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Vitreous Floaters Functional Questionnaire for Vision-Degrading Myodesopsia From Vitreous Floaters

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IMPORTANCE Vision-degrading myodesopsia (VDM) from vitreous floaters can be associated with degraded contrast sensitivity and poor visual quality of life, although it is unclear how to best evaluate subjective patient disturbances. Floater-specific, vision-related, patient-reported outcomes might improve assessment of disease severity and case selection for therapy as well as provide useful outcome measures of present and future treatments.

OBJECTIVES To develop a Vitreous Floaters Functional Questionnaire (VFFQ) and to determine if the VFFQ score correlates with vitreous density measured by quantitative ultrasonography and with visual function evaluated by measuring contrast sensitivity.

DESIGN, SETTING, AND PARTICIPANTS In a single-center cross-sectional study, Rasch analysis was performed in 169 participants with floaters. Test-retest reliability at 3 time points over 6 months was performed in 24 other participants. Correlations of the VFFQ score with contrast sensitivity and quantitative ultrasonography were performed in a separate group of 224 participants. Data analysis was performed from 2017 to 2024.

EXPOSURES Participants completed the self-administered questionnaire and underwent ultrasonography, measures of contrast sensitivity, and clinical evaluation.

MAIN OUTCOMES AND MEASURES Contrast sensitivity (Freiburg Acuity Contrast Test), Cook distance, intraclass correlation, quantitative ultrasonography, Rasch analysis, and VFFQ composite score were measured.

RESULTS From 169 participants (mean [SD] age, 57.5 [14.4] years; 74 [43.8%] female), Rasch analysis eliminated 8 questions and identified 23 questions meeting acceptable criteria for the VFFQ. The intraclass correlation of Rasch-calibrated composite scores from 24 participants (mean [SD] age, 56.0 [13.5] years; 14 [58.3%] female) who completed the 23-item VFFQ (VFFQ-23) on 3 occasions found high test-retest reliability (0.850 [95% CI, 0.721 to 0.928]; $P < .001$). Clinical correlations were evaluated among 224 participants (mean [SD] age, 58.5 [15.0] years; 99 [44.2%] female). There were significant correlations between VFFQ-23 scores and both vitreous echodensity ($r = -0.752$ [95% CI, −0.805 to −0.688]; $P < .001$) and contrast sensitivity ($r = -0.744$ [95% CI, −0.799 to −0.677]; $P < .001$).

CONCLUSIONS AND RELEVANCE The VFFQ-23 had high test-retest reliability and correlated with vitreous structure and visual function. This vision-related patient-reported outcome of disease severity in patients with vitreous floaters might be useful for individual patient evaluations, population screening and triage, and assessing the response to current therapies, like vitrectomy and YAG laser vitreolysis, and future therapies, such as nanoparticle treatments and pharmacologic vitreolysis.

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Invited Commentary
Supplemental content

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Vitreous floaters are dark, linear, hairlike obscurations in vision that occasionally have glass-noodle translucency from fetal hyaloid vessel remnants.[1,2] The visual phenomenon of floaters results from posterior vitreous detachment[3-7] in older individuals and myopic vitreopathy[8-11] in youths.[12-15] Past studies detected degradation in contrast sensitivity (CS)[5-8] that correlated with increased vitreous density by quantitative ultrasonography (QUS)[10,16] and with poor visual quality of life (QOL).[16] QUS has been shown to correlate with vitreous light scattering,[17] substantiating its potential use as a surrogate for measuring light scattering in vivo. Evaluating CS and QUS enables the diagnosis of vision-degrading myodesopsia (VDM),[8,10,16] but an informative assessment of subjective patient disturbance is lacking.

Despite increasing awareness about the importance of patient-reported outcomes (PROs) in ophthalmic disorders and treatments,[18] there are no PROs, to our knowledge, specifically evaluating floaters. A PRO to evaluate floaters not only might provide another way to assess disease severity but also might enable screening to find patients who could benefit from further diagnostics and best respond to therapy. Moreover, this assessment might provide a useful PRO of current and future therapies. Therefore, a way to quantify patient-reported vision-related QOL that correlates with abnormalities in vitreous structure and degradation in vision is needed. This study developed a questionnaire that measures the association of vitreous floaters with visual QOL from the patient's perspective.

Although previous studies used the National Eye Institute (NEI) Visual Function Questionnaire (VFQ) to assess the association of vitreous floaters with patient-reported vision-related QOL,[19,20] that questionnaire does not specifically query for the association of floaters with visual QOL. Thus, assessment of Nd:YAG laser vitreolysis with the 25-item VFQ (VFQ-25) showed minimal improvement,[21,22] perhaps due in part to the questionnaire.[23] While an expanded version (VFQ-39) was slightly more useful,[24] and although algorithms can improve interpretability of the NEI VFQ,[25] a floater-specific questionnaire might be a better way to assess the association of vitreous floaters with patient-reported, vision-related QOL. The Vitreous Floaters Functional Questionnaire (VFFQ) was developed to meet this need in evaluating patients with floaters, hypothesizing that VFFQ-determined severity would correlate with vitreous structure, assessed by QUS, and degradation in CS.

Key Points

Question Can a Vitreous Floaters Functional Questionnaire (VFFQ) quantify the association between floaters and visual quality of life among individuals with vision-degrading myodesopsia, and does the VFFQ score correlate with vitreous echodensity or contrast sensitivity in patients with floaters?

Findings In this cross-sectional study, Rasch analysis in 169 participants eliminated 8 questions, resulting in a 23-item VFFQ that in 224 additional participants correlated with vitreous echodensity and contrast sensitivity.

Meaning Correlation of the VFFQ score with vitreous structure and visual function supports its potential usefulness for patients with vitreous floaters.

Methods

Study Design

This cross-sectional study was conducted in patients with vitreous floaters evaluated at the VMR Institute for Vitreous Macula Retina in Huntington Beach, California, between 2011 and 2024. Institutional review board approval was granted by Providence Saint Joseph Hospital. Written informed consent was obtained from each participant; individuals were not offered any incentive to participate. This study adhered to Health Insurance Portability and Accountability Act regulations and was conducted in accordance with the principles in the Declaration of Helsinki. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines were used. Data analysis was performed from 2017 to 2024.

Study Groups

Table 1 shows demographic and clinical characteristics of 3 mutually exclusive study groups: Rasch analysis (n = 169), test-retest reliability (n = 24), and clinical correlations (n = 224). The

Table 1. Demographic Characteristics of Study Groups

Characteristic	Study group, No. (%)		
	Rasch analysis (n = 169)	Test-retest reliability (n = 24)	Clinical correlations (n = 224)
Age, mean (SD), y[a]	57.5 (14.4)	56.0 (13.5)	58.5 (15.0)
Sex[a]			
Female	74 (43.8)	14 (58.3)	99 (44.2)
Male	95 (56.2)	10 (41.7)	125 (55.8)
Pseudophakia[a,b]	35 (20.7)	4 (16.7)	64 (28.6)
Posterior vitreous detachment[a,c]	137 (81.1)	17 (70.8)	161 (71.9)
Myopia[a,d]	93 (55.0)	12 (50.0)	107 (47.8)

[a] There were no significant differences between the 3 groups in any of the demographic or clinical characteristics.

[b] While 64 participants (28.6%) had pseudophakia, only 10 (4.5%) had multifocal intraocular lenses. Despite the possibility that this type of intraocular lens can degrade contrast sensitivity, such a small number of participants having a multifocal intraocular lens was deemed to not have much influence on the results.

[c] Posterior vitreous detachment was diagnosed by ultrasonography and confirmed by optical coherence tomography in cases where the posterior vitreous was close enough to the retina for visualization.

[d] Defined as −3 diopters or worse.

Table 2. Clinical Test Results[a]

Result	Study group, mean (SD)		
	Rasch analysis (n = 169)	Test-retest reliability (n = 24)	Clinical correlations (n = 224)
Contrast sensitivity, %W	3.94 (1.64)	3.44 (1.34)	4.06 (1.65)
Vitreous echodensity on QUS, AU	976 (448)	866 (386)	949 (422)
Rasch-calibrated VFFQ-23 composite score	NA	67.7 (13.5)	67.8 (14.8)

Abbreviations: AU, arbitrary units; NA, not applicable; QUS, quantitative ultrasonography; VFFQ-23, 23-item Vitreous Floaters Functional Questionnaire; %W, Weber threshold.

[a] When comparing the 3 groups, no significant differences were found in contrast sensitivity (1-way analysis of variance: $F_{2,414} = 1.636$; $P = .20$) or vitreous echodensity (1-way analysis of variance: $F_{2,414} = 0.73$; $P = .48$). No significant difference in VFFQ-23 composite score was found between the test-retest reliability and clinical correlations groups ($P = .12$).

inclusion criterion was a chief complaint of floaters on presentation to the VMR Institute (J.S.). Exclusion criteria were history of vitrectomy, history of intravitreal injections, or history of a disease affecting vision (keratopathies, advanced cataracts, glaucoma, retinovascular diseases, etc). Differential item functioning determined whether there were differences in questionnaire items based on sex or self-reported race (Rasch analysis and clinical correlations: 220 men, 173 women).

Visual Function Testing

Best-corrected visual acuity was measured using the ETDRS chart. CS was measured using the Freiburg Acuity Contrast Test,[5-8,26,27] where psychometric methods combined with antialiasing and dithering provide accurate thresholding assessment of CS.[28] An 8-position tumbling Landolt C chart (18 stimulus trials) with varying levels of contrast was used. Results were reported as Weber threshold (%W): %W = 100 × [(maximum luminance − minimum luminance)/maximum luminance].

Vitreous Structure Assessment

Ultrasonography used the same clinical system (AVISO; Quantel Medical) as previously described,[7,8,16,24] with a customized 15-MHz single-element transducer, a 6-dB bandwidth extending from 9.5 to 20 MHz, a 20-mm focal length, and a 7-mm aperture. Acquired frames (100 at 16 frames/s) were reviewed to discard reverberation, acoustic uncoupling, and other artifacts. Analysis was performed as previously described[16] to generate 3 parameters: the sum of the square of acoustic values within the central and posterior vitreous divided by the area of measurement (energy [*E*]); the percentage of the central and posterior vitreous filled by echogenic clusters larger than 50 pixels (0.069 mm; *P50*); and the mean of the acoustic values divided by the area of the central and posterior measurement area (mean [*M*]). A composite[5,8,19] of parameters was calculated: QUS composite index = [0.5*E* + (*M* × 10) + (*P50* × 100)] arbitrary units.

PRO Measures of Visual QOL

Questions were originally formulated by Richard Hallam, PhD, consultant to One Clear Vision, who conducted interviews to develop a questionnaire that was tested in a pilot study (n = 137; mean [SD] age, 37.4 [13.4] years; age range, 14-69 years).[29] Each question contained the word *floaters* to exclude other visual symptoms. Answers were structured on a 4-point Likert ordinal scale. Based on factor analysis, Hallam decreased the number of questions to 51. A second study (n = 206; mean [SD] age, 44.1 [16.2] years; age range, 14-99 years) performed confirmatory factor analysis.[29]

Of the 51 questions developed by Hallam, 31 questions were selected (by J.S. and A.A.S.) as the most clinically relevant. Rasch analysis evaluated psychometric properties using Winsteps software version 5.9.2 (Winsteps).[30] Infit and outfit mean square values were used to evaluate item fit. Values outside the range of 0.7 to 1.3 indicated misfit or redundancy, and these items were excluded.[31,32] Participants with extreme scores (either 100% or 0% severity) were excluded from the person parameter estimates.[33] A person reliability index higher than 0.8 reflected consistency of each participant's responses. A person separation index higher than 2.0 indicated that the questionnaire effectively distinguished between varying levels of floater severity. Item targeting of the distribution of responses evaluated whether the mean person ability was within 0.5 logit of the mean item difficulty and identified the presence of large gaps in the person-item map.[34] Local independence was determined if the item-to-item correlation coefficient was less than 0.4. Unidimensionality was attained if the measures of the Rasch dimension accounted for more than 40% of the observed raw variance, the eigenvalues of the first contrast were less than 2.0, and the unexplained variance was less than 5%.[35]

Rasch-Calibrated VFFQ Composite Score

A Rasch-calibrated composite score was generated using Winsteps version 5.9.2[30] by anchoring item difficulty (as weights) and the response structures (Andrich τ). This resulted in a measure expressed in linear units.[36]

Statistical Analysis

Test-Retest Reliability

To assess the reliability of the finalized questionnaire, 24 participants with floaters who were not included in the other study groups (Table 1) completed the VFFQ 3 times: at study entry and then 3 and 6 months later. A single-measurement, absolute-agreement, 2-way, mixed-effects intraclass correlation coefficient was calculated.[37]

Correlations With Clinical Testing

The associations between VFFQ composite scores and both CS and QUS were investigated in 224 other participants using Pearson correlation analysis. Cook distance calculations identified influential points.[38,39]

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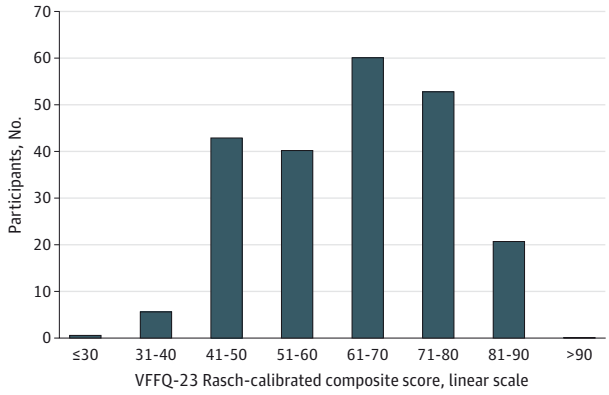
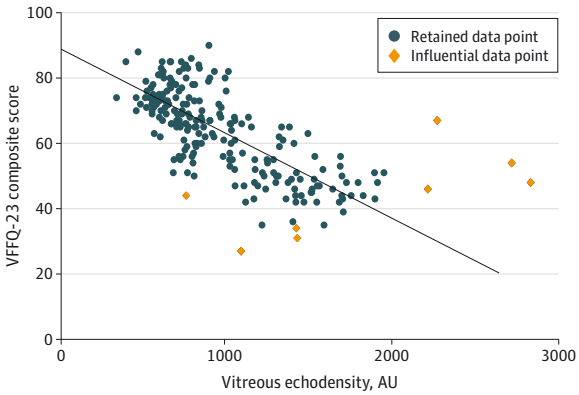
Figure 1. Distribution of Composite Scores on the 23-Item Vitreous Floaters Functional Questionnaire (VFFQ-23)



The VFFQ-23 composite scores in 224 patients with symptomatic vitreous floaters ranged from 27.0 to 90.0 (maximum score = 100), with a mean (SD) score of 63.0 (13.2) and a median (IQR) score of 65 (54-76). The distribution is nearly normal, indicating that the questionnaire effectively captures a representative range of patient-reported outcomes in this population.

Figure 2. Correlation Between the 23-Item Vitreous Floaters Functional Questionnaire (VFFQ-23) Composite Score and Vitreous Echodensity



The VFFQ-23 composite scores correlated with vitreous echodensity (measured by quantitative ultrasonography) in 224 participants (r = −0.685 [95% CI, −0.749 to −0.608]; P < .001). Cook distance calculations identified 8 influential data points (3.6%) (diamonds). After removing these, the correlation was significant (r = −0.752 [95% CI, −0.805 to −0.688]; P < .001), indicating that the greater the vitreous echodensity was, the worse was the VFFQ-23 assessment of visual quality of life. AU indicates arbitrary units.

Additional Statistical Analyses

One-way analysis of variance compared age, CS, QUS, and VFFQ composite scores in the 3 groups. Cook distance calculations were performed for sensitivity analyses of outliers. All P values were 2-sided and not adjusted for multiple comparisons.

Results

From 169 participants (mean [SD] age, 57.5 [14.4] years, 74 [43.8%] female) (Table 1), Rasch analysis identified 8 items with infit and outfit mean square values outside the range of 0.7 to 1.3. Removing these resulted in a 23-item questionnaire (VFFQ-23). Analysis of the VFFQ-23 yielded an item reliability index of 0.80 and an item separation index of 2.01, both meeting accepted thresholds.[40] Four of the 169 participants (2.4%) were deemed extreme due to entries of 0 scores on all 23 questions. Analysis of the 165 remaining participants yielded a person reliability index of 0.92 and a person separation index of 3.29, exceeding commonly accepted thresholds (≥0.80 and ≥2.0, respectively).[40]

The person ability had a mean value of −0.13 logit, while the mean item difficulty centered at 0 logits. The difference between the 2 measures was less than 0.5, meeting accepted criteria for being well targeted.[41] The absence of large gaps along the ability continuum shows that item targeting aligned well with respondent abilities. Additionally, the data showed no evidence of floor or ceiling effects, capturing the full range of responses.

Dimensionality analysis using the VFFQ-23 showed an eigenvalue of 2.00 for the first contrast, 5% unexplained variance, and 43.1% raw variance explained by the measures, supporting unidimensionality by established criteria.[42] Assessment of local item dependency revealed residual correlations ranging from 0.21 to 0.29, which were all below the accepted threshold of 0.4,[43] confirming local independence.

VFFQ-23 Test-Retest Reliability and Bias

Test-retest reliability was evaluated in 24 participants (mean [SD] age, 56.0 [13.5] years; 14 [58.3%] female) (Table 1) who completed the VFFQ-23 on 3 occasions. The single-measure, 2-way, mixed-effects, absolute-agreement intraclass correlation coefficient was 0.850 (95% CI, 0.721 to 0.928; P < .001), representing a high degree of test-retest reliability. Differential item functioning found no differences in items based on sex or race by Rasch-Welch t statistics.

VFFQ-23 Clinical Results

In 224 additional participants (mean [SD] age, 58.5 [15.0] years; 99 [44.2%] female) (Table 1), CS and QUS were comparable in all study groups (**Table 2**). VFFQ-23 composite scores ranged from 27.0 to 90.0 (**Figure 1**). Phakic participants had slightly better VFFQ-23 composite scores (mean [SD], 64.9 [13.2]) than pseudophakic participants (mean [SD], 58.3 [12.5]) (P < .001). VFFQ-23 composite scores correlated with vitreous echodensity, such that greater echodensity was associated with a worse VFFQ-23 score (r = −0.752 [95% CI, −0.805 to −0.688]; P < .001) (**Figure 2**). Similarly, there was a negative correlation (r = −0.744 [95% CI, −0.799 to −0.677]; P < .001) with CS such that the greater the %W was (ie, the worse the CS was), the worse the VFFQ-23 score was (**Figure 3**).

Discussion

A recent review of vision-related PRO measures found that while there has been progress in PRO development for cataract, glaucoma, medical retina, and low vision, there is a paucity of useful tools for other conditions.[44] The goal of the present study was to develop and evaluate a questionnaire, the

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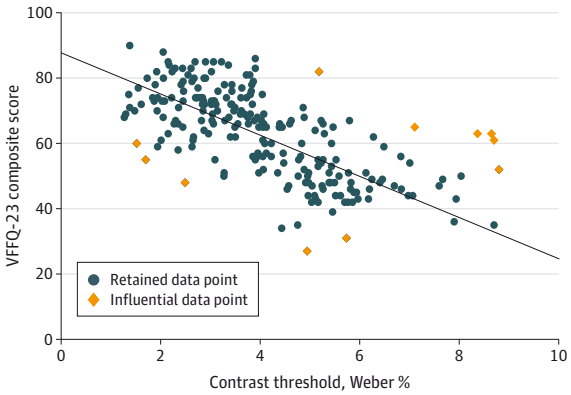
VFFQ, that specifically queries the association of vitreous floaters with visual QOL. It was hypothesized that the VFFQ would correlate with objective measures of vitreous structure and visual function in participants with VDM, the recommended term for clinically significant vitreous floaters.[10] A total of 761 patients were studied in the different stages of questionnaire development and testing to produce a 23-item questionnaire (VFFQ-23).

This study determined that the VFFQ-23 has excellent test-retest reliability. Furthermore, the VFFQ-23 correlated with increased vitreous echodensity, which previous studies have shown is associated with degradation in CS[5,8,10,16,25] and diminished visual QOL.[10,16] The more echodense the vitreous was, the worse the VFFQ-23 score was (Figure 2). CS has also been previously shown to be degraded in patients with VDM,[5-8,10] and this study found that the VFFQ-23 correlates with CS: the worse the participant's CS was, the worse the VFFQ-23 score was (Figure 3). Thus, in addition to enhancing patient evaluations, the VFFQ-23 could provide vision-related PRO measures useful in evaluating floater therapies, such as YAG laser vitreolysis,[19,21,45] pharmacologic vitreolysis,[46-49] and vitrectomy.[5,10,25,50-53]

Figure 3. Correlation Between the 23-Item Vitreous Floaters Functional Questionnaire (VFFQ-23) Composite Score and Contrast Sensitivity



The VFFQ-23 composite scores correlated with contrast sensitivity in 224 participants (r = −0.660 [95% CI, −0.728 to −0.579]; P < .001). Cook distance calculations identified 11 influential data points (4.9%) (diamonds). After removing these, the correlation was significant (r = −0.744 [95% CI, −0.799 to −0.677]; P < .001), indicating that the worse the contrast sensitivity was (higher contrast thresholds), the worse was the visual quality of life.

Limitations

This study has several limitations. This was a single-center study, and some races and ethnicities (Latino, Middle Eastern, Black) may have been underrepresented. There is also potential for sample-selection bias, as patients seeking floater evaluation in this tertiary center may skew results toward more severe cases, although the wide range of VFFQ-23 composite scores suggests that the study population represents a broad spectrum of disease severity. Also, usefulness would need to be tested prospectively in studies evaluating, monitoring, or treating vitreous floaters.

Conclusions

The VFFQ-23 seems to effectively quantify the subjective association of the visual phenomenon of floaters caused by vitreous opacities with vitreous structure, visual function, and QOL. The VFFQ-23 appears useful in identifying more severely affected individuals in whom further testing and consideration of treatment are warranted. Future studies should compare the VFFQ-23 with the 25-item NEI VFQ.

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Concept and design: Boneva, Yee, Sebag.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Nguyen, Boneva, Yee, Sebag.
Critical review of the manuscript for important intellectual content: Nguyen, Boneva, Nguyen-Cuu, Yu, Sadun, Sebag.
Statistical analysis: Nguyen, Boneva, Nguyen-Cuu, Yee, Yu.
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Administrative, technical, or material support: Nguyen, Nguyen-Cuu, Sebag.
Supervision: Sadun, Sebag.

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Additional Information: The VFFQ questionnaire used in this study derives from the prior work of One Clear Vision, who commissioned Richard Hallam, PhD, to construct and test questions in 2 separate validation studies. The results of those pilot studies appear at https://www.researchgate.net/publication/351819037_Manual_of_the_One_Clear_Vision_OCV_Vitreous_Eye_Floaters_Questionnaire_EFQ_Information_about_OCV_and_eye_floaters.

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