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Vitrectomy versus Vitrectomy with Scleral Buckling in the Treatment of Giant Retinal Tear Related Retinal Detachments

An International Multicenter Study

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Purpose: To determine the practice pattern for treating giant retinal tear (GRT) related detachments, and their anatomic and visual outcomes with pars plana vitrectomy (PPV) with or without scleral buckling (SB).

Design: Retrospective cohort study.

Subjects: Eyes with GRT detachments repaired from 2008 to 2020 with at least 6 months of follow-up from 7 institutions in North and South America, Europe, and Asia.

Methods: Eyes repaired using PPV versus PPV/SB were compared.

Main Outcome Measures: Anatomic and functional outcomes.

Results: A comparable number of eyes underwent PPV (n = 101) and PPV/SB (n = 99). Except for history of developmental abnormalities, prior intraocular surgery, and lens status, no differences in baseline demographics, ocular characteristics, or intraoperative surgical adjuncts were observed. The overall single surgery anatomic success (SSAS) at 6 months and 1 year were similar between the groups (82.2% and 77.2% of PPV, and 87.9% and 85.7% of PPV/SB). When stratified by age, the 1-year SSAS rate was higher for PPV/SB (88.5%) than PPV (56.3%) ($P = 0.03$) for children <18 years. For both children and adults, the mean best-corrected visual acuity (BCVA) at baseline did not differ between the PPV and PPV/SB groups. However, for children, mean BCVA at 1 year was better in the PPV/SB than PPV groups ($P = 0.001$) while for adults, no difference was found between the 2 groups. The mean time to the first redetachment was 7.9 months in the PPV group and 5.5 months in the PPV/SB group ($P = 0.8$). Proliferative vitreoretinopathy was the most common cause for redetachment (70.4% of PPV and 93.8% of PPV/SB in redetached eyes; $P = 0.1$). Postoperative complications were also similar between the 2 groups, including ocular hypertension, epiretinal membrane, and cataract formation.

Conclusions: PPV and PPV/SB are equally popular among surgeons globally for managing GRT detachments and have comparable anatomic and visual outcomes in adults. In children, PPV/SB is superior to PPV for anatomic and functional success at 1 year. In adults, the relief of traction by the GRT may reduce peripheral traction and obviate the need for an SB. However, in children, a supplemental SB can be beneficial as complete vitreous shaving and posterior hyaloid detachment, and postoperative positioning, are difficult in this group. *Ophthalmology Retina 2022;■:1–12 © 2022 by the American Academy of Ophthalmology*

Supplemental material is available at www.ophthalmologyretina.org.

A giant retinal tear (GRT) is defined as a full-thickness retinal break that involves at least 3 clock hours (90 degrees) of the retina and can be associated with a posterior vitreous detachment.[1] GRTs are uncommon, with a reported incidence of 0.094 to 0.15 per 100,000 people per year.[2,3] The majority of GRTs are thought to be idiopathic,[4] but have also been associated with trauma,[1] high myopia,[1] lattice degeneration, excessive cryotherapy or photo coagulation,[5] and hereditary vitreoretinopathies, such as Stickler's, Marfan's,[6] and Ehlers-Danlos syndromes.[7]

Retinal detachments associated with GRTs are challenging to manage surgically given the 40% to 50% rate of

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proliferative vitreoretinopathy (PVR) that causes redetachments.[8] Historically, a wide range of techniques have been employed to repair GRT-associated detachments with varying degrees of success, including rapid head movements,[9] fluid-air exchange with the patient in a prone position and the surgeon in a supine position, as well as intraoperative fixation of the retina with microincarceration, adhesives, sodium hyaluronate, retinal tacks, screws, and sutures.[10] Modern techniques using wide-field visualization, small-gauge pars plana vitrectomy (PPV), endolaser, perfluorocarbon liquids,[11-13] and silicone oil[14] have improved outcomes, but the role of adjuvant scleral buckling (SB) in GRT-associated detachments remains a debated topic.[4]

To date, no prospective randomized controlled trial has been conducted to examine the safety and efficacy of SB combined with PPV (PPV/SB) versus PPV alone in the management of GRT-associated detachments.[4] Retrospective studies, meanwhile, are limited by small sample size and have yielded contradictory results regarding the efficacy of adjunct SB.[11,14-23] The largest retrospective study comparing PPV and PPV/SB to date was published in 2002 and included 212 eyes.[13] Scott et al[13] found that the addition of SB was beneficial. However, this conclusion may be dated, given the introduction of improved vitrectomy instruments, and the trend to perform primary vitrectomy over primary scleral buckle and combined vitrectomy/buckle over the past 2 decades.[24-28]

Several reasons might explain why surgeons now favor primary vitrectomy over adding an SB. Local anesthesia is preferred for eye surgeries. Because an SB can be painful to the patient and, as a result, stressful to the surgeon, especially when performed with the patient under local anesthesia, primary vitrectomy has become the preferred surgical approach.[29] The addition of an SB to vitrectomy also lengthens operative time. Finally, vitreoretinal surgical fellowships have decreased the emphasis on SB during training,[30,31] resulting in a preference toward vitrectomy over SB and PPV/SB by retina surgeons.

Given the unclear benefit of adding an SB in the treatment of GRT-related retinal detachments and the increased popularity of PPV in the management of rhegmatogenous retinal detachments, we sought to determine the practice patterns for treating GRT-related detachments by an international cohort of surgeons in a clinical setting and to compare anatomic and visual outcomes among eyes with GRT-associated retinal detachments that were treated with PPV alone versus PPV/SB. Cases were retrospectively collected from 7 institutions in 7 countries in North and South America, Europe, and Asia.

Methods

An international multicenter retrospective review of electronic medical records was conducted between January 1, 2008, and December 31, 2020, at the Wilmer Eye Institute (Baltimore, MD), King Khaled Eye Specialist Hospital (Riyadh, Saudi Arabia), Federal University of Sao Paulo (Sao Paulo, Brazil), University of Puerto Rico (San Juan, Puerto Rico), Asociados de Macula, Vitreo y Retina de Costa Rica (San Jose, Costa Rica), Hospital de Clínicas de la Universidad de Buenos Aires (Buenos Aires, Argentina), and Hospital la Arruzafa (Córdoba, Spain). The study adhered to the Declaration of Helsinki and was compliant with the Health Insurance Portability and Accountability Act). Approval was obtained from the institutional review board or equivalent at each of the participating institutions. Written informed consent was waived, as the study was a retrospective medical chart review and posed minimal risk to the research participants. The electronic medical record was queried for retinal detachment with GRT and repair of detached retina.

Patient Demographics

Patients were included if they presented within the study period with a GRT-related retinal detachment with primary and any subsequent surgical repair at the participating institutions, and with at least 6 months of follow-up. Both adult and pediatric (defined as < 18 years old) patients were included. Patients were excluded if they had a concurrent large subretinal hemorrhage, history of prior retinal detachment, open globe injury, endophthalmitis, viral retinitis, or other inflammatory retinitis or choroiditis.

Baseline patient characteristics collected include age, gender, race, ethnicity, history of trauma, developmental abnormalities, history of myopia defined as −6.0 diopters or worse, prior intraocular surgery, retinal detachment in the contralateral eye, lens status, presence of posterior vitreous detachment, and presence of lattice degeneration. Data were also collected on clinical presentation, including retinal detachment size, size and number of retinal tears, location of GRT, presence of PVR grade C or worse, and time to repair. Anatomic characteristics of eyes that detached over the study period were also collected, including time and etiology of first detachment, number of reattachment surgeries, and eyes that remained attached at final follow-up.

Surgical Techniques

Type of surgical repair (PPV and PPV/SB) as well as surgical adjuncts were also collected, including laser and cryo retinopexy, use of perfluoro-n-octane, drainage retinotomy, membrane peeling, retinectomy, lensectomy, and type of tamponade agent.

Anatomic and Functional Outcomes

The primary outcomes in this study were single surgery anatomic success (SSAS) at 6 months and 1 year. Functional outcomes included best-corrected visual acuity (BCVA) at postoperative month (POM) 1 to 2, 3 to 7, and 8 to 15 converted to logarithm of the minimum angle of resolution (logMAR) equivalents. Postoperative complications, including hypotony, ocular hypertension, choroidal detachments, residual subretinal fluid, cystoid macular edema, epiretinal membrane, diplopia, and cataract formation, were also noted.

Statistical Analysis

Baseline patient characteristics and anatomic and functional outcomes were compared using chi-square or Fisher exact test for categorical variables and analysis of variance or Kruskal-Wallis tests for continuous variables. A P value < 0.05 was considered significant. Statistical analysis was completed using Stata version 15.0 (StataCorp, LLC).

Results

Two hundred twenty-two patients (225 eyes) were identified with a GRT-related retinal detachment treated at the participating institutions during the study period. Sixteen patients (16 eyes) had follow-up < 6 months (n = 8 for PPV/SB, n = 5 for PPV, n = 3

Table 1. Baseline Demographics and Ocular Characteristics in the Two Surgical Groups

Characteristics	PPV	PPV/SB	*P* Value
Total no. of patients	96	99	
Mean age, y (SD)	41.8 (18.3)	38.5 (20.6)	0.2
Age category			0.1
Less than 18 y	16 (16.7)	26 (26.3)	
18 to 49 y	39 (40.6)	28 (28.3)	
50 y and above	41 (42.7)	45 (45.5)	
Female sex, n (%)	19 (19.8)	23 (23.2)	0.7
Race, n (%)			0.5
White	36 (37.5)	36 (36.4)	
Black	12 (12.5)	9 (9.1)	
Asian	0 (0.0)	2 (2.0)	
Other	48 (50.0)	51 (51.5)	
Not reported	0 (0.0)	1 (1.0)	
Ethnicity, n (%)			0.1
Hispanic	25 (26.0)	15 (15.2)	
Arab	47 (49.0)	49 (49.5)	
Not Hispanic or Arab	24 (25.0)	35 (35.4)	
History of trauma, n (%)	24 (25.0)	25 (25.3)	1.0
Developmental abnormalities*			0.04**
Marfan	2 (2.1)	0 (0.0)	
Stickler	4 (4.2)	7 (7.1)	
Other	1 (1.0)	5 (5.1)	
None	85 (88.5)	87 (87.9)	
Total no. of eyes	101	99	
Left eyes, n (%)	46 (45.5)	49 (49.5)	0.7
-6D of myopia or worse, n (%)[†]	13 (26.5)	13 (28.3)	1.0
Prior intraocular surgery, n (%)	45 (44.6)	24 (24.2)	0.004**
History of RD in contralateral eye, n (%)	23 (22.8)	22 (22.7)	1.0
Mean VA at presentation, logMAR (SD)[‡]	1.52 (1.1)	1.48 (1.1)	1.0
Lens status, n (%)			0.03**
Phakic	62 (61.4)	77 (77.8)	
Pseudophakic	30 (29.7)	19 (19.2)	
Aphakic	9 (8.9)	3 (3.0)	
PVD present, n (%)[§]	64 (66.0)	62 (64.6)	1.0
Lattice degeneration present, n (%)	17 (17.0)	15 (15.2)	0.9
Macula off, n (%)[‖]	67 (66.3)	66 (68.8)	0.8
Mean detachment size, clock hours (SD)[¶]	7 (3.3)	7 (3.2)	1.0
Detachment size, quadrants, n (%)[¶]			0.7
2 or less	57 (57.6)	50 (53.8)	
More than 2	42 (42.4)	43 (46.2)	
Size of GRT[††]			0.3
90 degrees	17 (17.0)	26 (26.3)	
91−179 degrees	55 (55.0)	49 (49.5)	
180 degrees or greater	28 (28.0)	24 (24.2)	
No. of retinal breaks, n (%)			0.3
1	82 (81.2)	70 (70.7)	
2	8 (7.9)	13 (13.1)	
3	5 (5.0)	9 (9.1)	
4 or more	6 (5.9)	7 (7.1)	
GRT within inferior 2 clock hours, n (%)	47 (47.0)	38 (38.4)	0.3
Presence of PVR grade C or worse, n (%)	9 (9.5)	12 (13.5)	0.5
Mean time to primary repair, days (SD)[#]	7.0 (9.4)	4.8 (8.6)	0.09
Mean follow-up period, mo (SD)	44 (30)	51 (32)	0.09

GRT = giant retinal tear; logMAR = logarithm of the minimum angle of resolution; PPV = pars plana virectomy; PVD = posterior vitreous detachment; PVR = proliferative vitreoretinopathy; RD = retinal detachment; SB = scleral buckle; SD = standard deviation; VA = visual acuity.
*Missing information from 4 patients in PPV group.
[†]Missing information from 52 and 53 eyes from each group.
[‡]Missing information from 2 and 5 eyes from each group.
[§]Missing information from 4 and 3 eyes from each group.
[‖]Missing information from 3 eyes in PPV/SB group.
[¶]Missing information from 2 and 6 eyes from each group.
[#]One eye in the PPV group was repaired 210 days after presentation. The patient had developmental delay and was initially lost to follow-up. This outlier was removed from this analysis.
**Denotes statistically significant difference.
[††]Missing information from 1 eye in PPV group.

Table 2. Surgical Adjuncts Used in the 2 Surgical Groups

Characteristics	PPV	PPV/SB	P Value
Retinopexy			0.4
Laser	101 (100.0)	97 (98.0)	
Cryo	0	1 (1.0)	
Laser and cryo	0	1 (1.0)	
PFO usage, n (%)	98 (98.0)	92 (92.9)	0.2
Drainage retinotomy, n (%)	9 (10.2)	4 (4.3)	0.2
Membrane peeling, n (%)	14 (14.0)	22 (22.2)	0.2
Retinectomy, n (%)	6 (7.3)	3 (3.5)	0.4
Lensectomy, n (%)	16 (15.8)	13 (13.1)	0.7
Tamponade agent			0.9
SF6	5 (5.0)	6 (6.1)	
C3F8	33 (32.7)	34 (34.3)	
Silicone oil	63 (62.4)	59 (59.6)	

PFO = perfluoro-n-octane; PPV = pars plana vitrectomy; SB = scleral buckle.

for SB) and were therefore excluded. Of the remaining subjects with ≥ 6 months of follow-up, 8 eyes underwent SB alone and 1 eye had pneumatic retinopexy. These 9 eyes were excluded from the study. A total of 195 patients (200 eyes) were therefore included in the study, with 96 patients (101 eyes) having undergone PPV and 99 patients (99 eyes) having undergone PPV/SB.

As summarized in Table 1, the baseline demographics and ocular characteristics studied were not different between the 2 groups, except for the proportion of patients with a history of developmental abnormalities, and eyes that had prior intraocular surgery and were phakic. In the PPV group, 44.6% had a history of prior intraocular surgery, as compared with 24.2% in the PPV/SB group ($P = 0.004$). More eyes were phakic at baseline in the PPV/SB (77.8%) than the PPV (61.4%) groups ($P = 0.03$). Except in patients with Marfan disease, patients with developmental abnormalities were more likely to undergo PPV/SB (12.2%) than PPV (6.3%) ($P = 0.04$). Specifically, 7 patients in the PPV group had a history of developmental abnormalities (2 had Marfan syndrome, 4 had Stickler syndrome, and 1 had autism with developmental delay) while 12 patients in the PPV/SB group had a history of developmental abnormalities (7 with Stickler syndrome, 3 with autism and developmental delay, 1 each with Down syndrome and cerebral palsy).

The surgical adjuncts used between the PPV and PPV/SB groups were not significantly different (Table 2). All eyes in the PPV group and 98.0% of eyes in the PPV/SB group underwent laser retinopexy. In the PPV/SB group, 1 eye had cryopexy only and 1 eye had laser and cryopexy. Perfluorocarbon was used in most eyes (PPV, 98.0% and PPV/SB, 92.9%). A small proportion of eyes had drainage retinotomy (PPV, 10.2% and PPV/SB, 4.3%), peeling of PVR or epiretinal membranes (PPV, 14.0% and PPV/SB, 22.2%), relaxing retinectomy (PPV, 7.3% and PPV/SB, 3.5%), and lens extraction by phacoemulsification or pars plana lensectomy (PPV, 15.8% and PPV/SB, 13.1%). The most frequently used tamponade agent was silicone oil (PPV, 62.4% and PPV/SB, 59.6%), followed by C3F8 gas (PPV, 32.7% and PPV/SB, 34.3%)

As shown in Table 3, the SSAS rates at 6 months did not differ between the 2 groups studied. Six months after primary repair, 82.2% of the PPV group and 87.9% of the PPV/SB group had

Table 3. Surgical Anatomic Outcomes Between the Two Surgical Groups

Characteristics	PPV	PPV/SB	P Value
SSAS at 6 mo, n (%)	83 (82.2)	87 (87.9)	0.3
SSAS at 1 y, n (%)	71 (77.2)	78 (85.7)	0.2
1y SSAS based on presenting characteristics, n (%)			
Age category			
Less than 18 y	9 (56.3)	23 (88.5)	0.03*
18 to 49 y	29 (82.9)	23 (85.2)	1.0
50 and above	33 (80.5)	32 (84.2)	0.8
Lens status, n (%)			
Phakic	42 (75.0)	63 (86.3)	0.1
Pseudophakic/aphakic	29 (82.9)	15 (83.3)	1.0
Macula status, n (%)			
Detached	45 (73.8)	51 (85.0)	0.2
Not detached	26 (83.9)	26 (92.9)	0.4
GRT within inferior 2 clock hours, n (%)	39 (75.0)	45 (83.3)	0.3
Size of GRT, n (%)			
90 degrees	14 (87.5)	19 (76.0)	0.4
91−179 degrees	38 (79.2)	39 (92.9)	0.08
180 degrees or greater	18 (66.7)	20 (83.3)	0.2
PVR grade C or worse, n (%)	5 (62.5)	6 (60.0)	1.0
Lattice degeneration, n (%)	14 (82.4)	13 (86.7)	1.0
Tamponade agent, n (%)			
Gas	28 (77.8)	29 (78.4)	1.0
Silicone oil	43 (76.8)	49 (90.7)	0.07
SSAS over entire available follow-up, n (%)	74 (73.3)	83 (83.8)	0.09
Attached at final follow-up, n (%)	93 (92.1)	94 (94.9)	0.6

GRT = giant retinal tear; PPV = pars plana vitrectomy; PVR = proliferative vitreoretinopathy; SB = scleral buckle; SSAS = single surgery anatomic success.
*denotes statistically significant difference.

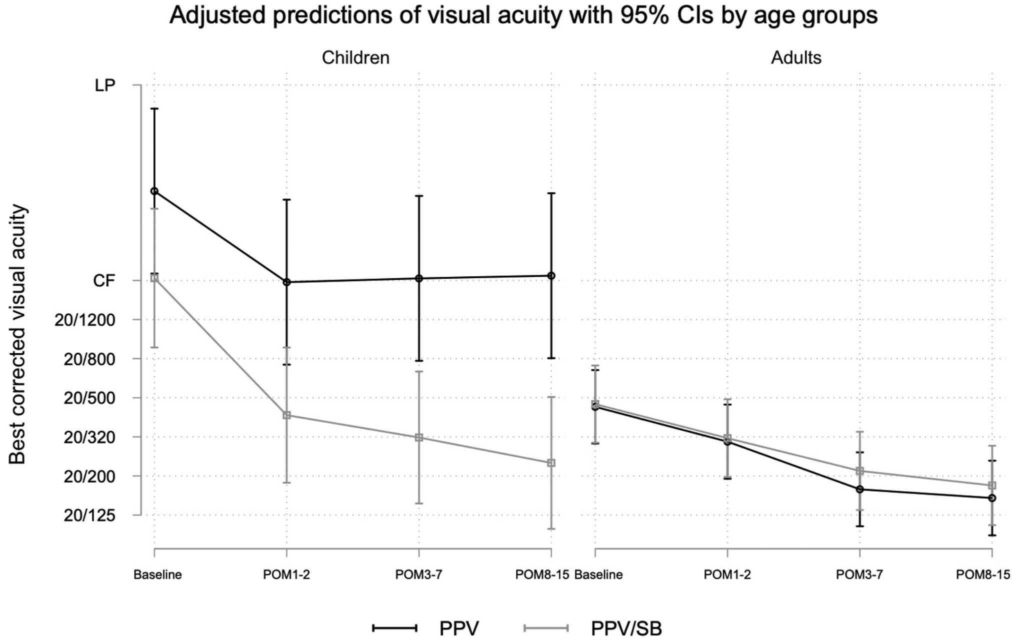

Figure 1. The mixed-effects model shows that mean best-corrected visual acuity (BCVA) improved at follow-up visits as compared with baseline. At baseline, mean BCVA was not different between the 2 surgical groups for both children (<18 years) and adults (age ≥18 years). For children, there is a statistically significant difference in mean BCVA between the 2 surgical groups at each of the follow-up visits. For adults, there is no statistically significant difference in mean BCVA between the 2 surgical groups at any of the follow-up visits, as all the interaction terms between visit and surgery type are not significant. The mixed-effects model included the interaction terms between visit and surgery, lens status, and cataract formation. CF = count fingers; CI = confidence interval; LP = light perception, POM = postoperative month, PPV = pars plana vitrectomy, SB = scleral buckle.

eyes that remained attached. Of the 183 eyes (PPV, 92, PPV/SB, 91) with at least 1 year of follow-up, overall SSAS at 1 year was also not statistically different across groups (PPV, 77.2% and PPV/SB, 85.7%). The mean time to first redetachment (± standard deviation) was 7.9 (± 9.1) and 5.5 (± 7.6) months in the PPV and PPV/SB groups, respectively ($P = 0.8$). Because the mean time to the first redetachment was > 6 months, we then stratified SSAS at 1 year by age, lens status, macula status, inferior location and size of GRT, PVR grade C or worse, lattice degeneration, and tamponade agent. SSAS at 1 year also did not differ between the 2 surgical groups in each of the subgroups studied, except in children < 18 years of age.

In patients < 18 years, a significantly higher 1-year SSAS was achieved with PPV/SB (88.5%) versus PPV (56.3%) ($P = 0.03$). A comparison of baseline characteristics for children versus adults showed that children were more likely to have a history of trauma (50.0% vs 18.3%; $P < 0.0001$), worse presenting BCVA (2.12 vs 1.35 logMAR; $P < 0.0001$), macula involving detachments (95.1% vs 60.3%; $P < 0.0001$), larger detachments (9.9 vs 6.5 clock hours; $P < 0.0001$), larger GRT (45.2% vs 21.0% with GRT 180 degrees or larger; $P = 0.009$), a single retinal tear (97.6% vs 70.3%; $P= 0.002$), and longer total follow-up (58.9 vs 44.1 months; $P = 0.006$) (Table S1, available at www.ophthalmologyretina.org).

At 6 months, SSAS rates were similar between eyes with and without PVR in both the PPV and PPV/SB groups (n = 0.09). However, at 1 year, SSAS was different among eyes with and without PVR ($P = 0.047$). Among PPV eyes, SSAS was 62.5% (n = 5) for eyes with PVR and 76.9% (n = 60) for eyes without PVR, and among PPV/SB eyes, SSAS was 60.0% (n = 6) for eyes with PVR and 88.7% (n = 63) for eyes without PVR.

In eyes that received silicone oil tamponade, there was a trend of higher 1-year SSAS in PPV/SB (90.7%) than PPV (76.8%) ($P = 0.07$). However, this trend was driven by the high proportion of pediatric eyes that received silicone oil (n = 37) vs gas (n = 5) tamponade. In children who received silicone oil tamponade, 1-year SSAS was 90.9% (20 of 22) for PPV/SB compared with 53.3% (8 of 15) for PPV ($P = 0.02$). In adults who received silicone oil tamponade, there was no statistically significant difference in 1-year SSAS between PPV/SB (29 of 32; 90.6%) and PPV (34 of 40; 85.0%) ($P = 0.7$). Furthermore, there was no statistically significant difference in 1-year SSAS between adult eyes that received silicone oil versus gas tamponade (85.0% vs 77.1%, $P = 0.6$ among PPV eyes; and 90.6% vs 78.8 %, $P = 0.3$ among PPV/SB eyes).

Over the entire follow-up period, in eyes that received silicone oil tamponade, 7 (11.9%) of 59 eyes in the PPV/SB group and 19 (30.2%) of 63 eyes in the PPV group detached ($P = 0.02$). Of the eyes that detached, 24 eyes (PPV, 17 and PPV/SB, 7) had data regarding time of oil removal; 7 (29.2%) detached after oil was no longer in the eye (PPV, 5 [29.4%] and PPV/SB, 2 [28.6%]), while the rest (70.8%) detached with silicone oil remaining in the eye (PPV, 12 [70.6%] and PPV/SB, 5 [71.4%]; $P = 1.0$). A comparison of baseline characteristics (Table S2, available at www.ophthalmologyretina.org) revealed that eyes that received silicone oil (when compared with gas tamponade) were younger (35.2 vs 48.1 years; $P < 0.0001$), had a history of trauma (33.1 vs 12.2%; $P = 0.001$), worse presenting BCVA (1.78 vs 1.07 logMAR; $P < 0.0001$), macula involving detachment (77.5 vs 52.0%), larger detachment size (7.8 vs 6.3 clock hours; $P = 0.002$), GRT measuring 91 to 179 degrees (60.2 vs 39.7%; $P = 0.003$), and delayed time to primary repair (7.6 vs 3.3 days; $P = 0.001$).

Table 4. Characteristics of Eyes that Detached over the Study Period

Characteristics	PPV	PPV/SB	*P* Value
Eyes that detached over entire follow-up period, n (%)	27 (26.7)	16 (16.2)	0.09
Mean time to first detachment, mo (SD)	7.9 (9.1)	5.5 (7.6)	0.8
Etiology of first redetachment, n (%)			
New/missed retinal tear	9 (33.3)	6 (37.5)	1.0
Lifted old retinal tear	5 (18.5)	2 (12.5)	0.7
PVR grade C or worse	19 (70.4)	15 (93.8)	0.1
Other	3 (11.1)	0	0.3
Eyes that underwent zero reattachment surgery, n (%)	3 (11.1)	4 (25.0)	0.4
Number of reattachment surgeries for remainder eyes, n (%)			0.03*
1	21 (87.5)	6 (50.0)	
2	2 (8.3)	4 (33.3)	
3	0	2 (16.7)	
4 or more	1 (4.2)	0	
Attached at final follow-up after reattachment surgeries, n (%)	18/24 (75.0)	10/12 (83.3)	0.7

PPV = pars plana vitrectomy; PVR = proliferative vitreoretinopathy; SB = scleral buckle; SD = standard deviation.
8 of 24 PPV group got PPV/SB on subsequent reattachment surgery, all others got PPV.
*Denotes statistically significant difference.

SSAS over the entire available follow-up period was also not statistically different between the PPV (73.3%) and the PPV/SB (83.8%) groups. High proportions of eyes remained attached at the final follow-up (PPV, 92.1% and PPV/SB, 94.9%). Figure 1 illustrates a comparison of visual acuity outcomes between the 2 surgical groups in children and adults using a mixed-effects model that includes interaction terms between visits and surgery, lens status, and cataract formation. In adults, BCVA between the 2 surgical groups was not different at baseline ($P = 0.9$) or any of the follow-up visits studied (POM 1−2, $P = 0.9$; POM 3−7, $P = 0.5$; and POM 8−15, $P = 0.7$). In children, the mean BCVA was similar between both surgical groups at baseline ($P = 0.1$) but was better in the PPV/SB group compared with the PPV group at the POM 1−2 ($P = 0.02$), POM 3−7 ($P = 0.003$) and POM 8−15 ($P = 0.001$) follow-ups.

The 27 and 16 eyes in the PPV and PPV/SB groups, respectively, that detached over the study period were examined in Table 4. The most common etiology for redetachment was PVR grade C or worse for both groups (PPV, 70.4% and PPV/SB, 93.8%). Three and 4 eyes in each group, respectively, did not undergo any further reattachment surgery as the surgeons had deemed the eyes to be inoperable (PPV, n = 2 and PPV/SB, n = 2), of poor visual potential (PPV/SB, n = 2), or lost to follow-up (PPV, n = 1). Most of the redetached eyes that underwent surgery required 1 additional surgery for reattachment (PPV, 87.5% and PPV/SB, 50.0%; $P = 0.03$). Of the redetached eyes that underwent reattachment surgery, 75.0% in the PPV group and 83.3% in the PPV/SB group remained attached at the final follow-up.

The development of postoperative complications between the 2 surgical groups was not different (Table 5). Postoperative ocular hypertension developed in 17.2% and 24.2% of the PPV and PPV/SB groups, respectively. Epiretinal membrane developed in 20.2% of the PPV and PPV/SB groups each. Of phakic patients, 71.1% and 84.6% of the PPV and PPV/SB groups, respectively, developed postoperative cataract. Of these eyes, 90.6% and 90.9% subsequently underwent lens extraction surgery over the course of the follow-up. Other less commonly encountered complications included choroidal detachments (3.0% for both groups), residual subretinal fluid not involving retinal breaks (PPV, 8.0% and PPV/SB, 7.1%), cystoid macular edema (PPV, 5.1% and PPV/SB, 9.1%), and diplopia (1 patient in PPV group only).

Table 5. Development of Postoperative Complications

Characteristics	PPV	PPV/SB	*P* Value
Intraocular pressure abnormalities			0.5
Hypotony	4 (4.0)	4 (4.0)	
Ocular hypertension	17 (17.2)	24 (24.2)	
Choroidal detachments, n (%)	3 (3.0)	3 (3.0)	1.0
Residual subretinal fluid, n (%)	8 (8.0)	7 (7.1)	1.0
Cystoid macular edema n (%)	5 (5.1)	9 (9.1)	0.4
Epiretinal membrane, n (%)	20 (20.2)	20 (20.2)	1.0
Diplopia, n (%)	1 (1.0)	0 (0.0)	1.0
Cataract formation among phakic patients			
Yes	32 (71.1)	55 (84.6)	0.1
No	13 (28.9)	10 (15.4)	

PPV = pars plana vitrectomy; SB = scleral buckle.

Discussion

The trend away from SB and toward vitrectomy for repair of rhegmatogenous retinal detachment[24-28] prompted this contemporary, international multicenter retrospective study. Contrary to this trend, we find that PPV and PPV/SB were both commonly used for the treatment of GRT-related detachments in patients with mostly similar baseline demographic and ocular characteristics between groups. In our study, SSAS at 6 months and 1 year was high (>75%) for both surgical groups. Importantly, SSAS was not different at either time point for eyes treated with PPV alone versus PPV/SB, except in children < 18 years.

There was no difference in SSAS across other presenting characteristics, including GRT size and inferior location, macula status, lens status, and presence of lattice

Table 6. Summary of Published Studies on Management of Giant Retinal Tear Related Retinal Detachments

Author (Publication Year)	Country	Study Period	Inclusion Criteria	Exclusion Criteria	PPV, n (%)	PPV/SB, n (%)	Follow-up	PFO	SiO	Anatomic Outcomes	Visual Outcomes
Studies that showed no difference in anatomic outcomes between PPV and PPV/SB											
Al-Khairi et al (2008)[11]	Saudi Arabia	1994–2005	GRT with ruptured globe, endophthalmitis, prior intraocular surgery	PVR	20 (17%)	97 (83%)	Mean 29.7 mo (range 3–144 mo)	100%	All: 54.7%	Recurrent RD: PPV: 35%, PPV/SB: 18.6% ($P = 0.1$)	Final VA ≥ 20/200: PPV: 40%, PPV/SB 54.6% ($P = 0.3$)
Ting et al. (2020)[18]	Singapore	1991–2015	GRT ± PVR (9.4%)	Follow-up less than 1 y	42 (33%)	85 (67%)	At least 1 y	All: 80.3%	All: 25.2%	Final anatomic success: PPV: 90%, PPV/SB: 92.2% ($P = 0.896$)	LogMAR VA <1.0 at 1 y: PPV: 70%, PPV/SB 68.8% ($P = 0.997$)
Gonzalez et al. (2013)[40]	USA, Florida	2005–2010	GRT ± PVR (15%), >1 mo follow-up	Penetrating trauma or prior PPV	12 (15%)	67 (85%)	Mean 20 mo	All: 71%	All: 57%	Recurrent RD: PPV: 14%, PPV/SB 16% (P = N/A)	Final VA ≥ 20/400: All: 73%
Pitcher et al. (2015)[16]	USA, Pennsylvania	2008–2013	GRT ± PVR C (17%)	Penetrating trauma, follow-up less than 3 mo	28 (48%)	30 (52%)	Mean 17 mo (range 3–43 mo)	100%	PPV: 40% PPV/SB: 57%	Single surgery success: PPV: 88%, PPV/SB 87% ($P = 1.0$)	Final mean VA: PPV: 20/62, PPV/SB 20/116, ($P = 0.07$)
Rodriguez et al. (2018)[17]	USA, Florida	2011–2017	GRT ± blunt trauma (18%)	History of ROP	16 (20%)	61 (76%) [SB only: 3]	Mean 10.3 mo	All: 78%	All: 68%	Recurrent RD after primary repair: PPV: 6%, PPV±-SB: 16% ($P = 0.33$)	Final VA: All: 19% ≥20/40 and 68% ≥20/400
Li et al (2021)[21]	USA, Michigan	2011–2020	GRT ± PVR C (14.6%)	None	40 (83%)	7 (15%), [SB only: n = 1]	Median 28 mo (range 3–124 mo)	All: 89.6%	All: 18.7%	Single surgery success: PPV: 65%, SB ± PPV: 87.5% ($P = 0.7$)	Final VA ≥ 20/40: All: 44%
Kumar et al. (2018)[15]	India	2015–2016	GRT ± PVR C (18%)	Penetrating trauma, prior vitreoretinal surgery, follow-up less than 3 mo	10 (59%)	7 (41%)	Mean 10.1 mo (range 7–16mo)	PPV: 70% PPV/SB: 100%	PPV: 70% PPV/SB: 86%	Primary reattachment at final follow-up: PPV: 90% PPV/SB: 85.7% ($P = 0.84$)	Final median VA: PPV: 20/120 PPV/SB: 20/120
Studies that showed PPV/SB yielded superior anatomic outcomes when compared with PPV											
Verstraeten et al. (1995)[20]	USA, Pittsburgh, New York, Michigan	N/A	GRT, phakic eyes	Trauma	20 (59%)	14 (41%)	Range 6–60 mo	100%	0%	Reoperation rate: PPV: 45%, PPV/SB: 14% (P = N/A)	Final VA ≥ 20/50: All: 59%

(*Continued*)

Table 6. (Continued.)

Author (Publication Year)	Country	Study Period	Inclusion Criteria	Exclusion Criteria	PPV, n (%)	PPV/SB, n (%)	Follow-up	PFO	SiO	Anatomic Outcomes	Visual Outcomes
Ghosh et al. (2004)[19]	UK	1991–2002	GRT ± PVR	None	13	16	Mean 28 mo (range 5 mo to 7 y)	All: 79.3%	All: 96.6%	Single surgery success: PPV: 65.5%, PPV/SB: 93.7% (*P* = N/A)	All: Postoperative VA improved in 75.86%
Scott et al (2002)[13]	24 sites	1994–1996	GRT ± PVR (38%)	Trauma	81 (38%)	131 (62%)	Median 3.5 mo	100%	All: 34%	Recurrent RD at 6 mo: PPV: 50%, PPV/SB: 28% (*P* = 0.006)	All: VA ≥ 20/80 at 6 mo in 33%
Goezinne et al. (2008)[14]	Netherlands	1998–2003	GRT ± PVR A (63%) or B (37%)	None	9 (30%)	21 (70%)	Mean 49 mo (range 13–101 mo)	N/A	All: 96.6%	Recurrent RD: PPV: 66.7%, PPV/SB: 14.3% (*P* = 0.008)	All: Final VA 0.1 or less in 43.4%
Studies that showed PPV yielded superior anatomic outcomes when compared with PPV/SB											
Falavarjani et al. (2017)[22]	Iran	2005–2015	GRT ± PVR grade C (23%) or trauma (29%)	Any ocular pathology that could decrease VA	62 (89%)	7 (11%)	Mean 21.5 mo (range 3–126 mo)	N/A	100%	Single surgery success: PPV: 71.0%; PPV/SB: 14.3% (*P* = 0.005)	All: Final mean VA: 1.43 logMAR
Adelman et al (2013)[23]	EVRS members from 48 countries	2010–2011	Large and GRT	Choroidal detachment or hypotony	439 (81%)	103 (19%)	3 mo to 1 y	N/A	N/A	Level 1 failure (Inoperable at end of follow-up) PPV: 1.6%, PPV/SB: 4.9% (*P* = 0.009)	N/A

EVRS = European VitreoRetinal Society; GRT = giant retinal tear; logMAR = logarithm of the minimum angle of resolution; N/A = not applicable; PFO = perfluoro-n-octane; PPV = pars plana vitrectomy; PVR = proliferative vitreoretinopathy; RD = retinal detachment; ROP = retinopathy of prematurity; SB = scleral buckle; SiO = silicone oil; VA = visual acuity.

degeneration. In adults, after controlling for lens status, we also found no difference between the 2 surgical groups in BCVA at any of the follow-up visits up to POM 8−15. Based on our data, although PPV/SB was as popular a surgical choice as PPV alone, the results indicate that for GRT detachment in children, a supplemental SB is beneficial, but in adults, an adjunct SB may not be needed.

Of the 42 pediatric eyes included in this study, 16 (38.1%) underwent PPV and 26 (61.9%) underwent PPV/SB. At baseline, children were more likely to have a history of trauma (50% vs 18%), worse presenting VA (2.12 vs 1.35 logMAR), macula off rhegmatogenous retinal detachment (95.1% vs 60.3%), larger detachments (9.9 vs 6.5 clock hours), and larger proportions with GRT 180 degrees or greater (45.2% vs 21.0%) when compared with adults. Children had larger GRTs and more severe detachments at baseline and this could be linked to a higher incidence of trauma, coupled with tight adherence between the vitreous and retina in pediatric eyes. At 1 year, the SSAS was higher for patients who had undergone PPV/SB (88.5%) vs PPV (56.3%; $P = 0.03$). Best-corrected visual acuity at 1 year was also better in the PPV/SB group compared with the PPV group ($P = 0.001$).

We hypothesize that the addition of SB in pediatric eyes increases the anatomic success rate by reducing vitreoretinal traction when complete vitreous shaving is difficult in the presence of a natural lens. Furthermore, the vitreous of children with GRTs are often tenacious with strong vitreoretinal interface adhesions, making posterior vitreous detachment induction and complete vitreous removal challenging. The abnormal vitreous in children with Marfan and Stickler syndromes can also make surgery more difficult. Children are also less likely to adhere to postoperative positioning.[32] In these situations, the supplemental reduction of vitreoretinal traction and external support of treated retinal break(s) conferred by an SB are probably beneficial.

Our study shows a higher SSAS rate compared with a recent study by Hasan et al[33] on pediatric GRTs. That report studied 91 eyes, including 54 eyes with PPV and 28 eyes with PPV/SB with > 6 months of follow-up, and found that only 40.24% remained attached after a single surgery and that the use of SB did not change the odds ratio of achieving SSAS.

Traditionally, primary SB has been advocated for the repair of pediatric GRT detachments.[34] However, given the need for extensive cryotherapy in this situation, which may increase the risk of future PVR formation,[35-37] PPV/SB provides a good alternative to allow laser retinopexy instead, while still reaping the benefits of an SB in these young eyes.

In adults, the lack of benefit with adding SB for GRT-related detachments, even in phakic eyes and eyes with inferior retinal breaks, is an important finding. For the repair of noncomplex non-GRT-related retinal detachments, our group and others have previously shown that primary reattachment rates are higher in PPV/SB compared with PPV alone.[15-18,38,39] In these noncomplex cases, an SB is thought to reduce vitreoretinal traction, especially in phakic eyes where complete vitreous shaving may be difficult, and counteract the gravitational forces of PVR, especially in eyes with inferior retinal breaks.

Based on our findings, we hypothesize that a GRT, by virtue of its size, reduces vitreoretinal traction and acts as a relaxing retinectomy. After relieving peripheral traction from the "natural relaxing retinotomy" of a GRT, the reduction in traction by an SB provides no significant benefit and may add morbidity, as described above. We note that cryoretinopexy use was minimal in our cases, which likely reduced the stimulus for PVR and also improved surgical reattachment.[35-37] In our series, the most common etiology for redetachment was PVR grade C or worse for both groups (PPV, 70.4% and PPV/SB, 93.8% of the eyes that redetached). Of the redetached eyes that underwent reattachment surgery, 75.0% in the PPV group and 83.3% in the PPV/SB group remained attached at the final follow-up.

The addition of SB to PPV in the management of GRT-related detachments has been controversial. Published studies have shown a wide range of efficacy comparing PPV alone and PPV/SB in the treatment of GRT-related detachments (Table 6). Most studies, like ours, have shown equal efficacy between PPV and PPV/SB in the management of GRT-related detachments.[15-18,21,40] Ting et al[18] published the other largest study of 127 eyes that shows comparable outcomes between PPV and PPV/SB. Their SSAS at 1 year was lower than that in our study but was comparable between the PPV (72.5%) and PPV/SB (76.6%) groups. Functional success in the Ting et al[18] study, defined as logMAR BCVA <1.0 at 1 year, was also comparable between the 2 surgical groups. Other surgeons advocate for the addition of SB because the technique can reduce early and late vitreoretinal traction, support new retinal breaks that can occur after surgery, and counteract late traction on the peripheral retina from contracture of the residual vitreous.[11,13,14,19,20] The largest study to date to show superior outcomes in eyes treated with PPV/SB examined 212 eyes that were operated on from 1994 to 1996 and found that the presence of an SB was associated with a lower rate of recurrent retinal detachment at 6 months (28%) compared with the absence of an SB (50%).[13] Others argue against adding a scleral buckle because it can cause retinal gaping, produce retinal folds, and lead to posterior retinal slip because a scleral buckle alters the ocular contour and shortens the sclera relative to the retina.[22,23] The European Vitreo-Retinal Society Retinal Detachment Study Group collected 1167 complex retinal detachments associated with large or GRTs and showed a higher failure rate in eyes treated with vitrectomy with a supplemental buckle (4.9%) compared with eyes that did not receive an SB (1.6%).[23] Given the nonrandomized nature of the study, eyes that had received a supplemental SB could have been cases with more inherent complexity and those that surgeons thought were more likely to fail.

It is challenging to compare previously published studies, given the variation in the proportion of eyes that were treated with PPV versus PPV/SB, differences in length of follow-up, and the use of different surgical adjuncts, including perfluorocarbon and tamponade agents. The strengths of our study, in contrast, include large and comparable numbers of eyes in each of the treatment groups (n = 101 and 99), standardized SSAS and BCVA outcomes collected at 6 months for all included eyes, and 1 year for eyes with available follow-up, and minimal difference between groups in baseline/ocular characteristics. Given that the mean time to redetachment was 6 and 8 months for PPV and PPV/SB, respectively, we suggest that our longer follow-up provides a more realistic assessment of the anatomic success rate than studies with shorter postoperative follow-up.

Our study is limited by its retrospective nature and variability in chart documentation, lack of standardization of surgical techniques, given the inclusion of cases from vitreoretinal surgeons from around the world with diverse training backgrounds, and lack of standardization in refraction limiting the BCVA collected. We note that these data were collected from 7 countries in North and South America, Europe, and Asia. However, at the same time, this diversity is a strength because these clinical results from around the world make our findings generalizable.

In summary, despite the trend toward PPV alone to repair uncomplicated rhegmatogenous retinal detachments, both PPV and PPV/SB were equally popular choices to repair GRT detachments among our cohort of participating surgeons from around the world. Importantly, the 1-year anatomic and visual outcomes were superior for PPV/SB than PPV in children < 18 years. In the adult cohort, anatomic and visual outcomes at the 1-year follow-up did not differ between eyes treated with PPV alone versus PPV/SB in this large, international, multicenter, retrospective study. It is possible that the GRT itself relieves peripheral traction sufficiently to reduce the need for the addition of an SB in adults with liquefied vitreous but not in children with formed vitreous. This study supports PPV/SB in children and PPV alone in adults as an option for treating GRT-related detachments.

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No animal subjects were used in this study.

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Abbreviations and Acronyms:

BCVA = best-corrected visual acuity; **GRT** = giant retinal tear; **logMAR** = logarithm of the minimum angle of resolution; **POM** = postoperative month; **PPV** = pars plana vitrectomy; **PVR** = proliferative vitreoretinopathy; **SB** = scleral buckling; **SSAS** = single surgery anatomic success.

Keywords:

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