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Subjective Quality of Vision Before and After Cataract Surgery

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Objective: To investigate the effect of cataract surgery on subjective quality of vision.

Methods: The Quality of Vision (QoV) questionnaire (Italian translation) was completed before and 3 months after cataract surgery in 4 groups of patients recruited from September through December 2010: first eye with ocular comorbidity, first eye without ocular comorbidity, second eye with ocular comorbidity, and second eye without ocular comorbidity. The questionnaire measures 3 aspects of quality of vision: frequency, severity, and bothersome nature of symptoms. The Lens Opacities Classification System (LOCS) III was used for cataract grading. Friedman and Kruskal-Wallis H tests were performed to compare QoV scores within and between groups. Spearman rank correlations (r_s) were calculated to investigate the correlation between LOCS III and QoV symptoms.

Results: Two hundred twelve patients (mean [SD] age, 74.2 [8.7] years) were recruited, and 212 eyes were included in the study. Improvements in QoV scores were found in all 4 groups ($P < .05$). There were no statistically significant ($P > .05$) differences among the 4 groups in the improvement in QoV scores or in the preoperative or postoperative scores. Blurred vision was correlated with posterior subcapsular cataract ($r_s = 0.420$, $P = .04$).

Conclusions: Cataract in one or both eyes causes a similar loss in subjective quality of vision, which is also irrespective of the presence of ocular comorbidity. Posterior subcapsular cataract causes the specific symptom "blurred vision." Cataract surgery resulted in a large and comparable improvement in subjective quality of vision, regardless of ocular comorbidity and first or second eye surgery.

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CATARACT SURGERY IS ONE of the most commonly performed surgical procedures worldwide.[1] There have been constant improvements in surgical techniques and equipment, resulting in fewer complications and quicker visual recovery.[2] Concurrently, patient expectation and the role of refractive error as both indication and outcome have increased.

Most studies[3] evaluating cataract surgery outcomes have focused on visual acuity and refractive status. Such objective measures are useful but may fail to highlight important patient perceptions, such as quality of vision (eg, glare and haloes), which may be present despite good visual acuity and minimal refractive error. A number of questionnaires have been developed and validated to provide a direct measure of subjective outcomes of cataract surgery. These questionnaires can measure a number of different traits, such as visual symptoms with the Quality of Vision (QoV) questionnaire,[4] visual functioning with the Visual Function Index–14,[5] and visual functioning and socioemotional status with the National Eye Institute Visual Function Questionnaire.[6]

The QoV questionnaire was recently developed to provide a patient-reported measure of quality of vision across a range of groups, including refractive correction (refractive surgery, spectacles, and contact lenses) and cataract. The questionnaire uses photographs to simulate visual symptoms, with patients reporting how often they experience the symptom (frequency), how severely they experience the symptom (severity), and how bothered they are by the symptom (bothersome). The questionnaire was developed, validated, and scored using Rasch analysis. Rasch analysis enables an in-depth assessment of the psychometric properties of the questionnaire, and it estimates interval-scaled measures from ordinal data. This analysis overcomes the disadvantages of simple summary scoring, which incorrectly assumes that the quantitative difference between each response option is

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equal and that each question has the same value.[7] It improves measurement precision, which has been demonstrated in cataract surgery outcome studies.[8,9] Rasch analysis is based on a probabilistic relationship between item difficulty and person ability (functional reserve). This analysis expresses the probability of any person being successful on any item with a polytomous Andrich rating scale model ($\ln[p(x)/p(x-1)]$), which is often used for multiple options. For each individual, rating scale responses are mutually exclusive. So, if person n responded to item i with rating category x or $x - 1$, then the posterior probability (p) of that person responding with any other rating category is 0.[10]

Cataract surgery has been convincingly demonstrated to provide significant improvements in objective measurements and subjective improvements in quality of life and visual functioning.[11] What has been less thoroughly studied is the improvement in visual symptoms, such as glare and haloes, after cataract surgery. The purpose of this prospective study was to investigate the change in subjective quality of vision after cataract surgery using the QoV questionnaire in patients undergoing first eye and second eye cataract surgery with or without ocular comorbidity. A secondary purpose was to investigate the correlation between preoperative visual symptoms and cataract morphology to determine which symptoms are predictive of different types of cataract.

METHODS

PATIENTS

In this prospective cohort study, consecutive patients undergoing cataract surgery by phacoemulsification and monofocal intraocular lens (IOL) implantation at an ophthalmology department in an Italian public hospital were invited to participate. Patients were recruited using standard informed consent procedures from September to December 2010. Patients completed an Italian-translated version of the QoV questionnaire via interview with an ophthalmologist before and at 3 months after cataract surgery. A 3-month period was chosen to enable patients to acquire refractive correction in the form of spectacles if needed and to enable a significant adaptation period to their new refractive correction and quality of vision. Patients were advised to obtain new spectacle correction approximately 6 weeks postoperatively. All patients in this study had only 1 eye operated on, and in the case of first eye surgery, the eye operated on had the worst visual acuity. All operations were performed by the same experienced cataract surgeon in the same center, and each patient was consecutive. The tenets of the Declaration of Helsinki were followed, and the study was approved by the University of Trieste Medical Ethics Committee.

Exclusion criteria consisted of poor comprehension of written or spoken Italian language and vulnerable patient groups. Patients with ocular comorbidity were not excluded to provide a representative sample of patients undergoing cataract surgery. *Ocular comorbidity* was defined as the presence of any potentially visually significant eye disease other than cataract even in a mild form. Data were collected for single eye surgery (first or second eye surgery) to ensure statistical independence. All study participants were 18 years or older and signed a consent form.

THE QoV QUESTIONNAIRE

The QoV questionnaire enables the measurement of subjective quality of vision. The QoV questionnaire consists of a 10-item instrument with 3 subscales, providing a QoV score in terms of frequency, severity, and bothersome nature of the following symptoms: glare, haloes, starbursts, hazy vision, blurred vision, distortion, double or multiple images, fluctuation in vision, focusing difficulties, and depth perception difficulties. The first 7 symptoms have an associated image to simulate the symptom for easier understanding. Rasch scaling is used with logits converted to a 0- to 100-unit linear scale, with higher scores indicating poorer quality of vision.

TRANSLATION OF THE QoV QUESTIONNAIRE FROM ENGLISH TO ITALIAN

The translation team consisted of a coordinator, an Italian ophthalmologist fluent in English, a professional native Italian-speaking translator, and 2 professional native English-speaking translators. Initially, 2 forward translations were produced by 2 independent native Italian speakers. The 2 translators met with the coordinator to produce a reconciled Italian version. The questionnaire was then back translated in an independent manner by 2 native professional English-speaking translators. Subsequently, the translating team met, and the reconciled forward translation was revised according to the review of the back translations. Pilot testing of the target version was then conduced to verify understanding of the questionnaire.

CLINICAL EXAMINATION

Each participant underwent a comprehensive eye examination, before and 3 months after cataract surgery, by an experienced ophthalmologist. In addition to completion of the QoV questionnaire, uncorrected distance visual acuity (UDVA) in log minimum angle of resolution (logMAR), spherical equivalent subjective refraction, logMAR corrected distance visual acuity (CDVA), and Lens Opacities Classification System (LOCS) III grading of cataract were recorded for each eye.[12] The LOCS III cataract severity was graded on a decimal scale for each of the 4 possible components: nuclear opalescence, nuclear color, cortical component, and posterior subcapsular component. For each cataract type or for nuclear color, higher grading scores indicate greater severity. The scale ranges from 0.1 (clear or colorless) to 5.9 (very opaque in cases of cortical and posterior subcapsular) or 6.9 (very opaque or brunescent in cases of opalescence and nuclear color). Biometry was performed using the IOL Master 500 (Carl Zeiss Meditec AG), and the target refractive error was 0 in all patients. Patients underwent standard phacoemulsification cataract surgery and monofocal IOL implantation. Standard demographic data were collected for each patient, including age and sex. The median and range of preoperative and postoperative QoV scores, logMAR UDVA, spherical equivalent subjective refraction, and logMAR CDVA were calculated.

STATISTICAL ANALYSIS

Patients were divided into 4 groups: first eye with ocular comorbidity, first eye without ocular comorbidity, second eye with ocular comorbidity, and second eye without ocular comorbidity. Data were assessed for normality using the Shapiro-Wilk test, which found QoV scores, LOCS III grade, visual acuity, and refraction to be nonnormally distributed. Friedman tests were performed to determine statistical significance of preoperative to postoperative changes within each group. Kruskal-Wallis H tests were performed to determine whether the pre-

Table 1. Preoperative Demographic Data and Cataract Grading With the Lens Opacities Classification System III of the 209 Patients in the Study Population[a]

Characteristic	First Eye (n = 106) Without Comorbidity (n = 78)	First Eye (n = 106) With Comorbidity (n = 28)	Second Eye (n = 103) Without Comorbidity (n = 78)	Second Eye (n = 103) With Comorbidity (n = 25)
Male/female, No.[b]	33/45	15/13	30/48	9/16
Age, mean (SD), y[c]	72.6 (8.9)	75.0 (8.6)	75.2 (9.0)	75.3 (6.7)
Nuclear opalescence	4.15 (4.00)	4.95 (5.79)	4.75 (4.90)	4.55 (4.10)
Nuclear color	4.05 (4.50)	4.50 (4.50)	4.55 (3.60)	5.00 (4.30)
Cortical	2.70 (4.00)	2.70 (5.40)	2.85 (4.20)	2.60 (4.00)
Posterior subcapsular	0.10 (4.80)	1.55 (5.80)	0.10 (4.40)	0.75 (4.60)

[a]Data are presented as median (range) unless otherwise indicated.
[b]Females and males were not equally distributed across groups ($P = .004$, χ^2 test).
[c]Mean age was comparable across questionnaires ($P > .05$, analysis of variance).

Table 2. Mean (Range) Preoperative and Postoperative QoV Scores, LogMAR UDVA, Spherical Equivalent Refraction, and LogMAR CDVA in Patients Undergoing First and Second Eye Cataract Surgery With and Without Comorbidity

Variable	Without Comorbidity Preoperative	Without Comorbidity Postoperative	Without Comorbidity χ^2 (*P* Value)	With Comorbidity Preoperative	With Comorbidity Postoperative	With Comorbidity χ^2 (*P* Value)
First eye						
Frequency QoV score	41.00 (87.00)	15.00 (72.00)	32.014 (<.001)	41.00 (77.00)	15.00 (90.00)	9.00 (.003)
Severity QoV score	35.00 (70.00)	13.00 (66.00)	25.657 (<.001)	35.00 (70.00)	6.50 (86.00)	9.00 (.003)
Bothersome QoV score	34.00 (85.00)	0.00 (75.00)	18.846 (<.001)	26.00 (85.00)	7.00 (88.00)	8.17 (.004)
LogMAR UDVA	0.70 (1.22)	0.26 (1.00)	69.208 (<.001)	1.00 (2.50)	0.28 (1.25)	24.14 (<.001)
Spherical equivalent	−0.75 (9.98)	−0.50 (2.38)	16.615 (<.001)	0.00 (13.25)	−0.56 (2.50)	3.57 (.06)
LogMAR CDVA	0.35 (0.78)	0.05 (0.40)	68.211 (<.001)	0.52 (2.68)	0.05 (1.00)	27.00 (<.001)
Second eye						
Frequency QoV score	41.00 (90.00)	0.00 (72.00)	32.143 (<.001)	45.00 (75.00)	25.00 (69.00)	8.909 (.003)
Severity QoV score	32.00 (78.00)	0.00 (52.00)	31.226 (<.001)	35.00 (68.00)	22.00 (57.00)	11.636 (.001)
Bothersome QoV score	29.00 (93.00)	0.00 (63.00)	28.452 (<.001)	34.00 (78.00)	0.00 (73.00)	5.261 (.02)
LogMAR UDVA	0.85 (2.75)	0.30 (1.00)	60.842 (<.001)	1.00 (2.70)	0.26 (1.00)	17.190 (<.001)
Spherical equivalent	0.00 (8.75)	−0.57 (4.50)	6.205 (.01)	−0.63 (10.75)	0.00 (5.50)	4.167 (.04)
LogMAR CDVA	0.30 (2.80)	0.00 (1.04)	74.0 (<.001)	0.40 (2.85)	0.15 (1.04)	12.565 (<.001)

Abbreviations: CDVA, corrected distance visual acuity; logMAR, logarithmic minimum angle of resolution; QoV, Quality of Vision; UDVA, uncorrected distance visual acuity.

operative and postoperative QoV scores and changes in scores among the 4 groups were statistically significantly different.

To determine the correlation between each LOCS III grading and the frequency of QoV symptoms, patients were grouped by their respective cataract morphology: nuclear, cortical, or posterior subcapsular (using the LOCS III grading). The cutoff for nuclear and cortical cataract was 2.5, and the cutoff for posterior subcapsular was 0.1, in line with previous studies.[13] Therefore, a *nuclear cataract* was defined as a LOCS III grading greater than 2.5 for nuclear opalescence, 2.5 or less for the cortical component, and 0.1 or less for the posterior subcapsular component. Similarly, a *cortical cataract* was defined as a LOCS III grading of greater than 2.5 for the cortical component, 2.5 or less for nuclear opalescence, and 0.1 or less for the posterior subcapsular component. *Posterior subcapsular cataracts* were defined as a LOCS III grading greater than 0.1 for the posterior subcapsular component and 2.5 or less for nuclear opalescence and the cortical component. Mixed cataracts were excluded from the analysis. Spearman rank correlation coefficients (r_s) were calculated.[14] A strong correlation was classified as a coefficient greater than 0.8, moderately strong within the range of 0.5 to 0.8, fair within the range of 0.3 to 0.5, and poor at less than 0.3.[15] All statistics were calculated using SPSS statistical software (SPSS Inc) and Excel (Microsoft). $P < .05$ was considered statistically significant in all statistical tests.

RESULTS

Two hundred twelve patients (mean [SD] age, 74.2 [8.7] years) were recruited, and 212 eyes were included in the study. Three patients had complicated surgery (capsular tear and anterior vitrectomy) and were excluded from the analysis, leaving 209 eyes of 209 patients. The standard demographics of the 4 groups in the study population are listed in **Table 1**. A statistically significant improvement was seen in UDVA and CDVA in all 4 groups and in spherical equivalent refraction in all groups except for patients who underwent first eye cataract surgery with ocular comorbidity (**Table 2**).

A statistically significant improvement was seen in QoV scores for frequency, severity, and bothersome nature of symptoms in all 4 groups of patients (**Figure**). Kruskal-Wallis H tests found no statistically significant differences in the improvement in the QoV questionnaire subscale among the 4 groups (**Table 3**). No statistically significant differences were found in the preoperative and postoperative QoV scores in each group. A poor correlation was found between the change in CDVA and QoV

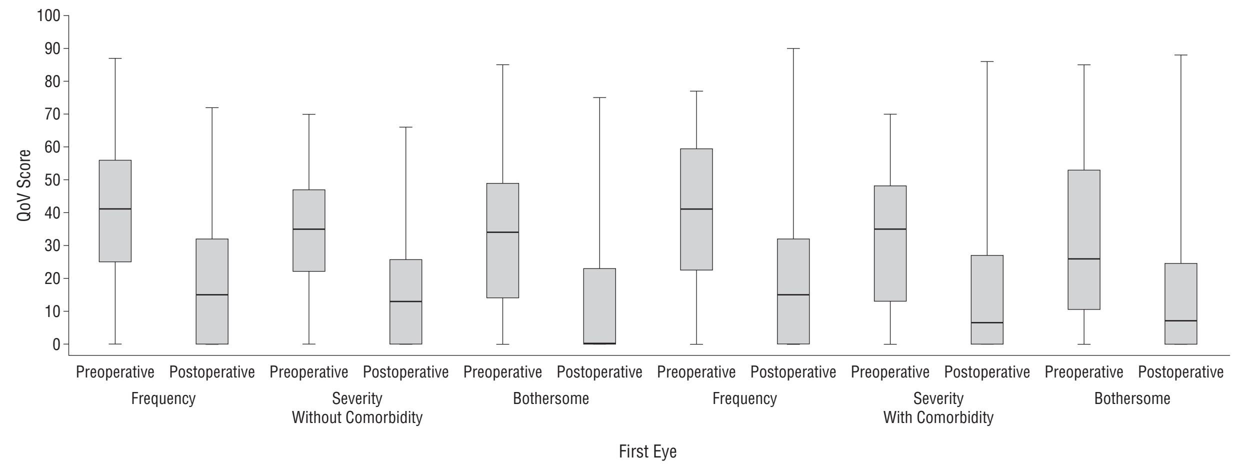

Figure. Box plot of Quality of Vision (Qov) questionnaire scores before and 3 months after cataract surgery in patients with or without ocular comorbidity. Boxes represent the 25th to 75th percentile; black lines within boxes, median; and error bars, ranges.

Table 3. Mean (95% CI) Improvement in QoV Scores in Each of the 4 Groups of Patients[a]

	First Eye		Second Eye	
Variable	**Without Comorbidity**	**With Comorbidity**	**Without Comorbidity**	**With Comorbidity**
Frequency QoV score	22.4 (16.8-28.0)	18.8 (8.6-29.0)	20.0 (13.9-26.1)	17.9 (8.3-27.5)
Severity QoV score	18.3 (13.3-23.3)	16.1 (7.5-24.7)	18.4 (13.0-23.8)	14.2 (6.0-22.4)
Bothersome QoV score	18.3 (12.6-24.0)	15.0 (6.2-23.8)	19.7 (13.5-25.9)	15.3 (5.6-25.0)

Abbreviations: QoV, Quality of Vision.
[a] All values are significant at $P < .05$.

scores (frequency subscale) for patients who underwent second eye cataract surgery without ocular comorbidity (r_s = 0.298; P = .008). All other comparisons yielded no statistically significant differences (first eye without ocular comorbidity, r = 0.114, P = .32; first eye with ocular comorbidity, r = 0.247, P = .21; second eye with ocular comorbidity, r = −0.166, P = .44).

Each of the 4 groups of patients had greater levels of nuclear than cortical or posterior subcapsular cataracts (Table 1). With all patients grouped together, there were 24 eyes with nuclear cataract, 25 eyes with posterior subcapsular cataract, and 3 eyes with cortical cataracts. The remaining eyes had mixed cataract morphology and were excluded from the analysis. Because of the low number of eyes with cortical cataract, it was not possible to correlate visual symptoms with LOCS III grading in this group. In the nuclear cataract group, no statistically significant correlations were found with visual symptoms. In the posterior subcapsular cataract group, a statistically significant correlation was found with the symptom of blurred vision (r_s = 0.420, P = .04). For all other comparisons, no statistically significant correlations were found.

COMMENT

In this study, UDVA and CDVA improved significantly in all cataract surgery groups. However, visual acuity is a crude assessment of visual quality and does not provide information about visual quality in real-life situations under different lighting conditions, such as bright sunlight or oncoming car headlights when driving at night.[16,17] This study found an improvement in subjective quality of vision after cataract surgery in patients undergoing first and second eye surgery, with or without ocular comorbidity, with no statistically significant differences in the improvement among the 4 groups. Most important, the preoperative level of visual symptoms experienced and postoperative improvement in quality of vision are similar whether patients have unilateral or bilateral cataract and whether they have ocular comorbidity or not. These improvements in quality of vision are in line with improvements using quality of life scores and visual functioning after cataract surgery, which may indicate a relationship between these latent traits.[18] Despite an overall large sample size, the sample sizes are smaller within each group, which indicates a limitation of the study. Assuming the same differences found here, sample sizes of 4921 in each group would be required to find differences due to ocular comorbidity, with much larger samples required to find differences between first and second eye results (80% power, type I error of .001 to account for multiple comparisons). This finding illustrates that there is no clinical significance between these groups. These findings are important because they demonstrate that the benefit of cataract surgery from the patient's perspective of symptom relief is comparable for all 4 situations. It is therefore possible that the threshold for surgery could be lowered and offered to patients with unilateral cataract or ocular comorbidity as readily as it is offered to patients with bilateral cataract and no ocular comorbidity. Additional shortcomings of this study are that only monofocal IOLs were assessed and the increasingly common multifocal and toric IOLs were not assessed.[19]

The extent of symptoms reported in patients with cataracts makes for an interesting comparison with those seen in refractive surgery. For example, in patients undergoing second eye cataract surgery without ocular comorbidity, the median frequency of visual symptoms improved from 41 (range, 90) to 0 (range, 72). A recent study[20] investigating quality of vision using the QoV questionnaire after laser-assisted subepithelial keratectomy (LASEK) found the median frequency of symptoms at postoperative intervals of 5 days, 2 weeks, 1 month, and 3 months to be 72 (range, 90), 52 (range, 72), 0 (range, 45), and 0 (range, 25), respectively. These comparisons suggest that quality of vision 3 months after the second eye cataract surgery is similar to 1 month after LASEK. In addition, the quality of vision in the first 2 weeks after LASEK is as poor or worse than with cataract. Visual symptoms have also been reported after cataract surgery and monofocal IOL implantation by other authors.[16,21-23] In this study, cataract patients had their residual refraction corrected with spectacles. Spectacles alone may induce visual symptoms secondary to factors such as lens refractive index, base curve, and antireflective coatings.[24,25]

A secondary aim of this study was to investigate the correlation between preoperative LOCS III grading of cataract with the 10 visual symptoms of the QoV questionnaire frequency subscale. Overall, results indicated no significant correlations between signs and symptoms except for one comparison: posterior subcapsular cataracts were correlated with the visual symptom of blurred vision ($r_s = 0.420$). A poor correlation was also found between the change in CDVA and the change in QoV scores. Our findings of a poor correlation between signs and symptoms are in line with previous cataract studies that compared different variables[26,27] and are consistent with previous research that found that posterior subcapsular cataracts cause disproportionately more visual disability than nuclear or cortical cataracts.[28,29] Vasavada et al[30] found that patients with posterior subcapsular cataracts experience reduced vision and not glare, despite objective glare disability being more common in posterior subcapsular cataracts than nuclear or cortical cataract.[31] Binocularity may be a significant confounder of this relationship because perception of visual symptoms will consist of the complexities of using both eyes together, not just the eye undergoing surgery. Eye dominance and strength of dominance and ocular comorbidity are also likely to be confounders.[32,33] In addition, the use of LOCS III may be problematic because the decimal grading provides an illusion to a linear measurement; however, evidence of the linearity of the relationship is lacking and would impair the correlation with other variables. Objective cataract grading, such as lens densitometry, may have yielded better correlations. Most patients in this study had relatively advanced cataract, and it is hypothesized that less dense cataract may cause more subtle visual symptoms and hence provide better correlations.

In conclusion, this study found an improvement in subjective quality of vision after cataract surgery in patients undergoing first or second eye surgery, with or without ocular comorbidity, and similar improvements occurred in all 4 groups. In general, poor correlations were found between cataract morphology and visual symptoms with the exception of the correlation found between blurred vision and posterior subcapsular cataracts. Patient-reported outcomes, such as the QoV questionnaire, are becoming important in the assessment of preoperative and postoperative cataract patients. Such questionnaires are likely to become an essential tool in general practice and in the clinical evaluation of new IOLs.

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