

A Quality of Life Comparison of People Wearing Spectacles or Contact Lenses or Having Undergone Refractive Surgery

Konrad Pesudovs, PhD; Estibaliz Garamendi, PhD; David B. Elliott, PhD

ABSTRACT

PURPOSE: To demonstrate the use of the Quality of Life Impact of Refractive Correction (QIRC) questionnaire for comparing the quality of life of pre-presbyopic individuals with refractive correction by spectacles, contact lenses, or refractive surgery.

METHODS: The 20-item QIRC questionnaire was administered to 104 spectacle wearers, 104 contact lens wearers, and 104 individuals who had undergone refractive surgery (N=312). These groups were similar for gender, ethnicity, socioeconomic status, and refractive error. The main outcome measure was QIRC overall score (scaled from 0 to 100), a measure of refractive correction related quality of life. Groups were compared for overall QIRC score and on each question by analysis of variance, adjusted for age, with post hoc significance testing (Scheffé).

RESULTS: On average, refractive surgery patients scored significantly better (mean QIRC score 50.2 ± 6.3 , $F_{2,309} = 15.18$, $P < .001$) than contact lens wearers (46.7 ± 5.5 , post hoc $P < .001$) who were in turn significantly better than spectacle wearers (44.1 ± 5.9 , post hoc $P < .01$). Convenience questions chiefly drove the differences between groups, although functioning, symptoms, economic concerns, health concerns, and well being were also important. Spectacle wearers with low strength prescriptions (46.18 ± 5.05) scored significantly better than those with medium strength prescriptions (42.74 ± 6.08 , $F_{2,190} = 3.66$, $P < .05$, post hoc $P < .05$). A small number ($n=7$, 6.7%) of refractive surgery patients experienced postoperative complications, which impacted quality of life (37.86 ± 2.13).

CONCLUSIONS: Quality of life was lowest in spectacle wearers, particularly those with higher corrections. Contact lens wearers had significantly better QIRC score than spectacle wearers. Refractive surgery patients scored significantly better than both. However, this was accompanied by a small risk of poor quality of life due to postoperative complications. The QIRC is an effective outcome measure for quality of life impact of refractive correction. [*J Refract Surg*. 2006;22:19-27.]

The provision of refractive error correction in the United States is a \$22.8 billion industry, with 59% of the US population possessing a refractive correction.¹ Although spectacles dominate this market, and approximately 12% of the adult population wears contact lenses, refractive surgery is gaining ground with 6.1 million (2.2%) Americans having undergone refractive surgery, including 1.2 million (~0.4%) in 2002.¹ Demonstrating the safety and benefit of refractive surgery is critical to its acceptance and growth in the marketplace. Objective methods for demonstrating the visual and optical benefits of refractive surgery exist.^{2,3} However, there is neither an agreed method nor a movement toward routine reporting of arguably the most important refractive surgery outcome—quality of life. The purpose of this study is to demonstrate the use of a newly described refractive correction specific quality of life questionnaire for comparing spectacle wearers, contact lens wearers, and post-refractive surgery patients.

No previous studies have specifically compared the quality of life of the three modes of refractive correction. However, changes in quality of life due to refractive surgery have previously been reported using two validated questionnaires: the Refractive Status Vision Profile (RSVP)⁴ and the National Eye Institute Refractive Quality of Life (NEI-RQL).⁵ The Subjective

From the Department of Ophthalmology, Flinders Medical Centre and Flinders University, Adelaide, South Australia, Australia (Pesudovs); and the Department of Optometry, University of Bradford, West Yorkshire, United Kingdom (Garamendi, Elliott).

This project was supported by an educational grant from Johnson & Johnson Vision Care, Europe. Dr Pesudovs is supported by the Sir Neil Hamilton Fairley Fellowship 007161 (National Health and Medical Research Council [NHMRC], Canberra, Australian Capital Territory, Australia).

The authors have no proprietary interest in the materials presented herein.

The authors thank all eye care practitioners who provided access to patients, in particular Ultralase laser eye clinics, for access to the majority of refractive surgery patients.

Correspondence: Konrad Pesudovs, PhD, Dept of Ophthalmology, Flinders Medical Centre and Flinders University, Bedford Park, South Australia, 5045, Australia. Tel: 61 8 8204 4899; Fax: 61 8 8277 0899; E-mail: Konrad.Pesudovs@flinders.edu.au

Received: July 7, 2004

Accepted: March 21, 2005

Vision Questionnaire (SVQ) has also been conventionally validated, but not tested for its responsiveness to refractive surgery.⁶ Other studies that report quality of life issues before and after refractive surgery have used informal, non-validated questionnaires.⁷⁻¹⁰ However, none of these questionnaires is suitable for the purpose of comparing the quality of life among spectacle wearers, contact lens wearers, and post-refractive surgery patients. The RSVP and the National Eye Institute Visual Functioning Questionnaire (NEI-VFQ) have been shown to be insensitive to quality of life issues relevant to people wearing contact lenses.^{11,12} Similarly, the NEI-RQL could not differentiate between spectacle and contact lens wearers although it could differentiate both from emmetropes.¹³

Perhaps the most important issue in questionnaire selection is the validity of the scoring system. The RSVP, NEI-RQL, and SVQ instruments all use traditional Likert scoring where patients' response scores for a selected set of questions are summed to derive the overall score.¹⁴ Likert scoring values all questions equally and therefore assumes that each question has equal importance on the scale being measured. In addition, the response categories used for each question are scored assuming uniform increments from category to category. For example, in a Likert scaled visual disability questionnaire, The Activities of Daily Vision Scale (ADVS),¹⁵ a response of "a little difficulty" (score of 4) is used to represent twice the level of ability as "extreme difficulty" (score of 2), which is similarly two times as good as "unable to perform the activity due to vision" (score of 1) for all questions. This appears illogical, and Rasch analysis has been used to confirm that differently weighted response scales are required for different questions to provide a valid scale.¹⁶ For question difficulty with the ADVS questionnaire an answer of "a little difficulty" to the question regarding visual difficulties "driving at night" scores the same as the "a little difficulty" with "driving during the day." Again, this is illogical and Rasch analysis has been used to confirm that driving at night is a more difficult task than driving during the day and Rasch analysis can provide an appropriate weighting factor for each question.¹⁶ The Rasch model is a mathematical hypothesis that the probability of a given outcome is a probabilistic function of person and item parameters. This new approach to questionnaire development using modern statistical methods, such as Rasch analysis,¹⁷⁻²⁰ to measure health outcomes has suggested improved validity in question inclusion and on assessment of question importance across individual quality of life.^{16,21-23}

Therefore, prior to comparing quality of life between the three different modes of refractive correction, we

developed and validated a questionnaire, using Rasch analysis, for the measurement of the impact of refractive correction on quality of life—The Quality of Life Impact of Refractive Correction (QIRC) questionnaire.²⁴ In the development of the QIRC questionnaire, equal numbers of completed pilot questionnaires from each mode of correction were analyzed in an effort to equalize the sensitivity of the final version to all three refractive correction types. In the following study, we determine whether the QIRC questionnaire is sensitive to quality of life issues differentially affecting people with different types of refractive correction. A quality of life instrument with such sensitivity and the superior scoring validity afforded by Rasch scaling would be the ideal outcome measure for refractive surgery.

MATERIALS AND METHODS

PATIENTS

Patients included in this study were prospectively recruited from 18 refractive surgery clinics, optometric practices, and contact lens specialist practices throughout the United Kingdom. The centers were chosen to provide data from rural and urban United Kingdom and with a good geographical spread to ensure the results were relevant to the UK population at large. Inclusion criteria were age between 16 and 39 years (adult pre-presbyopic age), the use of spectacles or contact lenses, or having undergone refractive surgery (LASIK, laser subepithelial keratomileusis, photorefractive keratectomy, or refractive lens implantation) between 1 month and 1 year previously. Exclusion criteria were ocular disease, ocular surgery (other than refractive), neurological or systemic disease, any medication that could alter visual function, and an inability to read and understand written English. Consecutive patients meeting the criteria were enrolled. Questionnaires were completed on site ensuring a 100% response rate. Informed consent was obtained from all patients during the interview, after the nature of the study had been fully explained. The tenets of the Declaration of Helsinki were followed and the study gained approval from the University ethical committee.

DEMOGRAPHIC DATA

Data collected from patients included age, gender, ethnicity, socioeconomic status, and self-reported strength of refractive correction. Ethnicity classification was sourced from the Compendia and Reference section of the National Statistics website.²⁵ Socioeconomic status was classified from self-report of occupation of the primary income earner in the household on a five-category scale.²⁶ This five-category scale is

assumed to be linear so the mean group scores can be used to compare socioeconomic status. For self-reported strength of refractive correction, we asked spectacle and contact lens wearers to declare whether the strength of their refractive correction was “low,” “medium,” or “high.” Although refractive error data would have been ideal, this was not available. Self-report of refractive status can have reasonable sensitivity and specificity especially if non-technical terms are used in the questions asked.²⁷ According to the inclusion criteria, the population included patients with myopia, hyperopia, and astigmatism. No stratification based on type of refractive error was made. The post-refractive surgery group was also asked to report any problems with their vision or eyes that arose after their surgery.

INSTRUMENT

The development and validation of the QIRC questionnaire is reported in detail elsewhere.²⁴ In summary, question identification and selection used literature and focus groups. Item reduction was performed by focus groups (647 questions to 90) and by administration of a pilot questionnaire. Two styles of questions were chosen: severity assessment (eg, How much difficulty do you have...?) and incidence (During the past month, how often have you experienced...?). A five-category response scale,²⁸ with suitably spaced response labels, was selected.²⁹ For example, for the question format “How concerned are you...?” the response labels were “not at all,” “a little bit,” “a moderate amount,” “quite a lot,” and “extremely.” The 90-question pilot questionnaire was administered across settings including optometry, contact lens, and refractive surgery (mostly, but not exclusively LASIK) practices to 306 patients with 102 questionnaire responses from each mode of refractive correction. Rasch analysis was used for item reduction,^{30,31} which led to a 20-item questionnaire.* Rasch analysis and standard psychometric techniques demonstrated that the QIRC questionnaire is both a valid and reliable measure of refractive correction related quality of life in patients with corrected refractive error (person separation, 2.03; reliability, 0.80; root-mean-square measurement error, 3.25; mean square \pm SD in-fit, 0.99 ± 0.38 ; outfit, 1.00 ± 0.39 , item in-fit range 0.70 to 1.24 and item outfit range 0.78 to 1.32; unrotated factor analysis principal factor loadings 0.40 to 0.76; Cronbach’s alpha 0.78; test re-test reliability intraclass correlation coefficient 0.88; and coefficient of repeatability of ± 6.85 units).²⁴ QIRC scores are reported on a 0 to 100 scale where a higher score represents a better

refractive correction related quality of life. Note that the well-being items are scored in reverse order so that a higher score on all questions equates to a better quality of life. Items are well targeted to patients so that average QIRC scores are close to 50 units and the scale is free of floor and ceiling effects. Rasch analysis of the data from the validation study was used to estimate values on a linear scale for each question. These values can be used in subsequent studies, including this one where we investigated the use of QIRC for comparing the refractive correction related quality of life of patients wearing spectacles, contact lenses, or having undergone refractive surgery.

ANALYSIS

The refractive correction related quality of life among people who wear spectacles, contact lenses, and who have undergone refractive surgery was compared by overall QIRC score (main outcome measure), and on a question-by-question basis. Means were compared using one-way analysis of variance (ANOVA) with Sheffé post hoc significance testing and the statistical results were considered significant at $P < .05$. These statistical analyses were performed on SPSS for Windows software package v10.1 (SPSS Inc, Chicago, Ill).

RESULTS

The 18 data collection centers forwarded 386 questionnaires to Bradford University. Twenty-three questionnaires were discarded due to absent demographic data or $>33\%$ missing item responses. Rasch outfit statistics identified 78 possible rogue responders and after review 42 were retained, as they appeared to provide reliable responses in a different pattern to the majority. Some of these were refractive surgery patients with postoperative complications. Thirty-six questionnaires were discarded as they appeared to provide unreliable responses. Many of them failed to note the scale reversal in the several well-being questions. This left 327 questionnaires (110 contact lens wearers, 113 spectacle wearers, and 104 refractive surgery patients). To equalize group sizes, random discarding led to a final total of 312, with 104 questionnaire responses from each refractive correction mode.

The demographic characteristics of the study population are shown in Table 1. The three groups were different for age (ANOVA, $F_{2,301} = 19.33$, $P < .001$), as the refractive surgery group was significantly older (28.7 ± 3.8 years, $P < .001$) than the spectacle (24.2 ± 6.5 years) and contact lens (24.9 ± 5.8 years) groups, which were similar to each other ($P > .05$). The three groups were similar for gender (approximately 69% female, chi-square $P > .05$), ethnicity (approximately 92%

*Available in full at <http://www.optvissci.com/pt/re/ovs/abstract.00006324-200410000-00009.htm> or www.pesudovs.com/konrad/questionnaire.html

TABLE 1
Demographic Characteristics
of the Study Sample*

Characteristic	Spectacles	Contact Lenses	Refractive Surgery
Age (y)	24.2±5.9	24.9±5.5	28.7±3.8
Gender (% female)	65	69	73
Socioeconomic status†	3.4±0.9	3.5±0.9	3.5±0.8
Race (%)			
White	93.3	92.3	90.4
Asian	1.0	6.7	1.9
Black	4.8	0.0	1.0
Mixed	0.0	2.9	1.0
Other	0.0	0.0	1.9

*The three groups were similar on all measures except the refractive surgery group was slightly older (ANOVA, $F_{2,301}=19.33$, $P<.001$, post hoc $P<.001$).

†Determined by using a five category occupational classification²⁶ (for the household chief income earner).

white, chi-square $P>.05$), and socioeconomic status (chi-square $P>.05$). Socioeconomic status and ethnicity were similar to the total UK population,^{25,26} and gender was similar to the UK population seeking eye care.³² The majority of the refractive surgery group comprised postoperative LASIK patients treated at Ultralase surgery centers in Leeds, London, Bristol, Birmingham, and Manchester using the Technolas 217 (V2 9997) excimer laser and Hansatome microkeratome (Bausch & Lomb Surgical, Rochester, NY).

The three groups were significantly different in terms of overall QIRC score ($F_{2,309}=29.29$, $P<.001$ unadjusted; and $F_{2,309}=15.18$, $P<.001$ adjusted for age) (no significant interaction effect was observed and age was not a significant effect after adjusting for mode of refractive correction), with the refractive surgery group having a better QIRC score (50.23 ± 6.31) than the contact lens wearers (46.70 ± 5.49 , $P<.01$) and the spectacle wearers (44.13 ± 5.86 , $P<.001$) (Fig 1). The contact lens wearers also had a better QIRC score than the spectacle wearers ($P<.05$). These post hoc differences were largely unaltered by adjusting for age.

To further investigate the differences between groups, each individual question was reviewed. Significant differences by ANOVA were noted between QIRC scores for the three modes of refractive correction for 18 of the 20 individual questions before adjusting for age, and 16 after adjusting for age (Fig 2). Two health concerns and two well-being questions

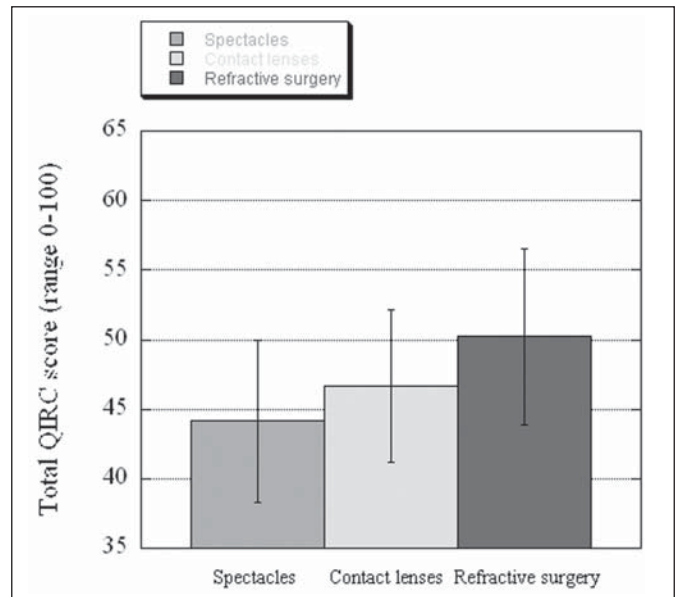


Figure 1. Columns showing mean (error bars \pm SD) responses for the total QIRC score by mode of refractive correction. Refractive surgery was significantly better than contact lenses ($P<.01$) and spectacles ($P<.001$). Contact lenses were significantly better than spectacles ($P<.05$).

did not detect differences between groups. Post hoc testing was then used to determine whether differences between individual groups (refractive surgery vs contact lens, refractive surgery vs spectacles, contact lens vs spectacles) were significant. After post hoc significance testing, which controlled for alpha inflation, differences between individual groups were demonstrated for 13 questions (Table 2). Only two well-being questions discriminated between groups. All five convenience questions (3-7) discriminated between groups—with refractive surgery scoring higher than one or both of the other modes on each question and contact lenses scoring higher than spectacles on two of these questions. The refractive surgery group had higher QIRC scores than both groups on “How concerned are you about the initial and ongoing cost to buy your current spectacles/contact lenses/refractive surgery?” and “How concerned are you about your vision not being as good as it could be?” The refractive surgery group had higher QIRC scores than the spectacle group on “How concerned are you about the cost of unscheduled maintenance of your spectacles/contact lenses/refractive surgery; eg, breakage, loss, new eye problems?” The refractive surgery group scored higher than the contact lens group on “During the past month, how often have you experienced your eyes feeling tired or strained?” The spectacle lens group had lower QIRC scores than both the contact lens and refractive surgery group on “How much difficulty do you have driving

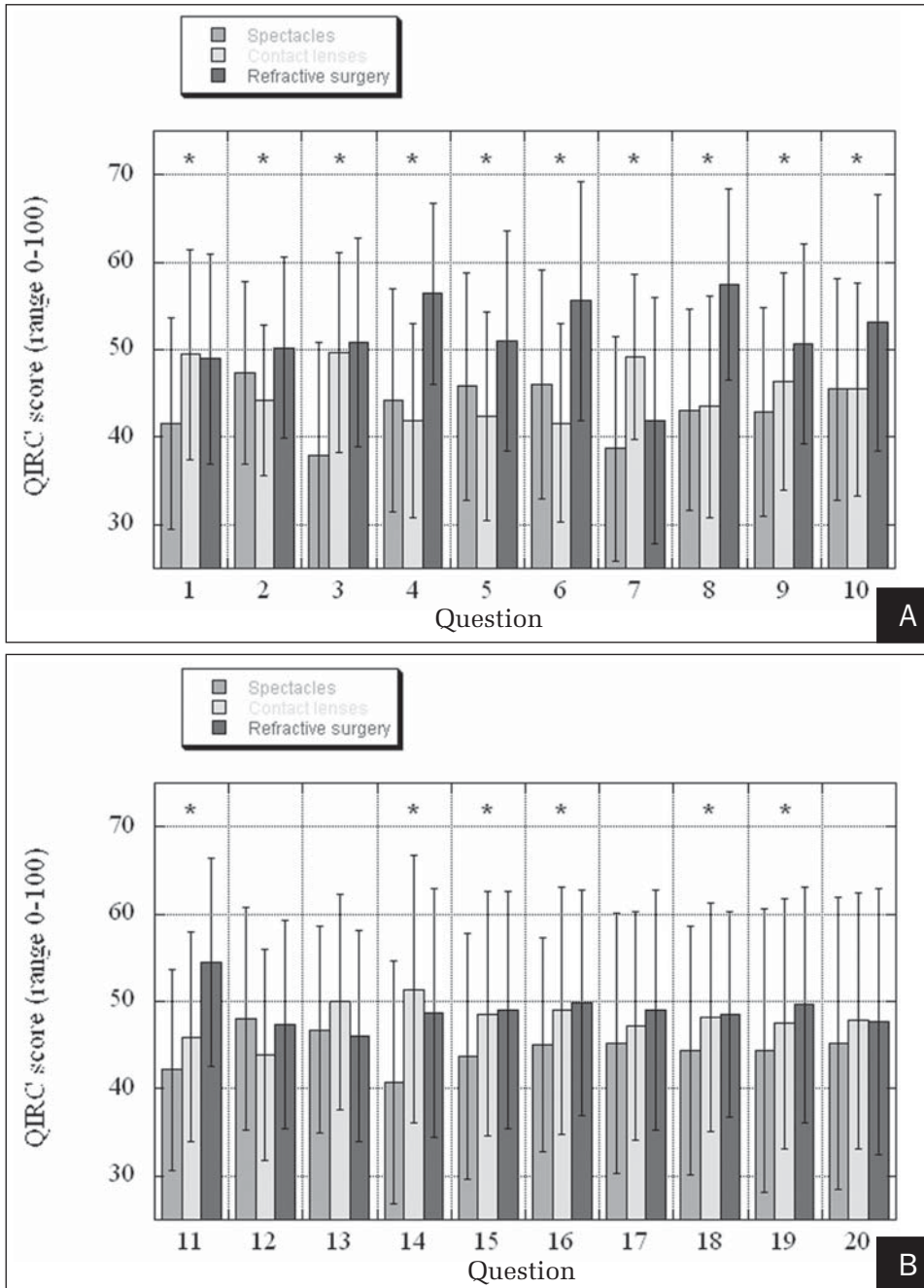


Figure 2. Columns showing mean (error bars±SD) responses on each QIRC question by mode of refractive correction (*significant difference by one-way ANOVA, $P < .05$). **A)** Questions 1-10. **B)** Questions 11-20.

in glare conditions?" The contact lens group scored better than the refractive surgery group on one question: "How much trouble are your spectacles or contact lenses when you wear them when using a gym/doing keep-fit classes/circuit training etc?"

For the spectacle group, significant differences were noted for self-reported strength of refractive correction ($F_{2,190}=3.66, P < .05$), with post hoc testing showing the low strength refractive error group (46.18 ± 5.05) had significantly better QIRC scores than those with medium strength refractive error ($42.74 \pm 6.08, P < .05$). Only 15

patients self-reported high refractive error (42.74 ± 7.48), therefore this group was not significantly different from the low strength group ($P > .05$). For the contact lens group, no significant difference was noted in overall QIRC score between strength of correction ($F_{2,98}=1.37, P > .05$).

A small number of refractive surgery patients optionally reported postoperative complications. Nine (8.6%) LASIK patients volunteered written comments regarding their vision postoperatively (including poor vision in low light, dry eyes, regression, and halos at night) and although their mean QIRC score was reduced

TABLE 2

A Comparison of Mean (\pm SD) Responses on Each QIRC Question by Type of Refractive Correction

Item Description
1 How much difficulty do you have driving in glare conditions? §
2 During the past month, how often have you experienced your eyes feeling tired or strained? * **
3 How much trouble is not being able to use off-the-shelf (non-prescription) sunglasses? §
4 How much trouble is having to think about your spectacles or contact lenses or your eyes after refractive surgery before doing things (eg, traveling, sport, going swimming)? #
5 How much trouble is not being able to see when you wake up (eg, to go to the bathroom, look after a baby, see alarm clock)? ‡
6 How much trouble is not being able to see when you are on the beach or swimming in the sea or pool, because you do these activities without spectacles or contact lenses? #
7 How much trouble are your spectacles or contact lenses when you wear them when using a gym/doing keep-fit classes/circuit training, etc? § ††
8 How concerned are you about the initial and ongoing cost to buy your current spectacles/contact lenses/refractive surgery? ¶
9 How concerned are you about the cost of unscheduled maintenance of your spectacles/contact lenses/refractive surgery (eg, breakage, loss, new eye problems)? § **
10 How concerned are you about having to increasingly rely on your spectacles or contact lenses since you started to wear them? * **
11 How concerned are you about your vision not being as good as it could be? ¶
12 How concerned are you about medical complications from your choice of optical correction (spectacles, contact lenses and/or refractive surgery)?
13 How concerned are you about eye protection from ultraviolet (UV) radiation?
14 During the past month, how much of the time have you felt that you have looked your best? † §
15 During the past month, how much of the time have you felt that you think others see you the way you would like them to (eg, intelligent, sophisticated, successful, cool, etc)? *
16 During the past month, how much of the time have you felt complimented/flattered?
17 During the past month, how much of the time have you felt confident?
18 During the past month, how much of the time have you felt happy?
19 During the past month, how much of the time have you felt able to do the things you want to do?
20 During the past month, how much of the time have you felt eager to try new things?
Total QIRC score ‡ #

Note. All questions except 17 and 20 showed significant differences by multi-factor ANOVA adjusting for age. The differences between groups as established by post hoc Sheffé testing is shown.

*Refractive surgery significantly better than spectacles ($P < .05$).

†Refractive surgery significantly better than spectacles ($P < .01$).

‡Refractive surgery significantly better than contact lenses ($P < .01$).

§Contact lenses significantly better than spectacles ($P < .001$).

||Refractive surgery significantly better than spectacles ($P < .001$).

¶Refractive surgery significantly better than contact lenses ($P < .001$).

#Contact lenses significantly better than spectacles ($P < .05$).

**Refractive surgery significantly better than contact lenses ($P < .05$).

††Contact lenses significantly better than refractive surgery ($P < .05$).

compared to the average for refractive surgery patients (50.23), their QIRC score remained good (46.64 ± 4.23) (ie, similar to contact lens wearers). Five of these nine patients were negative about their refractive surgery. Seven (6.7%) LASIK patients had a very low QIRC score (37.86 ± 2.13), which included the five who volunteered negative comments and the two who did not

comment. Three of these patients were still wearing spectacles all day every day and two of these patients were experiencing rapid increases in their myopia. Two patients suffered from significant dry eye, one of whom reported this prevented her from reading for any length of time and another was experiencing regular “eye infections” due to dry eye.

Spectacles	Contact Lenses	Refractive Surgery	ANOVA
41.53±12.11	49.45±12.03	48.96±11.96	$F_{2,256}=11.60, P<.001$
47.43±10.42	44.21±8.60	50.25±10.31	$F_{2,307}=6.32, P<.01$
37.86±12.99	49.65±11.47	50.77±11.91	$F_{2,221}=26.88, P<.001$
44.19±12.72	41.94±11.07	56.39±10.38	$F_{2,258}=14.89, P<.001$
45.82±12.99	42.42±11.88	50.98±12.57	$F_{2,238}=7.60, P<.01$
46.07±13.08	41.61±11.37	55.58±13.68	$F_{2,227}=15.88, P<.001$
38.69±12.78	49.12±9.43	41.93±14.06	$F_{2,190}=17.72, P<.001$
43.10±11.54	43.50±12.69	57.51±10.91	$F_{2,274}=17.43, P<.001$
42.91±11.98	46.36±12.49	50.74±11.43	$F_{2,289}=5.14, P<.01$
45.53±12.67	45.47±12.22	53.10±14.70	$F_{2,218}=3.93, P<.05$
42.19±11.48	45.90±11.99	54.42±11.93	$F_{2,285}=16.51, P<.001$
48.06±12.73	43.89±12.14	47.32±11.94	$F_{2,295}=1.24, P>.05$
46.73±11.83	49.98±12.31	46.07±12.04	$F_{2,302}=1.76, P>.05$
40.78±13.90	51.40±15.32	48.71±14.27	$F_{2,295}=15.88, P<.001$
43.72±14.05	48.55±13.97	49.06±13.59	$F_{2,284}=5.68, P<.01$
45.03±12.28	48.97±14.13	49.87±12.90	$F_{2,289}=3.25, P<.05$
45.14±14.90	47.15±13.07	49.01±13.81	$F_{2,300}=1.45, P>.05$
44.38±14.28	48.16±13.04	48.59±11.76	$F_{2,304}=0.56, P>.05$
44.37±16.17	47.50±14.32	49.61±13.53	$F_{2,305}=1.83, P>.05$
45.27±16.72	47.80±14.68	47.72±15.22	$F_{2,301}=0.77, P>.05$
44.13±5.86	46.70±5.49	50.23±6.32	$F_{2,309}=15.18, P<.001$

DISCUSSION

The Quality of Life Impact of Refractive Correction (QIRC) questionnaire was implemented on a sample that approximated the UK population demographics for refractive error correction in terms of age, gender, socioeconomic classification, and ethnicity. Although the groups were similar to population norms, the refractive

surgery group was older than the spectacle and contact lens wearing groups. This is probably inevitable as it reflects UK population averages for uptake of refractive surgery in the pre-presbyope.³³ Importantly, this shows that the population was representative of the overall UK population. Moreover, adjusting for age did not significantly diminish the significance of QIRC score dif-

ferences between groups. The issue of age differences could be overcome with a longitudinal outcome study of refractive surgery. Indeed this has been performed,³⁴ but this type of study raises selection bias issues as individuals self-selecting for refractive surgery may be more troubled by spectacles or contact lenses than individuals who are happy to continue to wear them. It is important to perform both of these studies.

The principle finding of this study is that the QIRC questionnaire is effective at discriminating between individuals who wear spectacles, contact lenses, and those who have had refractive surgery. An important secondary finding is that post-refractive surgery patients have better quality of life than spectacle or contact lens wearing patients (see Fig 1). This finding is supported by previous outcome studies of refractive surgery, which have shown improved quality of life after laser refractive surgery.^{5,7-10,34,35} McDonnell et al⁵ suggested that patients with worse scores on visual functioning and well-being subscales might be more likely to seek refractive surgery correction. However, in this study, convenience seemed to be the key difference. Refractive surgery patients typically have little or no trouble using non-prescription sunglasses, seeing when waking, seeing when swimming or on the beach, or while exercising, and have the convenience of not thinking about spectacles or contact lenses before traveling, etc (Table 2). They also often believe that they look their best and have few concerns regarding the cost of their refractive correction. However, the usually high quality of life afforded by refractive surgery comes with a risk. Some common complications of laser refractive surgery such as loss of contrast vision, loss of best-corrected vision, regression, and dry eye problems were reported in our group.³⁶ The QIRC effectively identified these patients, with the worse scores occurring for those patients who still required spectacle or contact lens correction or those with severe dry eye. The slightly higher than may be expected rate of individuals reporting poor outcomes may reflect the high sensitivity of the QIRC to these issues and the inclusion of hyperopic LASIK patients. Although we expect that our methodology resulted in a refractive surgery population typical of the UK refractive surgery population, it is likely that different results would occur with different procedures and in different settings.

Although the impact of surgery is most likely the cause of improvement in QIRC score, other factors should be considered such as cognitive dissonance.³⁷ Cognitive dissonance states that a change in attitude or belief occurs in an attempt to be consistent with the choice taken. Patients who have chosen to undergo surgery could justify this choice by indicating that the

outcome was successful. Dissonance increases as the degree of change increases. Although this probably plays a role, its impact is likely to be greater when asking about satisfaction or overall assessment of outcome as this directly targets justification issues, rather than when using a questionnaire where the way to distort measurement of outcome may not be as obvious. Nevertheless, cognitive dissonance may account for some of the differences between groups.

The majority of QIRC questions contributed to scoring differences between groups. The well-being questions were less discriminating by virtue of their high standard deviations. This indicates that individuals vary greatly in their response to these questions, although their fit to the Rasch model illustrates the importance of these items to the construct: refractive correction related quality of life.²⁴

Pre-presbyopic contact lens wearers had a higher QIRC score on average than spectacle wearers. Typically, they were happier with their appearance than spectacle wearers, confirming a previous report by Day and Jutai.³⁸ In addition, they had less difficulty driving in glare conditions, less trouble using non-prescription sunglasses, and less trouble seeing when exercising (Table 2). Spectacle wearers were shown to have a lower QIRC score than the other two refractive correction modes (Table 2). This was particularly true of those individuals who thought that their refractive correction was medium or high.

Compared to the risks of complications from refractive surgery, the risks from contact lens or spectacle wear are low. The annual incidence of a loss of vision to $<6/18$ from microbial keratitis, the main cause of visual morbidity in soft contact lens wearers, is 0.0019%.³⁹ Similarly, cases of traumatic eye damage from spectacle lenses have been reported, but the protective value of ordinary spectacle lenses (the relative risk of penetrating eye injury in non-wear of spectacles has been estimated at 10.2 times higher than in spectacle wear) far outweighs their danger.⁴⁰ The lower risk profile of spectacles and contact lenses may explain their popularity in the marketplace despite a better quality of life option (eg, refractive surgery) being available.

The QIRC questionnaire can effectively differentiate between spectacle wearers, contact lens wearers, and post-refractive surgery patients. It has also been shown to be responsive to the impact of refractive surgery³⁴ and has excellent validity and reliability.²⁴ These qualities, along with the truly linear scoring afforded by Rasch scaling, make the QIRC questionnaire an ideal instrument for measuring quality of life outcomes of all types of refractive surgery.

REFERENCES

- Vision Watch. *Vision Correction Market Review*. New York, NY: Jobson Publishing; 2003.
- Thibos LN, Applegate RA, Schwiegerling JT, Webb R. Standards for reporting the optical aberrations of eyes. *J Refract Surg*. 2002;18:S652-S660.
- Waring GO III. Standard graphs for reporting refractive surgery. *J Refract Surg*. 2000;16:459-466.
- Schein OD. The measurement of patient-reported outcomes of refractive surgery: the refractive status and vision profile. *Trans Am Ophthalmol Soc*. 2000;98:439-469.
- McDonnell PJ, Mangione C, Lee P, Lindblad AS, Spritzer KL, Berry S, Hays RD. Responsiveness of the National Eye Institute Refractive Error Quality of Life instrument to surgical correction of refractive error. *Ophthalmology*. 2003;110:2302-2309.
- Fraenkel G, Comaish F, Lawless MA, Kelly MR, Dunn SM, Byth K, Webber SK, Sutton GL, Rogers CM. Development of a questionnaire to assess subjective vision score in myopes seeking refractive surgery. *J Refract Surg*. 2004;20:10-19.
- Ben-Sira A, Loewenstein A, Lipshitz I, Levanon D, Lazar M. Patient satisfaction after 5.0-mm photorefractive keratectomy for myopia. *J Refract Surg*. 1997;13:129-134.
- McGhee CN, Craig JP, Sachdev N, Weed KH, Brown AD. Functional, psychological, and satisfaction outcomes of laser in situ keratomileusis for high myopia. *J Cataract Refract Surg*. 2000;26:497-509.
- Rose K, Harper R, Tromans C, Waterman C, Goldberg D, Haggerty C, Tullo A. Quality of life in myopia. *Br J Ophthalmol*. 2000;84:1031-1034.
- Hill JC. An informal satisfaction survey of 200 patients after laser in situ keratomileusis. *J Refract Surg*. 2002;18:454-459.
- Walline JJ, Bailey MD, Zadnik K. Vision-specific quality of life and modes of refractive error correction. *Optom Vis Sci*. 2000;77:648-652.
- Nichols JJ, Mitchell GL, Zadnik K. The performance of the refractive status and vision profile survey in a contact lens clinical trial. *Ophthalmology*. 2001;108:1160-1166.
- Nichols JJ, Mitchell GL, Saracino M, Zadnik K. Reliability and validity of refractive error-specific quality-of-life instruments. *Arch Ophthalmol*. 2003;121:1289-1296.
- Likert RA. A technique for the measurement of attitudes. *Arch Psychol*. 1932;140:1-55.
- Mangione CM, Phillips RS, Seddon JM, Lawrence GM, Cook EF, Dailey R, Goldman L. Development of the "Activities of Daily Vision Scale." A measure of visual functional status. *Med Care*. 1992;30:1111-1126.
- Pesudovs K, Garamendi E, Keeves JP, Elliott DB. The Activities of Daily Vision Scale for cataract surgery outcomes: re-evaluating validity with Rasch analysis. *Invest Ophthalmol Vis Sci*. 2003;44:2892-2899.
- Fisher WP Jr. The Rasch debate: validity and revolution in educational measurement. In: Wilson M, ed. *Objective Measurement: Theory Into Practice*. Vol 2. Norwood, NJ: Ablex; 1994:36-72.
- Fisher WP Jr, Eubanks R, Marier RL. Equating the MOS SF36 and the LSU HSI Physical Functioning Scales. *J Outcome Meas*. 1997;1:329-362.
- Massof RW. The measurement of vision disability. *Optom Vis Sci*. 2002;79:516-552.
- Wright BD, Linacre JM. Observations are always ordinal; measurements, however, must be interval. *Arch Phys Med Rehabil*. 1989;70:857-860.
- Raczek AE, Ware JE, Bjorner JB, Gandek B, Haley SM, Aaronson NK, Apolone G, Bech P, Brazier JE, Bullinger M, Sullivan M. Comparison of Rasch and summated rating scales constructed from SF-36 physical functioning items in seven countries: results from the IQOLA Project. *International Quality of Life Assessment*. *J Clin Epidemiol*. 1998;51:1203-1214.
- White LJ, Velozo CA. The use of Rasch measurement to improve the Oswestry classification scheme. *Arch Phys Med Rehabil*. 2002;83:822-831.
- Norquist JM, Fitzpatrick R, Dawson J, Jenkinson C. Comparing alternative Rasch-based methods vs raw scores in measuring change in health. *Med Care*. 2004;42:125-136.
- Pesudovs K, Garamendi E, Elliott DB. The Quality of Life Impact of Refractive Correction (QIRC) questionnaire: development and validation. *Optom Vis Sci*. 2004;81:769-777.
- Office for National Statistics. National Statistics Online Ethnicity Classification. Available at: http://www.statistics.gov.uk/about/Classifications/ns_ethnic_classification.asp. Accessed February 16, 2002.
- The Market Research Society. *Occupation Groupings. A Job Dictionary*. London, United Kingdom: The Market Research Society; 2003.
- Walline JJ, Zadnik K, Mutti DO. Validity of surveys reporting myopia, astigmatism, and presbyopia. *Optom Vis Sci*. 1996;73:376-381.
- Nagata C, Ido M, Shimizu H, Misao A, Matsuura H. Choice of response scale for health measurement: comparison of 4, 5, and 7-point scales and visual analog scale. *J Epidemiol*. 1996;6:192-197.
- Skevington SM, Tucker C. Designing response scales for cross-cultural use in health care: data from the development of the UK WHOQOL. *Br J Med Psychol*. 1999;72:51-61.
- Wright BD, Masters GN. *Rating Scale Analysis*. Chicago, Ill: MESA Press; 1982.
- Linacre JM. Investigating rating scale category utility. *J Outcome Meas*. 1999;3:103-122.
- Pointer JS. An optometric population is not the same as the general population. *Optometry in Practice*. 2000;1:92-96.
- Mintel. *Optical Goods and Eyecare*. London, United Kingdom: Mintel; 2002.
- Garamendi E, Pesudovs K, Elliott DB. Changes in quality of life after laser in situ keratomileusis for myopia. *J Cataract Refract Surg*. 2005;31:1537-1543.
- Schein OD, Vitale S, Cassard SD, Steinberg EP. Patient outcomes of refractive surgery. The refractive status and vision profile. *J Cataract Refract Surg*. 2001;27:665-673.
- Melki SA, Azar DT. LASIK complications: etiology, management, and prevention. *Surv Ophthalmol*. 2001;46:95-116.
- Erickson DB, Ryan RA, Erickson P, Aquavella JV. Cognitive styles and personality characteristics strongly influence the decision to have photorefractive keratectomy. *J Refract Surg*. 1995;11:267-274.
- Day H, Jutai J. Measuring the psychosocial impact of assistive devices: the PIADS. *Canadian Journal of Rehabilitation*. 1996;6:135-141.
- Cheng KH, Leung SL, Hoekman HW, Beekhuis WH, Mulder PG, Geerards AJ, Kijlstra A. Incidence of contact-lens-associated microbial keratitis and its related morbidity. *Lancet*. 1999;354:181-185.
- Wittenberg S. Do ordinary spectacle lenses reduce eye injuries? *Optom Vis Sci*. 2001;78:465-467.