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Vision-Related Functioning in Patients Undergoing Pneumatic Retinopexy vs Vitrectomy for Primary Rhegmatogenous Retinal Detachment

A Post Hoc Exploratory Analysis of the PIVOT Randomized Clinical Trial

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IMPORTANCE Although rhegmatogenous retinal detachment (RRD) repair techniques have high anatomical reattachment rates, there may be differences in various aspects of postoperative vision-related quality of life (VRQoL).

OBJECTIVE To explore the differences in various aspects of VRQoL between pneumatic retinopexy (PnR) and pars plana vitrectomy (PPV) following RRD repair.

DESIGN, SETTING, AND PARTICIPANTS Post hoc exploratory analysis of the the Pneumatic Retinopexy vs Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes randomized clinical trial conducted between August 2012 and May 2017 at St Michael's Hospital, Toronto, Ontario, Canada. Patients with RRD with a single break or multiple breaks within 1 clock hour of detached retina in the superior 8 clock hours of the retina with any number, location, and size of retinal breaks or lattice degeneration in attached retina.

MAIN OUTCOMES AND MEASURES Differences in the 25-Item National Eye Institute Visual Function Questionnaire 12 subscale scores between the PnR and PPV groups at 6 months following RRD repair.

RESULTS A total of 160 patients were included in this analysis, with 81 patients (92%) and 79 patients (90%) in the PnR and PPV groups, respectively. The PnR group consisted of 32% women with a mean (SD) age of 60.9 (9.3) years, while the PPV group consisted of 38% women with a mean (SD) age of 60.3 (7.6) years. For the 152 patients with 6-month follow-up (75 patients in PnR [85%] and 77 patients in PPV [88%]), there was evidence for an association of PnR with superior vision-related functioning compared with PPV for several subscales. There were no differences between groups at 1 year. After adjusting for age, sex, baseline macular status, visual acuity in the nonstudy eye, and lens status, patients who underwent PnR had higher scores for distance activities (mean [SD] PnR, 88.7 [13.4]; PPV, 82.8 [17.1]; adjusted difference, 6.5; 95% CI, 1.6-11.4; $P = .01$), mental health (mean [SD] PnR, 84.3 [17.4]; PPV, 78.7 [21.1]; adjusted difference, 6.7; 95% CI, 0.4-13; $P = .04$), dependency (mean [SD] PnR, 96.1 [10.1]; PPV, 91.1 [18.6]; adjusted difference, 5.7; 95% CI, 0.6-10.8; $P = .03$), and peripheral vision (mean [SD] PnR, 91.6 [16.2]; PPV, 81.2 [24.4]; adjusted difference, 10.8; 95% CI, 4.3-17.4; $P = .001$) at 6 months.

CONCLUSIONS AND RELEVANCE These findings demonstrate that patients undergoing PnR for RRD report higher mental health scores and superior vision-related functioning scores in several subscales of the 25-Item National Eye Institute Visual Function Questionnaire during the first 6 months postoperatively compared with PPV.

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Supplemental content

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Rhegmatogenous retinal detachment (RRD) is an acute, sight-threatening condition, with an incidence of approximately 10 per 100 000 people.[1] The optimal surgical technique for the treatment of RRD remains controversial. Current RRD repair techniques provide patients with excellent anatomical reattachment rates, reported to be as high as 81% for pneumatic retinopexy (PnR), 92% for scleral buckle (SB), and 94% for pars plana vitrectomy (PPV).[2,3] Despite anatomical reattachment, postoperative functional outcomes may be suboptimal and potentially influence patients' well-being and ability to perform daily activities.

The 25-Item National Eye Institute Visual Function Questionnaire (NEI VFQ-25)[4] is a reliable and validated quantitative instrument that has been used to assess patients' vision-related quality of life (VRQoL) in various ophthalmologic diseases and interventions.[5-11] Conventional clinical measurements, such as Snellen and Early Treatment Diabetic Retinopathy Study (ETDRS) visual acuity (VA), may fail to evaluate aspects of visual function that are important for the daily functioning and well-being of patients. Suñer et al[12] showed that a 4- to 6-point change in NEI VFQ-25 score represents a clinically meaningful change. Additionally, a previous study showed that a 4-point change in the composite scores and a 5-point change in individual subscale scores may be considered the minimum clinically meaningful changes in the NEI VFQ-25 scores.[13]

To our knowledge, no reports have compared VRQoL in patients undergoing PnR vs PPV for RRD repair. The Pneumatic Retinopexy vs Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes Randomized Trial (PIVOT) demonstrated PnR to be associated with better VA and less vertical metamorphopsia at up to 1-year follow-up when compared with PPV.[2] Specifically, ETDRS VA was better with PnR by 9.9, 10.6, and 4.9 letters at 3, 6, and 12 months.[2] Further analysis of Snellen VA results in the first 3 months also demonstrated a faster recovery of VA in PnR vs PPV.[14] The study investigators hypothesized that faster recovery of VA, particularly in the first 6 months, may lead to superior scores in several of the NEI VFQ-25 subscales that are dependent on VA, such as role difficulties and distance activities. The purpose of this study was to compare VRQoL using the NEI VFQ-25 subscales in PnR vs PPV in patients who were enrolled in the PIVOT trial.

Key Points

Question Is there a difference in vision-related quality of life between patients undergoing pneumatic retinopexy (PnR) and pars plana vitrectomy (PPV) following rhegmatogenous retinal detachment (RRD) repair?

Findings In this post hoc exploratory analysis of the Pneumatic Retinopexy vs Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes trial, patients undergoing PnR had superior 25-Item National Eye Institute Visual Function Questionnaire composite and subscale scores compared with PPV during the first 6 months following RRD repair.

Meaning The results provide evidence to suggest that PnR may be associated with better patient-reported visual function outcomes in the first 6 months following RRD repair compared with PPV.

Methods

Study Design

This study included 160 participants (160 eyes) of the 176 participants (176 eyes) from the randomized clinical trial comparing 2 surgical interventions (88 [50%] in PnR vs 88 [50%] in PPV) for the management of primary RRD (PIVOT) who completed the NEI VFQ-25 questionnaire during 1 or more of the follow-up visits at 3, 6, or 12 months. Those not included in the analysis comprised a small sample of trial participants that either did not complete the NEI VFQ-25 questionnaire at any of their follow-up visits or were lost to follow-up (**Figure**). This study took place at St Michael's Hospital, Unity Health Toronto, Toronto, Ontario, Canada, after obtaining research ethics board approval.[2] The research adhered to the tenets of the Declaration of Helsinki. The trial was registered at ClinicalTrials.gov (NCT01639209). All consecutive eligible adults with RRD were offered participation in the trial, and written informed consent was obtained prior to enrollment. Patients were not compensated for participation in this study. The inclusion and exclusion criteria have been outlined elsewhere.[2] Randomization took place in a stratified manner according to macular status at presentation. The ETDRS VA in the study eye was the primary outcome of the PIVOT trial and was performed at 3, 6, and 12 months. In addition, Snellen VA was measured in both eyes at every study visit.

Procedures

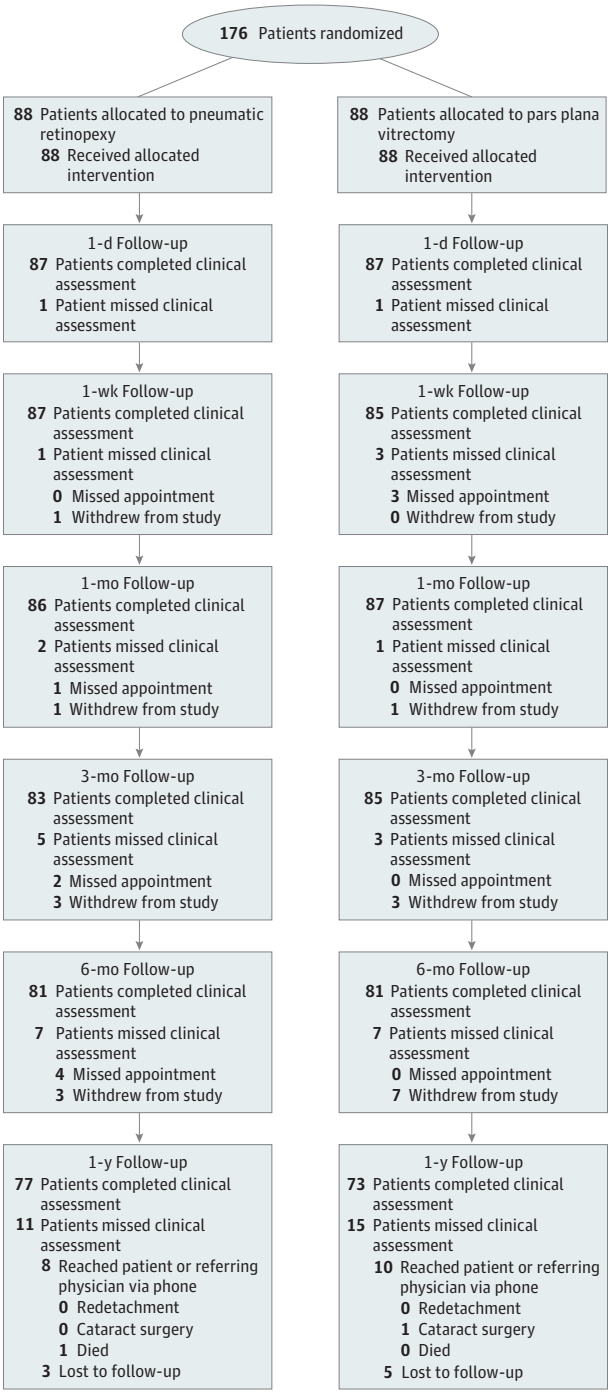
The detailed surgical technique for PnR and PPV used in the PIVOT trial has been published previously.[2] For PnR, laser retinopexy was applied to all breaks and lattice degeneration in the attached retina before gas injection. Breaks in the detached retina were treated with cryotherapy before gas injection or (preferably) laser retinopexy 24 to 48 hours after gas injection. Anterior chamber paracentesis was used to express as much fluid as safely possible (generally 0.3 mL), followed by injection of 100% sulfur hexafluoride (SF6; ideally 0.6 mL).

Pars plana virectomy took place using a 23-gauge system, with 360° peripheral vitreous shave. Laser retinopexy or cryopexy was applied as needed. Subretinal fluid generally was drained through the break responsible for the retinal detachment. A complete air-fluid exchange was performed, and isoexpansile SF6 or perfluoropropane (C3F8) gas was injected. Patients were placed face down immediately after PPV, except in macula-attached patients with no fluid close to the posterior pole at the end of surgery, who were positioned according to the location of the retinal break.

The 25-Item National Eye Institute Visual Function Questionnaire

Subjective visual function was assessed at 3-month, 6-month, and 12-month visits using the NEI VFQ-25.[4] At the time of initial arrival to each of the follow-up visits, patients were seated

Figure. Patient Flow Diagram



in a private room where research staff explained the questionnaire to the patients, verbally administered the instructions, and provided assistance when required. We asked patients to rate each visual symptom and the level of difficulty associated with vision-related daily activities. Preoperative NEI VFQ-25 at baseline was not assessed because our goal was to evaluate postoperative visual functioning rather than compare preoperative and postoperative scores. Additionally, we believed that patients presenting with sudden visual loss would be unlikely to have the emotional ability and or have gained sufficient time to understand how the acute condition might affect their vision-related functioning. An assessment of subjective health-related quality of life (36-item Short Form Health Survey, version 2) was made at baseline and repeated at 1 month. The 36-Item Short Form Health Survey is a widely used validated subjective assessment of the QoL.[15]

The NEI VFQ-25 is a vision-specific quality-of-life instrument composed of 12 subscales: general health, general vision, ocular pain, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving, color vision, and peripheral vision.[4] Each scale consists of a minimum of 1 and maximum of 4 items. Most items are scored using a 5-point or 6-point response scale. A standard algorithm was used to calculate the scale scores, which have a possible range of zero to 100.[4] Eleven of 12 scale scores (excluding the general health item) were averaged to yield a composite score.[4]

Statistical Analysis

Continuous variables are presented as mean and standard deviation or median values and interquartile range. Categorical variables are presented as count and percentages. Visual acuity measurements were converted to logMAR scale for the non-RRD eye. Statistical analysis was performed using R Project for Statistical Computing, version 3.6.1 (R Foundation for Statistical Computing), and 2-sided *P* values with a .05 level of significance were used.

The mean scores and standard deviations were calculated for each NEI VFQ-25 subscale as well as for the NEI VFQ-25 composite score at 3-month, 6-month, and 12-month visits. A Mann-Whitney *U* test was performed to compare each subscale score and composite score between the PnR and PPV groups. Furthermore, a linear mixed-effects model with random intercepts was used, which included treatment group, visit, treatment-by-visit interaction, and baseline measures, such as age, sex, baseline macular status and VA in the nonstudy eye, and preoperative lens study, as fixed effects to determine the adjusted differences in composite and subscale scores between groups. A difference of greater than 4 points within each of the NEI VFQ-25 subscale scores was considered to be clinically meaningful based on previous studies.[12,16] The χ^2 test was used to assess the association between pairs of categorical variables. A multivariate regression model was constructed to determine whether ETDRS VA in the operated-on eye was associated with the subscale scores at 3-month, 6-month, and 12-month visits while controlling for visual acuity in the nonstudy eye and treatment group.

Results

Of the 88 patients randomized to each of the PnR and PPV groups in PIVOT, 81 patients (92%) from the PnR group and 79 (90%) from the PPV group were included in the analysis (**Table 1**). Regarding each of the follow-up visits, 157 patients were included in the 3-month analysis (79 [90%] in PnR and

Table 1. Patient Demographics and Characteristics in Each of the Treatment Groups

Characteristic	No. (%)		
	Pneumatic retinopexy (n = 81)	Pars plana vitrectomy (n = 79)	*P* value[a]
Female	26.0 (32.1)	30.0 (38.0)	NA
Age, mean (SD), y	60.9 (9.3)	60.3 (7.6)	NA
Macular status, on	41.0 (50.6)	39.0 (48.8)	NA
Lens status, phakic	54.0 (66.7)	58.0 (72.5)	NA
ETDRS in study eye, mean (SD)			
Baseline	45.47 (36.86)	44.28 (37.06)	
3 mo	78.28 (12.30)	68.47 (17.80)	<.001[b]
6 mo	79.07 (11.13)	68.65 (17.20)	<.001[b]
12 mo	79.63 (10.36)	74.85 (15.31)	.03[b]
VA in fellow eye, mean (SD)			
Baseline	0.21 (0.293)	0.21 (0.213)	NA
3 mo	0.18 (0.288)	0.13 (0.156)	.20
6 mo	0.16 (0.295)	0.12 (0.168)	.36
12 mo	0.19 (0.318)	0.14 (0.185)	.40

Abbreviations: ETDRS, Early Treatment Diabetic Retinopathy Study; NA, not applicable; VA, visual acuity.

[a] Independent-samples *t* test.

[b] Difference is significant at the .05 level (2-tailed).

78 [89%] in PPV), 152 in the 6-month analysis (75 [85%] in PnR and 77 [88%] in PPV), and 139 in the 12-month analysis (67 in PnR [76%] and 72 [82%] in PPV). Baseline characteristics were balanced between the treatment groups. No differences were identified between groups for fellow-eye Snellen VA at 3-month, 6-month, and 12-month visits. In the PnR group, SF6 gas was used in all patients, while in the PPV group, C3F8 gas was used in 35% of patients (n = 28). Five patients had RRD in the contralateral eye during the 1-year postoperative period; 2 from the PnR group and 3 from the PPV group. One patient (1 study eye) in the PnR arm developed bacterial endophthalmitis that responded well to treatment, achieving a VA of 20/50. No other intraoperative or postoperative complications, such as subretinal hemorrhage or choroidal detachment, occurred. Eighteen patients had postoperative cystoid macular edema; 6 patients from the PnR group and 12 from the PPV group. Retinal reattachment was attained after the initial procedure in 83.9% of the PnR group (n = 68) and 93.7% of the PPV group (n = 74) for this PIVOT subgroup analysis. In the PnR group, 15% (n = 7) of the phakic eyes underwent cataract surgery compared with 63% (n = 34) in the PPV group.

Overall, there was evidence for association of PnR with superior composite scores compared with PPV at 3 months (mean [SD] PnR score, 86.49 [12]; PPV, 81 [15.7]; unadjusted difference [UAD], 4.9; 95% CI, 0.9-8.8; *P* = .02), and 6 months (PnR, 88.9 [10.4]; PPV, 84.8 [13.9]; UAD, 4.9; 95% CI, 0.8-8.9; *P* = .02), with comparable scores for the 2 groups at 1 year (PnR, 87.9 [12.3]; PPV, 88.8 [9.6]; UAD, −0.3; 95% CI, −4.4 to 3.8; *P* = .90; eAppendix in the Supplement). After adjusting for baseline age, sex, macular status, VA in the nonstudy eye, and preoperative lens status, there was evidence for association of PnR with superior vision-related functioning; specifically, noted in general vision (mean [SD] PnR score, 73.4 [12.8]; PPV, 67.9 [16.5]; adjusted difference [AD]: 5.1; 95% CI, 0.2-9.9; *P* = .04), distance activities (PnR, 87.5 [14.4]; PPV, 80.7 [18.6]; AD, 6.4; 95% CI, 1.5-11.2; *P* = .01), social functioning (PnR, 94.2 [12.8]; PPV, 89.3 [19.3]; AD, 4.7; 95% CI, 0.4-9; *P* = .03), mental health (PnR, 82.1 [18.5]; PPV, 74.4 [23.9]; AD, 7.1; 95% CI: 0.9-13.3; *P* = .02), role difficulties (PnR, 84.5 [20.2]; PPV, 77.3 [23.2]; AD, 6.4; 95% CI, 0.1-12.6; *P* = .04), dependency (PnR, 94.5 [13.4]; PPV, 88.1 [20.5]; AD, 6.3; 95% CI, 1.3-11.2; *P* = .01), and peripheral vision (PnR, 87.7 [19.6]; PPV, 78.9 [24]; AD, 6.7; 95% CI, 0.2-13.2; *P* = .04) at 3 months, and distance activities (PnR, 88.7 [13.4]; PPV, 82.8 [17.1]; AD, 6.5; 95% CI, 1.6-11.4; *P* = .01), mental health (PnR, 84.3 [17.4]; PPV, 78.7 [21.1]; AD, 6.7; 95% CI, 0.4-13; *P* = .04), dependency (PnR, 96.1 [10.1]; PPV, 91.1 [18.6]; AD, 5.7; 95% CI, 0.6-10.8; *P* = .03), and peripheral vision (PnR, 91.6 [16.2]; PPV, 81.2 [24.4]; AD, 10.8; 95% CI, 4.3-17.4; *P* = .001) at 6 months. There was no evidence of a difference between the 2 groups at 1 year (**Table 2**).

There was evidence for an overall association between ETDRS VA measured at 3-month, 6-month, and 12-month visits with the subscale scores after adjusting for VA in the nonstudy eye and treatment group in a multivariate model (**Table 3**).

Discussion

This study found that among the participants who took part in the PIVOT trial, patients who underwent PnR reported superior VRQoL overall and in several subscales of the NEI-VFQ 25 in the first 6 months. To our knowledge, PIVOT was the first randomized clinical trial that compared PnR vs PPV from the patient's perspective, incorporating the NEI VFQ-25. In our study, several of the NEI VFQ-25 subscale scores had more than a 6-point difference (range, 4.65-10.83) favoring PnR over PPV, which is considered a clinically relevant disparity based on previous publications.[12,13,16,17]

Our results are in line with a previous study by Okamoto et al,[10] which demonstrated that after successful reattachment surgery, patients with RRD had lower levels of VRQoL. They reported that the NEI VFQ-25 composite score and subscales associated with near activities, mental health, dependency, and peripheral vision were significantly lower in patients after RRD repair compared with normal control

Table 2. Linear Mixed-Effects Regression Model Assessing the Association of 25-Item National Eye Institute Visual Function Questionnaire Composite and Subscale Scores With Treatment Group[a]

NEI VFQ-25 subscales	No.	3 mo Pneumatic retinopexy, mean (SD)	3 mo Pars plana vitrectomy, mean (SD)	3 mo Adjusted difference (95% CI)[a]	3 mo P value	6 mo Pneumatic retinopexy, mean (SD)	6 mo Pars plana vitrectomy, mean (SD)	6 mo Adjusted difference (95% CI)[a]	6 mo P value	12 mo Pneumatic retinopexy, mean (SD)	12 mo Pars plana vitrectomy, mean (SD)	12 mo Adjusted difference (95% CI)[a]	12 mo P value
Composite score	161	86.5 (12.0)	81.0 (15.7)	4.67 (0.69 to 8.66)	.02	88.9 (10.4)	84.8 (13.9)	4.65 (0.59 to 8.72)	.02	87.9 (12.3)	88.8 (9.6)	−0.42 (−4.56 to 3.71)	.84
General													
Health	161	74.4 (16.6)	74.1 (15.1)	−0.21 (−5.05 to 4.64)	.93	74.3 (14.6)	74.3 (13.9)	1.29 (−3.6 to 6.18)	.6	71.0 (16.4)	74.2 (15.3)	−0.96 (−5.94 to 4.03)	.70
Vision	161	73.4 (12.8)	67.9 (16.5)	5.05 (0.21 to 9.88)	.04	73.6 (16.2)	69.6 (17.4)	3.59 (−1.32 to 8.51)	.15	75.4 (14.6)	75.6 (15)	0.20 (−4.87 to 5.28)	.93
Ocular pain	161	85.0 (15.8)	84.6 (18.7)	−0.06 (−5.01 to 4.88)	.98	88.0 (15.7)	86.8 (14.9)	1.09 (−3.91 to 6.09)	.67	86.4 (14.7)	90.3 (11.4)	−3.40 (−8.53 to 1.74)	.19
Activities													
Near	161	83.2 (12.1)	77.9 (18.0)	4.34 (−0.11 to 8.79)	.06	85.0 (11.8)	81.3 (15.2)	3.64 (−0.88 to 8.15)	.11	84.7 (13.7)	86.6 (11.8)	−2.15 (−6.82 to 2.51)	.36
Distance	161	87.5 (14.4)	80.7 (18.6)	6.38 (1.53 to 11.24)	.01	88.7 (13.4)	82.8 (17.1)	6.48 (1.56 to 11.4)	.01	88.7 (15.6)	88.9 (11.8)	0.09 (−4.98 to 5.16)	.97
Vision specific													
Social functioning	161	94.2 (12.8)	89.3 (19.3)	4.71 (0.42 to 8.99)	.03	95.8 (9.5)	93.8 (12.4)	2.44 (−1.91 to 6.79)	.27	92.9 (13.6)	96.6 (8.2)	−2.23 (−6.73 to 2.28)	.33
Mental health	161	82.1 (18.5)	74.4 (23.9)	7.10 (0.9 to 13.29)	.02	84.3 (17.4)	78.7 (21.1)	6.68 (0.42 to 12.95)	.04	83.8 (20.3)	83.6 (17.1)	1.37 (−5.06 to 7.79)	.68
Role difficulties	161	84.5 (20.2)	77.3 (23.2)	6.35 (0.06 to 12.64)	.04	87.6 (16.4)	82.6 (20.6)	5.90 (−0.47 to 12.27)	.07	87.1 (19.0)	88.8 (17.1)	−0.23 (−6.75 to 6.3)	.94
Dependency	161	94.5 (13.4)	88.1 (20.5)	6.27 (1.3 to 11.23)	.01	96.1 (10.1)	91.1 (18.6)	5.70 (0.64 to 10.75)	.03	93.9 (12.7)	94.7 (13.2)	1.08 (−4.12 to 6.28)	.68
Driving	147	86.9 (14.9)	82.6 (16.7)	2.21 (−3.58 to 8)	.45	84.3 (18.6)	83.1 (18.9)	1.26 (−4.52 to 7.05)	.67	86.4 (15.8)	86.9 (14.9)	−1.47 (−7.4 to 4.47)	.63
Vision													
Color	161	95.1 (12.2)	93.8 (14.1)	1.88 (−1.61 to 5.37)	.33	98.0 (6.9)	96.1 (12.2)	2.20 (−1.32 to 5.72)	.22	97.0 (10.2)	98.2 (7.7)	−0.59 (−4.23 to 3.04)	.75
Peripheral	161	87.7 (19.6)	78.9 (24.0)	6.7 (0.19 to 13.21)	.04	91.6 (16.2)	81.2 (24.4)	10.83 (4.27 to 17.4)	.001	89.9 (15.1)	87.3 (19.8)	2.99 (−3.72 to 9.71)	.38

Abbreviation: NEI VFQ-25, 25-Item National Eye Institute Visual Function Questionnaire.

[a] Adjusted for age, sex, macular status, and preoperative lens status and visual acuity in the nonstudy eye.

individuals.[10] Interestingly, other than near activities, all subscales found to be lower in patients following RRD repair by Okamoto et al[10] were also found to be significantly different between treatment groups in the PIVOT trial at 3 and 6 months. It is important to note that all their patients underwent combined vitrectomy with cataract extraction for RRD repair. This suggests that the reduction in the specific aspects of visual functioning post RRD repair by Okamoto et al,[10] which is consistent with the findings of this study, is not secondary to postoperative cataract development.

Although certain clinical circumstances may dictate a particular surgical technique vs another, the optimal surgical technique for the treatment of primary uncomplicated RRD remains controversial. A prospective, multicenter, randomized clinical trial[18] comparing PnR with SB for RRD demonstrated superior VA with PnR at 6 months and 2 years after surgery, including those in whom primary PnR had failed, with no significant difference in primary success rates.[18,19] In 2018, PIVOT compared long-term visual outcomes between PnR and PPV and demonstrated that the PnR group had superior VA and less vertical distortion when compared with the PPV group.

Many studies have shown that VA is associated with VRQoL in patients with various retinal pathologies, such as epiretinal membrane, macular hole, and central retinal vein occlusion, among others.[17,20-22] Previous studies[10,23] found no association between NEI VFQ-25 composite scores and postoperative VA in the operated eye in patients following RRD repair. Our results demonstrate evidence for an association between ETDRS VA and all of the NEI VFQ-25 subscales at all points, which supports the notion that differences in VRQoL measures are driven by vision outcomes in the operated eye. Although some studies[11,17,20] have found NEI VFQ-25 scores to be associated with the VA in the better-seeing eye, in this randomized trial there was no statistically significant difference in fellow eye VA between the groups at all time, and furthermore, our regression models controlled for VA in the nonstudy eye. Therefore, we believe that the disparity in VRQoL between the groups was representative of the visual function in the operated eye.

Lina et al[23] reported a negative association between NEI VFQ-25 composite score and metamorphopsia at 1 year following RRD repair. Because PIVOT demonstrated significantly worse vertical metamorphopsia with PPV vs PnR at 1 year, it is possible that metamorphopsia had an effect on the NEI VFQ-25 scores at 3 and 6 months in our population, although metamorphopsia was not measured directly at those times.

Our results suggest that the lower visual function scores in the PPV group might not be explained solely by the reduced VA at 3, 6, and 12 months com-

Table 3. Multivariate Regression Assessing the Association of 25-Item National Eye Institute Visual Function Questionnaire Subscales and ETDRS Visual Acuity[a]

	Estimate (95% CI)		
NEI VFQ-25 subscales	3 mo	6 mo	12 mo
General			
Health	0.974 (0.815-1.132)	0.771 (0.674-0.868)	0.664 (0.525-0.803)
Vision	0.979 (0.821-1.138)	0.768 (0.016-0.864)	0.668 (0.529-0.807)
Ocular pain	0.963 (0.804-1.122)	0.761 (0.665-0.858)	0.659 (0.520-0.798)
Activities			
Near	0.972 (0.814-1.131)	0.763 (0.666-0.860)	0.662 (0.523-0.801)
Distance	0.968 (0.810-1.127)	0.759 (0.662-0.856)	0.659 (0.520-0.798)
Vision-specific			
Social functioning	0.959 (0.801-1.118)	0.755 (0.658-0.852)	0.656 (0.516-0.795)
Mental health	0.977 (0.818-1.136)	0.762 (0.666-0.859)	0.660 (0.521-0.799)
Role difficulties	0.977 (0.818-1.136)	0.753 (0.657-0.850)	0.658 (0.519-0.798)
Dependency	0.962 (0.804-1.121)	0.748 (0.651-0.844)	0.652 (0.513-0.792)
Driving	0.769 (0.610-0.928)	0.677 (0.581-0.774)	0.708 (0.569-0.847)
Vision			
Color	0.937 (0.779-1.096)	0.755 (0.659-0.852)	0.654 (0.514-0.793)
Peripheral	0.980 (0.821-1.138)	0.758 (0.661-0.854)	0.660 (0.520-0.799)

Abbreviations: ETDRS, Early Treatment Diabetic Retinopathy Study; NEI VFQ-25, 25-Item National Eye Institute Visual Function Questionnaire.

[a] Adjusted for visual acuity in the nonstudy eye and treatment group in a multivariate model.

pared with the PnR group. We believe that other factors may also be affecting VRQoL, such as PnR being a less invasive treatment, with less morbidity compared with PPV, and faster recovery of VA in the first 6 months.[14]

Limitations

We acknowledge certain limitations of our study. The analysis of differences in subscale scores between groups is a post hoc analysis of the PIVOT. However, this study did demonstrate NEI VFQ-25 subscale score differences between the 2 treatment arms in subscales that have been previously shown to be significantly affected following RRD repair.[10] Although the gas had resorbed by the 3-month assessment in all cases, a proportion (35%) of the PPV group had a longer acting gas tamponade (C3F8) injected, the more proximal memory of which could have feasibly affected the 3-month postoperative NEI VFQ-25 scores. Various factors, such as general health, mental health, or social functioning, are associated with VRQoL. Thus, these are possible confounders. However, it is important to note that the health-related QoL scores (36-item Short Form Health Survey) were similar in the PnR and PPV groups at baseline and 1 month postoperatively. Additionally, previous studies observed that NEI VFQ-25 scores were significantly associated with contrast sensitivity in patients following surgical repair for RRD. Therefore, the differences in NEI VFQ-25 scores could have been affected by contrast sensitivity, which was not assessed in this study. To et al[24] evaluated the effect of cataract surgery on VRQoL using the NEI VFQ-25 questionnaire. They observed that there was a statistically significant improvement in mean scores in all the NEI VFQ-25 subscales after cataract surgery. Their findings suggest that cataract has a more global effect in the NEI VFQ-25 subscale scores rather than an effect on specific subscales. The PPV group required cataract surgery in 64% of phakic patients during the 1-year follow-up period, while 15% of phakic patients in the PnR group required cataract extraction, although no patients had cataract surgery during the first 6 months. It is certainly possible that cataract formation may have affected visual function scores, but the authors believe that the lower questionnaire scores in the PPV group are not entirely related to this. Based on the Okamoto et al findings[10] and ours, it seems that RRD affects specific areas of visual function rather than the global decrease in NEI VFQ-25 subscale scores associated with cataract.[24] Also, in this study, the linear mixed models demonstrated that PPV was associated with lower visual function scores after adjusting for age and other possible confounders, such as macular status and preoperative lens status. Lastly, some patients in the PIVOT trial were lost to follow-up; thus, NEI VFQ-25 results for these patients were unavailable. This may have introduced an element of selection bias, although we believe this to be unlikely owing to balance in characteristics reported in Table 1. The discrepancy between the number of patients enrolled and the number who completed the NEI VFQ-25 was mostly related to patients having difficulty attending long-term follow-up visits owing to the wide geographical area served. We previously performed an analysis and demonstrated no difference in the characteristics of those who did and did not attend follow-up.[2] Furthermore, most patients who did not follow up were contacted by telephone to confirm that they had not experienced any new issues, such as retinal redetachment, requiring additional surgery.[2]

Conclusions

This study demonstrates that patients who underwent PnR in the PIVOT trial reported superior vision-related functioning in several subscales of the NEI VFQ-25 during the first 6 months after RRD repair when compared with patients undergoing PPV. The VRQoL assessment is important because it captures the

mental and emotional aspects of a disease and its treatment. Because RRD treatment options, such as PnR, PPV, and SB, provide patients with excellent final anatomical reattachment rates, it is important to determine whether certain treatment options are associated with better visual functional results from the patients' perspective. The effect of treatment on the patient's capability to perform daily activities and on their emotional well-being may be as valued as, or even more valued than, the objective measure of VA. Thus, future studies comparing RRD treatment modalities should not be limited to anatomical and VA evaluation but should also include VRQoL assessment and other functional outcomes to help establish which treatment offers the best visual function to patients following RRD repair.

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Invited Commentary

Vision-Related Function Following Retinal Detachment Repair—Looking Beyond the Letter Chart

Christina Y. Weng, MD, MBA

Just about every vitreoretinal surgeon can think of a patient who underwent a successful retinal detachment repair—perhaps even resulting in 20/20 visual acuity—but reported suboptimal visual function. Surgeons often use the word *successful* to describe patient outcomes that meet or exceed certain objective criteria; for rhegmatogenous retinal detachment (RRD) repair, the focus is often primarily on anatomic reattachment and secondarily on best-corrected visual acuity levels. While these are important measures, they represent surgeon-set metrics rather than patient-reported parameters. We place so much emphasis on how many letters in a bright white box a patient can identify while sitting in an artificially darkened room yet fail to account for 99% of their vision-dependent daily activities, such as driving, reading, and socializing. There is growing interest in patient-centered functional outcomes for a variety of retinal conditions, including macular degeneration, epiretinal membrane, and diabetic macular edema, because it is clear that visual acuity is far more complex than just the number of letters one can read on a chart.

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In this issue of *JAMA Ophthalmology*, Muni et al[1] explored vision-related function in patients undergoing pneumatic retinopexy (PnR) vs pars plana vitrectomy (PPV) for primary RRD in a post hoc analysis of their previously published Pneumatic Retinopexy Versus Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes Randomized Trial (PIVOT) study. The PIVOT trial was a randomized clinical trial comparing outcomes of PnR vs PPV for the management of primary RRD meeting set criteria. While the primary anatomic success rate was higher after PPV at 1 year (93.2% vs 80.8%; $P = .045$), the Early Treatment Diabetic Retinopathy Study visual acuity was better (by 9.9, 10.6, and 4.9 letters at 3, 6, and 12 months, respectively) and less vertical metamorphopsia was present following PnR.[2] In this subsequent analysis of 160 participants, differences in vision-related function and quality of life (VRQoL) between the 2 study arms were evaluated using the validated 25-item National Eye Institute Visual Function Questionnaire. The investigators[1] found that patients who received PnR had superior composite and subscale scores during the first 6 months following RRD repair compared with those who received PPV. More specifically, patients treated with PnR had higher scores (adjusted differences range, 4.65-10.83; P range = .001-.004) for subscales, including distance activities, composite score, mental health, dependency, and peripheral vision, even after adjusting for factors such as age, sex, lens status, and visual acuity in the nonstudy eye.[1]

To best understand the implications of these findings, one must recognize the outcomes of an RRD and its surgical repair on visual function and VRQoL. Multiple studies have indicated that compared with normal control participants, patients who have had RRD surgery with scleral buckle or PPV have decreased VRQoL, even if the retina remains attached.[3,4] In addition to worse visual acuity, decreased contrast sensitivity,[3,5] increased metamorphopsia,[6,7] and diminished color vision[5] have all been implicated as drivers that may lower VRQoL. Muni et al[1] did not measure color vision, contrast sensitivity, or metamorphopsia at the 3-month and 6-month points, but they do suggest that the higher VRQoL in the PnR arm might be partially explained by the better visual acuity outcomes in the operated-on eye. But is it more than that? As Muni et al[1] propose, it seems reasonable to presume that the faster recovery time, avoidance of vitrectomy surgery, and more frequent use of a shorter-acting gas tamponade with PnR may not only positively affect a patient's ability to perform daily activities but also one's emotional and mental well-being.

Interestingly, the disparity in vision-related function and quality-of-life scores between the PnR and PPV arms were no longer observed at 12 months. This may be because of the narrowing of the Early Treatment Diabetic Retinopathy Study letter difference at the 1-year point, even though it still favored the PnR group by nearly 5 letters. Or perhaps it reflects that even the patients treated with PPV had fully recovered by this point and thus were less affected by recent memory of their longer recovery periods relative to their PnR counterparts. Re-