

# Recurrent Retinal Detachment after Pars Plana Vitrectomy for Rhegmatogenous Retinal Detachment

**Yan Fu**

Baoding First Central Hospital

**Yue-ling Zhang**

Baoding First Central Hospital

**Zhaohui Gu** (✉ [490409241@qq.com](mailto:490409241@qq.com))

Baoding First Central Hospital

**Ren-Fei Geng**

Baoding First Central Hospital

**Xin-Yu Yuan**

Baoding First Central Hospital

---

## Research article

**Keywords:** retinal detachment, proliferative vitreoretinopathy, visual outcome, vitrectomy

**Posted Date:** January 17th, 2020

**DOI:** <https://doi.org/10.21203/rs.2.21163/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background** The recurrence of retinal detachment (RD) following rhegmatogenous retinal detachment (RRD) is a relatively common complication that threatens vision and needs further surgery. The purpose of this study is to investigate the risk factors and visual outcomes of recurrent RD following pars plana vitrectomy (PPV) for primary RRD.

**Methods** This was a retrospective follow-up of 343 eyes that underwent initial PPV surgery for primary RRD. Patients were divided into a recurrence group and a reattachment group. The main outcome measures included the causative factors, visual outcomes of RD recurrence, and the perioperative factors most affecting the recurrence of RD.

**Results** After retinal reattachment, we observed recurrence of RD after PPV for primary RRD in 42 out of 343 eyes (12.2%) during the follow-up period. Most recurrence (69%) occurred within 6 months after surgery. Univariate analysis showed that the primary risk factor significantly associated with recurrent RD was the presence of proliferative vitreoretinopathy (PVR)  $\geq$  Grade C (  $P = 0.003$ ). Logistic regression analysis showed that a PVR  $\geq$  Grade C (odds ratio [OR]: 9.421, 95% confidence interval [CI]: 2.432 - 56.39;  $P = 0.020$ ) was a significant predictor for the development of recurrent RD. The recurrence of RD resulted in a significant decline in best-corrected visual acuity (BCVA) at the last follow-up visit compared with the reattachment group (  $P = 0.000$ ). Eyes with PVR prior to primary surgery or at the diagnosis of re-detachment showed a worse final BCVA.

**Conclusions** The presence of PVR  $\geq$  Grade C was the predominant risk factor for the recurrence of RD. PVR prior to primary surgery, or at the diagnosis of re-detachment, limited the recovery of final visual acuity.

## Background

The recurrence of retinal detachment (RD) following rhegmatogenous retinal detachment (RRD) is a relatively common complication that threatens vision and requires a second round of surgery, or even multiple rounds of surgery. The advent of wide-angle viewing systems and improvements in vitreoretinal surgical equipment and techniques have led to the final anatomical success rates of RRD repair reaching 93%[1]. However, in some cases, reparative surgery still fails. Previous studies have reported that a range of risk factors are associated with the recurrence of detachment, including: proliferative vitreoretinopathy (PVR)[2], inferior breaks[3], the duration of symptoms[4], and the extent of detachment[5]. However, little is known about the relationships between specific risk factors and RRD. There is also some degree of uncertainty with regards to the causes, risk factors, and outcomes of patients with recurrent RD. Understanding the risk factors associated with recurrent RD will help us to predict and prevent this complication. Therefore, the aim of this study was to conduct a retrospective review of a large cohort of patients who received an initial round of pars plana vitrectomy (PPV) surgery for primary RRD and to investigate the causes, risk factors, and visual outcomes, associated with the recurrence of RD.

# Methods

## Study design

This was a retrospective, long-term, follow-up study. All aspects of the study were conducted in accordance with the Declaration of Helsinki. Informed consent was provided by all of the patients involved using a form approved by the Institutional Review Board (number: 2019042). The study included 343 consecutive eyes from 332 patients between 1 January 2015 and 1 January 2018 at the Department of Ophthalmology, Baoding First Central Hospital, China. Patients were recruited if they had received an initial vitrectomy surgery for primary RRD, had a postoperative follow-up period exceeding 12 months, and were 18 years-of-age or older. Patients were excluded if they had received previous vitreoretinal surgery, had preexisting macular pathological features (e.g., macular hole, age-related macular degeneration, or macular edema), or if they had uveitis, retinal vascular diseases (e.g., diabetic retinopathy or vascular occlusive diseases) or retinal dystrophies.

The main outcome measures included the causative factors and visual outcomes of RDD, and the most predominant perioperative factors associated with the recurrence of RD. For each patient, both eyes were examined. Evaluations included a complete ophthalmological examination, including best-corrected visual acuity (BCVA), intraocular pressure (IOP), slit-lamp biomicroscopy, and optical coherence tomography (OCT) scanning. Images were captured after mydriatic drops had been placed in each eye. In order to evaluate the influence of various factors on the recurrence of retinal detachment, we divided the patients into a recurrence group and a reattachment group.

## Data collection

We collected a range of demographic and clinical data, including age, sex, medical and ophthalmic history, previous ophthalmic operations, refractive error (high myopia was defined as a preoperative spherical equivalent of  $-6D$  or more), lens status, macular status (on or off, as determined by preoperative OCT), duration and extent of detachment, number of breaks, presence of posterior vitreous detachment (PVD), proliferative vitreoretinopathy (PVR) grade (grading as per Retina Society PVR Classification, 1983[6]), presence of choroidal detachment, and BCVA at baseline and at follow-up. During surgery, whether or not retinectomy was performed, the procedures included membrane peeling (epiretinal or subretinal), quadrants of endolaser photocoagulation, use of perfluorocarbon liquid, and combined cataract surgery.

## Surgical technique

All surgeries were conducted by two experienced retinal surgeons (ZHG and YLZ). Patients underwent elective surgery after a complete physical examination. The time from definite diagnosis to surgery

ranged from 2 to 4 days. We performed a standardized 3-port vitrectomy using a 23- or 25-gauge microincision system. First, we carried out a vitrectomy to release vitreous traction around the retinal breaks and degenerations, and shaved the peripheral vitreous body by scleral indentation. Then, we performed internal drainage of the subretinal fluid to flatten the retina. Endolaser photocoagulation was performed around the breaks and degeneration areas. Then, we carried out a total fluid/gas exchange. Silicone oil was applied to all eyes because commercialized medical gas is not available in mainland China. Patients injected with silicone oil were made to adopt and maintain a facedown position during the first three postoperative weeks. The silicone oil was removed 3 months later after RRD repair.

## Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences version 25 (IBM Corp., Armonk, NY, USA). All data were tested for normality prior to analysis using the Shapiro-Wilk test. Qualitative parameters are presented as frequencies and percentages, while quantitative parameters are presented as means and standard deviations. BCVA data were converted to a logarithm of minimal angle of resolution (logMAR) prior to statistical analysis. We allocated logMAR values for counting fingers (logMAR = 2.5), hand movements (logMAR = 2.7), and light perception (logMAR = 3.0). Differences in categorical data were analyzed using the chi-square test. Paired t-tests were used to compare visual function between different time points. Multivariate regression analyses were performed to identify potentially confounding parameters. A *p*-value less than 0.05 was considered to be statistically significant.

## Results

### General characteristics

A total of 332 patients (343 eyes) were included in this study. The mean age of the patients was  $49.2 \pm 10.4$  years (range: 18 to 78 years). The mean duration of follow-up was  $18.4 \pm 9.1$  months (range: 12 to 43 months). The mean time between symptom onset and surgery was  $12.5 \text{ days} \pm 7.4 \text{ days}$  (range: 3 to 110 days). In total, 321 (93.6%) eyes were phakic and 22 (6.4%) eyes were pseudophakic. Retinal detachment was macula-on in 134 eyes (39.1%) and macula-off in 209 eyes (60.9%). Retinectomy was conducted in 38 eyes (11.1%). Following retinal reattachment, the recurrence of RD after PPV for primary RRD was observed in 42 of the 343 eyes (12.2%) during the follow-up period. The mean time from the recurrence of RD to initial RRD repair was  $5.3 \text{ months} \pm 2.7 \text{ months}$  (range: 2 to 13

months). Twenty-nine cases (69%) were diagnosed with recurrent RD within 6 months of the initial PPV for RRD.

### **The effect of various perioperative factors on the recurrence of RD**

In order to compare the effects of various factors on the recurrence of RD, we divided our patient population into a recurrence group and reattachment group. A comparison of the perioperative characteristics of the two groups of patients are shown in Table 1. The two groups showed similar perioperative characteristics, except for the presence of PVR  $\geq$  Grade C. Univariate analysis demonstrated that the presence of PVR  $\geq$  Grade C was a risk factor that was significantly associated ( $P = 0.003$ ) with the recurrence of RD. Both groups of patients showed a similar distribution of age, gender, lens status, number of breaks, duration of detachment, extent of retinal detachment, high myopia, macula status, PVD, giant retinal tears, choroidal detachment, use of perfluorocarbon liquid, retinectomy, and combined cataract surgery. The BCVA did not differ statistically between the groups at baseline ( $P = 0.342$ ). We also performed logistic regression analysis in a step-by-step manner to evaluate confounding variables. Logistic regression revealed that PVR  $\geq$  Grade C (odds ratio [OR]: 9.421; 95% confidence interval [CI]: 2.432 - 56.39,  $P=0.020$ ) was a significant predictor for the recurrence of RD.

**Table 1.** A comparison of perioperative characteristics between the recurrence group and reattachment group

Parameter	Overall (n = 343 eyes)	Recurrence group (n = 42 eyes)	Reattachment group (n = 301 eyes)	<i>P</i> - <i>value</i>
Gender, n (%)				
Male	172 (50.1)	20 (47.6)	152 (50.5)	0.727 <sup>a</sup>
Female	171 (49.9)	22 (52.4)	149 (49.5)	
Age, mean ± SD	49.2 ± 10.4	49.9 ± 11.7	48.7 ± 11.3	0.268 <sup>b</sup>
Laterality, n (%)				
Right eye	184 (53.6)	23 (54.8)	161 (53.5)	0.877 <sup>a</sup>
Left eye	159 (46.4)	19 (45.2)	140 (46.5)	
Lens status, n (%)				
Phakic	321 (93.6)	38 (90.5)	283 (94.0)	0.38 <sup>a</sup>
Pseudophakic	22 (6.4)	4 (9.5)	18 (6.0)	
Detachment duration (days), mean ± SD	12.5 ± 7.4	12.1 ± 9.1	12.9 ± 8.5	0.607 <sup>b</sup>
Quadrants of RRD, mean ± SD	2.8 ± 0.79	2.7 ± 0.69	2.8 ± 0.61	0.478 <sup>b</sup>
High myopia, n (%)	24 (7.0)	3 (7.1)	21 (6.9)	0.968 <sup>a</sup>
BCVA (logMAR) at baseline, mean ± SD	1.07 ± 0.51	1.04 ± 0.59	1.1 ± 0.53	0.342 <sup>b</sup>
Macular status				
On	134 (39.1)	18 (42.9)	116 (38.5)	0.591 <sup>a</sup>
Off	209 (60.9)	24 (57.1)	185 (61.5)	
PVD (%)	238 (69.4)	29 (69.0)	209 (69.4)	0.959 <sup>a</sup>
Giant retinal tears, n (%)	13 (3.8)	2 (4.8)	11 (3.6)	0.725 <sup>a</sup>
Number of breaks, n (%)				
Single breaks	243 (70.8)	31 (73.8)	212 (70.4)	0.652 <sup>a</sup>
Multiple breaks	100 (29.2)	11 (26.2)	89 (29.6)	
Choroidal detachment	23 (6.7)	3 (7.1)	20 (6.6)	0.904 <sup>a</sup>
PVR ≥ Grade C, n (%)	31 (9.0)	9 (21.4)	22 (7.3)	<b>0.003<sup>a</sup></b>

Retinectomy, n (%)	38 (11.1)	6 (14.3)	32 (10.6)	0.480 <sup>a</sup>
Perfluorocarbon liquid, n (%)	56 (16.3)	8 (19.0)	48 (15.9)	0.611 <sup>a</sup>
Cataract surgery, n (%)	28 (8.2)	4 (9.5)	24 (8.0)	0.731 <sup>a</sup>

Abbreviations: BCVA: best-corrected visual acuity; logMAR: logarithm of minimal angle of resolution; PVD: posterior vitreous detachment; RRD: rhegmatogenous retinal detachment; SD: standard deviation; PVR: proliferative vitreoretinopathy

<sup>a</sup>*P* values according to chi-square tests.

<sup>b</sup>*P* values according to t-tests.

*P* values that are statistically significant (<0.05) are given in bold.

## Causes and visual outcomes of patients with recurrent RD

We found that PVR was the main cause of RD recurrence. Overall 25 eyes (59.5%) were shown to have posterior PVR, 6 eyes (14.3%) had anterior PVR, and 3 eyes (7.1%) had a combination of anterior and posterior PVR. In other cases of RD, 5 eyes (11.9%) showed missed and/or new retinal breaks, 2 cases (4.8%) were caused by reopening of the primary retinal breaks, and one eye (2.3%) had a macular hole. In 34 cases, we performed another vitrectomy and used silicone oil to repair RD. A further 8 cases received scleral buckling (SB) surgery.

Silicone oil is usually removed 3 months after primary RRD repair if the retina was attached. In our present series, 12 (28.6%) cases showed re-detachment while the silicone oil was still retained in the eye. Of these 12 patients, 5 patients presented with an inferior RD, which was treated with a second round of SB surgery. Six cases presented with partial RD caused by PVR and underwent a second vitrectomy and oil procedure, while 3 cases underwent retinectomy. One case developed recurrent RD because of a new retinal break; this condition was treated with vitrectomy and oil. Anatomic reattachment was achieved in

all of these patients. Thirty cases (71.4%) developed recurrent RD following the removal of the silicone oil. The mean duration of time to recurrent RD following the removal of silicone oil removal was  $2.9 \pm 1.2$  months. With regards to the eyes that developed recurrent RD after the removal of silicone oil, 3 eyes achieved anatomical reattachment following the SB procedure, while a further 24 eyes underwent a second PPV and endolaser photocoagulation. If necessary, we also performed membrane peeling (epiretinal or subretinal), internal limiting membrane peeling, vitrectomy, and silicone oil endotamponade.

Of the 42 patients in which primary PPV failed, we successfully attached the retina in 39 (92.9%) cases during the second round of surgery. Three cases required a third round of surgery. At the final follow-up visit, the retina had successfully reattached in 41 cases. One of these patients had silicone oil and tamponade at the final follow-up. In one further case, RD persisted, despite the eye being filled with oil. However, this patient did not wish to undergo further surgery because vision was light conception only.

Recurrent RD resulted in a significant reduction in BCVA at the last follow-up visit when compared with the group of patients without recurrent RD. The mean BCVA at the last follow-up visit was  $0.45 \pm 0.32$  logMAR in the reattachment group, and  $0.71 \pm 0.22$  logMAR in the recurrence group. Visual acuity at final the final follow-up visit was worse in the recurrence group than in the reattachment group ( $P=0.000$ ). Eyes with PVR prior to primary surgery, or those diagnosed with re-detachment, showed a worse BCVA at the last follow-up visit. The mean final LogMAR BCVA was  $0.89 \pm 0.27$  in cases of PVR, whereas the mean final LogMAR BCVA was  $0.63 \pm 0.29$  in eyes without PVR ( $P=0.002$ ).

## Discussion

This study included 343 eyes from 332 patients, and revealed that 42 of the patients (12.2%) who underwent PPV for RRD went on to subsequently experience re-detachment. This result concurred well with the findings of previous studies on primary RRD[7, 8]. Most cases of postoperative re-detachment (69%) were diagnosed within 6 months of the initial surgery for RRD. This result is lower than that reported by previous studies; for example, one study reported that 97.9% of cases with recurrent RD were

diagnosed within 6 months of the initial vitrectomy[9]. This inconsistency may be related to the frequency of follow-up visits. Overall, we found that the rate of total final success was 97.6%; these findings were comparable to those reported by previous studies[10, 11].

Previous studies have reported that a wide variety of risk factors are associated with the recurrence of RD after RRD repair, including proliferative vitreoretinopathy (PVR)[12], inferior breaks[3], the duration of preoperative symptoms until surgery[13], lens status[14], vitreous hemorrhage[15], undetectable retinal tear[16], the extent of detachment[5], high myopia[17] and hypotonia[18], and the presence of multiple breaks[10]. Unlike these previous studies, our present study failed to identify significant differences between the groups of patients with recurrent and reattached RD with regards to age, gender, lens status, the number of breaks, detachment duration, the extent of the retinal detachment, high myopia, macula status, PVD, giant retinal tears, choroidal detachment, the use of perfluorocarbon liquid, retinectomy, and combined cataract surgery. However, we identified that  $PVR \geq$  Grade C was significantly associated with recurrent RD. Logistic regression analysis further showed that  $PVR \geq$  Grade C was a significant independent risk factors for the recurrence of RD. Previous studies have shown that PVR is the most important risk factor in RRD at presentation[15, 19]. However, in the present study, we confirmed that PVR is the best predictive factor for the failure of PPV in RRD.

We analyzed the causes of retinal detachment after vitrectomy and found that PVR is the most predominant reason for the primary failure of attachment surgery. We also found that the main causes of recurrent RD were the development of postoperative PVR and the generation of new retinal breaks. Overall, our data showed that 81.0% of recurrent RD was caused by the development of postoperative PVR, a condition that is also known to be an important cause of new retinal breaks during the postoperative period. Anterior PVR, or posterior PVR, can both lead to the recurrence of RD via tractional mechanisms or a combination of tractional and rhegmatogenous mechanisms[11]. PVR can cause contraction of the peri-retinal cellular membranes, and can therefore cause new retinal breaks, or cause old retinal breaks to re-open; PVR can also cause distortion of the retina, resulting in sequelae that are detrimental to the vision[20].

In this study, we assessed the visual acuity of patients undergoing secondary surgery for re-detachment and found that surgery only resulted in limited improvement in visual acuity. There was a significant deterioration in final visual acuity even if anatomical attachment was successfully achieved. It is noteworthy that the development of PVR led to low visual acuity, irrespective of whether the PVR developed preoperatively or postoperatively. The development of PVR not only affected the success rates of primary surgery, but also caused disruption to retinal function. The presence of PVR is an important reason for reduced final BCVA[21]. Despite the successful final anatomical reattachment, a previous study reported that most patients with primary and secondary PPV, with PVR grades of C and D, had a visual acuity of 20/200, or worse[22].

When patients experienced the recurrence of RD, the most common surgery intervention was secondary PPV. Nevertheless, an additional SB procedure can often be used in cases of inferior re-detachment. In our

present study, we experienced 5 cases with an inferior quadrant re-detachment. These were treated by silicon oil filling and SB. In all 5 cases, reattachment was successful. We found that it was safe to carry out supplementary SB in an eye filled with silicone oil in the presence of inferior retinal breaks.

There were several limitations to our study that need to be considered. First, the retrospective design of this study may have led to recruitment bias and overestimated the incidence of recurrent RD. It is possible that cases with a favorable visual acuity may have been excluded from our study because of the short follow-up period. Second, we only analyzed a relatively small number of patients. Larger-scale, prospective studies are now necessary to confirm our results. Third, other factors are known to affect the loss of vision, such as cataract and glaucoma; these conditions are known to be related to surgery and the use of silicone oil tamponade.

## Conclusions

In summary, we demonstrated that the presence of PVR  $\geq$  Grade C represents a significant independent risk factor for the recurrence of RD. The development of postoperative PVR and the generation of new retinal breaks were the main causes of recurrent RD. The development of PVR, either at initial presentation, or on the diagnosis of re-detachment, led to reduced levels of visual acuity, even after the retina had been completely reattached. In order to avoid the recurrence of postoperative RD, it is important to carefully undertake a comprehensive preoperative examination to avoid the omission of retinal breaks and degeneration. It is also important to select the most appropriate surgical methods to suit different situations. During surgery, it is important to take a delicate approach to operations so that further damage to the retina, such as iatrogenic hiatus and the formation of postoperative PVR, can be avoided. Long-term follow-up is essential following RRD repair. We therefore recommend that surgeons should pay more attention to the recovery of primary retinal breaks.

## List Of Abbreviations

RD: retinal detachment; RRD: rhegmatogenous retinal detachment; PVR: proliferative vitreoretinopathy; PPV: pars plana vitrectomy; BCVA: best-corrected visual acuity; IOP: intraocular pressure; OCT: optical coherence tomography; PVD: posterior vitreous detachment; logMAR: logarithm of minimal angle of resolution;

## Declarations

### Ethics approval and consent to participate

The study was conducted after obtaining the written informed consent from the patients and the ethical clearance from the ethics committee of Baoding First Central Hospital in accordance with the tenets of the Declaration of Helsinki. Ethical approval Reference Number: 2019042.

### Consent for publication

Written informed consents were obtained from the patients for publication of any information contained within the manuscript itself.

### **Availability of data and materials**

The datasets used and/or analyzed during the current study available from the corresponding authors on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

This study was supported by a grant (1941ZF047) from the Baoding science and technology support project, Hebei Province, China. The funding organizations had no role in the study design, conduct of this research, data analysis, decision to publish, or preparation of the manuscript.

### **Authors' contributions**

YF and ZHG contributed to research design, data collection, analysis and interpretation as well as preparation of the manuscript. YLZ contributed to data collection analysis and interpretation. RFG involved in the clinical examinations and and technical support. XYY participated in the collection of the data and interpretation of data. All authors review and approval of the final manuscript.

### **Acknowledgements**

No

## **References**

1. Quiram PA, Gonzales CR, Hu W, Gupta A, Yoshizumi MO, Kreiger AE, Schwartz SD: **Outcomes of vitrectomy with inferior retinectomy in patients with recurrent rhegmatogenous retinal detachments and proliferative vitreoretinopathy.** *Ophthalmology* 2006, **113**(11):2041-2047.
2. Tseng W, Cortez RT, Ramirez G, Stinnett S, Jaffe GJ: **Prevalence and risk factors for proliferative vitreoretinopathy in eyes with rhegmatogenous retinal detachment but no previous vitreoretinal surgery.** *Am J Ophthalmol* 2004, **137**(6):1105-1115.
3. Goto T, Nakagomi T, Iijima H: **A comparison of the anatomic successes of primary vitrectomy for rhegmatogenous retinal detachment with superior and inferior breaks.** *Acta Ophthalmol* 2013, **91**(6):552-556.
4. Enders P, Schick T, Kemper C, Schaub F, Fauser S: **Effect of Symptom Duration until Surgery on First-Year Outcome in Pseudophakic Primary Rhegmatogenous Retinal Detachment.** *Ophthalmologica* 2017, **237**(2):73-77.

5. Heimann H, Zou X, Jandek C, Kellner U, Bechrakis NE, Kreusel KM, Helbig H, Krause L, Schuler A, Bornfeld N *et al*: **Primary vitrectomy for rhegmatogenous retinal detachment: an analysis of 512 cases.** *Graefes Arch Clin Exp Ophthalmol* 2006, **244**(1):69-78.
6. **The classification of retinal detachment with proliferative vitreoretinopathy.** *Ophthalmology* 1983, **90**(2):121-125.
7. Regler R, Sachs HG, Hillenkamp J, Helbig H, Framme C: **Long-term evaluation of anatomic and functional results after complicated retinal detachment treated with pars plana vitrectomy and heavy silicone oil tamponade.** *Klin Monbl Augenheilkd* 2009, **226**(9):707-712.
8. Ozdek S, Yuksel N, Gurelik G, Hasanreisoglu B: **High-density silicone oil as an intraocular tamponade in complex retinal detachments.** *Can J Ophthalmol* 2011, **46**(1):51-55.
9. Lee E, El Housseini Z, Steel DH, Williamson TH: **An analysis of the outcomes for patients with failed primary vitrectomy for rhegmatogenous retinal detachment.** *Graefes Arch Clin Exp Ophthalmol* 2014, **252**(11):1711-1716.
10. Ambiya V, Rani PK, Narayanan R, Balakrishnan D, Chhablani J, Jalali S, Tyagi M, Pappuru RR: **Outcomes of Recurrent Retinal Detachment Surgery following Pars Plana Vitrectomy for Rhegmatogenous Retinal Detachment.** *Semin Ophthalmol* 2018, **33**(5):657-663.
11. Beuste T, Rebollo O, Parrat E, Guigou S, Merite PY, Meyer F, Rouhette H, Lorenzi U, Soler V, Le Piffer AL *et al*: **RECURRENCES OF RETINAL DETACHMENT AFTER RETINECTOMY: Causes and Outcomes.** *Retina* 2019.
12. Adelman RA, Parnes AJ, Michalewska Z, Ducournau D, European Vitreo-Retinal Society Retinal Detachment Study G: **Clinical variables associated with failure of retinal detachment repair: the European vitreo-retinal society retinal detachment study report number 4.** *Ophthalmology* 2014, **121**(9):1715-1719.
13. Uzel MM, Citirik M, Ilhan C, Tekin K: **The impact of duration on the recurrence of rhegmatogenous retinal detachment: optimal cutoff value.** *Int Ophthalmol* 2018.
14. Caiado RR, Magalhaes O, Jr., Badaro E, Maia A, Novais EA, Stefanini FR, Navarro RM, Arevalo JF, Wu L, Moraes N *et al*: **Effect of lens status in the surgical success of 23-gauge primary vitrectomy for the management of rhegmatogenous retinal detachment: the Pan American Collaborative Retina Study (PACORES) group results.** *Retina* 2015, **35**(2):326-333.
15. Wickham L, Bunce C, Wong D, Charteris DG: **Retinal detachment repair by vitrectomy: simplified formulae to estimate the risk of failure.** *Br J Ophthalmol* 2011, **95**(9):1239-1244.
16. Pournaras CJ, Kapetanios AD: **Primary vitrectomy for pseudophakic retinal detachment: a prospective non-randomized study.** *Eur J Ophthalmol* 2003, **13**(3):298-306.
17. He Y, Zeng S, Zhang Y, Zhang J: **Risk Factors for Retinal Redetachment After Silicone Oil Removal: A Systematic Review and Meta-Analysis.** *Ophthalmic Surg Lasers Imaging Retina* 2018, **49**(6):416-424.
18. La Heij EC, Hendrikse F, Kessels AG: **Results and complications of temporary silicone oil tamponade in patients with complicated retinal detachments.** *Retina* 2001, **21**(2):107-114.

19. Enders P, Schick T, Schaub F, Kemper C, Fauser S: **Risk of Multiple Recurring Retinal Detachment after Primary Rhegmatogenous Retinal Detachment Repair.** *Retina* 2017, **37**(5):930-935.
20. Sethi CS, Lewis GP, Fisher SK, Leitner WP, Mann DL, Luthert PJ, Charteris DG: **Glial remodeling and neural plasticity in human retinal detachment with proliferative vitreoretinopathy.** *Invest Ophthalmol Vis Sci* 2005, **46**(1):329-342.
21. de Silva DJ, Kwan A, Bunce C, Bainbridge J: **Predicting visual outcome following retinectomy for retinal detachment.** *Br J Ophthalmol* 2008, **92**(7):954-958.
22. Uney GO, Acar MA, Unlu N, Hazirolan D, Yalniz-Akkaya Z, Ornek F: **Pars plana vitrectomy with silicone oil tamponade in failed scleral buckle surgery.** *Can J Ophthalmol* 2016, **51**(5):331-335.