Surgical Considerations for Vitreous Opacities

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ABSTRACT

Vitreous opacities, often known as floaters, are a commonly diagnosed disease that appears to be prevalent in retinal surgery. Although most patients' symptoms are minor, they can cause severe impairment in vision-related quality of life in certain people. The awareness of the visual handicap caused by floaters, as well as the evidence foundation for treating this problem using small-gauge vitrectomy, has grown. Nonetheless, selecting acceptable individuals for surgery is sometimes problematic because of the relative absence of objective findings and results with which to quantify both visual impairment and post-procedure improvement. Even though there are no official recommendations on whether vitrectomy must be considered, there are some principles that should be followed when dealing with patients who have vitreous opacities. This review included an overview of symptomatic vitreous opacities and their treatment options, discussing best practices for identification of patients for surgical treatment, reviewing surgical pearls for vitrectomies and the role of laser treatment and photoablation by nanoparticles, as well as surgical management for proliferative diabetic retinopathy and its complications such as vitreous hemorrhage, tractional retinal detachment, macular hemorrhage, and edema, and offering further clarity regarding the treatment approaches for optimizing outcomes for patients having vitreous opacities.

Keywords: vitreous opacity; floater; surgical; vitrectomy; diabetic retinopathy; retinal tear.

INTRODUCTION

Vitreous floaters are among the most common issues seen in clinical practice. They are considered to be fairly common (76 percent in a survey of healthy as well as relatively young mobile phone users) and frequently cause substantial visual disruption (33 percent in the same survey)[1]. Despite their prevalence, appropriate imaging and grading of vitreous opacities remain elusive. This is due to the fact that most opacities caused by vitreous syneresis or posterior vitreous detachment (PVD), the two most common causes of vitreous floaters, are semi-transparent and thus difficult to distinguish from the background throughout a clinical assessment or using fundus images, which may be too anterior or even too posterior inside the vitreous cavity to be appropriately imaged using one device[2, 3].

Posterior vitreous detachment develops when the posterior vitreous cortex separates from the retina's inner limiting membrane (ILM), which begins posteriorly and proceeds up to the posterior boundary of the vitreous base. Perifoveal PVD, according to Johnson, is a gradual, insidious process that lasts until vitreopapillary separation[4]. The combination of vitreous liquefaction and vitreoretinal dehiscence results in posterior vitreous detachment, a common age-related condition that causes rhegmatogenous PVD by allowing liquid vitreous to enter the retro-cortical (preretinal) area through a cortical defect[5, 6]. Posterior vitreous detachment at a younger age not only causes floaters, but it also causes retinal tears with rhegmatogenous retinal detachment due to solid vitreoretinal adhesion to an uneven posterior vitreous foundation[7, 8].

Vitreous opacities (VO), often known as floaters, are a frequent occurrence that is generally associated with a posterior vitreous detachment. Vitreous opacities are uncomfortable for the great majority of patients, but they have no substantial impact on their quality of life or everyday activities[9]. When they do become visible, pars plana vitrectomy (PPV) may be a potential therapeutic option. This surgical method was first suggested over 20 years ago, but new evidence indicates that PPV for treatment of significant visual VOs is successful and typically safe[10]. As vitrectomy technology improves and becomes safer and more tolerable, more vitreoretinal physicians are beginning to provide PPV to patients diagnosed with vitreous opacities. In fact, most participants in a global online survey thought that symptomatic vitreous opacities required treatment, and this was true across geographical locations[11].

YAG laser vitreolysis (YLV) has recently developed as an alternative approach for treating vitreous opacification by vaporizing vitreous opacities at higher temperatures, dissolving the aggregated collagen fibrils, and forcing them to shift off the visual axis. Several studies have been published investigating the effectiveness of YAG laser vitrolysis for vitreous opacities, although there is no agreement in the literature about YAG laser procedures or the evaluation of vitreous opacities[12, 13]. Furthermore, for photoablation using nanoparticles, which is a nanotechnology-based strategy to locally ablate them with far less light energy than typical YAG laser treatment. The method is based on the plasmon characteristics of gold nanoparticles, which produce vapor nanobubbles under pulsed laser illumination, the mechanical force of which can ablate vitreous opacification[14]. Furthermore, for proliferative diabetic retinopathy (PDR), a thorough and proper evaluation, mostly during the initial encounter, enables the operator to set clear objectives for the surgical procedure and the patient's expectations of the post-operative outcome[15].

The goals of proliferative diabetic retinopathy surgery are to remove vitreous opacities, especially hemorrhages, cut away fibrovascular tissue to relieve pressure on the back of the eye, reattach tractional or rhegmatogenous retinal detachments, and finish pan-retinal photocoagulation to stop the disease from coming back. If these objectives are met, the retina should reattach, and the occurrence of proliferative disease must be reduced[15].

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Varieties of Floaters

Most patients notice floaters when a posterior vitreous detachment develops, although in many cases, this visual impairment arises owing to spontaneous syneresis and condensing of previously optically clear vitreous proteins. Furthermore, individuals may acquire symptomatic vitreous opacities (SVOs) during and after the beginning of intraocular inflammation or bleeding, which can be visually bothersome and induce assessment from patients seeking relief[16]. When not accompanied by other disorders, including uveitis and maybe even rhegmatogenous retinal detachment (RRD),' vitreous floaters are typically regarded as benign and do not cause irreversible loss of visual acuity. Floaters may be suggestive of more dangerous illnesses in some cases, such as cancer, as in the case of masquerade syndromes. Clinicians must consequently examine other diagnoses in individuals who have chronic or atypical symptoms[17].

A thorough clinical assessment and history can help distinguish between the various illnesses, including inflammatory causes such as uveitis, severe retinal tears, or even intraocular cancers. In these individuals, the presence of discomfort, redness, or systemic symptoms may raise the clinician's concern about other illnesses, and a diagnosis of vitreous floaters must be addressed with caution[18]. If there is any doubt about a diagnosis other than chronic non-pathological vitreous opacities, the patients must be thoroughly assessed by a retinal subspecialist, and more investigations as well as treatment, including retinal laser for acute retinal tears, should be considered[18].

Floaters can impair vision by interrupting light transmission to the retina, even if they do not significantly reduce visual acuity. This can be more pronounced when the floaters are bigger and more frequent. This may cause severe visual disturbances, affecting patients' quality of life. Significantly damaging floaters may be more likely in people with refractive error, possibly exacerbating their visual impairment[1, 19-21]. Primary vitreous floaters are those that develop from structures inside the vitreous body. Packed bunches of collagen fibrils generate visible fibers that first show in the core vitreous as linear structures. They grow more numerous, thicker, and uneven with maturity and are prevalent in children with axial myopia[22, 23].

The vitreous corpus liquefies and creates lacunae with age, the walls of which interfere with photon penetration to the retina and contribute to the feeling of floating. Primary vitreous floaters distort and scatter light and are recognized as movable black lines, spots, or nodules in the visual field. Certain linear floaters have the appearance of a translucent "glass noodle," while others are characterized as "spider web-like."[5]. Secondary floaters are opacities within the vitreous body that have an external origin and are often comprised of proteins, amyloid, or cells. The most common source of secondary vitreous floaters is pre-retinal or vitreous hemorrhage, which causes floaters and cloudy vision to appear suddenly[24, 25].

Vitreous hemorrhage can be caused by an acute posterior vitreous detachment with traction on retinal vessels, retinal tears that include retinal blood vessels, ischemic conditions leading to retinal or optic disc neo-vascularization, retino-vascular abnormalities, trauma, tumors, and some rare abnormalities like vitreoretinal dystrophies like x-linked schisis and familial exudative [5, 7, 25].

In addition to the curtain impact of the detached retina, retinal detachments can be linked with vitreous hemorrhage and the discharge of retinal pigment epithelium cells into the vitreous body, resulting in bothersome floaters. Following an anomalous posterior vitreous separation with a retinal break but no retinal detachment, avulsed retinal tissue (operculum) may also provide the symptom of a floater. [4, 26].

Vitrectomy:

Vitrectomy for vitreous opacification was considered unacceptable until clinical evidence demonstrating excellent patient outcomes was published in 2000. Vitrectomy is now the most frequent surgical treatment for vitreous opacities[27, 28]. Although there are no standards for vitrectomy for vitreous opacities, the treatment is normally reserved for individuals whose symptoms are chronic and cause severe visual impairment over time[18]. Smaller gauge operative incisions have enhanced safety, and studies show that quality of life improves following vitrectomy. However, there is still a tiny danger of substantial vision loss[10, 28, 29].

Several studies, however, have found that following vitrectomy for the elimination of vitreous floaters, there is a marked improvement in symptoms, patient satisfaction, quality of life, and reading speed[29-32]. Transconjunctival sutureless pars plana vitrectomy is now the most routinely utilized surgical procedure in the treatment of vitreous opacities. The initial vitreous removal is performed using a typical high speed vitrectomy cutter, extracting the vitreous up to the vitreous base as well as any floaters inside the vitreous[18]. Following vitreous clearance, some authors recommend inducing a posterior vitreous detachment in situations with posterior vitreous cortex adhesion, which can be accomplished with the help of visibility dyes such as bromophenol blue or triamcinolone[33, 34].

However, as stated further below, posterior vitreous detachment induction raises the chance of retinal break development. Finally, the peripheral retina is examined, and any retinal fractures are repaired with laser photocoagulation, retinopexy, or cryotherapy. In circumstances where there is a high risk of rhegmatogenous retinal detachment, a tamponade agent such as intravitreal gas may be used[28, 33]. Floaters indicate a circumstance in which smaller gauge (23-G or even smaller) operative incisions can be used efficiently without significantly impacting surgical results due to the minimum surgical procedures necessary[18].

Recent research reporting surgical results shows that narrow gauge (23-G or 25-G) vitrectomy is associated with reduced retinal break and rhegmatogenous retinal detachment rates than bigger-gauge (20-G) surgeries, although more prospective studies need to be done to fully assess this. Even a narrower-gauge vitrectomy operation (27-G) has been utilized to treat vitreous floaters effectively[35-38]. Small-gauge (23-G or smaller) surgery is therefore recommended for the treatment of vitreous floaters. Interestingly, there could be a limit to how much smaller incisions reduce the rate of complications, with some studies indicating that a 25- or 27-G vitrectomy is no safer than a 23-G surgery[39-41].

Wide-angle viewing devices, which have been utilized effectively in instances of vitreous opacities, may improve surgical ergonomics and eliminate the need for endo-lumination[42]. The purposeful intraoperative production of a posterior vitreous detachment is an area of procedural controversy about the efficacy of vitrectomy for vitreous opacities. Posterior vitreous detachment induction has been proposed to avoid further posterior vitreous detachment development by dissociating the residual posterior vitreous cortex. This, in turn, might result in the return of floaters or rhegmatogenous retinal detachment, although there has been little evidence that this has occurred recently[18, 43]. In two prior studies on pars plana vitrectomy for floaters, a small sample of patients underwent core vitrectomy with no posterior vitreous detachment induction, and another group underwent posterior vitreous detachment induction. Both trials found satisfactory effectiveness and reasonable safety profiles, raising questions about the need to induce posterior vitreous detachment[26, 44].

YAG Laser Vitrolysis:

Although vitrectomy is the most frequent therapy for vitreous opacities, additional methods have been investigated. One such method is vitreolysis, which uses a YAG laser to break up big floaters into smaller, less visually irritating bits[18]. A small number of ophthalmologists are increasingly using YAG laser vitreolysis for vitreous opacities. YAG vitreolysis for symptomatic vitreous opacities is a non-surgical procedure that may be appropriate for some individuals. While less intrusive, the advantages of YAG laser in terms of patient symptom alleviation aren't as strong as pars plana vitrectomy[16]. This treatment is typically regarded as the most appropriate for Weiss rings (a kind of floater caused by a posterior vitreous detachment in which the vitreous connection at the optic disc splits), as they are isolated lesions positioned along the central visual axis. More floaters (>3) or even more periphery lesions have been thought to be less susceptible to laser vitreolysis[45, 46].

According to one study, when YAG laser was compared to vitrectomy, only 2.5% of YAG cases showed considerable alleviation (defined as 50 to 70% improvement), whereas 93.3 % of vitrectomy patients claimed total symptom remission. About one-third of YAG laser patients experienced overall moderate alleviation (30 to 50% improvement)[18, 47]. Another study that contrasted YAG laser with sham therapy found a 54% incidence of symptomatic alleviation. Only patients with a single Weiss ring were involved in this trial, and the ring was precisely targeted, which might explain why the clinical improvement was greater than in earlier investigations[48]. However, it has been noted that a more relevant comparison might have been with vitrectomy, which remains the cornerstone of therapy, and sadly, no prospective trials evaluating these two treatment techniques are now underway[45, 49].

Furthermore, one recent study found no distinction in functional indicators between those who received vitreolysis and those who did not, despite quantifiable reductions within echodensity on ultrasound, implying that vitreolysis may not always result in symptomatic improvement for a significant subset of patients[50]. There have also been a number of adverse events associated with YAG vitreolysis, including serious problems such as rhegmatogenous retinal detachment and treatment-resistant glaucoma. It is difficult to quantify the occurrence of such adverse effects because most published studies on vitreolysis are small, with at most 50 to 55 individuals, and more research in this field is needed to further evaluate the safety of this technique[45, 46, 51, 52]. A number of recent case reports have also indicated fast cataract development with posterior capsular rupture following laser vitreolysis, indicating that this treatment should be used with care in phakic patients[53-56].

In terms of the YAG technique for floaters, it's worth noting that much more shots (often more than 100) and larger quantities of energy are necessary to completely vaporize the vitreous opacity than are required for a posterior capsulotomy[16]. Another study by Shaimova et al. looked at vitreous opacities prior to and after Nd:YAG vitreolysis and found that big floaters disappeared after the surgery[13].

Photoablation by Nanoparticles:

Clearly, while using YAG lasers to treat biological aggregations in the vitreous is an appealing method, there is still much room for improvement. For example, it is widely assumed that the form, size, and position of aggregates within the vitreous might have a negative influence on the success of YAG laser therapy, demanding a trial-and-error method based on the practitioner's observation and opinion[14, 57]. As a result, technical advancements are required to enable photoablation of vitreous collagen aggregations of any size, shape, or location while remaining safe and simple to operate. Sauvage et al. devised a nanotechnology-based technique for more effective photoablation of micro- as well as macroscopic opacities within the human vitreous in response to this apparent therapeutic need. Usually, it relies on the surface plasmon characteristics of gold nanoparticles (AuNPs) in particular, which greatly improve laser light absorption[14, 58]. Gold nanoparticles are rapidly heated to several hundred degrees under pulsed-laser irradiation (usually nanosecond laser pulses). As a result, the water in the surrounding environment evaporates, forming vapor nanobubbles (VNBs) on the surface of the gold nanoparticle[58, 59].

Such vapor nanobubbles will grow and then collapse, producing high-pressure shockwaves. Furthermore, Sauvage et al. anticipated that vapor nanobubbles would allow the mechanical elimination of vitreous opacities if nanoparticles could be targeted to those opacities through intravitreal injection, a very effective administration method for delivering biological medications inside the eye[14]. Taken as a whole, gold nanoparticle-assisted photoablation of vitreous opacities may be less harmful to the posterior portion of the eye since a substantially smaller number of weaker laser pulses appear to be necessary to shatter opacities. Another practical benefit of being able to employ a wider laser beam is that even the distance along the optical axis (which is the direction of light propagation) along which an adequate energy density for photoablation is obtained is significantly greater. Of course, these benefits come at the cost of needing to inject sensitizing gold nanoparticles into the vitreous, which generates concerns about potential harmful consequences[14].

Despite the fact that the toxicity of various types of nanoparticles toward the retina has been mentioned in the literature, few studies have looked at the potential toxicity of gold nanoparticles on the retina. It has been revealed that 20-nm gold nanoparticles were able to pass the blood retinal barrier in rabbits without altering cell survival or producing structural alterations in the retina[60, 61]. In another investigation, gold nanoparticles were injected intravitreally into rabbits, and histological examinations were done for up to 1 month with no evident symptoms of toxicity[62]. Gold nanoparticles are also known to have anti-angiogenic as well as anti-inflammatory effects, which can help in the management of ophthalmological illnesses. This relative tolerability of utilizing gold nanoparticles was also validated in our early toxicity investigation of Müller cells, which exhibit end feet just at vitreo-retinal contact[63].

In terms of furthering the therapeutic use of gold nanoparticle-assisted photoablation, the half-life of the gold nanoparticles in the vitreous is critical. Furthermore, the gold nanoparticles may remain in the vitreous long enough to allow photoablation of opacities[14]. It could make sense to test the half-life of gold nanoparticles in animal models. However, it is unclear to what degree this information would be adequately predictive for the removal of gold nanoparticles in the human eye. The half-life of intravitreally administered drugs or nanoparticles may be (partially) predicted from their diffusion coefficient inside the vitreous using the mechanistic model proposed by Hutton-Smith et al[64]. Taking into consideration the diffusion coefficient inside the vitreous as well as the volume of such vitreous in human eyes, Sauvage et al. estimated the half-life in the vitreous to be roughly one day for gold nanoparticles of 10 nm. This implies that the intravitreal gold nanoparticle injection and laser therapy should be conducted on the same day[14].

Importantly, as compared to conventional YAG laser treatment for floaters, which involves hundreds of mJoule shots inside the eye, a significantly smaller amount of low-intensity laser shots appears to be adequate to shatter vitreous opacities that cause floaters. In conclusion, our trials have yielded encouraging results in the treatment of vitreous diseases, which may broaden therapeutic possibilities through the usage of pulsed lasers as well as nanotechnology in the posterior region of the eye, both of which are promising medical technologies[65]. As a result, gold nanoparticle-assisted photoablation may provide a safer, quicker, and more reliable method of destroying vitreous opacities in the management of ophthalmological illnesses.

Surgical Management of Diabetic Retinopathy:

Diabetes retinopathy is one of the primary causes of blindness among working-age people. The prevalence of diabetic retinopathy rises with diabetes duration, with virtually all Type 1 patients and more than 60% of Type 2 patients developing some indications of retinopathy after 20 years[66, 67]. Diabetic retinopathy is primarily a microvascular complication characterized by progressive retinal ischemia resulting in non-proliferative diabetic retinopathy or proliferation of new blood vessels within the late phase resulting in proliferative diabetic retinopathy, which progresses to the development of contractile epi-retinal fibro-cellular membranes[66, 68, 69].

Contraction of the fibrocellular membranes induces gradual traction on new vessels, culminating in vitreous or pre-retinal hemorrhage, tractional, or even combined retinal detachment[70, 71]. In the treatment of severe non-proliferative diabetic retinopathy as well as early proliferative diabetic retinopathy, pan-retinal photocoagulation or anti-VEGF injections are used. Despite this treatment, some people will develop proliferative diabetic retinopathy that can only be treated surgically[72-74]. For many years, vitrectomy has played an important role in the therapy of proliferative diabetic retinopathy complications, and technical developments in vitrectomy have considerably improved results[75, 76].

Chronic or recurrent unilateral vitreous hemorrhage, pre-macular sub-hyaloidal hemorrhage, bilateral vitreous hemorrhage, tractional retinal detachment, and neovascular glaucoma are all current indications for surgery. There are also less prevalent indications, such as ghost cell glaucoma and epiretinal traction, resulting in persistent refractory macular edema[15]. The most prevalent consequence of proliferative diabetic retinopathy is vitreous hemorrhage, which reduces visual acuity and interferes with pan-retinal photocoagulation. Previous research supported pars plana vitrectomy as well as endo-laser photocoagulation for chronic and non-clearing vitreous hemorrhage lasting more than 3 months[66, 74, 77].

Nevertheless, the Diabetic Retinopathy Vitrectomy Study (DRVS) has demonstrated a definite advantage to early surgery in individuals with Type 1 diabetes, since postponing surgery may result in aggressive fibrovascular proliferation and an increased risk of tractional or combined retinal detachment[78-80]. According to the Diabetic Retinopathy Vitrectomy Study results, 25% of patients who had early pars plana vitrectomy restored visual acuity of 20/40 or better, compared to 15% of those who received standard therapy[80]. There has been a tendency toward earlier as well as lower threshold vitrectomy for diabetic vitreous hemorrhage since the release of the DRVS study. With better surgical procedures, the outcomes of pars plana vitrectomy for non-resolving vitreous hemorrhage have improved in comparison to DRVS, with recent research revealing that 87 percent of patients improved by at least three Early Treatment of Diabetic Retinopathy Study (ETDRS) lines at 12 months[75].

In type 1 diabetes, the overall paradigm is to care for people conservatively for around one month from the time of presentation for serious vitreous hemorrhage with no signs of spontaneous clearing, whereas patients with type 2 diabetes are typically given a longer duration for spontaneous clearing of vitreous hemorrhage[66, 70]. Other considerations for doing pars plana vitrectomy include the degree of improvement or advancement of anterior segment neovascularization, prior pan-retinal photocoagulation, visual acuity, and the patient's preferences or desires[81, 82]. Aqueous outflow clears simple vitreous hemorrhage spontaneously through the zonules. The appearance of red blood cells within the anterior chamber demonstrates that this outflow route is functional. The existence of anterior chamber neovascularization or prolonged vitreous hemorrhage with vitreous base fibrosis restricts this channel for spontaneous drainage, indicating the need for an early vitrectomy[66, 83].

Furthermore, in the case of tractional retinal detachment (TRD), the fibrovascular growth of tissue compresses and drags the underlying retina because of vitreoretinal adhesions, culminating in tractional retinal detachment. The tractional retinal detachment often originates in the arcades and gradually develops to include the fovea, requiring pars plana vitrectomy. Tractional retinal detachment can be peripheral and hence avoid the fovea. If there is no urgent threat to the fovea, such instances without vitreous hemorrhage may be left untreated[66]. However, it is critical to follow these individuals for potential foveal involvement since this progressive illness may eventually involve the fovea, necessitating pars plana vitrectomy. Patients with recently impaired vision had better surgical results than those with long-standing macular heterotopia[84, 85].

Following the development of better surgical procedures, the outcomes of pars plana vitrectomy for tractional retinal detachment have improved. For example, with and without silicone oil tamponade, up to 75% of patients reported better vision[84]. However, a variety of variables impact visual prognosis, including patient age, the location and size of the tractional retinal detachment, and the length of macular heterotopia. Poorer visual results have been linked to advanced age, anterior part neovascularization, and chronic macular heterotopia[84, 86]. Tractional retinal detachment contains a fibrovascular component that may contract, inducing retinal fractures in combined tractional and rhegmatogenous retinal detachment.

The formation of retinal fractures transforms a tractional retinal detachment into a combined retinal detachment. The retinal breach exposes the retinal pigment epithelium cells that produce proliferative vitreoretinopathy, characterized by the formation of strongly adherent membranes upon the retinal surface. These preretinal membranes constrict, resulting in tangential traction. Following pars plana vitrectomy for combined retinal detachment, visual acuity in up to 70% of eyes may improve[66, 87]. These membranes are hard to separate from the mobile underlying retina and may need bimanual dissection, visco-dissection, or silicone oil tamponade[88, 89]. The location and amount of the retinal detachment will determine the result of surgery, with eyes with acceptable pre-operative visual acuity having a fair prognosis and eyes with macular heterotopia having poor outcomes[87-89].

While for pre-macular hemorrhage, which is a consequence of proliferative diabetic retinopathy, thick pre-macular hemorrhage is not. O'Henley and Canny reviewed 9 patients with dense pre-macular hemorrhage; of the 5 patients who got early pars plana vitrectomy within 4 weeks of the onset of hemorrhage, all achieved 6/12 or better visual acuity, whereas those who did not receive PPV within 4 weeks all established late macular traction with visual acuity not better than 6/30[66, 90]. Furthermore, for diabetic macular edema induced by vitreomacular traction or a tight posterior hyaloid membrane, pars plana vitrectomy is indicated to eliminate the tractional component leading to macular edema[91]. The relevance of pars plana vitrectomy in the treatment of macular edema without macular traction is debatable. A few studies showed that pars plana vitrectomy improved intractable diabetic macular edema that had been resistant to multiple laser photocoagulation treatments and had no signs of macular traction[91, 92]. Other studies, however, show no improvements in macular thickness or visual acuity among patients with a connected posterior hyaloid and no clinical indication of macular traction or tight posterior hyaloid[66, 93, 94]. These findings suggest that the possible repercussions of pars plana vitrectomy, including cataract advancement, glaucoma, and postoperative vitreous hemorrhage, may jeopardize visual acuity improvement. A taut internal limiting membrane that responds to pars plana vitrectomy and inner limiting membrane removal may result in persistent diabetic macular edema following posterior hyaloid removal[95].

In diabetic macular edema, a taut posterior hyaloid membrane found as a glistening reflex across the macula is a sign that a pars plana vitrectomy is needed. Optical coherence tomography shows a hyperreflective membrane with incomplete posterior vitreous detachment as well as a thickened retina[66]. Vitreomacular traction, defined as a partly posterior vitreous detachment with localized regions of solid adhesions between both the vitreoretinal interface and the retina, is another rationale for pars plana vitrectomy[66].

CONCLUSION

Vitreous floaters management should be customized, preceded by thorough history collection, and well recorded by imaging, enabling more focused, restricted, and focal intervention. Vitrectomy techniques might be refined by removing only floaters without infusion or by utilizing a robot-guided small-gauge 1- or 2-port high-speed vitrectomy that removes only floaters, filters out the collagen, and reinfuses the autologous anoxic hyaluronan, potentially mitigating cataract, though other effects may be induced. Although recent research has helped to better discover methods of measuring their influence on vision and emerging treatment modalities (such as laser vitreolysis) as well as approaches to improving the safety of established therapies such as vitrectomy, vitreous floaters remain an area of interventional controversy.

For evidence-based judgments about the relative safety and effectiveness of YAG laser treatment, further prospective studies employing objective, quantitative, and standardized outcome measures previously utilized for vitrectomy are necessary. In the end, pharmacological vitreolysis will most likely replace or simplify vitrectomy as a less invasive therapy for those with floaters. Furthermore, vapor nanobubbles formed by combining nanosecond laser beams with gold nanoparticles provide enough mechanical energy to shatter human opacities seen in the vitreous of patients who received vitrectomy. It has been discovered that gold particles coated with hyaluronic acid, which is a significant component of the vitreous, do not become caught in the vitreous while accumulating on the opacities. This gold nanoparticle clustering reduces the strength of the laser beams required to form vapor nanobubbles on the surface. Advances in vitreoretinal surgery have allowed for better results in previously inoperable eyes with severe proliferative diabetic retinopathy. A complete preoperative examination, correct preoperative medical management, proper counseling, precise surgical treatment, detailed post-operative care, and patients' compliance are all required for these patients to have a favorable surgical outcome.

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