Contribution of Multifocal Electroretinography and Optical Coherence Tomography in Predicting the Visual Prognosis of Rhegmatogenous Retinal Detachment

Yırtıklı Retina Dekolmanının Görme Prognozu Tahmininde Multifokal Elektroretinografinin ve Optik Koherens Tomografinin Katkıları

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ABSTRACT Objective: To determine the contribution of multifocal electroretinography (mfERG) and optical coherence tomography (OCT) in predicting the visual outcome in patients with macula-off retinal detachments. **Material and Methods:** Thirthy-seven eyes of 37 patients who had undergone conventional scleral buckling surgery with the diagnosis of macula-off retinal detachment were included in this prospective study. The fellow eyes of the patients served as the control group. Each study participant underwent a comprehensive ophthalmological examination and mfERG recordings were obtained preoperatively and postoperatively. Preoperative height of macular detachment (HMD) and scans of the fovea were assessed with OCT. **Results:** P1 and N1 amplitude responses of mfERG improved significantly in postoperative period (p<0.001). However, statistical analysis showed that both postoperative P1 and N1 amplitudes were significantly lower than the control group (p<0.001). Preoperative amplitudes of P1 of the summed mfERG showed positive (r=0.34, p=0.042) correlation with best corrected visual acuity (BCVA) levels at 6th month of follow-up. Preoperative BCVA was positively correlated to preoperative intensity of P1 response of concentric ring 1+2 (r=0.38, p=0.020) and P1 amplitudes of the total stimulated area (r=0.47, p=0.003). Preoperative changes of the foveal structure (r=-0.39, p=0.019) and HMD (r=-0.54, p=0.001) showed negative correlation with BCVA levels measured at the 6th month of follow-up. No correlation was found between postoperative BCVA and both the duration of macular detachment and preoperative BCVA. **Conclusion:** Preoperative assessments of OCT and mfERG in rhegmatogenous retinal detachment may provide valuable prognostic data regarding the postoperative visual outcome.

Key Words: Retinal detachment; tomography, optical coherence; electroretinography; scleral buckling

ÖZET Amaç: Makulası tutulmuş retina dekolmanı olan hastalarda görme keskinliği tahmininde multifokal elektroretinografinin (mfERG) ve optik koherens tomografinin (OKT) katkılarını belirlemek. **Gereç ve Yöntemler:** Makulası tutulmuş retina dekolmanı tanısı ile klasik skleral çökertme cerrahisi geçirmiş 37 hastanın 37 gözü bu prospektif çalışmaya dahil edildi. Hastaların diğer gözleri kontrol grubu olarak kullanıldı. Her çalışma katılımcısına kapsamlı bir oftalmolojik muayene yapıldı ve mfERG kayıtları cerrahi öncesi ve sonrası elde edildi. Cerrahi öncesi makula dekolman yüksekliği (MDY) ve fovea taramaları OKT ile değerlendirildi. **Bulgular:** mfERG P1 ve N1 genliği yanıtlarında cerrahi sonrası dönemde anlamlı düzelme saptandı (p<0,001). Ancak, istatistiksel analiz cerrahi sonrası hem P1 hem de N1 genliklerinin kontrol grubuna göre anlamlı derecede düşük olduğunu gösterdi (p<0.001). Cerrahi öncesi toplam mfERG P1 genlikleri, izlemin 6. ayındaki en iyi düzeltilmiş görme keskinliği (EİDGK) düzeyleri ile pozitif korelasyon gösterdi (r=0,34, p=0,042). Cerrahi öncesi EİDGK konsantrik halka 1+2'nin P1 yanıtları (r=0,38, p=0,020) ve toplam uyarılmış alan (r=0,47, p=0,003) P1 genliği ile pozitif korelasyonluydu. Foveanın yapısındaki cerrahi öncesi değişiklikler (r=-0,39, p=0,019) ve MDY (r=-0,54, p=0,001), izlemin 6. ayındaki EİDGK düzeyleri ile negatif korelasyon gösterdi. Hem makula dekolman süresiyle hem de cerrahi öncesi EİDGK ile cerrahi sonrası EİDGK arasında korelasyon bulunamadı. **Sonuç:** Yırtıklı retina dekolmanında cerrahi öncesi OKT ve mfERG değerlendirmeleri cerrahi sonrası görsel iyileşme sonucu açısından değerli prognostik veri sağlayabilir.

Anahtar Kelimeler: Retina dekolmanı; tomografi, optik tutarlı; elektroretinografi; skleral çökertme

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Rhegmatogenous retinal detachment (RRD) is a relatively rare but serious condition.[1] Accumulation of subretinal fluid leads to separation of neural retina from the underlying retinal pigment epithelium (RPE). Prolonged hypoxia of the outer retina and degeneration of photoreceptors may result in serious visual impairment. Surgical options such as pneumatic retinopexy, scleral buckling (SB) and pars plana vitrectomy are the mainstay of treatment.[2]

Along with anatomical success, functional outcome is extremely important in RRD and depends on the status of the macula. Several preoperative factors have been identified to determine the recovery of macula in RRD. However certain limitations of these factors have been reported before.[3] With this regard, it is clear that there is a growing need to collect more objective data.

Multifocal electroretinography (mfERG) and optical coherence tomography (OCT) are relatively new technologies that enable a detailed evaluation of the retina.[4,5] Evidence suggests that when together, these two techniques provide complementary information on retinal anatomy and function. In this prospective study, we aimed to evaluate the contribution of mfERG and OCT in predicting postoperative anatomical and functional success of cases who underwent conventional retinal detachment surgery.

MATERIAL AND METHODS

Fourty-six patients who had the diagnosis of macula-off RRD and those that were eligible for conventional scleral buckling surgery were selected in this study. Individuals whose RRD involved more than a quadrant, and those who had completely normal fellow eyes were enrolled in the study. Furthermore, cases whose retina remained attached and have completed a minimum of 6 month of follow-up were included. One patient was unable to complete the follow-up and the remaining 8 patients experienced recurrent detachment throughout the follow-up. Accordingly, 9 patients were removed from the study. Study group consisted of 37 eyes of 37 patients who had conventional RRD surgery between January 2007-June 2008 in Uludag University Department of Ophthalmology. The fellow eyes of the patients served as the control group in mfERG recordings (n=37).

Eyes with vitreous hemorrhage and high myopia (>-6 diopters) were excluded. Individuals with bleeding disorders and those who had more complicated detachments, such as giant retinal tears and proliferative vitreoretinopathy (PVR) grade C1 and higher, were not included in the study. In addition, patients who had any prior ocular surgery other than uncomplicated cataract extraction were excluded. Again, eyes with any ocular pathology which could be associated with neural retinal defects (e.g. glaucoma, diabetic neuropathy, optic neuropathy) were excluded from the study. The study was carried out with the approval of the local ethics committee and each case provided a written informed consent.

Each study participant underwent a comprehensive ophthalmological examination, OCT and mfERG evaluations at the baseline and at the certain follow-up points. Patients were asked to estimate the duration of macular detachment (DMD) definitely. DMD was defined as the time between onset of symptoms of sudden significant visual loss and surgery. Ophthalmological examination included best corrected visual acuity (BCVA) assessment and slit-lamp biomicroscopy. BCVA was assessed using the Early Treatment Diabetic Retinopathy Study (ETDRS) chart and converted to logarithm of the minimum angle of resolution (logMAR). Both preoperative and postoperative BCVA outcomes were classified into 3 groups and then were interpreted. Additionally, the extension of RRD in terms of quadrants was recorded in each individual. The structural changes within the fovea, central foveal thickness (CFT) and height of macular detachment (HMD) were evaluated by Stratus optical coherence tomography (OCT; Carl Zeiss Meditec Inc., Dublin, Calif., USA).

Recordings of mfERG and OCT were performed usually on the day before surgery and at certain follow-up visits. In this study, mfERG responses were obtained with the RETIscan system (Roland Consult, Brandenburg, Germany) in accordance with the guidelines of International Society for Clinical Electrophysiology of Vision (ISCEV). The stimulus matrix consisted of 61 scaled hexagonal elements displayed on a 20-inch monitor with frame rate of 75 Hz. The viewing distance was set at 26 cm and a red central-fixation cross was used. Pupils were dilated with 1% tropicamide and 2.5% phenylephrine hydrochloride. After topical anesthesia, ERG jet type contact lens electrode was used as the active electrode and a ground electrode was applied on the forehead. In order to eliminate artefacts, segments associated with blinks or small eye movements were repeated. mfERG recordings of the study eye and fellow eye were made separately. As an exception, preoperative mfERG recordings of the study eyes were performed with both eyes open. Herewith, patients' ability to focus the central-fixation cross of the monitor was increased. The first-order kernel responses were analyzed in this study (Figures 1A and B). Amplitudes and latencies of P1 and N1 response from ring 1 (6°) and ring 1+2 (10.35°) were measured. Additionally, amplitudes and latencies of P1 and N1 from the total area (30°) were evaluated.

According to OCT evaluations, preoperative structural changes within the fovea were divided into following 3 categories: Type 1 represented normal retinal architecture (n=10) (Figure 2A), OCT scans demonstrating splitting of the inner layers of the retina were entitled as type 2 (n=9) (Figure 2B). Cases who had splitting of the inner layers and ondulation of the outer retinal layers were categorized as type 3 (n=18) (Figure 2C).[6] HMD was defined as the distance between the RPE and the external surface of the central fovea. In some patients, RPE layer could not be identified in a single scan. In such a case, HMD was recorded as 2000 μ. At the follow-up, OCT was used to detect foveal or subfoveal fluid.

Throughout the study, all examinations and recordings of OCT and mfERG were performed by the same ophthalmologist (S.Y). All surgeries were done by the same surgeon (O.Y). In order to cover the retinal breaks, a silicone explant with or without encircling band was used at the discretion of the surgeon. Subretinal fluid was drained by scleral incision and SF6 was injected into the vitreous when needed (n=18). Follow-up examinations were scheduled on 1 day, at 1 week, and 1, 3 and 6 months postoperatively. OCT and mfERG assessments were performed 1, 3 and 6 months after the surgery.

All statistical analyses were performed using SPSS software version-13.0 (SPSS Inc, Chicago, IL)

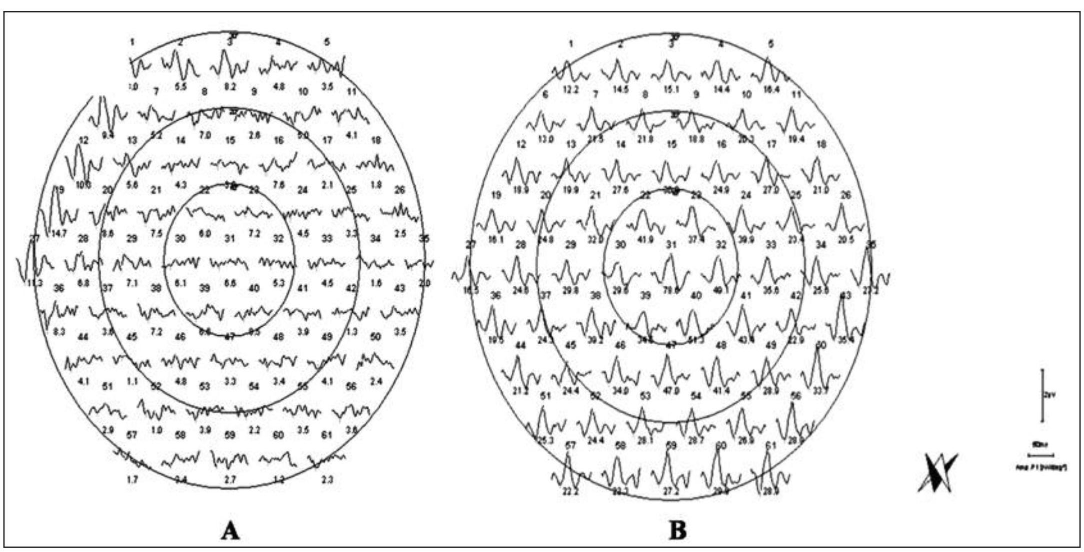

FIGURE 1: mfERG assessments of a case; preoperatively **(A)** and at the 6th month of follow-up **(B)**.

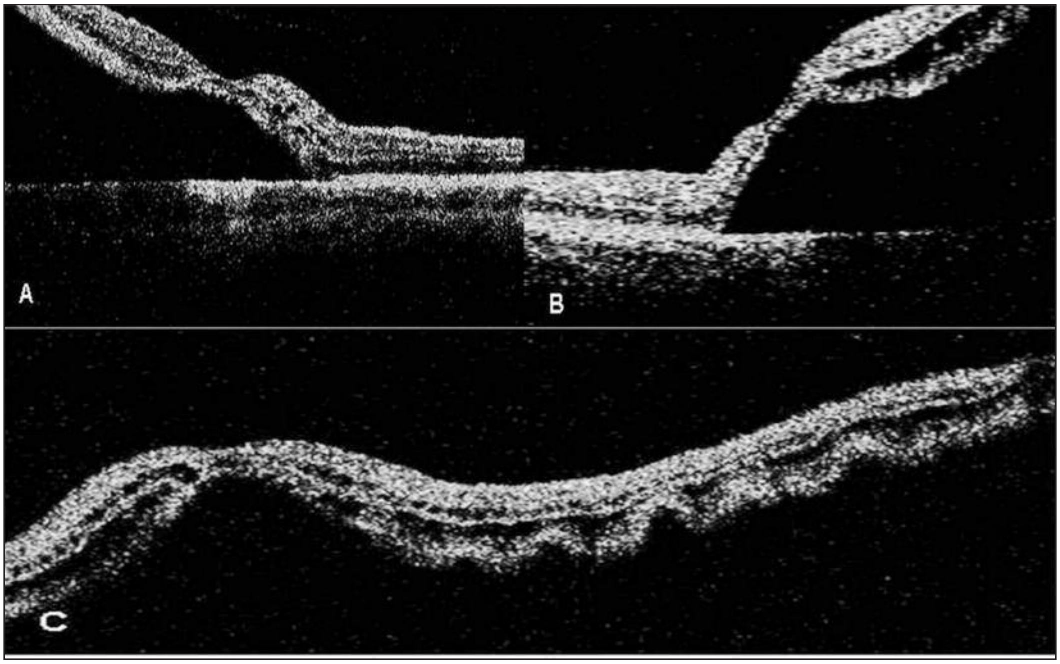

FIGURE 2: Preoperative evaluation of detached retina with OCT.
2A: Normal retinal architecture (Type 1).
2B: Splitting of the inner layers (Type 2).
2C: Splitting of the inner layers and ondulation of the outer retinal layers (Type 3).

and p values less than 0.05 were considered as statistically significant. For normally distributed data, arithmetic mean and standard deviation were used, however for abnormally distributed data, median values and data range (minimum-maximum) were used. McNamer test, Mann Whitney U test, Kruskal Wallis test, Wilcoxon Signed test, paired t-test, Pearson and Spearman correlation coefficients were used to compare the results.

RESULTS

The mean age of the patients in the study group was 54.0+14.7 years. Twenty six patients were males and 11 were females. Eight cases were pseudophakic (21.6%). Sixteen cases had total detachment; RRD involved 3 quadrants in 7 cases, and 2 quadrants in 14 cases. No additional procedures were performed in any of the cases. During surgery, 2 cases developed subretinal hemorrhage, fortunately none involved the macula. No significant intraoperative complications occurred in any of the remaining eyes. Along the follow-up, 6 cases (16.6%) experienced mild to moderate epiretinal membranes. Three cases (10.8%) had persistence of intraretinal edema.

Median preoperative BCVA in the study group and control group were 3.00 (0.7-3.0) and 0.1 (0.0-

TABLE 1: Classification of preoperative BCVA and the final postoperative BCVA.

	Postoperative BCVA at 6th month (logMAR units)		
	BCVA: > 1.0	BCVA: 1.0 to 0.4	BCVA: < 0.4
Preoperative BCVA (logMAR units)	Number of cases	Number of cases	Number of cases
= 3.0 (n=23)	2	17	4
3.0 to 1.0 (n=8)	0	5	3
< 1.0 (n=6)	0	3	3

BCVA: Best corrected visual acuity.

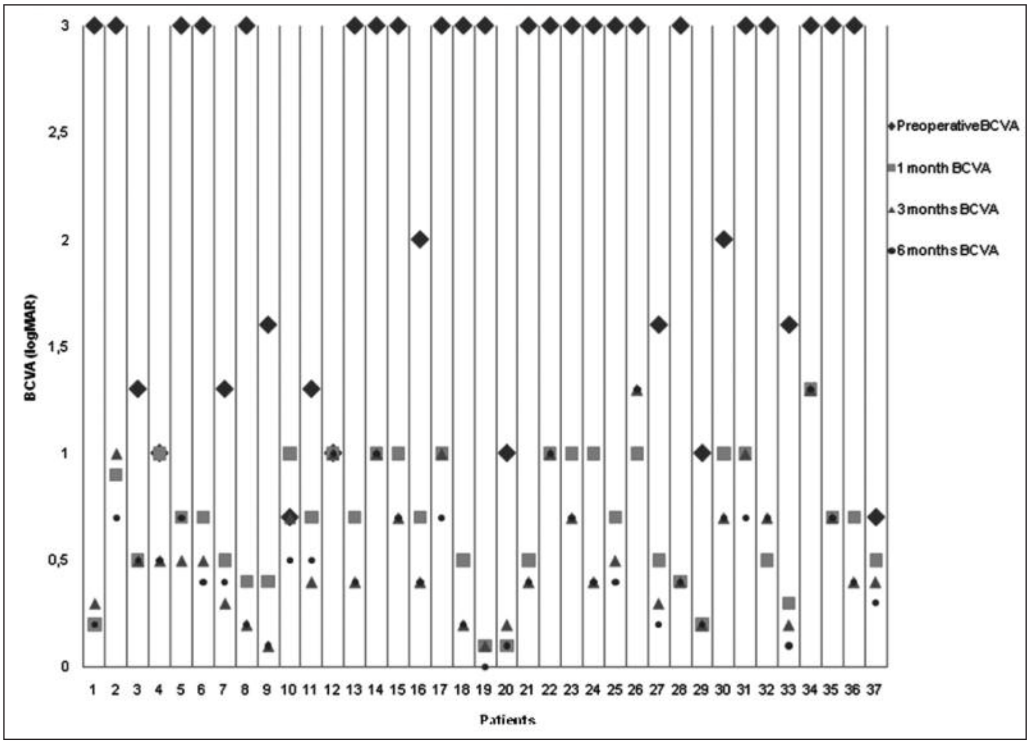

FIGURE 3: Best corrected visual acuity (BCVA) characteristics of 37 patients in preoperative, 1st, 3rd and 6th month of follow-up. BCVA significantly improved to postoperative period ($p<0.001$). Preoperative BCVA was worse than 1.0 logMAR units in the vast majority of cases (83%) and no correlation was found between preoperative and postoperative BCVA ($p=0.09$).

0.2) logMAR units respectively. Median postoperative BCVA significantly improved to 0.7 (0.1-1.3), 0.5 (0.1-1.3) and 0,4 (0.0-1.3) logMAR units in the 1st, 3rd and 6th month of follow-up, respectively ($p<0.001$). Preoperative BCVA was worse than 1.0 logMAR units (ETDRS equivalent: 20/200) in the vast majority of cases (83%). However postoperative BCVA was better than 1.0 logMAR units in 67% and better than 0.4 logMAR units (ETDRS equivalent: 20/50) in 27% of cases ($p<0.001$), (Table 1) (Figure 3). No correlation was found between the mean preoperative BCVA and the ultimate visual outcome ($p=0.09$). In this study, median DMD was 15.0 (5-90) days. DMD did not significantly effect final BCVA ($p=0.7$) (Figure 4) and final BCVA was not correlated to age ($p=0.5$).

Our results showed that P1 and N1 amplitude responses of mfERG improved significantly in the postoperative period ($p<0.001$). However, statistical analysis showed that both postoperative P1 and N1 amplitudes were significantly lower than the control group ($p<0.001$), (Table 2). Amplitudes of P1 and N1 remained steady beyond the 1st month of follow-up. Preoperative amplitudes of P1 of the

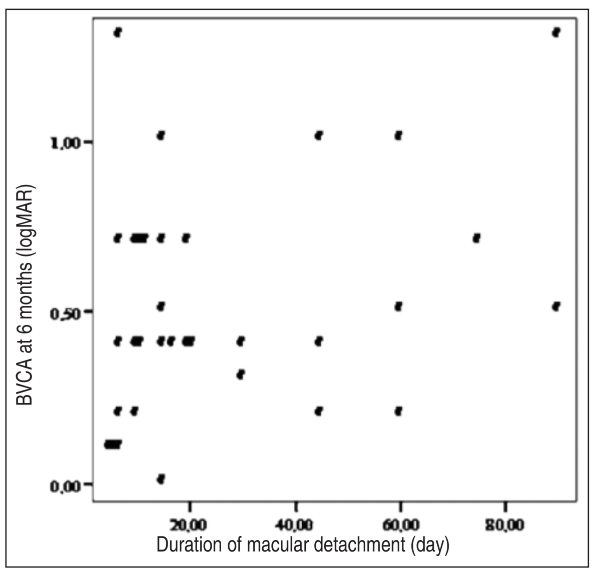

FIGURE 4: No correlation was found between best corrected visual acuity (BCVA) at 6 months and duration of macular detachment ($p=0.7$).

TABLE 2: Central foveal thickness measurements and BCVA assessments together with amplitudes and latencies of P1 and N1 in different locations of the retina

Description		Control (mean±SD), median (min-max)	Baseline (mean±SD), median (min-max)	First month (mean±SD), median (min-max)	Third month (mean±SD), median (min-max)	Sixth month (mean±SD), median (min-max)	Significance (p) Baseline-First month	Baseline-Third month	Baseline-Sixth month	Control-First month	Control-Third month	Control-Sixth month
BCVA (logMAR units)		0.1 (0.0-0.2)*	3.0 (0.7-3.0)*	0.7 (0.1-1.3)*	0.5 (0.1-1.3)*	0,4 (0.0-1.3)*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Central foveal thickness (µ)		199.2+16.4	N/A	260.3+88.1	260.4+85,2	258.4+83.1	N/A	N/A	N/A	<0.001	<0.001	<0.001
Amplitudes of P1	Ring 1 (nV/deg²)	115.57±27.1	31.71±14.9	71.37±23.5	77.69±20.2	79.15±22.4	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Ring 1 + 2 (nV/deg²)	47.85±13.2	10.15±4.6	28.28±11.8	30.57±11.7	31.64±12.3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Summed mfERG (mV)	78.92±19.2	17.31±11.3	50.65±19.6	60.04±17.9	59.52±19.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Latencies of P1	Ring 1 (ms)	38.17±1.9	43.72±3.4	38.64±1.4	38.53±1.4	38.74±1.5	<0.001	<0.001	<0.001	0.269	0.359	0.173
	Ring 1 + 2 (ms)	37.76±1.9	43.57±3.1	38.84±1.4	38.48±1.5	38.68±1.6	<0.001	<0.001	<0.001	0.052	0.075	0.091
	Summed mfERG (ms)	37.40±1.6	44.14±2.7	38.54±1.6	38.31±1.4	38.33±1.3	<0.001	<0.001	<0.001	0.056	0.081	0.098
Amplitudes of N1	Ring 1 (nV/deg²)	43.12±14.3	15.64±10.7	32.51±12.7	33.53±11.0	31.83±12.4	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Ring 1 + 2 (nV/deg²)	17.22±7.6	5.26±3.5	11.29±4.8	11.29±4.3	11.88±4.8	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Summed mfERG (mV)	24.13±8.8	7.12±5.1	17.67±6.8	21.22±7.7	19.71±7.8	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Latencies of N1	Ring 1 (ms)	18.78±1.7	23.45±2.0	19.14±1.4	19.04±1.4	18.94±1.3	<0.001	<0.001	<0.001	0.247	0.437	0.590
	Ring 1 + 2 (ms)	18.72±1.5	22.74±2.1	18,82±1.4	19.01±1.2	18.89±1.4	<0.001	<0.001	<0.001	0.729	0.226	0.505
	Summed mfERG (ms)	18.04±1.1	22.75±1.8	18.41±1.4	18.56±1.4	18.27±1.2	<0.001	<0.001	<0.001	0.157	0.056	0.288

BCVA: Best corrected visual acuity; µ: Micron, mV: Milivolt; nV/deg²: Nanovolt/degree²; mfERG: Multifocal electroretinography; ms: Millisecond; N/A: Non available; Min:Minimum; Max: Maximum; *: Median of BCVA.

summed mfERG (=total area) showed positive (r=0.34, p=0.042) correlation with the final BCVA levels (Figure 5). Preoperative BCVA was positively correlated to preoperative intensity of P1 response at concentric ring 1+2 (r=0.38, p=0.020) and P1 amplitudes of the summed mfERG (r=0.47, p=0.003). There was statistically significant difference between the preoperative mean latency of both P1 and N1 and postoperative mean latency of P1 and N1 (p<0.001). Mean latency values of preoperative P1 and N1 were significantly longer than those of postoperative P1 and N1. However, latencies of P1 and N1 returned to similar values of the control group. On the other hand, the extent of RRD was negatively correlated to preoperative intensity of P1 response at concentric ring 1 (r=-0.33, p=0.046), at concentric ring 1+2 (r=-0.41, p=0.013) and P1 amplitudes of the summed mfERG (r=-0.45, p=0.005).

Central foveal thickness measurements revealed that CFT was 199.2+16.4 μ in the control group. In order to avoid possible inaccurate measurements, CFT was not assessed at the baseline. Mean CFT was 260.3+88.1, 260.4+85.2 and 258.4+83.1 μ in the 1st, 3rd and 6th months of the follow-up, respectively. All postoperative values of CFT were somewhat thicker than the control group (p<0.001). Statistical analysis showed that preoperative changes within the foveal structure were also related to mean BCVA at the 6th month of follow-up. Mean BCVA was 0.24+0.2 logMAR units in type 1 (n=10), however it was 0.62+0.3 and 0.62+0.3 in type 2 (n=9) and type 3 (n=18) respectively (r=-0.39, p=0.019) (Figure 6). Preoperative OCT evaluations pointed out that median HMD was 1138.0 (232-2000) π, HMD was greater than 2000 μ in 18 cases. Statistically, HMD showed negative correlation with the ultimate BCVA (r=-0.54, p=0.001) (Figure 7).

Persistence of subretinal fluid (SRF) under the fovea was detected in 21 eyes (56.8%) in the first month of follow-up. Throughout the follow-up, SRF persistence was seen in 16 eyes (43.2%) and in 8 eyes (21.6%) at the third month and at the sixth month, respectively. Statistical analysis showed that there was no significant correlation between the presence of SRF and the preoperative features of OCT and mfERG. Besides, the persistence of SRF had no relevance with postoperative BCVA assessments and mfERG recordings.

DISCUSSION

Postoperative visual recovery has always been a special concern for vitreoretinal surgeons. Particular efforts have been made to determine preoperative and postoperative factors that could help to predict the visual outcome.[7] Preoperative BCVA, extent of RRD, duration and height of macular de-

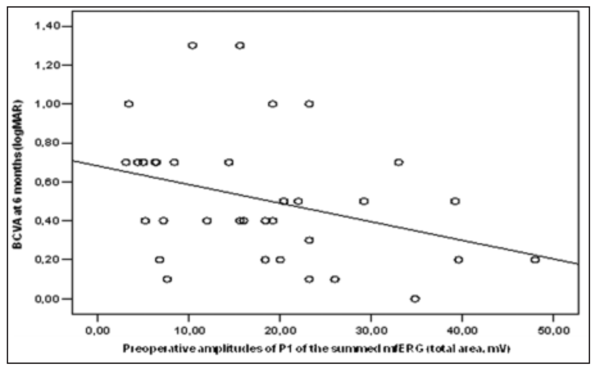

FIGURE 5: Preoperative amplitudes of P1 of the summed response were significantly correlated to final best corrected visual acuity (BCVA) (r=0.34, p=0.042).

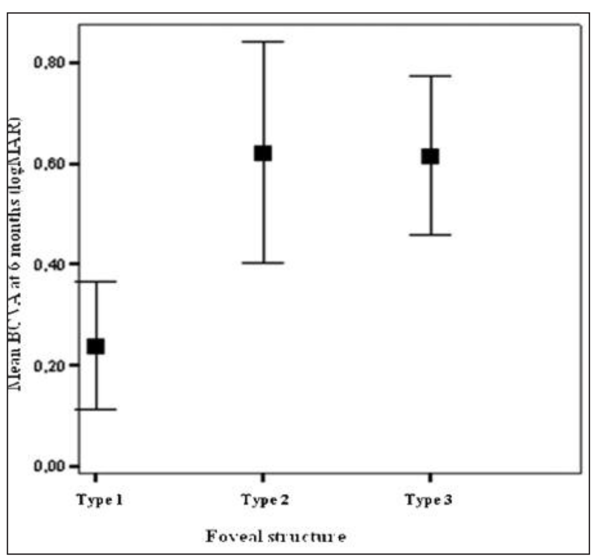

FIGURE 6: Preoperative architecture of the fovea is significantly related to final best corrected visual acuity (BCVA). Cases with normal architecture (type 1) achieved the best outcome among others (r=-0.39, p=0.019).

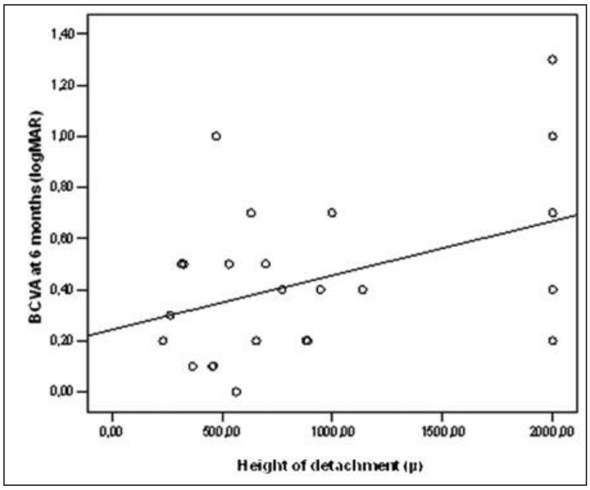

FIGURE 7: Final best corrected visual acuity (BCVA) was found to be better in cases with shallow detachments (r=-0.54, p=0.001).

tachment, structural changes within the fovea and proliferative vitreoretinopathy have been identified as prognostic indicators of final visual acuity.[6,8-10] However limitations of these factors have urged efforts to identify new hints for prognosis.

Over the last decades, novel techniques that help to evaluate the status of macula have been included in the diagnostic armamentarium of ophthalmology. These techniques have provided new insights regarding the anatomical and functional status. mfERG is an objective technique that simultaneously measures retinal function at multiple retinal locations in terms of negative deflections (N1 and N2), and a positive peak (P1). mfERG waveforms reflect not only the photoreceptor layer, but also bipolar and other cells in the inner retina. Evidence suggests that the inner portion of rods and cones contribute to formation of N1 wave while amacrine cells, bipolar cells and Muller cells contribute to formation of P1 and N2 wave.[11,12] Briefly, the amplitude of P1 is strongly related to the function and number of photoreceptors. Besides implicit time is also thought to be a reliable indicator of retinal injury.[13,14] In mfERG it is clearly known that ring 1 corresponds to fovea, ring 2 represents parafovea and ring 3 corresponds to perifovea.

In this study, we aimed to evaluate the status of the macula, accordingly we have studied ring 1 and ring1+2 with mfERG. In order to compare these 2 innermost rings with the entire retina, we have used summed values of the total area of hexagons as well. Results of our study showed that SB surgery helped to improve both amplitudes and latencies of P1 and N1 in the postoperative period. However, postoperative amplitudes of P1 and N1 were lower than the control group. In our opinion, this may imply that functional recovery could not be achieved at the desired extent postoperatively. Amplitudes of P1 improved more markedly than those of N1. A review of the literature shows that these results are consistent with the previously published data.[4,15]

Preoperative BCVA was in concordance with the preoperative amplitudes of P1 of ring 1+2 and the summed mfERG. There was statistically significant correlations between the extent of RRD and the preoperative amplitudes of P1 from the fovea, parafovea and the total area (summed mfERG) in a decremental manner. Statistical analysis revealed that preoperative amplitudes of P1 of summed mfERG was significantly correlated to final BCVA. We have to notify that there are insufficient data in the literature dealing with the prognostic value of P1. Our results indicate that preoperative amplitudes of P1 correlate well with the retinal damage. Statistically, amplitudes of P1 seemed to help distinguish those who are more likely to benefit from the surgery.

Results in this study showed that the amplitudes of P1 and N1 remained steady beyond the 1st month of follow-up; however Sasoh et al. have reported constancy beyond the third month.[4] This difference may be due to the characteristics of the study groups. In our study, basically all latencies of P1 and N1 recovered substantially in the postoperative period however they were slightly longer than the control group. Together with a decrease in amplitudes, a mild delay in the implicit time suggests outer segment damage of phororeceptors and/or cell loss which usually take place after RRD.

On the other hand, OCT is a relatively newer technique that allows to perform in vivo screening and evaluation of retinal structure in a non-invasive manner. In retinal detachment, the macula can be evaluated in detail with pre- and postoperative OCT.[16,17] In this study, OCT evaluations pointed out that preoperative architecture of the fovea is significantly related to final BCVA. Namely, cases with normal architecture on OCT (type 1) achieved the best outcome among others. Our results suggest that HMD was negatively correlated to final BCVA. Statistically, final BCVA was found to be better in cases with shallow detachments. The significance of foveal architecture and HMD has been reported previously.[6,8] Machemer and Norton have shown that increment in the distance between the detached retina and the RPE aggravates photoreceptor degeneration.[19] Similarly, our results suggest that HMD (r=0.54) has greater effect on the final visual acuity than preoperative changes of the foveal structure (r=0.39).

Postoperatively, SRF was detected as a common feature among the participants of our study. Fortunately SRF gradually resolved in the vast majority, however in 8 patients SRF still persisted even at the 6th month of follow-up. No significant correlation existed between the presence of SRF and the preoperative assessments of OCT and mfERG. Persistence of SRF has been reported in 30% to 50% of cases that have undergone conventional RRD surgery.[16-18] Wolfensberger and Gonvers have stated that longstanding accumulation of SRF could be associated with visual impairment, and SRF may persist up to 12 months postoperatively.[16] In most of our patients, SRF was inclined to decrease along the follow-up. Statistically, accumulation of SRF did not provoke any alteration in the recordings of mfERG. This situation made us think that persistence of SRF may not cause significant functional change in the retina at least in the short term.

Currently, there is ongoing debate regarding the contribution of preoperative BCVA in the determination of postoperative visual acuity. Several reports have emphasized that preoperative BCVA helps to estimate the final postoperative BCVA in macula-off RRD.[9] However some authors specify that preoperative visual acuity has a limited place in the determination of visual acuity.[3] Previously, it has been reported that the percentage of regaining postoperative acuity of 20/50 or better is 31% when preoperative acuity is less than 20/200. However, the percentage rises to 65% when preoperative BCVA is better or equal to 20/200.[20] In our study, the abovementioned results were found as 22% and 50% respectively. Nevertheless we could not find any statistically significant relationship between the preoperative BCVA and the final visual outcome. This situation has led to some doubts about the impact of preoperative vision on postoperative vision. We believe that further investigation is needed on this topic.

Moreover, duration of macular detachment has been stressed as a major prognostic factor in predicting visual prognosis.[9,10] Several reports have pointed out that in cases with macula-off RRD; the final visual outcome is diminished within 1 to 2 weeks after the onset of detachment.[21,22] However in this study, there was no statistically significant correlation between the final BCVA and DMD. This result clearly contradicts with the previously published data. We suppose that this discrepancy may be attributed to the characteristics of the study group.

There are some points that need to be explained in our study. Preoperative amplitudes of P1 of the summed response (total area) were significantly correlated to final BCVA. We were surprised to notice that amplitudes of ring 1 did not expose statistically proven correlation with the postoperative outcome. It may be attributed to inter-individual variation of mfERG measurements or the condition of the photoreceptors of the cases. Limitations of our study can be listed as the small number of subjects and the relatively short follow-up. One drawback of the study is regarding the technology of OCT. Certainly, spectral domain OCT provides more detailed data about the architecture of retina.[23] Especially studying the abnormalities in the IS/OS junction and external limiting membrane could have added valuable information to our study.

In conclusion, factors that help to predict the anatomical and functional success in macula-off

RRD have not been sufficiently enlightened yet. Indicators previously described on the subject still maintain value to some extent. However, it is obvious that a more practical and objective approach is needed for precise prescience on this topic. Our results indicate that both mfERG and OCT may help to document the potential functional recovery. These techniques may be utilized preoperatively in a complementary manner to distinguish patients who are most likely to benefit from the surgery. We believe that further studies with large scale are required to determine the factors that could contribute to predict the visual outcome in cases with RRD.

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