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ORIGINAL RESEARCH

Primary Rhegmatogenous Retinal Detachment Repair by Pars Plana Vitrectomy with and without Scleral Buckling: A Propensity Score Analysis

Pongthep Rajsirisongsri[1], Direk Patikulsila[1], Phichayut Phinyo[2–4], Paradee Kunavisarut[1], Voraporn Chaikitmongkol[1], Onnisa Nanegrungsunk[1], Atitaya Apivatthakakul[1], Sutheerada Seetasut[1], Yaowaret Tantivit[1], Napatsorn Krisanuruks[1], Apisara Sangkaew[1], Nawat Watanachai[5], Janejit Choovuthayakorn[1]

[1]Department of Ophthalmology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand; [2]Clinical Epidemiology and Clinical Statistics Center, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand; [3]Department of Biomedical Informatics and Clinical Epidemiology (Bioce), Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand; [4]Musculoskeletal Science and Translational Research (MSTR), Chiang Mai University, Chiang Mai, Thailand; [5]Department of Ophthalmology, Faculty of Medicine, Mahidol University, Bangkok, Thailand

Correspondence: Janejit Choovuthayakorn, Email janejit.c@cmu.ac.th

Purpose: To evaluate the anatomical and visual outcomes of patients with rhegmatogenous retinal detachment (RRD) who received primary repair by combined pars plana vitrectomy with scleral buckling (PPV/SB) or pars plana vitrectomy (PPV) alone by using a propensity analysis.

Patients and Methods: This study was a single center retrospective observational study. Medical records of patients who underwent surgical interventions between January 2013 and December 2019 were retrospectively reviewed. The single surgery anatomic success (SSAS) and final anatomic success were the primary outcomes, whereas the final visual acuity changes was the secondary outcome.

Results: This study included a total of 683 patients (683 eyes), with a median (interquartile range, IQR) follow-up duration of 13 (5.5 to 28.8) months. Of them, 211 patients (30.9%) underwent PPV/SB, while 472 patients (69.1%) underwent PPV as their primary procedure. The two treatment groups did not significantly differ in the risk of achieving SSAS (weighted risk difference: 0.012, 95% confidence interval (CI): −0.067 to 0.092, p value = 0.776) or achieving final retinal anatomic attachment (weighted risk difference: −0.038, 95% CI: −0.106 to 0.030, p value = 0.272). The occurrence of proliferative vitreoretinopathy was identical between the two treatment groups (56 patients (26.5%) for the PPV/SB group and 104 patients (22.0%) for the PPV group), p = 0.199. Nonetheless, the patients who received PPV alone showed a significantly greater mean improvement in VA (weighted mean difference; 0.295, 95% CI; 0.150, 0.440, p <0.001).

Conclusion: This work supports the findings that adding SB to PPV had little impact on anatomical results (either a single surgical success rate or the overall final success rate) for RRD repair. Although PPV alone is shown to improve vision, confirmation of these associations requires further prospective studies using standardized surgical techniques.

Keywords: rhegmatogenous retinal detachment, pars plana vitrectomy, combined pars plana vitrectomy and scleral buckling, visual outcomes, anatomical outcomes, propensity score analysis

Introduction

Rhegmatogenous retinal detachment (RRD) is one of the eye diseases that, if treatment is delayed, can result in significant and irreversible visual impairment. Even though the annual incidence varies widely, recent studies have revealed a greater incidence of RRD than previously reported.[1,2] This upward trend has been supported by several recent studies.[3,4] The rise in the number of high myopia or myopia within the population over the past few decades, along with the growing number of younger individuals receiving cataract surgery, have been suggested as potential contributors to this increase.[5–8]

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To manage RRD, the treatment strategy selected for each patient may be influenced by the surgeon's preference, the patient's ocular presentations, the patient's physical and regional factors, and advancements in microincisional vitrectomy instruments or wide-field retinal imaging systems.[9,10] Numerous studies have indicated that over the past two decades, pars plana vitrectomy (PPV) has increasingly been chosen as the primary surgical technique for repairing RRD.[11–13]

While PPV has been shown to be an effective treatment for retinal reattachment, in certain cases a supplementary scleral buckling (SB) has been administered concurrently with PPV. The addition of SB to PPV (PPV/SB) may be advantageous in cases requiring the reduction of retinal traction at the vitreous base, particularly in young phakic eyes. This technique has also been considered beneficial for providing additional support in cases with inferior retinal breaks (RB), significant proliferative vitreoretinopathy (PVR), or substantial vitreous hemorrhage (VH).[14–17]

However, patients undergoing the combined PPV/SB procedure have occasionally reported increased discomfort, alteration in refractive error, or diplopia compared to those who received PPV alone.[18–20] To date, there is still controversy over the advantages of combining SB with PPV.[21–26]

Thus, the primary objective of this study is to assess the probability of anatomical reattachment, including both single surgery anatomical attachment (SSAS) and anatomical attachment at the final follow-up, following RRD repair in patients receiving PPV/SB versus PPV alone. The assessment was conducted using propensity score (PS) analysis, a statistical approach designed to evaluate the causal effects in non-randomized studies. By adjusting the pre-operative confounding parameters related to treatment allocation through the use of PS, the influence of these factors on the treatment effectiveness could be minimized. Additionally, the secondary objective of this study is to evaluate visual changes, post-treatment, in the respective patient groups.

Material and Methods

This retrospective study was conducted in accordance with the tenets of the declaration of Helsinki. The Chiang Mai University Hospital's ethics committee reviewed and approved the study protocol (study code: OPT-2564-08508). Informed consent was waived because there was no direct patient involvement, and the data was gathered anonymously.

All consecutive patients who underwent PPV/SB or PPV alone for primary repair of RRD between January 1, 2013, and December 31, 2019, were defined using the operating lists of Chiang Mai University Hospital. Patients were included if they had at least two months of post-operative follow-up. The following individuals were excluded: 1) had prior vitreoretinal surgery; 2) had prior surgical interventions for this current RRD, excluding laser photocoagulation; and 3) had RRD related to head or eye trauma, combined RRD with tractional component, hereditary ocular disease, complicated cataract surgery, macular hole, or intravitreal injection. The medical records of eligible patients were reviewed for demographic information (age, gender, and associated systemic diseases), clinical characteristics (duration of the symptoms and the pre-operative ocular presentations), surgical interventions for RRD repair (primary and additional procedures), and post-operative anatomical and visual outcomes. If the patient had bilateral RRD, the eye that treated first was recruited. A Microsoft Excel spreadsheet was used to collect all the data.

Before analysis, the data was de-identified. Age was classified into those under 65 and those 65 and over. Retinal breaks (RB)s were divided into categories based on their characteristics including type (atrophic hole or operculated retinal tear), number (<3 breaks or ≥3 breaks), and the presence of an inferior RB (the lowest break lying inferiorly between 4 and 8 o'clock). Furthermore, the largest RBs were categorized into groups based on their size (<3 clock hours or ≥3 clock hours) and position (below the 9 and 3 o'clock meridian or above). Additionally, experience of the surgeon was also categorized by < 2 or ≥2 years. For visual acuity (VA), the Snellen best-corrected VA was converted to the Logarithm of the Minimum Angle of Resolution (LogMAR) unit. The LogMAR values of 1.9, 2.3, 2.7, and 3.0 were substituted for the verbal vision of counting fingers, hand movement, light perception (LP), and no LP, respectively.[27,28]

Patients who achieved successful retinal reattachment after the initial procedure and did not require further surgical interventions for the repair of RRD were classified as having SSAS. Of note, patients who underwent subsequent surgery for silicone oil removal, received additional laser retinopexy or secondary injection of gas in outpatient settings, or had subsequent surgeries not related to the retinal reattachment procedure, were not considered to have a failure of treatment. The remaining patients were defined as having treatment failure and were categorized based on the outcomes observed at the end of the follow-up period. These patients were classified as follows: Failure 1, if their eyes achieved macular attachment with no tamponade but necessitated multiple surgeries to manage both primary and recurrent RRD; Failure 2, if their eyes achieved macular attachment but continued to be tamponade by silicone oil (SO); and Failure 3, if their eyes did not achieve macular attachment, were considered inoperable, or had a poor prognosis for any further surgical intervention.[29,30]

Surgical Technique

All patients underwent a 3-port, 23-gauge PPV technique, utilizing either a contact wide-angle viewing system (Volk Optical, Inc., Mentor, OH, USA) or a non-contact wide-angle viewing system (Resight 700, Carl Zeiss Meditech, Dublin, California, USA). To remove the vitreous, core vitrectomy, posterior vitreous separation with a vitreous cutter (if there was no posterior vitreous detachment), and vitreous base shaving via scleral indentation were performed. All RBs and related abnormalities were identified, and each one was marked with endodiathermy. The fibrous membrane over the retina was removed by intraocular forceps. In cases of bullous detachment and retinal tightening, perfluorocarbon liquid (Perfluoron; Alcon Laboratories, Inc., Fort Worth, TX) was used to stabilize and flatten the retina. Subretinal fluid was drained through either posterior retinotomy or through pre-existing anterior RBs, followed by a complete fluid air exchange. Laser retinopexy was applied to all RBs, lattice, and posterior retinotomy with supplemental cryoretinopexy was performed on anterior RBs in certain cases.

The decision to perform a combined PPV/SB was made either before the operation based on pre-operative assessment or during the surgery based on intraoperative findings. Indications for a combined procedure included RRD associated with round retinal hole, inferior RBs, multiple RBs along the vitreous base, multiple RBs in different quadrants, retinal dialysis, PVR grade C, and significant VH. When SB was indicated, a 360° encircling buckle was placed (utilizing either silicone sponge #510 or silicone tire with encircling band #287/240, MIRA Inc, USA). Additionally, in certain cases, at the decision of the surgeons, a 287 segmental buckle was positioned over the location of RBs, accompanied with a 240-encircling band. The buckle was secured to the sclera using 5–0 ethibond sutures. Retinal endotamponade was performed using either non-expansile gas (sulfur hexafluoride; SF_6 or perfluoropropane; C_3F_8) or silicone oil (either 1000 or 5000 centistrokes). The postoperative prone position was advised for a duration of 10 to 14 days.

Statistical Analysis

The continuous variables were described as mean (standard deviation, SD) or median (interquartile range, IQR) depending on how the data were distributed, while the categorical variables were expressed as frequency (percentage). To address the imbalance of pre-operative factors that influence treatment allocation (PPV/SB versus PPV), which typically occurs in non-randomized designs, several methodologies may be employed. These methods encompass multivariable regression, stratification, and propensity score (PS) analysis.[31,32] In the existing literature on management of RRD, some studies have employed PS analysis to evaluate treatment outcomes.[33–35]

In this study, the pre-operative confounding factors affecting the decision to undergo surgical interventions were identified through a review of previous publications and surveys completed by the participating surgeons.[9–11] A logistic regression model was subsequently developed, with the dependent variable assigned as the probability of receiving either PPV/SB or PPV as the primary treatment option. The model incorporated independent variables derived from patient characteristics, surgeon preferences, and the indications or contraindications for the surgical procedure that could potentially confound treatment allocation. At the patient-level, the independent covariables included were age, gender, lens status, intraocular pressure, type and number of RB, size and location of the largest RB, status of the macula, presence of PVR, presence of choroidal detachment (CD), and presence of VH. Additionally, the surgeon's years of experience was included as an independent covariable at the surgeon-level. Based on this model, the predicted probability of receiving each treatment (PS) was calculated for each individual. Utilizing the inverse probability treatment weighting (IPTW) approach, each patient was assigned a weight corresponding to their inverse PS. This weighting facilitated a more balance distribution of confounders across the study population. The balance of these covariables between treatment groups was evaluated before and after the application of IPTW using the standardized difference (STD). An absolute STD value exceeding 10% indicated a significant difference.[36]

An exploratory multivariable logistic regression model was subsequently developed to predict anatomical success after treatment, incorporating axial length, PS factor, and baseline VA as confounding variables. To evaluate the robustness of the findings, the treatment effect was analyzed within the population that had a complete dataset, as well as in the group where missing data was imputed (axial length of forty-three patients: nineteen in the PPV/SB group and twenty-four in the PPV group) using a predictive mean matching approach with twenty datasets for estimation.

For visual outcome, a linear regression model was established, incorporating the PS factor and baseline VA as independent variables. The analysis of visual changes was performed on the cohort that had complete data. However, the variability in test-retest reliability associated with the conversion of VA from LP or no LP to LogMAR values may influence the results.[37] Consequently, to determine the effect size of treatment, the analysis was conducted on the entire study population, as well as after excluding 52 patients with LP vision or worse.

Furthermore, sensitivity analysis using the IPTW approach was performed on patients having PVR grade C to confirm the robustness of the influence of surgical methods on anatomical and visual outcomes. All statistical analyses were carried out using the STATA program version 16 (College Station, TX: StataCorp LLC) and p value <0.05 was considered statistically significant.

Results

This study included a total of 683 patients (683 eyes), with a median follow-up duration of 13 months (IQR: 5.5 to 28.8 months). Among these patients 211 (30.9%) underwent PPV/SB, while 472 (69.1%) underwent PPV as their primary procedure. When comparing the two groups, patients who underwent PPV/SB had a similar median (IQR) presenting LogMAR VA (1.7 (1.0 to 2.3) units, Snellen equivalent 20/800) to those who had PPV (1.6 (0.9 to 2.3) units, Snellen equivalent 20/800, p= 0.210). Furthermore, the mean (SD) axial length was comparable between the two groups, with PPV/SB patients measuring 24.1 (1.7) mm and PPV patients measuring 23.9 (1.3) mm (p = 0.160).

However, patients undergoing PPV/SB had a longer median (IQR) duration of symptoms, 30 days (14 to 60 days) compared to 14 days (7 to 30 days) for those receiving PPV (p <0.001). Additionally, there was a notably higher proportion of patients having PVR grade C among patients who received PPV/SB, as opposed to those who underwent only PPV (74 patients, 35.1% vs 61 patients, 12.9%, p <0.001). The details of other potential baseline characteristics that could affect treatment decisions are listed in Table 1. Figure 1 shows the standardized difference of pre-operative factors by treatment groups before and after IPTW. Intraoperative procedures performed during the initial treatment by treatment groups are described in Table 2. It was noted that patients receiving PPV/SB had a higher proportion of using SO tamponade at the initial operation (143 patients, 67.8% vs 181 patients, 38.4%, p <0.001). In addition, in both groups,

Table 1 Baseline Characteristics of Patients Undergoing Primary Rhegmatogenous Retinal Detachment Repair by Intervention Groups Before Inverse Probability Treatment Weighting

Characteristics	Surgical Interventions, n (%)		Unweighted Standardized Difference	P Value
	PPV+SB (n = 211)	PPV (n = 472)		
Age ≥65 years	62 (29.4)	94 (19.9)	0.221	0.008
Male	139 (65.9)	282 (59.8)	0.127	0.148
Pseudophakia lens status	67 (31.8)	86 (18.2)	0.316	<0.001
IOP <5 mmHg	50 (23.7)	68 (14.4)	0.237	0.004
Macular off status	205 (97.2)	429 (90.9)	−0.266	0.003
Type of RB			−0.076	0.466
Operculated tear	202 (95.7)	444 (94.1)		
Atrophic hole	9 (4.3)	28 (5.9)		

(*Continued*)

Table 1 (Continued).

Characteristics	Surgical Interventions, n (%)		Unweighted Standardized Difference	P Value
	PPV+SB (n = 211)	PPV (n = 472)		
Retinal break				
Number ≥3	74 (35.1)	131 (27.7)	0.158	0.058
Inferior retinal break	122 (57.9)	167 (35.3)	0.461	<0.001
The largest break lying within inferior meridian	78 (36.9)	86 (18.2)	0.428	<0.001
The largest break size <90 degrees	206 (97.6)	455 (96.4)	−0.072	0.488
Choroidal detachment	18 (8.5)	24 (5.1)	0.137	0.087
Vitreous hemorrhage	7 (3.3)	27 (5.7)	−0.116	0.253
PVR grade				
Grade B	16 (7.6)	29 (6.1)	0.057	0.506
Grade C	74 (35.1)	61 (12.9)	0.536	<0.001
Experience of surgeon ≥2 years	156 (73.9)	373 (79.0)	0.120	0.165

Abbreviations: PPV, pars plana vitrectomy; SB, scleral buckling; IOP, intraocular pressure; RB, retina break; PVR, proliferative vitreoretinopathy.

when compared to gas tamponade, SO was more frequently used in cases with PVR grade C, presence of CD, hypotony, and inferior RBs, (p <0.001 for all).

Anatomical Outcomes

After the initial treatment, 505 patients (73.9%) achieved SSAS. Based on multivariable analysis, the probability of obtaining SSAS did not differ significantly between the two treatment groups (weighted risk difference: 0.012, 95% confidence interval (CI): −0.067 to 0.092, p = 0.776). At the end of follow-up, 578 patients (84.6%) had overall retinal

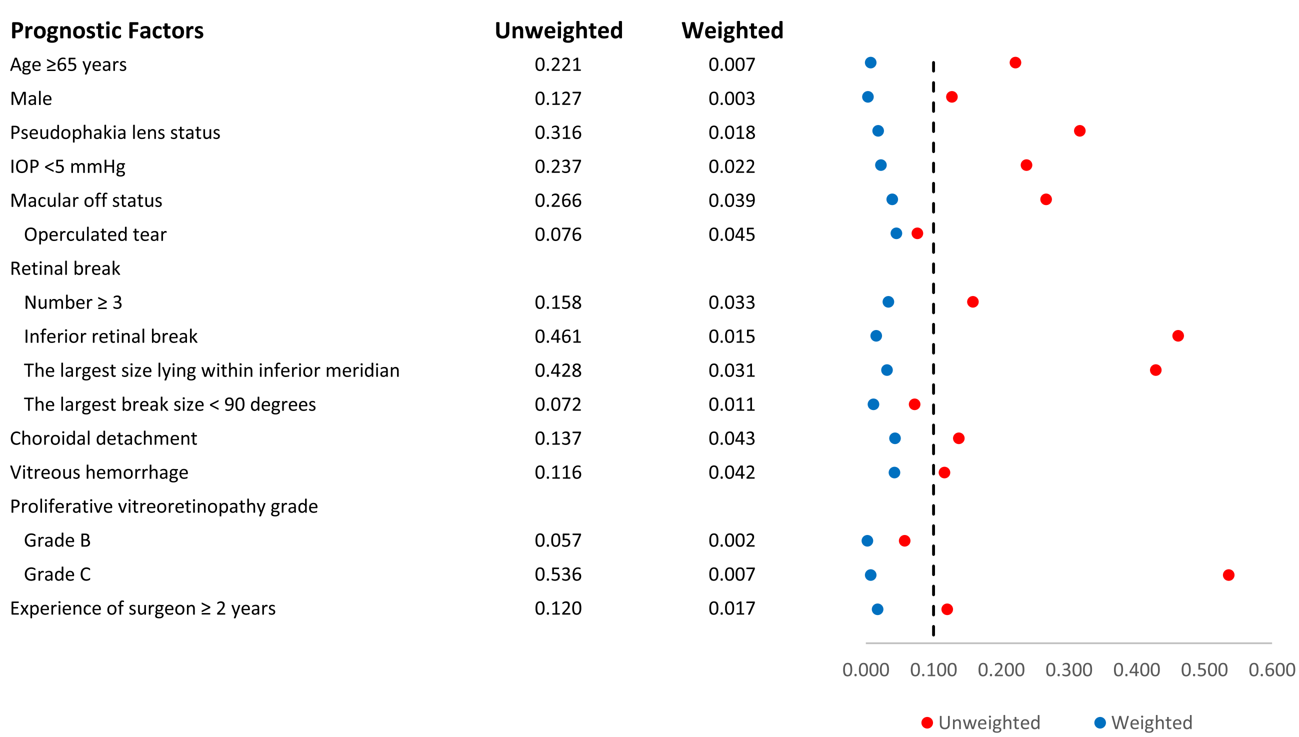

Figure 1 Standardized difference of pre-operative factors by treatment groups before and after inverse probability treatment weighting.

Table 2 Intraoperative Procedures Performed During the Initial Treatment by Treatment Groups

Interventions, n (%)	PPV/SB (n = 211)	PPV (n = 472)	P Value
Combined cataract surgery	32 (15.2)	54 (11.4)	0.212
Retinopexy 360 degree	14 (6.6)	18 (3.8)	0.118
Retinal break treatment			
Laser retinopexy	197 (93.4)	448 (94.9)	0.470
Cryoretinopexy	109 (51.7)	241 (51.1)	0.934
Tamponade agent			<0.001
Non-expansile gas (SF6, or C3F8)	68 (32.2)	291 (61.7)	
Perfluorocarbon liquid	2 (1.0)	1 (0.2)	
Silicone oil	140 (66.3)	180 (38.1)	
Heavy silicone oil	1 (0.5)	0	

Abbreviations: PPV, pars plana vitrectomy; SB, scleral buckling; SF6, sulfur hexafluoride; C3F8, perfluoropropane.

attachment while the remainder had retinal attachment but continued to have SO tamponade (69 patients, 10.1%) and retinal detachment that was considered inoperable (36 patients, 5.3%). Likewise, there was no statistically significant difference observed in the proportion of patients achieving overall retinal attachment between treatment groups (weighted risk difference; −0.038, 95% CI; −0.106 to 0.030, p = 0.272). The particular risk difference for each failure group is demonstrated in Figure 2. Notably, even though statistical significance was not reached, more patients in the PPV/SB group remained tamponade by SO and fewer patients required additional intervention to successfully reattach the retina than patients receiving PPV alone.

An analysis conducted on patients with a complete dataset revealed comparable treatment effects to those observed in the imputed dataset. No significant differences were found in the probability of achieving SSAS (weighted risk difference: 0.133, 95% confidence interval (CI): −0.301 to 0.567, p = 0.547) or in the rates of retinal attachment between the groups (weighted risk difference: 0.200, 95% confidence interval (CI): −0.720 to 0.318, p = 0.448).

Visual Outcomes

By IPTW, patients who achieved SSAS demonstrated a significant mean LogMAR VA improvement at the conclusion of follow-up (median: 13 months, IQR: 5.5 to 28.8 months) (−0.458 LogMAR units, CI; −0.591 to −0.325 for PPV/SB group vs −0.753 LogMAR units, CI; −0.809 to −0.696 for PPV group). The mean improvement of patients who underwent PPV alone was significantly greater than that of patients who underwent PPV/SB (weighted mean difference; 0.295, 95% CI; 0.150, 0.440, p <0.001). Patients who were grouped into failure categories did not show significant improvements in vision. The mean differences in VA improvement between treatment groups by failure categories are shown in Figure 3. Excluding patients with a baseline vision of LP or worse, a similar effect was observed. Patients

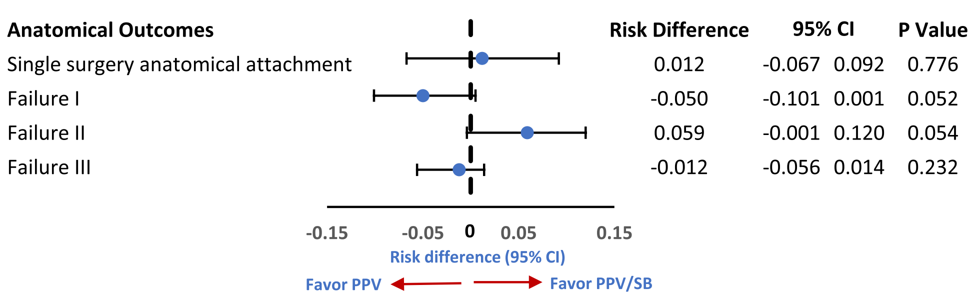

Figure 2 Risk difference of anatomical outcomes after inverse probability treatment weighting between combined pars plana vitrectomy and scleral buckling versus pars plana vitrectomy alone.

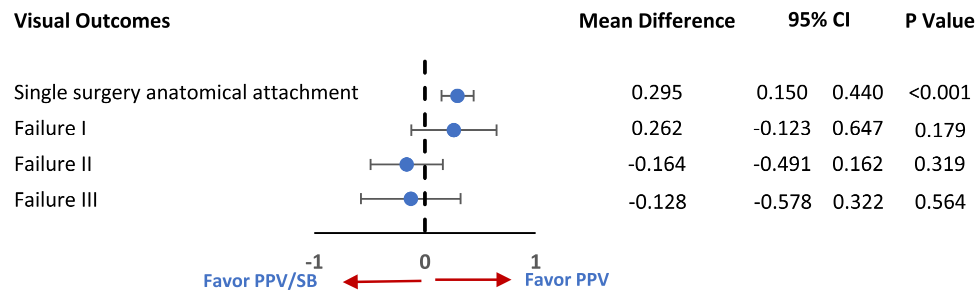

Figure 3 Mean difference of final vision improvement after inverse probability treatment weighting between combined pars plana vitrectomy and scleral buckling versus pars plana vitrectomy alone.

achieving SSAS by PPV/SB demonstrated a greater mean LogMAR VA improvement at the end of follow-up (−1.857 LogMAR units, CI; −2.207 to −1.507) compared to the PPV group (−1.213 LogMAR units, CI; −1.878 to −0.547 for PPV group), with p <0.001.

Post-Operative Complications

In the studied population, 160 patients (23.4%) developed postoperative PVR with no significant difference noted between treatment groups (PPV/SB group; 56 patients (26.5%), PPV group: 104 patients (22.0%), p = 0.199. Among patients with recurrent RRD, PVR occurred in 160 patients, (89.9%). Furthermore, 158 patients (23.1%) experienced secondary glaucoma, with significantly higher incidence in the PPV/SB group (68 patients, 32.2%) compared to the PPV group (90 patients, 19.1%). Additionally, 6 patients (0.9%) developed phthisis or hypotony, 57 patients (8.4%) developed an epiretinal membrane, and 4 patients (0.6%) experienced corneal decompensation, with no significant differences observed between the treatment groups. Details of the post-operative complications categorized by intervention groups are presented in Table 3.

Subgroup Analysis

Subgroup analysis for anatomical and visual results in 135 patients having RRD with PVR grade C was conducted using the IPTW technique in order to evaluate the results between the two interventions. There was no difference between the surgical approaches in terms of the SSAS (weighted risk difference: 0.008, 95% CI: −0.178 to 0.193, p = 0.941) and the final anatomical success (weighted risk difference: −0.067, 95% CI: −0.253 to 0.120, p = 0.492). The outcome was comparable to a study involving the entire group. Even though the patients in the PPV group showed a greater mean visual improvement (−0.482, 95% CI −0.689 to −0.275) compared to the PPV/SB group (−0.344, 95% CI: −0.506 to −0.182), the weighted mean difference (0.138, 95% CI; −0.129 to 0.405) did not reach a statistically significant difference (p = 0.311).

Table 3 Postoperative Complications Between Treatment Groups

Complications, n (%)	PPV/SB (n = 211)	PPV (n = 472)	P Value
Postoperative proliferative vitreoretinopathy	56 (26.5)	104 (22.0)	0.199
Secondary glaucoma	68 (32.2)	90 (19.1)	<0.001
Phthisis bulbi/hypotony	3 (1.4)	3 (0.6)	0.380
Epiretinal membrane	14 (6.6)	43 (9.1)	0.299
Corneal decompensation	0	4 (0.9)	0.317

Abbreviations: PPV, pars plana vitrectomy; SB, scleral buckling.

Discussion

When compared to PPV alone, the addition of SB to PPV for primary RRD repair did not increase the advantages in terms of SSAS or final anatomical success rate in this study. Additionally, patients who achieved SSAS by combined PPV/SB demonstrated less improvement in post-operative VA than those who received simple PPV.

Even though SB remained an effective surgical approach for a number of primary RRD cases, several reports have shown that PPV has been chosen more frequently and has become the preferred initial surgical intervention for RRD repair over the last two decades.[38,39] The authors noted that this shifting pattern might be partially explained by advancements in the microincisional vitrectomy instrument and surgical technique employed during PPV. Many studies have also been conducted to assess the benefit of combining SB with PPV, another surgical option for RRD repair; however, nearly all of them were predicted based on non-randomized controlled designs. The outcomes have been inconsistent, depending on the clinical or morphological presentation of RRD before surgery as well as the strategies used to control confounding factors. According to the European Vitreo-Retinal Society Retinal Detachment (EVRS) study, patients with either complicated or noncomplex RRD who received a supplemental SB to PPV had a higher proportion of patients judged to be inoperable following treatment (Failure I) than those who did not ($p = 0.048$).[29] However, it was noted that the surgeon's propensity to perform PPV/SB in eyes with a high failure probability might be a substantial confounding factor influencing the outcomes of this multicenter retrospective study.[29,30]

On the contrary, the advantages of adding SB to PPV for primary RRD repair have been documented in other studies.[14,24,26] Among those, the Scleral Buckling versus Primary Vitrectomy in Rhegmatogenous Retinal Detachment (SPR) study concluded that an addition of SB to PPV in eyes with noncomplex RRD increased the SSAS rate for eyes in the pseudophakic trial but not for those in the phakic trial. Specifically, the risk difference in re-detachment rate was 29.6% (95% CI, 13.6% to 45.5%) in the pseudophakic group, compared to 8.9% (95% CI, −2.8% to 20.7%) in the phakic group. Despite the fact that this was a randomized controlled study, its purpose was to compare the efficacy of SB vs PPV for RRD repair. SB was not assigned at random to eyes receiving PPV; therefore, interpreting their results should be done with caution.[39] Furthermore, the Primary Retinal detachment Outcome (PRO) study, a multicenter retrospective cohort analysis, indicated that in pseudophakic eyes, the addition of SB to PPV increased SSAS in cases with noncomplex RRD (92% in PPV/SB group compared to 84% in PPV alone group, $p = 0.009$). Additionally, the PRO study also revealed that in phakic eyes with moderately complex RRD, the SSAS for patients receiving SB, whether in conjunction with PPV or not, was significantly greater than those treated with PPV alone ($p = 0.004$).[40,41] However, the lack of controlling the confounding factors while selecting surgical interventions should be taken into account when considering these results.

An advantage of combining PPV/SB over PPV alone was also shown in a specific subgroup of primary RRD literature such as eyes with concurrent VH, eyes at high risk for post-operative PVR, and also in several meta-analyses.[16,42] Among those meta-analyses, Totsuka et al collected data from ten studies published up until November 2014; however, only one RCT was included in the analysis. According to the study, the greater SSAS rate in PPV/SB compared to PPV alone was evident when examining the entire cohort (odds ratio [OR], 1.70; 95% confidence interval, 1.21 to 2.39; $p = 0.002$), but it was questionable when evaluating the pseudophakic subgroup (OR, 1.28; 95% CI, 0.60 to 2.73; $p = 0.52$).[43] In a different study, Eshtiaghi et al extracted data from articles published between January 2000 and June 2021 in an effort to reduce historical bias brought on by advancements in vitreoretinal equipment. In total, there were thirty-eight papers included (6 RCTs and 32 observational studies). When examining all the included studies, there was a substantial benefit of combining SB with PPV to SSAS compared to PPV alone (88.2% versus 86.3%; relative risk (RR) = 0.97, 95% CI (0.95 to 1.00); $p = 0.03$. Nevertheless, the benefit was no longer evident when the subgroup analysis was done using only the 6 RCTs (82.5% versus 84.7%; RR = 0.98, 95% CI (0.91 to 1.06); $p = 0.62$).[44]

Although certain studies have described advantages of combining PPV/SB over PPV, the others have reported no benefit of adding SB to PPV in terms of the rate of SSAS. Thylefors et al conducted a retrospective evaluation of three surgical techniques (SB, PPV, and PPV/SB) in patients presenting with primary RRD. They found no significant difference ($p = 0.428$) in the SSAS among the different surgical interventions.[45] Similarly, Peck et al performed a retrospective assessment of the effectiveness of SB, PPV, and PPV/SB in RRD patients presenting with preoperative PVR grades B or C vs those without PVR. Their multivariable analysis reported that there was no significant difference in the probability of achieving SSAS between each intervention ($p = 0.77$).[46] Comparable SSAS rates were also seen in other studies (either observational or RCT) that compared PPV/SB and PPV, particularly in eyes that had noncomplex pseudophakic RRD.[21–23,25,47–49]

The results from this study demonstrated that, as compared with PPV alone, the addition of SB to PPV did not have additional benefit on either the SSAS rate or the final anatomical success rate for primary RRD repair. Even if SB may be helpful for supporting the vitreous base and minimizing peripheral retinal traction, the use of microincisional vitrectomy system may potentially make entire vitreous shaving feasible and lessen port-related peripheral vitreous incarceration, hence reducing the adjunctive impact of SB to PPV. The nondifference in SSAS and final anatomical success when supplementing SB to PPV demonstrated in this study is consistent with the results of earlier studies that used propensity score for analysis.[33] In addition, it was in line with the more recent meta-analysis published by Rosenberg et al which extracted data in July 2020 and included six RCTs in the analysis for comparing PPV to PPV/SB. The results indicated a RR of 0.99, with a 95% CI of 0.93 to 1.06 and a p value of 0.78. This evidence suggests that PPV/SB did not provide a superior SSAS compared to PPV.[50] It is also important to keep in mind that when a decision is made to undergo PPV/SB, one must be aware of the potential complications associated with SB, as described in prior research. These complications may include changes in refractive error, a prolonged duration of the procedure, or increased pain and discomfort both during and after the operation.[18,19]

In terms of visual improvement, it is unclear why patients undergoing PPV alone could obtain better visual improvement than those in the PPV/SB group. However, this finding was consistent with the results of prior propensity score analyses for RRD repair conducted by Hebert et al.[35] Recent studies by Quiroz-Reyes et al have demonstrated that a higher foveal choroidal vascularity index (CVI) and choroidal vascular flow (CFA), which are the optical coherence tomography (OCT) imaging techniques used to evaluate the choroidal vasculature, the main nutrient supplement of the outer retina, correlated significantly with postoperative VA improvement. Their findings revealed that patients receiving PPV/SB had a lower postoperative CVI than those in the PPV group suggesting that the addition of SB to PPV may be an underlying cause of this relationship.[51,52] However, because of the retrospective design of this study, certain data such as the height of RRD at the foveal zone, which may be associated with decreased vision, and the OCT parameters were not available. Further study that enables the evaluation of more specific features of retina reattachment including the integrity of the post-operative microstructural features of the retina, the outer retinal disruption or fold, persistent subretinal fluid, retinal vascular displacement, or the choroidal vasculature that have been the subject of increased interest in recent years might help define the possible association.[53]

Although not as effective as an RCT, the use of propensity score analysis to lessen bias from treatment allocation in non-randomized studies is one of this study's strengths. However, the limitations of this study include the non-standardization of surgical technique and co-interventions (such as the degree of laser retinopexy and SB element) between treatment groups, and a single setting study. Therefore, data interpretation needs to be done cautiously.

Conclusion

The findings from this study support a similar potential of achieving SSAS and final anatomical success in patients undergoing PPV when compared to PPV/SB for primary RRD repair. Additionally, VA improvement appears to be better in the PPV group with comparable post-operative PVR rates. However, to ascertain the actual risk difference between these two surgical procedures, prospective trials utilizing standardized surgical techniques and comprehensive data collection are necessary.

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