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Outcomes of Scleral Buckling After Failed Pneumatic Retinopexy

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Abstract

Purpose: To assess the visual and anatomic outcomes of eyes that had secondary scleral buckle (SB) surgery after unsuccessful pneumatic retinopexy (PR) for rhegmatogenous retinal detachment (RRD). **Methods:** A retrospective study, performed over a 12-year period, comprised patients who had secondary SB procedures after failed primary PR. Clinical parameters (eg, best-corrected visual acuity [BCVA], lens status, macula status, details of RRD and subretinal fluid) were assessed at presentation, before additional procedures, and at follow-up (6 months, 1 year, and last visit). Statistical comparisons were made using Brown-Forsythe and Welch analysis-of-variance tests, with significance levels set at $P < .05$. **Results:** Fifty-four eyes with adequate follow-up were included. Forty-four (81.5%) of 54 eyes had successful retinal reattachment with secondary SB alone. The remaining eyes had subsequent pars plana vitrectomy (PPV). Patients presenting with macula-on RRD who had successful secondary SB had no statistically significant change in BCVA from baseline (mean final, 0.23 ± 0.25 logMAR [Snellen 20/34]; $P = .999$). There was a statistically significant improvement in BCVA in patients presenting with macula-off RRD who had successful secondary SB (mean final, 0.32 ± 0.36 logMAR [20/42]; $P < .001$ and mean change, -1.06 ± 0.85 logMAR). Ten patients presenting with macula-off RRD who had failed secondary SB had a significant improvement in the final BCVA (mean final, 0.22 ± 0.28 logMAR [20/33]; $P = .044$), despite the need for an additional PPV to achieve reattachment. **Conclusions:** Secondary SB remains a good option for RRD repair after unsuccessful PR and may avoid the need for PPV.

Keywords

retinal detachment, scleral buckle, pneumatic retinopexy, retinal surgery

Introduction

The choice of surgical technique for repairing rhegmatogenous retinal detachments (RRDs) depends on multiple factors, including the clinical features of the RD, lens status or other anatomic considerations, surgical preferences, and patient factors. Pneumatic retinopexy (PR) is a well-established, office-based procedure and is considered the first choice of treatment for many patients.[1] Traditional indications include simple RRDs that involve retinal breaks within 1 clock hour of the superior two thirds of the retina with clear media in phakic patients who are able to comply with the required head positioning and office follow-up visits.[2] As indications have expanded to include more complex RRDs,[3] a recent study found that more than 50% of patients presenting with primary RRD may fulfill the criteria for PR.[4]

The Pneumatic Retinopexy vs Vitrectomy for the Management of Primary Rhegmatogenous Retinal Detachment Outcomes Randomized Trial (PIVOT) recently found that primary anatomic success after PR was as high as 81% compared with 93% after PPV in the treatment of RRD.[1] A recent report of nearly 10 000 patients with noncomplex RRD from the Intelligent Research in Sight (IRIS) registry had a primary anatomic success of 69%,[5] whereas other studies have reported varied rates ranging from 44% to 93%.[5–14] A comprehensive review of all series between 1986 and 2007 found an average single-procedure success rate of 74%.[11] Despite generally

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acceptable success rates with a simple, minimally invasive office-based procedure, there is a significant minority of cases in which PR may be unsuccessful and that require further options for secondary repair. These options include secondary PR, scleral buckling (SB), or pars plana vitrectomy (PPV) with or without SB.

The medical literature has few studies of the success of secondary surgical procedures after unsuccessful PR.[12,13,15–17] In particular, there is a lack of data comparing the success rates between SB and PPV as secondary procedures after failed PR. This is an important consideration given that a substantial proportion of patients with RRD may be young, myopic, and with a clear crystalline lens who are likely to require cataract surgery after PPV,[18] thus losing their ability to accommodate and potentially developing symptomatic anisometropia.

Although primary SB can reach single-surgery anatomic success rates up to 90% in the appropriate clinical setting, according to recent surveys the modern retina surgeon is much more likely to perform vitrectomy-based surgery for RRD.[19] In a large cohort of 9659 eyes with noncomplex RRD treated by PR, only 5% had secondary repair by SB alone.[5] The decline in SB is a reflection of surgical time, economic factors, and recent training patterns rather than of its true value.

This study retrospectively analyzed the visual and anatomic outcomes of patients who had SB after failed primary PR for the repair of RRD.

Methods

A retrospective single-center noncomparative consecutive case series was performed at the Department of Ophthalmology and Visual Sciences, University of British Columbia, Vancouver, Canada, over a 12-year period (January 1, 2009, to December 31, 2020). The series comprised patients who had secondary SB procedures for RRD after failed primary PR. Institutional research ethics board approval was obtained, and the study adhered to the tenets of the Declaration of Helsinki. All patients who had an SB procedure by 1 of 5 vitreoretinal surgeons during the 12-year period were identified by electronic medical records, and each case was further assessed to identify those who had previous unsuccessful PR before SB. All patients had primary PR with an intravitreal injection of 100% sulfur hexafluoride gas (volume ranging from 0.5 mL to 0.8 mL). Patients were excluded if they had less than 6 months of follow-up, proliferative vitreoretinopathy (PVR), RRD affecting the inferior 4 clock hours, a history of retinal breaks, RRD before the first PR attempt, or a history of amblyopia in the same eye.

Clinical parameters assessed at the patient's initial presentation included age, sex, days from onset of symptoms to clinical presentation, days to PR from clinical presentation, initial best-corrected visual acuity (BCVA), lens status, history of trauma, macula status of detachment, number of retinal breaks, location of retinal tears, presence of lattice, and total clock hours of detachment. In addition to the parameters detailing the RRD at the timepoint of primary PR failure, the characteristics of the failed PR and reason for failure (eg, new or missed breaks), if available, were recorded. New breaks were recorded when tears were found in areas of previously attached retina where no retinal tears were identified before the pneumatic procedure. Missed breaks were described in areas of previously unattached retina that might have been missed due to a bullous configuration of the detached retina and/or with signs of chronicity, such as having round edges.

The timing and technique of the secondary SB were also recorded. For the secondary SB, the existing intraocular gas bubble was displaced by rotating the patient's eye or tilting the head. If a PPV was required after secondary SB, the reasons were recorded.

Outcome measures included BCVA, lens status, and the presence of subretinal fluid (SRF) at 3 timepoints (6 months, 1 year, and last recorded visit) after a patient's presentation for RRD.

Statistical comparisons were made using Brown-Forsythe and Welch analysis-of-variance tests, with significance levels set at $P < .05$. All statistical analyses were conducted using SPSS software (version 24.0, SPSS Inc). Means are presented as ± SD.

Results

During the 12-year period, 870 eyes of 870 patients had SB procedures. Of these, 81 eyes of 81 patients had a secondary SB procedure after failed primary PR. Fifty-four eyes of 54 patients met the inclusion criteria, with adequate follow-up data. Most patients were younger than 60 years (77.7%), with a mean age of 47 ± 15 years. All 54 patients were phakic at the time of presentation.

At initial presentation, 53.7% of patients had macula-on RRD, and 46.3% had macula-off RRD. The mean BCVA of these patients was 0.3 logMAR (Snellen equivalent 20/40) and 1.3 logMAR (Snellen equivalent 20/400), respectively (Table 1).

The mean number of symptom days before RRD diagnosis was 9.0 ± 9.3. PR was performed a mean of 0.1 ± 0.6 days from presentation and was subsequently deemed unsuccessful after a mean of 7.5 ± 11.4 days. After unsuccessful PR, SB was performed in 54 patients after a mean of 1.9 ± 2.1 days. Secondary SB was successful in 44 patients and was unsuccessful in the remaining 10 patients, who subsequently required PPV. Subsequent PPV was performed a mean of 28.4 ± 31.5 days after unsuccessful secondary SB surgery. The 54 included patients had 6 months of follow-up data, and 33 patients had a further 12 months of follow-up data. The total mean final follow-up was 49.4 ± 32.3 months. Table 2 shows the clinical characteristics of patients who had failed PR.

Of the 54 patients who had secondary SB, 48 (88.9%) received 360-degree encirclements. Five patients had SB complications, including iatrogenic breaks secondary to deep suture pass (2 [3.7%]), submacular hemorrhage (1 [1.9%]), or SB revision due to irritation or anterior segment ischemia (2 [3.7%]). The final BCVA of the patient with submacular hemorrhage was 0.4 logMAR (Snellen equivalent 20/50), while other patients with SB complications did not have compromised

Table 1. Clinical Characteristics of Study Cohort at Baseline (N = 54).[a]

Characteristic	Value
Sex, n (%)	
Male	21 (38.9)
Female	33 (61.1)
Laterality, n (%)	
Right	30 (55.6)
Left	24 (44.4)
Age (y)	
Mean ± SD	47 ± 15
Range, n (%)	
<40	16 (29.6)
40–59	26 (48.1)
>60	12 (22.2)
Mean total number of involved clock hours ± SD	4.2 ± 1.7
Mean presenting BCVA ± SD	
Macula-on RRD	
LogMAR	0.3 ± 0.3
Snellen equivalent	20/40
Macula-off RRD	
LogMAR	1.3 ± 0.8
Snellen equivalent	20/400
Macula status at time of presentation, n (%)	
On	29 (53.7)
Off	25 (46.3)
Retinal breaks, n (%)	
1	34 (63.0)
2	10 (18.5)
3	6 (11.1)
4	3 (5.6)
5	1 (1.9)
Location of retinal tears per quadrant, n (%)	
Superotemporal	62
Superonasal	17
Inferotemporal	9
Inferonasal	1
Presence of vitreous hemorrhage, n (%)	1 (1.85)
Phakic status, n (%)	54 (100)
Presence of lattice in same eye, n (%)	15 (27.8)
Presence of other pathology in same eye, n (%)	20 (37.0)

Abbreviations: BCVA, best-corrected visual acuity; RRD, rhegmatogenous retinal detachment.
[a]The presence or absence of posterior vitreous detachment was recorded in only 6 of 54 patients and thus is not included in the table. One patient had 3 round holes and no tears; the remainder had RDs caused by retinal tears.

Table 2. Clinical Characteristics of Eyes After Failed Pneumatic Retinopexy.

Characteristic	Value
Predominant quadrant of persistent SRF, n (%)	
Superior	12 (22.2)
Inferior	35 (64.8)
Temporal	5 (9.3)
Nasal	1 (1.9)
Identified reasons for failure, n (%)[a]	
Positioning issues	4 (21.1)
Previous unidentified retinal breaks	6 (28.6)
New retinal breaks	5 (23.8)
Multiple breaks incompletely covered by pneumatic bubble	3 (14.3)
Poor laser adherence	1 (4.8)
Macular status after failed pneumatic retinopexy, n (%)	
Remained on	23 (42.6)
Remained off	12 (22.2)
Macular on to off	6 (11.1)
Macular off to on	13 (24.1)
Mean total clock hours of detachment	
Before pneumatic retinopexy	4.26
After pneumatic retinopexy	4.06

Abbreviation: SRF, subretinal fluid.
[a]n = 19.

visual outcomes. Ten of the 54 eyes required subsequent PPV for reasons that included PVR (n=4), new retinal breaks (n=3), progressing SRF (n=2), and persistent fluid (n=1) (Table 3). On final review, the anatomic success rate in patients after subsequent PPV was 100%.

For patients presenting with macula-on RRD, there was no significant difference between the initial BCVA and that at the time of failed PR or that at the final visit after SB. For patients presenting with macula-off RRD, there was a significant improvement in BCVA from initial presentation and at failed PR compared with the final BCVA after SB surgery (P=.013 and P=.014, respectively) (Table 4).

For the 44 patients with successful retinal reattachment with secondary SB alone, there was no significant difference between the final BCVA and presenting BCVA in cases initially presenting with macula-on RRD (n=23) (mean final, 0.23 ± 0.25 logMAR [Snellen equivalent 20/34]; P=.99). In the 16 eyes presenting with macula-off RRD that had successful secondary SB repair, there was a statistically significant improvement in the baseline BCVA compared with the BCVA at 6 months (P=.017), 1 year (P=.002), and the final measurement (mean final, 0.32 ± 0.36 logMAR [Snellen equivalent 20/42]; $P < .001$). There was a significant difference in visual outcomes between the macula-on RRD group and macula-off RRD group in patients with successful secondary SB (t score, −1.84; degrees of freedom, 21; P=.039). The mean change in BCVA was −1.06 ± 0.85 logMAR (Figure 1). In the 10 patients presenting with macula-off RRD who had failed secondary SB, there was a significant improvement in the final BCVA (mean final, 0.22 ± 0.28 logMAR [Snellen equivalent 20/33]; P=.044), despite the need for an additional PPV to achieve reattachment (Figure 2).

At the 12-month follow-up, the lens status was identified in 28 of the 54 patients. In eyes that did not require PPV after SB, 66.7% (14/21) were phakic at 1 year compared with 57.1% (4/7) that required PPV after unsuccessful secondary SB. At the 1-year follow-up, 2 (14.3%) of the 14 phakic patients who did

Table 3. Types of SBs, Additional Procedures, and Reasons for Failed SBs.

Parameter	n (%)
All SB (n = 54)	
360-degree encirclement	48 (88.9)
42 band/72 sleeve	18 (33.3)
42 band/70 sleeve	1 (1.8)
41 band/70 sleeve	6 (11.1)
41 band/72 sleeve	7 (13.0)
40 band/72 sleeve	1 (1.8)
Ross 5 band/72 sleeve	7 (13.0)
286 segment/240 band/270 sleeve	1 (1.8)
Not specified	5 (9.3)
180-degree segmental	2 (3.7)
286 segment/240 band/270 sleeve	0
90-degree segmental	1 (1.8)
286 segment alone	0
Radial sponge	4 (7.4)
505 sponge	1 (1.8)
506 sponge	1 (1.8)
509 sponge	2 (3.7)
Additional procedures (n = 11)	
External drainage	7 (63.6)
Pneumatic	9 (81.8)
SF_6	8 (72.7)
C_3F_8	1 (9.1)
Failed SBs requiring subsequent PPV (n = 10)	
360 encirclement	9 (90.0)
180 degrees	1 (10.0)
Reasons for failed SBs (n = 10)	
Persistent fluid	1 (10.0)
Progressing fluid	2 (20.0)
New breaks	3 (30.0)
PVR	4 (40.0)

Abbreviations: C_3F_8, perfluoropropane; PPV, pars plana vitrectomy; PVR, proliferative vitreoretinopathy; SB, scleral buckle; SF_6, sulfur hexafluoride.

Table 4. Brown-Forsythe and Welch Analysis-of-Variance Test Comparing Differences in BCVA at Different Times.

	P Value	
BCVA	Macula-On RRD (n = 26)	Macula-Off RRD (n = 23)
Initial vs failure of PR	.84	.013[a]
Initial vs 6 months	.97	<.0001[a]
Initial vs 1 year	.99	<.0001[a]
Initial vs final	.99	<.0001[a]

Abbreviations: BCVA, best-corrected visual acuity; PR, pneumatic retinopexy; RRD, rhegmatogenous retinal detachment.
[a]Statistically significant.

not require a PPV had progression of their cataract compared with 2 (50.0%) of the 4 phakic patients who required PPV after secondary SB.

Conclusions

PR is an effective in-office procedure that is suitable as a first-line treatment for many patients with RRD. Despite the relatively high rates of success,[1,11,12,16] it is unclear which type of secondary procedure should be used in patients with unsuccessful PR.

To our knowledge, this is the largest reported case series of patients with SB as a secondary procedure after unsuccessful PR. In our study, 44 (81.5%) of the 54 patients had successful retinal reattachment with secondary SB alone. In these patients, there was no significant difference in the final BCVA for patients initially presenting with macula-on RRD, indicating successful preservation of central vision (mean final, 0.23 ± 0.25 logMAR [Snellen equivalent 20/34]; $P = .99$). Patients presenting with macula-off RRD who had successful secondary SB had a significant improvement in the final BCVA (mean final, 0.32 ± 0.36 logMAR [Snellen equivalent 20/42]; $P < .001$), further supporting the benefits of successful secondary SB (Figure 1). In the 10 patients presenting with macula-off RRD who had failed secondary SB, there was still a statistically significant improvement in the final BCVA (mean final, 0.22 ± 0.28 logMAR [Snellen equivalent 20/33]; $P = .044$), despite the need for further surgery with PPV. Although these numbers are small, this may suggest that attempting secondary SB after PR may not compromise the final improvement in BCVA, despite the possible need for subsequent rescue PPV.

Studies have shown that, at present, the rates of secondary SB in eyes that have failed PR are low, while PPV has become a more popular choice, despite similar rates of success.[12,16,20,21] In earlier series, secondary SB was used in more than 40% of eyes with failed PR, with single-operation success rates ranging between 66% and 88%.[6,7,22,23] In a series published in 1987 by Hilton et al,[23] secondary SB was performed in all cases of failed PR (n = 16), with a single-procedure success rate of 88%. In contrast, more recent studies found a notable decline in the use of secondary SB, with a much higher uptake of secondary PPV, despite showing similar or higher rates of single-operation success.[12,16,20,21] In the largest series by Emami-Naeini et al[21] of 155 eyes with failed PR, 11% (n = 17) had secondary SB, with a single-operation success rate of 94%, while secondary PPV had a lower success rate of 84%. In another large series of 114 eyes by Vidne-Hay et al,[12] secondary PPV had a higher overall success rate (84%) than secondary SB (76%). However, the success of PPV was higher in cases that required combined PPV and SB (90%) or silicone oil tamponade (88%), suggesting that the presence of PVR or complex RRD treated by secondary SB alone (without PPV) would not likely be successful.

A recent retrospective study from our institution evaluated eyes with failed PR and compared the outcomes of secondary SB, PPV, and combined PPV and SB.[24] Over an 18-month period, 73 of 267 eyes with RRD had failed PR. Forty-nine patients had secondary PPV, 9 eyes had combined PPV and SB,

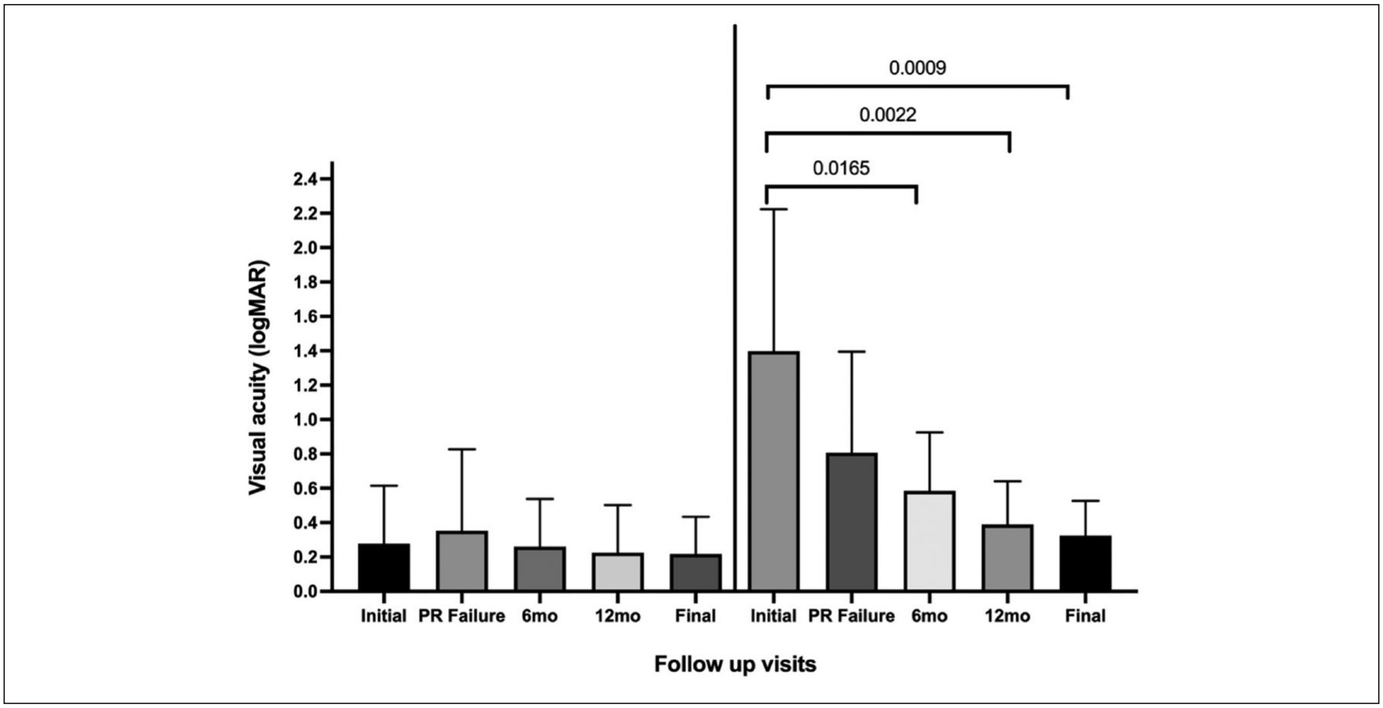

Figure 1. Mean VA of all patients with successful secondary SB (n = 39) at different time intervals. Left: Macula-on group (n = 23), Right: Macula-off group (n = 16).
Abbreviations: PR, pneumatic retinopexy; SB, scleral buckle; VA, visual acuity.

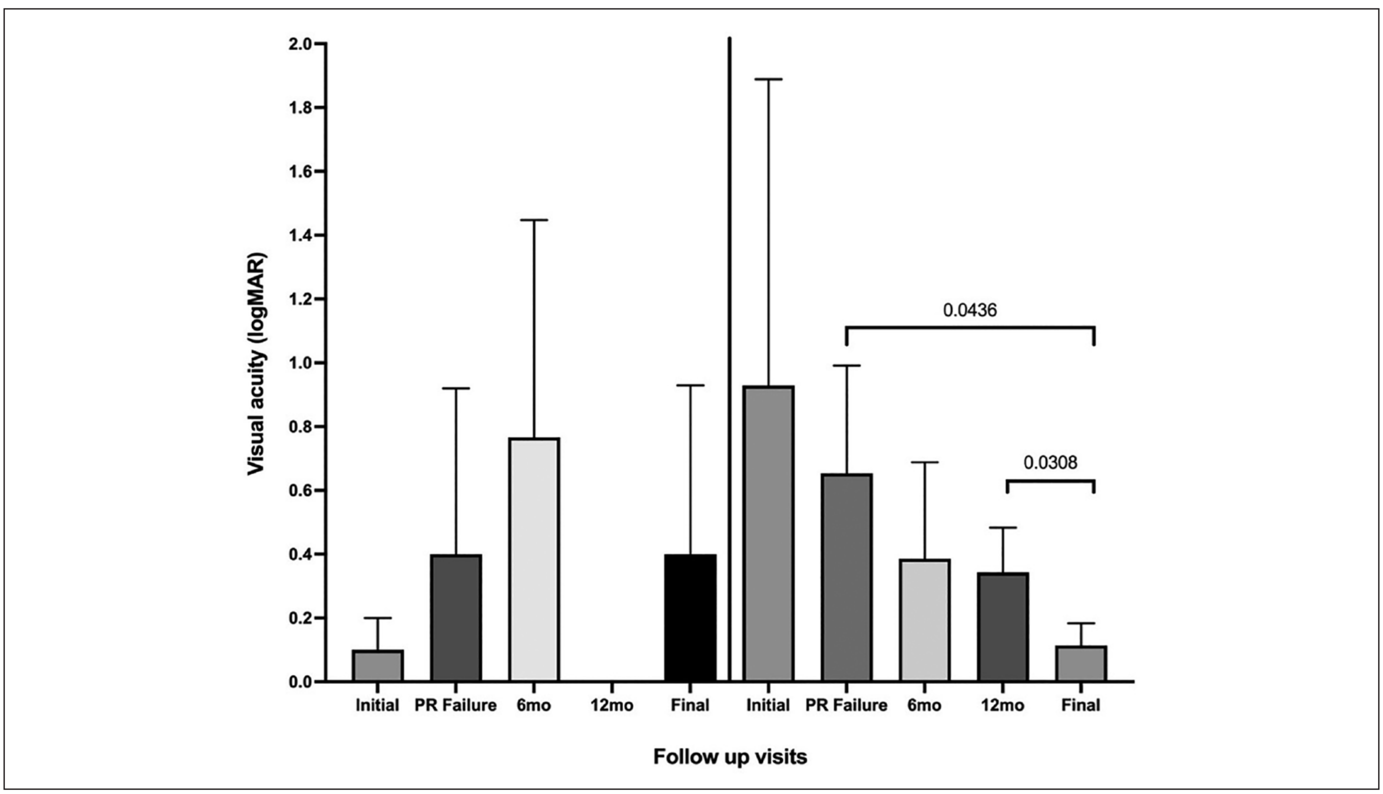

Figure 2. Mean VA of all patients with failed secondary SB requiring subsequent PPV (n = 10) at different time intervals. Left: Macula-on group (n = 3). Right: Macula-off group (n = 7).
Abbreviations: PPV, pars plana vitrectomy; PR, pneumatic retinopexy; SB, scleral buckle; VA, visual acuity.

and 15 eyes had secondary SB and were also included in the current study. The authors noted selection bias, in particular for PPV with SB in eyes with PVR, and a limited capacity to stratify phakic patients and pseudophakic patients because of the small number of patients. The anatomic success rates between these secondary procedures did not reach statistical significance but were comparable to those in previous studies of SB (87% [n=15]), PPV (96% [n=49]), and combined PPV with SB (89% [n=9]) (P=.33).

In almost all pertinent studies in which data were included, combined PPV and SB yielded higher single-operation success rates than PPV or SB alone, which may suggest a supplementary role for secondary SB when PPV is required.[6,12,14,20–22] In our study, identified reasons for failed secondary SB included features suggestive of complex RRD, such as the presence of PVR (40%), new retinal breaks (30%), and progressive SRF (20%). In such patients, combined PPV and SB to address these components may have resulted in greater success in retinal reattachment. Thus, it seems reasonable that in patients with complex RRD who would ultimately require combined PPV and SB, attempting secondary SB before performing PPV, if required, would not further compromise subsequent attempts at retinal reattachment but may contribute to its anatomic success.

Several studies reported that eyes with failed PR, including those that developed macula-off RRD, often have good visual outcomes with successful reattachment, whether the secondary repair is done using repeat PR, SB, or PPV.[1,12,25,26] Thus, attempting PR for primary RRD, in particular in cases fulfilling the criteria, does not result in any visual detriment, despite the risks for PR failure. In our study, in the 10 eyes presenting with macula-off RRD that also had unsuccessful secondary SB, there was still a statistically significant improvement in the final BCVA after subsequent PPV. This may provide a similar justification for attempting secondary SB after failed PR because it may not compromise the final BCVA, despite the possible need for rescue PPV, in particular in eyes that would benefit from being spared from progressive cataract formation.

A recent study of 8133 eyes found up to 20% of primary RRDs occurred in those younger than 50 years, with the large majority (83%) being phakic.[18] The study also found that the younger cohort was significantly associated with myopia and exhibited a myopia-related RRD phenotype. By performing secondary SB after failed PR, these patients may not require PPV, thus avoiding the potential loss of accommodation and anisometropia associated with the ensuing cataract surgery that is commonly required after PPV.[27] Although the mean age in our study was 47 years, an age at which loss of accommodation may not be a significant issue, 30% were younger than 40 years. Furthermore, 2 (14.3%) of 14 patients had cataract progression with successful secondary SB at 12 months compared with 2 (50.0%) of 4 patients who required PPV after unsuccessful secondary SB. Given that cataract progression often increases after 12 months,[27] it is likely that this proportion would further increase in the ensuing years of follow-up. Although secondary SB may minimize cataract progression compared with PPV, it may result in changes in axial length and refraction.

Limitations of this study include its retrospective noncomparative control nature. Thus, the study could not compare methods of secondary repair after failed PR but merely assessed the outcomes of secondary SB. Furthermore, there is inherent selection bias for patients who have secondary SB. In our cohort, more than 50% had failed PR resulting from new or previously unidentified retinal breaks, and 14.3% had multiple breaks incompletely covered by the pneumatic bubble. In our study cohort, 64.8% of patients undergoing secondary SB had persistent SRF in the inferior quadrant. This large proportion may represent a selection bias for SB, and SB may enhance the support of inferior retinal breaks and potential inferior PVR; in such cases, gas tamponade with PPV would have a limited effect. In addition, the study sample excludes a large proportion of cases of failed PR that might have instead benefited from PPV or combined PPV and SB for reasons such as media opacity, multiple retinal breaks, pseudophakia, or the presence of PVR. Last, 5 of the 54 eyes had complications related to the secondary SB procedure, including scleral perforations, anterior segment ischemia, and subretinal hemorrhages, which may reflect that the institution is a center of surgical training.

Our study found relatively high success rates of secondary SB after failed PR and, in the small number with unsuccessful secondary SB requiring subsequent PPV, there was still significant improvement in vision. The choice of treatment modality for RRD relies heavily on certain clinical and patient factors that are specific to each case. For younger patients who would benefit from being spared from cataract progression, secondary SB may be an option that offers good anatomic and visual outcomes in eyes with failed PR.

Authors' Note

Dr. Maberley is now affiliated with the Department of Ophthalmology, University of Ottawa, Ottawa, ON, Canada.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee), University of British Columbia.

Statement of Informed Consent

As this was a retrospective study, informed consent is not required by the institutional research ethics board.

Declaration of Conflicting Interests

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