Pars Plana Vitrectomy for Vitreous Floaters: An Evidence Review

Introduction

Vitreous floaters are among the most common complaints in ophthalmic practice. They result from age-related vitreous degeneration; dissociation of hyaluronan from collagen causes fibrous aggregation, liquefaction, and ultimately posterior vitreous detachment (PVD). The resulting opacities scatter light and cast shadows on the retina. Prevalence increases with age and myopia.

The traditional approach has been reassurance. This position is increasingly challenged by evidence that floaters can significantly impair contrast sensitivity, reading speed, and quality of life. Sebag and colleagues have shown that contrast sensitivity function (CSF) is substantially degraded in patients with vitreous floaters compared with age-matched controls, with reported reductions of roughly 50% to 90% across studies depending on the cohort and testing method (1,10,30). The health utility value associated with visually significant floaters has been reported as low as 0.67, comparable to age-related macular degeneration and diabetic retinopathy (2). In a utility study by Wagle et al., patients with symptomatic floaters reported they would accept a 7% risk of blindness to be relieved of their symptoms (3).

Two interventional options exist: pars plana vitrectomy (PPV) and Nd:YAG laser vitreolysis. This review examines the current evidence for PPV. A companion review covers laser vitreolysis.

Historical Context and Professional Attitudes

PPV for symptomatic floaters was first reported by Schiff et al. in 2000 (4). Despite two decades of accumulating evidence, the procedure remains controversial. Cohen et al. surveyed 2,600 US vitreoretinal specialists in 2015 and received 159 responses. Only 25% reported they would perform PPV for floaters, although 69% had previously done so. Those likely to operate performed more than 100 vitrectomy cases annually. Three barriers were identified among those unlikely to intervene: the surgical risks of PPV (86%), unrealistic patient expectations (58%), and the possibility of ridicule from the local retina community (32%) (5).

This last barrier is remarkable. It reflects a cultural bias within vitreoretinal surgery against treating a condition perceived as benign, despite evidence of significant functional impairment. The perception persists that floater surgery is somehow frivolous; the same profession routinely performs refractive lens exchange and LASIK to improve quality of life in patients with normal corrected vision.

Surgical Approach

Two philosophies exist regarding the extent of vitrectomy for floaters.

Complete Vitrectomy with PVD Induction

This approach removes all accessible vitreous gel, induces PVD if not already present, and may include vitreous base shaving and internal limiting membrane (ILM) peeling. Proponents argue that complete removal eliminates all current opacities and prevents recurrence from residual vitreous. Lim and others advocate this approach, citing lower recurrence rates (6).

The principal disadvantages are higher complication rates. Surgical PVD induction significantly increases the risk of iatrogenic retinal breaks. Chung et al. reported an incidence of breaks during PVD induction of 11.1% overall (7). In the European VitreoRetinal Society (EVRS) floater study, complete vitrectomy was associated with a higher risk of iatrogenic breaks than core vitrectomy (OR 0.05 for core vitrectomy; i.e. 95% lower risk) (8). More extensive vitreous removal also accelerates cataract formation by increasing intraocular oxygen exposure to the lens.

Limited (Core) Vitrectomy without PVD Induction

Sebag developed limited vitrectomy specifically for floater surgery, prioritising safety over completeness (9,10). The technique uses 25-gauge instruments; removes central vitreous containing the opacities; preserves 3-4 mm of retrolental vitreous in phakic eyes; and avoids surgical PVD induction when the posterior hyaloid is attached. The rationale is that avoiding PVD induction reduces retinal tear risk, and preserving anterior vitreous reduces cataract formation by maintaining the low-oxygen environment around the lens.

The disadvantage is incomplete treatment. Residual vitreous can generate new floaters. Boneva et al. reported that 14.1% of eyes (14 of 99) without complete preoperative PVD developed recurrent central floaters due to new-onset PVD at a mean follow-up of 39 months. Risk factors for recurrence were younger age, male sex, myopia, and phakic status. Eleven of 14 patients elected reoperation with resolution (11). The implication is that in younger myopic phakic patients, avoiding PVD induction trades a lower acute complication rate for a meaningful recurrence risk.

Gauge Selection

The transition from 20-gauge to small-gauge surgery has materially altered the risk profile of floater vitrectomy. In the EVRS study, retinal detachment rates declined with smaller gauge: 4.7% with 20-gauge, 2.5% with 23-gauge, 1.5% with 25-gauge, and 0% with 27-gauge, although this trend did not reach statistical significance (8). Lin et al. reported outcomes of 27-gauge PPV in 47 young patients (mean age 34.7 years) with 91.5% satisfaction. No clinically significant cataract was observed in 42 phakic eyes over a mean follow-up of 14 months, though this is too short for definitive conclusions regarding cataract (12). Higher cut rates (above 1,500 cuts/min) were also associated with lower iatrogenic break rates in the EVRS data (8).

Evidence for Efficacy

Systematic Reviews

Dysager et al. (2022) published the most comprehensive systematic review with meta-analysis (13). Eighteen eligible studies were identified, encompassing 2,077 eyes in 1,789 patients. Studies reported at least 90% patient satisfaction or symptom relief. BCVA improved by -0.08 logMAR (95% CI -0.10 to -0.06; $p<0.0001$). Contrast sensitivity improved by -2.26% Weber index (95% CI -3.26 to -1.26%; $p<0.0001$).

The review's limitations are important. Most included studies were retrospective. No RCTs comparing PPV for floaters against sham or observation were identified. There was no standardised outcome measure across studies. Publication bias is likely; surgeons with poor outcomes are less inclined to report them.

Ivanova et al. (2016) conducted an earlier evidence-based review reaching similar conclusions: high satisfaction rates but uniformly low-quality evidence (14).

The Sebag Series

Sebag's group has published the most extensive prospective data from a single centre. The 2014 study of 76 eyes demonstrated CSF normalisation within one week of surgery, sustained at 3-9 months. Complete symptom resolution occurred in 93.8% of prospectively evaluated patients. No retinal breaks, infection, or glaucoma occurred; 23.5% of phakic eyes required cataract surgery at a mean of 15 months (1).

The 2018 series expanded this to 195 eyes with follow-up averaging 32.6 months (range 3-115 months). CSF was degraded by 91.3% preoperatively compared with age-matched controls. After limited vitrectomy, CSF normalised in each case and remained normal for more than 4 years. Postoperative retinal tears occurred in 1.5% of eyes. Retinal detachment occurred in 1.5%. Cataract surgery was required in 16.9% of phakic eyes, with a mean onset of 13.1 months (10).

These are compelling data, but they come from a single expert centre with a strong advocacy position. Sebag's group has pioneered the concept of "vision degrading myodesopsia" (VDM) and "limited refractive vitrectomy" as diagnostic and therapeutic frameworks. The terminology itself carries rhetorical force; reframing floater surgery as "refractive" is designed to legitimate it. The data should be interpreted in this context, though this does not invalidate it.

The EVRS Study

Zeydanli et al. reported the EVRS survey study: 48 vitreoretinal surgeons from 16 countries contributing data on 581 eyes (8). This is the largest multicentre dataset. 92% of patients were satisfied. 86.3% reported complete resolution of daily-life symptoms. Satisfaction was lower in patients with smaller vitreous opacities at presentation (OR 0.4), which is an important finding for patient selection. Iatrogenic retinal breaks occurred in 5%. Retinal detachment occurred in 2.4%. Cataract surgery was required in 48.6% of phakic eyes at a median of 16 months.

The cataract rate of 48.6% in this multicentre study is substantially higher than the 16.9% reported by Sebag. This likely reflects the difference between limited and complete vitrectomy techniques, though the study did not control for this adequately.

Long-term Outcomes

Duke et al. (2025) reported the longest patient-reported outcomes: 142 eyes followed 4-7 years after sutureless (25-

or 27-gauge) PPV. 91.1% rated the procedure a complete or significant success. 94.1% reported floaters had impacted quality of life moderately or severely before surgery. Recurrence of any floaters occurred in 31.7% of eyes, but only 2% reported significant recurrence. Early complications occurred in 4.9% (4 transient CME, 3 vitreous haemorrhage). 69.9% of eyes were pseudophakic at surgery, which limits conclusions about cataract incidence (15).

De Nie et al. (2013) reported 110 eyes from the Netherlands with follow-up ranging from 4 to 136 months. 84% were completely cured; an additional 9.3% improved. 9.3% were dissatisfied; 5.6% had serious complications with permanent visual loss. Retinal detachment occurred in 10.9% overall (4.5% within 3 months; 6.4% later). Cystoid macular oedema occurred in 5.5%. These high complication rates likely reflect the predominant use of 20-gauge and 23-gauge instruments in an era before small-gauge surgery was standard (16).

Schulz-Key et al. (2011) reported 73 eyes from Sweden with a mean follow-up of 37 months. 88% were satisfied. Retinal detachment occurred in 6.8%. Cataract surgery was required in 60.5% of phakic eyes (17).

The IRIS Registry Data

Rubino et al. analysed the American Academy of Ophthalmology IRIS Registry, identifying 17,615 eyes that underwent vitrectomy linked exclusively to vitreous opacity codes between 2013 and 2017. This is the largest real-world dataset. 12.4% returned to the operating room for cataract surgery within one year. 3.7% returned for a non-cataract procedure. 2.6% returned for retinal detachment repair (18).

This 2.6% retinal detachment rate from a real-world registry is reassuring compared with the 6.8-10.9% rates reported in earlier European series using larger-gauge instruments. It is consistent with the rates reported in more recent small-gauge series.

The Karunatilake 2025 Series

Karunatilake et al. reported 410 eyes from a single centre in Northern Alberta, the largest published single-centre cohort. The overall complication rate was 7.3%. Retinal detachment occurred in 2.4%. Cataract requiring surgery occurred in only 1.5%, though this low rate reflects a predominantly pseudophakic cohort. CME occurred in 0.98%. 29.9% of patients returned for contralateral eye surgery, which is an indirect indicator of satisfaction (19).

Complications

Cataract

Cataract formation is the most common consequence of vitrectomy for floaters in phakic eyes. Rates vary widely depending on technique and follow-up. The EVRS multicentre study reported 48.6% at a median of 16 months (8). Sebag's limited vitrectomy series reported 16.9% (10).

Yee et al. directly compared cataract incidence after limited versus extensive vitrectomy for vitreous opacities (20). In 96 phakic eyes undergoing limited 25-gauge vitrectomy (preserving 3-4mm retrolental vitreous, no PVD induction), 18% required cataract surgery at a mean follow-up of 20 months. With a minimum 24-month follow-up (48 eyes), the rate was 35%. This compared with 87% in 23 eyes undergoing extensive vitrectomy with PVD induction at the University of Amsterdam ($P<0.0001$). The interval to cataract surgery was also longer after limited vitrectomy: 12.4 months versus 7.3 months ($P<0.002$). At 12 months, Kaplan-Meier analysis showed cumulative cataract surgery incidence of approximately 20% after limited vitrectomy versus 70% after extensive vitrectomy. Notably, 14 eyes from patients under 40 years of age (mean follow-up 21 months; one patient followed 70 months) did not require cataract surgery following limited vitrectomy.

These findings should be interpreted with caution. The two groups were operated in different centres, by different surgeons, in different healthcare systems (US versus Netherlands). The study was not randomised. Practice patterns and thresholds for cataract surgery may differ between settings. The extensive vitrectomy group was small (23 eyes). The authors acknowledge these limitations but argue the populations were otherwise comparable in gender, age distribution, and pre-cataract visual acuity.

The proposed mechanism is rooted in a computational model of oxygen transport in the vitreous (20). The intact vitreous acts as an oxygen sink; retrolental partial pressure of oxygen (pO2) is predicted at 4-6 mmHg in an eye with intact vitreous and no PVD. After limited vitrectomy without PVD induction, predicted retrolental pO2 rises to 6-9 mmHg. After extensive vitrectomy with PVD induction, it rises to 10-12 mmHg. This near-doubling of retrolental oxygen exposure is hypothesised to accelerate oxidative damage to lens crystallins, particularly through consumption of protective alpha-crystallin. Vitrectomy also removes endogenous vitreous antioxidants such as ascorbate. The model predicts that preserving anterior vitreous attenuates but does not eliminate this oxygen exposure; this is consistent with the clinical observation that limited vitrectomy delays but does not prevent cataract formation.

For practical purposes, cataract should be considered an inevitability in phakic patients over time. This is an important element of informed consent. Some surgeons recommend combined phacovitrectomy in patients over 50 or those with early lens changes. However, combined surgery was associated with a higher iatrogenic break rate in the

EVRS study (16.5% versus 2.9%; $p<0.001$), likely because complete vitrectomy was performed in most combined cases (8).

Retinal Detachment

Retinal detachment is the most feared complication. Reported rates range from 0% to 10.9% depending on the series. Early European studies using 20-gauge instruments reported 6.8-10.9% (16,17). More recent series using 25- and 27-gauge instruments report 0-2.6%. The IRIS Registry real-world rate is 2.6% (18).

Several factors influence risk. Surgical PVD induction substantially increases the risk of iatrogenic retinal tears. Higher cut rates reduce traction-related breaks. Core vitrectomy is safer than complete vitrectomy (8). Pre-existing retinal pathology such as lattice degeneration increases risk. Many surgeons perform prophylactic laser to lattice degeneration prior to floater surgery; Sebag's group reported treating pre-existing retinal breaks or lattice in 21.5% of eyes prior to vitrectomy (10).

An important observation from the De Nie series is that the majority of retinal detachments occurred in a delayed fashion, often years after the original PPV (16). This underscores the need for long-term follow-up beyond the typical study periods of 6-18 months.

Endophthalmitis

Endophthalmitis is rare but reported. Lin et al. reported one case (2.1%) in their 27-gauge series (12). Park et al. conducted the first prospective nationwide study of endophthalmitis following PPV in the UK, reporting an overall incidence of 1 in 1,730 (0.058%; 95% CI 1 in 1,263 to 1 in 2,747) across 48,433 PPVs for all indications (21). Vitreous opacity was the indication in 2 of the 28 cases; both grew gram-positive cocci (one *S. epidermidis*, one unspeciated gram-positive coccus) (22). Smaller gauge port sizes did not increase endophthalmitis risk. Immunosuppression (OR 19.0) and preoperative topical steroid use (OR 131.4) were independent risk factors. Gas tamponade, as typically used in retinal detachment surgery, appeared protective (OR 0.10 for RD as indication) (21).

The companion outcomes paper from the same study underscores the severity of this complication when it occurs. Across all 28 cases, 29.6% of eyes were eviscerated or had no perception of light or perception of light at minimum 6 months follow-up. Only 14.8% achieved 6/12 or better. Mean time from surgery to endophthalmitis diagnosis was 5 days. Culture was positive in 60.7% of cases; *S. epidermidis* was the most frequent isolate. Culture-positive and culture-negative cases did not differ in time to presentation, symptoms, signs, or visual outcome (22). These data are directly relevant to consent discussions for floater surgery; endophthalmitis is rare, but this is an elective quality-of-life procedure and the consequences of this complication are devastating.

Other Complications

Cystoid macular oedema is reported in 0.98-5.5% of cases. Epiretinal membrane formation occurs in approximately 0.24-3.6%. Macular hole formation is rare (0.9% in De Nie's series). Vitreous haemorrhage is typically transient. Open-angle glaucoma may develop months to years after vitrectomy; the mechanism is unclear but may relate to altered aqueous dynamics in the vitrectomised eye (23).

Patient Selection

There are no standardised criteria for patient selection. However, several principles emerge from the literature.

Symptom duration: Most investigators require symptoms for at least 3-6 months before considering surgery. This allows time for neuroadaptation and spontaneous improvement following acute PVD.

Objective assessment: Sebag advocates contrast sensitivity testing (using Freiburg Acuity Contrast Testing) and quantitative ultrasonography as objective measures of disease severity. His 2025 study of 651 eyes demonstrated that patients selected for observation had 43.7% less vitreous echodensity and better contrast sensitivity than those electing surgery, supporting the use of these measures to distinguish patients who can be safely observed (24). However, these tools are not widely available and have not been validated independently.

PVD status: Patients with complete PVD and a Weiss ring are the most straightforward surgical candidates. Floaters are typically discrete and easily removed. The vitreoretinal interface does not require manipulation. In the EVRS study, satisfaction was lower in patients with smaller vitreous opacities, suggesting that discrete large opacities respond better than diffuse syneresis (8).

Lens status: Pseudophakic patients are ideal candidates; the principal risk of cataract is eliminated, and the perception of floaters is often heightened after cataract surgery due to improved media clarity. Morris notes that 70% of his series were pseudophakic (25).

Age and myopia: Younger myopic patients without PVD are the most challenging group. Surgery can be effective, but the risk of recurrent floaters from subsequent PVD is significant (14.1% in Boneva's series), and cataract formation is a concern over decades of follow-up (11). In this group, inducing surgical PVD may be preferable despite the higher acute risk, to prevent later recurrence.

Psychological profile: Multiple authors emphasise the importance of patient expectations. Patients should understand that surgery eliminates most but not all floaters, that occasional small floaters may persist, and that the procedure carries real risks in an eye that otherwise sees well. Cohen's survey identified unrealistic expectations as the second most common barrier to surgery (5).

Cost-Effectiveness

Rostami et al. performed a cost-utility analysis of limited vitrectomy for floaters. Mean VFQ-39 scores improved by 19% after surgery. BCVA improved by 13.5% and CSF by 53%. The incremental patient value gain was 2.38 quality-adjusted life-years (QALYs). The average cost-utility ratio was $1,574 per QALY, which is superior to cataract surgery ($2,262/QALY), amblyopia therapy ($2,710/QALY), and retinal detachment repair ($45,304/QALY) (26).

These figures come from a selected population treated at an expert centre. They are not generalisable without qualification. Nevertheless, they challenge the assumption that floater surgery is poor value.

Comparison with Laser Vitreolysis

No RCT has compared PPV with YAG laser vitreolysis (27). The 2017 Cochrane review found no such trials and concluded that appropriately designed RCTs are needed.

The available indirect comparison is unfavourable for vitreolysis. In Delaney's UK series, full symptomatic resolution occurred in 93.3% of vitrectomy patients versus approximately one-third with vitreolysis (28). Vitrectomy consistently achieves satisfaction rates of 85-95%; vitreolysis achieves 50-60% at best, and only for favourable Weiss ring phenotypes.

Vitreolysis has the advantage of being an outpatient laser procedure without the risks of intraocular surgery. It does not cause cataract. It can be reasonable as a first step in patients with discrete Weiss ring floaters, with vitrectomy reserved for non-responders. Shah has advocated this stepwise approach (29).

Limitations of the Evidence

The evidence base for floater vitrectomy is entirely observational. No sham-controlled or observation-controlled RCTs exist. All published series are subject to selection bias, reporting bias, and the placebo effect of surgery. The absence of a standardised floater severity grading system and validated patient-reported outcome measure limits comparison across studies.

The conflict of interest dimension is relevant. Much of the supportive literature comes from centres that actively perform and advocate for the procedure. Sebag's group has published prolifically and coined terminology that frames floaters as a treatable disease requiring surgical intervention. This is good science but it is also advocacy. The opposing position; that floaters are benign and surgery is unwarranted; is itself a bias, but one that carries less financial incentive.

The follow-up in most studies is inadequate. Late complications including retinal detachment, open-angle glaucoma, and macular pathology may not manifest for years. The longest follow-up data (Duke's 4-7 year series; Sebag's series with some eyes followed beyond 5 years) are reassuring but remain insufficient for a procedure performed on young patients with decades of remaining life.

Conclusions

Pars plana vitrectomy is effective for symptomatic vitreous floaters. Satisfaction rates consistently exceed 85% across multiple series and a systematic meta-analysis. CSF normalises within days of surgery and this improvement is sustained over years. The procedure is the only intervention that reliably eliminates visually significant floaters.

The risk profile has improved substantially with the transition to small-gauge instrumentation. Retinal detachment rates have declined from 7-11% with 20-gauge instruments to approximately 2.5% with 25- and 27-gauge systems. Cataract formation remains inevitable in phakic eyes over time but can be delayed by limited vitrectomy technique. Endophthalmitis, CME, and ERM are uncommon.

Patient selection is critical. Pseudophakic patients with complete PVD and discrete opacities are the ideal candidates. Younger myopic phakic patients without PVD represent a challenging group where the benefits of surgery must be weighed against long-term risks of cataract and recurrence.

The principal gap in the evidence is the absence of randomised controlled trials. Observational data consistently support efficacy, but the contribution of placebo effect, regression to the mean, and neuroadaptation cannot be quantified without appropriate controls. A well-designed RCT comparing PPV to delayed surgery or structured observation with validated outcome measures would substantially advance the field.

In the interim, floater vitrectomy should be offered to carefully selected patients following thorough informed consent covering the established risks. The evidence supports it as a safe and effective procedure when performed by experienced vitreoretinal surgeons using modern small-gauge techniques with appropriate patient selection.

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