Prospective Retinal and Optic Nerve Vitrectomy Evaluation (PROVE) Study

Twelve-Month Findings

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Purpose: To report 1-year outcomes of the Prospective Retinal and Optic Nerve Vitrectomy Evaluation study.

Design: Prospective, controlled, observational study.

Participants: Eighty eyes of 40 participants undergoing pars plana vitrectomy for epiretinal membrane (ERM), macular hole (MH), or vitreous opacities.

Methods: Enrolled participants underwent baseline evaluation of the study (surgical) and fellow (control) eyes by a masked fellowship-trained glaucoma specialist; evaluation included intraocular pressure (IOP; Goldmann applanation and Tono-Pen), central corneal thickness, gonioscopy, and cup-to-disc ratio measurement. Baseline testing included bilateral color fundus and optic disc photography, fundus autofluorescence, automated perimetry, and optical coherence tomography (OCT) of the macula and optic nerve. Evaluations were repeated at 3 months and 1 year after surgery.

Main Outcome Measures: The primary outcome measure was changes in peripapillary retinal nerve fiber layer (pRNFL) thickness. Secondary outcomes included changes in macular thickness and IOP.

Results: Thirty-eight of 40 patients completed 1 year of follow-up. Mean visual acuity (VA) improved in study eyes from baseline (P = 0.003) but remained worse than fellow eyes (P < 0.001). Study eyes had thinner inferior pRNFL thickness (114±16.8 μm) compared with fellow eyes (123±14.7 μm; P = 0.004). Mean IOP difference between study eyes and fellow eyes increased from baseline to 1 year. At 1 year, MH study eyes had higher mean IOP (16.0±3.7 mmHg) compared with fellow eyes (14.8±3.4 mmHg; P = 0.08). Mean IOP for pseudophakic study eyes increased from 14.5±3.2 mmHg at baseline to 16.0±2.8 mmHg at 1 year (P = 0.04). Central subfield thickness (CST) and cube volume decreased in study eyes at 1 year but remained greater than that of fellow eyes (P < 0.05). Reduction in CST from baseline correlated with degree of VA improvement (P < 0.05). Mean deviation (MD) improved in ERM study eyes at 1 year when compared with baseline (−2.2 vs. −4.0; P = 0.02) but remained worse than fellow eyes (−1.2; P = 0.002).

Conclusions: One year after vitrectomy, VA, CST, and MD improved in study eyes but not to the level of fellow eyes. Inferior pRNFL thickness decreased in study eyes. Reduction in CST from baseline correlated with degree of VA improvement. Pseudophakic study eyes demonstrated increased IOP when compared with baseline. Ophthalmology 2014;121:1983-1989 © 2014 by the American Academy of Ophthalmology.
Methods

The PROVE study was approved by the Vanderbilt University Institutional Review Board, complied with the Health Insurance Portability and Accountability Act, and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All subjects gave informed consent before enrollment. Consecutive enrollment took place at Vanderbilt Eye Institute between April 2010 and February 2012. The study is registered at clinicaltrials.gov (identifier NCT01162356).

Eighty eyes of 40 patients undergoing unilateral vitrectomy surgery were enrolled. Inclusion criteria included 18 years of age or older; planned vitrectomy for visually significant unilateral ERM, MH, or VO; and the ability to comply with testing and long-term follow-up. Exclusion criteria included any media opacity that would interfere with imaging, history of glaucoma, uveitis, trauma, use of aqueous suppressants for ocular hypertension, history of advanced retinal disease (exudative age-related macular degeneration, diabetic macular edema) that would interfere with retinal thickness measurements, and history of previous vitrectomy in either eye or postoperative complications requiring repeat vitrectomy surgery within 3 months. Patients with disease in the fellow control eye that, in the opinion of the investigator, was likely to warrant future vitrectomy surgery also were excluded.

The primary objective of the PROVE study was to determine the incidence of and associated risk factors for peripapillary retinal nerve fiber layer (pRNFL) changes after vitrectomy surgery. Secondary objectives included changes in macular thickness and IOP after surgery and characterization of long-term functional consequences of pRNFL and macular changes with regard to central and peripheral visual field defects.

Patient characteristics, including age, sex, medication use, and lens status, were recorded. All patients underwent comprehensive baseline testing of both their study (surgical) and fellow (control) eye within 4 weeks before their surgery. Testing consisted of a complete ocular examination by a fellowship-trained vitreoretinal surgeon, glaucoma evaluation by a fellowship-trained glaucoma specialist, fundus and optic nerve photography, fundus autofluorescence, visual field testing, and macula and optic nerve optical coherence tomography (OCT).

Glucoma Evaluation

The baseline glaucoma evaluation was performed in masked fashion with the glaucoma specialist having no knowledge of the patient’s history, indication for surgery, or which eye was to be operated on. The glaucoma evaluation included best-corrected visual acuity (VA), 3 IOP measurements by 2 independent methods (Goldmannplanation and Tono-Pen; Reichert, Depew, NY), gonioscopy, central corneal thickness measurement by pachymetry (DGH Technology, Inc., Exton, PA), and clinical assessment of cup-to-disc ratio. Best-corrected VA was measured using Snellen charts. All information was recorded on a data sheet with the time of day and was archived separately from the patient’s medical record. Follow-up evaluations were performed by the same glaucoma specialist (J.A.K., R.W.K., K.M.J.) who was masked to previous test results, and every effort was made to ensure that follow-up evaluations were performed at the same time of day. All patients had visual field testing and were evaluated by a glaucoma specialist (J.A.K., R.W.K., K.M.J.) before dilation. All remaining testing and grading of cup-to-disc ratio was performed after pharmacologic dilation with 2.5% phenylephrine and 1% tropicamide.

Photography

Color optic nerve (30°) and fundus photographs of the macula (50°) were obtained from the study and fellow eyes by experienced photographers (Zeiss 450+ fundus camera, OIS WinStation version 10.3; Dublin, CA).

 Autofluorescence

Fundus autofluorescence imaging of the macula with an excitation filter of 580 nm (bandwidth, 500–610 nm) and barrier filter of 695 nm (bandwidth, 675–715 nm) also was performed.

Visual Fields

Visual fields were assessed before dilation using a 24-2 static white-on-white Swedish interactive thresholding algorithm test program (SITA Fast, Humphrey visual field analyzer; Carl Zeiss Meditec, Dublin, CA). A field test was defined as reliable when the sum of fixation losses, false-positive rates, and false-negative rates were less than 33%. Visual field parameters, including mean deviation (MD), pattern standard deviation, and glaucoma hemifield test results, were recorded.

Optical Coherence Tomography

Spectral-domain OCT images of both eyes were generated with the Cirrus OCT (Carl Zeiss Meditec) in accordance with the manufacturer’s instructions. In brief, the retinal map algorithm produced a circular plot in which the central subfield formed the center, with a diameter of 1 mm. Two concentric zones were mapped: inner, with a width of 2 mm, and outer, with a width of 3 mm. For the purposes of this study, the central subfield and the 4 quadrants of the inner concentric zone (superior, nasal, inferior, temporal) were analyzed. Total macular volume was measured in cubic millimeters. The numerical values for these parameters were obtained directly from the retinal map algorithm. Scans were evaluated for decentration and artifacts. Macular change analysis was available to determine the amount of change between baseline and subsequent study visits.

An optic disc cube scan protocol was used to measure pRNFL thickness in a 6×6-mm² area, consisting of 200×200 axial scans (pixels) at the optic disc region. The center of the optic nerve was detected automatically and a circle (3.46-mm diameter) centered over this point was used to obtain standardized measurements. Two hundred fifty-six A-scan patterns were performed along this circle, the pRNFL thickness at each pixel was measured, and a thickness map was generated. Scan quality scores of 7 or more were acceptable. Average and 4-quadrant measurements of the pRNFL were used in statistical analysis. The cup volume was measured in cubic millimeters.

Surgery

All vitrectomy surgeries were performed by 1 of 3 fellowship-trained vitreoretinal surgeons (E.F.C., F.M.R., S.J.K.) using a 23- or 25-gauge 3-port pars plana approach and were video recorded. Intraoperative use of indocyanine green, gauge of vitrectomy instrumentation, intraocular tamponade (air, octofluoropropane, sulfur hexafluoride), and all other intraoperative procedures were at the discretion of the primary surgeon. A corticosteroid and antibiotic were applied after surgery for no longer than 4 weeks.

Follow-up Testing

All testing, as described previously, was repeated at 3 months and 1 year after surgery. All additional testing, care, or consultation was at the discretion of the treating retina specialists or any other eye care provider whom the patient was regularly seeing.
Sample Size Calculation

Assuming an approximately 15% and 5% rate of loss in mean pRNFL thickness (with standard deviation of 15%) among study and fellow (control) eyes, respectively, over 2 years, 1-sided inference of mean analysis resulted in a sample size requirement of 36 patients to allow for adequate power with an α set at 0.05 and a β set at 0.80. Anticipating a 10% loss to follow-up, the enrollment goal was set for 40 patients.

Statistical Analysis

Descriptive statistics, including mean and standard deviation, were calculated for case characteristics. The cohort was analyzed as a whole and also was stratified based on surgical indication and lens status. Statistical software was used to analyze the data and generate tables and figures (GraphPad Software, La Jolla, CA; and Microsoft Excel Software, Redmond, WA). Snellen VA was converted to logarithm of the minimal angle of resolution units for generating tables and subgroups was 59.3. OCT cube volume (mm³) Study eye 11.0 at 1 year from baseline in all eyes (P = 0.01). The temporal and inferior pRNFL changes observed above were influenced largely by ERM and MH eyes, respectively. Temporal pRNFL thickness was greatest in ERM eyes at baseline (86.7 ± 22.3 μm) and decreased to 71.3 ± 18.1 μm at 3 months (P = 0.01) and 70.2 ± 18.0 μm at 1 year (P = 0.007). Inferior pRNFL thickness became thinnest in MH eyes and was 118 ± 17 μm at baseline, decreasing to 110 ± 20 μm at 3 months (P = 0.03) and 108 ± 16.6 μm at 1 year (P = 0.003). There were no significant temporal or inferior pRNFL changes observed in the VO group over time.

There was an overall trend of increasing mean difference in IOP between study eyes and fellow eyes over time (Fig 1). When analyzing IOP by surgical indication, mean IOP at 1 year was 16.0 ± 3.7 mmHg in MH study eyes and 14.8 ± 3.4 mmHg in MH fellow eyes (Fig 2), which approached the level of statistical difference (P = 0.08). Similarly, in ERM eyes, mean IOP was 15.4 ± 2.9 mmHg in study eyes and 14.9 ± 2.2 mmHg in fellow eyes (P = 0.26). Multivariate analysis demonstrated no confounding effect on IOP because of lens status or surgical indication.

At baseline, 20 study eyes and 15 fellow eyes were pseudophakic (Table 1). No eyes underwent subsequent cataract surgery at 3 months, but 8 study eyes (2 ERM eyes, 6 MH eyes) and 2 fellow eyes had undergone cataract surgery by 1 year (between 4 and 9 months after vitrectomy). Mean IOP for the 15 pseudophakic fellow eyes at baseline was 15.1 ± 3.5 mmHg before surgery and 15.7 ± 3.3 mmHg at 1 year (P = 0.42). In contrast, mean IOP for the 20 pseudophakic study eyes increased 1.5 mmHg, from 14.5 ± 3.2 mmHg before surgery to 16.0 ± 2.8 mmHg at 1 year (P = 0.04; Fig 3). For the remaining 10 study eyes that were still phakic at 1 year, mean IOP was 17.3 ± 4.7 mmHg at baseline and 16.9 ± 2.2 mmHg at 1 year (P = 0.61).

### Results

Thirty-eight of 40 patients (95%) completed 1-year follow-up. Surgical indications included 20 ERMs, 13 MHs, and 5 VOs. Baseline, 3-month, and 1-year results of study eyes and fellow eyes are shown in Table 1. The average operative time among all subgroups was 59.3 ± 17.2 minutes, with mean times of 57.8 ± 16.8 minutes for ERMs, 67.8 ± 13.2 minutes for MHs, and 38.0 ± 9.7 minutes for VOs. Mean VA for study eyes improved at 1 year from baseline in all eyes (P = 0.003) but remained significantly worse than that of fellow eyes (P < 0.001). There were no significant differences from baseline or between study eyes and fellow eyes with respect to cup-to-disc ratio or central corneal thickness at any time point.

### Table 1. One-Year Clinical Outcomes for Study Eyes and Fellow Eyes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Eye Group</th>
<th>Baseline</th>
<th>3 Months</th>
<th>1 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>logMAR VA (Snellen VA)</td>
<td>Study eye</td>
<td>0.40 (20/50)*</td>
<td>0.23 (20/34)*</td>
<td>0.23 (20/34)*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>0.06 (20/23)</td>
<td>0.06 (20/23)</td>
<td>0.05 (20/22)</td>
</tr>
<tr>
<td>Pachymetry (μm)</td>
<td>Study eye</td>
<td>554±33.2</td>
<td>557±33.6</td>
<td>558±34.7</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>559±34.0</td>
<td>559±31.0</td>
<td>562±35.6</td>
</tr>
<tr>
<td>Phakic eyes, n (%)</td>
<td>Study eye</td>
<td>20 (50.0)</td>
<td>20 (50.0)</td>
<td>10 (26.3)</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>25 (62.5)</td>
<td>25 (62.5)</td>
<td>21 (55.3)</td>
</tr>
<tr>
<td>Pseudophakic eyes, n (%)</td>
<td>Study eye</td>
<td>20 (50.0)</td>
<td>20 (50.0)</td>
<td>28 (73.7)</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>15 (37.5)</td>
<td>15 (37.5)</td>
<td>17 (44.7)</td>
</tr>
<tr>
<td>PSD</td>
<td>Study eye</td>
<td>2.36±0.84</td>
<td>2.60±1.91</td>
<td>2.82±1.74*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>2.51±1.67</td>
<td>2.15±0.98</td>
<td>2.03±0.85†</td>
</tr>
<tr>
<td>OCT cube volume (mm³)</td>
<td>Study eye</td>
<td>11.0±1.35*</td>
<td>10.5±0.78*</td>
<td>10.4±0.81*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>10.2±1.0</td>
<td>10.0±0.53</td>
<td>10.1±0.54</td>
</tr>
</tbody>
</table>

logMAR = logarithm of the minimum angle of resolution; OCT = optical coherence tomography; PSD = pattern standard deviation; VA = visual acuity.

*P < 0.05 between study eye and fellow eye.
†P < 0.05 between baseline and 3 months.
‡P < 0.05 between baseline and 1 year.

Average and temporal pRNFL thickness decreased significantly at 1 year from baseline in study eyes (Table 2). Average pRNFL was 94.4 ± 11.6 μm at baseline in study eyes and decreased to 91.2 ± 10.5 μm at 1 year (P = 0.04), whereas no significant changes were observed in fellow eyes. Similarly, temporal pRNFL thickness was 76.1 ± 22.8 μm in study eyes at baseline and decreased to 66.5 ± 16.3 μm at 1 year (P = 0.008). Although temporal pRNFL thickness was significantly different between study eyes and fellow eyes at baseline (P < 0.05), there were no significant differences by 1 year. In contrast, mean inferior pRNFL thickness decreased to 115 ± 17.0 μm in study eyes compared with 123 ± 14.6 μm in fellow eyes at 1 year (P = 0.01). The temporal and inferior pRNFL changes observed above were influenced largely by ERM and MH eyes, respectively.
Central subfield thickness (CST) in study eyes was 390±106 µm at baseline and decreased significantly to 309±56 µm at 3 months (P<0.05) and 305±46 µm at 1 year (P<0.05; Table 3). There was no significant decrease in CST after 3 months (3 months vs. 1 year, P = 0.40). Despite decreasing thickness, CST remained significantly thicker in study eyes compared with fellow eyes at 1 year (P<0.05). Similar trends were seen when analyzing MH and ERM eyes separately. The mean difference in CST between study eyes and fellow eyes with MH and ERM decreased significantly by 3 months (P<0.01), but no further changes were observed thereafter, and mean differences (between study eyes and fellow eyes) remained significant for both subgroups (P<0.01) at 1 year (Fig 4). As expected, there were no significant changes in CST or significant differences between study eyes and fellow eyes over time in the VO subgroup. Reduction in CST from baseline correlated with degree of VA improvement (P<0.05). Macular cube volume for the entire cohort decreased from 11.0±1.35 mm³ in study eyes before surgery to 10.4±0.81 mm³ at 1 year (P = 0.01), but remained greater than that of fellow eyes (P<0.05; Table 1).

Mean deviation on Humphrey visual field testing improved in study eyes from −2.79±2.26 dB at baseline to −1.82±2.15 dB at 3 months (P = 0.04), but then modestly worsened at 1 year (−2.27±2.07 dB). Mean deviation was significantly worse in study eyes compared with fellow eyes at baseline (P = 0.002) and 1 year (P = 0.002) but not at 3 months (P = 0.05; Fig 5). For ERM eyes, MD improved from −3.89±0.22 dB at baseline to −2.14±1.78 dB at 1 year (P = 0.02) but remained worse than that of fellow eyes (−1.12±1.46 dB; P = 0.04). In contrast, MD worsened in MH eyes from −1.83±1.27 dB at baseline to −3.20±2.27 dB at 1 year (P = 0.06). Pattern standard deviation did not change significantly in study eyes over time but was significantly greater than that of fellow eyes (P = 0.009) at 1 year (Table 1). Although there was no significant change in ERM eyes, pattern standard deviation

![Mean IOP Difference (Study Eye - Fellow Eye)](image)

![Mean IOP Difference - Subgroup Analysis (Study Eye - Fellow Eye)](image)

Figure 1. Mean intraocular pressure (IOP) difference with 95% confidence intervals between study eyes and fellow eyes.

Figure 2. Mean intraocular pressure (IOP) difference between study eyes and fellow eyes by surgical indication. ERM = epiretinal membrane; MH = macular hole; VO = vitreous opacity. -•- ERM; •-•- MH; -•- VO.
Discussion

The 1-year results of PROVE suggest that pRNFL thickness decreases after vitrectomy surgery and IOP increases in pseudophakic eyes. To our knowledge, this is the first prospective study to report these findings, which may have clinically meaningful implications because pRNFL thinning is an early sign of glaucomatous damage and IOP is a known risk factor for OAG.

Glaucoma is a leading cause of irreversible vision loss worldwide. Although it is well known that acute increases in IOP occur in the immediate postoperative period after vitrectomy, there is surprisingly little information on long-term IOP outcomes. Intraocular pressure as a significant risk factor for OAG is a well-established parameter in clinical studies and is the only parameter that can be used to assess the progression of OAG with vitrectomy.

Intraocular pressure (IOP) is an early sign of glaucomatous damage and IOP is a known risk factor for OAG. Therefore, monitoring IOP is essential for the prevention and management of OAG.

Additional evidence to support a possible causal association of OAG with vitrectomy.

The normal neuroretinal optic nerve rim follows a characteristic configuration. It is broadest in the inferior rim, followed by the superior and nasal rims, and thinnest in the temporal disc region. In clinical practice, violation of this rule helps to detect early glaucomatous optic neuropathy. Whereas the 3-month results of the PROVE study showed temporal pRNFL thinning that was attributable to repair of macular pathologic features, observation of inferior thinning combined with Humphrey visual field changes at 1 year is concerning for a glaucomatous process. Longer follow-up of this cohort may demonstrate progressive structural and functional changes consistent with glaucoma.

Our understanding of the vitreous has evolved rapidly over the last decade. In addition to providing support and serving as a medium for light transmission, the vitreous may actively regulate reactive oxygen species. Although 99% water, the vitreous is composed of a network of type II collagen fibers, hyaluronic acid, proteins, and ascorbate (vitamin C). The latter exists in extremely high concentrations in the vitreous when compared with plasma and reacts chemically with oxygen to produce water. By consuming oxygen, the vitreous gel may reduce generation of free radical oxygen species and thereby lessen oxidative tissue damage. In support of this, vitreous syneresis or surgical removal results in higher intraocular oxygen tension and may account for the accelerated nuclear sclerosis observed almost universally (except in ischemic eyes) after modified to influence the onset and progression of OAG. Moreover, it is quantitative and can be assessed objectively, which lends itself well as an outcome measure in interventional studies. Consequently, the PROVE study was designed to detect small changes in IOP.

Chang and other investigators have reported an increased risk of OAG after vitrectomy surgery. However, these studies were retrospective in nature and therefore were unable to establish cause and effect. Moreover, diagnoses of OAG can be subjective and depend in part on optic disc and visual field changes that may result from surgery itself or from the underlying surgical indication. Because of the clear implications of increasing IOP, the PROVE study provides additional evidence to support a possible causal association of OAG with vitrectomy.

Table 3. Mean ± Standard Deviation Central Subfield Thickness (μm)

<table>
<thead>
<tr>
<th>Group</th>
<th>Eyes</th>
<th>Baseline</th>
<th>3 Months</th>
<th>1 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Study eye</td>
<td>390±106*</td>
<td>309±55*</td>
<td>305±47*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>257±29</td>
<td>259±32</td>
<td>262±37</td>
</tr>
<tr>
<td>Epiretinal membrane</td>
<td>Study eye</td>
<td>407±94*</td>
<td>341±42*</td>
<td>332±32*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>267±30</td>
<td>269±34</td>
<td>277±42</td>
</tr>
<tr>
<td>Macular hole</td>
<td>Study eye</td>
<td>413±112*</td>
<td>276±55*</td>
<td>281±50*</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>239±23</td>
<td>240±23</td>
<td>239±22</td>
</tr>
<tr>
<td>Vitreous opacities</td>
<td>Study eye</td>
<td>263±18.2</td>
<td>267±12.5</td>
<td>263±8.2</td>
</tr>
<tr>
<td></td>
<td>Fellow eye</td>
<td>263±12.5</td>
<td>267±14.6</td>
<td>265±14.1</td>
</tr>
</tbody>
</table>

*p<0.05 between study eye and fellow eye at the respective period.

1p<0.05 between baseline and 3-month values.

2p<0.05 between baseline and 1-year values.
macular hole; VO

Figure 4. Change in mean central subfield thickness (CST) difference between study eyes and fellow eyes. ERM = epiretinal membrane; MH = macular hole; VO = vitreous opacity.

Figure 5. Mean deviation of visual field testing, with 95% confidence intervals, in study eyes (SE) and fellow eyes (FE).

vitrectomy surgery because of accelerated oxidation of crystalline lens proteins.5,17,18 The crystalline lens also consumes oxygen and may serve as a relative barrier to oxygen diffusion from the vitreous cavity into the anterior chamber.19 In support of this barrier function, aphakic and pseudophakic eyes demonstrate much higher aqueous oxygen tension than phakic eyes.4,5 Higher aqueous oxygen tension in turn may result in greater oxidative damage to trabecular endothelial cells over time and progressive dysfunction of the trabecular meshwork with consequent increased outflow resistance.20

A comprehensive meta-analysis in 2002 reported that IOP was lowered by 2 to 4 mmHg after cataract surgery.21 This analysis prompted some to suggest cataract surgery as a means to lower IOP in eyes with moderate OAG.22 However, this meta-analysis defined long-term as only more than 24 hours after cataract surgery, and the quality of the data was considered weak overall because of confounding factors. In the PROVE study, IOP also decreased at 1 year in 8 phakic study eyes at baseline that underwent cataract surgery between 4 and 9 months after vitrectomy, but increased by a mean of 0.5 mmHg at 1 year in baseline pseudophakic (but not phakic) fellow eyes. These observations suggest that removal of the crystalline lens decreases IOP initially, consistent with other reports. However, it ultimately may increase IOP with longer follow-up. Continued monitoring of these fellow eyes should provide more definitive information on the long-term influence of the crystalline lens on IOP.

There was a trend of increasing IOP in MH eyes. Furthermore, this observation was not influenced by pseudophakia, because only 2 of 13 MH eyes (15%) were pseudophakic at baseline versus 14 of 20 ERM eyes (70%). A more complete vitrectomy was performed routinely in MH eyes because of the intended use of intraocular gas, which may explain this finding. Other potential explanations include trabecular meshwork toxicity from indocyanine green or damage from prolonged prone positioning and intraocular gas tamponade. The latter may increase relative pupillary block, which could damage the trabecular meshwork directly by repeated or prolonged episodes of angle closure.0,23

As with all prospective studies, our results should be interpreted with caution. A relatively small number of eyes were enrolled in the PROVE study overall. Nonetheless, our comparative analysis with matched fellow eyes gives us statistical power to detect small differences. Although a 1- to 2-mmHg increase in IOP is not likely to be clinically important in the near term, this observation has obvious long-term implications. Despite the study’s limitations, we emphasize the strengths of the PROVE study, which include its rigorous design, investigation of a timely and unaddressed topic, and use of advanced imaging methods to improve the sensitivity and validity of our findings.

In conclusion, the 1-year results of the PROVE study demonstrate that VA, CST, and MD improve in study eyes but not to the level of fellow eyes. Reduction in CST from baseline correlated with degree of VA improvement. Intraocular pressure was increased significantly in pseudophakic study eyes, and there was a trend toward increased IOP in MH eyes. Inferior pRNFL thinning was observed in study eyes and may indicate early glaucomatous damage. Continued longitudinal follow-up of this cohort may provide important information on anatomic and functional outcomes that may have direct implications for the prevention and treatment of complications occurring after vitrectomy.

References


Footnotes and Financial Disclosures

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Abbreviations and Acronyms:
CST = central subfield thickness; ERM = epiretinal membrane; IOP = intraocular pressure; MD = mean deviation; MH = macular hole; OAG = open-angle glaucoma; OCT = optical coherence tomography; pRNFL = peripapillary retinal nerve fiber layer; PROVE = Prospective Retinal and Optic Nerve Vitrectomy Evaluation; VA = visual acuity; VO = vitreous opacity.

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