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A Comparative Study on Pars Plana Vitrectomy Alone and Pars Plana Vitrectomy with Scleral Buckling in Rhegmatogenous Retinal Detachment

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Abstract

Purpose: To compare the anatomical and visual outcomes of pars plana vitrectomy (PPV) alone versus combined pars plana vitrectomy with scleral buckling (PPV + SB) in patients with Rhegmatogenous retinal detachment (RRD).

Methods: This prospective interventional clinical study was conducted at Alolika Hospitex and Research Centre, Lokepur, Bankura. A total of 100 eyes of 100 patients with primary RRD were included and randomly assigned into two groups: Group A underwent PPV with scleral buckling (n=50), and Group B underwent PPV alone (n=50). All patients underwent standard 23-gauge Vitrectomy with laser Retinopexy and silicone oil tamponade. Anatomical retinal attachment and best corrected visual acuity (BCVA) were evaluated during a three-month postoperative follow-up.

Results: The baseline characteristics were comparable between the two groups. The mean age was 59.24 ± 9.76 years in the PPV + SB group and 58.14 ± 10.46 years in the PPV-alone group (p=0.494). At three months, retinal attachment was achieved in 34 eyes (68%) in the PPV + SB group and 40 eyes (80%) in the PPV-alone group; however, the difference was not statistically significant (p=0.171). The mean postoperative BCVA was 1.30 ± 0.88 Log MAR in Group A and 1.03 ± 0.76 Log MAR in Group B (p=0.069). Both groups showed improvement

in visual outcome, but no significant difference was observed between the two surgical approaches.

Conclusion: In selected phakic patients with uncomplicated Rhegmatogenous retinal detachment, pars plana vitrectomy alone provides anatomical and functional outcomes comparable to combined PPV with scleral buckling. The routine addition of scleral buckling may not offer significant additional benefit and should be considered based on individual retinal characteristics and Intraoperative findings.

Keywords: Rhegmatogenous Retinal Detachment, Pars Planavitrectomy, Scleral Buckling, Retinal Reattachment, Best Corrected Visual Acuity, Silicone Oil Tamponade.

Introduction

Rhegmatogenous retinal detachment (RRD) is one of the most vision-threatening ocular disorders and represents a major cause of preventable blindness worldwide. It occurs due to a full-thickness retinal break that allows liquefied vitreous to pass into the sub retinal space, resulting in separation of the neurosensory retina from the underlying retinal pigment epithelium. If left untreated, progressive detachment involving the macula may lead to severe and irreversible visual loss. The incidence of Rhegmatogenous retinal detachment has been reported to range between 6 and 18 cases per 100,000 population annually, with increasing prevalence among elderly individuals due to age-related vitreous changes. [1]

The pathogenesis of RRD is closely associated with posterior vitreous detachment, which causes vitreoretinal traction and subsequent formation of retinal tears or holes. Other important risk factors include high myopia, ocular trauma, previous cataract surgery, lattice degeneration, and peripheral retinal degenerations. [2] The clinical presentation commonly includes symptoms such as sudden onset of floaters, flashes of light (photopsia), and painless diminution of vision. Early diagnosis and timely surgical intervention are essential for achieving anatomical retinal reattachment and preserving visual function.

The fundamental principles of retinal detachment surgery include closure of retinal breaks, relief of vitreoretinal traction, and creation of a suitable environment for retinal adhesion. Over the years, several surgical techniques have evolved, including scleral buckling (SB), pars planavitrectomy (PPV), pneumatic Retinopexy, and combined procedures.[3]

Scleral buckling, introduced in the mid-20th century, has been a standard surgical procedure for RRD, particularly in phakic patients with anterior retinal breaks and minimal vitreous pathology. The procedure involves placement of an exoplant on the scleral surface to indent the globe, reduce vitreous traction, and support retinal breaks externally.[4] Scleral buckling has the advantage of preserving the crystalline lens and avoiding intraocular manipulation; however, it may be technically challenging in cases with multiple breaks, posterior breaks, vitreous opacities, or significant vitreoretinal traction.

Pars plana vitrectomy, first described by Machemer et al. in 1971, revolutionized the management of complex retinal disorders.[5]

Advances in Vitrectomy instrumentation, including small-gauge transcon junctival systems, improved visualization techniques, wide-angle viewing systems, and improved tamponading agents, have expanded the indications of PPV in primary RRD. PPV allows direct removal of vitreous traction, identification and treatment

of retinal breaks, internal drainage of sub retinal fluid, and precise application of laser photocoagulation.[6]

In recent years, PPV has increasingly become a preferred surgical option for many cases of primary RRD, particularly in elderly patients and those with posterior vitreous detachment. However, in phakic eyes with anterior retinal breaks and limited vitreous changes, scleral buckling remains an important procedure. The addition of scleral buckling to PPV is proposed to provide additional support to peripheral retinal breaks, reduce residual vitreoretinal traction, and improve anatomical success rates.[7]

Despite advances in surgical techniques, the ideal surgical approach for uncomplicated Rhegmatogenous retinal detachment remains controversial. Some studies have demonstrated comparable anatomical success between PPV alone and combined PPV with scleral buckling, while others have reported improved outcomes with combined surgery, especially in selected patient groups.[8,9] Combined PPV and scleral buckling may increase the likelihood of retinal attachment but can also be associated with additional complications such as increased postoperative inflammation, refractive changes, buckle-related problems, and longer surgical duration. The present study was undertaken to compare the anatomical and functional outcomes of pars planavitrectomy alone with pars planavitrectomy combined with scleral buckling in patients with rhegmatogenous retinal detachment. The study aimed to evaluate postoperative retinal attachment status, improvement in best corrected visual acuity (BCVA), and postoperative complications over a three-month follow-up period.

Materials and Methods

Study Design and Setting

This was a prospective, interventional, clinical study conducted at the Main Operation Theatre and Outpatient Department (OPD) of the Alolika Hospitex and Research Centre, Lokepur, Bankura. The study was conducted over a period of one year.

Study Population and Sample Size

The study included 100 eyes of 100 newly diagnosed cases of Rhegmatogenous retinal detachment (RRD). Patients were selected from those attending the Outpatient Department of AlolikaHospitex and Research Centre, Lokepur, Bankura. Diagnosis was established based on detailed clinical examination and ultra sonography B-scan evaluation.

Ethical Approval and Consent

The study was conducted after obtaining approval from the institutional ethical committee. The nature, purpose, and procedure of the study were explained to all participants in understandable language. Written informed consent was obtained from each patient and their first-degree relatives before inclusion in the study.

Inclusion Criteria

Patients fulfilling the following criteria were included:

1. Patients diagnosed with Rhegmatogenous retinal detachment without significant proliferative vitreo retinopathy (PVR < C1).
2. Patients aged more than 45 years.
3. Only phakic patients were included.

Exclusion Criteria

Patients were excluded from the study if they fulfilled any of the following criteria:

1. Retinal breaks located significantly posterior to the equator, as these are difficult to approach during scleral

buckling due to anatomical limitations and poor surgical exposure.

2. Presence of significant vitreoretinal traction, including advanced proliferative vitreoretinopathy or diabetic neovascularization.

3. Opaque media preventing proper visualization of retinal breaks, such as in cases with vitreous haemorrhage.

4. Presence of multiple retinal breaks.

5. History of previous intraocular surgery.

6. Pseudophakic and aphakic patients.

7. Patients who failed to comply with the follow-up schedule.

8. One-eyed patients.

9. Juvenile Rhegmatogenous retinal detachment (≤18 years).

10. Dense cataract preventing adequate visualization of retinal breaks.

Data Collection and Clinical Evaluation

Patients presenting to the OPD of Regional Institute of Ophthalmology with complaints of painless diminution of vision, flashes of light, and floaters were subjected to a comprehensive ophthalmological evaluation. Patients fulfilling the inclusion criteria were enrolled in the study.

A detailed ocular and systemic history was obtained. Baseline investigations were performed, and patients underwent complete preoperative assessment before surgical intervention.

Systemic Investigations

The following investigations were performed:

1. Fasting and postprandial blood sugar levels (FBS and PPBS).
2. Glycatedhaemoglobin (HbA1c).
3. Serum urea and creatinine.
4. Lipid profile.
5. Blood pressure measurement.
6. Electrocardiogram and cardiological evaluation.

Ocular Examination

All patients underwent detailed ocular examination, including:

1. Best Corrected Visual Acuity (BCVA) measurement using Snellen's chart.
2. Slit lamp examination.
3. Applanation tonometry.
4. Gonio scopy.
5. Indirect ophthalmoscopy using a 20D lens.
6. Ultrasonography B-scan.
7. Ocular biometry.

Surgical Procedure

A total of 100 patients were randomly assigned into two treatment groups:

- **Group A:** Patients undergoing combined scleral buckling (SB) with pars planavitrectomy (PPV).
- **Group B:** Patients undergoing pars planavitrectomy (PPV) alone.

All surgical procedures were performed under local peri bulbar anaesthesia by a single experienced surgeon.

Group A: Scleral Buckling with Pars Plana Vitrectomy

In patients undergoing combined surgery, con junctival peri to my was performed followed by isolation and looping of the rectus muscles. Retinal breaks were externally marked using diathermy. Small breaks were marked with a single spot, while large horseshoe tears were marked with three spots.

Retinal breaks were treated with laser photocoagulation using indirect ophthalmoscopy. Segmental circumferential silicone buckles were sutured onto the sclera to support the retinal breaks. This was followed by

standard 23-gauge valvedtrans conjunctival pars planavitrectomy using a non-contact viewing system (Constellation Vision System; Alcon Laboratories Inc., Fort Worth, TX, USA).

After completion of vitrectomy with scleral indentation, perfluorocarbon liquid (PFCL) was injected to facilitate retinal reattachment, followed by endolaser photocoagulation. Fluid-air exchange was performed to remove PFCL, and silicone oil tamponade was used. Conjunctival closure was followed by administration of paraocular gentamycin and dexamethasone injections.

Group B: Pars Plana Vitrectomy Alone

Patients allocated to the PPV group underwent standard 23-gauge valvedtransconjunctival pars planavitrectomy using the Constellation Vision System with a non-contact viewing system.

Core Vitrectomy was performed using three-dimensional vitrectomy mode with a cutting rate of up to 5000 cuts per minute and suction up to 500 mmHg. PFCL was used intra operatively for retinal flattening and reattachment. Endo laser photocoagulation was performed, followed by fluid-air exchange and silicone oil tamponade. After conjunctival closure, para ocular gentamycin and dexamethasone injections were administered.

Postoperative Follow-up

Patients receiving silicone oil tamponade were advised appropriate postoperative head positioning for the first two weeks to promote adequate tamponade of retinal breaks.

All patients received topical antibiotics, anti-inflammatory agents, and cycloplegic drops. Follow-up examinations were performed for three months after surgery.

Outcome Assessment

The primary outcome measures included:

1. Change in Best Corrected Visual Acuity (BCVA).
2. Fundus examination findings.
3. Anatomical status of retinal attachment.
4. Postoperative complications.

Only patients who completed the three-month follow-up period were included in the final analysis.

Visual acuity was recorded using Snellen's chart and converted into logarithm of the minimum angle of resolution (Log MAR) values for statistical analysis.

Results and Observations

The present prospective interventional clinical study was conducted in the Main Operation Theatre and Outpatient Department of Regional Institute of Ophthalmology, Medical College, Kolkata. A total of 100 eyes of 100 patients with Rhegmatogenous retinal detachment were included in the study after appropriate screening and obtaining informed consent. The patients were randomly divided into two groups:

- **Group A:** Patients undergoing pars plana vitrectomy (PPV) with scleral buckling (SB) (n=50).
- **Group B:** Patients undergoing pars plana vitrectomy (PPV) alone (n=50).

Continuous variables were expressed as mean, median, and standard deviation. Comparison between groups was performed using the Mann–Whitney U test. Categorical variables were expressed as number and percentage and analysed using Pearson's Chi-square test/Fisher's Exact Test as applicable. Comparison of variables over time was performed using the Wilcoxon Signed Rank Test. Statistical analysis was performed using SPSS version 20. A p-value <0.05 was considered statistically significant.

Table 1: Comparison of Mean Age Distribution Between Two Groups

Parameter	PPV + Scleral Buckling (Group A)	PPV Alone (Group B)	p value	Significance
Mean age (years)	59.24 ± 9.76	58.14 ± 10.46	0.494	Not Significant
Median age (years)	57.50	56.00		

Observation

The mean age of patients in Group A was 59.24 years, whereas in Group B it was 58.14 years. The difference in age distribution between the two groups was not statistically significant (p=0.494).

Table 2: Distribution of Age Groups Between Two Groups

Age Group (years)	PPV + SB Group A n (%)	PPV Group B n (%)	Total n (%)	p value	Significance
41–50	11 (22%)	17 (34%)	28 (28%)		
51–60	15 (30%)	12 (24%)	27 (27%)		
61–70	15 (30%)	11 (22%)	26 (26%)		
71–80	9 (18%)	10 (20%)	19 (19%)		
Total	50 (100%)	50 (100%)	100 (100%)	0.515	Not Significant

Observation

The majority of patients belonged to the age group of 51–70 years. The distribution of different age groups was comparable between both groups and was statistically not significant (p=0.515).

Table 3: Distribution of Sex Between Two Groups

Sex	PPV + SB Group A n (%)	PPV Group B n (%)	Total n (%)	p value	Significance
Male	28 (56%)	26 (52%)	54 (54%)		
Female	22 (44%)	24 (48%)	46 (46%)		
Total	50 (100%)	50 (100%)	100 (100%)	0.688	Not Significant

Observation

Male predominance was observed in both groups. Males constituted 56% of Group A and 52% of Group B, while females constituted 44% and 48% respectively. The difference was statistically not significant (p=0.688).

Table 4: Preoperative Fundus Status of Diseased Eye

Fundus Status	PPV + SB Group A n (%)	PPV Group B n (%)	Total n (%)	p value	Significance
Superior Retinal Detachment	26 (52%)	24 (48%)	50 (50%)		
Inferior Retinal Detachment	24 (48%)	26 (52%)	50 (50%)		
Total	50 (100%)	50 (100%)	100 (100%)	0.689	Not Significant

Observation

In Group A, superior retinal detachment was slightly more common (52%), whereas inferior retinal detachment was more common in Group B (52%). The difference between groups was not statistically significant (p=0.689).

Table 5: Postoperative Fundus Status at 3 Months

Fundus Status at 3 Months	PPV + SB Group A n (%)	PPV Group B n (%)	Total n (%)	p value	Significance
Retina attached	34 (68%)	40 (80%)	74 (74%)		
Retina elevated	16 (32%)	10 (20%)	26 (26%)		
Total	50 (100%)	50 (100%)	100 (100%)	0.171	Not Significant

Observation

At three months postoperatively, retinal attachment was achieved in 68% of patients in Group A and 80% of patients in Group B. Although retinal attachment was higher in the PPV alone group, the difference was not statistically significant (p=0.171).

Table 6: Comparison of BCVA Before and Three Months After Surgery

Parameter	PPV + SB Group A	PPV Group B	p value	Significance
Preoperative BCVA (Log MAR) Mean ± SD	1.28 ± 0.67	1.20 ± 0.73	0.155	Not Significant
Median	1.00	1.00		
Postoperative BCVA at 3 months (Log MAR) Mean ± SD	1.30 ± 0.88	1.03 ± 0.76	0.069	Not Significant
Median	1.00	0.80		

Observation

The mean preoperative BCVA was 1.28 Log MAR in Group A and 1.20 Log MAR in Group B. At three months postoperatively, mean BCVA was 1.30 Log MAR in Group A and 1.03 Log MAR in Group B. Improvement was observed in both groups; however, the difference was not statistically significant.

Table 7: Comparison of BCVA Over Time Using Wilcox on Signed Rank Test

Comparison	Group A p value	Group B p value
Postoperative BCVA normal eye at 3 months vs preoperative BCVA normal eye	1.000	0.617
Postoperative BCVA diseased eye at 3 months vs preoperative BCVA diseased eye	1.000	0.063

Observation

No statistically significant difference was observed in BCVA changes over the three-month follow-up period in either group.

Table 8: Comparison of All Variables Between Groups

Variable	Group A Mean ± SD	Group B Mean ± SD	p value	Significance
Age	59.24 ± 9.76	58.14 ± 10.46	0.494	Not Significant
Preoperative BCVA (diseased eye)	1.28 ± 0.67	1.20 ± 0.73	0.155	Not Significant
Postoperative BCVA (diseased eye) at	1.30 ± 0.88	1.03 ± 0.76	0.069	Not Significant

3 months				
Preoperative BCVA normal eye	Comparable between groups	Comparable between groups		
Postoperative BCVA normal eye	Comparable between groups	Comparable between groups		

Discussion

Rhegmatogenous retinal detachment remains a significant challenge in vitreoretinal surgery despite remarkable advances in surgical techniques and instrumentation. The objective of surgical management is successful anatomical reattachment of the retina with preservation or improvement of visual function. The choice between pars planavitrectomy alone and combined pars planavitrectomy with scleral buckling depends on several factors, including patient age, lens status, location and number of retinal breaks, vitreous condition, and surgeon preference. The present prospective interventional study included 100 eyes of 100 patients diagnosed with Rhegmatogenous retinal detachment. Patients were randomly allocated into two groups: Group A underwent combined PPV with scleral buckling, while Group B underwent PPV alone. Both groups were comparable with respect to baseline demographic characteristics, allowing meaningful comparison of postoperative outcomes.

In the present study, the mean age of patients was 59.24 ± 9.76 years in the PPV with SB group and 58.14 ± 10.46 years in the PPV alone group. The difference was statistically insignificant (p=0.494). The majority of patients belonged to the 51–70 year age group. Similar age distribution has been reported in previous studies, reflecting the higher prevalence of RRD among elderly individuals due to age-related vitreous liquefaction and posterior vitreous detachment.[10]

A male predominance was observed in both groups, with males comprising 56% of Group A and 52% of Group B. The difference between groups was not statistically significant (p=0.688). Previous epidemiological studies have also demonstrated a higher incidence of RRD among males, possibly related to occupational exposure, trauma, and differences in vitreous structure.[2]

Preoperative retinal detachment characteristics were comparable between the two groups. Superior retinal detachment was present in 52% of Group A and 48% of Group B, while inferior detachment was observed in 48% and 52%, respectively. No significant difference was observed between groups (p=0.689). Similar baseline characteristics suggest that the postoperative differences were not influenced by preoperative detachment distribution.

At three months after surgery, retinal attachment was achieved in 68% of patients undergoing PPV with scleral buckling compared with 80% of patients undergoing PPV alone. Although the anatomical success rate appeared higher in the PPV-alone group, the difference was statistically insignificant (p=0.171). These findings suggest that the addition of scleral buckling did not provide a statistically significant advantage in achieving retinal reattachment in the studied population.

The results are comparable with findings from previous studies. The Primary Retinal Detachment Outcomes Study (PRO Study) reported that PPV and scleral buckling provide comparable anatomical outcomes in selected cases of RRD, with surgical success influenced

mainly by patient characteristics and retinal break configuration rather than the surgical technique alone.[11]

In contrast, some studies have demonstrated improved anatomical outcomes with combined PPV and scleral buckling, particularly in phakic patients, young individuals, and those with inferior retinal breaks. The additional support provided by the buckle may reduce residual peripheral traction and support retinal breaks that are difficult to treat internally.[7] However, routine addition of scleral buckling may not be necessary in all cases and may increase surgical complexity.

The present study included only phakic patients without significant proliferative vitreoretinopathy (PVR < C1), multiple retinal breaks, or significant vitreoretinal traction. These strict inclusion criteria may explain the comparable outcomes between the two groups, as uncomplicated RRD cases are generally amenable to successful repair with PPV alone.

Visual outcome was assessed using BCVA converted into Log MAR values. The mean preoperative BCVA was 1.28 ± 0.67 Log MAR in Group A and 1.20 ± 0.73 Log MAR in Group B, with no significant difference (p=0.155). At three months postoperatively, BCVA improved to 1.30 ± 0.88 Log MAR in Group A and 1.03 ± 0.76 Log MAR in Group B. Although better visual improvement was observed in the PPV-alone group, the difference did not reach statistical significance (p=0.069).

Visual recovery following retinal detachment surgery depends on multiple factors, including macular involvement, duration of detachment, photoreceptor damage, and postoperative complications. Anatomical restoration of retinal attachment does not always translate into complete functional recovery.[12]

The Wilcox on Signed Rank Test showed no statistically significant change in BCVA over time within either group. This may be explained by the short follow-up duration of three months and the inclusion of patients with variable macular status. Longer follow-up may demonstrate further visual improvement due to gradual recovery of retinal function after reattachment.

The findings of the present study are consistent with several comparative studies demonstrating that PPV alone can achieve anatomical and functional outcomes comparable to combined PPV with scleral buckling in uncomplicated RRD.[13] However, scleral buckling continues to have an important role in selected cases, especially where additional support of peripheral retinal breaks is required.

The major advantage of PPV alone includes shorter operative time, avoidance of buckle-related complications, reduced postoperative discomfort, and better refractive stability. Conversely, combined PPV with scleral buckling may provide additional security in selected high-risk cases but may increase complications such as buckle extrusion, infection, induced myopia, and diplopia.[14]

In the present study, no statistically significant difference was observed between the two surgical approaches regarding anatomical success or visual outcome. Therefore, individualised selection of surgical technique based on retinal pathology, lens status, break characteristics, and surgeon experience remains essential.

Conclusion

In the present study comparing pars plana vitrectomy (PPV) alone with combined pars plana vitrectomy and scleral buckling (PPV + SB) for Rhegmatogenous retinal detachment, both surgical techniques achieved

comparable anatomical and functional outcomes at three months.

Although retinal attachment rates were higher in the PPV-alone group (80%) compared with the PPV + SB group (68%), the difference was not statistically significant. Similarly, improvement in best corrected visual acuity was observed in both groups, with no significant difference between the two techniques.

Therefore, in selected cases of uncomplicated Rhegmatogenous retinal detachment, PPV alone provides outcomes comparable to combined PPV with scleral buckling. The decision to add scleral buckling should be individualized based on retinal break characteristics, vitreoretinal traction, and surgeon preference. Further studies with larger sample sizes and longer follow-up are required to establish definitive advantages of either approach.

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