

# Surgical Outcomes for Primary Rhegmatogenous Retinal Detachments in Patients with Pseudophakia after Phacoemulsification

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**Purpose:** To evaluate the clinical features and surgical outcomes for primary rhegmatogenous retinal detachments (RDs) in patients with pseudophakia after phacoemulsification.

**Methods:** The medical records of patients with pseudophakia after phacoemulsification and intraocular lens implantation who had undergone surgery for primary rhegmatogenous RDs with a minimum duration of follow-up of 12 months were reviewed retrospectively.

**Results:** A total of 104 patients were enrolled in this study and 106 eyes were analyzed. Post-operative retinal attachment was achieved in 87 of the eyes (82.1%) and the final visual acuities (logarithm of the minimum angle of resolution) were improved to  $0.65 \pm 0.49$  from the baseline measurement of  $1.51 \pm 1.14$  ( $p < 0.001$ ). Re-operations were performed in 24 of the eyes (22.6%) and there were no visible retinal breaks in 30 of the eyes (28.3%). The failure to identify a retinal break during surgery was associated with a lower rate of retinal reattachment, worse final visual acuity, and a higher rate of re-operation ( $p = 0.002$ ,  $p = 0.02$ , and  $p = 0.002$ , respectively). The location of the identified retinal break was more common in the superotemporal quadrant than in the other quadrants.

**Conclusions:** The inability to identify a retinal break during surgery was associated with a poor final outcome. Other factors were less important for the functional and anatomic success in patients with pseudophakic RDs.

**Key Words:** Phacoemulsification, Pseudophakia, Rhegmatogenous retinal detachment

With the increase in the number of cataract operations, pseudophakic retinal detachment (RD) will comprise an increasing proportion of rhegmatogenous RDs in the coming years [1-3]. The development of phacoemulsification and the intraocular lens as a technique for cataract removal has replaced cataract surgery as it is much less intrusive and a more curative procedure [4]. However, most studies pertaining to patients with pseudophakic RDs were reported long ago and they only included intra- or extra-capsular cataract extraction or cases in which the iris or anterior chamber lenses were fixated [5]. The surgical techniques for RD have continued to develop and RD after surgery has more favorable outcomes

with the development of new instruments. In this study, we report the clinical features and surgical outcomes for primary rhegmatogenous RD in patients with pseudophakia after phacoemulsification.

## Materials and Methods

This was a retrospective study that included consecutive cases undergoing surgery for primary rhegmatogenous RD in patients with pseudophakia after phacoemulsification between the dates of January 2000 and June 2008 that had a follow-up duration of at least 12 months. Eyes were excluded from the study if they had non-primary rhegmatogenous RDs, such as from trauma, RDs associated with coloboma, uveitis, or glaucoma, RDs with a macular hole, or had an axial length  $>26$  mm. Patients were excluded from the study if they had atopic dermatitis or if they had a pre-operative proliferative vitreoretinopathy grade C-1 or higher according to the Retina Society Classification [6].

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The baseline data (gender, age, laterality, intraocular lens [IOL] status, best-corrected visual acuity, and intraocular pressure [IOP]) and the intra-operative findings (operative procedure, macular status, lens capsule status, extension of the RD, number of retinal breaks, and location of retinal breaks) were recorded. The visual acuity was recorded in Snellen units and converted to logarithm of the minimum angle of resolution (logMAR) units for statistical analysis. Each patient underwent a slit lamp biomicroscopy, fundus photography, and Goldmann’s three mirror lens in order to identify retinal breaks at baseline. The duration of time from when the cataract surgery took place to the time at which the RD was diagnosed was recorded as the time of RD evolution. Scleral buckling (SB) or 20-gauge pars plana vitrectomy was performed according to the surgeon’s preference. Vitrectomy combined with SB was considered for total RD, and multiple or unidentified retinal breaks.

Statistical analyses were performed using statistical software (SPSS ver. 11.0; SPSS Inc., Chicago, IL, USA). Univariate and multivariate linear regression analyses were undertaken for the dependent variable in each model. Univariate categorical analysis was performed using the two paired *t*-test, chi-square test, Mann-Whitney *U*-test, or the Fisher exact test, as appropriate. Data were analyzed via a repeated-measures analysis of variance with a Bonferroni correction. Correlation analyses were conducted via Spearman’s correlation. Statistical significance was set at 0.05 (two-sided) for all of the tests.

**Results**

This study comprised 106 eyes of 104 patients (70 males and 34 females), with a mean age of 55.4 ± 16.7 years (range, 20 to 85 years). The time between onset of RD (defined by the onset of early signs and symptoms, including flashes and

floaters) and surgery was 15.4 ± 34.7 days (range, 4 to 75 days). The time of RD evolution was 35.8 ± 26.9 months (range, 1 to 120 months). The mean duration of follow-up was 18.0 ± 8.7 months (range, 12 to 60 months). Ten of the eyes (9.4%) have had previous ocular surgery (an anterior vitrectomy in six eyes, a penetrating keratoplasty in one eye and refractive surgery in two of the eyes).

Cataract surgery was performed on 16 eyes in our hospital and surgery was performed on the remaining 90 eyes in another hospital. There were no sclera tunnel incisions and no iris-fixated or anterior chamber lenses. A superior incision was made in four of the eyes (3.8%) and 60 eyes (56.5%) had a temporal incision. The incisional approach for 42 of these eyes (39.6%) was ill-defined. The location of the IOL was in the ciliary sulcus in six eyes, scleral fixation in four eyes, and in the bag in the remaining eyes.

Univariate analysis did not show any statistically significant differences between the baseline visual acuity and the following variables: gender; age; laterality; the time of RD evolution; the duration of symptoms; lower IOP; IOL location; lens capsule status; identification of a retinal break; number of retinal breaks; location of retinal breaks; and type of surgery. A smaller extension of the RD and a macula-on RD had better baseline visual acuity (*p* = 0.005, *p* = 0.002).

**Surgical management**

In the SB group (14 eyes), ten of the eyes had segmental SB and four of the eyes had encircling with segmental SB. A primary vitrectomy was performed in 56 eyes (52.8%) and a vitrectomy with SB was performed in 36 eyes (33.9%) (Table 1). Intraocular gas tamponade was used for all 92 eyes that underwent vitrectomy (20% SF<sub>6</sub> [40 eyes] and 14% C<sub>3</sub>F<sub>8</sub> [52 eyes]). There were no cases in which air or silicone oil tamponade

**Table 1.** The operative procedure and intra-operative findings in 106 pseudophakic eyes with primary rhegmatogenous retinal detachment after phacoemulsification

Factors	No. of eyes (%)
<b>Operation</b>	
Primary vitrectomy	56 (52.8)
Scleral buckling	14 (13.2)
Vitrectomy + scleral buckling	36 (33.9)
<b>Macular status</b>	
On:off	48 (45.2):58 (54.8)
<b>Lens capsule status</b>	
Defect:intact	28 (26.4):78 (73.6)
<b>Extension of retinal detachment</b>	
<1Q:1-2Q:2-3Q:3-4Q	16 (15.1):42 (39.6):20 (18.9):28 (26.4)
<b>No. of retinal breaks</b>	
1:2:3<:with retinal dialysis	50 (47.2):14 (13.2):8 (7.5):4 (7.5)
Unidentified break	30 (28.3)
<b>Position of retinal break</b>	
Superotemporal Q:superonasal Q:inferotemporal Q:inferonasal Q:perimacular area	32 (42.1):16 (21.0):14 (18.4):12 (15.7):2 (2.6)

Q = quadrant.

nade was used during the primary surgery. Perfluorocarbon was used in 48 of the 92 eyes during the vitrectomy.

Post-operatively, 24 eyes (22.6%) underwent re-operation due to recurrence of RD. Ten eyes had repeat vitrectomies, eight eyes had vitrectomies with silicone oil tamponade, and six of the eyes had fluid-gas exchange. Silicone oil was used for the long-standing tamponade according to the surgeon's preference and the removal of the silicone oil was performed in four of the eyes one year from the date of the last surgery. Three of the four eyes that underwent silicone oil removal achieved final and complete retinal attachment. The remaining eye that had the silicone oil removal received a silicone-oil re-injection due to a recurrence of the RD. At the time of the last follow-up, silicone oil tamponade was continued in eight eyes including the cases that received further silicone oil injections. There were no significant silicone oil-related complications in the silicone oil-filled eyes throughout the follow-up period except for controlled IOP elevation. In addition, one eye with permanent silicone tamponade and one eye receiving further fluid-gas exchange presented complete retinal attachment at the time of the patient's last follow-up. Thus, among the 24 eyes that were re-operated on, five of them (20.8%) achieved retinal reattachment. The final visual acuities of the recurrent RD cases were  $1.80 \pm 0.25$  (range, 0 to 3), which were worse than the  $0.63 \pm 0.55$  of the eyes without recurrence ( $p = 0.045$ ) (Table 2).

The major complications after surgery were macular pucker, which occurred in four of the eyes, and IOL dislocation, which occurred in another four eyes. Visually significant macular pucker was diagnosed approximately 3 to 6 months after surgery in three of the eyes and all of these eyes underwent a subsequent removal of the epiretinal membrane. Four eyes began to develop IOL dislocation, and thus two of these eyes underwent one or two point IOL fixation and the other two eyes underwent IOL repositioning. There were no other major complications.

**Table 2.** Characteristics of eyes with recurrence of retinal detachment after the primary operation

Variables	Eyes undergoing re-operation (n = 24)
Initial visual acuity*	$1.36 \pm 1.27$
Primary operation	
Vitrectomy	4
Scleral buckling	2
Vitrectomy + scleral buckling	18
Second operation	
Vitrectomy + gas tamponade	10
Vitrectomy + silicone oil tamponade	8
Fluid-gas exchange	6
Final visual acuity	$1.80 \pm 0.25$
Complete retinal attachment at last follow-up	5 (20.8%)

\*Logarithm of the minimum angle of resolution best-corrected visual acuity.

## Intra-operative findings

Intra-operatively, the macula was already detached in 58 of the eyes (54.7%). Twenty-eight eyes (26.4%) had a defect in the posterior lens capsule and the remaining 78 eyes had an intact posterior lens capsule. During surgery, a retinal break was not identified in 30 of the eyes (28.3%), even though the surgeon performed a careful examination with 360 indentations.

In regards to the number of retinal breaks that occurred in 76 eyes, 50 of the eyes had on break, 14 eyes had two breaks, eight of the eyes had more than three breaks present, and four eyes presented with retinal dialysis <1 quadrant. Retinal breaks were predominately small horse-shoe tears that were often located anterior to the equator, near the ora serrata. Breaks were found in the superotemporal quadrant in 32 of the eyes, the superonasal quadrant in 16 of the eyes, the inferotemporal quadrant in 14 of the eyes, the inferonasal quadrant in 12 of the eyes, and the perimacular area in two of the eyes (Table 1).

## Anatomical results

The retina was attached in 82 of the eyes (77.3%) after primary surgery and in 87 of the eyes (82.1%) at the time of the last follow-up. Multivariate analysis did not show any statistically significant differences between anatomic success and the following pre-operative variables: baseline visual acuity; gender; age; laterality; presence of systemic complications; the time of RD evolution; the time between the onset of RD and surgery; an intact lens capsule; the location of the intraocular lens; and a lower IOP. An inability to identify retinal breaks was associated with a significantly lower anatomic success rate ( $p = 0.002$ ). The other analyzed intra-operative factors and surgical factors were not associated with different reattachment rates (Table 3).

In eyes with unidentified retinal breaks, the retinal attachment rate after the primary surgery was performed was 15 (50%) out of 30 eyes. Fifteen (50%) of 30 eyes had a re-operation and tiny retinal breaks were identified in three eyes during the re-operation. The final retinal attachment rate was 20 (66.6%) of 30 eyes, which is significantly lower than the eyes with identified breaks ( $p = 0.02$ ) (Table 4).

## Functional results

The final visual acuities (logMAR) were improved from the baseline of  $1.51 \pm 1.14$  (range, 0.1 to 3) to  $0.65 \pm 0.49$  (range, 0 to 3) ( $p < 0.001$ ). There was no correlation between the baseline and the final visual acuity ( $r = 0.128$ ,  $p = 0.463$ ). At the last follow-up, 50 of the eyes (47.1%) had a visual acuity of 20/50 or better and 42 of the 106 eyes (39.6%) achieved a visual acuity of 6 / 18 or better.

Based on multivariate analysis, the characteristics associated with a worse final visual acuity were an inability to

**Table 3.** Multivariate regression analysis of factors for post-operative outcomes in patients with pseudophakia undergoing retinal detachment surgery

Variables	Rate of retinal reattachment	<i>p</i> -value* Rate of reoperation	Final visual acuity
Baseline visual acuity	0.254	0.384	0.058
Intact of lens capsule	0.796	0.540	0.163
The location of intraocular lens	0.852	0.340	0.153
Lower IOP (<10 mmHg)	0.491	0.452	0.020
Macular sparing	0.602	0.425	0.194
Extension of RD	0.733	0.080	0.433
Identification of retinal break	0.002	0.002	0.020
No. of retinal breaks	0.468	0.263	0.563
Location of retinal break	0.192	0.406	0.492
Type of operation	0.796	0.364	0.154
Recurrence after primary surgery	0.060	0.000	0.048

Excluded variables: gender, age, laterality, presence of systemic complications, the time of retinal detachment evolution, the time between onset of retinal detachment and surgery, use of perfluorocarbonate liquid, gas for intraocular tamponade, drainage for retinotomy, and type of implant for encircling bands and/or scleral sponges.

IOP = intraocular pressure; RD = retinal detachment.

\**p*-value, multivariate linear regression analysis.

**Table 4.** Characteristics of eyes with unidentified retinal breaks during the primary operation

Variables	Eyes with unidentified retinal breaks (n = 30)
Initial visual acuity*	1.25 ± 0.45
Macular status on:off	5:25
Extension of retinal detachment <1Q:1-2Q:2-3Q:3-4Q	0:1:9:20
Initial operation	
Vitrectomy combined scleral buckling	30
Second operation	
Vitrectomy + gas tamponade	8
Vitrectomy + silicone oil tamponade	7
Retinal attachment after primary surgery	15 (50%)
Retinal attachment at last follow-up	20 (66.6%)
Final visual acuity	1.40 ± 1.32

Q = quadrant.

\*Logarithm of the minimum angle of resolution best-corrected visual acuity.

identify retinal breaks, a lower IOP, and recurrence after the primary surgery (Table 3). The operative procedure, including the use of perfluorocarbon liquid, gas for intraocular tamponade, retinotomy for drainage, and type of implant used for encircling bands and/or scleral sponges, did not influence the final visual acuity.

Eyes with unidentified retinal breaks presented larger extension of the RD and a higher rate of pre-operative macula-off RD and the final visual acuity in the eyes with unidentified retinal breaks was worse than in the eyes with identified breaks (1.40 ± 1.32 and 0.73 ± 0.75, respectively; *p* = 0.02) (Table 4). In addition, a lower IOP was observed in 10 of the eyes (9.4%) pre-operatively and a lower IOP resulted in worse final visual acuity when compared to the eyes with an IOP in

the normal range (2.50 ± 0.83 and 1.39 ± 1.12, respectively; *p* = 0.02).

## Discussion

Surgical techniques in patients with pseudophakia after phacoemulsification have rapidly advanced in parallel with the development of better equipment. Previous studies involving patients with pseudophakic RDs have been reported before the era of phacoemulsification with micro-corneal incisions [5]. Thus, the reported surgical outcomes of patients with pseudophakic RDs may be improved upon. This retrospective study involved 106 patients with a primary of idiopathic pseudophakic rhegmatogenous RDs who had surgery by one surgeon over an 8-year period. Data relating to 21 pre-, intra-, and post-operative variables were studied.

The final reattachment rate was 82%, which is slightly greater than what previous studies have reported [6-8]. Previous reports have identified the following negative prognostic factors for reattachment after surgery: age >65 years; poor pre-operative vision; RD involving >3 quadrants; macula-off RDs; a lower IOP; inability to identify a retinal break; longer duration of symptoms; and grades C or D of proliferative vitreoretinopathy [6-13]. In the current study, only an inability to identify a retinal break was significantly associated with lower reattachment success. Proliferative vitreoretinopathy grade C or D was not analyzed due to the exclusion criteria used in this study.

A critical step in successful RD surgery is to locate and seal all of the causative retinal breaks. However, in pseudophakia, tiny breaks, poor mydriasis, cortical remnants, capsular opacification, glare or pitting from the intraocular lens implant, and corneal or vitreous opacities may make identification difficult, especially since anterior breaks commonly occur in

pseudophakic and aphakic RDs. Thus, a retinal break is not identified in 9% to 20% of pseudophakic RDs, which would be a risk factor for surgical failure [11-17]. Cases with unidentified retinal breaks have traditionally been managed using SB and broad application cryopexy, which has a reported primary success rate of 53% to 70% [18,19]. We think an internal approach with vitrectomy offers some advantages that might result in the detection of these breaks. Scleral external indentation together with endoillumination and magnification during the vitrectomy may help locate previously undetected breaks [20]. Also during vitrectomy, breaks can be searched for with an aspirating instrument or by using perfluorocarbon liquids that may identify a stream of fluid that is exiting the subretinal space via the hole [21]. We performed vitrectomy combined with either segmental or encircled SB in all 30 of the eyes that had unidentified breaks with a final anatomical success rate of 66%. Previous case series have reported that the anatomical success rate of vitrectomy when combined with SB was superior to SB alone [19,22-24]. In contrast, some authors have found that vitrectomy was not of additional value in terms of a better success rate [25,26]. A larger prospective randomized trial is needed in order to determine an accurate surgical method for RDs with unidentified breaks.

As mentioned above, we indicated that identifying a retinal break is an important factor for both anatomic and functional outcomes for pseudophakic RD repair. The area of the retinal break was most frequently found in the superotemporal area. One of the most important changes in the posterior segment after cataract surgery is anomalous posterior vitreous detachment, which would induce a retinal tear [27-29]. Although the reasons for an increased incidence of posterior vitreous detachment after cataract surgery remain unknown, it is thought that the anterior movements of the vitreous during surgery might play a role in the development of posterior vitreous detachment [30,31]. We believe that it is possible that the insertion of an instrument during surgery via the main incision could produce vitreous movement and the subsequent vitreous traction may then result. In the current cases, the main incision for the cataract surgery was via a temporal approach and the eyes with an undetermined incisional approach may have undergone a temporal corneal approach. Although it is not clear why retinal breaks occur more frequently in the superiotemporal quadrant, meticulous examinations of the superiotemporal area during surgery are important to identify these retinal breaks.

It has been reported that the previously mentioned negative prognostic variables for anatomical outcomes are also associated with worse visual outcomes [5-13]. Among these variables, a lower IOP, unidentified retinal breaks, and the recurrence after primary surgery were associated with poorer final visual acuity in the current study. A lower IOP was related to a poor final visual acuity and this relationship has previously been reported [32-35]. This finding might reflect a more bullous RD, a pre-operative choroidal detachment or

surgical difficulty. These factors are related with retinal glial cell up-regulation and retinal pigment epithelium dispersion, which resulted in a delayed morphologic recovery including that of the photoreceptor reposition of the reattached retina [36,37].

It is thought that the visual results of pseudophakic detachment depend on the pre-operative macula status and approximately 80% of pseudophakic RD typically presents with the macula detached [12-14]. However, 45% of the RDs in this study were macula-on at the time of surgery. We showed that the macula-off RD is not more highly related to poorer outcome, in spite of the worse baseline visual acuity, and that pseudophakic detachment is not present more often with the macula detached. We believe that patients tend to have accurate and frequent eye examinations, which would lead to an earlier diagnosis before there is macular involvement and this is reflected in our final results.

In addition, both vitreous loss at the time of the cataract surgery and Nd:YAG posterior capsulotomy appear to increase the risk of RD when performed after cataract surgery [14]. A defect in the lens capsule may be related to more vitreous involvement and reflect more complex intraocular manipulations. We investigated the defects in the lens capsules and the IOL position, but defects in the lens capsules and the IOL position were not prognostic factors for post-operative outcomes.

Although earlier reports suggested that vitrectomy without SB, the use of perfluorocarbon liquids during vitrectomy, and the performance of a drainage retinotomy were associated with the existence of more complex RDs, and consequently poorer functional results [38-40], more recent reports have shown that the surgical outcomes appear to be independent of the surgical procedure that is chosen to resolve the RD [41,42]. In the current study, the type of surgical procedure (vitrectomy or SB) and intra-operative factors were not associated with the post-operative results. Thus, these results suggest that surgical outcomes are independent of the methods or complexity of the surgery.

This study has some limitations. This retrospective series had a relatively small sample size within one retinal center and the surgical procedures that were used were heterogeneous. We did not describe the size of the retinal breaks, vitreous status, or the intra-operative events that occurred during the cataract surgery. A large, multicenter study is needed to evaluate the precise prognostic factors for surgical outcomes in patients with pseudophakic RDs. However, the surgical treatment of all the patients in this study was performed by one experienced retinal specialist. We believe this report is of importance to clinicians who perform surgery for RDs in pseudophakic patients.

Consequently, retinal breaks that were not identified during surgery were related to poor anatomic and functional outcomes. Clinicians should perform careful examinations in the superotemporal quadrant to find retinal breaks when visible breaks are not identified. A poorer pre-operative state, including a worse pre-operative visual acuity, the macula-off RD, a

larger area involved in the RD, and multiple breaks was not related to a poorer surgical outcome. Adequate surgery that is performed according to the preference of the surgeon may lead to successful outcomes in patients with pseudophakic RDs.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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