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SIX MONTHS PRIMARY SUCCESS RATE FOR RETINAL DETACHMENT BETWEEN VITRECTOMY AND SCLERAL BUCKLING

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Purpose: To compare clinical outcomes between pars plana vitrectomy (PPV), scleral buckling (SB), and PPV+SB for rhegmatogenous retinal detachment in the Japan-RD Registry.

Methods: This is a nation-wide, multicenter, observational study based on the registry data between 2016 and 2017. The failure levels were defined as Level 1 (a failure of retinal detachment repair), Level 2 (remaining silicone oil), and Level 3 (multiple surgeries to achieve reattachment). We compared cases treated by SB or PPV in the subgroup of simple rhegmatogenous retinal detachment using multivariate Cox proportional hazard models.

Results: A total of 2,775 cases were included. Overall, 6 months any levels of failure in total, SB, PPV, and PPV+SB were 9.2% (n = 256), 6.9% (n = 48), 8.2% (n = 157), and 21.3% (n = 51), respectively. Poor visual acuity at baseline in SB and inferior rhegmatogenous retinal detachment and larger retinal tear in PPV were associated with a higher risk of failure. Pars plana vitrectomy was associated with a higher chance of achieving primary success in cases with simple RRD, especially for cases with superior RRD (adjusted hazard ratio 3.61, 95% confidence interval 2.22–5.94, $P < 0.001$).

Conclusion: In this nationwide study, surgical anatomic outcomes were equally successful in either SB or PPV. There were different baseline characteristics associated with primary success between SB and PPV.

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Surgical management for rhegmatogenous retinal detachment (RRD) includes three widely accepted methods, namely, scleral buckling (SB), pars plana vitrectomy (PPV), and pneumatic retinopexy. Pneumatic retinopexy may result in lower rates of reattachment and higher rates of recurrence than SB[1] and requires careful selection of patients with a single retinal break or multiple breaks within 1 clock hour of the superior retina.[2] Therefore, SB or PPV is suitable for eyes with all other types of RRD. There is a tendency in the selection of the surgical method, that is, PPV is often selected for cases of old age because of retinal tears or with vitreous hemorrhage, whereas SB for young age because of retinal holes. Vitrectomy is often the preferred choice for superior retinal detachment, but there is controversy for inferior retinal detachment. Choosing between SB and PPV is based on the surgeon's own experience in addition to influences at the clinic, such as the preferences of colleagues or supervisors.

Whether SB or PPV has superiority when treating cases with RRD remains controversial. There have been multiple randomized controlled trials comparing SB and PPV to treat RRD.[3–10] There is also a Cochrane review and meta-analysis of studies conducted between 2002 and 2007.[11] This Cochrane review concluded that there was little or no difference between SB and PPV in primary success rate with low certainty due to limitations of the studies, namely small sample size, lack of randomization details, and differences in surgical procedures.

In the past few decades, sutureless microincision vitrectomy surgery (MIVS) with a small gauge (G) probe has emerged as an advancement in the surgical technique.[12–15] Although there have been several small retrospective case series[13–15] reporting promising primary success rate using MIVS compared with 20G PPV, no large scale study has compared the success rate between SB and PPV in this era of MIVS.

The Japanese Retina and Vitreous Society established the Japan-Retinal Detachment (J-RD) Registry. Qualified institutions located throughout Japan participated in this registry to collect data on all patients with RRD treated between 2016 and 2017 and followed to 6 months. In this study, we aimed to report 6-month success rates, failures, and associated factors and then compared surgical procedures adjusting for background factors in a real-world setting.

Methods

Detailed study designs have been published elsewhere.[16] In brief, this registry collected data regarding consecutive eyes with RRD treated at 26 institutions located all over Japan. The participating facilities are listed in the Acknowledgments. The main study protocol was approved by the Ethics Committee of the Kagoshima University (140093 [28-38]), and all participating facilities thereafter, and the procedures used conformed to the tenets of the Declaration of Helsinki.

Study Participants

There were 3,446 cases with RRD having information on surgical procedures; then, 227 cases were excluded because of previous surgeries for RRD. Of the 3,219 remaining cases, 86.2% (n = 2,775) had completed 6-month follow-up to determine the status of success or failure as a treatment outcome. When comparing those who were included in the analysis with those who dropped out by the end of follow-up, the latter had lower visual acuity, hyperopic refractive errors, longer time between RRD onset and surgery, and were more likely to have total detachment, macular-off detachment, breaks at the vitreous base, and to more likely to be treated by PPV (see **Table S1, Supplemental Digital Content 1**, http://links.lww.com/IAE/B325). Most patients received 25G PPV (93.6%), followed by 27G (3.9%), 23G (1.9%), and 20G (0.6%). The clinical characteristics of patients are shown in **Supplemental Digital Content 2** (see **Table S2**, http://links.lww.com/IAE/B326). The background factors of cases treated with PPV, SB, and PPV+SB are considerably different. We found significant associations between the choice of SB/PPV and the risk of completing 6-month follow-up without adjustment; however, there was no significant association after adjusting for hospitals. Thus, we interpret that the cause of loss to follow-up depends on the hospitals and not on the choice of surgeries. We therefore adjusted for the hospitals for the following analyses.[16,17]

Data Collection

Clinical characteristics before the surgery were collected using a standardized web-based electronic data capture system as: age, sex, and ocular treatment history (Group A, patients who had had surgery related to the current RRD [excluded from the current analysis]; Group B, patients who had had vitreoretinal surgery not related to the current RRD; Group C, patients who had had intraocular surgery other than surgeries for vitreoretinal disease, such as corneal, cataract, or glaucoma surgery, or intravitreal injections; Group D, patients who had had prophylactic laser photocoagulation for the RRD; None, patients who had had no ocular interventions in the past) with the following information: time between RRD onset and surgery (0, 1–3, 4–7, 8–13, 14–28, or 29+ days), logarithmic minimum angle of resolution (logMAR) visual acuity at baseline (<−0.1, −0.1 to 0.2, 0.2–0.9, or 1.0+), intraocular pressure (IOP) (0–10, 11–12, 13–14, or 15+ mmHg), spherical equivalent refraction (<−10D, −10D to <−5D, −5D to <−1D, −1D to <+1D, +1D to <+5D, or ≤+5D), axial length (<22.0, 22.0–26.0, or 26.0+ mm), lens status (aphakia, phakia, or pseudophakia), type of tears/holes (atrophic holes, tears, macular hole, or breaks at/near the vitreous base), number of tears/holes (1, 2–3, or 4+), location

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Human subjects are included in this study. The Human Ethics Committee at Kagoshima University approved the study. All research and surgical procedures adhered to the Declaration of Helsinki. Patients were instructed that they had the right to opt out of inclusion in the registry if they wished. No animal subjects were included in this study.

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of the largest retinal breaks (superior–temporal, superior–nasal, inferior–temporal, inferior–nasal, or the posterior pole), size of the largest tears/holes (0–30, 30–60, 60–90, or 90+ degrees), area of detachment (1–4 quadrants [Qs]), presence of macula detachment, choroidal detachment (CD), hypotony (IOP < 5 mmHg), and proliferative vitreoretinopathy (PVR) category (N/A, B, or C).

Clinical Information After the Surgery

The clinical data regarding the surgical procedures and postoperative findings, including complications developed at 1, 3, and 6 months postoperatively, were collected as previously described.[16]

Definitions of Primary Success and Failure Levels

Primary success was defined as having no additional surgery by 6 months. Silicone oil removal was planned within 6 months if no other additional procedures were required. Definitions of Level 1 to 3 failures were adopted from studies by the European VitreoRetinal Society.[18–21] A Level 1 failure was defined as the persistence of RRD after initial surgery with or without additional surgeries at 6 months. A Level 2 failure was defined as having silicone oil remaining in the eyes at 6 months either after the initial surgery or additional surgeries. A Level 3 failure was defined as having recurrent RRD after the initial surgery that took an additional surgery for retinal reattachment at 6 months.

Statistical Analysis

First, we described the background characteristics of patients. Second, we used the time to event data using the Cox proportional hazard model to determine the hazard ratios (HRs) for any failure with a random intercept that takes into account the within-hospital correlation. We separately modeled for all patients, patients treated with SB, patients treated with PPV, and patients treated with PPV+SB. In the models, we included covariates of age, ocular treatment history, time between RRD onset and surgery, logMAR visual acuity, IOP, spherical equivalent refraction, axial length, lens status, type of tears/holes, number of tears/holes, location of the largest retinal breaks, size of the largest tears/holes, area of detachment, macula detachment, CD, hypotony, and PVR category. Finally, we determined the HRs for failure comparing SB and PPV. Apparently, cases treated by PPV+SB were severer and their potential risk factor distribution did not overlap with that of eyes treated with SB. Thus, we used a subset of "simple RRD cases" by excluding cases with a macular hole or posterior pole breaks, cases aged ≤39 year, large tear (90° or larger), short axial length (<22.0 mm), hypotony, or aphakia. This was based on the observation that most of those cases were treated with PPV or PPV+SB and rarely by SB alone or vice versa. All models were adjusted for potential confounding factors, and hospitals were included as a multilevel variable. All analysis was conducted using Stata 16.0 (College Station, TX), and a P value of <0.05 was considered to be statistically significant in this analysis.

Results

Primary Success and Failure Levels by Surgical Procedures

The overall 6 months primary success rate was 90.8%; primary success rates in eyes treated with SB, PPV, and PPV+SB were 93.1%, 91.8%, and 68.7%, respectively. Results by failure level are presented in Table 1. The percentages of treatment successes and failures by surgical procedures are shown in **Supplemental Digital Content 3** (see **Table S3**, http://links.lww.com/IAE/B327), and illustrated in Figure 1. In both SB and PPV treated eyes, those with lower baseline visual acuity, pseudophakic eyes, larger area of detachment, presence of macular detachment, and more severe PVR were more likely to have any level of treatment failure. The proportion of failures by the location of the largest retinal break differed between SB and PPV. The proportion of failures was higher in eyes treated by SB and lower in eyes treated with PPV if the breaks were in the inferior retina rather than the superior retina.

Table 1. Primary Success and Failure Levels by Surgical Procedures

	Primary success		Failure*					
	n	%	Level 3		Level 2		Level 1	
Overall patients	2,519	90.8	118	4.3	131	4.7	7	0.3
SB	648	93.1	41	5.9	4	0.6	3	0.4
PPV†	1759	91.8	73	3.8	80	4.2	4	0.2
PPV+SB	112	68.7	4	2.5	47	28.8	0	0.0

*Failure level: Level 1 failure was defined if retinal detachment remained after initial surgery with or without additional surgeries at 6 months. Level 2 failure was defined as having silicone oil remaining in the eyes at 6 months either after the initial surgery or additional surgeries. Level 3 failure was defined as having recurrent retinal detachment after the initial surgery and took additional surgery to be reattached at 6 months.

†PPV was mainly conducted with 25G vitrectomy (93.6%), followed by 27G (3.9%), 23G (1.9%), and 20G (0.6%).

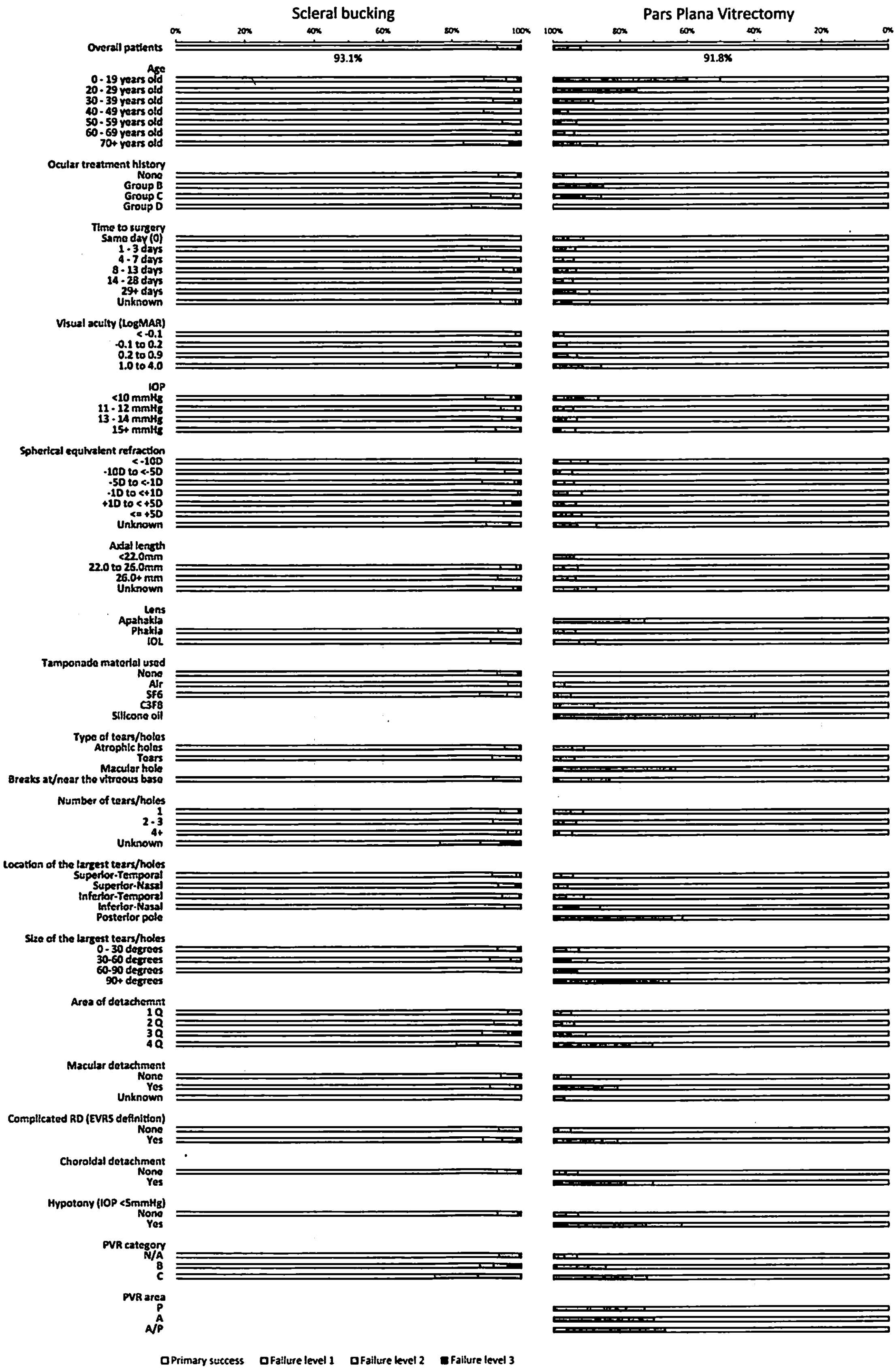

Fig. 1. Proportion of patients with 6-month outcomes after treatment of RRD by scleral buckling or PPV or both.

Factors Associated With Any Failure by Surgical Procedures

As shown in the **Supplemental Digital Content 3** (see **Table S3**, http://links.lww.com/IAE/B327) less than 10 patients were treated by SB when posterior pole breaks, 90° or larger breaks, CD, hypotony, or PVR category C was present. Because we observed more complicated cases in general were more likely to be treated with PPV, we separately examined factors associated with primary success or failures by SB, PPV, or PPV+SB using Cox proportional hazard models (Table 2).

Overall, inferior RD had a higher risk of failure compared with superior temporal RD. The larger area of detachment and PVR category C were associated with a higher risk of failure as well. In patients treated with SB, worse visual acuity, myopic eyes of −5D to −1D were significantly associated with an increased risk of failure after adjustment with multivariate analysis. In patients treated with PPV, inferior–nasal detachment (compared with superior–temporal detachment), 90+ degree break, and total retinal detachment (4Q) were associated with a higher risk of failure. In patients treated with PPV or PPV+SB, inferior–nasal or temporal detachment (compared to superior–temporal detachment), 90+ degree break, and 3Q or larger RD were associated with a higher risk of failure.

Association of Choice of Surgical Procedures (Pars Plana Vitrectomy vs. Scleral Buckling) and Failure by Location of the Detachment

Clinical characteristics by surgical procedures in this subgroup analysis are presented in the **Supplemental Digital Content 3** (see **Table S3**, http://links.lww.com/IAE/B327). The primary success rates for SB and PPV were 92.4% and 94.3%, respectively. As we observed from data in **Supplemental Digital Content 3** (see **Table S3**, http://links.lww.com/IAE/B327) and Table 2, there was a clear suggestion that eyes with inferior RRD treated with PPV/PPV+SB had a higher risk of treatment failure while there was no such association found for eyes treated by SB alone. When examined with a chi-square test, this difference in the single surgery success rate by the location of tears/holes was statistically significant ($P < 0.001$). Therefore, we explored the interaction between treatment choice and the location of the RRD (superior/inferior) by stratifying eyes by the location of the largest retinal breaks (see Supplement Table S4, **Supplemental Digital Content 4,** http://links.lww.com/IAE/B328, and Table 3). As seen in Table 3, SB was associated with a higher risk of failure than PPV (Figure 2) in patients with relatively simple RRD. There was a 2. 53 higher risk of developing any failure in SB compared with PPV after adjustment with age, ocular treatment history, time to surgery, logMAR visual acuity, IOP, spherical equivalent refraction, axial length, lens status, type of tears/holes, number of tears/holes, location of the largest tears/holes, size of the largest tears/holes, area of detachment, macular detachment, CD, and PVR category; clinics were included as a multilevel variable (adjusted HR 2.53, 95% confidence interval [CI]: 1.67–3.84, $P < 0.001$). When confined to superior detachment, cases treated with SB had a significantly higher risk of any failure compared with PPV, whereas this was not observed in cases with inferior RRD.

Discussion

There were multiple randomized controlled trials comparing SB and PPV to treat RRD,[3–10] and a Cochrane review and meta-analysis of 10 studies comparing the two methods[11] found little or no difference in primary success rate between SB and PPV. However, there remained low certainty due to the limitations of the reported studies. If one is to conduct an randomized controlled trial with two study arms of SB and PPV, 200 patients each were required to detect a 10% difference in the success rate (alpha <0.05 and beta <0.2). However, it is quite challenging to conduct such a study in large scale. Observational studies with detailed information can be a realistic alternative study design. This is especially so when larger study participants were recruited so that multivariate adjustment can be performed. There have been studies that collected real-world clinical information on RRD from either a dedicated registry (e.g., the European VitreoRetinal Society RD study[18–21]), integrated electronic health record system (e.g., the Intelligent Research in Sight [IRIS] Registry[22] and United Kingdom National Ophthalmology Database Study of Vitreoretinal Surgery[23]), or health claims database.[24] In the European VitreoRetinal Society RD study, a multicenter retrospective investigation was conducted on the success or failure of RRD treatment in 7,678 patients who were treated by 176 surgeons from 48 countries.[18–21] International participation has a strength, whereas self-reported data entry without the standardization of wide range of surgical backgrounds over countries could increase heterogeneity in the definition of surgical procedures. The J-RD Registry was established under the strong leadership of the Japanese Retina and vitreous Society and its council members. The strength of this

Table 2. Association of Any Levels of Failure by Surgical Procedures (the Multilevel Mixed-Effect Cox Proportional Hazard Model)

Characteristics	Overall Patients			SB			PPV			PPV or PPV+SB		
	HR	95% CI	*P*	HR	95% CI	*P*	HR	95% CI	P	HR	95% CI	*P*
Age												
per 10 years	1.00	0.99–1.01	0.943	1.01	0.99–1.02	0.411	1.01	0.99–1.02	0.341	1.00	0.99–1.01	0.503
Ocular treatment history												
None	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
Group B	1.01	0.34–3.02	0.989	3.19	0.34–29.68	0.308	0.87	0.19–4.04	0.855	1.30	0.43–3.99	0.643
Group C	1.24	0.68–2.25	0.478	0.51	0.11–2.30	0.378	1.46	0.64–3.31	0.364	1.25	0.67–2.34	0.482
Group D	0.34	0.08–1.38	0.130	1.23	0.35–4.33	0.752	Not available*		0.20	0.03–1.44	0.110	
Time to surgery												
0 (on the day)	1.00	reference		Not available (No failure)*			1.00	reference		1.00	reference	
1–3 days	3.36	0.44–25.49	0.240	1.00	reference		0.65	0.14–2.97	0.581	0.87	0.25–3.04	0.822
4–7 days	3.81	0.52–28.23	0.190	2.17	0.74–6.31	0.157	0.58	0.13–2.58	0.474	0.74	0.22–2.51	0.623
8–13 days	3.61	0.19–26.83	0.210	1.58	0.53–4.70	0.414	0.79	0.18–3.49	0.751	0.97	0.28–3.30	0.956
14–28 days	3.09	0.40–23.61	0.278	1.70	0.50–5.77	0.394	0.51	0.11–2.45	0.399	0.67	0.18–2.43	0.542
29+ days	4.52	0.61–33.74	0.141	1.61	0.52–5.02	0.412	1.02	0.23–4.61	0.979	1.17	0.34–4.01	0.806
Unknown	4.12	0.56–30.13	0.163	1.34	0.48–3.72	0.578	0.84	0.73–3.69	0.821	1.11	0.33–3.72	0.865
Visual acuity (logMAR (Snellen))												
<−0.1 (20/16)	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
−0.1 (20/16) to 0.2 (20/32)	3.81	1.19–12.16	0.024	4.50	1.05–19.29	0.043	2.36	0.55–10.06	0.248	2.44	0.58–10.19	0.221
0.2 (20/32) to 0.9 (20/160)	3.56	1.08–11.79	0.038	6.27	1.36–29.02	0.019	2.03	0.45–90.5	0.354	2.70	0.63–11.60	0.183
1.0 (20/200) to 4.0 (sl(−))	4.99	1.46–16.77	0.009	8.45	1.72–41.38	0.008	3.32	0.73–15.03	0.119	3.86	0.89–16.81	0.072
Intraocular pressure (mmHg)												
0–10	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
11–12	0.93	0.63–1.37	0.713	0.80	0.37–1.72	0.568	1.15	0.72–1.84	0.558	0.90	0.60–1.36	0.611
13–14	0.98	0.68–1.44	0.936	0.58	0.28–1.19	0.138	1.22	0.75–1.98	0.417	0.99	0.66–1.47	0.943
15+	1.14	0.81–1.61	0.460	1.06	0.55–2.04	0.873	1.33	0.85–2.07	0.212	0.94	0.65–1.36	0.732
Spherical equivalent refraction (D)												
<−10	1.39	0.74–2.62	0.311	1.87	0.63–5.49	0.256	0.72	0.24–0.22	0.555	0.73	0.31–1.68	0.454
−10 to <−5	1.14	0.74–1.76	0.548	1.97	0.83–4.67	0.123	1.18	0.66–2.09	0.579	0.86	0.52–1.42	0.549
−5 to <−1	1.11	0.77–1.60	0.568	2.40	1.06–5.41	0.035	0.74	0.45–1.19	0.213	0.76	0.50–1.15	0.195
−1 to <+1	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
+1 to < +5	0.88	0.53–1.46	0.360	1.08	0.30–3.90	0.905	1.12	0.65–1.93	0.686	0.93	0.56–0.56	0.778
≥ +5	0.47	0.11–1.97	0.302	Not available*		0.38	0.10–1.41	0.147		0.53	0.19–0.19	0.230
Unknown	0.95	0.61–1.16	0.803	1.40	0.38–5.26	0.614	0.78	0.47–1.31	0.344	0.85	0.55–0.55	0.438
Axial length (mm)												
<22.0	Not available*		Not available*	0.42	0.05–3.18	0.398	0.39	0.05–2.90	0.361			
22.0 to 26.0	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
26.0+	0.91	0.66–1.26	0.576	1.11	0.66–1.86	0.697	0.77	0.49–1.21	0.250	0.97	0.67–1.40	0.872

(*continued on next page*)

Table 2. *(Continued)*

	Overall Patients			SB			PPV			PPV or PPV+SB		
Characteristics	HR	95% CI	*P*	HR	95% CI	*P*	HR	95% CI	P	HR	95% CI	*P*
Unknown	0.97	0.68–1.38	0.850	0.85	0.45–1.61	0.622	1.15	0.72–1.82	0.566	1.02	0.69–1.51	0.906
Lens												
Apahakia	Not available*		Not available*	2.16	0.53–8.91	0.285	1.64	0.62–4.36	0.318			
Phakia	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
IOL	1.03	0.57–1.85	0.925	1.08	0.23–5.12	0.922	0.95	0.42–2.12	0.893	1.09	0.59–2.03	0.778
Type of tears/holes												
Atrophic holes	1.00	reference		1.00	reference		1.00	reference			1.00	reference
Tears	0.62	0.45–0.85	0.003	0.83	0.50–1.39	0.490	1.23	0.70–2.18	0.470	0.86	0.55–1.35	0.525
Breaks at vitreous base	1.08	0.60–1.92	0.805	1.17	0.42–3.24	0.766	1.82	0.73–4.53	0.197	1.07	0.55–2.09	0.843
Number of tears/holes												
1	1.00	reference		1.00	reference		1.00	reference			1.00	reference
2–3	0.97	0.75–1.27	0.846	1.13	0.73–1.76	0.581	0.83	0.58–1.17	0.285	0.88	0.66–1.18	0.396
4+	0.87	0.60–1.27	0.400	1.12	0.55–2.29	0.746	0.82	0.49–1.34	0.419	0.85	0.57–1.27	0.430
Location of the largest tears/holes												
Superior–Temporal	1.00	reference		1.00	reference		1.00	reference			1.00	reference
Superior–Nasal	0.80	0.56–1.14	0.208	0.56	0.29–1.09	0.089	0.85	0.51–1.34	0.491	0.82	0.56–1.21	0.312
Inferior–Temporal	1.49	1.09–2.02	0.012	0.78	0.48–1.26	0.311	1.89	1.26–2.84	0.002	1.84	1.31–2.58	<0.001
Inferior–Nasal	1.51	1.01–2.25	0.045	0.66	0.31–1.41	0.283	2.41	1.42–4.08	0.001	1.68	1.07–2.62	0.023
Size of the largest tears/ holes (degrees equivalent)												
0–30	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
30-60	1.24	0.81–1.90	0.331	0.59	0.17–2.08	0.415	1.31	0.76–2.25	0.332	1.49	0.97–2.28	0.066
60-90	0.84	0.30–2.32	0.731	0.96	0.11–8.33	0.970	1.05	0.36–3.07	0.930	1.62	0.74–3.70	0.221
90+	* Not available		* Not available	4.79	1.94–11.84	0.001	3.28	1.67–6.43	0.001			
Area of detachment (quadrant, Q)												
1 Q	1.00	reference		1.00	reference		1.00	reference			1.00	reference
2 Q	1.38	0.97–1.97	0.073	1.29	0.78–2.13	0.324	1.60	0.98–2.62	0.060	1.72	1.09–2.71	0.020
3 Q	1.84	1.17–2.91	0.009	1.48	0.72–3.03	0.287	1.86	0.99–3.49	0.053	2.23	1.28–3.89	0.005
4 Q	2.73	1.54–4.86	0.001	0.93	0.19–4.56	0.929	4.58	2.23–9.43	<0.001	4.42	2.38–8.24	<0.001
Macular detachment												
Yes versus No	1.09	0.76–1.58	0.640	1.17	0.66–2.07	0.599	1.13	0.69–1.84	0.627	0.78	0.51–1.19	0.247
CD												
Yes versus No	1.49	0.84–2.66	0.176	1.24	0.14–10.71	0.844	1.32	0.72–2.43	0.369	1.45	0.91–2.29	0.115
PVR category												
N/A	1.00	reference		1.00	reference		1.00	reference		1.00	reference	
B	1.77	1.11–2.84	0.017	0.61	0.13–2.93	0.541	1.61	0.91–2.83	0.101	1.67	1.07–2.61	0.025
C	3.23	2.09–4.99	<0.001	5.59	1.53–20.39	0.009	2.49	1.41–4.40	0.002	2.48	1.60–3.86	<0.001

Models include all variables listed.
*No estimates available.
OR, odds ratio.

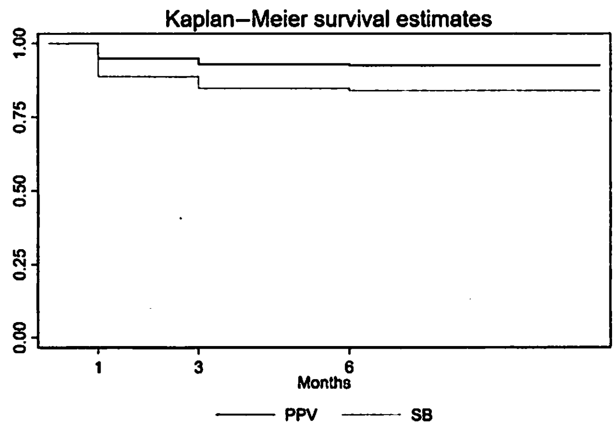

Fig. 2. Kaplan-Meier curve representing any levels of failure by SB and PPV.

study is that the treatment in all cases was by standardized approaches approved by the Japanese Retina and vitreous Society and performed by well-trained qualified surgeons. Furthermore, the data were prospectively and consecutively collected nationwide. The registry could collect data from 26 major hospitals and maintained a 6 months follow-up rate of 86.2%.

The European VitreoRetinal Society RD study determined the risk characteristics associated with failure after the treatment of RRD and also compared the success rate between SB and PPV. They found that SB resulted in fewer incidences of Level 1 and Level 2 failures (0.5% and 0.4%, respectively) compared with PPV (1.2% and 3.2%, respectively). In their study, the unadjusted proportion of failures at any level was slightly lower for PPV at Level 1 (0.4% vs. 0.2%, SB vs. PPV, respectively) and higher for PPV at Level 2 (0.6% vs. 4.2%, SB vs. PPV, respectively) than for SB. No association between the choice of SB or PPV and primary success or any level of failure was found, and it was consistent with the Cochrane review.[11]

Even with the large number of study participants, there is the selection of treatment choice based on individual surgeons' preference. This has caused an unbalanced baseline characteristics of those treated with SB or PPV.[25] Therefore, we took two steps to minimize the bias caused by the unbalanced background characteristics. The first is to use a multivariate model with potential confounders. The second is to confine the study sample to those cases with relatively simple RRD and either SB or PPV can be a potential option. Here, PPV+SB was specifically chosen to treat complicated severe RRD and not being comparable with SB or PPV. We confined the comparison of SB and PPV in cases after excluding those with a macular hole or posterior pole breaks, younger age (age ≤39 year), large tear (90° or larger), extremely short axial length (<22.0 mm), hypotony, or aphakia. With these two

Table 3. Association of Choice of Surgical Procedures (PPV vs. SB) and Any Failure by the Location of the Detachment

Multilevel Mixed-Effects Cox Proportional Hazard model*	Cumulative% of Any Levels of Failure		Unadjusted			Adjusted		
	PPV	SB	HR†	95% CI	*P*	HR†	95% CI	*P*
Overall cases	153/1,651 (9.27%)	51/344 (14.8%)	1.60	1.14–2.25	0.006	2.53	1.67–3.84	<0.001
Models by the location of the detachment								
Patients with superior detachment only (n = 1,545)	96/1,295 (7.41%)	40/250 (16.0%)	2.23	1.49–3.32	<0.001	3.61	2.20–5.94	<0.001
Patients with inferior detachment only (n = 449)	57/355 (16.1%)	11/94 (11.7%)	0.67	0.35–1.30	0.238	1.27	0.53–3.01	0.594
Superior/Inferior and SB/PPV (HR for any level of failure comparing with patients who have superior detachment treated by SB as a reference group)								
Superior detachment and SB	40/250 (16.0%)		1.00	reference		1.00	reference	
Superior detachment and PPV	96/1,295 (7.41%)		0.45	0.30–0.66	<0.001	0.29	0.18–0.46	<0.001
Inferior detachment and SB	11/94 (11.7%)		0.69	0.35–1.35	0.281	0.60	0.28–1.27	0.183
Inferior detachment and PPV	57/355 (16.1%)		1.08	0.70–1.67	0.727	0.59	0.35–0.98	0.041

Adjusted for age category, ocular treatment history, time to surgery, logMAR visual acuity, IOP, spherical equivalent refraction, axial length, lens status, type of tears/holes, number of tears/holes, location of the largest tears/holes, size of the largest tears/holes, area of detachment, macular detachment, CD, and PVR category; Clinics were included as a multilevel variable.

*Patients with a macular hole or posterior pole breaks, age ≤39 years, large tear (90° or larger), extremely short axial length (<22.0 mm), hypotony (IOP <5 mmHg), or aphakia were excluded.

†Higher HR indicating a higher chance of any level of failure when treated by SB compared with PPV.

steps, we consider that reasonable comparison was achieved. Importantly, we found a significant association between the surgical choice of SB or PPV in simple RRD, and the results was more contrasted by retinal break location using a detailed multivariate adjusted model. Pars plana vitrectomy treatment in eyes with superior RRD halved the risk of failure when compared with SB. It should be emphasized that this analysis was confined to patients with simple RRD, and this finding applies only when the surgeon is free to choose between SB and PPV depending on preference. We previously reported that surgeons with higher activity during the case registration period significantly associated with selecting PPV over SB.[25] The benefit of PPV in superior RRD and marginal benefit of SB in inferior RRD are also consistent with the clinical observation that gas tamponade after PPV is more suitable for superior RRD. It also should be noted that the emerging role of MIVS could account for less failures compared with SB. Since the early 2000s, 23G,[12] 25G,[26] or 27G[27] systems have been introduced, and MIVS has become the mainstream PPV procedure. Most of the studies comparing SB and PPV were conducted in the late 1990s to early 2000s, using 20G systems. In this study, 93.6% of the PPV was performed using a 25G system. To the best of our knowledge, this is the first study to determine that PPV performed using MIVS primarily has a potential benefit, increasing the chance of 6 months primary success by 3-fold, in patients aged 40 years or older with noncomplicated RRD in the superior retina.

There are some strengths and limitations in this study. A large-scale detailed clinical data set from the J-RD Registry provided us with an opportunity to examine the difference in the primary success rate for treatment of RRD between SB and PPV after careful adjustment for clinical characteristics. With prospective consecutive case registration, detailed clinical data acquisition, and rigorous follow-up data, registries can become a vast data resource for investigating clinical outcomes and risk factors. Limitations include time and resources to complete data entry and difficulty in collecting follow-up information. Also, the coverage of data collection or credibility of data entry cannot necessarily be guaranteed in registry studies. Pneumatic retinopexy is rarely performed in Japan, so the data of pneumatic retinopexy could not be obtained. Identifying prognostic characteristics of patients with complex RRD are another important issue. Furthermore, the selection of surgery type was at the surgeon's discretion. We used a random-intercept model to account for within-hospital correlation and minimize the bias associated with surgeons/facilities.

In conclusion, we reported that naive RRD can be treated successfully either by SB or PPV. Overall, inferior RD, larger area of detachment, and PVR category C were associated with a higher risk of failure in both SB and PPV cases. There were different baseline characteristics associated with primary success in cases treated by SB and PPV. Worse visual acuity, myopic eyes were associated with an increased risk of failure in SB, and inferior detachment and total retinal detachment were associated with a higher risk of failure in PPV.

Key words: retinal detachment, registry data, J-RD Registry, vitrectomy, scleral buckling.

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