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ORIGINAL RESEARCH

Long-term follow-up of vitrectomy, with or without 360° encircling buckle, for rhegmatogenous retinal detachment due to inferior retinal breaks

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Objective: The aim of this study was to report and compare the anatomic and functional results of primary vitrectomy with and without 360° encircling scleral buckle (SB) for the treatment of rhegmatogenous retinal detachment (RRD) due to inferior retinal break(s).

Background: A variety of options, including SB, pars plana vitrectomy (PPV) with or without SB, and pneumatic retinopexy have been described as methods to repair RRDs. The use of additional SB with vitrectomy for RRD associated with inferior breaks has been a recent controversy after the introduction of transconjunctival cannula systems.

Patients and methods: A retrospective, interventional, comparative case study was performed. In this study, we reviewed 105 consecutive patients who underwent vitrectomy for primary RRD with inferior retinal break(s) at the vitreoretinal center, performed by a single surgeon. Ninety four patients (94 eyes) were followed up for at least 4 months after silicon oil removal (SOR), and were analyzed. They were divided into two groups: group I included 50 patients who underwent PPV alone + silicon oil (SO); and group II included 44 patients who underwent PPV with 360° SB + SO. The essential parameters were single-operation success rate (SOSR) before SOR, incidence of retinal redetachment after SOR, and final visual acuity.

Results: SOSR was obtained in 89 eyes (47 [94%] in group I and 42 [95.5%] in group II). From overall 59 phakic retinal detachments (RDs), SOSR was obtained in 56 eyes (30 in group I [93.8%] and 26 in group II [96.3%]) while from overall 35 aphakic or pseudophakic RDs, SOSR was obtained in 33 eyes (17 in group I [94.4%] and 16 in group II [94.1%]). Retinal redetachments after SOR occurred in three patients in group I and two patients in group II. Visual acuity improvement was greater in group I than in group II before SOR.

Conclusion: Both surgical procedures had similar reattachment rates. The addition of 360° SB to PPV + SO might not have additional benefits in patients with RD due to inferior retinal break.

Keywords: pars plana vitrectomy, scleral buckle, rhegmatogenous retinal detachment

Introduction

Currently, there is controversy concerning the best surgical technique to employ when repairing phakic and pseudophakic rhegmatogenous retinal detachments (RRDs). Pars plana vitrectomy (PPV) and scleral buckle (SB) surgery remain the most popular techniques used in the primary repair of RRD. Combining these two techniques (PPV/SB) has also become a popular and reliable method of repairing certain types of RRD.[1,2]

Historically, SB has been the method preferred over PPV in the repair of phakic RRD in order to avoid the high incidence of post-PPV cataract formation. However, a significant number of vitreoretinal surgeons seem to be moving away from straight

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SB and toward PPV.[3] The use of SB in association with vitrectomy surgery for RRD is associated with several risks such as hypotony during the placement of the buckle, choroidal hemorrhage, and longer time of operation. Postoperative complications include diplopia, explant intrusion, extrusion or infection, refractive changes, and a risk of decreased retinal blood flow and anterior segment ischemia.[4,5]

Inferior breaks are retinal breaks located between 4 o'clock and 8 o'clock.[6] It is generally believed that inferior retinal detachments due to inferior breaks represent a challenging surgery to be managed by PPV without supplemental SB for two main reasons: difficulty completely shaving the inferior vitreous, especially in phakic eyes; and difficulty with conventional intraocular tamponade agents producing a direct tamponade effect on the inferior breaks.[7] On the other hand, in a large, prospective randomized study of standard 20 G PPV and gas to repair RRD, inferior retinal breaks were not a risk factor for redetachment.[8] Many surgeons suggest that vitrectomy alone can achieve acceptable success rates, and the theoretical advantages of SB are outweighed by their potential complications.[9]

A current debate is whether to add a circumferential buckle to the vitrectomy surgery when decided for the treatment of RRD, especially after the recent shift from conventional vitrectomy to transconjunctival vitrectomy; we have therefore attempted to determine whether 360° encircling band is required to support vitreous base and inferior retinal breaks during vitrectomy surgery for noncomplex RRD. We conducted a prospective, comparative case series evaluating PPV vs PPV/SB for the primary repair of noncomplex phakic and pseudophakic RRD due to inferior break(s).

Patients and methods

This study included 105 consecutive patients who underwent vitrectomy for primary RRD with inferior retinal break(s) at the vitreoretinal center by a single surgeon, The study was approved by the Ethical Committee of the Magrabi Eye Hospital Foundation and the patients were fully informed regarding the technique of the surgery, including the potential risks and complications, all subjects signed a written informed consent document before surgery. Eleven of these 105 patients were lost to follow-up before 6 months after silicon oil removal (SOR), thereby giving a final study population of 94 eyes. Eyes were submitted to PPV surgery, 50 patients (53.2%) without SB (group I) and 44 patients (46.8%) with SB (group II) in a time period from August 2012 to May 2014. Patients with phakic, aphakic, and pseudophakic RRD with inferior break(s) between 4 o'clock and 8 o'clock were included in this study. All surgeries were performed at El Magrabi Eye Hospital, Tanta, Egypt, by one surgeon (HHG).

Patients with any of the following characteristics were excluded: younger than 16 years, retinal detachment from upper retinal breaks, recurrent retinal detachment, traumatic retinal detachment, proliferative vitreoretinopathy (PVR) of grade B or worse, visual acuity (VA) ≤ perception of light (PL), combined tractional and rhegmatogenous detachment, vitreous hemorrhage, preexisting macular disease, giant tear, or documented follow-up of <6 months. Of 105 patients, 94 eyes were identified as study participants.

A comprehensive ophthalmological examination was performed including the measurement of VA (aided and unaided), refraction using automated refractometer, anterior segment examination using slit-lamp biomicroscopy to detect any pathological disorders, rubeosis iridis, intraocular tension measurement, and posterior segment examination using indirect ophthalmoscope and slit-lamp biomicroscopy with the 90 D Volk lens. The patients were fully informed of the technique including the potential risks, complications, and the postoperative position.

In the PPV/SB group, a 360° circumferential buckle (band size 240) was employed in an attempt to provide further support to vitreous base and the retinal breaks.

A standard 20 G three-port PPV technique using the Constellation Surgical System (Alcon, Inc., Hünenberg, Switzerland) and a noncontact wide-angle viewing system (binocular indirect ophthalmo microscope; Oculus, Wetzlar, Germany) was used in all patients. If a posterior vitreous detachment was not already present, it was achieved using aspiration by a vitreous cutter alone or assisted by triamcinolone. Perfluorocarbon (PFC) was used to stabilize the posterior pole, and an attempt was made in every case to shave the vitreous base 360°, as safely as possible without lensectomy if the lens is present, using high-speed vitreous cut rates (4,000–5,000 cuts/min) and low vacuum settings (50–75 mmHg). Subretinal fluid was drained anteriorly with the assistance of PFC and air–PFC exchange. Endolaser diode retinopexy was performed around all identifiable retinal tears and 360° to the vitreous base. Silicon–air exchange using silicon oil (SO) 5,000 centistoke was performed in every patient. SO was the preferred tamponade of the surgeon due to long-term tamponade effect; the ability to take flights or travel to high altitude locations; the minimal required follow-up time; and the ability to see through the oil to some extent making it suitable for single-eye patients, unreliable patients for postoperative positioning, and self-pay patients who have no health insurance. Appropriate postoperative

positioning was requested for each patient for a minimum of 7 days after surgery.

The primary outcome evaluated was single-operation success rate (SOSR). This was defined as stable retinal reattachment during the entire postoperative follow-up period after one surgery. Early surgical failure, was described as recurrent retinal detachment occurring within 2 months from the surgery, and late surgical failure was described as recurrent retinal detachment occurring after 2 months. Secondary outcome measures included the final anatomic success rate, VA improvement, incidence of postoperative PVR, and state of retina and VA after SOR. The Landolt's broken ring chart VA test results were converted into decimal from VA notations table for statistical analysis. The final anatomic success rate was defined as retinal reattachment at the final follow-up visit, regardless of the number of surgeries required.

Results were collected, tabulated, and statistically analyzed by IBM personal computer and Statistical Package for the Social Sciences (SPSS) Version 10. Paired, two-tailed Student's *t*-test was used to statistically analyze changes in the VA test. The two-tailed Fisher's exact test was used to compare baseline characteristics and to calculate differences in anatomic outcomes in all groups. A *P*-value <0.05 was considered to be significant.

Results

Ninety-four patients were included in our series. The PPV group included 50 eyes, and the PPV/SB group included 44 eyes. The postoperative follow-up period ranged from 12 months to 18 months. Preoperative characteristics are summarized in Table 1. For the comfort of the patients supplied with SB in group II, general anesthesia was needed more frequently. One break was found in 25 eyes (50%) and 20 eyes (45.5%); two or three breaks were found in 12 eyes (24%) and 13 eyes (29.5%); and four or more breaks were found in 13 eyes (26%) and eleven eyes (25%), in groups I and II, respectively. These differences were statistically insignificant. Of the 32 phakic eyes that underwent PPV alone, 30 (93.8%) achieved SOSR, while of the 27 phakic eyes that underwent combined PPV/SB, 26 (96.3%) experienced successful single-surgery reattachment before SOR (*P*=0.7). Among aphakic/pseudophakic eyes, 17 of 18 (94.4%) in the PPV group and 16 of 17 (94.1%) in the PPV/SB group remained reattached after a single surgery before SOR (*P*=0.93). Final reattachment rates (after two surgeries) in siliconized eyes were 100% in group I and 96.3% in group II for phakic patients as one patient refused to do any surgery after two previous unsuccessful operations, while it was 100% in group I and 100% in group II for aphakic/pseudophakic patients (Table 2).

Table 1 Comparison of preoperative characteristics

	PPV group (n=50)	PPV plus SB (n=44)	*P*-value
Average age (years)	51.4	46.2	0.008
Male (%)	64	68.2	0.97
Aphakia and pseudophakia (%)	36	38.6	0.19
Mean intraocular pressure (mmHg)	11.6	11.5	0.981
Visual acuity (decimal)	0.075	0.031	0.013
Macula off (%)	87.2	92.7	0.09
One break (%)	50.5	46.7	0.617
Two to three breaks (%)	26.3	37.3	0.124
Four or more breaks (%)	21.1	10.7	0.069
One quadrant (%)	18.9	6.6	0.02
Two quadrants (%)	31.6	33.3	0.808
Three quadrants (%)	28.4	30.6	0.749
Four quadrants (%)	21.1	29.3	0.214

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

The mean best-corrected VA in group I was 0.075 preoperatively and 0.22 (decimal) 2 months postoperatively, while in group II it was 0.031 and 0.15 preoperatively and 2 months postoperatively, respectively (Table 3). There was a statistically significant difference between both groups with respect to 2-month postoperative VA (*P*-value <0.05). In addition, there was a highly statistically significant difference between the mean preoperative and postoperative VA in each group. Table 4 shows the comparison between groups I and II regarding postoperative change of VA.

The overall incidence of postoperative PVR was 3.2% in group I and 2.7% in group II (*P*=0.788). Breaks unrelated to PVR, that is, new breaks, missed breaks, or reopening of known breaks, were the largest proportion of redetachment, and accounted for two of three redetachments in group I and two of two redetachments in group II. Postoperative PVR with or without associated breaks accounted for one of three redetachments in group I (Table 5).

All patients were followed up for at least 4 months after SOR (plus cataract extraction in phakic patients). Retinal redetachments after SOR occurred in four patients in group I and three patients in group II, which is statistically insignificant (Table 6). All the patients needed additional surgical procedure (SO reinjection).

Discussion

There is current debate regarding the advantage and importance of performing a 360° encircling SB before vitrectomy

Table 2 Comparison between groups I and II regarding SOSR in aphakic, phakic, and pseudophakic patients

	Phakic			Aphakic and pseudophakic		
	Group I, PPV	Group II, PPV plus SB		Group I, PPV	Group II, PPV plus SB	
	n=32	n=27		n=18	n=17	
SOSR	30 (93.8%)	26 (96.3%)	X^2=0.134 P=0.7	17 (94.4%)	16 (94.1%)	X^2=0.005 P=0.93
Early failure	1 (3.1%)	1 (3.7%)	X^2=1.1 P=0.317	1 (5.6%)	1 (5.9%)	X^2=0.24 P=0.69
Late failure	1 (3.1%)	0 (0%)	X^2=0.36 P=0.55	0 (0%)	0 (0%)	X^2=0.5 P=0.47
Final attachment rate	32 (100%)	26 (96.3%)	X^2=1.03 P=0.31	18 (100%)	17 (100%)	X^2=0.5 P=0.47

Abbreviations: SOSR, single-operation success rate; PPV, pars plana vitrectomy; SB, scleral buckle.

surgery. Some surgeons pretend that additional buckle could improve surgical results of vitrectomy surgery.[10,11] Others report that with precise shaving of the vitreous base, the supplemental encircling band is not beneficial or may cause complications.[12] Pournaras and Kapetanios stated that there is no statistical difference in the success rate between PPV and PPV plus SB in pseudophakic retinal detachments (RDs).[13] Arya et al[6] compared PPV with PPV plus SB groups regarding the initial and final reattachment rates in patients with pseudophakic retinal detachment and reported that both techniques achieved similar results.

In our series, SOSR was achieved in 92.9% of group I and in 96.3% of group II for phakic patients, while it was achieved in 94.4% of group I and in 94.1% of group II for aphakic/pseudophakic patients. The anatomical success rates approximate each other in both groups regardless of the state of crystalline lens. These results are better than those recorded in the study by Heimann et al,[14] in which SOSR occurred in 64% and 53% with PPV in phakic and pseudophakic patients, respectively. As regards the addition of SB in that study, it did not reduce failure rates in the phakic group, but did so in the pseudophakic group (41% without SB vs 11% with SB).

Other studies have recorded SOSR rates comparable to or better than those achieved in our study with PPV and PPV/SB: 89% and 73%,[5] 93% and 94%,[15] and even 98% and 92%, respectively.[16] Gartry et al[17] reported eight eyes with RRD associated with inferior retinal breaks in a retrospective series of 114 patients undergoing PPV. Those patients had an additional lower segmental explant and achieved 75% (6/8) success with single surgery. Heimann et al,[18] in a retrospective study of 53 patients, reported six patients with primary RD associated with inferior retinal breaks in which they operated with PPV and sulfur hexafluoride as a vitreous substitute. Recurrent retinal detachment occurred in 50% (3/6) of these eyes, but no explanation was mentioned about the cause of recurrent retinal detachment in those patients. Tanner et al[19] showed that SOSR for the management of RRD due to inferior retinal break(s) was 8/9 (89%). Wickham et al[20] reported an overall primary success rate of 81.4% (89% for vitrectomy and gas alone, 73% for vitrectomy, gas, and buckle) in a retrospective study of inferior break retinal detachments. This was similar to the study by Kinori et al[21] who reported that RRDs due to inferior breaks had similar anatomical result as RRDs due to superior breaks (85.1% and 81.2%) for PPV and PPV plus SB groups, respectively.

Table 3 Comparison between groups I and II regarding preoperative and 2-month postoperative best-corrected visual acuity

	Group I, PPV	Group II, PPV plus SB	Paired *t*-test	*P*-value
	n=50	n=44		
Preoperative#	0.075±0.14	0.031±0.056	2.5	0.013
Postoperative#	0.22±0.12	0.15±0.09	4.2	0.021
Baseline paired *t*-test	5.25	6.85		
Baseline *P*-value	0.000	0.000		

Note: #Data is mean ± SD.
Abbreviations: PPV, pars plana vitrectomy; SB, scleral buckle.

Table 4 Comparison between groups I and II regarding postoperative change of VA

VA change	Group I, PPV	Group II, PPV plus SB	*P*-value
	n=50	n=44	
≥3 lines#	15/50	9/45	0.421
<3 lines#	30/50	31/45	0.646
Stable	2/50	3/45	0.124
Worse	3/50	1/45	0.086

Note: #Landolt broken ring chart.
Abbreviations: VA, visual acuity; PPV, pars plana vitrectomy; SB, scleral buckle.

Table 5 Causes of failure in groups I and II

	Group I, PPV	Group II, PPV plus SB	*P*-value
	n=3	n=2	
Reopening of original break	1 (33.3%)	1 (50%)	0.836
Missed/new break	1 (33.3%)	1 (50%)	0.584
PVR	1 (33.3%)	0 (0%)	0.988

Abbreviations: PVR, proliferative vitreoretinopathy; PPV, pars plana vitrectomy; SB, scleral buckle.

Several prospective and retrospective series have compared primary PPV with combined PPV/SB under a variety of conditions. Table 7 shows the percentage of SOSR of these studies.

The final reattachment rate (after two operations) with both techniques in our series was 100% in group I and 96.3% in group II for phakic patients as one patient in group II refused further surgical interference after the failure of second surgery, while it was 100% in group I and 100% in group II for aphakic/pseudophakic patients. Mehta et al's final reattachment rates were 100% in both surgical groups, regardless of phakic status.[22] This is in disagreement with Martínez-Castillo et al[12] who reported that primary vitrectomy in association with SB without postoperative facedown positioning has led to the improvement of anatomical and functional outcomes in retinal detachment surgery. As regards the VA outcome in PPV vs PPV plus SB, Weichel et al's study for pseudophakic retinal detachment records VA of 20/40 or better in 72% of the PPV group, while it was only 42% in the PPV plus SB group.[15] Other series recorded improvement in VA by three lines or more in 60% of the PPV group and in 69% of the PPV plus SB group.[13] In our study, postoperative VA improvement by three lines or more occurred in 30% of group I and in 20% of group II. It is believed that poor preoperative VA, preoperative macular detachment (87.2% and 92.7% in groups I and II respectively), and probably prolonged duration of macular detachment all explain the poor visual outcome of this study. In addition, postoperative cataract formation also affected the overall visual outcome.

Postoperative PVR is the most critical complication after retinal detachment surgery and has been recounted to occur in up to 18% of eyes after vitrectomy for RRD.[22] Wickham et al[20] found that PVR occurred commonly in patients with RRD with inferior breaks who underwent supplemental SB with PPV than in those who underwent PPV alone. In our study, PVR was the cause of redetachments only in one of three eyes that developed redetachments in the PPV group. This disagrees with the study by Kinori et al[21] who reported that PVR was the most common cause of recurrent retinal detachment: 66% and 45% of redetachments in the PPV group and PPV plus SB group, respectively. Jahangir[24] reported in his study that 14 (30%) out of 47 eyes that underwent PPV and SO for RRD developed recurrent RD, whereas in 33 eyes (70%), the retina remained attached in the 6-month follow-up period after SO removal. In our study, the overall incidence of recurrent retinal detachment after SOR was 7.5% (seven out of 94 eyes).

We found that the location of break(s) in cases of redetachments was one eye at 6 o'clock and two eyes at 5 o'clock in group I, while in group II it was between 4 and 5 o'clock in one eye and 7 o'clock in another one.

We think that the introduction of wide-angle viewing systems, such as the binocular indirect ophthalmo microscope, makes it easier to maximize the removal of vitreous and relieve traction from retinal breaks during PPV. Ultravit high-speed vitrectomy probes deliver up to 7,500 cuts/min dual-pneumatic drive technology; also they allow the surgeon to modify duty cycle to control flow independent of vacuum and cut rate; this provides safe and efficient vitreous shaving. We cannot absolutely recommend the use of SB in all patients with inferior retinal breaks, particularly in those patients who cannot remain in prone position, postoperatively. However, in this study, we have found that the addition of 360° encircling band did not enhance either the anatomical results or the success rates in patients undergoing PPV + SO for noncomplex RRD.

Conclusion

Both surgical procedures (vitrectomy with and without 360° SB + SO) give acceptable and comparable anatomical results in the treatment of RRD with inferior breaks.

Table 6 Comparison between groups I and II regarding incidence of retinal redetachment after SOR

	Group I, PPV		Group II, PPV plus SB		*P*-value
	Phakic	Aphakic and pseudophakic	Phakic	Aphakic and pseudophakic	
	n=32	n=18	n=27	n=17	
Re-RD	3 (10%)	1 (5.6%)	1 (3.7%)	2 (11.8%)	0.29

Abbreviations: RD, retinal detachment; SOR, silicon oil removal; PPV, pars plana vitrectomy; SB, scleral buckle.

Table 7 Results of retinal reattachment of some studies

Studies	Number of patients	SOSR (%)				Used tamponade	Comment
		Phakic		Aphakic/pseudophakic			
		PPV	PPV + SB	PPV	PPV + SB		
Tanner et al[19]	9	80%	–	100%	–	Two eyes (SO) Seven eyes (gas)	Lower RD
Wickham et al[20,^]	86	PPV alone: 89% PPV + SB: 73%			–	Gas	Lower RD
Martínez-Castillo et al[12]	40	–	–	90%	–	Gas	Lower RD
Alexander et al[10]	60	95% (PPV + SB)			–	Gas	Lower RD
Our study	95	93.8%	96.3%	94.4%	94.1%	Silicon	Lower RD
Pournaras and Kapetanios[13]	51	–	–	92%	100%	Gas	Upper and lower RD
Stangos et al[16]	71	–	–	97.8%	92.3%	Gas	Upper and lower RD
Siqueira et al[23,^]	51	85.7% for PPV 87% for PPV + SB			–	Silicon	Upper and lower RD
Kinori et al[21]	181	92%	87.5%	77.5%	86.7%	Gas	Upper and lower RD
Mehta et al[22]	219	83.8%	97.1%	87.5%	93.9%	Gas	Upper and lower RD

Notes: ^Wickham et al,[20] Alexander et al,[10] and Siqueira et al[23] didn't sort and classify their works according to lens state (phakic versus aphakic/pseudophakic). '–' signifies that this study didn't work in this group.
Abbreviations: PPV, pars plana vitrectomy; RD, retinal detachment; SB, scleral buckle; SO, silicon oil; SOSR, single-operation success rate.

Intra- and postoperative complications were similar in the two techniques. Functional outcome was better in the group of vitrectomy without SB than the group of vitrectomy with 360° scleral buckle.

Disclosure

The authors report no conflicts of interest in this work.

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