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Original Research Article

Outcome of pars plana vitrectomy versus scleral buckling in the treatment of rhegmatogenous retinal detachment

M. Saifulla-Hel-Azam[1]*, Abrar Ahmed Nabil[2], Goutam Das[3], Sha Muhammad Sayem[4], Mosfica Najnin[5], Nahid Sultana[6]

[1]Department of Ophthalmology, 250 Bedded General Hospital, Meherpur, Bangladesh
[2]Department of Ophthalmology, Vision Eye Hospital, Dhaka, Bangladesh
[3]Department of Ophthalmology, Brahmanbaria Medical College, Brahmanbaria, Bangladesh
[4]Department of Ophthalmology, Fashion Eye Hospital and Institute, Boro Mogbazar, Dhaka, Bangladesh
[5]Department of Ophthalmology, BERDO Eye Hospital, Dhaka, Bangladesh
[6]Department of Ophthalmology, Mymensingh Medical College Hospital, Bangladesh

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***Correspondence:**
Dr. M. Saifulla-Hel-Azam,
E-mail: saifullatonmoy@gmail.com

ABSTRACT

Background: Variety of surgical techniques are available to treat RRD. So, it is very difficult to choose the option. Objectives were to assess and compare the surgical outcome which includes retinal re-attachment rate, functional success rate and post-operative complications between pars plana vitrectomy (PPV) and scleral buckling (SB) in the treatment of rhegmatogenous retinal detachment (RRD).
Methods: This prospective observational study was conducted on 60 (sixty) eyes of 60 (sixty) patients with RRD in vitreo-retina department, at NIO and H. Subjects were divided into SB group (n=30) and PPV group (n=30). Ophthalmological data were included pre-operative and post-operative visual acuity, refractive status of the eye, intra ocular pressure, presence and extent of RRD, number and location of retinal breaks, presence of proliferative vitreoretinopathy, status of macula and peripheral retinal degenerations.
Results: Among 60 patients, majority (30% and 36.7%) were in the age between 41-50 years in PPV and SB group respectively. In both groups, males were predominant. Majority breaks were in total 25 (41.7%) eyes in superotemporal quadrant. Subtotal RRD was highest, in 19 (31.7%) eyes in total. Retinal anatomical re-attachment was achieved in total 55 (91.7%) eyes; among them 27 (90.0%) eyes in PPV group and 28 (93.3%) eyes in SB group.
Conclusions: Scleral buckling surgery may be taken as a unique option for uncomplicated rhegmatogenous retinal detachment surgery, as it is non-invasive and not accompanies with high incidence of post-operative cataract formation.

Keywords: Pars plana vitrectomy, Rhegmatogenous retinal detachment, Scleral buckling

INTRODUCTION

The retina contains the receptors for vision and is the innermost layer of the eye. It functions to transform visual light stimuli into neural signals which are transmitted and interpreted in the brain. The retina is bounded externally by Bruch's membrane and the choroid and internally by the vitreous. It is a transparent membrane being thickest at the posterior pole (0.56 mm) and thinning towards its anterior extension (0.1 mm), the ora serrata. It is continuous posteriorly with the optic nerve and anteriorly with the epithelium of the ciliary body.[1] It consists of two layers, an outer pigmented layer (RPE) and an inner neurosensory layer (NSR) between

which there is a potential space important in rhegmatogenous retinal detachment pathology, the sub-retinal space. Based on light microscopy and principally for descriptive purposes, the retina consists of ten layers.[2,3] The NSR contains the photoreceptors and nerve fibre layer. The RPE is a single layer of cells extending from the optic nerve head to the ora serrata which have numerous functions in metabolism, photo-transduction and adhesion to the neurosensory layer. Between these two layers is a potential space, the sub-retinal space. When the retina detaches, the sensory retina separates from the RPE and the RPE remains attached to Bruch's membrane and the underlying choroid.[2]

The term rhegmatogenous is derived from the Greek word rhegma, which means a discontinuity or a break. A rhegmatogenous retinal detachment (RRD) occurs when a tear in the retina leads to fluid accumulation with a separation of the neurosensory retina from the underlying RPE; this is the most common type of retinal detachment. Rhegmatogenous retinal detachment (RRD) is characterized by the presence of a full thickness retinal break. This break is held open by vitreoretinal traction that allows accumulation of liquefied vitreous under the retina separating it from the RPE. Therefore, the precursors to RRD are liquefied vitreous, tractional forces that can produce and maintain a retinal break and a break through which fluid gains access to the sub-retinal space.[4,5] Most eyes with retinal breaks do not develop RRD because the physiological forces attaching the NSR to the RPE are sufficient to hold the retina in place. However, when the opposing forces involved in RRD pathogenesis (vitreo-retinal traction, currents within the vitreous, gravitational forces) overwhelm the forces of attachment and liquefied vitreous fluid passes into the sub-retinal space at a faster rate than can be removed by the RPE, RRD results.[2]

A retinal break occurs when the vitreous detaches posteriorly and reaches a point of firmer attachment of the vitreous to the retina causing traction at that point. This commonly occurs around areas of exaggerated vitreo-retinal adhesion, such as the posterior margin of the vitreous base, areas of lattice degeneration or other vitreoretinal degenerations and around equatorial blood vessels. As the process of vitreous detachment continues and the vitreous remains attached to the flap of the tear, a horse-shoe tear (HST) will result. On the other hand, if the vitreous traction is strong enough to cause avulsion of the retinal tear at its base, a round hole (RH) results and the traction resolves. These are the two most common types of breaks causing RRD.[2,4,6] There are three types of retinal detachment: rhegmatogenous, tractional and exudative. Rhegmatogenous retinal detachment has a tear or hole in retina. This allows fluid from within eye to slip through the opening and get behind retina. The fluid separates the retina from the retinal pigment epithelium, which is the membrane that provides retina with nourishment and oxygen, causing the retina to detach. This is the most common type of retinal detachment. Tractional retinal detachment occurs when scar tissue on the retina's surface contracts and causes retina to pull away from the back of eye.

This is a less common type of detachment that typically affects people with diabetes mellitus. Poorly controlled diabetes mellitus can lead to issues with the retinal vascular system and this vascular damage can later lead to scar tissue accumulation in eye that could cause retinal detachment. In exudative detachment, there are no tears or breaks in retina.[7] Initially used in complicated cases of RRD pars plana vitrectomy is becoming an increasingly performed procedure for all cases of RRD. PPV is a microsurgical procedure which aims to remove the posterior hyaloid face, relieve vitreoretinal traction, manipulate and reattach the retina and create space for internal tamponade. Numerous agents can be used for internal tamponade including gas (sulphur hexafluoride, perfluoropropane), heavy liquid (perfluorocarbon) and silicone oil. The instrumentation and techniques used for PPV are continually being advanced and improved. PPV holds numerous advantages over scleral buckling including better visualization of the posterior pole as well as the ability to remove and manipulate opacities and proliferative membranes. PPV has a high final success rate of up to 95% in RRD complicated by PVR, pseudophakia or multiple breaks.[8-10]

Objective of the study

General objective

To assess and compare the surgical outcome which includes retinal re-attachment rate, functional success rate and post-operative complications between pars plana vitrectomy (PPV) and scleral buckling (SB) in the treatment of rhegmatogenous retinal detachment (RRD).

Specific objectives

To compare the anatomical outcome which includes retinal re-attachment rate between pars plana vitrectomy and scleral buckling in the treatment of RRD. To compare the functional outcome which includes change in best corrected visual acuity [BCVA, in terms of logarithm of the minimum angle of resolution (LogMAR)] between pars plana vitrectomy and scleral buckling, in the treatment of RRD. To compare post-operative complications which include raised intra ocular pressure, PVR rate and cataract formation between pars plana vitrectomy and scleral buckling in the treatment of RRD.

METHODS

Study design and place

It was a prospective observational study carried out at the department of vitreo-retina, NIO and H, Dhaka.

Period of study

This study took place from July 2017 to June 2019.

Study population

This study carried out on patients above 18 years of age, having rhegmatogenous retinal detachment (RRD), attending into vitreo-retina department, at National Institute of Ophthalmology and Hospital (NIO and H), Dhaka, during this study period.

Sample size

Sixty (60) patients were selected. Among them thirty (30) patients were for PPV group and another thirty (30) patients for SB group.

Sampling technique

Non-randomized purposive sampling technique was applied to collect the sample from the study population.

Inclusion criteria

RRD over 18 years of age. RRD without any proliferative vitreoretinopathy (PVR) changes. RRD with proliferative vitreoretinopathy (PVR) changes grade-B.

Exclusion criteria

Giant retinal tears. Defective PR (projection of rays). Posterior located tears. Exudative retinal detachment. Traumatic rhegmatogenous retinal detachment. Retinal detachment with macular hole. Recurrent retinal detachment following a previously failed retinal re-attachment surgery.

Data collection method

All the selected patients were undergone detail ophthalmological and systemic examinations as well as relevant investigations included B-scan ultrasonography, color fundus photography and optical coherence tomography. Age, gender, the presence of additional systemic disease, pre-operative lens status, the length of time between onset of disease and admission, location of retinal break and detachment, presence of macular involvement and PVR grade were recorded. Patients were monitored for anatomical retinal re-attachment, functional success and post-operative complications. During follow-up, functional success was determined by final BCVA.

Statistical analysis of data

Statistical analysis was performed on the recorded data, by using windows software SPSS version 23.0. For two groups comparisons qualitative data were analyzed by two-factor χ^2 test.

RESULTS

Table 1 showing distribution of the patients by age according to treatment category. It was found that in PPV group, highest percentage (30%) was in the age between 41-50 years followed by age group 51-60 years (23.3%). Similar age status was also in SB group, where highest percentage (36.7%) was in the age group between 41-50 years followed by 51-60 years (23.3%). In total 11.7% were in age between 18-30 years, 15.0% were in age group 31-40 years and 16.7% were in age group above 60 years. Mean age±SD was higher in PPV group (48.23±12.76) than SB group (45.37±12.08). There was no statistically significant (p>0.05) difference between age and both groups.

Table 1: Distribution of the patients by age according to treatment category.

Age in years	Category of treatment		Total (%) n=60	P value
	PPV (%) n=30	SB (%) n=30		
18-30	3 (10)	4 (13.3)	7 (11.7)	0.318^{NS}
31-40	5 (16.7)	4 (13.3)	9 (15.0)	
41-50	9(30)	11 (36.7)	20 (33.3)	
51-60	7 (23.3)	7 (23.3)	14 (23.3)	
>60	6 (20)	4 (13.3)	10 (16.7)	
(Mean±SD)	48.23±12.76	45.37±12.08	46.80±12.40	

NS=not significant.

Table 2: Distribution of the patients by gender in each group.

Gender	Category of treatment		Total (%) n=60	P value
	PPV (%) n=30	SB (%) n=30		
Male	17 (56.7)	16 (53.3)	33 (55.0)	0.500^{NS}
Female	13 (43.3)	14 (46.7)	27 (45.0)	
Total	30 (100)	30 (100)	60 (100)	

NS=not significant.

Table 3: Number of breaks in the two study groups.

Number of breaks	Category of treatment		Total (%) n=60	P value
	PPV (%) n=30	SB (%) n=30		
Single	16 (53.3)	19 (63.3)	35 (58.3)	0.833^{NS}
Multiple (two or more)	14 (46.7)	11 (36.7)	25 (41.7)	
Total	30 (100)	30 (100)	60 (100)	

NS=not significant.

Table 4: Configuration of RRD in the two study groups.

Configuration of RRD	Category of treatment		Total (%) n=60	P value
	PPV (%) n=30	SB (%) n=30		
Bullous inferior RRD	5 (16.7)	4 (13.3)	9 (15.0)	0.982^{NS}
Subtotal RRD	10 (33.3)	9(30.0)	19 (31.7)	
Total RRD	6 (20.0)	7 (23.3)	13 (21.7)	
Inferior RRD	7 (23.3)	9(30.0)	16 (26.7)	
Superior RRD	2 (6.7)	1 (3.3)	3 (5.0)	
Total	30 (100)	30 (100)	60 (100)	

NS=not significant.

Table 5: Predisposing factors for RRD in the two study groups.

Predisposing factors	Category of treatment		Total (%)	P value
	PPV (%) n=30	SB (%) n=30		
Myopia	12 (40.0)	12 (40.0)	24 (40.0)	0.924^{NS}
Lattice degeneration	10 (33.3)	9(30.0)	19 (31.7)	
Pseudophakia	4 (13.3)	4 (13.3)	8(13.3)	
Aphakia	2 (6.7)	2 (6.7)	4 (6.7)	
Unknown etiology	2 (6.7)	3 (10.0)	5 (8.3)	
Total	30 (100)	30 (100)	60 (100)	

NS=not significant.

Table 6: Time between the onset of RRD and surgical intervention.

Duration	Category of treatment		Total (%)	P value
	PPV (%) n=30	SB (%) n=30		
<2 months	4 (13.3)	6 (20.0)	10 (16.7)	0.534^{NS}
3-6 months	13 (43.3)	16 (53.3)	29 (48.3)	
7-12 months	10 (33.3)	6 (20.0)	16 (26.7)	
>12 months	3 (10.0)	2 (6.7)	5 (8.3)	
Total	30 (100)	30 (100)	60 (100)	

NS=not significant.

Table 7: Post-operative complications of the two study groups.

Post-operative complications	Category of treatment		P value
	PPV (%) n=30	SB (%) n=30	
Early complication			0.522^{NS}
Raised IOP (>21 mm of Hg)	10 (33.3)	7 (23.3)	
Late complications			
Raised IOP (>21 mm of Hg)	3 (10.0)	1(3.3)	
PVR (proliferative vitreo-retinopathy)	4 (13.3)	2 (6.7)	
Cataract	8 (33.3)	1 (4.1)	

NS=not significant.

Table 2 is showing distribution of the patients by gender in each group. It was found that males were more in both PPV and SB groups. It was revealed that in PPV group 17 (56.7%) were male and 13 (43.3%) were female. In SB group male also higher 16 (53.3%) than female 14 (46.7%). No significant (p=0.500) difference was observed between gender and both groups.

Table 3 is showing the number of breaks in both groups. Majority breaks were single in both groups, where 16 (53.3%) eyes in PPV group and 19 (63.3%) eyes in SB group. Multiple (two or more) breaks in 14 (46.7%) eyes were found in PPV group and in 11 (36.7%) eyes were found in SB group of patients. No significant (p=0.833) difference was observed between number of breaks and both groups.

Table 4 shows the configuration of RRD. In total majority 19 (31.7%) eyes were subtotal RRD, among them 10 eyes (33.3%) and 9 eyes (30%) in PPV and SB treatment category group respectively, followed by in total inferior RRD in 16 (26.7%) eyes. Total RRD was found in 13 (21.7%), bullous inferior RRD in 9 (15.0%) and superior RRD in 3 (5.0%) eyes in total. Chi-square test shows that there was no statistically significant (p>0.05) difference between configurations of RRD and in PPV and SB treatment category groups.

Table 5 is showing the presence of predisposing factors for RRD. Myopia was detected in 12 (40.0%) eyes in both PPV and SB groups. Lattice degeneration was detected in 19 (31.7%) eyes in total. Pseudophakia was detected in 8(13.3%) eyes in total. Aphakia was detected in 4 (6.7%) eyes in total. In total unknown etiology was found in 5(8.3%) eyes, 2 eyes in PPV and 3 eyes in SB group. No significant (p=0.924) difference was observed between predisposing factors for RRD and both groups.

Table 6 is showing time between the onset of RRD and surgical intervention ranged from 1 month to 18 months. It was found that the highest amount of the cases in total 29 eyes (48.3%) belonged to 3-6 months, followed by in total 16 eyes (26.7%) belonged to 7-12 months. Then in total 10 eyes (16.7%) belonged to less than 2 months, then in total 5 eyes (8.3%) belonged to more than 12 months.

Table 7 shows post-operative complications of the two study groups. Early complication was raised IOP, where 10 (33.3%) eyes in PPV group and 7 (23.3%) eyes in SB group. Late complications were raised IOP 3 (10.0%) eyes, PVR 4 (13.3%) eyes and cataract 8 (33.3%) eyes in PPV group. Raised IOP 1 (3.3%) eye, PVR 2 (6.7%) eyes and cataract 1 (4.1%) eye in SB group.

Table 8: Comparative evaluation of pre-operative and post-operative BCVA (LogMAR) in PPV and SB groups.

Follow-up	Category of treatment				P value
	PPV n=30		SB n=30		
	BCVA (LogMAR)				
	(Mean±SD)	Median	(Mean±SD)	Median	
Pre-operative	1.93±0.39	2.0	1.92 ±0.35	2.0	0.321
After 7 days	1.65±0.71	1.63	0.88±0.35	0.78	0.092
After 1 month	1.14±0.74	1	0.73±0.41	0.78	0.066
After 3 months	0.77±0.45	0.6	0.68±0.43	0.6	0.394
After 6 months	0.69±0.33	0.6	0.60±0.36	0.6	0.366

Table 8 is showing comparative evaluation of pre-operative and post-operative BCVA (LogMAR) in the two study groups. There was no statistically significant difference between the two study groups in terms of final BCVA (LogMAR) (p=0.366). However, BCVA (LogMAR) in the SB group after 1 week (median: 0.78, mean±SD: 0.88±0.35) and after 1 month (median: 0.78, mean±SD: 0.73±0.41) post-surgery was found to be better than in the PPV group after 1 week (median: 1.63, mean±SD: 1.65±0.71) and after 1 month (median: 1, mean±SD: 1.14±0.74). The final BCVA (LogMAR) in the PPV group improved from a pre-operative median of 2.0 (Mean±SD: 1.93±0.39) to a median of 0.6 (Mean±SD: 0.69±0.33). In the SB group, final BCVA (LogMAR) improved from a pre-operative median of 2.0 (Mean±SD: 1.92±0.35) to a median of 0.6 (Mean±SD: 0.60±0.36).

DISCUSSION

Location of retinal breaks were observed in this study that out of 60 patients in the two groups, superotemporal breaks were found in 25 eyes (41.7%), inferotemporal 16(26.7%), superonasal 6 (10%), inferonasal 9 (15%) eyes and also not detected in 4 eyes (6.7%). Majority 12 (40.0%) and 13 (43.3%) eyes were reported in superotemporal quadrant in PPV and SB group respectively. This is consistent with a study where reported that quadrantic distribution of breaks in eyes with RRD is approximately 45% in the superotemporal quadrant, 7.5% in the superonasal quadrant, 32.5% in the inferotemoral quadrant, 10.0% in inferonasal quadrant and not detected in 2 (5.0%) eyes.[11] A study observed that configuration of RRD that subtotal and inferior RRD were 30.0% and 30.0% respectively. Total RRD was found in 22.5%, bullous inferior RRD 12.5% and superior RRD 5.0%.[11] The present study showed the configuration of RRD that majority (31.7%) were subtotal RRD in both groups that were 10 eyes (33.3%) and 9 eyes (30%) in PPV and SB treatment category group respectively. Inferior RRD in total 16 eyes (26.7%); total RRD in total 13 eyes (21.7%), inferior bullous RRD in total 9 eyes (15.0%) and superior RRD in total 3 eyes (5.0%), which closely resembled with above study. Total RRD were found in 21.7%, inferior bullous RD 15.0% and superior RD 5.0% in both groups together, closely resembled with above study.

In the present study the predisposing factors for RRD was observed. Myopia was detected in 12 (40%) eyes in both PPV and SB groups. Lattice degeneration was detected in 19 (31.7) eyes in both PPV and SB groups. Pseudophakia was detected in 8 (13.3%) eyes in both PPV and SB groups. Aphakia was detected in 4 (6.7%) eyes in both PPV and SB groups. Unknown etiology also found in 5 (8.3%) eyes. In a study observed a total of 50 eyes, out of which 32.0% were myopic, 26.0% were pseudophakic and 24.0% had history of trauma.[12] Another study found, blunt ocular trauma 47.02%, myopia 29.85%, aphakia/ pseudophakia 12.5% and unknown causes 10.44%, which is closely resembled with the present study.[13] A SPR study found seven hundred and sixty patients (68.2%) were phakic, while 343 eyes (30.8%) were recorded as aphakic or pseudophakic; the lens status was missing in 12 cases (1.1%). Myopia of more than −7.0 diopters was present in 143 eyes (12.8%), central retinal breaks in 49 (4.4%), other eye diseases in 248 (22.2%) and severe systemic diseases in 329 (29.5%).[14]

Another study mentioned in their study that the period between the retinal detachment and surgery ranged from 1 day to 1 year with mean duration 6.25±11.2 week, which support the current study.[12] For our study, eyes at a high risk of developing PVR had been excluded, which contributed to lowering the incidence of post- operative PVR. Present study showed the presence of post-operative complications. Early complication was raised IOP, where 10 (33.3%) eyes in PPV group and 7 (23.3%) eyes in SB group. Late complications were raised IOP 3 (10.0%) eyes, PVR (proliferative vitreo retinopathy) 4 (13.3%) eyes and cataract 8 (26.7%) eyes in PPV group. Raised IOP 1 (3.3%) eye, PVR 2 (6.7%) eyes and cataract 1 (3.3%) eye in SB group. Raised IOP, PVR and cataract formation were higher in case of PPV treatment category group than in case of SB treatment category group. In a study found in the PPV group, the incidence of cataract progression and lens damage, occurrence of iatrogenic breaks was significantly more common when compared with the SB procedure. In phakic patients, cataract progression was greater in the PPV group ($p<0.00005$).[15]

Another study found that, at the final follow-up, the BCVA improved in 70% eyes in the SB group and in 68% eyes in the PPV group.[16] BCVA was 1.04±0.57 pre-operatively and became 0.89±0.77 post-operatively in the SB group, whereas in the PPV group the pre-operative BCVA was 1.08±0.58 and became 0.79±0.52 post-operatively. There was no statistically significant difference between the two groups. In this study, the visual outcome results showed no statistically significant difference between the two treatment groups. The final BCVA improvement is more in SB cases than PPV group. Study results are comparable to a study showed the overall mean±SD pre-operative (pre-op) BCVA was 2.39±1.03 logMAR units; 2.32±1.07 in PPV group and 2.18±1.15 in SB group.[17] The overall mean BCVA at the final visit was 0.77±0.88 logMAR units, 0.83±0.97 in PPV group and 0.79±0.94 in SB group. No significant difference was observed between the groups in terms of pre-operative ($p=0.168$) and final visit ($p=0.950$) BCVA values. In this study there was no statistically significant difference between the two study groups in terms of final BCVA (LogMAR) ($p=0.366$). In summary, this study demonstrated that SB achieved more favorable effects with less post-operative complications than PPV in the treatment of primary RRD.

There were some limitations in spite of taking optimum care in every steps of this study. Sample collected from single selected institute. So, the study result may not he generalized. Cost-effectiveness of the two modalities of treatment options was not studied.

CONCLUSION

Though the effect of scleral buckling surgery in rhegmatogenous retinal detachment patients shows superiority over pars plana vitrectomy, but it is not statistically significant. Even then, scleral buckling surgery may be taken as a unique option for uncomplicated rhegmatogenous retinal detachment surgery, as it is non-invasive and not accompanies with high incidence of post-operative cataract formation. The major drawback of pars plana vitrectomy procedure is the high incidence of post-operative cataract formation.

Recommendations

Scleral buckling (SB) is although an old technique, still holds good and can give excellent results if performed well. Visual rehabilitation takes place earlier with scleral buckling than with pars plana vitrectomy. So, it would be advisable for the retina surgeons to acquire scleral buckling skill set.

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