Validation set.

ual activities that are listed in the questionnaire or possibly postoperative improvements in areas that are not covered by the content of the survey.

We used a statistical definition of improvement based on the test-retest variability of the ADVS. As a clinical example, a patient could have a nine-point improvement on the ADVS if he or she reported that three of the night driving activities changed from being moderately difficult before surgery to not difficult at all. A 14-point change would occur if a patient reported improvement in three night driving activities and additionally reported that three of the near vision tasks had changed from being moderately difficult to a little difficult. By applying this definition of improvement that attempts to account for inpatient response variation due to chance, 165 (39%) of the cohort overall were classified as patients with substantial improvement and 85 (20%) as patients with some improvement.

Most studies of outcome after cataract extraction in the intraocular lens era have not estimated the likelihood of deriving benefit from surgery in the setting of specific other eye diseases (eg, glaucoma and AMD) that are relatively common in patients with cataracts. Much in line with our findings, the study by Bernth-Petersen⁹ regarding outcome after cataract extraction in the pre-intraocular lens era found that the presence of macular disease before surgery attenuated improvement in visual function after surgery. Steinberg et al¹⁹ also found that patients with other

eye diseases were less likely to have VF-14 scores above the highest decile after surgery.

A previous investigation that was designed to predict outcome after cataract extraction used visual acuity rather than patients' reports of visual functioning to define improvement.⁸ Our decision rule used the patients' impression of visual functioning as a gold standard for defining improvement. In addition, previous investigations have not estimated the relative importance of age, specific chronic eye conditions, and medical conditions in attenuating the expected improvements in visual functioning after cataract extraction. The selection of change in the ADVS scores at 12 months after surgery was driven by a belief that the wisest use of resources would provide surgery for patients who were still experiencing benefit at 1 year afterward.

Our study has several limitations. Because clinical characteristics (eg, measured visual acuity and chronic eye conditions) were abstracted from the medical record, we could not grade the severity of underlying eye diseases. However, our data do not suggest that all patients with chronic eye conditions are unlikely to benefit from surgery. For example, a patient younger than 75 years who has AMD and a low preoperative ADVS score would still be classified as having a 70% to 80% chance of substantial improvement in self-reported visual function after surgery. In addition, we did not collect data that described symptoms referable to cataracts; some patients may have had symptoms that were bothersome but were not severe enough to cause difficulty with visual activities. Therefore, within this group, the resolution of symptoms after surgery would not translate into improved scores on the ADVS. The patients in our study population were principally white, 98% were recipients of Medicare, most patients resided in New England, and many patients received care in private practices. The generalizability of our decision rule to other groups of elderly patients is unknown.

Preoperative clinical characteristics can be combined with a standardized patient report of visual functioning to predict which patients have the greatest probability of improving in common visual activities after surgery. Incorporation of such a prediction rule into the preoperative evaluation may provide both the ophthalmologist and patient who is considering surgery with a preoperative estimate of the likelihood of functional improvement after cataract extraction.

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