

APPLICATION OF MODIFIED NEI VFQ-25 AFTER RETINAL DETACHMENT TO VISION-RELATED QUALITY OF LIFE

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Purpose: We examined the postoperative visual recovery and quality of life after retinal detachment (RD) surgery.

Methods: In addition to a baseline clinical examination, patients filled out the National Eye Institute Visual Functioning Questionnaire at three time points: preoperatively and 1 and 3 months postoperatively (M1 and M3, respectively). We analyzed the composite score and short-form scores (socioemotional scale [SFSES] and visual functioning scale [SFVFS]).

Results: One hundred ninety-four patients were enrolled in this study; 47 (26 macula-ON RD and 21 macula-OFF RD) returned all three questionnaires. The best corrected visual acuity was Snellen equivalent 20/25, 20/25, and 20/20 at the preoperative, M1, and M3 assessment, respectively. At M3, we found a positive correlation between SFSES and best corrected visual acuity measures among macula-OFF patients ($P < 0.001$, $R^2 = 0.58$). A significant correlation with the best corrected visual acuity among macula-ON patients was observed only at M3 with the SFVFS score ($P < 0.001$, $R^2 = 0.41$).

Conclusion: The quality of life differs between ON and OFF RD in regard to the composite score and especially SFSES and SFVFS. We found a transient decrease in the quality of life at M1 for macula-ON patients, whereas the quality of life improved throughout follow-up among macula-OFF patients. These data may help improve the management of patients' expectations after RD surgery.

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After surgery for rhegmatogenous retinal detachment (RD), the retina will be reattached in 95% of treated patients, with useful vision retained in most cases.^{1–4} Surgical success is assessed based on the postoperative

visual acuity,^{2,5–8} but a patients' appreciation of success in the vision-related quality of life (QoL) often diverges from the surgeon's assessment.^{9–13} The QoL after successful RD surgery has been assessed in six studies,^{4,13–17} including two reports that compared the postoperative outcomes of patients presenting with preserved macula (macula-ON) and those with RD extending through the macula (macula-OFF). In these articles, there was a significant difference in the postoperative visual acuity after macula-OFF and macula-ON RD, but it does not manifest as a significant difference in the QoL.^{14,16} Recently, Pesudovs et al¹⁸ indicated that the instrument used to measure the QoL is not appropriate.

In social sciences, QoL instruments are assessed for validity (i.e., the concept to be measured is assessed by the instrument),^{19,20} reliability (any significant results obtained are repeatable),²¹ and responsiveness (captures changes over a period of time in participants with modified ability during follow-up).^{19,20} Furthermore, a

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QoL instrument must be shown to be unidimensional (i.e., measures only one underlying construct) and on an interval-level scale (i.e., the periods alongside the measurement scale should be the same sizes).^{21,22} Rasch analysis is a statistical transformation used to verify these criteria^{23–25}; thus, it plays an important role in developing or revalidating questionnaires for use in patients with RD.^{20,26}

The instrument most commonly used to quantitatively assess the vision-related QoL is the National Eye Institute Visual Functioning Questionnaire (NEI-VFQ-25).^{15,27–33} This instrument has 25 questions and has been used to assess the QoL in patients with various eye-related diseases.^{34–37} Recently, Pesudovs et al¹⁸ performed Rasch analysis on this questionnaire and reported several fundamental problems. The authors provided a reengineered NEI-VFQ-25 to redress these problems with respect to reliability and unidimensionality, with better targeting of individuals.¹⁸ This work provided two short-forms (SFs): the visual functioning scale (SFVFS) containing six items and the socioemotional scale (SFSES) containing seven items. This reengineered version has been deemed the most suitable instrument for patients with RD.^{18,33} Here, we assessed the role of the modified NEI-VFQ-25 in assessing patients with RD after successful intervention and to analyze the preoperative and postoperative outcomes.

Methods

This study received approval from the Ethical Committee of Canton Vaud, Switzerland (protocol no 483/14) and was conducted in accordance with the Declaration of Helsinki.

Patients

This observational, prospective, single-center cohort study was performed from February 2015 to March 2017 at the Department of Vitreoretinal Surgery at Jules-Gonin Eye Hospital. Patients with RD (macula-ON or macula-OFF) were enrolled in the study after their first clinical examination. Ethical approval was obtained to include patients younger than 99 years of age and older than 18 years of age who presented with primary RD. We excluded all patients with RD after eye trauma, long-lasting RD (>30 days), grade C or greater proliferative vitreoretinopathy, or other ocular comorbidities (e.g., diabetic retinopathy, retinal vascular occlusions, or age-related macular degeneration in either eye). Of 204 subjects recruited for the study, the analysis included 194. A standard clinical examination was performed in all patients preoperatively to measure the best corrected visual acuity (BCVA) measured as logMAR and Snellen

equivalent (SE), intraocular pressure, and axial length measured using an IOL Master 500 (Carl Zeiss Meditec, Dublin, CA). Each patient also underwent a fundus examination. Spectral-domain optical coherence tomography was performed using HEYEX software (version 1.7.1.0; Heidelberg Engineering, Heidelberg, Germany). Patients were asked to complete the self-administered, modified version of the validated NEI-VFQ-25 (NEI-VFQ-13) according to Nordmann's protocol in the French language preoperatively and at 1 (M1) and 3 months (M3) postoperatively.³⁶

As an observational study, surgical techniques varied; 43 patients had a silicone tamponade, 41 a C3F8, 103 received SF6, and 7 underwent scleral buckling. Given the known difference in the BCVA about the tamponade type, we restricted the analysis to only those patients with SF6. Nine patients (9%) were reoperated for RD, 10 (10%) withdrew or were lost to follow-up immediately after surgery, and five were lost to follow-up before M3. In the remaining 79 patients, 47 (59%) returned the completed questionnaire at all time points. The questionnaire was explained in detail to the patients by the study team, who provided assistance when required. The participants gave the most appropriate response. Complete questionnaire data were available for 47 patients who attended postoperative appointments at M1 and M3 after 23-G pars plana vitrectomy with gas tamponade (23% SF6). Twenty-six patients had macula-ON RD, and 21 patients had macula-OFF RD.

NEI-VFQ-13

For appropriate analysis of the NEI VFQ-13, the modified version of the NEI-VFQ-25, the rules of Rasch analysis were respected following Pesudovs et al¹⁸'s explanation. As NEI-VFQ-13 is composed of two subscales comprising 13 questions total (Table 1), we analyzed and report on both the composite score (CS) and the SFVFS (six items) and SFSES (seven items) subscale scores. Each item contained four categories.^{18,33}

Statistical Analysis

To summarize the data obtained by the NEI-VFQ-13, the instructions from the test manual were used. Results were presented as the total score and a subscales sum score. All answers to each question were transformed into a 100-point scale, where 0 represents the worst score. The subscale scores and CS were calculated as the mean scores for each item.^{37,38} In addition, the subscale scores and the CS were converted into Rasch scores as described previously.¹⁸

Descriptive statistics, including mean and SD, were used to evaluate visual acuity, age, and QoL. The CSs

Table 1. Remediated National Eye Institute Visual Functioning Questionnaire (NEI-VFQ-25) (After Performed Rash Analysis, According to Pesudovs et al¹⁸)

Subscale 1 = short version of the visual functioning scale (SVFVS)	
Q1	At the present time, would you say your eyesight using both eyes (with glasses or contact lenses, if you wear them) is excellent, good, poor, very poor, or are you completely blind?
Q2	How much difficulty do you have reading ordinary print in newspapers?
Q3	How much difficulty do you have doing work or hobbies that require you to see well up close, such as cooking, sewing, fixing things around the house, or using hand tools?
Q4	Because of your eyesight, how much difficulty do you have finding something on a crowded shelf?
Q5	How much difficulty do you have reading street signs or the names of stores?
Q6	Because of your eyesight, how much difficulty do you have going down steps, stairs, or curbs in dim light or at night?
Q7	Because of your eyesight, how much difficulty do you have visiting with people in their homes, at parties, or in restaurants?
Subscale 2 = short version of the socioemotional scale (SVSES)	
Q1	Do you accomplish less than you would like because of your vision?
Q2	Are you limited in how long you can work or do other activities because of your vision?
Q3	I stay home most of the time because of my eyesight.
Q4	I have much less control over what I do, because of my eyesight.
Q5	Because of my eyesight, I have to rely too much on what other people tell me.
Q6	I worry about doing things that will embarrass myself or others because of my eyesight

and mean QoL subscale scores were compared within the group over time using the Wilcoxon paired test and between macula-ON and macula-OFF groups using the Mann–Whitney test. The correlation between the QoL scores and the BCVA was tested in linear regression analysis. *P* values were adjusted using the Bonferroni method for multiple comparisons. *P* < 0.05 was considered significant. All statistical analyses were conducted in R software (version 3.1.3).

Results

Baseline Characteristics

The average age of the 47 patients who completed the NEI-VFQ-13 (14 women and 33 men) was 62.45 ± 8.96 years (Table 2). We analyzed 31 right and 16 left eyes with RD. Cataract surgery was performed previously in 20 eyes, whereas 27 eyes were phakic. We measured an average axial length of 24.90 ± 1.71 mm. We found no significant difference between groups with respect to baseline characteristics, with the exception of the BCVA (*P* < 0.001). At baseline, the visual acuity (median [interquartile range] logMAR) was 0.1 [0.2–0.0] (SE 20/25) among macula-ON patients and 2 [2.0–0.8] (SE 20/2000) among macula-OFF patients.

At M1, the BCVA improved to 0.1 [0.1–0.0] (SE 20/25) among macula-ON patients and 0.3 [0.4–0.1] logMAR (SE 20/40) among macula-OFF patients (*P* = 0.01). The BCVA at M3 (final follow-up) was 0 [0.1–0.0] (SE 20/20) among macula-ON patients and 0.1 [0.3–0.1] (SE 20/25) among macula-OFF patients (*P* = 0.05, Table 2).

Quality of Life NEI-VFQ-13 Scores in Macula-ON Versus Macula-OFF

The QoL scores varied during follow-up in both groups. Preoperatively, the CS was 68% ± 26%, SFVFS score was 67% ± 27%, and SFSES score was 69% ± 28% in the macula-OFF group. Quality of life scores improved at M1 and M3 among macula-OFF patients (Table 3). Preoperatively, among macula-ON patients, the CS was 86% ± 17%, SFVFS score was 83% ± 15%, and SFSES score was 89% ± 19%. The QoL scores decreased at M1, but at M3, they recovered (Table 3).

Preoperatively, a significant difference in QoL scores (*P* < 0.03) was observed between the two patient groups, with the highest sensitivity in the SFSES score. At M1, we found no difference in the QoL between the two groups (Tables 3 and 4). However, 3 months after surgery, we found a

Table 2. Baseline Characteristics and the Best Corrected Visual Acuity Pre-operatively, 1 Month (M1), and 3 Months (M3) After Surgery in Patients With Macula-ON (ON) and Macula-OFF (OFF) RD (Wilcoxon-Paired Test)

	Macula-ON	Macula-OFF
Baseline characteristics		
Age	62.85 ± 7.97 years	61.96 ± 10.24 years
Gender	10 women and 16 men	4 women and 17 men
Operated eye	16 right eyes and 10 left eyes	15 right eyes and 6 left eyes
Lens status	17 phakic and 9 pseudophakic	10 phakic and 11 pseudophakic
Axial length	24.76 ± 1.53 mm	25.06 ± 1.94 mm
Time Point	Mean	Mean
BCVA median		
logMAR [IQR] (SE)		
Preop	0.1 [0.2–0.0] (SE 20/25)	2 [2.0–0.8] (SE 20/2000)
Postop M1	0.1 [0.1–0.0] (SE 20/25)	0.3 [0.4–0.1] (SE 20/40)
Postop M3	0 [0.1–0.0] (SE 20/20)	0.1 [0.3–0.1] (SE 20/25)
Within group comparisons	<i>P</i>	<i>P</i>
Pre-op vs. M1	0.45	0.000
Pre-op vs. M3	0.18	0.000
M1 vs. M3	0.03	0.001

BCVA, best corrected visual acuity; SE, Snellen equivalent; IQR, interquartile range.

significant difference between the two groups in regard to the CS and SFSES score ($P = 0.03$, $P = 0.002$) but not the SFVFS score ($P = 0.10$; Tables 3 and 4).

Quality of Life NEI-VFQ-13 Scores during Follow-Up

During follow-up, QoL scores were not significantly different in the macula-OFF group (Table 4).

An important decrease in the QoL based on the SFSES score occurred at M1 in the macula-ON group ($P = 0.03$). This change inverted from M1 to M3, with a significant progress in the QoL regarding both the CS ($P = 0.03$) and SFSES ($P = 0.006$). This caused a slight general alteration in QoL scores in the macula-ON group between the preoperative measurement and M3 ($P > 0.25$; Table 4).

Table 3. Quality of Life Scores Preoperatively, 1 Month (M1), and 3 Months (M3) After Surgery in Patients With Macula-ON (ON) and Macula-OFF (OFF) RD (Unpaired Two-Samples Wilcoxon Test)

Time Point		Macula-ON Mean Score	Macula-OFF Mean Score	<i>P</i> (ON vs. OFF)
Composite score				
Preop	%	86% ± 17%	68% ± 26%	0.007
Postop M1	%	79% ± 21%	75% ± 17%	0.15
Postop M3	%	87% ± 19%	79% ± 17%	0.03
Subscale 1 (SFVFS)				
Preop	%	83% ± 15%	67% ± 27%	
	R	−3.7 ± 1.7	−2.1 ± 3.1	0.05
Postop M1	%	78% ± 20%	74% ± 16%	
	R	−3.4 ± 2.3	−3.3 ± 1.7	0.19
Postop M3	%	82% ± 20%	77% ± 17%	
	R	−3.9 ± 2.2	−3.5 ± 1.7	0.11
Subscale 2 (SFSES)				
Preop	%	89% ± 19%	69% ± 28%	
	R	1.9 ± 1.2	0.8 ± 1.6	0.002
Postop M1	%	79% ± 22%	76% ± 20%	
	R	1.2 ± 1.3	1.0 ± 1.4	0.30
Postop M3	%	90% ± 21%	81% ± 20%	
	R	2.0 ± 1.1	1.4 ± 1.2	0.01

%, the QoL score is expressed in %, where 0 represents the worst and 100 the best QoL; R, the QoL score transformed to the Rasch scale; SFVFS, short-form visual functioning scale; SFSES, short-form socioemotional scale.

Table 4. Comparison of Quality of Life Scores Reported by Patients With Macula-ON and Macula-OFF RD, Between Time Points: Preoperatively, 1 Month (M1), and 3 Months (M3) After Surgery (Wilcoxon-Paired Test)

	Time Point	Macula-ON	Macula-OFF
CS	Preop vs. M1	$P = 0.06$	$P = 0.27$
	Preop vs. M3	$P = 0.37$	$P = 0.11$
	M1 vs. M3	$P = 0.03^*$	$P = 0.18$
SFVFS	Preop vs. M1	$P = 0.18$ (0.30)	$P = 0.31$ (0.30)
	Preop vs. M3	$P = 0.40$ (0.32)	$P = 0.13$ (0.13)
	M1 vs. M3	$P = 0.12$ (0.12)	$P = 0.27$ (0.33)
SFSES	Preop vs. M1	$P = 0.03^*$ (0.02)	$P = 0.27$ (0.40)
	Preop vs. M3	$P = 0.26$ (0.30)	$P = 0.10$ (0.11)
	M1 vs. M3	$P = 0.006^{**}$ (0.006)	$P = 0.19$ (0.16)

* $P < 0.05$, ** $P < 0.01$.

CS, composite score; SFVFS, short-form visual functioning scale; SFSES, short-form socioemotional scale.

Relationship Between Quality of Life and Best Corrected Visual Acuity

The preoperative BCVA significantly improved postoperatively in the macula-OFF group ($P < 0.001$ at both M1 and M3). Despite this change corresponding to amelioration of the QoL (CS and SFSES score), the difference was not significant. However, a significant reduction was noted in the SFSES score at M1 in the macula-ON group, despite no change in the BCVA. Consequently, between M1 and M3, the BCVA significantly improved ($P = 0.03$), coinciding with an important improvement on the SFSES ($P = 0.006$). The correlation between BCVA and QoL was poor preoperatively ($R^2 < 0.20$; Table 5). Postoperatively, in the macula-OFF group, the BCVA positively correlated with the CS and subscale scores, with the strongest relationship occurring at M3 in the QoL SFSES score ($P < 0.001$, $R^2 = 0.58$; Table 5). In macula-ON patients, the BCVA did not exhibit a positive correlation with QoL scores except the SFVFS subscale at M3 ($P < 0.001$, $R^2 = 0.41$; Table 5).

Discussion

The NEI-VFQ-25 is the most widely used QoL questionnaire, but significant limitations in its construction have been identified. To redress these issues, we used the transformation steps suggested by Pseudovs et al¹⁸ to form the SFVFS and SFSES subscales. Using these subscales, we observed an important decrease in the QoL in patients with macula-OFF RD compared with patients with macula-ON RD, particularly in regard to the SFSES score. Moreover, using these less noisy instruments, we were able to observe for the first time a negative effect of RD surgery on the QoL in patients with macula-ON RD, but this was a transient consequence because the QoL returned to preoperative values by M3. Moreover, we observed for the first time a correlation between postoperative QoL and BCVA in both groups regarding the CS and visual functioning subscale. However, the socioemotional subscale correlated with the BCVA only in macula-OFF patients, reflecting a secondary impact of the observed vision loss.

Table 5. Linear Regression Analysis to Examine the Relationship Between Quality of Life Scores and the Best Corrected Visual Acuity at Each Time-Point During Follow-up

	Time Point	Macula-ON	Macula-OFF
CS	Preop	$R^2 = 0.08$; $P = 1$	$R^2 = 0.12$; $P = 1$
	M1	$R^2 = 0.06$; $P = 1$	$R^2 = 0.25$; $P = 0.35$
	M3	$R^2 = 0.12$; $P = 1$	$R^2 = 0.55$; $P < 0.001$
SFVFS	Preop	$R^2 = 0.07$; $P = 1$	$R^2 = 0.03$; $P = 1$
	M1	$R^2 = 0.02$; $P = 1$	$R^2 = 0.16$; $P = 1$
	M3	$R^2 = 0.41$; $P = 0.007$	$R^2 = 0.39$; $P = 0.05$
SFSES	Preop	$R^2 = 0.08$; $P = 1$	$R^2 = 0.19$; $P = 0.82$
	M1	$R^2 = 0.10$; $P = 1$	$R^2 = 0.25$; $P = 0.35$
	M3	$R^2 = 0.09$; $P = 1$	$R^2 = 0.58$; $P = 0.001$

Pearson correlation coefficient and corresponding P value.

M1, month one follow-up; M3–M6, 3 to 6 months follow-up; R^2 , Pearson correlation coefficient value, and corresponding P value, the Bonferroni correction was applied to adjust for the multiple tests performed; CS, composite score; SFVFS, short-form visual functioning scale; SFSES, short-form socioemotional scale.

The relationship between postoperative BCVA and postoperative QoL was examined previously in patients who underwent vitreoretinal surgery for different disorders comprising RD.^{14–16,32,33,39} Our article presents a more complete overview of the impact of RD for the impact on patient QoL and the relationship with the BCVA, particularly immediately after surgery, and the visual function and socioemotional subscales. Zou et al¹⁶ previously showed that the long-term QoL (up to 3 years postoperatively) improved alongside the BCVA after both macula-OFF and macula-ON RD using a different QoL questionnaire. Okamoto et al¹⁴ reported significantly a better postoperative BCVA after macula-ON than macula-OFF RD, with no significant difference observed in the QoL using the standard NEI-VFQ-25. Using multivariate regression analysis, Okamoto et al, Smretschning et al, and Zou et al all examined the relationship between the macular status and QoL. However, only Zou et al observed a significant relationship, and this was present before 3 years postoperatively.¹³ Similar numbers of patients were recruited for our study and previous studies, but the subscales used and the homogeneity of patients for surgical procedures reduced the measurement noise such that a significant difference in the QoL was observable between the two RD patient groups at M1 and M3.

Significant differences between normal controls and RD patients have been reported by Smretschning et al using standard subscales of mental health, driving, social functioning, general vision, and color vision.¹³ In contrast, regarding standard subscale findings, Okamoto et al reported poorer results among RD patients for near and distance activities, dependency, mental health, and peripheral vision.^{14,15} The absence of repeatability among the results in the two studies is most probably due to the difference in the study groups or due to the already identified lack of subscale validity and the recognized problems with person separation, multidimensionality, and mis-fitting items.¹⁸

The impact of decreased BCVA on reduced QoL has been recognized as a significant risk factor, and many ophthalmologists use BCVA to define the functional success of surgery for RD. However, used alone, BCVA is not a good measure for summarizing visual function.^{4,30,34,40} In the literature, QoL scores after pars plana vitrectomy in RD patients vary between 76% and 80% in macula-OFF patients 3 months after surgery (in our study, the score was 87% in macula-ON patients at M3), reaching 89% 1 year after surgery in patients following macula-OFF RD.¹³ Comparable QoL scores were tested in other retinal diseases, including epiretinal membrane surgery (79%–83%) and macular hole surgery (mean

CS 79%–82%). Very low QoL scores have been reported in patients with age-related macular degeneration, but were dependent on the disease stage and activity restriction (44%–80% of days).^{4,41,42}

This study contains several limitations, including the small sample size and short duration of follow-up, which limits our observations. Smretschning et al¹³ reported that QoL improves 3 to 12 months after surgery, and Van de Put et al⁴ have reported a significantly high QoL CS score 12 months after surgery for macula-OFF RD. In our study, the mean CS (79%) was similar to that reported by Smretschning et al (mean CS 76.3%) in patients with macula-OFF RD. Interestingly, Van de Put et al reported a significantly higher CS than other studies (mean 88.9%).^{13,43} This finding may be an indicative of an improvement in the QoL between 6 and 12 months postoperatively.⁴³ The presence of metamorphopsia and/or outer retinal folds was identified recently as potential risk factors for reduced QoL, but we did not assess either of these criteria in study patients.⁴⁴ In addition, how NEI-VFQ and other similar questionnaires are targeted may not be entirely optimal given the poor separation of patients with good visual function/ability. During follow-up, changes become more difficult to detect in these patients with improvements in visual outcomes. More than 75% of macula-OFF patients had a BCVA of 0.3 logMAR (SE 20/40) or better by M3, indicating that patient separation would become problematic with longer follow-up.

The product of gain in the QoL and life expectancy are used to calculate the gain in quality-adjusted life years because of the intervention. Health policy makers are increasingly relying on these types of measures of cost effectiveness to determine reimbursement models. As such, the QoL is rapidly gaining importance in health care research. For example, Ma et al⁴⁵ demonstrated the cost effectiveness of RD surgery in a geriatric population. Similarly, the differences in QoL measures between macula-ON and macula-OFF patients in our study could also be expressed for cost-effectiveness. Given rising health care costs, this may be necessary to maintain the emergency status of macula-ON RD surgery.

Conclusion

With health care 4.0, the concept of QoL valuation is gaining significance. Rasch analysis is recognizing and solving existing problems in QoL instruments in a very simple and elegant way. Here, we used a modified NEI-VFQ-25, which uses the adjusted scale after Rasch analysis, reportedly producing the most

statistically robust results using this QoL instrument. In our study, we demonstrated a significant QoL difference between patients with macula-ON versus macula-OFF RD. This difference was present both preoperatively and postoperatively. Patients with macula-OFF RD demonstrated a consistent increase in their satisfaction throughout the recovery postoperative period. The most pronounced QoL variations were present in the socioemotional subscale. However, despite anatomically successful RD surgery and good BCVA recuperation after surgery, patients still report postoperative visual impediments and socioemotional limitations, which may have important consequences for their mobility and independence.

Key words: modified version NEI-VFQ-25, quality of life, rasch analysis, retinal detachment, vitrectomy.

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