Transient Increase of Flicker Electroretinography Amplitudes after Cataract Surgery: Association with Postoperative Inflammation

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Title: Transient Increase of Flicker Electroretinography Amplitudes after Cataract Surgery: Association with Postoperative Inflammation

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Short title: Retinal Electrophysiological change after Cataract Surgery.

Abbreviations: ERG, electroretinography; CMT, central macular thickness; AFV, aqueous flare value; BCVA, best-corrected visual acuity; IOP, intraocular pressure; NO, nitric oxide.

Key Words: cataract surgery, electroretinography, inflammation, central macular thickness, aqueous flare value

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Abstract

**Purpose**: To determine the characteristics and cause of the increase in the amplitude of flicker electroretinography (ERG) after cataract surgery.

**Design**: Prospective, observational clinical study.

**Participants**: 30 patients who underwent cataract surgery.

**Methods**: Flicker ERGs were recorded with the RETeval system without mydriasis. The central macular thickness (CMT) was measured by optical coherence tomography, and the aqueous flare value (AFV) by laser flare-cell photometry. These examinations were performed before the surgery, one day, one week, one month, two months, and three months after the surgery. Linear regression analysis through the origin was used to compare the correlations between the relative changes in the flicker ERG amplitudes and the changes in the CMT and the AFV at different times after the surgery.

**Main Outcome Measures**: The amplitude of flicker ERG, CMT and AFV.

**Results**: The mean amplitude of the flicker ERGs increased significantly by 31% at one week after the surgery \( (P < 0.001) \), then the significant increase of the amplitudes was not present at three months after the surgery. The mean AFV was significantly increased at one day after the surgery \( (P < 0.001) \), and the CMT was significantly increased at one to three months after the surgery \( (P < 0.001) \). The changes of the flicker ERG amplitudes at one week after the surgery was significantly associated with the changes of the CMT at
one to three months after the surgery ($P<0.05$), and they were weakly associated with the changes of AFV at one day after the surgery ($P=0.05$).

**Conclusions:** These results suggest that the increase in the amplitude of the flicker ERGs after the cataract surgery is a transient phenomenon that has a peak at one week after the surgery. The increase of flicker ERG amplitude was associated with measures that is frequently used to evaluate postoperative inflammation.
**Introduction**

Electroretinography (ERG) is widely used to diagnose inherited retinal diseases with dysfunctions of the inner and/or outer retinal layers.\(^1\)\(^-\)\(^4\) It is known that the characteristics of the ERGs are important in evaluating the ischemic status of the retina in eyes with vascular diseases including diabetic retinopathy\(^5\)\(^-\)\(^7\) and retinal vascular occlusions.\(^8\)\(^-\)\(^10\)

Relevant to this study, ERGs have been used to detect retinal dysfunction associated with various types of intraocular inflammation.\(^11\)\(^-\)\(^13\)

Most studies on the effect of cataract surgery on the ERGs have demonstrated that the ERG amplitudes increased slightly after cataract surgery.\(^14\)\(^-\)\(^16\) Recently, Miura et al.\(^17\) reported that the amplitude of the flicker ERGs increased by 51-67% even though the degree of cataract was relatively mild. Similarly, Tanikawa et al.\(^18\) reported that the amplitudes of all ERG components including the rod and cone responses increased by 11 to 23% at one week after the cataract surgery in eyes with mild cataracts. They attributed the increases to the removal of the light absorption effects of the cataract and/or the changes in the distribution of stimulus light scattering over the entire retina after the surgery.\(^17\)\(^,\)\(^18\)

Based on our clinical experience using ERGs in various ocular diseases by ERGs, we developed a hypothesis that the increase of the ERG amplitude, particularly the flicker ERG amplitude, after the cataract surgery may be a transient phenomenon which
is caused by postoperative intraocular inflammation. This hypothesis was made because we have recently observed an increase of the ERG amplitudes in eyes with the non-ischemic type of central retinal vein occlusion\textsuperscript{10}, mild diabetic retinopathy\textsuperscript{7}, and acute uveitis.\textsuperscript{19}

To test this hypothesis, we performed a prospective clinical study of recording flicker ERGs before and periodically for up to three months after cataract surgery in patients with mild degree of cataract. To determine whether there was a relationship between the change of ERG amplitude and postoperative intraocular inflammation, we also measured the aqueous flare value (AFV) using a laser flare photometer, and central macular thickness (CMT) using optical coherence tomography (OCT), both of which are widely used for evaluating postoperative intraocular inflammation after cataract surgery.

**METHODS**

**Study Design**

This was a prospective, single center study conducted at the Mie University Hospital between December 2019 and March 2021. The Medical Ethics Committee of Mie University Hospital approved the procedures used (No. 2019-156), and the procedures conformed to the tenets of the Declaration of Helsinki of the World Medical Association.
All participants signed a written informed consent form after they were provided with information on the procedures to be used.

**Subjects**

The eligibility criteria were patients who required cataract surgery and were ≥50-years-of-age. Only eyes with relatively mild cataract with grade 1-2 nuclear, cortical, or posterior subcapsular cataract were included. The exclusion criteria included eyes with diabetic retinopathy, retinal vein occlusion, epiretinal membrane, uveitis, and with glaucoma receiving topical medications because these eyes are known to have a high incidence of developing cystoid macular edema (CME) after cataract surgery. Patients who had myopia of ≥ −6.0 diopters (D) were also excluded. In the end, 33 eyes of 33 patients that underwent cataract surgery were studied.

**Cataract Surgery**

Cataract surgery was performed by nine experienced surgeons (KK, HM, KI, HT, YM, AI, TN, MS, and MK) in the Mie University Hospital. After topical or sub-Tenon capsule anesthesia by lidocaine hydrochloride, a standard microincision cataract surgery was performed including a 2.4-mm corneal or corneoscleral incision, continuous curvilinear capsulorrhexis, phacoemulsification, and implantation of a foldable intraocular lens.
Topical moxifloxacin and betamethasone were applied 3/day and bromfenac 2/day beginning postoperative day one. At one month after the surgery, all of these eye drops were discontinued after we confirmed that there were no obvious ocular complications.

**Protocols of Examinations**

The best-corrected visual acuity (BCVA) was measured with a standard Japanese decimal visual acuity chart at 5 meters. The intraocular pressure (IOP) was measured by a non-contact automatic tonometer (CT-1P, Topcon, Tokyo, Japan). The CMT was measured by a spectral-domain OCT device (Spectralis; Heidelberg Engineering Inc., Heidelberg, German), and the CMT was defined as the average thickness of the macula within the central 1 mm of the retina. The AFV was measured by a laser flare photometer (Kowa FC-1000 LFCM; Kowa Co, Ltd, Tokyo, Japan), and the value was expressed in photon counts/millisecond (ph/ms). These clinical examinations were performed before the surgery, one day, one week, one month, two months, and three months after the surgery.

**Flicker Electroretinography Recordings by RETeval**

Full-field flicker ERGs were recorded with natural pupils using the RETeval system.24,25 Full-field stimuli were presented with a 60-mm diameter dome, and the white stimuli
were created by a combination of three colored light emitting diodes. In this study, we used a stimulus flash of 32 photopic Td-s, which we have reported to be less susceptible to the effects of sequence of recordings of the tested eye compared with weaker stimuli. The ERGs were picked up with a special skin electrode array (Sensor Strip; LKC Technologies, Inc.) that was placed 2 mm from the margin of the lower eyelid.

The amplitudes and implicit times of the fundamental component were automatically measured and displayed by the RETeval system using a special algorithm using discrete Fourier transformation and cross-correlation analysis. In this study, we analyzed the results of fundamental component of flicker ERG because the fundamental component is known to be sensitive to various functional changes in the retina.27-30

Relative Changes of the Amplitude of ERGs Compared to Baseline Value

The relative change (Δ) in the amplitude of the flicker ERGs after the surgery were compared to the preoperative values (%) as follows:

\[ \Delta (\%) = \frac{\text{postoperative value} - \text{preoperative value}}{\text{preoperative value}}. \]

Statistical Analyses

Two-way layout ANOVA was performed to examine if there was a significant change in the implicit times or amplitudes of the fundamental component of the flicker
ERGs, CMT, and AFV during each postoperative times after the surgery. Then, the Dunnett’s multiple comparison tests were used to identify which time points were significantly different from the baseline values before the surgery.

To determine whether the degree of change of two different factors were significantly correlated, a linear regression analysis through the origin was performed. Thus, we examined whether the changes of the flicker ERGs at one week after the surgery were correlated with the changes of the AFV or the changes of the CMT at each time point after the surgery.

Multivariate linear regression analysis was used to determine if other factors were significantly associated with the changes of the amplitudes of the flicker ERGs at one week after the surgery. The explanatory variables were the age, sex, axial lengths, operation times, and baseline flicker ERG amplitudes. All of the statistical analyses were performed using the IBM SPSS Statistics software program (version 27.0.1). \( P \) values of <0.05 were taken to be statistically significant.

RESULTS

Clinical Characteristics of Patients Who Underwent Cataract Surgery

All 33 eyes had successful cataract surgery without any complications. After the surgery, one patient could not visit the hospital as scheduled and two patients were excluded
because of missing test data. In the end, a total of 30 eyes were used for the final analysis.

The mean preoperative BCVA of the 30 patients (13 men and 17 women) who underwent the cataract surgery was $0.32 \pm 0.23$ logMAR units (range 0 - 1.00), and the mean BCVA at the final visit was $-0.06 \pm 0.08$ logMAR units (range -0.18 - 0.10). The mean age of the 30 patients was 72.3 $\pm$ 6.1 years (range: 55-82 years). The mean operation time was 18.2 $\pm$ 5.0 min, and there were no patients who had abnormal intraocular pressure elevation, abnormal ocular inflammation, CME, or endophthalmitis after the surgery.

**Changes of Flicker Electroretinography after Cataract Surgery**

Representative flicker ERGs recorded before and one day, one week, one month, two months, and three months after the cataract surgery are shown in Figure 1A. The fundamental component (red dotted line) is superimposed on the Fourier analyzed flicker ERGs (solid black line) using the first eight harmonics. The actual values of the amplitudes and implicit times of the fundamental components are also shown in the rightmost column.

The amplitude of fundamental component of the flicker ERGs did not change significantly at one day after the surgery. However, it became significantly larger from
14.6 μV to 26.6 μV at one week after the surgery (Fig. 1A, 3rd row from the top). After that, the amplitude of the ERG gradually decreased. There was no significant change in the implicit times after the surgery.

To assess the changes in the flicker ERG amplitude before and after cataract surgery quantitatively, we plotted the amplitude at each time point of the 30 subjects in Figure 1B. We found that amplitude of the fundamental component of the flicker ERGs was significantly larger than that at the baseline at one week after the surgery ($P<0.001$) with a mean increase from the preoperative value of 31.2%. After that, the amplitude of flicker ERGs gradually decreased. At 2 months, just after the postoperative anti-inflammatory eye drops wore off, the amplitudes tended to increase slightly again and remained above the preoperative values (Fig. 1B, red arrow). At 3 months after the surgery, the mean amplitude of the flicker ERGs decreased and was not significantly different from the preoperative value.

We have also plotted the changes in the implicit times of the fundamental component of the flicker ERGs before and after the surgery in Figure 1C. The implicit times became significantly but only slightly earlier at one day after the surgery ($P<0.001$), but there were no significant differences at any other time point.

There was no significant change in the pupillary diameter during RETeval flicker ERG testing at any test points after the surgery compared with the preoperative baseline (data
not shown). We performed the same analysis using the reconstructed flicker ERG waveforms that is comprised of the first eight harmonics, and similar trends were observed (Supplementary Figure 2).

**Changes in Aqueous Flare Value (AFV) and Central Macular Thickness**

Because we considered the possibility that the increase in the amplitude of the flicker ERG may be related to intraocular inflammation after the cataract surgery, we also analyzed the changes in the AFV and CMT in the same 30 eyes. The changes in the mean AFV before and after the cataract surgery are plotted in Figure 3A. We found that the mean AFV increased significantly only at day one after the surgery ($P < 0.001$), but it did not significantly differ from preoperative values at all other time points after the surgery.

The mean CMT before and after the surgery is plotted in Figure 3B. We found that the mean CMT was significantly decreased at day one after the surgery ($P = 0.010$), but then began to increase gradually and reached the maximum at 2 months. The mean CMT was significantly thicker at one to three months after the cataract surgery than that at the baseline ($P < 0.001$, Fig. 3B). A color map of the retinal thickness recorded from one representative patient is shown in Figure 3C. The map shows a gradual increase of the CMT at 1-3 months after the surgery.
Correlations of Flicker Electroretinography Amplitude with Aqueous Flare Value or Central Macular Thickness

Next, we sought to determine whether the changes of the flicker ERGs after the surgery were correlated with two known indicators of postoperative ocular inflammation, viz., the AFV and CMT using a linear regression analysis through the origin.\textsuperscript{31,32}

The results of the standardized partial regression coefficients ($\beta$) and $P$-values for the correlation between the changes in the flicker ERG amplitude ($\Delta$ERG) at one week after the surgery and the changes of AFV ($\Delta$AFV) or the changes of CMT ($\Delta$CMT) at each time point are shown in Table 1. We found that the $\Delta$ERG at one week after the surgery was significantly correlated with the $\Delta$CMT at one to three months after the surgery ($\beta = 0.429–0.491$, $P<$0.05, gray areas of Table 1) with strongest correlation at two months after the surgery (see also Fig. 4).

We also noted that the $\Delta$ERG at one week after the surgery tended to be correlated with the $\Delta$AFV at one day after the surgery, but this correlation was week ($\beta = 0.354$, $P=0.051$, Table 1). We performed the same analysis using the reconstructed waveform of the flicker ERGs, and similar trends were observed (Supplementary Table 2).
Factors Associated with Amplitude Increase of Flicker Electroretinography after Cataract Surgery

Finally, to investigate the baseline factors of the patients which were associated with the increase in the flicker ERGs at one week after the surgery, we performed the multivariate linear regression analyses (Table 3). The independent variables were sex, age, affected eye (right or left), axial length, operation time, and the baseline amplitude of the flicker ERGs. We found that only the baseline amplitude of flicker ERGs was significantly and negatively associated with the ΔERG at one week after the surgery ($\beta = -0.560$, $P = 0.004$, Table 3). This indicated that smaller baseline amplitude of flicker ERGs was associated with greater changes of flicker ERG amplitudes at one week after the surgery (see also Fig. 5).

DISCUSSION

Our results showed for the first time that the amplitude increase of the flicker ERGs after the cataract surgery is a transient phenomenon that peaks at one week after the surgery (Fig. 1). We also showed that the increase of the flicker ERG amplitudes at one week after the surgery were significantly correlated with the changes of the CMT at one and three months after the surgery, and it is weakly correlated with the changes of the AFV at one day after the surgery (Table 1, Fig. 4). In addition, we also noted that after the
postoperative anti-inflammatory eye drops were discontinued at one month after the surgery, the ERG amplitude tended to increase slightly (Fig. 1B, red arrow). These results suggested that the increase of the flicker ERG amplitudes after the cataract surgery was most likely caused by the postoperative intraocular inflammation rather than by the removal of light absorption or scattering effects of the cataract. These findings provide a new insight into this interesting electrophysiological phenomenon of the eye.

The phenomenon of transient increases in the ERG amplitude has been reported in several pathological conditions including early phase of intraocular iron foreign body\textsuperscript{33} and in some eyes at the early stages of diabetic retinopathy\textsuperscript{7,34} We also recently reported that “supernormal” ERG amplitudes were seen in some eyes with non-ischemic central retinal vein occlusion\textsuperscript{10} and acute uveitis due to the lens fragments.\textsuperscript{19} Therefore, it would be reasonable to assume that the increase of ERG amplitudes was associated with the intraocular mediators produced by pathological conditions such as trauma, ischemia, or inflammation.

At present, what intraocular mediators are responsible directly for the amplitude increase of ERG under some pathological conditions have not been determined. However, we have speculated that one major candidate may be nitric oxide (NO). It is known that the NO is produced in the eyes in various pathological conditions such as diabetic retinopathy, retinal ischemia, uveitis, and trauma.\textsuperscript{35-37} NO is also known to be
generated in the eye after cataract surgery.38 Interestingly, Vielma et al. reported that the amplitude of all ERG components increased after the intravitreal injection of NO in rats.39 They also showed that the ERG amplitudes of the cone responses increased by 47% after NO injection, a value is comparable to the degree of flicker ERG increase after the cataract surgery in our study of 31%.

The time course of the changes in the values of the flicker ERGs, CMT, and AFV after the cataract surgery is plotted in Figure 6. We found that the time of the peak of ERG amplitude was later than the peak time of AFV, but earlier than the peak time of CMT. It is widely believed that the surgical invasion causes blood-aqueous barrier disruption with leakage of inflammatory molecules and cells into the anterior chamber which results in an increase of the AFV. These inflammatory mediators released by the anterior uvea gradually diffuse into the vitreous and increase the permeability of perifoveal capillaries, resulting in the intraretinal fluid accumulation and increase of the CMT.40 At the same time, these inflammatory mediators may have acted directly or indirectly on retinal neurons, resulting in an increase in the flicker ERG amplitudes. If this was the case, it would not be too surprising if these electrophysiological changes in the retina occurred earlier than the morphological changes in the retina.

We also noticed that the degree of change in the flicker ERG amplitudes at one week after the cataract surgery was not uniform among the 30 eyes and ranged from -
30% to +82% (Fig. 5). We studied what kinds of background factors of the patients were associated with the degree of changes of ERG amplitude and found that it was dependent on the initial ERG amplitude: thus, the eyes with smaller initial ERG amplitudes tended to have greater degree of amplitude increase (%) after the surgery (Table 3, Fig. 5). Although the exact reason for this was not determined, we have one suggestion called the “ceiling effect of the ERG amplitude increase”. The ERGs arise from the electrical activities of the retinal neurons elicited by light stimuli, and the amplitudes can be increased in response to some intraocular mediators. However, there must be an upper limit of the maximal amplitude value. Therefore, the larger the initial amplitude, the smaller the degree of increase due to the intraocular inflammation.

Alternative hypothesis is that the eyes with larger preoperative flicker ERG amplitudes may have already had some preoperative inflammations so were already enhanced.

Finally, we discuss the impact of the results on the functional evaluations using the ERGs before and after ophthalmic surgery. ERGs are often examined before and after surgery to determine whether an improvement of retinal function has occurred after the vitreoretinal surgery. However, our results clearly showed that the intraocular changes other than improvement of optical quality caused by the surgery can increase the amplitude of the ERGs transiently. Therefore, when an increase in ERG amplitude is observed after surgery, it is necessary to determine whether the increase of the ERG
amplitude was caused by the improvement of retinal function due to the surgery or by the transient physiological changes of the retina associated with the surgery. This would be of especially important when the ERG is recorded within 2-3 months of the surgery.

There are several limitations in this study. First, although we suggested that the amplitude increase of flicker ERG may be caused by some intraocular mediators produced by cataract surgery, we did not identify which cytokine or chemokine is responsible for the ERG amplitude increase. We also cannot deny the possibility that factors other than ocular inflammation such as improvement in optical properties may be involved in the increased ERG amplitudes. Second, we recorded only the flicker ERGs before and after the surgery. If all ERG components including the a- and b-waves, and the oscillatory potentials of the cone and rod responses had been recorded, it would have been possible to determine which retinal neurons in the retina were responsible for the increase. Third, we examined the changes of the flicker ERGs for only 30 eyes before and after the uncomplicated cataract surgery. Therefore, we could not determine whether the changes of the ERGs can help in predicting which eyes will develop macular edema after the cataract surgery. We are currently continuing our prospective studies including eyes prone to have inflammation and complications to determine whether the ERG values can predict the development of macular edema after cataract surgery. Forth limitation was that, we followed up patients for only three months after the
surgery. At 3 months postoperatively, there was residual increase in central retinal thickness and the amplitude of the ERG had not returned to baseline value. A follow-up to 6 months postoperatively would have provided more interesting insights. We are in the process of developing a study plan with an extended follow-up period.

In conclusion, we demonstrated that the increase in the amplitude of the flicker ERGs after the cataract surgery is a transient phenomenon that peaks at one week after the surgery. We also showed that this ERG increase is significantly associated with postoperative intraocular inflammatory process. Further studies are needed to determine what mediators are responsible for this ERG amplitude increase, and whether the flicker ERG can be used to predict the eyes which will develop macular edema after the cataract surgery at the early stages, or to evaluate the effect of anti-inflammatory medications on the postoperative inflammation.

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Palmer Eye Institute of the University of Miami (Miami, FL, USA) for critical discussion and final manuscript revisions.

**Author Contributions:** KK and MK designed the study. KK, RN, HM, KI, HT, YM, TN, MS, and MK collected the data. KK and MK analyzed the data. KK, DM and MK wrote the manuscript. All authors reviewed the manuscript.
References


Figure Legends

Figure 1: Changes of flicker electroretinography (ERG) before and after the cataract surgery. (A) Changes of flicker ERG before and after the cataract surgery in a representative normal subject. The fundamental component (red dot line) is superimposed on the reconstructed flicker ERG (solid black line) using the first eight harmonics. Actual values of the amplitudes and implicit times of fundamental components are also shown on the rightmost column. (B) Plot of the amplitude of fundamental component of flicker ERG before and at each time point after the cataract surgery. The bars indicate the standard error of the mean (SEM). *P<0.05, **P<0.001. (C) Changes in the implicit times of fundamental component of flicker ERG before and at each time point after the cataract surgery. The bars indicate the standard error of the mean (SEM). **P<0.001.

Figure 3: Changes of aqueous flare value (AFV) and central macular thickness (CMT) before and after the cataract surgery. (A) Plot of the AFV before and after each time point of cataract surgery. The bars indicate the standard error of the mean (SEM). **P<0.001. (B) Plot of the CMT before and at each time point after the cataract surgery. The bars indicate the standard error of the mean (SEM). *P<0.05, **P<0.001. (C)
Changes in the color map of retinal thickness before and at each time point after the cataract surgery.

**Figure 4:** Plot of changes of central macular thickness (ΔCMT) at one, two, and three months after the surgery against the changes of flicker electroretinography (ERG) amplitude (ΔERG) at one week. A linear regression analysis through the origin showed that the ΔERG at one week was significantly associated with ΔCMT at one to three months after the surgery (\(P<0.05\)) with highest correlation at two months after the surgery.

**Figure 5:** Plot of the changes of flicker electroretinography (ERG) amplitude (ΔERG) at one week after the surgery against the preoperative flicker ERG amplitude. There was a significant negative correlation between the preoperative amplitude of flicker ERG and ΔERG at one week after the surgery (\(r=-0.519, P=0.003\)).

**Figure 6:** Schema showing the time courses of changes for the values of the flicker electroretinography (ERG) amplitude, central macular thickness (CMT), and aqueous flare value (AFV) after the cataract surgery. The AFV (blue line) increased immediately at one day after the surgery and returned to baseline within one week. The amplitude of
flicker ERG (red line) showed a peak at one week after the surgery. The CMT (black line) gradually increased and peaked at two months after the surgery.
Table 1: Correlation between the changes of flicker electroretinography amplitude (ΔERG) at one week and the change of aqueous flare values (ΔAFV) or central macular thickness (ΔCMT) at each time point.

<table>
<thead>
<tr>
<th>Time point</th>
<th>ΔAFV</th>
<th>ΔCMT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>β</td>
</tr>
<tr>
<td></td>
<td>(CI)</td>
<td>(CI)</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>1 day</td>
<td>0.354</td>
<td>-0.172</td>
</tr>
<tr>
<td></td>
<td>-0.001 – 0.629</td>
<td>-0.496 – 0.194</td>
</tr>
<tr>
<td></td>
<td>0.051</td>
<td>0.356</td>
</tr>
<tr>
<td>1 week</td>
<td>-0.080</td>
<td>-0.041</td>
</tr>
<tr>
<td></td>
<td>-0.423 – 0.282</td>
<td>-0.390 – 0.318</td>
</tr>
<tr>
<td></td>
<td>0.667</td>
<td>0.825</td>
</tr>
<tr>
<td>1 month</td>
<td>-0.250</td>
<td>0.429</td>
</tr>
<tr>
<td></td>
<td>-0.555 – 0.114</td>
<td>0.087 – 0.680</td>
</tr>
<tr>
<td></td>
<td>0.174</td>
<td>0.016*</td>
</tr>
<tr>
<td>2 months</td>
<td>-0.157</td>
<td>0.491</td>
</tr>
<tr>
<td></td>
<td>-0.484 – 0.209</td>
<td>0.166 – 0.720</td>
</tr>
<tr>
<td></td>
<td>0.400</td>
<td>0.005**</td>
</tr>
<tr>
<td>3 months</td>
<td>-0.166</td>
<td>0.443</td>
</tr>
<tr>
<td></td>
<td>-0.492 – 0.200</td>
<td>0.104 – 0.689</td>
</tr>
<tr>
<td></td>
<td>0.371</td>
<td>0.013*</td>
</tr>
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</table>

A linear regression analysis through the origin was used. Standardized partial regression coefficient (β), and P value are shown. CI: 95% confidential interval. * P < 0.05 was considered significant. ** P < 0.01. The gray areas indicate the time points when significant correlations were found.
Table 3: Results of multiple linear regression analysis to identify the factors that were associated with the changes of flicker electroretinography amplitude at one week after the surgery compared to preoperative values (%).

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>β</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>0.119</td>
<td>0.536</td>
</tr>
<tr>
<td>Sex (men/women)</td>
<td>0.261</td>
<td>0.170</td>
</tr>
<tr>
<td>Axial length (mm)</td>
<td>-0.037</td>
<td>0.846</td>
</tr>
<tr>
<td>Operation time (min.)</td>
<td>0.002</td>
<td>0.993</td>
</tr>
<tr>
<td>Baseline flicker ERG amplitude (uV)</td>
<td>-0.560</td>
<td>0.004*</td>
</tr>
</tbody>
</table>

ERG, electroretinography. Standardized partial regression coefficient (β), and P-values are calculated for five independent variables which were associated with the changes of flicker ERG amplitude at one week after the surgery compared to preoperative values (%). *P < 0.05 was considered significant.
A

Before surgery

1 day

1 week

1 month

2 months

3 months

Amplitude: 14.6μV
Implicit time: 30.5ms

Amplitude: 14.8μV
Implicit time: 29.7ms

Amplitude: 26.6μV
Implicit time: 29.9ms

Amplitude: 16.0μV
Implicit time: 30.1ms

Amplitude: 21.3μV
Implicit time: 30.5ms

Amplitude: 20.6μV
Implicit time: 30.6ms

B

Amplitude of fundamental component (μV)

Before surgery 1 day 1 week 1 month 2 months 3 months

16.0 14.1 21.0 18.5 18.9 18.0

P=0.156 **P<0.001 *P=0.032 *P=0.008 P=0.117

C

Implicit time of fundamental component (ms)

Before surgery 1 day 1 week 1 month 2 months 3 months

31.5 30.4 31.1 31.3 31.2 31.4

**P<0.001 P=0.999 P=1.000 P=1.000 P=0.996
The scatter plot shows the correlation between preoperative flicker ERG amplitude (μV) and ΔERG at 1 week (%). The correlation coefficient is $r = -0.519$ and the p-value is $P = 0.003$. The data points are plotted on a graph with the ΔERG on the y-axis and the preoperative flicker ERG amplitude on the x-axis.
Précis
The transient increase in amplitude of the flicker electroretinography after cataract surgery correlated with the increase in central macular thickness, a known indicator of postoperative inflammation, we hypothesized that electroretinography can assess postoperative intraocular inflammation.