Original Contribution Kitasato Med J 2010;40:6-11

Relationships of quality-of-life to visual acuity and visual field state in Japanese patients with low vision

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Objective: To investigate the relationships between quality-of-life (QOL) and each of visual acuity (VA) and visual field (VF) state using the Japanese version of the National Eye Institute Visual Function Questionnaire-25 (VFQ-25).
Methods: We evaluated QOL in 115 Japanese patients with low vision (LV), using seven vision-related subscales of the VFQ-25 (component 7). Average of decimal VA in the better eye was 0.12 (range, 0.01-1.2). Causes of vision loss included glaucoma (50 [43.5%]) patients), macular degeneration (25 [21.7%]), pigmentary retinal degeneration (14 [12.2%]), diabetic retinopathy (11 [9.6%]) and others (15 [13.0%]). We investigated the relationships between QOL and both VA and VF state based on a composite of the V-4e or I-4e isopter reults of Goldmann perimetry in both eyes.
Results: QOL correlated with VA (I-4e: P = 0.39, V-4e: P = 0.34). On the VFQ-25, VA correlated with all subscales (r = 0.31-0.49, P < 0.05). Conversely, VF (P = 0.42) did not correlate with QOL nor any of the subscales.
Conclusions: All though VA evidently reflects patient QOL, the VF state alone did not correlate with QOL. It is, therefore, necessary to re-examine the methods of evaluating the state of VF.

Key words: low vision, VFQ-25, quality-of-life, visual acuity, visual field

Introduction

Visual disability may lead to difficulties in carrying out various actions and movements that require vision; for this reason, visual disability can lead to an unavoidable deterioration in the quality of life (QOL). The purpose of low vision (LV) care is to improve the patients' QOL. In providing that care, it is important to understand each patient's perception of his or her visual disability in daily life. Conventionally, the degree of visual impairment impacting patient QOL has been estimated using visual acuity (VA) and the visual field (VF) state. However, there has been a recent call for an outcome index based on the patient's perception. Towards that goal, these are some of the questionnaires that have been developed to measure this perception: The Activities of Daily Vision Scale,[1,2] Vision-Specified Sickness Impact Profile,[3] National Eye Institute (NEI) Visual Function Questionnaire (VFQ-25),[4,5] and Sumi's Questionnaire.[6] Additionally, several studies have investigated the efficacy of the QOL measurement of visually impaired patients via the NEI VFQ-25.[7-10]

In Japan, there is a welfare system that classifies degree of visual impairment. The classifications are ranked from 1 to 6, according to degrees of VA impairment and VF state impairment. VA is judged according to decimal VA as measured by Landolt's rings, and the VF state is judged from the I-4e (or I-2e) isopter results of the Goldmann perimetry test. In Japan, Goldmann perimetry test results are used as the standard in determining VF status.[11] Persons who are ranked at any grade from 1 to 6 are defined as visually impaired. Grade 1: summation of binocular decimal VA is less than 0.01. Grade 2: summation of binocular decimal VA is

Received 15 July 2009, accepted 30 September 2009
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<0.04 and >00.2, or binocular VF is <10 degrees, respectively, and the VF loss is >95%. Grade 3: summation of binocular decimal VA is <0.08 and >00.5, or binocular VF is <10 degree respectively, in addition the VF loss is >90%. Grade 4: summation of binocular decimal VA is <0.12 or >0.9, and binocular VF is <10 degrees, respectively. Grade 5: summation of binocular decimal VA is <0.2 and >0.13, or binocular VF defect is >1/2. Grade 6: one eye of decimal VA is <0.2 and the other eye of decimal VA is <0.6, and summation of binocular decimal VA is >0.2. In case of duplication visually impaired (VA and VF), the classifications are different. It has recently been pointed out that results such as those for VA and VF, even under controlled conditions, do not always reflect the degrees of difficulty experienced by patients in daily life. We recently reported on the relationship between a patient's QOL and visual impairment level categorized by the degree of visual difficulty.[12] There have been many studies of VA and QOL, and the relationship therein has traditionally been considered within the context of specific diseases.[13,14] Most studies on the effect of VF state have used the mean deviation value of the Humphrey Field Analyzer[6,15] and Esterman's score[16-19] to define the VF state. There have also been a few reports on the relationship between QOL and peripheral VF status, but there have been no reports on peripheral VF status according to the Goldmann perimetry test. Neither have there been any reports examining the relationship between the area of VF and OQL. Peripheral VF is suspected to influence QOL. Therefore, we investigated QOL with the Japanese version of the 25-item NEI VFQ-25[5] and estimated the relationships of QOL to VA and VF state based on a composite of the V-4e or I-4e isopter results from the Goldmann perimetry tests in both eyes.

Subjects and Methods

All the studies described below were carried out at the Department of Ophthalmology, University of Tokyo Graduate School of Medicine. The studies were approved by the Institutional Review Board, and we observed the Declaration of Helsinki. An informed consent was obtained from all patients after the purpose and experimental procedures to be used in this study were carefully explained to them.

We retrospectively evaluated QOL in 115 consecutive Japanese patients (61 males and 54 females) with LV and followed them up at the LV clinic of Tokyo University Hospital from April 2005 to June 2008. These patients received regular outpatient treatment for more than 1 year each had the grades of from 1 to 6. The Goldmann perimetry test was conducted within 3 months of the initial visit, and the VFQ-25 was performed on all the subjects with an interview. We reviewed the completed questionnaires for any missing data. The mean age of the patients ($\pm$ standard deviation [SD]) was 62.4 $\pm$ 13.7 years, (range, 22-81 years). The average of decimal VA in the better eye was 0.12 (range, 0.01-1.2) in the eye with better VA. Causes of vision loss included glaucoma (50 patients [43.5%]), macular degeneration (25 [21.7%]), pigmentary retinal degeneration (14 [12.2%]), diabetic retinopathy (11 [9.6%]), and others (15 [13.0%]). We evaluated the QOL of patients using the Japanese version of the VFQ-25. The VFQ-25 was developed as a vision-targeted measure of QOL. It was translated into Japanese by Suzukamo et al.[5] who assessed it for its reliability and validity and proved it to accurately measure QOL in Japanese individuals. In this report, Cronbach's coefficient alpha validity was more than 0.7. The VFQ-25 is composed of 12 vision-targeted scales.[4] Each scale consisted of a minimum of one and maximum of four items. The standard algorithm was used to calculate the scale scores, which have a possible range of zero to 100.[4] The higher the score, the better the QOL pertinent to that specific symptom or activity. The total score generally was calculated by averaging the scores of 11 subscales, and the general health subscale was excluded.[4] In addition, the original English version of the VFQ-25 included a driving subscale, because being able to drive a car is indispensable to most people in their everyday lives in Europe and North America. However, in Japan it is not common for the elderly to drive cars; therefore, more than 60% of the responses to the driving subscale were missing. Furthermore, a factor analysis indicated that the ocular pain, color vision and peripheral vision subscales correlated strongly with a second factor. If only one composite score is to be computed, that score should not include any of these three subscales. Therefore, we used the total score of seven components (i.e., seven subscales) because there were fewer inherent errors.[5] We determined scores for each of the seven subscales, or seven components (general vision: GV, near vision: NV, distance vision: DV, social function: SF, mental health: MH, role limitations: RL, and dependency: DV) shown in Table 1. The total score was calculated by averaging the scores of the seven subscales.

Using a shareware program to determine the length area measurement (Lenara2.20®), VF areas were measured based on a composite of both eyes for the V-4e or I-4e isopters, as obtained with the Goldmann perimetry test. The Lenara2.20® software measures the

Table 1. The list of items on the Japanese VFQ 25: seven subscales

Subscales	No. of items	Items
General vision: GV	1	5-level general vision
Near vision: NV	3	Reading normal newsprint
		Seeing well up close
		Finding objects on crowded shelf
Distance vision: DV	3	Going out to movies/plays
		Going down stairs at night
		Reading street signs
Social function: SF	2	Seeing how people react
		Visiting others
Mental health: MH	4	Amount true: Frustrated
		Amount true: Embarrassment
		Amount true: No control
		Amount true: Worry
Role limitations: RL	2	Accomplish less
		Limited in endurance
Dependency: DP	3	Need much help from others
		Stay home most of time
		Rely too much on others' word

VFQ-25, The 25-Item National Eye Institute Visual Function Questionnaire: seven subscales (component 7)

Table 2. Score and Spearman correlation coefficients between VFQ-25 subscales and visual acuity

	Scores All (115)	Coefficients All (115)	Scores Glaucoma (50)	Coefficients Glaucoma (50)
General vision: GV	37.2 ±18.4	0.36 0.001	34.8 ±16.6	0.34 0.043
Near vision: NV	32.7 ±25.4	0.31 0.005	28.8 ±21.3	0.29 0.082
Distance vision: DV	31.3 ±21.9	0.33 0.003	25.6 ±21.8	0.47 0.004
Social function: SF	39.0 ±28.9	0.46 <0.001	35.7 ±29.0	0.29 0.072
Mental health: MH	30.0 ±22.5	0.36 0.001	30.2 ±22.1	0.48 0.004
Role limitations: RL	36.5 ±26.8	0.45 <0.001	34.5 ±28.1	0.57 <0.001
Dependency: DP	35.3 ±24.9	0.49 <0.001	39.1 ±25.4	0.46 0.005

VFQ-25, The 25-Item National Eye Institute Visual Function Questionnaire
Visual acuity is the mean of the best-corrected decimal visual acuity in the better eye.
Data are shown as mean ± standard deviation. For all correlation coefficients, the correlation was significant at $P < 0.05$. The upper numbers are Spearman correlation coefficients. The lower numbers are P values indicating differences between VFQ-25 subscale scores and visual acuity.

area of interest on the Goldmann chart through a manual trace of the isopter on a computer monitor with a mouse input.[20] We measured the areas three times per eye and assumed the average as the total area of the isopter. In both eyes, blind-spot areas were measured and subtracted from the total area. Normal areas for V-4e and I-4e isopters are 61.7 cm^2 and 41.8 cm^2, respectively. We then examined correlations between VA and VF area with the total scores and the subscale scores, respectively.

Because the 50 glaucoma patients represented the majority of our study patients, we also studied these patients as a separate group. Of these 50 cases, 40 patients suffered from open-angle glaucoma, and 10 patients suffered from other forms of glaucoma. The mean (± SD) age of the patients with glaucoma was 63.2 ± 14.2 years (range, 22-81 years). The average of decimal VA in the better eye was 0.14 (range, 0.01-1.0). We then calculated Spearman correlation coefficients between these scores and VA or VF areas in all patients and for the patients with glaucoma. For all analyses, a value of $P < 0.05$ was considered to indicate significant a correlation. A stepwise regression analysis was also performed using the VA or VF areas as dependent variables, and the total score and the seven subscale scores were used as independent variables. All the statistical calculations were carried out using Statistical Analysis Software (SAS) System, Version 6, Second Edition (SAS Institute, Cary, NC, USA).

Results

The total VFQ-25 score for all patients was 34.5 ± 17.3, and the VA in the better eye correlated significantly with the total score ($r = 0.48$, $P < 0.0001$). Moreover, VA correlated significantly with all seven subscale scores ($r = 0.31$-0.49, $P < 0.0001$ to $P = 0.013$) (Table 2). Using a stepwise variable selection, the total score was found to be a significant predictor of VA in the better eye ($P < 0.0001$). The standardized partial regression coefficient for the total score was 0.47. The R value determined between the predicted and the actual VA in the better eye, was 0.26. Conversely, in all subjects, the mean (± SD) areas of the V-4e and I-4e isopters were 22.5 ± 16.4 cm^2 and 6.1 ± 8.4 cm^2, respectively. Neither I-4e nor V-4e of the VF area correlated with the total score ($P = 0.39$ and $P = 0.34$, respectively), nor did either correlate with any of the subscale scores ($P > 0.07$). Using a stepwise variable selection, the total score was found to be a significant predictor of VA in the better eye ($P = 0.0005$). The standardized partial regression coefficient for the total score was 0.51, and the R value determined between the predicted and actual VA in the better eye was 0.31.

For the glaucoma patients, the VFQ-25 total score was 32.6 ± 17.2, and VA in the better eye correlated significantly with the total score ($r = 0.58$, $P = 0.001$). As for the seven subscale scores, neither near vision nor social function correlated with VA ($P > 0.05$) (Table 2).

The mean (±SD) areas of the V-4e and I-4e isopters were 20.5 ± 15.3 cm^2 and 5.7 ± 7.2 cm^2, respectively. Regarding the VF area in glaucoma, neither the V-4e nor the I-4e isopter of the VF area correlated with the total score ($P = 0.69$), nor were there any correlations with any of the seven subscale scores ($P > 0.28$).

Discussion

In this study, we used the VFQ-25 (Japanese version) to determine correlations between VA and VF state and QOL. Though the QOL studies are popular in Europe and North America,[7-10] there have been few outcome studies on QOL in Japan. In Japan, many studies that investigated the relationship between VFQ-25 and VA have been done based on disease distinctions. Asano et al.,[13] reported that the QOL decline was small if the VA in the better eye was more > 0.7 in the glaucoma patients; when VA of the better eyes fell below 0.3, VA significantly correlated with QOL decline. In other words, Asano et al. found that QOL deteriorates as VA decreases. Yuzawa et al.[14] reported that scores of patients whose VA was < 0.1 were, for several subscales, lower than those of patients with VA of 0.4. They also found that the VA in the better eye influenced the subscale of QOL.

We evaluated the QOL of patients with LV, using the VFQ-25, in order to examine how VA and VF area reflected the QOL in LV patients, and we investigated correlations with VA and VF area. In particular, we used the Goldmann perimetry test, to investigate the influence of the peripheral VF area on OQL. In Japan, the VF state is evaluated from the I-4e (or I-2e) isopter result of the Goldmann perimetry test. Controversially, we measured the area of the VF on the Goldmann chart, not the solid degrees of visual angle. The reason was that there have been few reports about VF evaluation by the area on the chart and because we wanted to use a new evaluative method other than the visual angle. In all patients, VA correlated significantly with the total score and the seven subscale scores. These results indicated that VA reflected the QOL of patients with LV.

For glaucoma patients, total score was correlated significantly with VA, in agreement with Asano et al.'s study.[13] In the seven subscale scores, neither near vision

nor social function correlated with VA. In patients with glaucoma, we speculated that because the main visual impairment is a centripetal VF defect, it worsens comparatively slowly. In other words, glaucoma is considered a disease where there is seldom a sudden VA decline or a sudden VF defect. That is the reason the total score and the seven subscale scores correlated significantly with visual acuity. If visual acuity declines, the QOL score declines as well.

Furthermore, in assessing QOL, we found that neither V-4e nor I-4e isopter area correlated with either the total score or the seven subscale scores. These observations indicated that the VF area alone does not reflect the QOL of LV patients. In the past, there have been many reports on the relationship between QOL to VF.[6,15,17-19] The questionnaires used in these previous studies were different, but they all reported that the degree of VF impairment correlated significantly with QOL, particularly so with glaucoma patients. Those studies used the mean deviation value of the Humphrey Field Analyzer or the Esterman's score. However, those results differed from ours due to our use of the Goldmann perimetry test. In Japan, Goldmann perimetry test results are used as the standard in determining VF status, so it is logical to use that test in examinations.

In the present study, we used VF areas as determined by the composite results of the V-4e and I-4e isopters for both eyes obtained by the Goldmann perimetry test. By this evaluation method, the degree of influence on daily living was not reflected in the differences in VF impairment, e.g., a peripheral visual field disturbance could affect ambulation. Moreover, the basis of disability in daily living activities clearly differ among lower and upper hemianopia.[16] VF evaluation by area alone may not have been the best approach, based on our finding of no correlation between VF area and total score or the subscale scores.

The model in which VF areas were determined by composite results for both eyes was reported previously.[17,19] Nelson-Quigg et al.[15] reported that the binocular summation model and the best location model did correlate significantly with QOL. These models estimate the binocular VF from the monocular VF, as measured on single eyes with the Humphrey Field Analyzer. Although it might have been more pertinent if we had estimated the binocular VF from the monocular VF, such interpretations of results are not definitive and are not easily calculated. Further studies are needed to distinguish between VF area and VA and to determine the method that best reflects the patient's QOL.

In our version of the VFQ-25, the peripheral vision subscale was not included. We examined this subscale, to determine whether the V-4e or I-4e area of the VF showed any correlation; and, in fact, it did ($r = 0.44$, $P < 0.001$; $r = 0.45$, $P < 0.001$) (Table 3). Using a stepwise variable selection, the peripheral vision score was found to be a significant predictor of the V-4e or I-4e isopter area of the VF ($P < 0.0001$ and $P = 0.001$, respectively). The standardized partial regression coefficients for the peripheral vision subscale were 0.45 and 0.34 for the V-4e and I-4e, respectively. The R values between the predicted scores and the V-4e and I-4e areas of the VF area were 0.21 and 0.12, respectively. In patients with glaucoma, either V-4e or I-4e area of the VF area correlated with the peripheral vision subscale score (V-4e: $r = 0.46$, $P = 0.004$; I-4e: $r = 0.37$, $P = 0.02$) (Table 3).

In the standard VFQ-25 questionnaire, most of the 25 questions focus on psychological QOL factors and there is only one VF question, whereas there are six questions about the actions involving VA. In other words, one of the reasons why there were no correlations with the VF area and the composite score was because there are relatively few questions in the VFQ-25 related to the VF. This suggests that the seven components of the VFQ-

Table 3. Spearman correlation coefficients of subscale scores for peripheral vision and V-4e and I-4e of the visual field area

	Peripheral vision scores	V4e	I4e
All (n = 115)	38.32 ± 26.1	0.44 (<0.001)	0.45 (<0.001)
Glaucoma (n = 50)	32.89 ± 22.6	0.46 (0.004)	0.37 (0.02)

Data are shown as mean ± standard deviation.
Upper numbers are Spearman correlation coefficients. Lower numbers are P values. For all correlation coefficients, a value of $P < 0.05$ was considered to indicate significant correlation.

25 insufficiently evaluate VF impairment. In addition, because the sample size of the present study was small, we plan to increase the sample size and compare the evaluation of QOL in other diseases using other instruments.

In conclusion, it is necessary to investigate not only the actual VA and the state of the VF but also essential to show how a patient's symptoms change to assess disability in LV patients. We examined all the data including various diseases in the present study, but further investigation is warranted on many other diseases in the future. In evaluating the VF, it is necessary to examine the state of visual function, classified according to differences in disability associated with various forms of VF impairment. Furthermore, it is important to examine the validity of QOL evaluations in LV patients when using QOL questionnaires.

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