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International consensuses and guidelines on rhegmatogenous retinal detachment (RRD) surgery by the Asia-Pacific Vitreo-retina Society (APVRS), the Academy of Asia-Pacific Professors of Ophthalmology (AAPPO) and the Academia Retina Internationalis (ARI)

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ABSTRACT

Purpose: To establish expert consensus on the contemporary surgical management of rhegmatogenous retinal detachment (RRD) using a structured Delphi approach.
Methods: A panel of experienced vitreoretinal surgeons participated in a multiround Delphi survey evaluating statements related to surgical approach, vitrectomy techniques, tamponade selection, anesthesia, postoperative care, special populations, and future technologies. Consensus was defined as $\geq$ 75 % agreement. Voting outcomes were analyzed to identify areas of agreement and topics requiring further discussion.
Results: Strong consensus emerged on tailoring surgical choice to patient age, lens status, and retinal break characteristics. Scleral buckle (SB) was preferred in younger, phakic patients, while pars plana vitrectomy (PPV) was favored in pseudophakic eyes and complex detachments. Pneumatic retinopexy was supported for limited superior breaks. Small-gauge vitrectomy (23–27 gauge, G), meticulous peripheral vitreous management, and judicious use of perfluorocarbon liquids were widely endorsed. Postoperative positioning, careful intraocular pressure monitoring, and early intervention for macula-on detachments were emphasized. Moreover, macula-off retinal detachment (RD) may carry good prognosis especially in young patients. Areas of ongoing debate included the comparative benefit of PPV versus SB depending on lens status, the default use of silicone oil in complex detachments, and adoption of 27 G+ instruments in pediatric cases. Emerging technologies, including widefield imaging, intraoperative optical coherence tomography, artificial intelligence–assisted analysis, and pharmacologic adjuvants, were recognized as promising but require further validation.
Conclusions: This Delphi study provides structured guidance on RRD management while identifying areas of ongoing debate. Consistently, individualized surgical strategy, meticulous vitreous management, and careful postoperative care remain central to optimizing anatomical and functional outcomes, highlighting the importance of clinical judgment in evolving surgical practice.

1. Introduction

Rhegmatogenous retinal detachment (RRD) surgery has evolved significantly since its inception, with multiple surgical approaches and techniques available.[1,2] Despite advances in surgical technology and understanding of retinal anatomy, numerous controversies persist regarding optimal surgical approaches, timing of intervention, choice of tamponade agents, and management of specific clinical scenarios. This manuscript explores the major areas of debate in retinal detachment (RD) surgery, encompassing RRD.

These controversies reflect the complexity of RD surgery and the ongoing evolution of surgical techniques and technology. Given its high prevalence and propensity for visual morbidity, and the recent developments in our ability to manage RRD with good anatomical and functional outcomes, the Asia Pacific Vitreo-retina Society (APVRS), the Academy of Asia-Pacific Professors of Ophthalmology (AAPPO) and the Academia Retina Internationalis (ARI) felt the need for such consensus statements and guidelines for RRD management, and the senior authors (DSCL and PR) of this manuscript were appointed to coordinate this consensus project. Despite high success rates, several aspects of the procedure remain controversial among vitreoretinal surgeons. This consensus statement aims to synthesize evidence-based real-world practice recommendations from leading global experts to guide diagnosing and managing RRD.

2. Methods

Further to appointing the coordinators, the APVRS, AAPPO and ARI invited 13 more experts (NVR, MH, CCL, WCL, WFM, MPS, CWT, DWKW, PC, NYG, PTL, SS, SKHS) to join as core group members. This core group of 15 members performed an extensive literature search and review critically the materials on RRD, after which the first draft of the manuscript and consensus statements with explanation and elaboration was written. English-only articles were included for literature review from PubMed using combinations of the terminologies, including rhegmatogenous retinal detachment, retinal detachment, pars plana vitrectomy, scleral buckle, pneumatic retinopexy, laser, cryotherapy, endotamponade, gas tamponade, silicone oil, inferior break retinal detachment, air travel, management and complications. The preliminary search query was performed as follows: ("Retinal Detachment" OR "retinal detachment" OR "retinal breaks" OR "retinal tear") AND ("rhegmatogenous" OR "RRD" OR "giant retinal tear" OR "GRT") AND ("1960/01/01" to "2025/04/30"). This search strategy was applied to identify all available publications indexed between January 1960 and April 2025. Duplicates were screened and removed. Cross-references were studied from references wherever relevant and included. Since the primary focus of the literature review was to identify common controversies and generate consensus statements, a literature review in the line of systematic review or meta-analysis was not strictly followed. Instead, whenever common or existing controversies or consensus points were identified, they were noted down and refined as necessary for the voting exercise. The statements were organized into 9 sessions. Some additional papers published after April 2025 were searched and cited during the formation of the consensus statements.

An additional 13 leading VR experts were invited to join the International Panel of Experts (IPE), which was composed of 28 panelists from 12 countries/territories in total. Each panel member independently reviewed each statement and provided comments to the core group. The first voting by the IPE members was also done using a five-point Likert scale—ranging from "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly disagree". The core group then reviewed and evaluated the feedback and comments, revised it, and sent out the second draft for further opinions and voting. The process was repeated until all the statements were finalized. Subsequently, when the final draft was ready, each panel member voted on each statement anonymously. A consensus was reached when at least 75 % of the experts voted either "Agree" or "Strongly Agree" for a statement as per the methodology described in a previous consensus paper.[3]

[1] contributed as first author.

3. Consensus and controversies on rhegmatogenous retinal detachment repair

The consensus statements are organized into a total of 9 sections: (1) Surgical Approach Selection, (2) Vitrectomy Technique, (3) Tamponade Agent, (4) Endolaser and Cryotherapy, (5) Special Situations, (6) Anesthesia and Positioning, (7) Postoperative Management, (8) Special Populations, and (9) Future technology and Innovation.

Section 1. Surgical approach selection

Pars plana vitrectomy vs. scleral buckling vs. pneumatic retinopexy

Age remains a controversial yet clinically relevant factor in RRD surgical decision-making. Younger patients, particularly those under 35 with clear lenses and well-formed vitreous, are ideal candidates for scleral buckling (SB) due to its lens-sparing advantage, whereas age over 35 has been associated with an increased risk of primary anatomical failure.[4] In addition, the attached posterior hyaloid in patients with younger age may be a factor for the worse outcomes of pars plana vitrectomy (PPV), compared to older age. Conversely, older patients tend to have more posterior vitreous detachment, liquefied vitreous, and may already be pseudophakic, which favor the use of PPV. While age alone should not be the sole determinant, it often correlates with other anatomical and physiological changes that influence surgical decision-making.

In pseudophakic eyes, visualization of retinal breaks is more difficult due to media opacities and altered anterior segment anatomy. In addition, the characteristics of retinal breaks differ between pseudophakic and phakic patients with RRD, with pseudophakic eyes more commonly exhibiting smaller, round atrophic holes.[5] PPV achieves higher reattachment rates in pseudophakic RDs by effectively relieving vitreous traction, facilitating the identification of occult breaks, and enabling internal tamponade.[5–9] SB may be technically more challenging and associated with higher failure rates in these cases. In phakic patients with RRD, SB is associated with superior visual outcomes and higher single-surgery anatomical success compared to PPV.[5,6,8,10]

Pneumatic retinopexy (PR) yields favorable outcomes in carefully selected cases, particularly those with a single break or clustered breaks within 30 degrees, provided all breaks are located within the detached retina above the 8 and 4 o′clock meridians, minimal media opacity, absence of significant proliferative vitreoretinopathy (PVR), and in patients amenable to posturing.[11,12] Its minimally invasive nature and ability to be performed in-office make it an appealing option. The Pneumatic Retinopexy versus Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes Randomized Trial (PIVOT) showed that PR is associated with better visual acuity, less vertical metamorphopsia, and lower procedural morbidity when compared with PPV.[11]

The anatomical position of the break is a critical determinant in choosing the optimal surgical technique for RRD. PR is particularly suitable for superior retinal breaks confined to the upper 8 clock hours,[11] as the buoyant properties of intraocular gas tamponade facilitate subretinal fluid (SRF) reabsorption and promote retinal reattachment. However, in eyes with multiple breaks, large retinal lesions, or inferior detachments, PR has a significantly higher failure rate due to inadequate tamponade contact or undetected lesions. In contrast, SB relies heavily on the external accessibility of the break and is generally effective for peripherally located lesions that are readily indentable and reachable externally. More recently, the IRIS Registry (Intelligent Research in Sight) data revealed that the single operation success (SOS) rate for PR was not as high as reported in other major studies in past. With a SOS rate of 59.82 % for a combined cohort of nearly 13,000 pseudophakic and phakic patients, the study does provide a valuable insight about the choice of PR as a quick and cost-effective method when urgent treatment options are less feasible.[13]

PPV is recommended for more complex cases, as it allows complete vitreous removal and comprehensive capacity to manage complex pathologies, utilizing long-acting tamponades and internal drainage to achieve superior anatomical reattachment. A large-scale study demonstrated that vitrectomy is the preferred procedure in cases of RRD complicated by choroidal detachment, significant hypotony, large or giant retinal tears (GRT), or PVR, where flow control and tamponade with gas or silicone oil may be beneficial.[14]

Consensus Statement 1.1: *Younger patients, particularly those under 35, are often ideal candidates for SB, whereas older patients are more likely to benefit from PPV. (Consensus score: 95 % [strongly agree: 45 %; agree: 50 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.2: *PPV yields superior anatomic success in pseudophakic eyes, whereas SB offers better anatomic and functional outcomes in phakic patients. (Consensus score: 70 % [strongly agree: 15 %; agree: 55 %; neutral: 20 %; disagree: 10 %; strongly disagree: 0 %])*

Consensus Statement 1.3: *PR is best suited for RRD involving a single break or clustered breaks within 30 degrees, confined to the upper 8 clock hours. (Consensus score: 90 % [strongly agree:40 %; agree: 50 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 1.4: *Retinal break location plays a critical role in surgical planning; PR is ideal for superior break, whereas SB is influenced by the accessibility of buckle placement. (Consensus score: 10 % [strongly agree:35 %; agree: 65 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.5: *PPV is the preferred surgical approach for RRD complicated by choroidal detachment, marked hypotony, large or giant retinal tears, or the presence of proliferative vitreoretinopathy (PVR). (Consensus score: 100 % [strongly agree: 85 %; agree: 15 %; neutral: %; disagree: %; strongly disagree: %])*

Combination of PPV and SB (PPV+SB)

PPV-SB has been proposed as a strategy to maximize reattachment rates in complex RRD cases. PPV allows for traction relief and internal tamponade. SB provides mechanical support to peripheral or anterior breaks that are difficult to visualize or address during vitrectomy, and the addition of a supplemental buckle may further stabilize the peripheral retina by reducing vitreous traction, minimizing the risk of secondary retinal tear formation, and sealing small occult breaks that might otherwise result in primary surgical failure.[15] There is no consensus on universal criteria for PPV-SB, making patient selection a critical consideration. PPV-SB has been associated with a higher anatomic success rate in pseudophakic RDs, particularly in cases involving macula-on or inferior detachments.[15] Inferior or anterior retinal breaks, pre-existing lattice degeneration, and high myopia are factors that may favor the addition of SB. Conversely, patients with posterior or well-visualized breaks may derive minimal additional benefit. The Primary Retinal Detachment Outcomes (PRO) Study Group report 9 also revealed that adding a SB to PPV improved single-surgery success for IRDs, most notably in phakic eyes.[16] Individualized surgical planning, guided by ocular anatomy and detachment characteristics, is essential to optimize outcomes.

The addition of SB to PPV is not without drawbacks. Buckle-related complications, including extraocular muscle imbalance or injury, diplopia, choroidal detachment, anisometropia, buckle extrusion, buckle infection, and scleral perforation, can affect long-term visual and functional outcomes.[17–19] The increased surgical time and technical complexity may also elevate the risk of intraoperative or postoperative adverse events. Some studies have reported that the addition of SB does not significantly improve anatomical success rates and is associated with a higher incidence of complications, including macular pucker, macular edema, and glaucoma.[8,14,19,20]

SB, PPV, and PPV-SB have all demonstrated favorable cost-utility profiles in the management of moderately complex RRD.[21] From a healthcare economics perspective, the combined procedure increases surgical time, resource utilization, and complication risks. While the anatomical success rates may be marginally improved in some subsets of patients, the routine addition of SB to PPV in all RRD cases does not appear cost-effective.

Consensus Statement 1.6: *PPV+SB may offer additive benefits in selected cases, especially in pseudophakic eyes with inferior or anterior breaks, lattice degeneration, or extensive vitreoretinal pathology. (Consensus score: 85 % [strongly agree: 40 %; agree: 45 %; neutral: 10 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 1.7: *PPV+SB may increase the risk of complications such as diplopia, refractive changes, and buckle-related issues, etc. (Consensus score: 85 % [strongly agree: 25 %; agree: 60 %; neutral: 15 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.8: *The cost-effectiveness of PPV+SB remains unclear and best to be used on a case-by-case basis. (Consensus score: 100 % [strongly agree: 42.86 %; agree: 57.14 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Macula-on vs. macula-off urgency, extent of detachment impact on approach selection

In macula-on RD, the central vision is preserved, making prompt surgical repair a priority to prevent macular involvement. Macula-on RRD can rapidly progress to macula-off status, particularly in cases with superior, bullous detachments or involvement of the temporal arcades, warranting urgent surgical intervention.[22,23] Conversely, in cases of shallow, localized detachments with stable symptoms, a modest delay in surgical timing for macula-on RRD may be justifiable, as it has not been shown to adversely affect visual outcomes.[22] For macula-off RRD, surgical repair within 0–3 days of symptom onset is associated with better final best-corrected visual acuity (BCVA) compared to repair performed between 4 and 7 days; similarly, for macula-on RRD, intervention within 24 h of presentation may result in superior visual outcomes compared to delayed repair beyond 24 h.[24] However, institutional limitations and surgeon availability often influence whether weekend surgery is feasible, raising the question of balancing urgency with logistical practicality. Visual outcomes are strongly tied to macular status at the time of surgery. To mitigate the risk of macular involvement during preoperative waiting, patients are often advised to maintain strict head positioning or bed rest. Preoperative bed rest and posturing have been shown to significantly reduce the progression toward the fovea.[25] Furthermore, bilateral patching may effectively reduce detachment height and promote retinal reattachment.[26] These strategies help optimize visual prognosis by maintaining the macula-on status until surgery.

Total RD presents a high-risk scenario for vision loss, often associated with multiple or large retinal breaks and potential PVR. PPV with or without SB is generally the preferred surgical approach in eyes with total RRD and posterior vitreous detachment (PVD) due to its comprehensive ability to remove vitreous traction, identify and treat multiple breaks, and apply long-acting tamponade agents. SB and PR are rarely sufficient in such extensive cases due to limited visualization and inadequate control of posterior pathology. In cases of subtotal detachment, especially with a single or few localized breaks, less invasive techniques such as PR or SB may be appropriate. PR can be effective if the break is small, superior, and within the mobile retina,[11] while SB remains suitable for young, phakic patients with anterior breaks.[8] PPV with or without supplemental SB may still be chosen in cases with media opacity, uncertain break location, or complex detachment morphology.[14] Bullous RDs can progress rapidly, making it difficult to localize breaks and secure retinal reattachment with external techniques alone. The fluid dynamics in such cases often overwhelm the tamponade force of PR and complicate buckle placement. PPV allows for internal drainage, better visualization, and stability during repair.

Shallow detachments often progress more slowly and may remain localized for days, offering an opportunity to consider less invasive treatments.

Early surgical repair yields better visual outcomes in RRD, with macula-off cases benefiting from intervention within 3 days of symptom onset, and macula-on cases within 24 h of presentation. (Consensus score: 89.47 % [strongly agree: 52.63 %; agree: 36.84 %; neutral: 10.53 %; disagree: 0 %; strongly disagree: 0 %])

Consensus Statement 1.10: *Preoperative bed rest, posturing, and bilateral patching can slow RRD progression. For macula-on RRD, this procedure may help preventing its progression into macula-off RRD. (Consensus score: 94.74 % [strongly agree: 52.63 %; agree: 42.11 %; neutral: 5.26 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.11: *Total retinal detachment may best be managed with PPV, given its capacity to address extensive and multiple pathologies and allow for internal examination and tamponade. (Consensus score: 87.5 % [strongly agree: 37.5 %; agree: 50 %; neutral: 12.5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.12: *Subtotal detachment with well-localized breaks may be managed with a broader range of techniques, including PR, SB, or PPV, depending on break characteristics, extent of detachment, and lens status. (Consensus score: 95 % [strongly agree: 75 %; agree: 20 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.13: *Bullous RRDs are associated with high mobility and rapid progression, favoring early PPV to prevent macular involvement, improve surgical control, and better postoperative visual outcome. (Consensus score: 75 % [strongly agree: 30 %; agree: 40 %; neutral: 25 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 1.14: *Shallow or localized detachments may be amenable to PR or SB, especially when the break is superior and easily accessible. (Consensus score: 100 % [strongly agree: 60 %; agree: 40 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Section 2. Vitrectomy techniques

Gauge selection and instrumentation

The first three-port 20-gauge (G) vitrectomy system was introduced in 1974, however, 20 G vitrectomy requires conjunctival peritomy and suturing of sclerotomies and conjunctival wounds with absorbable sutures.[27] Transconjunctival 23 G vitrectomy system quickly gained popularly among retinal surgeons since its introduction by Eckardt et al.[28] The trend toward sutureless transconjunctival vitrectomy continued as the introduction of 25 G and 27 G instruments became available.[29]

There are numerous advantages of using small gauge vitrectomy systems. First, small instruments mean that most vitrectomy could be performed transconjunctival with self-sealing wounds. The vitrectomy cutter opening in small gauge systems is also closer to the tip of the probe, allowing the probe to reach closer to the retina during peripheral vitreous shaving.[30] Sutureless vitrectomy surgery and the avoidance of conjunctival peritomy may improve patient comfort, hasten post-operative recovery and reduce conjunctival scarring. Minimizing conjunctival scarring may be ideal in patients with a history of or pending glaucoma surgery.[27,31,32] In addition, 27 G vitrectomy system was associated with a lower rate of postoperative hypotony compared to 23 G and 25 G vitrectomy systems.[33,34] In a corneal topography study, Okamoto et al. reported that surgically induced corneal astigmatism was lower in 25 G compared to 20 G vitrectomy.[35] In pediatric eyes with narrow operative space, the smaller instruments of small gauge vitrectomy may be particularly useful.

The flow and aspiration rate of vitrectomy system is dictated by the Poiseuille's law, which states that resistance is proportional to the radius of the lumen of the tubing, hence reducing the flow rate.[27] Therefore, one trade-off of using small gauge vitrectomy system, particularly 27 G vitrectomy, is the lower flow rate and efficiency. In fact, in a comparative study, Rizzo et al. reported that the operation time of 27 G vitrectomy was longer than 25 G system in repairing RRD.[36] The reduction in flow rate in 27 G system may be partially compensated by using a higher cut rate.[37,38] In a recent prospective randomized controlled trial, Huang et al. showed that 20,000 cpm 27 G cutter could achieve shorter surgical time in performing core vitrectomy and peripheral vitreous shaving compared to 10,000 cpm 27 G cutter.[38] When small gauge vitrectomy system was first introduced, there were concerns regarding the efficiency of silicone oil infusion. With improvement in surgical instruments, silicone oil (SO) infusion can now be achieved efficiently in both 25 G and 27 G vitrectomy systems.[39–41]

Overall, the indications of small gauge vitrectomy have expanded from simple macular surgery initially to managing simple RRD and then to complex RRD with PVR.[38] Currently, the safety and effectiveness of 25 G and 27 G systems in managing RRD have been validated across multiple studies and centers, so surgeons may select 23 G, 25 G or 27 G vitrectomy systems based on their resources and expertise.[34,36,38–40]

Consensus Statement 2.1: *Small gauge vitrectomy, i.e., 23 G, 25 G, and 27 G, can be used in repairing RRD across all spectrums of complexity. (Consensus score: 90 % [strongly agree: 35 %; agree: 55 %; neutral: 10 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.2: *When 27 G vitrectomy is used, a high cut rate (≥10,000 cpm) cutter is preferred as it offsets the limitation of small gauge system to improve the efficiency of both core and peripheral vitrectomy. (Consensus score: 94.74 % [strongly agree: 52.63 %; agree: 42.11 %; neutral: 5.26 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.3: *No matter which gauge of vitrectomy is chosen, the principle of "First-In, Last-Out" of an infusion port should always be applied. (Consensus score: 100 % [strongly agree: 80 %; agree: 20 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Vitreous removal procedures

In simple RRD, core vitrectomy alone, particularly using a wide-angle viewing system, may lead to a high surgical success rate.[42] However, adequate peripheral vitreous base shaving is required to maintain a high single surgery success rate in complex RRD as the vitreous base may act as a scaffold for PVR membrane development, and contraction of the vitreous base may also cause new retinal tears and redetachment.[20,43] In fact, the rate of retinal redetachment after SO removal is significantly higher when vitreous base shaving is inadequate.[44,45] The use of wide-angle noncontact viewing system, chandelier illumination, and triamcinolone staining of vitreous cortex remnant can assist retinal surgeons in performing adequate vitreous base shaving.[46] Acar et al. reported that triamcinolone-assisted vitrectomy was associated with a slightly lower (but statistically insignificant) redetachment rate in RRD with PVR.[47] In macular hole RD (MHRD), the use of triamcinolone was found to be a useful adjunct in visualizing epiretinal membrane and posterior hyaloid remnant.[47]

Consensus Statement 2.4: *Peripheral vitreous shaving should be performed in all complex RRD cases to maximize the single surgical success rate. (Consensus score: 95 % [strongly agree: 70 %; agree: 25 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.5: *In complicated RRD, the use of triamcinolone-assisted vitreous shaving would enhance visibility of vitreous and could improve surgical success rate through ensuring more complete removal of peripheral vitreous. (Consensus score: 100 % [strongly agree: 37.5 %; agree: 62.5 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Retinotomy vs. retinotomy-free approaches

Intraoperative drainage of SRF is imperative to achieve effective laser photocoagulation. The creation of retinotomy allows the drainage of SRF without the use of perfluorocarbon liquid (PFCL), avoiding the potential complication of retained PFCL (either in subretinal space of the vitreous cavity) and saving cost. However, there are controversies and conflicting reports regarding the safety and efficacy of retinotomy in repairing RRD.[48–53]

A recent meta-analysis showed that the postoperative BCVA and primary reattachment rates were similar regardless of different SRF drainage techniques. Moreover, the rate of postoperative abnormal foveal contour was lower in posterior retinotomy–treated eyes compared to eyes with PFCL used in the primary surgery.[50] In the post hoc analysis of the post-RD trial (a prospective randomized controlled trial comparing the effect of immediate face-down versus support the break positioning), drainage through posterior retinotomy was associated with less postoperative retinal displacement and metamorphopsia compared to drainage through retinal breaks.[52]

However, there are several potential caveats associated with SRF drainage through posterior retinotomy. In the post-RD trial, a higher incidence of outer retinal folds was observed in the posterior retinotomy group.[52] In a nationwide, multicenter study involving 2239 cases, Ishikawa et al. reported that posterior drainage retinotomy was associated with over two-fold risk of postoperative epiretinal membrane (ERM) formation.[51] This finding was later validated by a meta-analysis which showed that the risk of ERM formation was higher in the posterior retinotomy group compared to through preexisting retinal breaks or the use of PFCL.[53] Similarly, in a retrospective analysis involving 519 eyes that underwent PPV for RRD repair, Ohara et al. reported that posterior drainage retinotomy was associated with lower primary reattachment rate and higher rate of ERM formation after adjusting for baseline characteristics.[51] Considering this, a prophylactic internal limiting membrane (ILM) peeling may be considered if contemplating a posterior drainage retinotomy, as studies have shown its ability to reduce the risk of ERM formation and a second surgery, thereby reducing cost to the patient. However, ILM peeling has been shown to be without any additional visual benefit.[54,55]

In summary, the evidence on posterior drainage retinotomy is inconsistent regarding primary reattachment rates and postoperative visual outcomes. Retrospective studies and meta-analyses suggest a higher risk of ERM formation when this technique is used. Surgeons may consider prophylactic macular ILM peeling to lower this risk. However, existing studies are mostly retrospective or post hoc analyses and often limited by surgeon-dependent decision-making. More robust research is needed to clarify its true impact.

Consensus Statement 2.6: *Posterior drainage retinotomy should only be performed when it is required to achieve effective fluid-air exchange to flatten the detached retina. (Consensus score: 90 % [strongly agree: 35 %; agree: 55 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 2.7: *Routine internal limiting membrane peeling over the macula to reduce the risk of postoperative ERM is not recommended, when posterior drainage retinotomy is made. (Consensus score: 87.5 % [strongly agree: 37.5 %; agree: 50 %; neutral: 12.5 %; disagree: 0 %; strongly disagree: 0 %])*

PFCL utilization controversies

The physical properties of PFCL, such as high specific gravity, moderate surface tension, and low viscosity, make it ideal to flatten detached retina temporarily during vitrectomy surgery to repair RRD. The use of intraoperative PFCL enhances vitrectomy safety, minimizes the risk of iatrogenic retinal tears, and avoids the need for posterior drainage retinotomy.[56,57]

PFCL may be assist retinal surgeons in complicated RRD, such as RRD associated with PVR, GRT and traumatic RRD.[56,57] In RRD associated with PVR, the use of PFCL could help identify residual retinal traction and PVR membranes and determine the extent and location of relaxing retinotomies/retinectomy.[57] Moreover, through displacing SRF from the macula and acting as a counterforce, PFCL could assist the peeling of premacular membranes. For RRD associated with GRT, the risk of slippage of the posterior retinal flap could be avoided by performing direct PFCL-SO exchange. An alternative technique to direct PFCL-SO exchange is performing a 2-stage surgery. In the primary vitrectomy surgery, PFCL would be left in the vitreous as a short-term tamponade followed by a second stage surgery (usually performed 1 week later) to remove PFCL and replaced it with gas tamponade. As there is a potential negative effect of SO on vision and retina, the 2-stage surgery could avoid the use of SO in eyes with good visual potential, such as macula-on RRD with GRT with no PVR.[57–62]

The clinical benefits of routine use of PFCL in uncomplicated or "simple" RRD are less clearly defined. Recently, an analysis of a national database with 3446 eyes showed that the use of PFCL during initial vitrectomy was not associated with a higher single-surgery reattachment rate compared to PFCL-free vitrectomy.[56] However, it is worth noting that the use of PFCL may reduce the risk of redetachment in eyes with macular detachment, previous ocular intervention, worse preoperative BCVA, large extent of RD, and inferior retinal tear.[56]

When PFCL is used, retinal surgeons should be aware of the risk of retained PFCL, either in the vitreous cavity or subretinal space. Retained PFCL may promote intraocular inflammation or retinal toxicity.[63] Subretinal PFCL may occur from 1 % to 11 % of eyes. Inadvertent subretinal entry of PFCL may occur when large peripheral retinectomy is made or traction at retinal break when PFCL is injected up to the level of retinal break.[63] Moreover, small gauge vitrectomy may increase the risk of subretinal PFCL by 4.5-fold compared to 20 G vitrectomy due to higher fluid flow in small gauge vitrectomy system, which may disrupt the surface tension of PFCL.[64] Extramacular subretinal PFCL may be tolerated without detrimental effect on vision. However, subfoveal PFCL could cause scotoma, diminished retinal function and atrophy of outer photoreceptors layers and retinal pigment epithelium (RPE) due to toxicity or mechanical effect.[65–68] Therefore, removal of subretinal PFCL should be considered when it affects the fovea or is at risk of migrating to the fovea.[64] Although spontaneous migration of subfoveal PFCL to extra-macular region has been reported, surgical removal of subfoveal PFCL in symptomatic patients may improve visual acuity.[64,69] In a recent review of 26 publications, Liu et al. reported that removal or displacement of subfoveal PFCL was associated with significant improvement in visual acuity.[60] Therefore, timely surgical removal of subfoveal PFCL should be considered to prevent irreversible retina/RPE atrophy and vision loss.[64]

To summarize, PFCL is valuable in complex RRD (PVR, GRT, trauma), but its routine use in simple RRD remains discretionary. Care is essential to avoid retained or subfoveal PFCL, which can cause toxicity, atrophy, and permanent vision loss.

Consensus Statement 2.8: *In complex RRD surgery, including eyes with PVR, GRT, and traumatic RRD, the use of PFCL is to be used when needed. (Consensus score: 100 % [strongly agree: 25 %; agree:75 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.9: *In simple RRD surgery, the use of PFCL should be based on surgeons' discretion. (Consensus score: 85 % [strongly agree: 30 %; agree: 55 %; neutral: 10 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 2.10: *All subfoveal PFCL should be removed surgically before finishing PPV, provided that the eye has reasonable visual prognosis. (Consensus score: 10 % [strongly agree: 45 %; agree: 55 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Intraoperative viewing systems

There are 2 main categories of viewing systems—contact viewing systems and noncontact viewing systems.[70] The contact viewing systems have high magnification and provide good resolution. These systems, such as Landers lens™ (Volk Optical, Mentor, OH, USA), are very useful for macular surgeries but may have limited field of view. The other contact systems, such as the AVI system, which has been available since 1989, and the newer HRX Vit ™ (Volk Optical, Mentor, OH, USA), was designed and developed to provide a wide field of view up to 130–150 degrees for PPV. The main drawback of the contact wide-angle viewing systems is the requirement of an assistant to hold the lens for stabilization. During frequent movements of lens, there is a risk of corneal epithelial damage. However, contact imaging systems have been described where surgeons can perform the surgery alone without the need for frequent stabilization by assistants.[71] Commercially available lenses such as HRX Vit ™ (Volk Optical, Mentor, OH, USA) also come in an optional model of SSV-Self stabilizing vitrectomy version where dependence on an assistant is reduced.

The noncontact viewing systems provide a wide field of view (up to 130 degrees). They are ideal for peripheral vitreous shaving without the requirement of assistants to hold the lens. However, the resolution is less than the contact system. Moreover, these systems often require repeated focusing and centration during PPV and the cornea needs to be kept moist often, thus reducing the chances of corneal abrasions. A multicenter, comparative, retrospective study found no statistical difference in anatomical success in primary RRD surgery using either the wide-angle contact or noncontact systems.[72] Some examples of the noncontact systems include BIOM ® (OCULUS Surgical, Inc., Wetzlar, Germany), OFFISS ® (Oculus, Inc., Arlington, Washington, USA), RESIGHT ® (Carl Zeiss Meditec AG, Oberkochen, Germany), etc.

These are the latest upgrades in the viewing systems providing better surgeon ergonomics, with added digital overlays, and reduced phototoxicity. However, they require a longer learning curve. Head-up display, which replaces microscope with high-definition 3-dimensional (3D) monitor and polarized surgical glasses, may limit musculoskeletal pain and long-term disability from poor ergonomics[73] (e.g. Ngenuity ® (Alcon Laboratories, Inc., Fort Worth, Texas, USA), Artevo ® 800 (Carl Zeiss Meditec AG, Oberkochen, Germany).

Good visualization is key to safer surgery. High magnification helps in seeing fine details like the internal and external limiting membranes but narrows the field and reduces depth, requiring frequent refocusing. Low magnification works better for the periphery, while high magnification is ideal for macular surgeries. Lighting also needs balance—lower intensity for the macular surgeries to avoid phototoxicity, and higher intensity for PPV of dense vitreous hemorrhage or peripheral vitreous dissection. Chandelier lighting enables bimanual technique, which may be suitable for membrane dissection.

Consensus Statement 2.11: *Using intraoperative wide-angle viewing system should generally improve success rate of PPV for RRD. (Consensus score: 100 % [strongly agree: 70 %; agree: 30 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.12: *The using of contact or noncontact wide-angle viewing systems depends on surgeon's preference and should not affect surgical outcomes. (Consensus score: 95 % [strongly agree: 50 %; agree: 45 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.13: *Newer noncontact viewing systems offer advantage of large field of view without compromising on higher resolution needed for macular procedures. (Consensus score: 80 % [strongly agree: 20 %; agree: 60 %; neutral: 5 %; disagree: 10 %; strongly disagree: 5 %])*

Consensus Statement 2.14: *Heads-up 3D viewing systems are best suited for surgeons ergonomically, but do not improve surgical outcomes or success rate. (Consensus score: 85 % [strongly agree: 40 %; agree: 45 %; neutral: 15 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.15: *Optimal visualization during vitrectomy requires a balance of magnification and illumination. (Consensus score: 100 % [strongly agree: 60 %; agree: 40 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Intraoperative complications management

Iatrogenic breaks. Common situations or procedures in which iatrogenic breaks may occur are induction of PVD,[74,75] dealing with mobile retina,[76] traction of vitreous at sclerotomy sites,[77] and retinal touch in vitreomacular surface surgery.[78]

To reduce the risk of the breaks, vigorous induction of PVD should be avoided. Retinal tears can occur if, during the induction, the vitreous is stripped peripherally in a forceful rapid manner. Limiting instrument passes through sclerotomy ports and checking the periphery with scleral indentation at the end of surgery are recommended. After removing cannulas, gentle pressure on the sclerotomy sites may prevent vitreous incarceration. Retinal trauma can be minimized by choosing the right tools—forceps are often enough for epiretinal or PVR membrane peel, while diabetic tissue may need scissors or a cutter. As the retina has a curved surface, avoiding wide sweeping movements of instruments close to it and a tangential lift-and-peel motion are recommended instead.

Table 1
Options of gas tamponade agents.

Gas Tamponades	Molecular Weight (g/mol)	Maximal Expansion (Hours)	Duration	Non-Expansile Concentration	Expansivity (times)
Air	28.97	–	5–7 days	N/A	1x
Sulfur Hexafluoride (SF_6)	146.06	24–48	1–2 weeks	20 %	2x
Perfluoroethane (C_2F_6)	138.01	36–60	4–5 weeks	16 %	3x
Perfluoropropane (C_3F_8)	188.02	72–96	6–8 weeks	12–14 %	4x

More attention should be paid while surgery is performed in highly myopic eyes or those with staphyloma.

The first step in the management of iatrogenic retinal breaks is ensuring there is no residual traction in the area by vitreous or proliferative tissue. Endolaser retinopexy or cryopexy is then applied to surround the break. Endodiathermy may be necessary to control significant bleeding from iatrogenic breaks or the underlying choroid. Raising the vitrectomy infusion pressure momentarily can also be helpful. Tamponade is then applied if necessary. A shorter-acting gas or air may be adequate for small superior breaks. A longer-acting gas is required for larger and inferior breaks. SO tamponade may be required in situations of PVR and proliferative diabetic retinopathy if there is a likelihood of persistent residual traction or recurrence of traction.

Choroidal detachment or hemorrhage. Acute choroidal detachment during vitrectomy should be managed by raising infusion pressure, ensuring ports are sealed, and maintaining a closed system for 3–5 min. If limited and near case completion, surgery can cautiously continue with adequate tamponade. Extensive choroidal detachments (CDs) should halt surgery, pressurize the eye and seal ports. Postoperatively, monitor with B-scan—most mild CDs resolve spontaneously, while very large or persistent ones may require surgical drainage within days or weeks.

Immediate drainage of significant choroidal detachments can be considered in uncommon instances if conditions are favorable, e.g. the surgeon is experienced, the patient is well sedated and anesthetized, visualization is adequate, the sclera is accessible, etc.[79]

Management of acute CD during scleral buckling can be the following procedures. On visualization of CD, raise the intraocular pressure (IOP) by immediately applying digital pressure on the eye for 3–5 min. The IOP may be maintained with injection of intraocular gas. Surgery should not be proceeded if there is inadequate visualization or doubt about the extent of the CD. Immediate conversion to vitrectomy, providing a view to drainage of the CD and RD repair, may be considered if conditions are favorable.[80]

Choroidal hemorrhage (CH), which should be differentiated from CD by its darker appearance, is another distinct scenario. This complication is not common during PPV. The eyes with risk factors include those with high myopia, aphakia, or pseudophakia. CH associated with PPV is usually limited and has relatively good visual prognosis.[81]

Consensus Statement 2.16: *To prevent iatrogenic breaks, it is crucial to avoid vigorous induction of posterior vitreous detachment (PVD), using high cutter speeds near mobile retina, and minimizing instrument trauma. (Consensus score: 95 % [strongly agree: 70 %; agree: 25 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.17: *If acute choroidal detachment occurs during vitrectomy, infusion port should be checked first. surgery should not proceed. (Consensus score: 95 % [strongly agree: 70 %; agree: 25 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 2.18: *If acute choroidal detachment occurs during scleral buckle, immediate applying digital pressure on the eye for 3–5min is advisable. Immediate conversion to vitrectomy providing a view to drainage of the CD and retinal detachment repair may be considered if conditions are favorable. (Consensus score: 80 % [strongly agree: 20 %; agree: 60 %; neutral: 5 %; disagree: 15 %; strongly disagree: 0 %])*

Section 3. Tamponade agents

Intraocular tamponades have been used in the treatment of RD since its first application by Ohm in 1911. The high surface tension between intraocular tamponades and fluid enables the formation of an effective seal around a retinal break, thus allowing the RPE to absorb any remaining SRF to facilitate reattachment of the retina. Intraocular tamponades also prevent further fluid flow into the subretinal space, which maintains retinal break closure until chorioretinal adhesions created by retionopexy have matured to full strength.

Gases, SOs and heavy SOs are the major classes of intraocular tamponades. Ongoing debate persists regarding the selection of tamponade agents, as well as the removal timing if oil is used. Below, we outline the common intraocular tamponade agents and consolidate the current evidence surrounding these controversies.

General consideration and gas tamponades

Sulfur hexafluoride (SF6) and perfluoropropane (C3F8) are the most used intraocular gases in clinical practice. Hexafluoroethane (C2F6) is less frequently used, as it is not approved by the US Food and Drug Administration. These gas tamponade agents are colorless, odorless, inert, and nontoxic, with high surface tension and low specific gravity, allowing them to maintain a tamponade effect within the eye.

Gas tamponades could be used in their pure forms or as a mixture with air. Mixing the pure form with air in different proportions can adjust the expansible property of the gas. Pure SF6, C2F6, and C3F8 expand at least twice their initial volume inside the eye (Table 1**).** Non- or minimally-expansile gas mixtures are preferred in clinical practice to reduce risks such as IOP elevation—commonly 20 % SF6, 16 % C2F6, and 12–14 % C3F8. The duration of gas tamponade depends on solubility: longer carbon chains dissolve slower, giving SF6 ~1–2 weeks, C2F6 ~4–5 weeks, and C3F8 ~6–8 weeks. Gas works through two main principles: surface tension, which keeps the bubble intact to seal retinal breaks, and buoyancy, which allows the bubble to float and appose the retina to the RPE. The tamponade effect can be optimized by adjusting the patient's head posture, as the buoyant force is greatest at the apex of the bubble. Recent studies also explored pure air as an intraocular gas tamponade for RD.[82,83] A recent meta-analysis of ten studies involving 2677 eyes showed that air has a good tamponade efficacy and can achieve a similar primary anatomical success rate when compared to conventional gas tamponades in primary RRD.[84] Nevertheless, Tan et al. found air tamponade inferior to gas tamponade in RRD cases with lower quadrant involvement.[85] To date, the effectiveness of air tamponade for primary non-complicated RRD remains controversial.

Overall, there is a paucity of evidence in the literature comparing C3F8 or SF6 tamponade.[86] Schöneberger et al. reported a similar primary surgical success rate of about 91 % for both long-acting gas tamponades (C3F8 or C2F6) and short-acting gas tamponade (SF6) in surgical treatment of RD not complicated by PVR or high myopia.[87] However, another study found a higher anatomic reattachment rate with C3F8 tamponade compared to SF6 in highly myopic patients with RD secondary to macular hole.[88] Postoperative visual requirements are another consideration when selecting tamponade agents, especially for patients with only one functioning eye. Since the resorption time for SF6 is considerably shorter than that of long-acting gas tamponades, it offers the clear advantage of faster visual recovery after surgery. Additionally, studies have shown that SF6 results in a lower incidence of gas-related postoperative complications, such as cataract formation and increases in intraocular pressure, compared to C3F8.[89]

Consensus Statement 3.1: *The effectiveness of air tamponade for primary RRD remains controversial, as its shorter half-life may be inadequate for inferior or complex retinal breaks compared to conventional gas tamponades. (Consensus score: 95 % [strongly agree: 55 %; agree: 40 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Silicone oil tamponades

SO is used as an intraocular tamponade because of its transparency, chemical inertness, high surface tension, and strong interfacial tension with water. This interfacial tension restricts fluid movement in the vitreous cavity and prevents subretinal migration through retinal breaks. The oil also exerts tamponade against residual vitreous, sealing retinal breaks and promoting adhesion after retinopexy.

Ophthalmic silicone oils are synthetic polydimethylsiloxanes (PDMS) with varying chain lengths. They float in the vitreous due to a lower specific gravity (0.97 g/ml) than vitreous (1.005–1.008 g/ml). Common viscosities are 1000 and 5000 centistokes (cSt). Viscosity affects both handling and emulsification: lower-viscosity oils (1000 cSt) are easier and faster to inject or remove, while higher-viscosity oils (5000 cSt) resist emulsification but require more effort for manipulation.

The recent trend towards small gauge vitrectomy has led some centers to revert to use of low viscosity oils for ease of delivery and removal through narrow gauge cannulas.[90] On the other hand, viscosity also determines the emulsification rate. Emulsification susceptibility increases with lower viscosity or a higher proportion of low-molecular-weight constituents.

There is conflicting evidence on whether 5000 cSt SO offers significant advantages over 1000 cSt in complex RD.[91–93] In practice, higher viscosity silicone oil may be preferable in complex cases, particularly when the retinal blood barrier is compromised and there is increased risk of emulsification.[91,92] High viscosity oil is also recommended to reduce the risk of emulsification when permanent silicone tamponade is desired.[94]

Controversies on gas vs. silicone oil selection

Choosing between gas and SO tamponade depends on the required tamponade duration, RD etiology, surgeon preference, patient's visual needs, ability to posture, and risks of future oil removal. SO is generally preferred when a longer tamponade is needed. The most common indication for using SO in cases of RRD is the presence of established PVR or a high risk of developing PVR, such as giant tears, signs of uveitis or preoperative choroidal detachment.[95–97] The use of SO is also advocated for tractional RD associated with severe proliferative diabetic retinopathy,[98,99] RRD where effective retinopexy is not feasible (e.g. macular hole RRD),[96,100] RRD with extensive posterior breaks, or in cases of viral retinitis.[101]

However, the role of SO in complex RD remains a subject of debate. The Silicone Study was a prospective multicenter randomized clinical trial that compared 1000 cSt SO to long-acting intraocular gases (20 % SF6 or 14 % C3F8) in patients with complex RD associated with PVR.[102,103] The study found significantly better anatomical and visual outcomes with SO compared to SF6 after one year. However, no significant differences in outcomes were observed between SO and C3F8. Among the subjects who maintained macular attachment at 36 months, there were no significant differences in anatomical or visual outcomes among the SO, SF6, and C3F8 groups after a follow-up period of up to six years.[104] Similar findings were also reported in the European Vitreo-Retinal Society (EVRS) Retinal Detachment Study, which showed similar rates of inoperable failed reattachment between gas and silicone tamponade in complex RD with PVR.[14] A recent meta-analysis comparing SO and gas tamponade in uncomplicated RRD also found no significant difference in primary retinal reattachment rates between the two tamponade agents,[86] although gas tamponade was associated with better final visual acuity and SO was linked to a greater thinning of certain retinal layers.[86] In contrast, other smaller studies demonstrated a benefit of SO over gas or vice versa for certain groups of patients, such as recurrent RD associated with PVR[105] and macular hole RD in high myopic eyes.[106]

Other patients factor that should be considered include the compliance to head posturing and the need for air travel. SO may be a better choice for patients who have difficulty maintaining a prescribed head position or who need to travel by air or to high altitudes.

Controversies on timing of oil removal

Conventional recommendations suggest removal of SO after 3–6 months to balance anatomical benefits and complication risks.[96,107,108] This recommendation is supported by observations that the rate of redetachment is independent of the duration of SO tamponade, provided that there was at least 3 months of tamponade.[45] In practice, the optimal timing of oil removal varies widely among surgeons and between individual cases, depending on the retinal condition being treated, the stability of the retina, risk of redetachment, and any complications arising from the oil tamponade. Additionally, patient preference and service availability may also be taken into consideration.

One major concern following oil removal is retinal redetachment, which is most likely to occur within the first 3 months after the procedure.[109] The recurrence rate of RRD varies widely from 0 % to 35.5 % in the literature, with majority of studies reporting rates between 8 %–12 %.[107,109–111] Substantial evidence suggests that the duration of oil tamponade does not significantly affect the final anatomical success in complex RD surgeries.[44,45,110,112] Nonetheless, a slightly higher rate of retinal redetachment has been observed when the tamponade duration is less than three months.[113] Prophylactic 360-degree laser retinopexy, either performed at the time of SO removal or as a separate procedure prior to the removal, has been shown to reduce the risk of retinal redetachment[114–116] whereas this protective effect was not shown in a retrospective case series.[117]

The risk of redetachment should be balanced against the potential complications associated with long-term oil tamponade. Notable complications such as keratopathy,[118] inner retinal toxicity,[119] cataract formation,[120] or glaucoma[121] have been reported with the use of SO and its emulsification. The issue of SO-related visual loss (SORVL) also raised significant concerns in recent years.[122] The clinical features of SORVL vary including a reduction in inner retinal thickness,[62] visual field defect,[123] and abnormal electrophysiological response.[124] Further studies are needed to evaluate the risk and understand the underlying mechanism of SORVL.

Consensus Statement 3.2: *The selection between gas tamponades and silicone oil for RRD repair is contentious, particularly in cases of complex RRD or PVR, with variable outcomes based on tamponade duration and patient-specific factors. (Consensus score: 95 % [strongly agree: 50 %; agree: 45 %; neutral: 0 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 3.3: *The impact of prolonged silicone oil tamponade on visual outcomes and complications, such as silicone oil-related visual loss (SORVL), remains poorly understood and controversial, with no consensus on the underlying mechanisms. (Consensus score: 85 % [strongly agree: 35 %; agree: 50 %; neutral: 15 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 3.4: *The optimal timing for silicone oil removal remains controversial, with recommendations varying from 3 to 6 months to longer durations depending on the individual risk of complications like emulsification and retinal redetachment. (Consensus score: 95 % [strongly agree: 60 %; agree: 35 %; neutral: 0 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 3.5: *Whether prophylactic 360-degree laser retinopexy reduces redetachment risks after oil removal is debated, with some studies suggesting benefits while others report no significant impact on outcomes. (Consensus score: 90 % [strongly agree: 40 %; agree: 50 %; neutral: 10 %; disagree: 0 %; strongly disagree: 0 %])*

Table 2
Options of oil tamponade agents.

Oil Tamponades	Composition(s)	Viscosity (cSt)	Specific Gravity (g/cm^3)	Interfacial Tension (mN/m)	Refractive Index
1000 cSt SO	100 % PDMS	1000	0.97	35	1.4
5000 cSt SO	100 % PDMS	5000	0.97	35	1.4
Densiron 68	69.5 % 5000 cSt PDMS + 30.5 % F6H8	1400	1.06	41	1.4
Oxane HD	88.1 % 5700 cSt Oxane + 11.9 % RMN−3	3300	1.02	45	1.4
HWS46–3000	55 % F4H6 + 45 % 100000 cSt SO	3109	1.105	39.87	1.366

cSt, centistoke; SO, silicone oil; RMN-3, a partially fluorinated olefin; PDMS, polydimethylsiloxane.

Heavy silicone oil

Inferior retinal detachments (IRDs), especially with breaks between 4 and 8 o'clock or associated PVR, are challenging because standard SO and gas are lighter than water and provide limited inferior support without strict prone positioning. Heavy SOs (HSOs), like Densiron-68—a mixture of 69.5 % PDMS and 30.5 % perfluorohexyloctane (F6H8) with a specific gravity of 1.06 g/cm^3 —offer direct tamponade for the inferior retina, overcoming these limitations (Table 2**)**.

Outcomes and complications

Densiron achieves high anatomical success rates in IRDs, particularly in cases complicated by severe PVR. For instance, a 2024 multicenter study reported an 87.6 % anatomical success rate using Densiron for primary RD with inferior pathology and severe PVR, showing superior results compared to conventional SO group.[125] Similarly, Liu et al. reported a 90.5 % reattachment rate in Chinese eyes with complex RDs treated with Densiron.[126] PVR occurs when retinal cells are exposed to inflammatory cytokines and growth factors in the vitreous humor. HSOs may theoretically displace this "PVR soup" away from the inferior retina, potentially reducing PVR formation.

However, some studies have reported no significant difference between Densiron and SO in primary anatomical success. A large retrospective study in 2022 involving 259 primary RDs found similar redetachment rates for Densiron and SO (10.1 % vs. 10 %, respectively) at six months.[127] Additionally, no significant differences were observed in subsequent glaucoma surgeries, visual outcomes, or PVR-C development between the two groups. These findings suggest that the advantage of Densiron may be case-specific, particularly in complex RDs with inferior breaks or severe PVR.

Recurrent retinal detachments after tamponade removal

Both Densiron and conventional SO face challenges with recurrent detachments after removal. Studies reported redetachment rates ranging from 6 to 50 % following Densiron removal, with most recurrences occurring in the upper retina and within one month of removal.[128,129] Inferior recurrences, however, tend to occur during tamponade, raising concerns about whether HSOs fully prevent PVR progression or merely delay recurrence. It is important to note that Densiron is generally reserved for cases with high PVR risk, especially those with inferior breaks, large detachments, and PVR grade C complications. A large multicenter cohort study by Tzoumas et al., involving 1061 eyes, showed that Densiron resulted in higher anatomical success rates and improved visual outcomes in these challenging cases.[125]

Choices of heavy silicone oil

Visual outcomes are comparable between Densiron and Oxane HD, as demonstrated by pooled meta-analyses and the HSO study.[130] Densiron may have a higher complication rate, with potential issues including emulsification, glaucoma, intraocular inflammation, cataract formation, and intraretinal or subretinal fibrosis, which often occur in a time-dependent manner.[131–135] Transient macular thinning has also been observed with Densiron, though recovery occurs after its removal.[136]

The newer generation of HSOs, such as DensironXTRA, offers improvements over Densiron 68. With a lower viscosity (1200 cSt), DensironXTRA is easier to inject using 25 G systems and demonstrates a lower emulsification rate.[137,138] A study of 202 eyes comparing DensironXTRA with gas tamponade revealed low complication rates and no significant differences in outcomes between the two groups, though the study emphasized that DensironXTRA was predominantly used for cases with inferior breaks.[139]

Consensus Statement 3.6: *There is ongoing debate over whether 5000 cSt silicone oil provides significant general advantages over 1000 cSt, with studies showing conflicting outcomes regarding anatomical success, emulsification rates, and ease of removal. (Consensus score: 95 % [strongly agree: 25 %; agree: 70 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 3.7: *The preference of heavy silicone oil, such as Densiron-68, over standard silicone oil for complicated cases, such as inferior detachment, large detachment, and PVR Garde C or more, is debated, with studies highlighting case-specific benefits for Densiron but concerns about its higher rate of complications, such as emulsification, inflammation, fibrosis, or macular thinning. (Consensus score: 100 % [strongly agree: 30 %; agree: 70 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 3.8: *The recommended duration of Densiron tamponade is 70–140 days, which is shorter than standard silicone oil, due to its complication risks, though prolonged use up to 26 months may be necessary in select complex cases. (Consensus score: 85 % [strongly agree: 15 %; agree: 70 %; neutral: 15 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 3.9: *Heavy silicone oil should be removed sooner than conventional silicone oil. (Consensus score: 75 % [strongly agree: 35 %; agree: 40 %; neutral: 25 %; disagree: 0 %; strongly disagree: 0 %])*

Section 4. Endolaser and cryotherapy

Retinopexy, using either cryotherapy or laser photocoagulation, is a critical step in RRD surgery to create chorioretinal adhesion at the edge of retinal breaks to effectively seal the defects to prevent SRF accumulation.

Cryopexy

Cryopexy induces chorioretinal adhesion by applying extreme cold through a trans-scleral probe, causing localized necrosis and scarring at break margins. As an extraocular procedure, it complements scleral buckle surgery. In vitrectomy, cryopexy is useful for anterior or sclerotomy-adjacent breaks that cannot be reached with a laser, though access to posterior breaks can be limited. Other drawbacks may include slower formation of chorioretinal adhesion compared to laser retinopexy, and a higher risk of inducing postoperative inflammation or PVR, especially with excessive applications.[140,141]

Some surgeons perform scleral buckling for RRD without retinopexy. The retina can be reattached if the buckle is placed properly and precisely to support retinal breaks releasing all the vitreoretinal traction. A recent systematic review and meta-analysis included seven randomized controlled trials involving 1103 patients found that treating RRD using SB with or without cryoretinopexy provided similar success rate with comparable postoperative visual acuity and complications. Laser retinopexy may be performed to the retinal breaks without cryoretinopexy later. However, the same systematic review and meta-analysis found there was comparable surgical success rate between the group with laser retinopexy and without laser retinopexy.[142]

Laser retinopexy

Laser retinopexy seals retinal breaks by creating chorioretinal adhesion through thermal photocoagulation, typically applied in 3–5 concentric rows until white burns are seen. In vitrectomy, endolaser delivers energy directly inside the eye, while external laser (contact or noncontact) is used after PR or SB. Compared with cryopexy, laser causes less inflammation, less collateral retinal damage, and lower PVR risk, though the choice between the two techniques remains debated. A recent observational study reported no statistically significant difference in surgical success rates between using cryotherapy (87 %) or laser photocoagulation (82 %) for RRD surgery at 3 months after vitrectomy.[143] Another randomized controlled study compared the effects of cryotherapy and laser retinopexy on visual recovery. The results showed that cryotherapy was associated with significantly higher postoperative aqueous flare and slower visual recovery, although final visual acuity at 10 weeks was similar between the two groups.[144]

Laser retinopexy may be applied to asymptomatic retinal breaks in the fellow eyes of RRD. It is generally accepted to treat all the retinal breaks, including both retinal tears and holes, without any symptoms in the fellow eyes of RRD. For the first eyes presented with retinal breaks without RRD, it is generally accepted to treat only symptomatic retinal tears in these eyes.

Consensus Statement 4.1: *Cryoretinopexy is usually recommended* as a routine *for treating retinal breaks in SB for RRD. (Consensus score: 100 % [strongly agree: 37.5 %; agree: 62.5 %; neutral: %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 4.2: *In SB for RRD, alternative to cryoretinopexy, laser photocoagulation can be used to treat retinal breaks postoperatively or, if necessary, prior to buckle removal. (Consensus score: 85 % [strongly agree: 35 %; agree: 50 %; neutral: 10 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 4.3: *The most concern adverse event of cryoretinopexy is the higher risk of PVR due to RPE pigment dispersion after the procedure. (Consensus score: 95 % [strongly agree: 45 %; agree: 50 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 4.4: *Symptomatic horseshoe retinal tears in eyes without retinal detachment should almost always be treated with laser photocoagulation. (Consensus score: 100 % [strongly agree: 65 %; agree: 35 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 4.5: *All retinal breaks, e.g. retinal holes, retinal tears without symptoms, in the fellow eyes of RRD should be treated with laser photocoagulation. (Consensus score: 95 % [strongly agree: 50 %; agree: 45 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Section 5. Special situations

Giant retinal tear

Selection of surgical approach. In majority of situations, vitrectomy is the surgery of choice in GRT-associated RD.[145] However, in few select situations, scleral buckling can be attempted – superior GRT's with no or shallow detachment where scleral buckling is combined with pneumoretinopexy, GRT's without rolled edges, around 90 degrees in extent and GRT not freely moving with eye movements. Both PPV and PPV+SB achieve comparable success rates in terms of anatomical and visual outcomes for GRT repair in adults, whereas PPV+SB may provide better outcomes than PPV in children.[146]

Consensus statement 5.1: *Vitrectomy is the preferred surgical approach in the management of Giant retinal tear related retinal detachment. (Consensus score: 100 % [strongly agree: 80 %; agree: 20 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Bimanual vs. single-handed technique. With the latest advancements in vitrectomy kinetics, instrumentation and understanding the pathophysiology of GRT-related detachment, majority of times – 3 port PPV is sufficient in management of GRT-related RD. In chronically detached retina with rolled retinal edges or PVR, second instrument such as soft tip cannula may be needed to unfold stiff or curled edges. Intravitreal forceps can be used to rip the membranes and in some cases with anterior hyaloid proliferation, scissors dissection may be needed. A bimanual double aspiration technique can help prevent retinal flap slippage, especially when the tear is more than 180 degrees.[147]

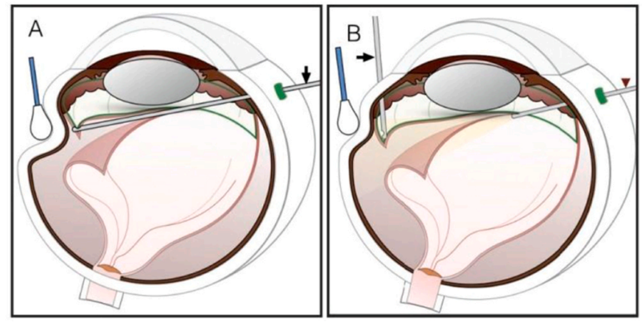

Fig. 1. A, A careful scleral depression by the surgeon himself using cotton tipped applicator, will allow removal of the anterior flap. Cutter is indicated by black arrow. **B,** Vitrectomy cutter (black arrow) is used to access the vitreous base on the same side to prevent iatrogenic lens damage. *(Fig. 1 is contributed by MS and SS, original authors.)*.

Consensus Statement 5.2: *In fresh GRT-retinal detachment, 3 port pars plana vitrectomy is most of the time sufficient, while in chronic cases and in cases with PVR, bimanual techniques offer better surgical control. (Consensus score: 75 % [strongly agree: 12.5 %; agree: 62.5 %; neutral: 12.5 %; disagree: 12.5 %; strongly disagree: 0 %])*

Lens removal. Lens management should be individualized, taking into account the tear location, lens clarity, patient age, and choice of tamponade. In younger patients with tears located posterior to the equator, lens preservation is usually preferred to avoid early cataract formation. With wide-angle viewing systems and careful scleral depression, adequate peripheral dissection can often be achieved without lensectomy. A cotton-tipped applicator may be used for controlled depression, allowing the vitrector to access the anterior flap on the same side while minimizing the risk of lens trauma.

When tears extend anteriorly, or when lens opacity compromises visualization, a combined phaco-vitrectomy is recommended, as it facilitates better access to the vitreous base and manipulation of anterior flaps. In pseudophakic eyes, an intraoperative surgical posterior capsulotomy may be necessary if posterior capsular opacification is present, and a decentered intraocular lens may require repositioning or explantation. In aphakic eyes, secondary intraocular lens implantation is

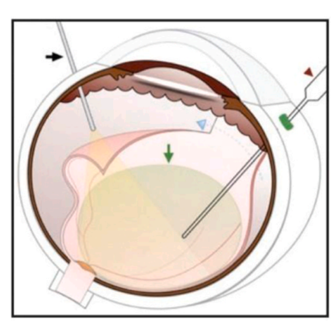

Fig. 2. The eyeball is rolled away from the GRT during injection of the PFCL (black arrow). This will flatten the retina away from the GRT and push subretinal fluid toward the GRT (blue dashed arrow) *(Fig. 2 is contributed by MS and SS, original authors.)* GRT indicates giant retinal tears; PFCL, perfluorocarbon liquid.

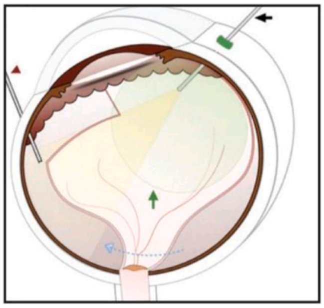

Fig. 3. In small GRT, the eye is rolled towards the GRT thereby allowing the air (black arrow) to float up to the quadrant opposite the GRT, thus pushing the fluid towards the GRT (blue dashed arrow) and simultaneous aspiration of SRF with flute needle (red arrowhead). *(Fig. 3 is contributed by MS and SS, original authors.)* GRT indicates giant retinal tears; SRF, subretinal fluid.

typically deferred until after retinal reattachment is achieved.

Consensus statement 5.3: *Lens preservation is preferred in younger patients with posterior retinal tears, but lens removal has to be considered when there is an anterior extension or lens opacity limits safe peripheral access. (Consensus score: 100 % [strongly agree: 25 %; agree: 75 %; neutral: 0 %; disagree: 0 %; strongly disagree:: 0 %])*

Retinal positioning strategies. Intraoperative positioning plays a crucial role in successful outcomes. Rolling the eye away from the GRT during PFCL injection flattens the retina away from the tear and directs SRF toward the break, thereby preventing fluid entrapment (Fig. 1). Conversely, during fluid–air exchange, rolling the eye toward the GRT allows air to displace fluid toward the break (Fig. 2). Postoperatively, prone positioning can help flatten minor circumferential folds caused by retinal slippage (Fig. 3).

Consensus statement 5.4: *Appropriate intraoperative positioning of eye is crucial for successful outcomes. (Consensus score: 84.21 % [strongly agree: 47.37 %; agree: 36.84 %; neutral: 15.79 %; disagree: 0 %; strongly disagree: 0 %])*

Unfolding techniques. Several techniques exist for unfolding GRT. PFCL-assisted unfolding is most common, often aided by intraoperative eye rotation. Chronic detachments with stiff edges or PVR may require bimanual soft-tip cannula manipulation, edge cauterization to remove immature membranes, or relaxing retinectomy for persistent folds. Mild folds may resolve with strict prone positioning.

Once unfolded, preventing retinal slippage is crucial. A stable PFCL bubble must be maintained during retinopexy, and during SO/air exchange, trapped fluid is drained using a flute needle positioned at the periphery near the GRT edge. Rotating the eye toward the tear and keeping the GRT edge dependent ensures complete PFCL removal and minimizes slippage. Wide-angle visualization facilitates safe fluid management throughout the exchange.

Fluid air / Fluid oil exchange. In direct PFCL–SO exchange, SO is infused via the infusion cannula, but this method has drawbacks due to high resistance in the tubing, which can increase pressure and cause disconnection. The lubricating nature of oil makes reattachment difficult, and improper cleaning can lead to oil contamination in future cases, causing floaters. However, there are fewer chances of slippage of retinal flap in this method.[148] An alternative is PFCL–air exchange followed by air–SO injection, which avoids using the infusion cannula for oil and instead delivers oil through a superior cannula directly into the vitreous cavity, minimizing these issues.

Consensus statement 5.5: *While direct PFCL–silicone oil exchange may reduce retinal flap slippage, PFCL–air exchange followed by air–silicone oil injection is generally preferred due to lower procedure related complication. (Consensus score: 80 % [strongly agree: 15 %; agree: 65 %; neutral: 15 %; disagree: 5 %; strongly disagree: 0 %])*

PFCL vs silicone oil primary tamponade. SO is the tamponade of choice in the majority of GRT cases due to its stability and ease of use. However, in patients at risk of inferior PVR or those unable to maintain prone positioning, heavy tamponades such as Densiron, or even PFCL, may be considered.[6] In particularly complex detachments with extensive PVR and intrinsic retinal contraction, PFCL may be used as a temporary tamponade for one to two weeks before being replaced with SO.[5] For smaller superior GRTs, gas tamponades can be attempted, or as a combination of scleral buckling and pneumoretinopexy.

Consensus statement 5.6: *Silicone oil is the tamponade of choice in majority of cases, with selected use of other agents such as Densiron, or gas for postoperative tamponade, or PFCL for intraoperative assistance. (Consensus score: 62.5 % [strongly agree: 12.5 %; agree: 50 %; neutral: 12.5 %; disagree: 25 %; strongly disagree: 0 %])*

Retinal orientation assessment post-surgery. Correct retinal orientation ensures correct alignment of retinal photoreceptors with RPE, enabling good post-operative vision free of distortion.[149] It also ensures avoiding retinal slippage and development of retinal folds. Normal orientation is characterized by continuity of retinal vessels in their natural arcades, a flush flap edge, absence of folds under air or oil, and restoration of the central foveal dip on OCT imaging.

Consensus statement 5.7: *Maintaining correct retinal orientation is essential to prevent slippage and folds and ensure optimal visual and anatomical outcomes postoperatively. (Consensus score: 94.74 % [strongly agree: 42.11 %; agree: 52.63 %; neutral: 5.26 %; disagree: 0 %; strongly disagree: 0 %])*

Management of retinal incarceration. In GRT cases, the highly mobile retina increases the risk of prolapse or incarceration into sclerotomy ports, especially during trocar insertion in hypotonous eyes or when the flap is not stabilized with PFCL amid IOP fluctuations. Early recognition is vital–suspect incarceration if unexplained resistance occurs during instrument withdrawal. Management involves stopping infusion, reforming the globe with PFCL or balanced salt solution, and gently releasing the retina with a soft-tip cannula or microforceps. If release is not possible, a relaxing retinectomy with endolaser and long-acting SO tamponade may be necessary to prevent redetachment.

Consensus statement 5.8: *Early detection and prompt management of retinal incarceration are key to preventing redetachment and ensuring stability and improve success rate in repair of RRD from GRT. (Consensus score: 94.73 % [strongly agree: 21.05 %; agree: 73.68 %; neutral: 5.26 %; disagree: 0 %; strongly disagree:: 0 %])*

Inferior retinal detachment

The management of IRD poses a significant challenge for vitreoretinal specialists due to a lack of consensus on the most effective surgical approach. The guarded prognosis and higher rates of redetachment are largely attributed to the physical properties of conventional tamponade agents like gas and light SO (LSO). These agents, having a specific gravity lower than water, float superiorly, making it difficult to effectively tamponade inferior retinal breaks.[150,151] This necessitates strict and prolonged face-down postoperative positioning (FDP) to ensure break closure. However, FDP is often poorly tolerated by patients thus contributing to surgical failure. Inadequate positioning can also increase the risk of PVR as inflammatory factors accumulate in the inferior quadrants.[152]

Laser photocoagulation. Laser photocoagulation can be an effective treatment for specific types of IRD. For localized, macula-on, and chronic or asymptomatic cases, demarcation laser barricade may be sufficient as a primary treatment. This method is effective due to the relatively slow progression of such detachments. However, laser alone is

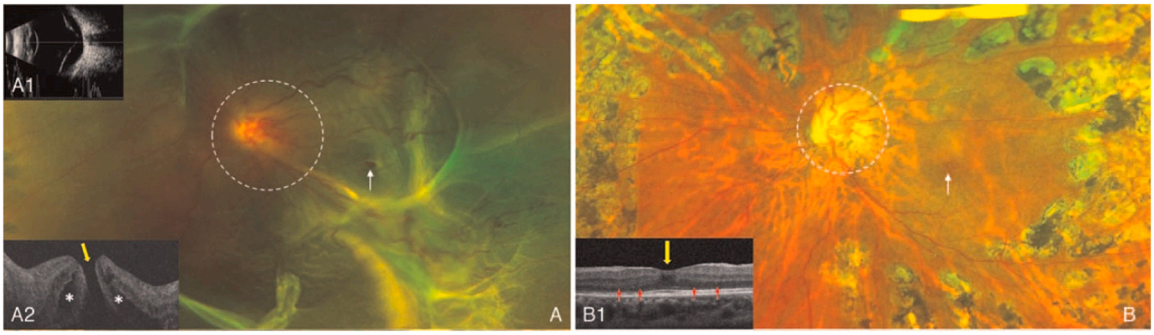

Fig. 4. Young lady chronic retinal detachment (RD) case, (A) showing macular hole (MH) (white arrow) with chronic RD, preretinal fibrosis and yellow subretinal gliosis. The preoperative A-B ultrasonic scan (A1) shows a funnel-shaped retinal detachment. The preoperative optical coherence tomography (OCT) scan (A2) shows a full-thickness MH (yellow arrow) with intraretinal edema (asterisk). Postoperative fundus photo (B) showing a closed MH (White arrow) and a well-ablated attached retina. Postoperative OCT scan (B1) shows near-normal external retinal layers (red arrows). The respective white dotted circles in the preoperative and postoperative fundus photos (A and B) show vascular anomalies over the disc, confirming that the two fundus photos are from the same eye. The final best-corrected visual acuity was 20/25. *(Adapted from*[159] CC-BY-NC-ND).

generally not indicated when the macula is already detached.[152,153]

Scleral buckle (SB) alone. Historically, scleral buckling was the primary surgical option for RRD and can be effective for IRD as it avoids the postoperative positioning challenges of internal tamponades.[154] A systematic review by Bonnar et al. found a very low number of cases where SB alone was used, making it difficult to analyze its outcomes.[151] Despite limited data, some surgeons still advocate for SB in specific scenarios, particularly in younger patients without media opacities or significant PVR.[151]

PPV alone. The current trend favors PPV-based surgery for most RRDs. PPV alone for IRDs can yield good results, but it faces the same challenge as other internal tamponades: the buoyancy of gas and LSO. A critical step in PPV for IRD is meticulous peripheral vitreous shaving under scleral indentation to remove all residual vitreous cortex. Remaining vitreous can cause traction and lead to surgical failure and PVR.[155] Triamcinolone can be used to stain the vitreous for better visualization. In phakic eyes, lens removal may be necessary to ensure complete vitreous clearance.

Combined PPV and SB. Combining PPV with a SB provides external support to the vitreous base, which is particularly beneficial for patients at high risk for PVR or those with diffuse retinal pathology.[155] The PRO Study found a significantly higher single-surgery success rate with this combined approach (87.4 %) compared to PPV alone (76.8 %).[16] Additional details have already been discussed earlier in the manuscript.

Combined PPV and gas/air tamponade. Recent studies seem to suggest that using long-acting gas or air tamponade in PPV for uncomplicated IRDs offers a viable, patient-friendly alternative to SO, Densiron or short-term retention of PFCL all of which necessitate a second procedure of removal. Singh et al. reported that air tamponade, when combined with proper SRF drainage, facilitates retinal reattachment without the need for strict postoperative positioning, a significant benefit that improves patient comfort and simplifies postoperative care.[156]

This is further supported by Uemura et al., who found that air tamponade provides surgical outcomes equivalent to SF6 gas in managing

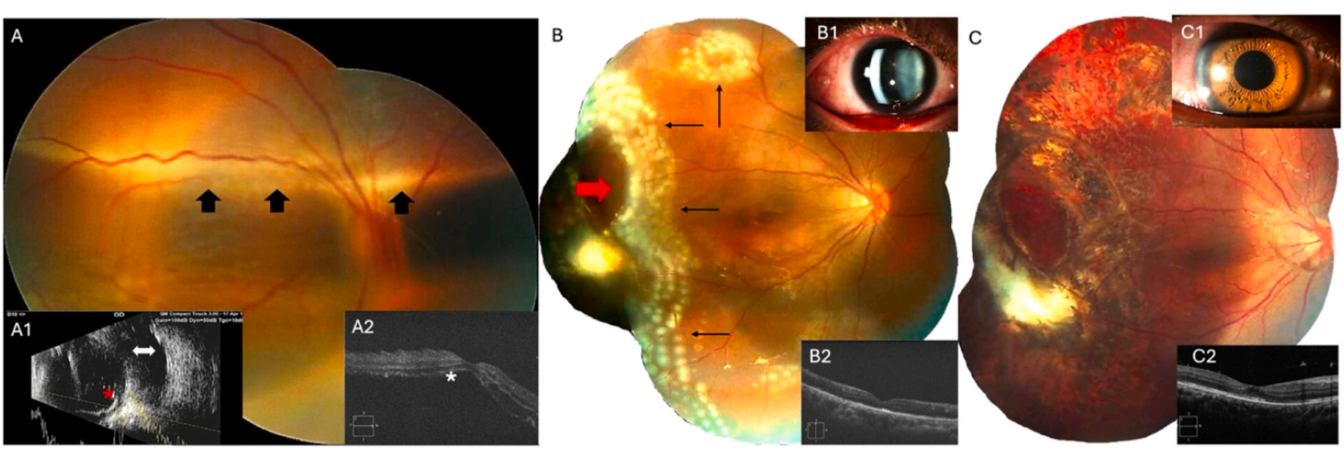

Fig. 5. Case of pediatric recurrent chronic retinal detachment (RD); status post-primary surgery 1 month back elsewhere with silicone oil underfill. Best-corrected visual acuity (BCVA): PL + PR accurate (A) color montage of recurrent macula off total RD with oil meniscus (solid black arrows) showing oil underfill. A1, Corresponding B-scan ultrasonography showing partial oil fill related apparent elongation of globe and globe within globe artefact (bidirectional solid white arrow). Thickened second membrane (solid red asterisk) clearly seen on vector scan, suggesting RD with proliferative vitreoretinopathy. A2, Optical coherence tomography (OCT) scan showing macula off RD. Note subfoveal subretinal fluid (white asterisk). B, Postoperative day 1 color montage with oil in situ and well-attached retina. Note fresh photocoagulation oedema (black arrows) and flat RR edge with bare choroid temporally (solid red arrow pointing toward RR edge and sitting on bare choroid). B1, 1-month follow-up OCT macula shows well-attached retina. B2, 4-month follow-up: nuclear sclerosis noted on slit-lamp examination. C, Post-phacoemulsification + intraocular lens implantation + silicone oil removal 3-month follow-up. Colour montage showing well-attached retina and attached macula. C1, Clear cornea and dark pupil due to pseudophakia. C2, Normal macular contour with restored outer retinal layers. BCVA was 20/20. *(Fig. 5 is contributed by DSCL, original author.)*.

RRD with inferior breaks, often without the need for additional procedures like scleral buckling.[157] Their findings reinforce that air tamponade, under precise surgical conditions, can achieve excellent anatomical success. Moreover, Zhou et al. documented that air provides an equivalent tamponade effect with a significantly shorter postoperative prone positioning period and fewer complications.[83] They also highlighted the favorable economic implications of using air, making it a cost-effective option for managing uncomplicated inferior breaks.

However, the choice of tamponade agent remains a subject of debate. Tetsumoto et al. noted the perception that while air is effective, long-acting gases like SF6 are generally considered superior for ensuring adequate reattachment in cases with more complex retinal geometries.[82] Despite this, Duvdevan et al. reinforce that anatomical and functional success rates are comparable between inferior and superior RRDs when using SF6, suggesting that air is a strong and effective alternative in the right context.[158]

In summary, gas or air tamponade is a compelling alternative for uncomplicated inferior RRDs, offering comparable success rates and significant benefits regarding patient comfort, compliance, and cost.

Postoperative positioning. Traditionally, FDP has been a standard practice following PPV with gas or LSO tamponade to ensure the tamponade agent occludes the retinal breaks. For IRDs, this position is crucial but often poorly tolerated, adding physical and psychological stress to patients.

An alternative, face-up positioning (FUP), has been proposed for SO injection, with one small study reporting a 94 % success rate.[155] The rationale is that FUP allows the oil to float anteriorly, securing all peripheral breaks. However, there is limited evidence comparing FUP to the traditional FDP approach. Regardless of the specific position, maintaining some form of postoperative head positioning remains a critical factor for surgical success.

Consensus Statement 5.9: *Surgery for Inferior RRD, in general, may have lower postoperative re-attachment rate, compared to RRD due to retinal breaks somewhere else. (Consensus score: 84.21 % [strongly agree: 5.26 %; agree: 78.95 %; neutral: 10.53 %; disagree: %; strongly disagree: 5.26 %])*

Consensus Statement 5.10: *PPV and meticulous vitreous base excision, judiciously combined with phacoemulsification achieves similar re-attachment rates as SB for repair of inferior RRD. (Consensus score: 87.5 % [strongly agree: 37.5 %; agree: 50 %; neutral: 12.5 %; disagree: 0 %; strongly disagree:: 0 %])*

Consensus Statement 5.11: *Optimal volume of tamponade agent with compliance to face down positioning is essential for the success of PPV for inferior RRD. (Consensus score: 100 % [strongly agree: 62.5 %; agree: 37.5 %; neutral: 0 %; disagree: 0 %; strongly disagree:: 0 %])*

Consensus Statement 5.12: *In uncomplicated inferior break RD, PPV with gas endotamponade achieves comparable success with silicone oil. For complex RD with inferior breaks, the tamponade of choice is silicone oil. (Consensus score: 87.5 % [strongly agree: 37.5 %; agree: 50 %; neutral: 12.5 %; disagree: 0 %; strongly disagree:: 0 %])*

Special cases – even chronic macula-off RD may have good visual outcome in young patients

Figs. 4 and 5 show two cases demonstrating very good visual outcomes that could be achieved in chronic macula-off RD.

The above two cases highlight the visual potential in young patients. Very good visual outcome could still be achieved even in chronic macula-off RD. Early and timely intervention for RD cases are important.

Section 6. Anesthesia and positioning

Anesthesia for vitrectomy

Various factors influence the choice of anesthesia for a vitrectomy procedure – patient's age and systemic condition, Complexity of procedure, ocular condition and surgeon preference.

Types of anesthesia

Regional anesthesia is widely used in vitrectomy as it offers flexibility, particularly in high-risk patients with severe cardiac disease or multiple comorbidities. It provides faster recovery, fewer systemic side effects, and is generally cost-effective. However, it requires patient cooperation and may not be suitable for prolonged or complex surgical procedures.[44] Among the regional techniques, peribulbar anesthesia provides good akinesia and analgesia but carries a risk of globe perforation, especially in highly myopic eyes with long axial lengths. Retrobulbar anesthesia is also effective in achieving akinesia and analgesia, though it carries risks such as retrobulbar hemorrhage, which can cause orbital pressure spikes and compromise optic nerve and retinal function. Sub-Tenon's anesthesia is a safer alternative with lower risks of perforation or hemorrhage, though akinesia and analgesia may occasionally be suboptimal.[160]

General anesthesia provides complete akinesia and analgesia[161] and is indispensable in certain situations. It is especially useful in pediatric patients, anxious or uncooperative adults, those with claustrophobia, and in lengthy or complex procedures such as combined encirclage with vitrectomy or extensive proliferative diabetic retinopathy. It is also essential in surgeries requiring hypotensive anesthesia, such as tumor resections. However, its use may be restricted in patients with poor systemic or airway status or in emergencies where rapid surgical intervention is needed.

Topical anesthesia has limited utility in vitrectomy as it does not provide globe akinesia and offers only partial analgesia. This limitation hampers trocar placement, scleral indentation, and the management of unexpected complications like suprachoroidal hemorrhage. It may rarely be considered for short procedures such as 25/27 G vitrectomy for floaters in highly cooperative patients with explained consent.[162]

Consensus statement 6.1: *Regional anesthesia is a cost-effective and safe procedure with higher utility in various vitrectomy settings. (Consensus score: 100 % [strongly agree: 78.95 %; agree: 21.05 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 6.2: *General anesthesia is essential for select population such as pediatric age group and anxious adults. (Consensus score: 95 % [strongly agree: 65 %; agree: 30 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 6.3: *Topical anesthesia has limited utility in vitrectomy procedures,* particularly for RRD. *(Consensus score: 95 % [strongly agree: 65 %; agree: 25 %; neutral: 0 %; disagree: 10 %; strongly disagree: 0 %])*

Preoperative factors influencing type of anesthesia

The choice of anesthesia depends on patient, ocular, surgical, and logistical factors. In children, general anesthesia is preferred due to limited cooperation. In the elderly, systemic comorbidities and cooperation guide the choice: cooperative patients with cardiovascular or respiratory issues may tolerate regional anesthesia, while anxious, claustrophobic, or spinal-compromised adults usually require general anesthesia.

Ocular factors also influence the approach. Sub-Tenon's or general anesthesia is safer in axial myopia or staphyloma to reduce perforation risk. In trauma or open-globe injuries, general anesthesia is mandatory.

Surgical complexity matters: prolonged or combined procedures, complex tractional detachments, or bilateral surgeries are best performed under general anesthesia. Logistic considerations, such as resource limitations and daycare settings, may favor regional techniques for practicality and cost-effectiveness.

Intraoperative considerations

Regardless of anesthesia type, certain intraoperative factors are important. The oculocardiac reflex can occur during muscle manipulation, especially in children. In diabetic vitrectomy, IOP fluctuations should be minimized to reduce bleeding. Patients under general anesthesia or with systemic comorbidities need close hemodynamic

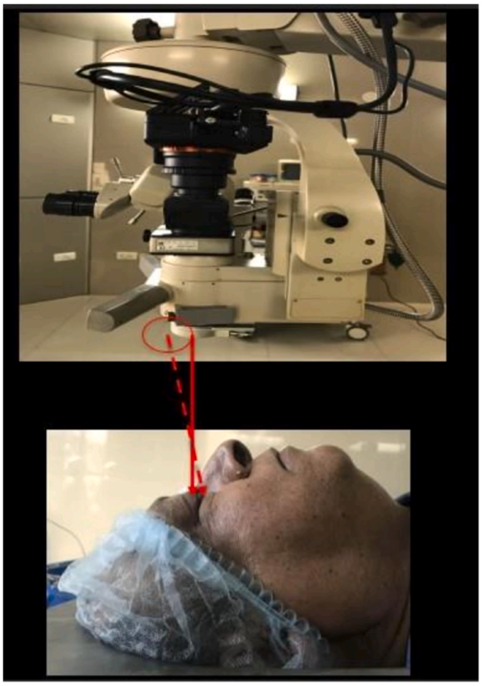

Fig. 6. Patient positioning: supine position with neck roll and gel ring beneath head, visual axis aligned with operating microscope. *(Fig. 6 is contributed by MS and SS, original authors.)*.

monitoring. Importantly, nitrous oxide should be avoided when intraocular gas tamponade is used, as it can expand the gas bubble and raise intraocular pressure.[163]

Postoperative considerations

Postoperative care is crucial. Controlling nausea and vomiting prevents Valsalva-induced IOP spikes and rebleeding, especially in diabetic vitrectomy. Adequate analgesia supports proper positioning and is vital in polytrauma patients. Infants should be monitored for apnoea. General anesthesia may delay recovery, cause confusion or discomfort, and hinder positioning, whereas regional anesthesia keeps patients alert, promoting earlier and better compliance.

Consensus statement 6.4: *Intraoperative and postoperative factors play a role in choosing appropriate anesthesia technique. (Consensus score: 84.21 % [strongly agree: 36.84 %; agree: 47.37 %; neutral: 15.79 %; disagree: 0 %; strongly disagree: 0 %])*

Emergency surgery anesthesia protocols

In emergencies such as open-globe injuries, endophthalmitis, or intraocular foreign bodies, the anaesthetic approach must ensure rapid and safe induction while providing adequate akinesia and analgesia. Trauma cases pose unique challenges, including the need for urgent consent, assessment of fasting status, and systemic stabilization. General anesthesia with rapid sequence induction is preferred in open-globe injuries with or without intraocular foreign bodies. For endophthalmitis, regional anesthesia is generally sufficient.

Consensus statement 6.5: *Regional anesthesia is the preferred anesthesia modality in various emergency situations for RRD repair. (Consensus score: 80 % [strongly agree: 35 %; agree: 45 %; neutral: 20 %; disagree: 0 %; strongly disagree: 0 %])*

Intraoperative positioning

Patient positioning. The supine position remains the standard for most vitrectomy procedures because it is straightforward to implement and provides optimal visualization of the surgical field. In certain situations, however, lateral decubitus positioning may be required. This approach is useful for patients unable to tolerate the supine position, such as those with kyphosis or orthopnoea. It may also be necessary when adjusting globe orientation to align the area of interest with the microscope axis, during complex RDs involving inferior breaks, or for outpatient department fluid–gas exchange.[164] Despite these advantages, lateral decubitus positioning can be technically challenging, less ergonomic for the surgeon, and carries a higher risk of patient movement and slippage.

Consensus statement 6.6: *Supine positioning of patient remains the standard positioning in vitrectomy with limited role of lateral decubitus positioning. (Consensus score: 89.47 % [strongly agree: 36.84 %; agree: 52.63 %; neutral: 10.53 %; disagree: 0 %; strongly disagree: 0 %])*

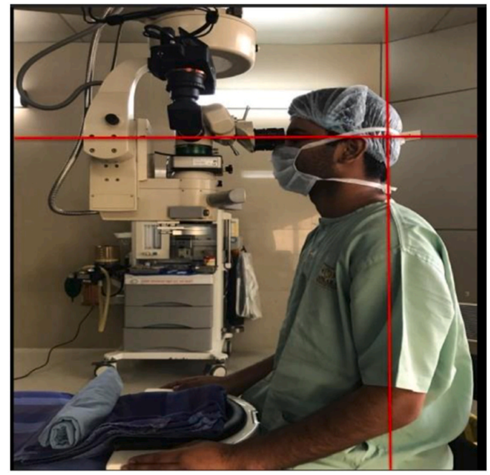

Fig. 7. Surgeon ergonomics: Sit in neutral position without excessive neck flexion or extension, elbows 90–110 degrees, forearms supported. *(Fig. 7 is contributed by MS and SS, original authors.)*.

Patient head positioning. Proper head positioning is essential to optimize the surgical view. The globe should generally be maintained in the primary position (**Fig. 6**). A neutral supine posture with the head stabilized in a gel ring, without rotation or flexion, represents the standard position. In selected situations, variations can improve surgical access: a chin-up position enhances visualization of the inferior retina; head tilt toward the surgeon allows better viewing of the temporal and inferior periphery; and head rotation away from the surgeon facilitates instrument access in patients with narrow orbits, especially when employing a temporal approach.

Consensus statement 6.7: *Patient head positioning plays important role to achieve optimal field of view. (Consensus score: 100 % [strongly agree: 50 %; agree: 50 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Surgical setup

The surgical setup should ensure comfort and efficiency: the surgeon's chair should be height adjustable, equipped with lumbar support, and ideally include a foot ring. Microscope oculars should be adjusted for interpupillary distance, tilt, and optical power, while foot pedals must be positioned to allow smooth ankle movement. The operating table should be set so that the surgeon's forearms are parallel to the floor while operating.

During surgery

During surgery, the surgeon should maintain a neutral posture, keeping shoulders relaxed, elbows at 90–110 degrees, wrists straight or slightly extended, and thighs parallel to the floor with feet flat (**Fig. 7**). The forearms should be supported, and unnecessary movements minimized. The usual surgeon position is toward the forehead of the patient, although a lateral position may be adopted in specific scenarios, such as all nasal vitrectomy for retinopathy of prematurity (ROP) to avoid temporal sclerotomies in temporal RD in ROP.

Consensus statement 6.8: *Surgeon ergonomics plays an important role not just in surgical outcomes but also influences career longevity. (Consensus score: 95 % [strongly agree:55 %; agree: 40 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Section 7. Postoperative management

Head positioning and activities

The patients underwent vitrectomy are almost always advised to adopt the FDP immediately for at least 24 h after surgery to reattach the macula, or to prevent SRF from being pushed to the macula from a peripheral detachment.[165] In contrast to scleral buckling procedure in which patients are usually encouraged to resume light daily activities without head position limitations.[166] If the macula is seen to be attached on the initial days after surgery, a posture best supporting the break (the "optimal" position) can be advised as an alternative to strict face-down posturing to close retinal breaks. Patients are advised to posture "as much as is possible" (e.g. aim for 2/3–3/4 of the time of a day) in the optimal position. A "never adopt" position is also advised, e.g. face-up, face-forward/propped sitting up for inferior breaks, lateral with the break side down in predominantly temporal and nasal breaks.

A systematic review found trade-offs in complications between the prone and support-the-break positioning. However, the immediate prone positioning after surgery could help mitigate risk of retinal displacement.[167] A family or household member can be tasked to supervise and encourage the patient to maintain the correct position. Posturing aids, such as shaped cushions, face supports, massage chairs and beds, may be useful.

A gradual return to activity is important after retinal reattachment surgery. During the first 1–2 weeks, maximal rest with minimal head and eye movement is advised. Most normal activities, including noncontact sports, can generally resume after three months, though high-risk activities that may expose the eye to trauma or rapid motion should still be avoided.

Head positioning is one of the key elements to successful vitrectomy for RRD. A face-down position in the first 24 h after surgery is usually advised to flatten the macula and prevent fluid re-accumulation under the macula. (Consensus score: 100 % [strongly agree: 50 %; agree: 50 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])

Consensus Statement 7.2: *The optimal head position, at least 2/3 or 3/4 of the time during a day, to close the retinal break is advisable at least the initial 1–2 weeks after PPV. (Consensus score: 90 % [strongly agree: 45 %; agree: 45 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 7.3: *A 'never adopt' head position is also advised (e.g. face up, face forward/propped sitting up' for inferior breaks, lateral with the break side down for predominantly temporal and nasal breaks). (Consensus score: 90 % [strongly agree: 25 %; agree: 65 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 7.4: *Patients should maintain maximal rest and minimal head/eye movement during the initial 1–2 weeks to ensure appropriate posture, gradually resuming light activities like leisurely walks after this period. (Consensus score: 80 % [strongly agree:40 %; agree: 40 %; neutral: 15 %; disagree: 5 %; strongly disagree: 0 %])*

Postoperative management

Elevated intraocular pressure. Elevated IOP is a common early complication after RRD surgery,[168–171] more frequent following vitrectomy than scleral buckle due to factors, such as tamponade overfill, expansion, or intraocular inflammation. Rebound IOP elevation may occur after reattachment of extensive detachments because of abrupt changes in uveo-scleral outflow. Overfill should be avoided at the end of surgery; digital estimation of IOP is usually reliable. Tamponade overfill is suspected when elevated IOP is accompanied by a shallow anterior chamber and often resolves as gas resorbs over days. If medical therapy fails, gas release via a needle or, rarely, re-exchange in the operating room may be required, as delayed detection can cause permanent vision loss. In aphakic eyes with SO, early IOP spikes can occur if inferior iridectomy is obstructed by fibrin or inflammatory debris. Treating inflammation, performing a YAG laser iridotomy, or partially removing SO may be necessary to manage persistent elevation.

Elevated IOP in the late postoperative period of RRD repair[172–174] is often due to steroids use. Topical IOP-lowering medication with decreasing or cessation of steroids are usually sufficient.

The development of primary open-angle glaucoma is possible after RRD surgery due to natural progression of the eyes, particularly eyes with high myopia, which may be prone for RRD themselves. Some of these eyes may have normal tension glaucoma without elevated IOP. Awareness of this condition is essential during follow-up period of RRD surgery.

High altitude and intraocular gas. Vitreoretinal surgery frequently employs intraocular gases such as SF6 or C3F8 to tamponade retinal breaks until chorioretinal adhesion develops. Although smaller bubbles may pose lower risk, individual variation makes prediction unreliable. Standard guidance is to avoid flying until complete gas resorption—-which usually takes around 2 weeks for SF6 and 6 weeks for C3F8.[175] The Aerospace medical association guidelines suggest that air travel should be avoided till the gas bubble has at least decreased to a volume less than 30 %.[175] A cruising altitude of about 6000 feet or ~1830 m above sea level is typically attained in 20 min of ascent and the cabin pressures reduce from 760 mmHg at sea level to 609 mmHg. This reduction results in an 125 % increase in volume per Boyles law (P1V1 = P2V2; where P is pressure and V is Volume. 760/609 ~ 125).[176] This expansion can overwhelm ocular compensatory mechanisms, raise IOP sharply, and lead to irreversible vision loss.[176] Houston et al. calculated the maximum theoretical bubble size for the IOP to remain unchanged as 0.36 ml based on aqueous production, outflow capacity and a baseline IOP of 18 mmHg.[176] Other experimental and observational studies have reported that a maximum residual volume of 0.6 ml to 1 ml may be tolerated in air travel.[177,178] Lincoff et al. reported in their study that a residual volume less than 10 % may be safe for air travel.[178] Foulsham et al. also attempted periodic IOP measurements in a patient with 50 % gas bubble in a helicopter flight up to a height of 2600 feet where the cabins were not pressurized. The IOP rose by an average of 10.8 mmHg per 1000 ft of ascent, peaking at 42 mmHg. The patient reported no pain or vision loss but noticed a change in the gas bubble meniscus at 2100 ft[179] Muzychuk AK et al. highlighted the risks of air travel with intraocular gas, even with a small (<10 %) perfluoropropane bubble. A patient developed optic nerve damage and new visual field loss after flying, likely from acute IOP rise. The report reinforces that no residual gas volume is entirely safe for flight.[180]

The estimated IOP change using rabbit eyes and the human Friedenwald rigidity coefficient, was 2.1, 1.8, 1.4, and 1.1 mmHg per every 100 m of attitude rise in an animal study.[181] Evidence suggests that patients with a complete intraocular gas fill after vitrectomy may safely travel by land through mountain elevations up to ~3900 ft, with ascent rates around 29 ft/min, without sight-threatening IOP spikes or vascular complications.[182] A pilot study demonstrated that post-vitrectomy patients with intraocular gas experience a statistically significant rise in intraocular pressure even during rapid elevator travel across modest floor heights. Although no immediate adverse events were observed, these findings highlight the potential risks for patients living or traveling in high-rise buildings. Further research is warranted to define safe ascent limits and rates, particularly in cities with numerous tall buildings, to guide postoperative patient counseling.[183]

In summary, patients with intraocular gas after vitreoretinal surgery should strictly avoid air travel until the gas is fully resorbed as even small residual bubbles can cause dangerous IOP spikes and irreversible vision loss. When traveling by land through high-altitude or mountainous regions, gradual ascent is recommended, and prophylactic antiglaucoma medications (AGM) may be considered in high-risk eyes. For patients in high-rise buildings, rapid elevator travel may induce small but significant IOP changes, warranting caution, especially in the early postoperative period.

Follow-up protocols ad imaging. After both PPV and SB, the patients should be seen on 1 day, then every 1–2 weeks (until gas tamponade has resorbed in PPV). If the retina is reattached, the follow-up of 4–6 weeks, then 3–6 months is possible. The patients may be discharged from clinic after 1–2 years if there are no significant adverse events. Some postoperative adverse events, such as those related to extraocular muscles, may be more specific to SB whereas secondary glaucoma and retinal membrane can occur from both procedures. There has been a recent report on delayed onset of recurrent RD after more than a year from the first RRD repair. Therefore, long-term follow-up after a year may still be important.[184]

Widefield, ultra-widefield,[185–187] or OCT retinal images are useful to document and demonstrate to the patient the initial state of the retina preoperatively, and the progress after surgery.

Consensus Statement 7.5: *Patients with intraocular gas should avoid air travel until complete gas resorption. If travelling by land, ascend gradually in high-altitude regions with consideration of prophylactic AGM, and exercise caution with elevator travel in tall buildings postoperatively. (Consensus score: 87.5 % [strongly agree: 50 %; agree: 37.5 %; neutral: 12.5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.6: *On the first day after PPV with vitreous tamponade or SB for RRD, intraocular pressure (IOP) should be measured for all patients to detect overfill of vitreous tamponades or other causes. (Consensus score: 100 % [strongly agree: 80 %; agree: 20 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.7: *Tamponade overfill should be avoided at the completion of surgery. Digital estimation of IOP is usually adequate and reliable with experience. (Consensus score: 100 % [strongly agree: 45 %; agree: 55 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.8: *Prophylactic oral acetazolamide may be initiated if gas overfill is suspected; if this medical therapy fails, partial gas removal may be needed. (Consensus score: 100 % [strongly agree: 35 %; agree: 65 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.9: *Inferior peripheral iridectomy should be routinely performed in aphakic eyes filled with silicone oil to avoid pupillary block. (Consensus score: 100 % [strongly agree: 75 %; agree: 25 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.10: *For silicone oil tamponade, acute IOP elevation due to oil in the anterior chamber often requires surgical intervention, such as partial oil removal or reformation of the inferior iridotomy. (Consensus score: 100 % [strongly agree: 55 %; agree: 45 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.11: *Significant "kissing" choroidal detachments, if found postoperatively, may require surgical drainage within days, while less severe ones can be observed. (Consensus score: 90 % [strongly agree: 50 %; agree: 40 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 7.12: *Widefield retinal imaging or optical coherence tomography (OCT) are useful tools to document postoperative retina re-attachment or redetachment. (Consensus score: 95 % [strongly agree: 65 %; agree: 35 %; neutral: 5 %; disagree: %; strongly disagree: 0 %])*

Postoperative cataract formation. Accelerated cataract formation is common after vitrectomy with or without tamponade,[188,189] occurring within months in older patients and over years in younger individuals, typically presenting as nuclear sclerosis. Surgery for secondary cataract is planned once the retina is stable, usually after at least six months. Phacoemulsification is generally routine, but surgeons should anticipate challenges such as weak zonules, posterior capsule opacities (PCO) from prior surgery, and exaggerated anterior chamber instability, especially in highly myopic eyes. PCO can be treated with YAG laser after three months. Rapid formation of mature cortical cataracts may signal iatrogenic lens injury, and precautions for potential nucleus drop should be taken. Surgery should not be delayed unnecessarily once vision is significantly affected.

Consensus Statement 7.13: *Surgery for slow progressing secondary cataract after PPV can be planned at a minimum of 6 months after the retina is re-attached and stable. (Consensus score: 95 % [strongly agree: 25 %; agree: 70 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.14: *Phacoemulsification for a secondary cataract after vitrectomy is usually routine and uncomplicated with some caveats which cataract surgeons should anticipate, such as weak zonules, unusually deepen anterior chamber, fibrosed posterior capsule, etc. (Consensus score: 100 % [strongly agree: 65 %; agree: 35 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.15: *Extremely rapid cataract formation, especially of the mature cortical variety, may indicate an iatrogenic injury to the lens during vitrectomy. Phacoemulsification for these cases can be performed sooner and may encounter more complications than usual. (Consensus score: 100 % [strongly agree: 55 %; agree: 45 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Reoperation options

After SB, a persistent RD may be observed for 3–4 weeks. Favorable signs suggesting no further surgery is needed include a concave detachment within the indent, clear support of the causative retinal tear, absence of other open breaks, and slow but progressive resolution. If the detachment worsens or re-detaches, prompt intervention is required. Options include PPV with tamponade, PR for suitable superior breaks, or buckle readjustment, although the latter can be surgically challenging.

Following primary PPV, persistent or worsening detachment also warrants expedient action. Fluid-gas exchange with laser retinopexy may suffice for superior open breaks in an outpatient setting, though success is limited for inferior breaks. Repeat PPV with retinopexy and gas or SO tamponade may be necessary, with encirclage added if absent. When vitrectomy serves as a rescue procedure after prior failure, every effort should be made to achieve definitive reattachment.

If proliferative vitreoretinopathy (PVR) is present or likely, complete relief of vitreous traction, removal of PVR tissue, retinectomy for anterior shortening, encirclage or buckle placement, and long-acting tamponade with SO is advised. Some surgeons prefer waiting 4–6 weeks for PVR to mature before reoperation.

Final visual outcomes are generally poorer when initial surgery fails, emphasizing the importance of preoperative counselling. Patients and caregivers should understand the potential need for further surgery and maintain realistic expectations, considering factors such as macular involvement, duration of macular detachment, risk of redetachment from PVR, and potential complications like epiretinal membranes or secondary glaucoma.

Consensus Statement 7.16: *After primary SB, a persistent detachment might be observed for 3–4 weeks if signs indicate gradual resolution, but if the detachment worsens, expedient intervention, most likely vitrectomy with tamponade, is required. (Consensus score: 100 % [strongly agree: 30 %; agree: 70 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.17: *If redetachment occurs after primary vitrectomy, options include fluid-gas exchange in the office or repeat vitrectomy with retinopexy, and gas/silicone oil fill in the operating room. (Consensus score: 95 % [strongly agree: 40 %; agree: 55 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.18: *If repeated vitrectomy is the 'rescue' procedure after initial failed surgery, every effort should be made to ensure this will be the definitive and final procedure to attain permanent retinal attachment. (Consensus score: 100 % [strongly agree: 70 %; agree: 30 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.19: *If PVR is deemed to be the cause of* *persistent detachment or redetachment, waiting 4–6 weeks for the PVR to 'mature' before reoperation is best considered on a case-by-case basis. (Consensus score: 75 % [strongly agree: 50 %; agree: 25 %; neutral: 25 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 7.20: *Final visual outcomes are generally poorer if initial surgery is unsuccessful and further surgery is required. Initial counselling with patients and their caregivers before primary surgery should have included the chances and consequences of failure to re-attach the retina and the possible need for further surgery. (Consensus score: 100 % [strongly agree: 70 %; agree: 30 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Section 8. Special populations

Pediatric considerations

RDs in the pediatric population span a variety of congenital and acquired conditions with some not commonly seen in adults. In this consensus paper, we delve into the special considerations in managing pediatric RRDs, taking into account the anatomy, preferred surgical techniques as well as unique disease characteristics.

Pediatric vitreoretinal surgery has its unique set of challenges compared to surgery in the adult eye. Both vitrectomy and scleral buckling techniques may be used, but each has its advantages and disadvantages peculiar to the pediatric population. The reported overall anatomic success rate of surgical repair of pediatric RRDs ranges from 74.9 % to 80 %.[190,191]

Surgical techniques: vitrectomy vs. scleral buckle

In pediatric eyes, the surgical method of choice should take into account the anatomical differences compared to adult eyes, in addition to increased vitreoretinal adhesion and increased propensity for membrane proliferation.

Vitrectomy. Babies and infants have lower systolic blood pressure compared to adults, and surgeons must bear in mind that iatrogenic occlusion of the central retinal artery can be induced if the infusion pressure is too high or with prolonged scleral depression. Therefore, the optic nerve must be observed at all times to ensure patency of the central retinal artery.[192] In the anterior trans-limbal approach, the infusion is usually supplied via a self-retaining anterior chamber maintainer. A shelving corneal wound is made with a 20 G MVR blade and the 20 G anterior chamber maintainer anchored in the corneal wound via grooves on its side. The infusion pressure should be optimized to reduce the risk of corneal clouding and retinal incarceration during withdrawal of instruments.

Creation of a PVD is an important step in the successful management of a RD. This may be essential in managing RRD in older children. However, this is not recommended in eyes with ROP because of the very firmly adherent posterior vitreous. Forceful creation of a PVD when there is firmly adherent vitreous is not only challenging but also carries a high risk of inducing retinal tears.[193]

In eyes with PVR, it is preferable to perform segmentation instead of delamination when removing preretinal membranes due to the firm vitreoretinal attachments in children. Retinectomies are also preferably avoided as a method to relieve anterior traction because of the high risk of scrolling and contraction of the cut retina.

Pharmacologic vitreolysis has been attempted in pediatric eyes as an adjuvant to vitrectomy surgery with limited success. The hypothesis is that enzymatic vitreolysis can weaken the vitreoretinal junction, resulting in a more complete dissection of the hyaloid from the retina with less trauma to the retina and less iatrogenic breaks.

In pediatric eyes, smaller gauge instruments are beneficial in a smaller vitreous cavity, reducing the risk of lens touch and allowing easier manipulation. High-speed cutting and smaller sclerotomies have been found to be helpful in reducing both intraoperative and postoperative complications. The 27 G vitrectomy system offers a safe and feasible minimally invasive option for pediatric RD, though caution is advised due to potential instrument fragility, hypotony, and the occasional need for gauge conversion.[194] Of note, in ROP eyes, the surgeons perform mainly core vitrectomy and are thereby able to keep the instruments more perpendicular compared to in adult eyes where base shaving is typically required.[195]

A line of shorter vitrectomy instruments (vitrectomy cutter probe and endoilluminator) has been designed specifically for children (25 + Short, Alcon). These shorter instruments (18 mm length vs the standard 27 mm length) are also stiffer and allow better control of the eye with entry into the anterior periphery. However, the shorter length limits the ability for posterior work in longer eyeballs.

Scleral buckling. In pediatric RDs, single surgery success rates are higher in primary SBs due to the firmly adherent posterior hyaloid. Initial vitrectomy has been shown to have a lower rate of success than either SB or combined SB/PPV.[196]

A SB may be used as a primary cerclage or as an encircling band in combination with vitrectomy. When combined with a vitrectomy, the element of our choice for an encircling band in infants is a number 40 (2 mm) or 240 (2.5 mm) silicone band, and the band is usually placed just anterior to the equator. If additional height is needed, number 20 segmental element can be added. Suture fixation of the silicone element with non-absorbable material is preferred over scleral belt loop because of the thin sclera in children.

Postoperative complications of scleral buckling in children include limitation of eye growth, development of amblyopia and loss of vision from cycloplegic eyedrops. Some authors recommend dividing the encircling band approximately 3 months after the operation in children less than 2 years of age or in those whose eye growth is retarded.

The band is preferably divided rather than removed as continued support may be provided by the encapsulated explant. In children with good visual potential in both eyes, atropine 1 % eye drops should be avoided, instead a short acting cycloplegic such as cyclopentolate 0.5 % −1 % may be prescribed to reduce the risk of developing amblyopia.[197] Refractive errors are also treated aggressively in the post-operative period to maximize visual outcomes.

Consensus statement 8.1: *Vitrectomy is the preferred procedure of choice in pediatric RRD cases, mainly for cases with retinal breaks posterior to the equator, presence of proliferative vitreoretinopathy, media opacities or in retinal redetachment. (Consensus score: 89.47 % [strongly agree: 42.11 %; agree: 47.37 %; neutral: 10.53 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 8.2: *Lens sparing vitrectomy surgery is the preferred approach in pediatric RRD cases as much as possible. Sparing the lens reduces postoperative complications like glaucoma or cataract and facilitates quicker rehabilitation. (Consensus score: 100 % [strongly agree: 47.37 %; agree: 52.63 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 8.3: *Primary scleral buckle is the procedure of choice in pediatric RRD cases with pathology anterior to the equator as it offers a higher rate of anatomical success especially in eyes with formed and adherent posterior hyaloid. (Consensus score: 100 % [strongly agree: 63.16 %; agree: 36.84 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 8.4: *Achieving posterior vitreous detachment is essential in older children to increase the success of RRD vitrectomy surgery. However, forceful creation should be avoided in ROP or infants where the vitreous adhesion is strong, and the risk of iatrogenic tears is high. (Consensus score: 94.74 % [strongly agree: 52.63 %; agree: 42.11 %; neutral: 5.26 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 8.5: *The standard 25 G instruments are a good middle ground in pediatric eyes, allowing efficient clearing of the more tenacious vitreous, yet small and rigid enough to enable safe maneuvering in* *the thick vitreous and thin sclera. (Consensus score: 94.74 % [strongly agree: 36.84 %; agree: 57.89 %; neutral: 5.26 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 8.6: *The current 27 G+ vitrectomy and its instruments still lack popular support among the pediatric VR surgeons. (Consensus score: 72.23 % [strongly agree: 16.67 %; agree: 55.56 %; neutral: 22.22 %; disagree: 5.56 %; strongly disagree: 0 %])*

Pneumatic retinopexy

Performing a PR, which is a less-invasive outpatient option, may be considered in some older children with RRD. Figueiredo et al. reported a 75 % success rate by the last follow-up in 20 patients who underwent initial PR, with RRD fulfilling the PIVOT criteria.[198]

Factors contributing to success in this age group are the denser vitreous and presumably healthier RPE pump which may allow for more rapid resolution of SRF after gas injection. Motivated parents also play an important part in ensuring pediatric patients maintain strict posturing

Consensus Statement 8.7: *Pneumatic retinopexy is an option in older children with RRD fulfilling the PIVOT criteria. Support from motivated parents is crucial in achieving primary reattachment success. (Consensus score: 78.95 % [strongly agree: 26.32 %; agree: 52.63 %; neutral: 10.53 %; disagree: 10.53 %; strongly disagree: 0 %])*

Endoscopic vitrectomy

Endoscopic vitrectomy is complementary to conventional top-down microscope-based viewing systems as it is able to bypass anterior segment opacities and provide undistorted and unobstructed views of the space between the vitreous base and the posterior iris.[199] The surgeon performs heads-up surgery and looks at a display screen to see the posterior segment and anterior structures including the vitreous base, pars plicata, pars plana, ciliary body, lens, posterior iris surface and the anterior hyaloid face. The on-screen image is, however, 2-dimentional rather than 3-dimensional, thus the surgeon needs to compensate by using non-stereoscopic clues such as shadows to judge distance.[199–201]

Endoscopy is particularly useful in advanced pediatric tractional RDs in ROP or familial exudative vitreoretinopathy (FEVR), in which there is often a significant anteroposterior tractional component with the RD extending towards the anterior hyaloid and lens. The endoscope enables better visualization of the side profile of the RD, versus looking at the top edge of the RD with a conventional top-down view, thereby facilitating more direct and potentially more complete tissue dissection.[200,201]

In ROP and PFV, extensive retrolental plaques may occur, blocking direct visualization of the underlying retina. Avoiding iatrogenic retinal breaks is critical in these cases. In persistent fetal vasculature (PFV), the retina is also often drawn up along the hyaloidal stalk. Differentiating the limit of the retina along the stalk to allow safe transection is challenging with a bird's eye view in conventional microscope-based systems. With endoscopy, direct visualization enables the entire side profile of the hyaloidal stalk and its relationship to the retina to be seen with greater ease.[199]

Vitreous tamponades

Heavy liquids are often used intraoperatively to unfold and stabilize the retina during surgery for RDs. In pediatric RDs where extensive PVR may be present with intrinsic retinal thickening, F-decalin® ($C_{10}F_{18}$) is the preferred choice as it is the highest density heavy liquid (1.93 g/cm3) and can stabilize the retina well. Posterior drainage retinotomies should generally be avoided, as they can lead to extensive postoperative fibrous proliferation and RD. If unavoidable, the retinotomy is best placed near the ora serrata. Viscoelastic substances can be helpful intraoperatively for retinal manipulation, easing separation of contracted retina and improving visualization for PVR membrane removal.

Gas tamponade can be challenging in pediatric patients, particularly when posturing is difficult; longer-acting gas may be considered. SO is often preferred for predominantly inferior pathology, but should be avoided in advanced detachments, such as stage 5 ROP, advanced posterior PFV, or RDs associated with coloboma, due to the high risk of subretinal migration from incomplete traction release or colobomatous defects.

In complex pediatric PVR-detachments, some advocate the use of heavy liquid perfluoro-n-octane as a short term post-operative tamponade for 1–4 weeks.[202,203]

Choice of vitreous tamponade

Consensus Statement 8.8: *Longer-acting gas is the preferable choice of vitreous tamponade mainly in older children (16–18years old). (Consensus score: 89.48 % [strongly agree: 26.32 %; agree: 63.16 %; neutral: 10.53 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 8.9: *Silicone oil is preferred in infants and children who are unable to posture, in cases where longer tamponade is needed and the retinal pathology is predominantly inferior. (Consensus score: 100 % [strongly agree: 45 %; agree: 55 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus statement 8.10: *Silicone oil use in coloboma-RRD and optic nerve pit-RRD remains controversial due to the concern of silicone oil leak through the coloboma defect or optic nerve pit, that will access the central nervous system. (Consensus score: 95 % [strongly agree: 40 %; agree: 55 %; neutral: 0 %; disagree: 5 %; strongly disagree: 0 %])*

Special disease populations in pediatric RRD

Stickler syndrome. RRD is the most serious ocular complication of type 1 Stickler syndrome and may occur early in life. Eight percent of affected children have RRD between the ages of 0 and 9 years and 26 % between 10 and 19 years.[204,205] The incidence of RRD varies between different reports and ranges between 10 % and 73 %.[203,206–209] There is a propensity for giant retinal tear formation, but a spectrum of retinal breaks may be seen.[205,209]

A detailed examination of both eyes is mandatory in patients with type 1 Stickler syndrome, with the need to consider prophylactic treatment of high-risk peripheral retinal pathology in the fellow eye. Bilateral RDs are common and range from 39 % to 51 %.[207,209,210]

Ang et al.[207] did a large retrospective study on 204 type I Stickler syndrome patients and concluded that prophylactic treatment (either unilateral or bilateral 360 degrees of cryotherapy applied to the post-oral retina) reduced the risk of developing a RD. However, this approach is unconventional and based on one study.

The Cambridge Prophylactic Cryotherapy Protocol[211] was published in 2014 with the rationale of preventing RD related to GRTs. Under general anesthesia, 360 transconjunctival prophylactic cryotherapy was applied in a contiguous ribbon at the junction of the post-oral retina with the pars plana. The bilateral control group had a 7.4-fold, and the unilateral control group had a 10.3-fold increased risk of RD, compared to the corresponding prophylaxis groups.

The results of an extended outcome analysis of a large cohort of type 1 Stickler syndrome patients were recently published, with follow-up ranging from 1 to 44 years.[212] The prevalence of second-eye RD was 9.6 % (9 of 94) in the unilateral cryotherapy group and 78.0 % (92 of 118) in the unilateral control group. The risk of RD in the matched unilateral control group (59 patients) was higher than that in the matched unilateral cryotherapy group (59 patients) by a factor of 8.0 (3.4–19.3, $P < 0.001$).

It is preferable to carry out prophylactic treatment only to high-risk lesions such as lattice degeneration. However, in view of some pediatric retinal specialists, the prophylaxis may be performed in eyes of genetically confirmed patients even without visible peripheral lesions to prevent 360-degree GRT.

Predictive molecular testing in family pedigrees with known mutations allows confirmation of the subtype of the Stickler syndrome at an early age, facilitating prophylactic treatment before RD occurs.

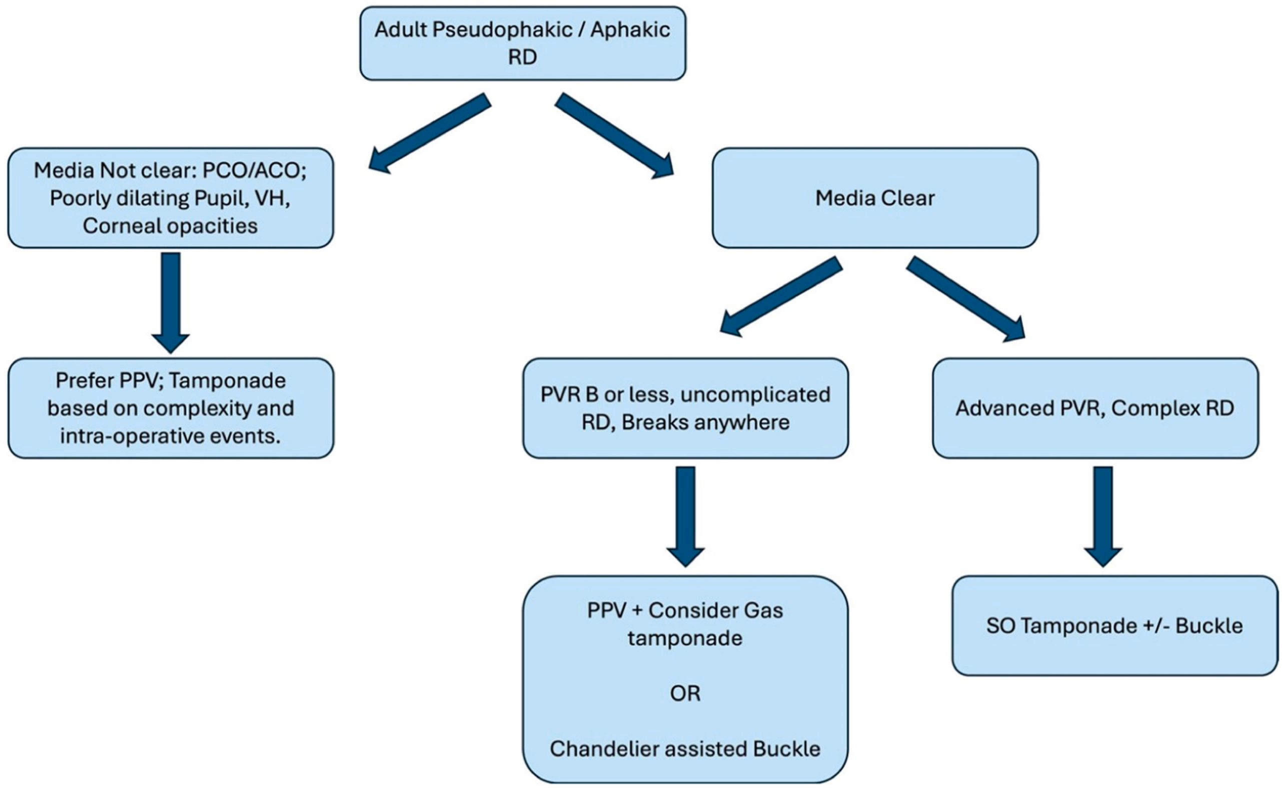

Fig. 8. Suggested management algorithm of adult pseudophakic/aphakic RD patients. RD, Retinal detachment; PCO, posterior capsular opacity; ACO, anterior capsular opacity; VH, vitreous haemorrhage; PPV, pars plana vitrectomy; PVR B, proliferative vitreo-retinopathy grade B; SO, silicone oil. *(Fig. 8 is contributed by NVR and PC, original authors.)*.

Prophylactic treatment to peripheral pathology (Stickler syndrome). ***Consensus Statement 8.11:*** *In patients with type 1 Stickler syndrome, prophylactic treatment with cryotherapy to the peripheral retina is controversial. We prefer to perform this with laser photocoagulation, and only in those with high-risk peripheral retinal lesions such as lattice degeneration. (Consensus score: 100 % [strongly agree: 45 %; agree: 55 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Marfan syndrome. RD occurs in 5 %-11 % of these patients and increases to 8 %-38 % in those who have ectopia lentis or who have undergone cataract surgery.[213–215] Most develop RD at a young age.[213] In a large series, it has been reported that 70 % of 160 patients with RD were below the age of 20 years. Bilateral RD is common and may reach 70 %.[216,217]

Due to the high incidence of bilaterality, careful evaluation and monitoring of the fellow eye is recommended, and prophylactic treatment may be justified.[217] Patients with Marfan syndrome tend to have more complex RRDs including giant retinal tears. The main difference between patients with Marfan syndrome versus Stickler syndrome is that the congenital vitreous anomaly seen in Stickler syndrome is absent. The incidence of detachment is related to the level of myopia, and these patients have vitreous degenerative changes similar to myopic eyes.[213,218] Lens subluxation and lens extraction are also risk factors for developing RD.[214]

RDs in Marfan syndrome can be a surgical challenge. Special considerations include a poorly dilating pupil and subluxed lens that can sometimes limit visualization of the retina. In eyes with complex RDs with severe lens subluxation are better managed with pars plana lensectomy, vitrectomy, and endotamponade using long-acting gas or SO, with or without scleral buckling. With current advanced surgical techniques, anatomic success rates reported for repair of RDs in Marfan syndrome are comparable with non-Marfan eyes at 75 %-86 %.[216,217]

Prophylactic treatment to the asymptomatic fellow eye of Marfan syndrome. ***Consensus Statement 8.12:*** *In Marfan eyes with high myopia, prophylactic treatment to high-risk lesions (eg. lattice degeneration, retinal holes) in the asymptomatic fellow eye is recommended, similar to any patient with high myopia and retinal detachment in one eye. (Consensus score: 100 % [strongly agree: 30 %; agree: 70 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Choroidal coloboma. Repair of these coloboma-associated RDs remains a surgical challenge to date, especially if the optic nerve is involved and if there are associated ocular anomalies such as microphthalmia, cataract and lens coloboma.[219] In RDs occurring in a colobomatous eye that do not involve the area of the coloboma, surgical repair principles are the same.

With the advent of small gauge PPV, most coloboma-related RDs are now repaired via the intraocular approach. The identification of breaks in the intercalary membrane (ICM) is easier with intraocular visualization in a PPV.[220] Direct closure of the breaks with cyanoacrylate glue has been described.[221] However, in most cases, direct closure is not possible. Glue is not effective in a split or atrophied ICM as only the inner layer of the schisis will be sealed and progressive atrophy may enlarge the hole as the ICM contracts. The best approach, therefore, would be to isolate the coloboma from the rest of the retina.[222]

Meticulous removal of vitreous attachments and incision of the ICM to weaken it are important to relieve traction on the break within the ICM. Laser retinopexy can then be applied around the coloboma margin to create a border of chorioretinal adhesion. It is difficult to create chorioretinal adhesion directly around holes in the ICM as the choroid and RPE are absent. After creating a circumferential barrier of chorioretinal adhesion, endotamponade with gas[223] is preferred as SO has the potential risk of getting into the subretinal space through the colobomatous defect.[220,224]

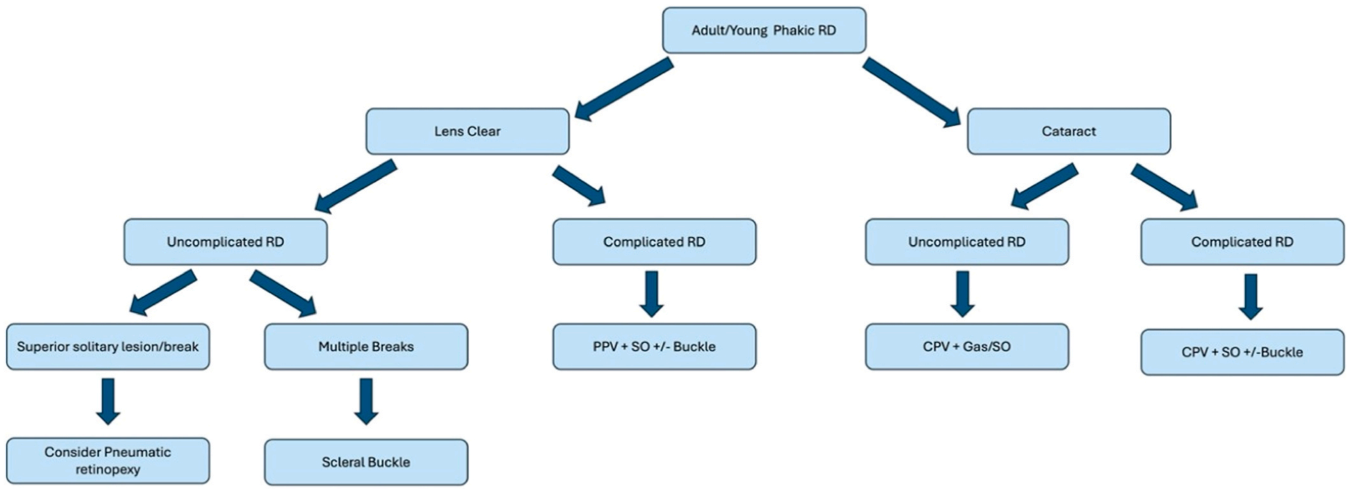

Fig. 9. Suggested management algorithm of adult or young phakic RD patients. RD, retinal detachment; PPV, pars plana vitrectomy; SO, silicone oil; CPV, combined phaco-vitrectomy. *(Fig. 9 is contributed by NVR and PC, original authors.)*.

In eyes where the coloboma involves the optic nerve, peripapillary endolaser photocoagulation through the papillomacular bundle may result in laser-induced retinal nerve fiber layer damage, leading to poor visual improvement even with retinal reattachment.[225] In these eyes, underlying amblyopia also limits functional recovery. McDonald et al. suggested that postoperative laser treatment through the papillomacular bundle may be preferable.[225] However, this is not easily performed in the clinic.

Repair of these coloboma-associated RDs remains a surgical challenge to date, especially if the optic nerve is involved and if there are associated ocular anomalies such as microphthalmia, cataract and lens coloboma.[219] In RDs occurring in a colobomatous eye that do not involve the area of the coloboma, surgical repair principles are the same.

Resource-limited settings

Equipment availability adaptations. In a limited resource setting, there should be selective reutilization of various instruments without compromising the patient's safety and surgical outcomes. Instruments such as the vitrectomy cutter, trocar–cannula sets, laser probes, and air tubing can be sterilized using ethylene oxide (ETO) and safely reused. This not only reduces cost but also minimizes environmental impact.[226] In parallel, investment in research and development aimed at creating modular vitrectomy technology can make surgical care scalable, affordable, and of consistently high quality.

Consensus Statement 8.13: *Safe reuse of select instruments and investment in modular technology can promote high quality, affordable vitrectomy. (Consensus score: 85 % [strongly agree: 15 %; agree: 70 %; neutral: 10 %; disagree: 5 %; strongly disagree: 0 %])*

Modified surgical techniques for limited resources. Adaptations in surgical practice can further optimize vitrectomy under constrained resources. Strengthening manpower training is essential, enabling surgeons to develop skills that reduce reliance on multiple specialized instruments. For instance, a simple needle can be used to initiate a PVD or begin membrane peeling, eliminating the need for devices such as Tano diamond-dusted scrapers. Similarly, cortical vitreous remnants can be removed with a PVA sponge.[227] The use of noncontact viewing systems can decrease the need for trained assistants, allowing surgeons to perform procedures more independently. In addition, compressors may be used in place of gas cylinders to power vitrectomy machines, making them more accessible and cost effective.

Training programs can be enhanced using wet labs, surgical simulators, and low-cost 3D-printed eye models for hands-on experience, while "train the trainer" initiatives build a sustainable pool of skilled surgeons. Cost-effective care is promoted through regional anesthesia, daycare procedures, reusable instruments, accessible imaging, and preventive strategies like regular screenings and timely laser treatment to reduce disease progression and the need for advanced surgery.

Consensus statement 8.14: *Enhanced surgical training, promoting autonomous techniques and use of cost-effective alternatives can optimize vitrectomy in limited resource settings. (Consensus score: 90 % [strongly agree: 25 %; agree: 65 %; neutral: 5 %; disagree: 5 %; strongly disagree: 0 %])*

Consensus statement 8.15: *The approaches to sustainable practices in RRD surgery should be applied to not only resource-limited settings but to settings for the RRD surgery worldwide. (Consensus score: 100 % [strongly agree: 50 %; agree: 50 %; neutral: %; disagree: %; strongly disagree: 0 %])*

A general guideline to approach RRD in pseudophakic/aphakic patients and phakic patients is being provided in the form of flowcharts (Fig. 8 & 9).

Section 9. Future technology and innovation

Ultra-widefield prior to surgery

Ultra-widefield (UWF) fundus photography is a valuable tool for aiding RD care. Its ability to capture wide-angle view of the retina facilitates comprehensive evaluation, particularly for documenting the extent of detachment, localizing retinal lesions, and monitoring changes before and after surgery. The UWF imaging also provides more accurate and reproducible assessment of peripheral breaks[228,229] when compared to indirect ophthalmoscopy, especially in eyes with gas-filled or small pupil.[185] However, its performance on detecting lesion at either superior or inferior location is suboptimal compared to horizontal field, thus this limitation should be considered in clinical use.

Intraoperative OCT

Introperative OCT (iOCT) system is another additional feature integrated into surgical microscope. This feature enables surgeons to visualize delicate anatomy of macula and its surroundings during the surgery by generating OCT images and video in real time.[230] For example, remaining epiretinal membrane, residual heavy liquid or SRF can be clearly visualized using iOCT.[231] As a result, this could improve decision making and surgical planning with greater precision and confidence. Because there are still debates around the utility of this technology, a significant change in clinical practice has yet observed.

Table 3
Voting results of consensus statements on retinal detachment.

Section	Consensus Statements	C Score	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1. Surgical Approach Selection							
1.1	Younger patients, particularly those under 35, are often ideal candidates for SB, whereas older patients are more likely to benefit from PPV.	**95 %**	45 %	50 %	5 %	0 %	0 %
1.2	PPV yields superior anatomic success in pseudophakic eyes, whereas SB offers better anatomic and functional outcomes in phakic patients	70 %	15 %	55 %	20 %	10 %	0 %
1.3	PR is best suited for RRD involving a single break or clustered breaks within 30 degrees, confined to the upper 8 clock hours.	**90 %**	40 %	50 %	5 %	5 %	0 %
1.4	Retinal break location plays a critical role in surgical planning; PR is ideal for superior break, whereas SB is influenced by the accessibility of buckle placement.	**100 %**	35 %	65 %	0 %	0 %	0 %
1.5	PPV is the preferred surgical approach for RRD complicated by choroidal detachment, marked hypotony, large or giant retinal tears, or the presence of proliferative vitreoretinopathy (PVR).	**100 %**	85 %	15 %	0 %	0 %	0 %
1.6	PPV+SB may offer additive benefits in selected cases, especially in pseudophakic eyes with inferior or anterior breaks, lattice degeneration, or extensive vitreoretinal pathology.	**85 %**	40 %	45 %	10 %	5 %	0 %
1.7	PPV+SB may increase the risk of complications such as diplopia, refractive changes, and buckle-related issues, etc.	**85 %**	25 %	60 %	15 %	0 %	0 %
1.8	The cost-effectiveness of PPV+SB remains unclear and best to be used on a case-by-case basis.	**100 %**	42.86 %	57.14 %	0 %	0 %	0 %
1.9	Early surgical repair yields better visual outcomes in RRD, with macula-off cases benefiting from intervention within 3 days of symptom onset, and macula-on cases within 24 h of presentation.	**89.47 %**	52.63 %	36.84 %	10.53 %	0 %	0 %
1.10	Preoperative bed rest, posturing, and bilateral patching can slow RRD progression. For macula-on RRD, this procedure may help preventing its progression into macula-off RRD.	**94.74 %**	52.63 %	42.11 %	5.26 %	0 %	0 %
1.11	Total retinal detachment may best be managed with PPV, given its capacity to address extensive and multiple pathologies and allow for internal examination and tamponade.	**87.5 %**	37.5 %	50 %	12.5 %	0 %	0 %
1.12	Subtotal detachment with well-localized breaks may be managed with a broader range of techniques, including PR, SB, or PPV, depending on break characteristics, extent of detachment, and lens status.	**95 %**	75 %	20 %	5 %	0 %	0 %
1.13	Bullous RRDs are associated with high mobility and rapid progression, favoring early PPV to prevent macular involvement, improve surgical control, and better postoperative visual outcome.	**75 %**	30 %	45 %	25 %	0 %	0 %
1.14	Shallow or localized detachments may be amenable to PR or SB, especially when the break is superior and easily accessible.	**100 %**	60 %	40 %	0 %	0 %	0 %
2. Vitrectomy Techniques							
2.1	Small gauge vitrectomy, i.e., 23 G, 25 G, and 27 G, can be used in repairing RRD across all spectrums of complexity.	**90 %**	35 %	55 %	10 %	0 %	0 %
2.2	When 27 G vitrectomy is used, a high cut rate (≥10,000 cpm) cutter is preferred as it offsets the limitation of small gauge system to improve the efficiency of both core and peripheral vitrectomy.	**94.74 %**	52.63 %	42.11 %	5.26 %	0 %	0 %
2.3	No matter which gauge of vitrectomy is chosen, the principle of "First-In, Last-Out" of an infusion port should always be applied.	**100 %**	80 %	20 %	0 %	0 %	0 %
2.4	Peripheral vitreous shaving should be performed in all complex RRD cases to maximize the single surgical success rate.	**95 %**	70 %	25 %	5 %	0 %	0 %
2.5	In complicated RRD, the use of triamcinolone assisted vitreous shaving would enhance visibility of vitreous and could improve surgical success rate through ensuring more complete removal of peripheral vitreous.	**100 %**	37.5 %	62.5 %	0 %	0 %	0 %
2.6	Posterior drainage retinotomy should only be performed when it is required to achieve effective fluid-air exchange to flatten the detached retina.	**90 %**	35 %	55 %	5 %	5 %	0 %
2.7	Routine internal limiting membrane peeling over the macula to reduce the risk of postoperative ERM is not recommended, when posterior drainage retinotomy is made.	**87.5 %**	37.5 %	50 %	12.5 %	0 %	0 %
2.8	In complex RRD surgery, including eyes with PVR, GRT, and traumatic RRD, the use of PFCL is to be used when needed.	**100 %**	25 %	75 %	0 %	0 %	0 %
2.9	In simple RRD surgery, the use of PFCL should be based on surgeons' discretion.	**85 %**	30 %	55 %	10 %	5 %	0 %
2.10	All subfoveal PFCL should be removed surgically before finishing PPV, provided that the eye has reasonable visual prognosis.	**100 %**	45 %	55 %	0 %	0 %	0 %
2.11	Using intraoperative wide-angle viewing system should generally improve success rate of PPV for RRD.	**100 %**	70 %	30 %	0 %	0 %	0 %
2.12	The using of contact or noncontact wide-angle viewing systems depends on surgeon's preference and should not affect surgical outcomes.	**95 %**	50 %	45 %	5 %	0 %	0 %
2.13	Newer noncontact viewing systems offer advantage of large field of view without compromising on higher resolution needed for macular procedures.	**80 %**	20 %	60 %	5 %	10 %	5 %
2.14	Heads-up 3D viewing systems are best suited for surgeons ergonomically, but do not improve surgical outcomes or success rate.	**85 %**	40 %	45 %	15 %	0 %	0 %
2.15	Optimal visualization during vitrectomy requires a balance of magnification and illumination.	**100 %**	60 %	40 %	0 %	0 %	0 %

(*continued on next page*)

Table 3 (*continued*)

Section	Consensus Statements	C Score	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
2.16	To prevent iatrogenic breaks, it is crucial to avoid vigorous induction of posterior vitreous detachment (PVD), using high cutter speeds near mobile retina, and minimizing instrument trauma.	**95 %**	70 %	25 %	5 %	0 %	0 %
2.17	If acute choroidal detachment occurs during vitrectomy, infusion port should be checked first. surgery should not proceed.	**95 %**	70 %	25 %	5 %	0 %	0 %
2.18	If acute choroidal detachment occurs during scleral buckle, immediate applying digital pressure on the eye for 3–5 min is advisable. Immediate conversion to vitrectomy providing a view to drainage of the CD and retinal detachment repair may be considered if conditions are favorable.	**80 %**	20 %	60 %	5 %	15 %	0 %
3. Tamponade Agents							
3.1	The effectiveness of air tamponade for primary RRD remains controversial, as its shorter half-life may be inadequate for inferior or complex retinal breaks compared to conventional gas tamponades.	**95 %**	55 %	40 %	5 %	0 %	0 %
3.2	The selection between gas tamponades and silicone oil for RRD repair is contentious, particularly in cases of complex RRD or PVR, with variable outcomes based on tamponade duration and patient-specific factors.	**95 %**	50 %	45 %	0 %	5 %	0 %
3.3	The impact of prolonged silicone oil tamponade on visual outcomes and complications, such as silicone oil-related visual loss (SORVL), remains poorly understood and controversial, with no consensus on the underlying mechanisms.	**85 %**	35 %	50 %	15 %	0 %	0 %
3.4	The optimal timing for silicone oil removal remains controversial, with recommendations varying from 3 to 6 months to longer durations depending on the individual risk of complications like emulsification and retinal redetachment.	**95 %**	60 %	35 %	0 %	5 %	0 %
3.5	Whether prophylactic 360-degree laser retinopexy reduces redetachment risks after oil removal is debated, with some studies suggesting benefits while others report no significant impact on outcomes.	**90 %**	40 %	50 %	10 %	0 %	0 %
3.6	There is ongoing debate over whether 5000 cSt silicone oil provides significant general advantages over 1000 cSt, with studies showing conflicting outcomes regarding anatomical success, emulsification rates, and ease of removal.	**95 %**	25 %	70 %	5 %	0 %	0 %
3.7	The preference of heavy silicone oil, such as Densiron−68, over standard silicone oil for complicated cases, such as inferior detachment, large detachment, and PVR Garde C or more, is debated, with studies highlighting case-specific benefits for Densiron but concerns about its higher rate of complications, such as emulsification, inflammation, fibrosis, or macular thinning.	**100 %**	30 %	70 %	0 %	0 %	0 %
3.8	The recommended duration of Densiron tamponade is 70–140 days, which is shorter than standard silicone oil, due to its complication risks, though prolonged use up to 26 months may be necessary in select complex cases.	**85 %**	15 %	70 %	15 %	0 %	0 %
3.9	Heavy silicone oil should be removed sooner than conventional silicone oil.	**75 %**	35 %	40 %	25 %	0 %	0 %
4. Endolaser and Cryotherapy							
4.1	Cryoretinopexy is usually recommended as a routine for treating retinal breaks in SB for RRD.	**100 %**	37.5 %	62.5 %	0 %	0 %	0 %
4.2	In SB for RRD, alternative to cryoretinopexy, laser photocoagulation can be used to treat retinal breaks postoperatively or, if necessary, prior to buckle removal.	**85 %**	35 %	50 %	10 %	5 %	0 %
4.3	The most concern adverse event of cryoretinopexy is the higher risk of PVR due to RPE pigment dispersion after the procedure.	**95 %**	45 %	50 %	5 %	0 %	0 %
4.4	Symptomatic horseshoe retinal tears in eyes without retinal detachment should almost always be treated with laser photocoagulation.	**100 %**	65 %	35 %	0 %	0 %	0 %
4.5	All retinal breaks, e.g. retinal holes, retinal tears without symptoms, in the fellow eyes of RRD should be treated with laser photocoagulation.	**95 %**	50 %	45 %	5 %	0 %	0 %
Section 5. Special situations							
5.1	Vitrectomy is the preferred surgical approach in the management of Giant retinal tear related retinal detachment.	**100 %**	80 %	20 %	0 %	0 %	0 %
5.2	In fresh GRT-retinal detachment, 3 port pars plana vitrectomy is most of the time sufficient, while in chronic cases and in cases with PVR, bimanual techniques offer better surgical control.	**75 %**	12.5 %	62.5 %	12.5 %	12.5 %	0 %
5.3	Lens preservation is preferred in younger patients with posterior retinal tears, but lens removal has to be considered when there is an anterior extension or lens opacity limits safe peripheral access.	**100 %**	25 %	75 %	0 %	0 %	0 %
5.4	Appropriate intraoperative positioning of eye is crucial for successful outcomes.	**84.21 %**	47.37 %	36.84 %	15.79 %	0 %	0 %
5.5	While direct PFCL–silicone oil exchange may reduce retinal flap slippage, PFCL–air exchange followed by air–silicone oil injection is generally preferred due to lower procedure related complication.	**80 %**	15 %	65 %	15 %	5 %	0 %
5.6	Silicone oil is the tamponade of choice in majority of cases, with selected use of other agents such as Densiron (a heavy silicone oil), or gas for postoperative tamponade, or PFCL for intraoperative assistance.	62.5 %	12.5 %	50 %	12.5 %	25 %	0 %
5.7	Maintaining correct retinal orientation is essential to prevent slippage and folds and ensure optimal visual and anatomical outcomes postoperatively.	**94.74 %**	42.11 %	52.63 %	5.26 %	0 %	0 %
5.8	Early detection and prompt management of retinal incarceration are key to preventing redetachment, ensuring stability, and improve success rate in repair of RRD from GRT.	**94.73 %**	21.05 %	73.68 %	5.26 %	0 %	0 %

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Table 3 (*continued*)

Section	Consensus Statements	C Score	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
5.9	Surgery for Inferior RRD, in general, may have lower postoperative re-attachment rate, compared to RRD due to retinal breaks somewhere else.	**84.21 %**	5.26 %	78.95 %	10.53 %	0 %	5.26 %
5.10	PPV and meticulous vitreous base excision, judiciously combined with phacoemulsification achieves similar re-attachment rates as SB for repair of inferior RRD.	**87.5 %**	37.5 %	50 %	12.5 %	0 %	0 %
5.11	Optimal volume of tamponade agent with compliance to face down positioning is essential for the success of PPV for inferior RRD.	**100 %**	62.5 %	37.5 %	0 %	0 %	0 %
5.12	In uncomplicated inferior break RD, PPV with gas endotamponade achieves comparable success with silicone oil. For complex RD with inferior breaks, the tamponade of choice is silicone oil.	**87.5 %**	37.5 %	50 %	12.5 %	0 %	0 %
6. Anesthesia and Positioning							
6.1	Regional anesthesia is a cost effective and safe procedure with higher utilitiy in various vitrectomy settings.	**100 %**	78.95 %	21.05 %	0 %	0 %	0 %
6.2	General anesthesia is essential for select population such as paediatric age group and anxious adults.	**95 %**	65 %	30 %	5 %	0 %	0 %
6.3	Topical anesthesia has limited utility in vitrectomy procedures, particularly for RRD.	**90 %**	65 %	25 %	0 %	10 %	0 %
6.4	Intraoperative and postoperative factors play a role in choosing appropriate anesthesia technique.	**84.21 %**	36.84 %	47.37 %	15.79 %	0 %	0 %
6.5	Regional anesthesia is the preferred anesthesia modality in various emergency situations for RRD repair.	**80 %**	35 %	45 %	20 %	0 %	0 %
6.6	Supine positioning of patient remains the standard positioning in vitrectomy with limited role of lateral decubitus positioning.	**89.47 %**	36.84 %	52.63 %	10.53 %	0 %	0 %
6.7	Patient head positioning plays important role to achieve optimal field of view.	**100 %**	50 %	50 %	0 %	0 %	0 %
6.8	Surgeon ergonomics plays an important role not just in surgical outcomes but also influences career longevity.	**95 %**	55 %	40 %	5 %	0 %	0 %
7. Postoperative Management							
7.1	Head positioning is one of the key elements to successful vitrectomy for RRD. A face-down position in the first 24 h after surgery is usually advised to flatten the macula and prevent fluid re-accumulation under the macula.	**100 %**	50 %	50 %	0 %	0 %	0 %
7.2	The optimal head position, at least 2/3 or 3/4 of the time during a day, to close the retinal break is advisable at least the initial 1–2 weeks after PPV.	**90 %**	45 %	45 %	5 %	5 %	0 %
7.3	A 'never adopt' head position is also advised (e.g. face up, face forward/ propped sitting up' for inferior breaks, lateral with the break side down for predominantly temporal and nasal breaks).	**90 %**	25 %	65 %	5 %	5 %	0 %
7.4	Patients should maintain maximal rest and minimal head/eye movement during the initial 1–2 weeks to ensure appropriate posture, gradually resuming light activities like leisurely walks after this period.	**80 %**	40 %	40 %	15 %	5 %	0 %
7.5	Patients with intraocular gas should avoid air travel until complete gas resorption. If travelling by land, ascend gradually in high-altitude regions with consideration of prophylactic AGM, and exercise caution with elevator travel in tall buildings postoperatively.	**87.5 %**	50 %	37.5 %	12.5 %	0 %	0 %
7.6	On the first day after PPV with vitreous tamponade or SB for RRD, intraocular pressure (IOP) should be measured for all patients to detect overfill of vitreous tamponades or other causes.	**100 %**	80 %	20 %	0 %	0 %	0 %
7.7	Tamponade overfill should be avoided at the completion of surgery. Digital estimation of IOP is usually adequate and reliable with experience.	**100 %**	45 %	55 %	0 %	0 %	0 %
7.8	Prophylactic oral acetazolamide may be initiated if gas overfill is suspected; if this medical therapy fails, partial gas removal may be needed.	**100 %**	35 %	65 %	0 %	0 %	0 %
7.9	Inferior peripheral iridectomy should be routinely performed in aphakic eyes filled with silicone oil to avoid pupillary block.	**100 %**	75 %	25 %	0 %	0 %	0 %
7.10	For silicone oil tamponade, acute IOP elevation due to oil in the anterior chamber often requires surgical intervention, such as partial oil removal or reformation of the inferior iridotomy.	**100 %**	55 %	45 %	0 %	0 %	0 %
7.11	Significant "kissing" choroidal detachments, if found postoperatively, may require surgical drainage within days, while less severe ones can be observed.	**90 %**	50 %	40 %	5 %	5 %	0 %
7.12	Widefield retinal imaging or optical coherence tomography (OCT) are useful tools to document postoperative retina re-attachment or redetachment.	**95 %**	65 %	35 %	5 %	0 %	0 %
7.13	Surgery for slow progressing secondary cataract after PPV can be planned at a minimum of 6 months after the retina is re-attached and stable.	**95 %**	25 %	70 %	5 %	0 %	0 %
7.14	Phacoemulsification for a secondary cataract after vitrectomy is usually routine and uncomplicated with some caveats which cataract surgeons should anticipate, such as weak zonules, unusually deepen anterior chamber, fibrosed posterior capsule, etc.	**100 %**	65 %	35 %	0 %	0 %	0 %
7.15	Extremely rapid cataract formation, especially of the mature cortical variety, may indicate an iatrogenic injury to the lens during vitrectomy. Phacoemulsification for these cases can be performed sooner and may encounter more complications than usual.	**100 %**	55 %	45 %	0 %	0 %	0 %
7.16	After primary SB, a persistent detachment might be observed for 3–4 weeks if signs indicate gradual resolution, but if the detachment worsens, expedient intervention, most likely vitrectomy with tamponade, is required.	**100 %**	30 %	70 %	0 %	0 %	0 %

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Table 3 (*continued*)

Section	Consensus Statements	C Score	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
7.17	If redetachment occurs after primary vitrectomy, options include fluid-gas exchange in the office or repeat vitrectomy with retinopexy, and gas/ silicone oil fill in the operating room.	**95 %**	40 %	55 %	5 %	0 %	0 %
7.18	If repeated vitrectomy is the 'rescue' procedure after initial failed surgery, every effort should be made to ensure this will be the definitive and final procedure to attain permanent retinal attachment.	**100 %**	70 %	30 %	0 %	0 %	0 %
7.19	If PVR is deemed to be the cause of persistent detachment or redetachment, waiting 4–6 weeks for the PVR to 'mature' before reoperation is best considered on a case-by-case basis.	**75 %**	50 %	25 %	25 %	0 %	0 %
7.20	Final visual outcomes are generally poorer if initial surgery is unsuccessful and further surgery is required. Initial counselling with patients and their caregivers before primary surgery should have included the chances and consequences of failure to re-attach the retina and the possible need for further surgery.	**100 %**	70 %	30 %	0 %	0 %	0 %
8. Special Populations							
8.1	Vitrectomy is the preferred procedure of choice in pediatric RRD cases, mainly for cases with retinal breaks posterior to the equator, presence of proliferative vitreoretinopathy, media opacities or in retinal redetachment.	**89.47 %**	42.11 %	47.37 %	10.53 %	0 %	0 %
8.2	Lens sparing vitrectomy surgery is the preferred approach in pediatric RRD cases as much as possible. Sparing the lens reduces postoperative complications like glaucoma or cataract and facilitates quicker rehabilitation.	**100 %**	47.37 %	52.63 %	0 %	0 %	0 %
8.3	Primary scleral buckle is the procedure of choice in pediatric RRD cases with pathology anterior to the equator as it offers a higher rate of anatomical success especially in eyes with formed and adherent posterior hyaloid.	**100 %**	63.16 %	36.84 %	0 %	0 %	0 %
8.4	Achieving posterior vitreous detachment is essential in older children to increase the success of RRD vitrectomy surgery. However, forceful creation should be avoided in ROP or infants where the vitreous adhesion is strong and the risk of iatrogenic tears is high.	**94.74 %**	52.63 %	42.11 %	5.26 %	0 %	0 %
8.5	The standard 25 G instruments are a good middle ground in pediatric eyes, allowing efficient clearing of the more tenacious vitreous, yet small and rigid enough to enable safe manoeuvring in the thick vitreous and thin sclera.	**94.74 %**	36.84 %	57.89 %	5.26 %	0 %	0 %
8.6	The current 27 G+ vitrectomy and its instruments still lack popular support among the pediatric VR surgeons.	72.23 %	16.67 %	55.56 %	22.22 %	5.56 %	0 %
8.7	Pneumatic retinopexy is an option in older children with RRD fulfilling The Pneumatic Retinopexy versus Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes Randomized Trial (PIVOT) criteria. Support from motivated parents is crucial in achieving primary re-attachment success.	**78.95 %**	26.32 %	52.63 %	10.53 %	10.53 %	0 %
8.8	Longer-acting gas is the preferable choice of vitreous tamponade mainly in older children (16–18years old).	**89.48 %**	26.32 %	63.16 %	10.53 %	0 %	0 %
8.9	Silicone oil is preferred in infants and children who are unable to posture, in cases where longer tamponade is needed and the retinal pathology is predominantly inferior.	**100 %**	45 %	55 %	0 %	0 %	0 %
8.10	Silicone oil use in coloboma-RRD and optic nerve pit-RRD remains controversial due to the concern of silicone oil leak through the coloboma defect or optic nerve pit, that will access the central nervous system.	**95 %**	40 %	55 %	0 %	5 %	0 %
8.11	In patients with type 1 Stickler syndrome, prophylactic treatment with cryotherapy to the peripheral retina is controversial. We prefer to perform this with laser photocoagulation, and only in those with high-risk peripheral retinal lesions such as lattice degeneration.	**100 %**	45 %	55 %	0 %	0 %	0 %
8.12	In Marfan eyes with high myopia, prophylactic treatment to high-risk lesions (eg. lattice degeneration, retinal holes) in the asymptomatic fellow eye is recommended, similar to any patient with high myopia and retinal detachment in one eye.	**100 %**	30 %	70 %	0 %	0 %	0 %
8.13	Safe reuse of select instruments and investment in modular technology can promote high quality, affordable vitrectomy.	**85 %**	15 %	70 %	10 %	5 %	0 %
8.14	Enhanced surgical training, promoting autonomous techniques and use of cost-effective alternatives can optimize vitrectomy in limited resource settings.	**90 %**	25 %	65 %	5 %	5 %	0 %
8.15	The approaches to sustainable practices in RRD surgery should be applied to not only resource-limited settings but to settings for the RRD surgery worldwide.	**100 %**	50 %	50 %	0 %	0 %	0 %
9. Future technology and Innovation							
9.1	Ultra widefield images would help detect peripheral retinal breaks before the surgery and therefore be recommended when the facility is available.	**100 %**	62.5 %	37.5 %	0 %	0 %	0 %
9.2	Intraoperative OCT offers surgical advantages in providing real-time anatomical visualization during surgery for RRD. However, its overall clinical benefits remain equivocal without significant impact on final surgical outcomes.	**95 %**	10 %	85 %	0 %	5 %	0 %
9.3	Development of an accurate artificial intelligence (AI) model to analyze widefield retinal images may provide guidance on the surgical approach	**87.5 %**	12.5 %	75 %	12.5 %	0 %	0 %

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Table 3 (*continued*)

Section	Consensus Statements	C Score	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
	and predict surgical outcome in RRD, and therefore is warranted for further research.						
9.4	Large language model (LLM) chatbots, such as ChatGPT, may be used with caution to support the comprehensive care of patients with RRD.	**95 %**	20 %	75 %	5 %	0 %	0 %
9.5	The role of adjuvant, such as low-dosed intravitreal methotrexate, for preventing PVR in complicated RRD remains under investigations. Further studies of adjuvants or other modalities to prevent PVR are needed.	**100 %**	40 %	60 %	0 %	0 %	0 %

Consensus Score (C Score) was defined as the value of the summation of the ‘strongly agree’, and ‘agree’ percentages; C Score ≥ 75 % was considered ‘consensus achieved’ and C Score < 75 % was ‘consensus not reached’. Only three statements were ‘consensus not achieved’ (with the C Score underlined).

Artificial intelligence

Artificial intelligence (AI) has been integrating to daily life of many people. Large language model chatbots, such as ChatGPT or Google Gemini, is one of the recent advancements in AI that is particularly useful in various aspects. From an ophthalmology perspective, it not only enhances patient accessibility to basic medical knowledge but also serves as a clinician assistant by supporting patient counselling and suggesting surgical planning.[232–235]

For example, ChatGPT can response to questions regarding RRD patient education with 84.6 % appropriateness, evaluated by vitreoretinal specialists.[236] In addition, recent studies demonstrated that ChatGPT can generate RRD surgical suggestion for vitreoretinal surgeons with more than 80 % agreement.[237]

In conclusion, AI can serve as a valuable tool for patient education and clinical support for physicians in association with RRD management. However, there are several limitations, such as the accuracy of information and ethical concerns, which must be carefully considered before integrating such AI into medical practice.

Adjuvants for PVR prevention

Methotrexate is an antimetabolite that targets folic acid pathway, inhibiting DNA synthesis and subsequently reducing cellular proliferation. Intravitreal methotrexate has been proven to be effective in the treatment of vitreoretinal lymphoma and retinoblastoma.

More recently, the clinical applications have recently expanded to various intraocular conditions, such as PVR in complicated RRD, diabetic retinopathy and uveitis. While the commonly used dosage for managing intraocular lymphoma is 400 μg of intravitreal methotrexate, lower doses ranging from 100 μg to 250 μg have been explored for PVR prevention in RRD.[238]

In addition, low-dose intravitreal methotrexate can help control postoperative inflammation and PVR in complex RRD cases, particularly in pediatric patients and redetachment RRD.[238,239]

However, there remains a lack of strong evidence supporting clinical efficacy of intravitreal methotrexate in RRD surgery.

Consensus Statement 9.1: *Ultra widefield images would help detect peripheral retinal breaks before the surgery and therefore be recommended when the facility is available. (Consensus score: 100 % [strongly agree: 62.5 %; agree: 37.5 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 9.2: *Intraoperative OCT offers surgical advantages in providing real-time anatomical visualization during surgery for RRD. However, its overall clinical benefits remain equivocal without significant impact on final surgical outcomes. (Consensus score: 95 % [strongly agree: 10 %; agree: 85 %; neutral: %; disagree: 5 %; strongly disagree: 0 %])*

Consensus Statement 9.3: *Development of an accurate artificial intelligence (AI) model to analyze widefield retinal images may provide guidance on the surgical approach and predict surgical outcome in RRD and therefore is warranted for further research. (Consensus score: 87.5 % [strongly agree: 12.5 %; agree: 75 %; neutral: 12.5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 9.4: *Large language model (LLM) chatbots, such as ChatGPT, may be used with caution to support the comprehensive care of patients with RRD. (Consensus score: 95 % [strongly agree: 20 %; agree: 75 %; neutral: 5 %; disagree: 0 %; strongly disagree: 0 %])*

Consensus Statement 9.5: *The role of adjuvant, such as low-dosed intravitreal methotrexate, for preventing PVR in complicated RRD remains under investigations. Further studies of adjuvants or other modalities to prevent PVR are needed. (Consensus score: 100 % [strongly agree: 40 %; agree: 60 %; neutral: 0 %; disagree: 0 %; strongly disagree: 0 %])*

4. Results of voting and discussion

Table 3 shows the voting results of consensus statements on RD.

The consensus statements in this Delphi exercise highlight both areas of clarity and ongoing debate in the surgical management of RRD.

A clear pattern emerged around surgical approach: SB was favored for younger, phakic patients, while PPV was widely preferred in pseudophakic eyes and in more complex scenarios such as GRT, PVR, or detachments complicated by hypotony. PR was supported in selected cases, particularly superior breaks confined to limited quadrants. Retinal break location was consistently emphasized as central to planning.

Vitrectomy techniques received strong consensus, especially around the versatility of small-gauge surgery (23 G–27 G), the importance of meticulous peripheral vitreous shaving, and selective use of PFCL. Enhanced visualization using wide-angle systems and adjunctive triamcinolone was widely endorsed. Safety principles—such as avoiding vigorous posterior vitreous detachment induction and maintaining careful infusion control—were viewed as fundamental.

Tamponade selection, while reaching consensus on many points, remains nuanced. Gas tamponades were seen as sufficient for most primary detachments, whereas SO retains an important role in complex or inferior pathology, and in patients unable to posture. However, there was no consensus on its role as the tamponade of choice in the majority of special RRD situations, with mixed views on whether alternatives such as Densiron or gas might sometimes be preferable. Similarly, the optimal timing for SO removal and the role of prophylactic 360-degree laser remains debated.

Two further areas did not reach consensus. First, the statement that PPV yields superior anatomic success in pseudophakic eyes, while SB is superior in phakic patients, achieved only 70 % agreement—suggesting surgeons value these principles but recognize overlapping indications. Second, in pediatric surgery, the adoption of newer 27 G+ instruments failed to gain broad support (72.2 %), with many surgeons preferring 25 G as a more balanced option.

Overall, strong consensus was achieved across anesthesia choices, patient positioning, postoperative care, and most surgical strategies. Future directions such as widefield imaging, intraoperative OCT, AI, and pharmacologic adjuvants were acknowledged as promising but requiring further study before routine adoption.

Limitations of this study are similar to those with Delphi-based. The conclusions may be limited by the opinions of the experts who participated, which are prone to selection bias. The absence of direct outcome validation may also restrict the conclusions drawn from this study.

Conclusions

This consensus process revealed broad agreement on the surgical management of RRD while highlighting a few key areas of uncertainty. Most statements reached consensus, underscoring the enduring value of tailoring surgical choice to patient age, lens status, and retinal break characteristics. Small-gauge vitrectomy, careful vitreous base management, and appropriate postoperative positioning were universally emphasized as cornerstones of success. Notably, three domains did not reach full consensus: the relative benefits of PPV versus SB depending on lens status (70 %), the use of SO as the default tamponade in complex RRD (62.5 %), and the role of 27 G+ systems in pediatric surgery (72.2 %). These areas highlight persisting variability in surgical practice and a degree of caution in adopting newer technologies. As with all Delphi-based designs, the conclusions are limited by expert opinion, potential selection bias, and the absence of direct outcome validation. Nevertheless, the process does provide some valuable collective guidance to readers. These findings reaffirm the established principles while identifying areas for further study. Personalized surgical planning adaptable to individual patient context remains the foundation for optimal outcomes in RRD repair.

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Consent

All authors consent to be co-authors of this manuscript.

Declaration of competing interests

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