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ORIGINAL ARTICLE

Evaluation of the factors affecting visual outcome after successful pars plana vitrectomy surgery for rhegmatogenous retinal detachment

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Abstract

Purpose: The objective of the study was to evaluate the factors affecting visual prognosis and to analyze optical coherence tomography findings after successful pars plana vitrectomy (PPV) surgery for rhegmatogenous retinal detachment (RRD).

Methods: Forty-one eyes of 41 patients who underwent PPV for RRD for the 1st time between December 2010 and July 2013 were included in the study with a retrospective design. Patients were divided into two groups according to visual acuity: Group 1 consisted of 24 patients with improved final best corrected visual acuity (BCVA) after post-operative 6th month; Group 2 consisted of a total of 17 patients: 14 patients with stable final BCVA and 3 patients with deteriorated final BCVA after the post-operative 6th month. Correlation between preoperative and postoperative variables was assessed.

Results: The mean follow-up period was 16.93±7.5 (range, 7–36) months. While 26 (63.4%) patients had macula-off RRD, 15 (36.6%) patients had macula-on RRD. Pre-operative BCVA ($p<0.001$) and post-operative BCVA ($p=0.002$) was significantly better in eyes with macula-on RRD. Pre-operative and post-operative BCVA were found to have positive correlation ($p<0.001$, $r=0.58$). The number of eyes with intact photoreceptor inner segment/outer segment (IS/OS) junction, disrupted IS/OS junction, foveal epiretinal membrane (ERM), and parafoveal ERM was 8 (33.3%), 2 (8.3%), 1 (4.2%), and 13 (54.2%) in Group 1, while it was 2 (11.8%), 3 (17.6%), 2 (11.8%), and 10 (58.8%) in Group 2, respectively.

Conclusion: Pre-operative BCVA and absence of macular detachment are important prognostic factors in patients with RRD.

Keywords: Optical coherence tomography; pars plana vitrectomy; rhegmatogenous retinal detachment.

Rhegmatogenous retinal detachment (RRD) is a severe ophthalmological emergency that requires early surgical intervention and results in permanent vision loss in case of delayed treatment. Pars plana vitrectomy (PPV) is a highly effective and widely accepted surgical method in the treatment of this retinal disorder.[1]

Reduced post-operative visual acuity or delay in visual recovery is an important problem despite anatomically suc-

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cessful RRD surgeries. Many pre-operative factors such as preoperative best corrected visual acuity (BCVA), presence of macular detachment, duration of macular detachment, the height of macular detachment, and post-operative persistent subretinal fluid, cystoid macular edema, ERM, retinal pigment epithelial cell migration, macular hole, myopic shift, or cataract have been associated with poorer visual outcome after surgery in the previous studies.[2–4]

Optical coherence tomography (OCT) provides valuable data in cases with subtle changes in the foveal structure, which may cause visual symptoms and make it difficult to identify during standard clinical examinations such as slit-lamp biomicroscopy or binocular indirect ophthalmoscopy. Advances in technology of OCT facilitate improved visualization of the intraretinal microstructures and help identification of pathologic changes.[5]

In this study, we aimed to evaluate the clinical factors affecting visual prognosis and analyse OCT findings after successful PPV surgery for primary RRD.

Materials and Methods

Forty-one eyes of 41 patients who underwent PPV for RRD between December 2010 and July 2013 were included in the study with a retrospective design. Possible complications of surgery were explained to all patients, and informed consent forms were obtained prior to surgery. The study was organized with the approval of Akdeniz University Faculty of Medicine Hospital Ethics Committee (date: 27/02/2014, decision no: 129) in accordance with the Helsinki Declaration.

Inclusion criteria were as follows: (1) Successfully repaired primary RRD by a single, uncomplicated PPV, (2) duration of follow-up more than 6 months in the postoperative period, (3) in patients with silicone endotamponade, duration of follow-up more than 6 months after silicone extraction.

Exclusion criteria were as follows: (1) traumatic RRD, (2) retinal detachment (RD) associated with giant retinal tears, degenerative myopia or vitreous hemorrhage, (3) accompanying tractional RD, (4) pediatric age patients, (5) a history of previous vitreoretinal surgery, (6) patients with uveitis or uncontrolled glaucoma, and (7) patients whose OCT images could not be obtained clearly due to fixation loss or media opacity. Having previous cataract operation was not an exclusion criteria.

Pre-operative data included a complete medical and ophthalmic history, age, gender, the time interval from the onset of the symptoms to diagnosis, the time interval between the diagnosis and surgery, laterality of the eye. In comprehensive ophthalmological examination, BCVA of the patients that determined with the snellen chart and converted to logMAR, intraocular pressure (IOP) measured by non-contact tonometry, pre-operative lens status (phakic, pseudophakic, and aphakic), location of intraocular lens (IOL) in pseudophakic patients (in the bag, sulcus, or scleral fixated) were noted. After pupillary dilation, fundus examination was performed by indirect ophthalmoscopy and slit-lamp biomicroscopy with the three-mirror Goldmann lens and the number of tears, the anatomical location of the tears, the size of RD, the status of macula and the proliferative vitreoretinopathy (PVR) stage were recorded. All PPV surgeries were performed by the same vitreoretinal surgeon (ABB) under general or local anesthesia using Constellation system (Alcon, Fort Worth, Texas, US). The surgical technique included a three-port 23 gauge or 25 gauge complete PPV with perfluorodecaline, drainage of the subretinal fluid with backflush, fluid-air exchange, endolaser around retinal tears and endotamponade with sulfur hexafluoride (SF_6), perfluoropropane (C_3F_8) or silicone oil. The target period for silicone extraction was planned approximately 3 months. In 5 eyes, PPV was combined with phacoemulsification with 2.75 mm corneal incision. The number of tears determined during surgery, simultaneous cataract surgeries, endotamponade material, and complications were recorded.

Complete ophthalmological examinations were performed at 1st, 3rd, and 6th months, with 6-month intervals from the 6th month after surgery and OCT images were obtained. The OCT images were taken using spectral-domain OCT (SD-OCT) (OCT/SLO System, OPKO/OTI, V2,26, Miami, Florida, USA) device and structural changes in the fovea were recorded. Post-operative OCT findings at the last follow-up were analyzed in four categories; (a) an intact photoreceptor inner segment/outer segment (IS/OS) junction, (b) disrupted IS/OS junction, (c) foveal ERM, and (d) parafoveal (within the area of 500 μm surrounding the fovea) ERM.

Patients were divided into two groups according to visual acuity: Group 1 consisted of 24 patients who had improved final BCVA (BCVA at the last follow-up) after post-operative 6th month; Group 2 consisted of a total of 17 patients: 14 patients with stable final BCVA and 3 patients with deteriorated final BCVA after the postoperative 6th month. Final BCVA was evaluated at least 6 months after silicone extraction in patients with silicone endotamponade.

Statistical Analysis

Statistical analysis was performed with SPSS 18.0 (SPSS

Inc, Chicago, USA) package program. Descriptive statistics were presented with frequency, percentage, mean standard deviation, median, and minimum-maximum values. Pearson's Chi-square test was used to analyze the relationship between categorical variables. Wilcoxon paired test and Spearson test (r) were used to analyze the differences between dependent measurements. Results with $p<0.05$ were considered statistically significant. As descriptive statistics, if the standard deviation rate was more than half of the data obtained, median, minimum and maximum values were evaluated together with the data.

Results

A total of 41 (21 right and 20 left) eyes of 41 patients with a mean age of 61.24±9.49 (range, 44–80) years were included in the study. Of the patients, 29 (70.7%) were male and 12 (29.3%) were female. The mean follow-up period was 16.93±7.51 (range, 7–36) months. The time interval from the onset of symptoms to the diagnosis was 10.80 (median 5; min 2–max 90) days. The time interval between the diagnosis and surgical treatment was 5.9 (median 5; min 0–max 28) days. While a total of 26 (63.4%) patients had macula-off RRD, 15 (36.6%) patients had macula-on RRD. Pre-operative retinal tear could not be detected in 14 (34.1%) patients, while tear was detected in 27 (65.9%) patients. The endotamponade material was C_3F_8 in 17 (41.5%), silicone oil in 15 (36.6%) and SF_6 in 9 (22%) eyes. There was no significant difference between the groups in terms of the time interval from the onset of the symptoms to diagnosis (p=0.512), the time interval between diagnosis and surgical treatment (p=0.68), status of the macula (p=0.695), retinal tear detected preoperatively (p=0.742), and endotamponade material (p=0.788) (Table 1). The mean time interval for silicone extraction in patients with silicone endotamponade was 5.40±1.84 (range, 3–9) months. While this period was 5.33±1.80 months for Group 1, it was 5.50±2.07 months for Group 2. There was no significant difference between the groups in terms of the time interval for silicone extraction (p=0.857).

Likewise, no significant difference was noticed between the groups in terms of the number of tears preoperatively (p=0.552) and the number of retinal tears detected intraoperatively (p=0.234). Retinal tear was observed intraoperatively in 13 of 14 patients which retinal tear could not

Table 1. Clinical features of the patients

	Total	Group 1	Group 2	p-value
Age	61.24±9.4 (range, 44–80)	63.04±8.5 (range, 48–77)	58.71±10.3 (range, 44–80)	
Gender, n (%)				
Male	29 (70.7)	13 (54.2)	16 (94.1)	
Female	12 (29.3)	11 (45.8)	1 (5.9)	
Laterality, n (%)				
Right	21 (51.2)	11 (45.8)	10 (58.8)	
Left	20 (48.8)	13 (54.2)	7 (41.2)	
Mean follow-up period (months)	16.93±7.51 (range, 7–36)	17.96±6.28 (range, 9–32)	15.47±8.96 (range, 7–36)	0.105
The time interval from the onset of the symptoms to diagnosis (days)	10.80 (median 5; range, 2–90)	12.04 (median 6; range, 2–90)	9.06 (median 5; range, 2–45)	0.512
The time interval between the diagnosis and surgery (days)	5.9 (median 5; range, 0–28)	4.79 (median 3,5; range, 0–14)	7.47 (median 6; range, 2–28)	0.68
Retinal tear detected preoperatively, n (%)				
Detected	27 (65.9)	15 (62.5)	12 (70.6)	0.742
Not detected	14 (34.1)	9 (37.5)	5 (29.4)	
Status of the macula, n (%)				
Off	26 (63.4)	15 (62.5)	11 (64.7)	0.695
On	15 (36.6)	9 (37.5)	6 (35.3)	
Endotamponade material, n (%)				
Silicone	15 (36.6)	9(37.5)	6 (35.3)	0.788
C_3F_8	17 (41.5)	9(37.5)	8 (47.1)	
SF_6	9 (22)	6 (25)	3 (17.6)	

C_3F_8: Perfluoropropane; SF_6: Sulfur hexafluoride.

Table 2. The number of tears detected preoperative and intraoperatively, number of detached retinal areas, and location of retinal detachment of the patients

	Total	Group 1	Group 2	p-value
	n (%)	n (%)	n (%)	
The number of tears detected preoperatively				
0	14 (34.1)	9 (37.5)	5 (29.4)	0.552
1	20 48.8)	12 (50)	8 (47.1)	
2	5 (12.2)	2 (8.3)	3 (17.6)	
3	1 (2.4)	1 (4.2)	0	
4	1 (2.4)	0	1 (5.9)	
The number of tears detected intraoperatively				
0	1 (2.4)	1 (4.2)	0	0.234
1	13 (31.7)	11 (45.8)	2 (11.8)	
2	11 (26.8)	5 (20.8)	6 (35.3)	
3	8 (19.5)	3 (12.5)	5 (29.4)	
4	4 (9.8)	2 (8.3)	2 (11.8)	
5	4 (9.8)	2 (8.3)	2 (11.8)	
The number of detached retinal area				
3 clock hours	1 (2.4)	0	1 (5.9)	0.466
4 clock hours	3 (7.3)	2 (8.3)	1 (5.9)	
6 clock hours	32 (78)	20 (83.3)	12 (70.6)	
8 clock hours	1 (2.4)	1 (4.2)	0	
9 clock hours	1 (2.4)	0	1 (5.9)	
12 clock hours	3 (7.3)	1 (4.2)	2 (11.8)	
Location of retinal detachment				
Inferior	12 (29.3)	6 (25)	6 (35.3)	0.311
Superior	11 (26.8)	6 (25)	6 (29.4)	
Temporal	9 (22)	8 (33.3)	1 (5.9)	
Superior, nasal	3 (7.3)	2 (8.3)	1 (5.9)	
Total	3 (7.3)	1 (4.2)	2 (11.8)	
Superior, inferior, temporal	1 (2.4)	1 (4.2)	0	
Superior, inferior, nasal	1 (2.4)	0	1 (5.9)	
Inferior ve nasal	1 (2.4)	0	1 (5.9)	

be detected preoperatively. In the one patient with undetected retinal tear, drainage retinotomy was made to reattach retina. There was also no significant difference between the groups in terms of the number of detached retinal areas (p=0.466) and location of RD (p=0.311) (Table 2).

The lens status of the eyes in the study and the cataract surgeries performed are shown in Table 3. The number of phakic (14 [58.3%]) eyes in Group 1 and pseudophakic (12 [70.6%]) eyes in Group 2 was higher, and the difference was statistically significant (p=0.038). In this study, cataract surgery was performed in 4 eyes 6 months after PPV. The final BCVA increased in these four patients and they were included in group 1. Cataract was observed in two patients from Group 2. Although the BCVA of these eyes increased after PPV surgery, it did not change after the postoperative 6^{th} month, and cataract surgery was recommended. IOL was placed in the capsular bag in all eyes that underwent cataract surgery. At the last follow-up, 35 (85.4%) eyes were pseudophakic and 6 (14.6%) eyes (2 eyes from group 1 and 4 eyes from group 2) were phakic. Cataract was observed in five of these six phakic eyes.

PVR which was present at least stage B was evaluated in this study. Preoperatively, only 4 (9.8%) eyes had PVR. There was PVR-C1 in only 1 (4.2%) of 24 eyes in Group 1. Among 17 eyes in Group 2, 2 eyes had PVR-B and 1 had PVR-C1; a total of 3 eyes (17.6%) had PVR of Stage B and above. PVR was not detected postoperatively.

While postoperative hypertonia that was controlled with local anti-glaucomatous drops was observed in 11 (26.8%) eyes, IOP was normal in 30 (73.2%) eyes. Post-operative hypertonia was observed in 6 (40%) of 15 eyes with silicone endotamponade, while it was observed in 5 (19.2%) of 26 eyes with C_3F_8 and SF_6 endotamponade. Although the rate of postoperative hypertonia was higher in eyes with sili-

Table 3. The lens status of the patients and cataract surgeries performed

	Total		Group 1		Group 2	
Preoperative lens status						
Phakic	18 (43.9%)		14 (58.3%)		4 (23.5%)	
Pseudophakic	22 (53.7%)		10 (41.7%)		12 (70.6%)	
In the bag		19		8		11
Sulcus		2		1		1
SF-IOL		1		1		0
Aphakic	1 (2.4%)		0		1 (5.9%)	
PPV+phaco-IOL	5 (12.1%)		5 (20.8%)		0	
Silicone extraction+phaco-IOL	3 (7.3%)		1 (4.2%)		2 (11.8%)	
Phaco-IOL during follow-up	4 (9.7%)		4 (16.6%)		0	

SF-IOL: Scleral fixated intraocular lens; PPV: Pars plana vitrectomy.

Table 4. Pre-operative and post-operative BCVA of the patients

	Total	Group 1	Group 2	p-value
Pre-operative BCVA	1.32 (median 1.51; range, 0–2.10)	1.37 (median 1.4; range, 0.15–2.10)	1.26 (median 1.51; range, 0–2.10)	0.676
Post-operative BCVA	0.34 (median 0.22; range, 0–2.10)	0.17 (median 0.18; range, 0–0.4)	0.58 (median 0.52; range, 0–2.10)	0.073
Difference between post-operative-pre-operative BCVA	0.98 (median 0.81; range, 0–2.10)	1.20 (median 1.22; range, 0.1–2.1)	0.68 (median 0.7; range, 0–1.8)	0.013

BCVA: Best corrected visual acuity.

Table 5. The association between pre-operative status of the macula and preoperative and post-operative BCVA

	Macula-off	Macula-on	p-value
Pre-operative BCVA	1.73 (median 1.8; range, 0.52–2.10)	0.55 (median 0.7; range, 0–1)	<0.001
Post-operative BCVA	0.48 (median 0.3; range, 0–2.10)	0.08 (median 0; range, 0–0.4)	0.002

BCVA: Best corrected visual acuity.

cone endotamponade numerically, the difference was not statistically significant (p=0.272). There was no significant difference between the groups in terms of post-operative hypertonia (p=0.753).

The mean pre-operative logMAR BCVA was 1.32 (median 1.51; min 0–max 2.10) and the mean post-operative logMAR BCVA was 0.34 (median 0.22; min 0-max 2.10). There was no significant difference between the groups in terms of pre-operative BCVA (p=0.676) and post-operative BCVA (p=0.073) (Table 4). Pre-operative BCVA was significantly in positive correlation with postoperative BCVA (p<0.001, r=0.58). We found a stronger relationship between pre-operative and post-operative BCVA in Group 2 (p=0.01, r=0.751) compared to Group 1 (p=0.036, r=0.429). In other words, patients with better pre-operative BCVA in Group 2 had better postoperative BCVA. When the difference between post-operative and pre-operative logMAR BCVA was evaluated, the difference was higher in Group 1 and it was statistically significant (p=0.013) (Table 5).

Pre-operative BCVA (p<0.001) and post-operative BCVA (p=0.002) were significantly better in patients with macula-on RRD in comparison to macula-off RRD (Table 5).

When OCT findings were evaluated, 10 (24.4%) patients had an intact IS/OS junction, 5 (12.2%) had a disrupted IS/OS junction, 23 (56.1%) had parafoveal ERM, and 3 (7.3%) had foveal ERM. While the number of eyes with an intact IS/OS junction was higher in Group 1, the number of eyes with disrupted IS/OS junction and foveal ERM was higher

Table 6. Post-operative OCT findings

OCT findings	Total	Group 1	Group 2
	n (%)	n (%)	n (%)
Intact IS/OS junction	10 (24.4)	8 (33.3)	2 (11.8)
Disrupted IS/OS junction	5 (12.2)	2 (8.3)	3 (17.6)
Parafoveal ERM	23 (56.1)	13 (54.2)	10 (58.8)
Foveal ERM	3 (7.3)	1 (4.2)	2 (11.8)

OCT: Optical coherence tomography; IS/OS: İnner segment/outer segment; ERM: Epiretinal membrane.

in Group 2. However, these numerical differences could not be evaluated statistically because the sample size was small (Table 6). Furthermore, foveal residual detachment was observed in 2 (4.8%) eyes, but by the 6th postoperative month, the subretinal fluid had been completely resorbed.

Discussion

Decreased visual acuity or delay in visual recovery after anatomically successful PPV surgery for primary RRD is an important problem. This shows that anatomically successful reattachment of the retina may not always point out the functional achievement. In the previous studies, pre-operative BCVA, pre-operative status of the macula, the duration of symptoms, the previous lens extraction or other intraocular surgeries, and the presence of PVR have been demonstrated to be associated with post-operative BCVA.[6]

Pre-operative BCVA has been reported to be an important prognostic factor for predicting the post-operative BCVA. Suzuki et al.[7] analyzed 56 eyes with macula off RRD treated with PPV or scleral buckling and found that post-operative BCVA at 6 months after the surgery was positively associated with preoperative BCVA. Benda et al.[6] followed 88 eyes with 20 macula-on and 68 macula-off RRD and demonstrated a significant positive correlation between pre-operative BCVA and post-operative BCVA. Similarly, in our study, pre-operative BCVA was significantly in positive correlation with post-operative BCVA ($p<0.001$, $r=0.58$).

The duration of symptoms was significantly associated with functional visual outcome in the study of Pastor et al.,[8] in which 517 eyes treated with PPV or scleral buckling for RRD were evaluated. Furthermore, in the study of Benda et al.,[6] there was significantly negative correlation between the duration of symptoms and postoperative BCVA. A similar result was demonstrated in the study of Kim et al.,[9] in which 81 eyes treated with PPV for macula-off RRD were analyzed. They reported that the duration of symptoms in <6 days was associated with a better postoperative BCVA and after 7 days visual outcome was not affected by the timing of the surgical repair. In this study, the duration of symptoms was not accepted as a prognostic factor. Because, the time interval from the onset of symptoms to diagnosis was more than 7 days in 20 patients, and the time interval between the onset of symptoms and surgical treatment was more than 7 days in 34 patients in total.

Another important pre-operative factor reported to be affecting visual prognosis and functionality of fovea was the presence and duration of macular detachment. Pastor et al.[8] and Gerding and Hersener.[10] have reported that macular detachment was associated with poor visual prognosis. In this study, both pre-operative and post-operative BCVA were significantly better in eyes with macula-on RRD in comparison to macula-off RRD. In the study of Van de Put et al.,[11] it was reported that better postoperative BCVA was associated with the shorter duration and the lower height of macular detachment. In the study of Ehrlich et al.,[12] in which 114 eyes with macula-on RRD were examined, 62 were operated on the same day they were diagnosed, 46 were operated on the day after presentation, and 6 were operated in 2–5 days. It has been reported that short-term surgical delay does not have a negative effect on visual acuity in macula-on RRD.[12] It has been emphasized in many studies that photoreceptor destruction develops in eyes with macular detachment, the rate of irreversible damage increases as the height and duration of macular detachment increases, and the chance of better visual outcome decreases despite anatomically successful surgical treatment.[3,13,14]

OCT is very helpful in evaluating the function of the macula. Abnormal findings such as ERM, cystoid macular edema, retinal folds, residual foveal detachment, macular hole, intraretinal separation, multiple small cystic cavities in the inner nuclear, and outer nuclear layers have been demonstrated in OCT and their association with preoperative and postoperative BCVA has been reported.[2,15,16] In the study of Hagimura et al.,[15] in which OCT changes of 25 eyes with macula-off RRD were evaluated, a negative correlation was observed between postoperative BCVA and the height of macular detachment. As the height of detachment increases, it is thought that irreversible damage occurs mostly in these regions as a result of the deterioration of the nutritional support of the retina. Matsui et al.[4] found that pre-operative and post-operative BCVA were statistically significantly worse in eyes with a pre-operative detachment height >1000 μm than in eyes with a preoperative detachment height <1000 μm. In contrast, Karacorlu et al.[17] reported that there was no correlation between the height of foveal detachment and post-operative BCVA. Since only post-operative OCT findings were evaluated in this study, no comparison could be made regarding the height of the detachment.

Schocket et al.[3] observed disrupted IS/OS line indicating irreversible damage to photoreceptors in 14 of 17 patients in which functional visual outcome could not be achieved after anatomically successful RRD surgery. Nakanishi et al.[18] revealed that disruption of the IS/OS line after successful surgery may be the reason for insufficient visual improvement. Wakabayashi et al.[5] reported that the most

important OCT findings for visual restoration after successful surgery for macula-off RRD was the integrity of IS/OS line and external limiting membrane (ELM) signal. In the study of Seymenoğlu et al.,[19] it was shown that post-operative visual outcome was strongly in positive correlation with the integrity of the IS/OS line.

In this study, the number of patients with intact IS/OS line in Group 1 and with disrupted IS/OS line in Group 2 was higher. Furthermore, the number of patients with foveal and parafoveal ERM was higher in Group 2. The better final BCVA in Group 1 could have been explained by the higher number of patients with an intact IS/OS line, and the worse final BCVA in Group 2, by the higher number of patients with disrupted IS/OS line and ERM. However, statistical analysis could not be performed because the sample size was not enough.

Many studies have suggested that residual foveal detachment may also be responsible for limited visual recovery in the postoperative period.[2,15] In the study of Shimoda et al.,[20] in which 20 eyes with macula-off RRD were followed, residual foveal detachment have persisted up to 6 months in 40% of eyes, and the visual outcome was as good as those with intact IS/OS line. In the same study, the ratio of intact IS/OS line increased from 5% to 50% at postoperative 6th month, while the ratio of disrupted IS/OS line decreased from 55% to 17%, which shows that the outer retinal segments are gradually restored after retinal reattachment. In this study, foveal residual detachment was observed in only 2 (4.8%) patients, but by the 6th post-operative month, the subretinal fluid had been completely resorbed. An intact IS/OS line was observed in one patient, and a parafoveal ERM in the other. In these two patients, the improvement in the postoperative BCVA was limited and it was attributed to nuclear cataract.

RRD following cataract surgery ranges from 21.6% to 37.2% of all RRDs. The 10-year incidence of RRD after phacoemulsification was reported between 0.36% and 2.9%.[21] The development of cataract after anatomically successful PPV surgery is another factor that may cause insufficient visual improvement. In this study, cataract surgery was performed in 4 eyes during the follow-up period after PPV surgery. BCVA increased in these four eyes and they were included in Group 1. Nuclear cataract was observed in 2 eyes from Group 2. Although BCVA of these two eyes increased after PPV, it did not change after 6th month and cataract surgery was recommended. In this study, 6 (14.6%) of 41 eyes, 2 from Group 1 and 4 from Group 2, remained phakic. Cataract was observed in 5 of these 6 phakic eyes. At the last follow-up, 35 (85.4%) of 41 eyes were pseudophakic. We reported postoperative BCVA, 0.34 logMAR, with the rate of 85.4% pseudophakic eyes; while Karacorlu et al.[17] reported it was logMAR 0.14, with the rate of 93.2% pseudophakic eyes (n=41). As well as anatomical and microstructural integrity of macula on OCT, the high rate of pseudophakic eyes may have improved final BCVA in this study, because cataract could mask visual restoration due to retinal recovery.

Despite advances in vitreoretinal surgical techniques and equipment, PVR still remains the most important cause of RRD recurrence. In this study, stage A PVR was not evaluated, and PVR at Stage B and over was observed in only 4 (9.8%) eyes preoperatively, 2 of which were Stage B and 2 of which were stage C1. While it was not a prognostic factor in this study, PVR (A or B) was associated with a worse functional visual outcome in the study of Pastor et al.[8] In some series, the incidence of post-operative PVR after primary RRD surgery ranges from 4.9% to 11.7%.[22,23] However, PVR was not detected in our patients postoperatively.

There are some limitations and analyzes that could have been done differently. The major limitation of this clinical study is the non-randomized and the retrospective design. In this study, two main groups were formed related to BCVA; Group 1, patients with improved BCVA after postoperative 6th month, and Group 2, patients who had stable or deteriorated BCVA after postoperative 6th month. Under these two Groups, 4 more subgroups were formed according to OCT changes and the number of patients in subgroups got too small to compare. However, if four main groups had been formed directly according to OCT parameters, since the number of patients in these four groups could be sufficient, comparisons and statistical analysis could be performed and more homogeneous results could be obtained. In addition, 6 eyes that BCVA increased to 20/20 before 6th month postoperatively were included in Group 2. This may have caused the number of patients with intact IS/OS line to be similar in both groups. One limitation is that at the last follow-up there were still 5 patients which had cataract that could inhibit visual improvement after PPV. Also, if preoperative OCT examination, height of detachment, foveal thickness, and ELM signal evaluation had been performed, this study could be more valuable.

Conclusion

Pre-operative BCVA and absence of macular detachment are important prognostic factors in patients with RRD. The development of cataract after PPV may mask the visual improvement provided by vitreoretinal surgery. SD-OCT is an

imaging modality that assists in the evaluation of foveal microstructural changes.

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References

1. Schmidt JC, Rodrigues EB, Hoerle S, Meyer CH, Kroll P. Primary vitrectomy in complicated rhegmatogenous retinal detachment--A survey of 205 eyes. Ophthalmologica 2003;217:387–92. [CrossRef]
2. Wolfensberger TJ, Gonvers M. Optical coherence tomography in the evaluation of incomplete visual acuity recovery after macula-off retinal detachments. Graefes Arch Clin Exp Ophthalmol 2002;240:85–9. [CrossRef]
3. Schocket LS, Witkin AJ, Fujimoto JG, Ko TH, Schuman JS, Rogers AH, et al. Ultrahigh-resolution optical coherence tomography in patients with decreased visual acuity after retinal detachment repair. Ophthalmology 2006;113:666–72.
4. Matsui A, Toshida H, Honda R, Seto T, Ohta T, Murakami A. preoperative and postoperative optical coherence tomography findings in patients with rhegmatogenous retinal detachment ınvolving the macular region. ISRN Ophthalmol 2013;2013:1–6. [CrossRef]
5. Wakabayashi T, Oshima Y, Fujimoto H, Murakami Y, Sakaguchi H, Kusaka S, et al. Foveal microstructure and Visual acuity after retinal detachment repair. Imaging analysis by fourier-domain optical coherence tomography. Ophthalmology 2009;116:519–28. [CrossRef]
6. Benda PZ, Vratanar B, Petrovski G, Gavrić AU, Matović M, Gornik A, et al. Prognostic factor analysis of visual outcome after vitrectomy for rhegmatogenous retinal detachment. J Clin Med 2020;9:3251. [CrossRef]
7. Suzuki N, Kunikata H, Aizawa N, Abe T, Nakazawa T. Predicting visual outcomes for macula-off rhegmatogenous retinal detachment with optical coherence tomography. J Ophthalmol 2014;2014:269837. [CrossRef]
8. Pastor Jimeno JC, Fernández I, De La Rodríguez Rúa E, Coco R, Colmenares MR, Sánchez-Chicharro D, et al. Surgical outcomes for primary rhegmatogenous retinal detachments in phakic and pseudophakic patients: The retina 1 project--report 2. Br J Ophthalmol 2008;92:378–82. [CrossRef]
9. Kim JD, Pham HH, Lai MM, Josephson JW, Minarcik JR, Von Fricken M. Effect of symptom duration on outcomes following vitrectomy repair of primary macula-off retinal detachments. Retina 2013;33:1931–7. [CrossRef]
10. Gerding H, Hersener A. Anatomical and functional results of primary pars plana vitrectomy in rhegmatogenous retinal detachment. Klin Monbl Augenheilkd. 2013;230:409–12. [CrossRef]
11. Van De Put MA, Croonen D, Nolte IM, Japing WJ, Hooymans JM, Los LI. Postoperative recovery of visual function after macula-off rhegmatogenous retinal detachment. PLoS One 2014;9:e99787. [CrossRef]
12. Ehrlich R, Niederer RL, Ahmad N, Polkinghorne P. Timing of acute macula-on rhegmatogenous retinal detachment repair. Retina 2013;33:105–10. [CrossRef]
13. Chang CJ. Apoptotic Photoreceptor cell death after traumatic retinal detachment in humans. Arch Ophthalmol 1995;113:880-6. [CrossRef]
14. Arroyo JG, Yang L, Bula D, Chen DF. Photoreceptor apoptosis in human retinal detachment. Am J Ophthalmol 2005;139:605–10. [CrossRef]
15. Hagimura N, Suto K, Iida T, Kishi S. Optical coherence tomography of the neurosensory retina in rhegmatogenous retinal detachment. Am J Ophthalmol 2000;129:186–90. [CrossRef]
16. Lecleire-Collet A, Muraine M, Menard JF, Brasseur G. Predictive visual outcome after macula-off retinal detachment surgery using optical coherence tomography. Retina 2005;25:44–53.
17. Karacorlu M, Muslubas IS, Hocaoglu M, Arf S, Ersoz MG. Correlation between morphological changes and functional outcomes of recent-onset macula-off rhegmatogenous retinal detachment: Prognostic factors in rhegmatogenous retinal detachment. Int Ophthalmol. 2018;38:1275–83. [CrossRef]
18. Nakanishi H, Hangai M, Unoki N, Sakamoto A, Tsujikawa A, Kita M, et al. Spectral-domain optical coherence tomography imaging of the detached macula in rhegmatogenous retinal detachment. Retina 2009;29:232–42. [CrossRef]
19. Seymenoğlu G, Şahin BÖ, Top CG, Kayikçioğlu O, Başer E. Evaluation of macula with optical coherence tomography in patients with decreased visual acuity after successful retinal detachment surgery.Turk Oftalmoloiji Derg 2012;42:274–9.
20. Shimoda Y, Sano M, Hashimoto H, Yokota Y, Kishi S. Restoration of photoreceptor outer segment after vitrectomy for retinal detachment. Am J Ophthalmol 2010;149:284–90. [CrossRef]
21. Qureshi MH, Steel DH. Retinal detachment following cataract phacoemulsification-a review of the literature. Eye (Lond) 2020;34:616–31. [CrossRef]
22. Heimann H, Bornfeld N, Friedrichs W, Helbig H, Kellner U, Korra A, et al. Primary vitrectomy without scleral buckling for rhegmatogenous retinal detachment. Graefes Arch Clin Exp Ophthalmol 1996;234:561–8. [CrossRef]
23. Speicher MA, Fu AD, Martin JP, von Fricken MA. Primary vitrectomy alone for repair of retinal detachment following cataract surgery. Retina 2000;20:459–64. [CrossRef]