

Anatomical and Functional Outcomes Following Silicone Oil Removal: A Retrospective Analysis

Résultats anatomiques et fonctionnels après ablation d'huile de silicone: Une étude rétrospective

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ABSTRACT

Introduction: Silicone oil (SO) tamponade is widely employed in the management of complex retinal detachments. Despite its advantages, SO requires subsequent removal, which carries a risk of complications and variable visual recovery.

Aim: To evaluate anatomical and functional outcomes, as well as postoperative complications, following SO removal in patients with complex retinal detachments.

Methods: A retrospective review was conducted of patients who underwent SO removal between January 2020 and June 2025 at a tertiary ophthalmic care center. Inclusion criteria comprised adults with rhegmatogenous retinal detachment, tractional retinal detachment, or trauma-related detachment, with ≥ 6 months of postoperative follow-up. Primary outcomes were anatomical reattachment and best-corrected visual acuity (BCVA) improvement. Secondary outcomes included rates of recurrent detachment, hypotony, ocular hypertension, cataract progression, and corneal complications.

Results: Ninety-eight eyes of 94 patients were analyzed. The mean SO tamponade duration was 11.56 ± 4.8 months. Final anatomical success was achieved in 88.8% of eyes. Functional success (BCVA $\geq 20/200$ at 6 months) was observed in 53.1% of cases. Recurrent retinal detachment occurred in 11.2% of eyes. Hypotony developed in 17.3%, ocular hypertension in 8.2%, and corneal complications in 12.2%. Cataract extraction was combined with SO removal in 83.9% of phakic eyes. Significant BCVA improvement was noted across all major etiological subgroups ($p < 0.01$).

Conclusion: SO removal yields high anatomical reattachment rates but variable functional recovery. Complication risks remain clinically relevant, underscoring the importance of individualized timing and surgical planning to optimize long-term visual and anatomical outcomes.

Keywords: Silicone oil removal, Rhegmatogenous retinal detachment, Tractional retinal detachment, Vitrectomy Retinal reattachment, Postoperative complication

RÉSUMÉ

Introduction: Le tamponnement par huile de silicone (HS) est largement utilisé dans la prise en charge des décollements de rétine complexes. Malgré ses avantages, l'HS nécessite un retrait secondaire, comportant un risque de complications et une récupération visuelle variable.

Objectif: Évaluer les résultats anatomiques et fonctionnels ainsi que les complications postopératoires après ablation de l'HS chez des patients présentant un décollement de rétine complexe.

Méthodes: Une étude rétrospective a été réalisée chez des patients ayant bénéficié d'une ablation de l'HS entre janvier 2020 et juin 2025 dans un centre hospitalo-universitaire tertiaire. Les critères d'inclusion comprenaient des adultes atteints de décollement de rétine rhégmatoïde, de décollement de rétine tractionnel ou secondaire à un traumatisme oculaire, avec un suivi postopératoire ≥ 6 mois. Les critères principaux étaient la réapplication anatomique rétinienne et l'amélioration de la meilleure acuité visuelle corrigée (MAVC). Les critères secondaires incluaient les taux de récurrence, d'hypotonie, d'hypertension oculaire, de progression de la cataracte et de complications cornéennes.

Résultats: Quarante-deux yeux de 94 patients ont été analysés. La durée moyenne de tamponnement par HS était de $11,56 \pm 4,8$ mois. Le succès anatomique final a été atteint dans 88,8% des yeux. Le succès fonctionnel (MAVC $\geq 20/200$ à 6 mois) a été observé dans 53,1% des cas. Une récurrence de décollement de rétine est survenue dans 11,2% des yeux. Une hypotonie a été observée dans 17,3%, une hypertension oculaire dans 8,2%, et des complications cornéennes dans 12,2%. L'extraction de la cataracte a été associée à l'ablation de l'HS dans 83,9% des yeux phakes. Une amélioration significative de la MAVC a été observée dans tous les principaux sous-groupes étiologiques ($p < 0,01$).

Conclusion: L'ablation de l'HS permet d'obtenir des taux élevés de réapplication anatomique mais une récupération fonctionnelle variable. Les risques de complications restent cliniquement significatifs, soulignant l'importance d'un calendrier individualisé et d'une planification chirurgicale adaptée pour optimiser les résultats visuels et anatomiques à long terme.

Mots-clés: Ablation de l'huile de silicone, Décollement de rétine rhégmatoïde, Décollement de rétine tractionnel, Vitrectomie, Réapplication rétinienne, Complication postopératoire

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What is known ?

- Silicone oil tamponade is frequently used in the management of complex and refractory retinal detachments.
- Removal of silicone oil is essential after retinal stability is achieved but may result in anatomical and functional complications.
- The discrepancy between anatomical success and visual recovery following silicone oil removal has been consistently observed.

What this article adds ?

- This study demonstrates a high rate of anatomical reattachment (88.8%) following silicone oil removal in a large retrospective cohort.
- Functional visual improvement was achieved in 53.1% of eyes, while complication rates such as hypotony, ocular hypertension, and corneal decompensation remain clinically significant.
- Individualized timing and careful surgical planning for silicone oil removal are emphasized to optimize both anatomical and functional outcomes in patients with complex retinal detachment.

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) represents the most common form of retinal detachment encountered in ophthalmic practice (1). It constitutes an ocular emergency, as delayed treatment can rapidly worsen visual prognosis. Tractional retinal detachment (TRD), most often secondary to diabetic retinopathy, similarly results in severe and rapid vision loss and may progress to blindness if left untreated (2). Management options for retinal detachment include primary scleral buckle, pars plana vitrectomy with tamponade using silicone oil (SO) or gas, or a combination of these techniques.

SO was first introduced as a vitreous substitute by Cibis et al. in 1962 (3) (4). Its clinical use expanded following the development of pars plana vitrectomy in the 1970s, and it received FDA approval for intraocular application in 1997. Since then, SO tamponade has become a standard approach in the treatment of complex retinal detachments, particularly those complicated by giant retinal tears, proliferative vitreoretinopathy (PVR), viral retinitis, and ocular trauma (5) (6). Multiple studies have confirmed that SO provides more effective internal tamponade compared to sulfur hexafluoride gas (SF6) in eyes with advanced PVR, resulting in improved anatomical and functional outcomes (7) (8).

The physical properties of SO, notably its high viscosity and buoyancy, generate a sustained tamponade effect that promotes retinal reattachment (9). Furthermore, its optical clarity supports early postoperative visual assessment and accurate monitoring of retinal status (9). Despite these advantages, long-term SO use is associated with complications such as glaucoma and keratopathy,

limiting its use to severe or complex cases (10). Once retinal stability is achieved, SO must be removed, requiring an additional surgical procedure that carries a risk of recurrent retinal detachment (11).

The objective of this retrospective study is to describe and evaluate the anatomical and functional outcomes, as well as postoperative complications, in patients who underwent SO removal at our institution.

METHODS**Study Design and Setting**

This retrospective study was conducted at a tertiary ophthalmic care center. Clinical data from patients who underwent SO removal following vitreoretinal surgery for retinal detachment were reviewed. Data were collected between January 2020 and June 2025. The study adhered to the tenets of the Declaration of Helsinki and received approval from the Institutional Review Board.

Inclusion Criteria

Patients aged 18 years or older who underwent SO removal after vitreoretinal surgery for RRD, TRD, or ocular trauma were included. A minimum postoperative follow-up of six months after SO removal was required.

Exclusion Criteria

Eyes with insufficient follow-up were excluded. Cases of endophthalmitis, or eyes treated with heavy SO were also excluded. Furthermore, eyes affected by macular or optic nerve diseases confirmed prior to retinal detachment diagnosis—such as macular hole or epiretinal membrane—were not included. Patients with unreliable visual acuity (VA) measurements were excluded to ensure precise functional evaluation.

Surgical Procedures

Surgeries were performed by five surgeons (BI, AM, CF, BA, and MH), employing a standardized technique throughout the study period. SO with a viscosity of 5000 centistokes was used in all cases. SO removal was conducted under local or general anesthesia using a standard three-port pars plana vitrectomy approach. Complete aspiration of SO was ensured. In patients with significant visual loss secondary to cataract, cataract extraction was performed concurrently with SO removal. Following removal, vitreous substitutes included balanced salt solution or air in 90% of eyes, and gas tamponade (SF6 18–20% or C3F8 12–15%) in 10% of eyes. Postoperative management included topical antibiotics and steroids. Follow-up examinations were scheduled at 1 day, 1 month, and 6 months.

Data Collection

Demographic and clinical data were retrospectively extracted from medical records. Best-corrected visual

acuity (BCVA) was assessed using Snellen charts at multiple time points: before SO removal and at day 1, month 1, and month 6 post-removal. Intraocular pressure (IOP) was measured using a non-contact tonometer. Slit-lamp biomicroscopy and fundus examinations were documented. Additional variables collected included indications for SO placement and removal, duration of SO tamponade, cataract progression, rates of retinal redetachment, and corneal complications.

Surgical factors potentially influencing the risk of postoperative complications were also recorded, including the use of 360° peripheral laser photocoagulation during the initial vitreoretinal procedure, the extent of retinotomy or retinectomy, and the use of a scleral encircling band

Outcome Measures

The primary outcomes were anatomical success, defined as retinal reattachment at 6 months follow-up, and functional success, defined as BCVA $\geq 20/200$ at 6 months after silicone oil removal. Changes in BCVA across visits were analyzed as a continuous outcome. Secondary outcomes included recurrent retinal detachment, hypotony (IOP < 6 mmHg on ≥ 2 visits), ocular hypertension (IOP > 24 mmHg on ≥ 2 visits), cataract progression, and corneal complications.

Statistical Analysis

Snellen VA measurements were converted to the logarithm of the minimum angle of resolution (logMAR) for statistical analysis. Continuous variables were summarized as mean $\pm$ standard deviation (SD) when approximately normally distributed, or as median with interquartile range (IQR) otherwise. Categorical variables were presented as counts and percentages. Normality of continuous variables was assessed using the Shapiro–Wilk test.

For within-eye comparisons of preoperative and postoperative values, paired Student t-tests were used for normally distributed data, and Wilcoxon signed-rank tests for non-normally distributed data. Between-group comparisons of continuous variables were performed using independent-samples Student t-tests when normality and homoscedasticity assumptions were met, or Mann–Whitney U tests otherwise. Categorical variables were compared using the Chi-square test, or Fisher's exact test when expected cell counts were < 5 . All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant.

RESULTS

Patient Demographics and Baseline Characteristics

A total of 98 eyes from 94 patients underwent SO removal between January 2020 and June 2025. All eyes demonstrated complete retinal reattachment and no longer required SO tamponade at the time of removal.

The mean follow-up duration after SO removal was 8.65 ± 2.02 months.

The mean age at presentation was 61.7 ± 8.8 years. Male patients comprised 68.08% (64/94) of the cohort. The most common systemic comorbidities included diabetes mellitus (42 patients, 44.68%), hypertension (37 patients, 39.36%), and dyslipidemia (17 patients, 18.09%).

Regarding retinal detachment etiology, complex RRDs—including combined RRD/TRD with PVR or giant retinal tears—were present in 55.1% (54/98). Diabetic TRDs due to multiple stretch holes and extensive traction accounted for 29.6% (29/98), while trauma-related detachments, including open globe injuries, occurred in 15.3% (15/98). The mean duration of SO tamponade prior to removal was 11.56 ± 4.8 months. SO extraction was performed using 23 gauge sclerotomies (Table 1).

Table 1. Demographic and Clinical Characteristics of the Study Population

Parameter	Value
Mean age (y) $\pm$ SD	61.7 ± 8.8
Sex, n(%)	
▪ Male	64 (68.08%)
▪ Female	30 (31.91%)
Eye, n(%)	
▪ Right	41 (41.83%)
▪ Left	57 (58.16%)
Indication for SO, n(%)	
▪ Complex RRD	54 (55.10%)
▪ Diabetic TRD	29 (29.59%)
▪ Ocular trauma	15 (15.30%)
Mean duration of silicone oil tamponade (month) $\pm$ SD	11.56 ± 4.8

SD: Standard Deviation, RD: Recurrent retinal detachment, RRD: Rhegmatogenous retinal detachment, TRD: Tractional retinal detachment

Preoperative Outcomes

The mean VA before SO removal was 1.1 ± 0.5 LogMAR. Prior to SO removal, 31.6% (31/98) of eyes were phakic, 58.2% (57/98) were pseudophakic (all with posterior chamber intraocular lenses), and 10.2% (10/98) were aphakic. Among phakic eyes, a visually significant cataract—defined as $\geq 3+$ nuclear sclerosis, $\geq 2+$ posterior subcapsular cataract, or mature cataract—was noted in 83.9% (26/31). No cases of phacodonesis were identified. The mean preoperative IOP was 17.1 ± 6.8 mm Hg (range: 10.2 to 37 mmHg). Ocular hypertension (IOP > 24 mm Hg) was observed in 12.2% (12/98), while no preoperative hypotony (IOP < 6 mm Hg) was detected.

Surgical Characteristics of Initial Vitreoretinal Procedure

During the initial vitreoretinal surgery, 360° peripheral laser photocoagulation was performed in 50.0% (49/98) of cases, a scleral encircling band was placed in 6.1% (6/98), and extensive retinotomy or retinectomy was performed in 15.3% (15/98).

Postoperative Outcomes

The primary functional outcome—defined as BCVA $\geq$

20/200 at 6 months postoperatively—was achieved in 53.1% (52/98) of eyes. Final anatomical success—defined as complete retinal reattachment without the need for SO—was achieved in 88.8% (87/98).

Mean VA significantly worsened from 1.1 ± 0.5 logMAR preoperatively to 1.70 ± 0.60 on postoperative day one ($P < 0.001$), reflecting transient postoperative effects. By month one, VA had substantially improved to 1.07 ± 0.58 logMAR, and by month six, further recovery was observed, with mean VA reaching 0.91 ± 0.72 logMAR ($P < 0.001$ compared to baseline). Statistically significant visual improvement was noted in all major subgroups: complex RRD ($P = 0.002$), diabetic TRD ($P = 0.009$), and trauma-related detachments ($P = 0.003$) (Table 2).

Retinal redetachment occurred in 11.2% (11/98) of eyes and was managed with repeat pars plana vitrectomy using gas or oil tamponade. When stratified by etiology, recurrence rates were 13% (7/54) in complex RRD, 3.4% (1/29) in diabetic TRD, and 20% (3/15) in trauma-related detachments ($p = 0.21$). Although recurrence appeared more frequent in trauma-related cases, no statistically significant difference was observed between subgroups (Table 3). When stratified by intraoperative 360° laser photocoagulation status, recurrent detachment occurred in 8.2% (4/49) of eyes that received 360° laser versus 14.3% (7/49) of those that did not ($p = 0.522$), indicating no statistically significant association between prophylactic laser treatment and recurrence risk.

Table 2. Changes in Visual Acuity (LogMAR) and Intraocular Pressure (IOP) Before and After Silicone Oil Removal

	Preoperative	Postoperative			p*	p**
		Day 1	Month 1	Month 6		
LogMar VA						
▪ Mean +/- SD	1.1 ± 0.5	1.70 ± 0.6	1.07± 0.58	0.91 ± 0.72	< 0.001	<0.001
▪ Complex RRD	1.15 ± 0.52	1.80 ± 0.62	1.10 ± 0.58	0.95 ± 0.63		0.002
▪ Diabetic TRD	1.10 ± 0.50	1.70 ± 0.60	1.07 ± 0.58	0.93 ± 0.32		0.009
▪ trauma-related detachments	1.20 ± 0.53	1.85 ± 0.65	1.15 ± 0.60	1.00 ± 0.70		0.003
IOP (mm hg)						
▪ Mean +/- SD	17.1 ± 6.8	15.81 ± 7.76	16.21 ± 5.66	16.52 ± 6.76	0.341	0.783

VA: Visual Acuity, IOP: Intraocular Pressure, SD: Standard Deviation

P*: Paired comparison between preoperative and postoperative Day 1 VA (logMAR).

P**: Paired comparison between preoperative and postoperative Month 6 VA (logMAR).

Postoperative IOP remained stable at 16.52 ± 6.76 mmHg compared to the preoperative mean of 17.1 ± 6.8 mm Hg ($P = 0.783$), with no significant changes noted across etiological subgroups (Table 2).

Hypotony (IOP < 6 mm Hg on ≥ 2 visits) developed postoperatively in 17.3% (17/98) of eyes, with rates of 16.7% (9/54) in complex RRD, 10.3% (3/29) in diabetic TRD, and 33.3% (5/15) in trauma-related detachments ($p = 0.159$). Seven eyes with hypotony had undergone extensive retinotomies or retinectomies during the initial surgery. SO reinjection was required in one case, and one eye progressed to phthisis bulbi. Preoperative VA in hypotonic eyes was limited to finger counting (Table 3). Conversely, ocular hypertension (IOP > 24 mm Hg on multiple visits) occurred in 8.2% (8/98) of eyes, distributed as 7.4% (4/54) in complex RRD, 6.9% (2/29) in diabetic TRD, and 13.3% (2/15) in trauma-related cases ($p = 0.727$). Medical therapy was effective in 75% (6/8) of cases, while two eyes required glaucoma filtering surgery (Table 3).

Corneal complications were reported in 12.2% (12/98) of eyes. Three eyes developed non-healing epithelial defects, two of which progressed to corneal ulcers requiring penetrating keratoplasty. Corneal edema secondary to ocular hypertension occurred in six eyes, and band keratopathy developed in three eyes. In one case, band keratopathy was associated with residual SO ($< 10\%$) in the anterior chamber. Corneal complications were more frequently observed in diabetic TRD (6/29, 20.7%) compared to complex RRD (3/54, 5.6%) and

trauma-related detachments (3/15, 20%), although these differences did not reach statistical significance ($P = 0.082$).

Combined cataract extraction with SO removal was performed in 83.9% (26/31) of phakic eyes due to visually significant cataract. Among the remaining five phakic eyes, one remained phakic at six months, while four developed significant cataracts requiring future intervention.

Subsequent pars plana vitrectomy was performed in 14.3% (14/98) of eyes, with indications including recurrent retinal detachment (11 eyes), full-thickness macular hole without detachment (2 eyes), and hypotony management (1 eye).

Table 3. Comparative Analysis of Postoperative Complications by Etiological Subgroup After Silicone Oil Removal

Subgroup	Number (%)			p
	Complex RRD (n=54)	Diabetic TRD (n=29)	Trauma-related detachments (n=15)	
Recurrent retinal detachment	7 (12.96%)	1 (3.44%)	3 (20%)	0.21
Hypotony	9 (16.66%)	3 (10.34%)	5 (33.33%)	0.159
Hypertension	4 (7.40%)	2 (6.89%)	2 (13.33%)	0.727
Corneal complications	3 (5.55%)	6 (20.68%)	3 (20%)	0.082

RRD: Rhegmatogenous retinal detachment, TRD: Tractional retinal detachment

DISCUSSION

Silicone oil tamponade is widely used in the management of complex retinal detachments, particularly in eyes with advanced proliferative vitreoretinopathy, giant retinal tears, tractional components related to diabetic retinopathy, or ocular trauma (7) (12). Although silicone oil provides effective long-term internal tamponade, its removal represents a critical step in the surgical course and is associated with a risk of anatomical failure and variable functional recovery (13,14) (15). In this retrospective study, we evaluated anatomical outcomes, visual results, and postoperative complications after silicone oil removal and compared our findings with previously published series.

A well-established discrepancy persists between anatomical and functional outcomes following SO removal. While anatomical reattachment rates remain high (72–96%), functional recovery is more variable, with only 35–76% of cases achieving VA $\geq 20/200$ (16) (17). In the present study, anatomical success was achieved in 88.8% of cases and functional success in 53.1%, both within reported ranges and consistent with recent series by Issa et al. (18) and Jiao et al. (19). This gap highlights the multifactorial determinants of visual outcomes extending beyond retinal reattachment alone.

Our cohort demonstrated significant visual improvement across all etiological subgroups (complex RRD, diabetic TRD, trauma; all $P < 0.01$), despite transient postoperative VA deterioration on day one. This pattern aligns with Jiao et al. (19), who attributed early recovery to reversal of SO-induced hyperopic shift (+5.00 to +9.00 diopters). The predominance of pseudophakia (58.2%) and high rate of combined cataract extraction (83.9% of phakic eyes) in our series support previous findings identifying these factors as favorable prognostic indicators for visual recovery (20,21). Conversely, Kanpirom et al. (20) reported that circumferential peripheral retinopexy during SO removal was associated with poorer outcomes in complex cases, suggesting that surgical complexity influences final visual function.

The average SO retention time in our cohort was 11.56 months, exceeding the 9.3 months reported by Jiao et al. (19). This relatively long tamponade duration may be associated with the observed anatomical success (88.8%); however, causality cannot be inferred from this retrospective design. Jiao et al. demonstrated that early removal (~6 months) increased redetachment risk compared to later removal (~10 months) (19). However, prolonged tamponade must be balanced against complications including IOP elevation, emulsification, inflammation, and corneal decompensation.

Retinal redetachment occurred in 11.2% (11/98) of eyes, consistent with reported rates of 8–12% (22) (23) (24) (11) (25) (26). Recurrence was highest in trauma-related cases (20%) and lowest in diabetic TRD (3.4%), though differences were not statistically significant ($p = 0.21$). This compares favorably with Issa et al.'s 7% recurrence rate (18) but is lower than Jiao et al.'s 20.6% (19). The role of 360° peripheral laser photocoagulation remains

controversial: in this cohort, recurrence occurred in 8.2% of laser-treated eyes versus 14.3% of non-treated eyes ($p = 0.522$), suggesting a trend toward protection without statistical significance. While some studies report that prophylactic 360° laser reduces recurrence from 33% to 3–12% (24) (25) (27) (28). In our cohort, recurrence still occurred despite laser use, indicating that laser treatment was not uniformly associated with prevention of recurrence.

Postoperative IOP remained stable (17.1 mm Hg preoperatively vs. 16.52 mm Hg postoperatively, $P = 0.783$). Hypotony developed in 17.3% of eyes, within the reported range of 2–39% (11) (10) (27) (29) (30), and was most common in trauma cases (33.3%) and eyes with extensive retinotomy or retinectomy. Seven hypotonic eyes (41%) had undergone such procedures, supporting the association between surgical complexity and ciliary body dysfunction. Conversely, ocular hypertension occurred in 8.2%, consistent with reported ranges of 9–16% (27), with medical therapy effective in 75% of cases. Only 2% required glaucoma surgery, lower than the 7% reported in some series, possibly reflecting our shorter follow-up duration.

Corneal complications occurred in 12.2% of eyes, slightly exceeding typical reports of 3–11% (27) (26), but consistent with Issa et al.'s 11% (18). Two eyes (1.6%) required penetrating keratoplasty. This higher incidence likely reflects our longer mean tamponade duration (11.56 months), as prolonged SO exposure compromises corneal endothelial health (26) (31). In contrast, Jiao et al. reported only 1.9% corneal decompensation with no transplantations, attributed to shorter tamponade duration and lower rates of anterior chamber IOLs or glaucoma drainage devices (19). The pathophysiology remains debated: SO in the anterior chamber may transiently shield compromised endothelium, and its removal eliminates this protection, precipitating decompensation in susceptible eyes.

Cataract progression remains ubiquitous after SO tamponade, with rates of 49–100% reported (32) (33). In this series, 83.9% of phakic eyes with visually significant cataracts underwent combined extraction and SO removal, comparable to the 68–69% reported by Issa et al. (18) and Jiao et al. (19). This high incidence, driven by oxidative stress and inflammation, underscores the clinical preference for concurrent surgery to reduce surgical burden and optimize visual rehabilitation. Despite IOL calculation challenges due to underlying retinal pathology, outcomes appear comparable whether surgeries are combined or sequential.

This study has several limitations. The retrospective design and absence of a control group limit causal inference and direct comparisons with other tamponade agents. Variability in follow-up duration (mean 8.65 ± 2.02 months) and small subgroup sizes reduce statistical power and may underestimate late-onset complications. Critically, the absence of systematic OCT-based macular assessment restricts detection of subtle structural changes influencing visual outcomes, contributing to the observed anatomical-functional discrepancy.

Future prospective studies with standardized protocols, including comprehensive OCT evaluation and longer follow-up, are necessary to identify prognostic factors and optimize outcomes following SO removal.

CONCLUSION

SO removal remains a critical step in the long-term management of complex retinal detachments. In this study, high anatomical success rates were achieved, with 88.8% of eyes maintaining retinal attachment post-removal. However, functional visual recovery was more variable, with 53.1% achieving VA $\geq 20/200$, emphasizing the multifactorial nature of visual outcomes beyond anatomical reattachment alone. Complications such as recurrent retinal detachment, hypotony, ocular hypertension, and corneal decompensation underscore the need for careful case selection, preoperative assessment, and individualized surgical planning. Future prospective and controlled studies with standardized OCT-based macular assessment and longer follow-up are warranted to better define prognostic factors, refine timing strategies for SO removal, and optimize both anatomical and functional outcomes.

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