Changes in Contrast Sensitivity after Surgery for Macula-On Rhegmatogenous Retinal Detachment

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• PURPOSE: To evaluate changes in contrast sensitivity after surgery for macula-on rhegmatogenous retinal detachment (RRD).

• DESIGN: Prospective, interventional, consecutive, case-control study.

• METHODS: This study included 84 eyes of 84 patients with unilateral macula-on RRD undergoing primary scleral buckling or vitrectomy without postoperative macular complication. We examined the logarithm of the minimal angle of resolution best-corrected visual acuity (logMAR BCVA) and contrast sensitivity at 4 spatial frequencies (3, 6, 12, and 18 cycles/degree) using the CSV-1000E (Vector Vision) before and after surgery. From the data obtained with the CSV-1000E, the area under the log contrast sensitivity function was calculated. The logMAR BCVA and contrast sensitivity in the contralateral normal eyes also were measured and were used as normal controls. Clinical data were collected, including age, gender, surgical procedures, the number of retinal tears, circumferential dimension of retinal tears, and area of retinal detachment, to determine the clinical factors related to visual function.

• RESULTS: Preoperative contrast sensitivity was significantly worse in eyes with RRD than in normal controls, but the preoperative logMAR BCVA was not different from that of normal controls. Contrast sensitivity decreased significantly after surgery, but logMAR BCVA did not change by surgery. Multiple regression analysis revealed that postoperative contrast sensitivity had a significant correlation with the circumferential dimension of retinal tears, whereas no clinical parameters were associated significantly with postoperative BCVA.

• CONCLUSIONS: Surgery for macula-on RRD did not change visual acuity, whereas contrast sensitivity was affected significantly in association with the extent of retinal tears. (Am J Ophthalmol 2013;156:667–672. © 2013 by Elsevier Inc. All rights reserved.)

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CURRENT TECHNIQUES OF RHEGMATOGENOUS retinal detachment (RRD) repair allow most detachments to be repaired successfully. As a result, visual prognosis has been improved. In macular-on RRD and macula-off RRD, however, some cases show decreased visual acuity after surgery.[1–4] Subretinal fluid, epiretinal membrane, or cystoid macular edema could be a cause for deteriorated vision.[5–14] Recent advancement of optical coherence tomography (OCT) technologies has provided critical insights into various retinal conditions. OCT enhances the resolution and shows the intraretinal architectural morphologic features clearly, such as the ganglion cell layer, inner nuclear layer, outer plexiform layer, outer nuclear layer, photoreceptor inner and outer segment junction (IS/OS), and external limiting membrane (ELM).[15,16] Studies using OCT revealed that visual acuity of RRD patients deteriorated because of disruption of the IS/OS,[17–21] disruption of the ELM,[21,22] and thickening of outer retina.[21] Even after successful retinal reattachment and normal OCT findings, however, postoperative vision may be unsatisfactory in some cases despite good visual acuity. Such patients may report poor visual function that cannot be detected by visual acuity tests. Contrast sensitivity is an index capable of assessing visual function more sensitively than visual acuity.[23] It was known that the longer the duration of macular detachment, the smaller the increase in contrast sensitivity in patients after RRD surgery.[4] However, no reports have addressed contrast sensitivity in patients with macula-on RRD. The purpose of this study was to assess the effect of macula-on RRD on contrast sensitivity and the effect of RRD surgery without postoperative complications on contrast sensitivity.

METHODS

WE CONDUCTED THIS PROSPECTIVE STUDY IN ACCORDANCE with the tenets of the Declaration of Helsinki, and the study protocol was approved by the institutional review committees of Tsukuba University Hospital. Before inclusion in the study, all patients provided written informed consent after the nature of the study was explained to them. We included patients with unilateral, macular-on RRD who were treated successfully either with a scleral buckling procedure or pars plana vitrectomy. Surgery was

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performed at our clinic by 2 experienced vitreoretinal surgeons (F.O., Y.O.) from January 2007 through February 2011. Healthy contralateral eyes of RRD patients served as normal controls. Inclusion criteria included (1) macular-on RRD; (2) no postoperative macular complication, including cystoid macular edema, epiretinal membrane, macular hole, and subretinal fluid; (3) no abnormal spectrum-domain OCT findings of the macula, including disruption of the IS/OS and ELM line; and (4) no postoperative cataract progression by slit-lump examination. Exclusion criteria included (1) a previous history of ocular surgery in the study eye, (2) ophthalmic disorders except for refractive errors and mild cataract, and (3) complicated vitreoretinal disease such as proliferative vitreoretinopathy and retinal detachment resulting from giant retinal tears, a macular hole, or ocular trauma. Patients with vitreous hemorrhage resulting from RRD also were excluded because their contrast sensitivity can decrease.

Best-corrected visual acuity (BCVA) and contrast sensitivity were obtained before surgery and at 12 months after surgery. Contrast sensitivity was measured by CSV-1000E chart (Vector Vision, Greenville, Ohio, USA) with the best spectacle correction. The CSV-1000E, used to test contrast sensitivity, provides a fluorescent luminance source that retroilluminates a translucent chart and automatically calibrates to 85 cd/m^2. The reliability of this instrument has been demonstrated previously.[24] Four spatial frequencies—3, 6, 12, and 18 cycles/degree (cpd)—were present, and each frequency included 8 different levels of contrast. The test was performed monocularly with the best spectacle correction in an undilated state at 2.5 m. With the patients' manifest refraction in place, they identified the rows and 8 columns of patches. They were then asked to identify the grating pattern in each column. The contrast level of the last correct response was recorded as the contrast threshold in logarithmic values.[24] From the data obtained by CSV-1000E, the area under the log contrast sensitivity function was calculated according to the method of Applegate and associates.[25] The log of contrast sensitivity was plotted as a function of log spatial frequency, and third-order polynomials were fitted to the data. The fitted function was integrated between the fixed log spatial frequency limits of 0.48 (corresponding to 3 cpd) and 1.26 (corresponding to 18 cpd), and the resulting value was defined as the area under the log contrast sensitivity function.

Clinical data were collected, including age, gender, surgical procedures, postoperative lens status, the number of retinal tears, circumferential dimension of retinal tears, area of retinal detachment, and proximity to the foveal center (≤10 degrees or >10 degrees of the foveal center) to determine clinical factors related to visual acuity and contrast sensitivity.

The patients' eyes were classified into 2 groups based on the type of surgical procedure performed: pars plana vitrectomy or scleral buckling. The buckling surgery consisted of cryopexy and circumferential silicone sponge buckling (no. 506; MIRA, Waltham, Massachusetts, USA). The encircling was performed with a silicone band (no. 240; MIRA) or silicone sponge (no. 506G; MIRA). Subretinal fluid drainage and sulfur hexafluoride (SF_6) gas injection were performed when required. Combined cataract surgery and 20- or 23-gauge vitrectomy were performed in all patients in the pars plana vitrectomy group. The surgical technique comprised a vitrectomy that released vitreous traction around the breaks, internal drainage of the subretinal fluid, a total gas–fluid exchange with 20% SF_6, and endolaser photocoagulation. In both treatment groups, patients injected with gas were instructed to maintain a facedown position during the first postoperative week.

Visual acuity measured with the Landolt chart was expressed as the logarithm of minimal angle of resolution (logMAR). An unpaired *t* test was performed to compare visual acuity and contrast sensitivity between RRD eyes and normal eyes. The significance of difference between the preoperative and postoperative values was assessed with a paired *t* test. The correlation between postoperative contrast sensitivity and the number of retinal tears, circumferential dimension of retinal tears, and area of retinal detachment was analyzed by the Spearman rank correlation. All tests were considered statistically significant if $P < .05$. The analyses were carried out with StatView software version 5.0 (SAS Institute, Cary, North Carolina, USA).

RESULTS

AMONG THE 93 PATIENTS WITH MACULAR-ON RRD WITHout ophthalmic disorders, 9 patients (10%) subsequently were excluded after surgery for the following reasons: cystoid macular edema (4 eyes : 4%), epiretinal membrane (2 eyes : 2%), and cataract formation (3 eyes : 3%). Finally, 84 eyes of 84 patients were included. All patients had unilateral RRD and underwent surgery only in the RRD eye during the perioperative and 12-month postoperative period. Retinal reattachment was attained at initial operation in all eyes. No significant intraoperative and postoperative complications were observed, such as movement of subretinal fluid to the fovea, subretinal hemorrhage, persistent elevation of intraocular pressure for more than 7 days, or choroidal detachment. The Table shows clinical characteristics and surgical procedures of patients with macula-on RRD. Among the 84 RRD patients, 54 underwent scleral buckling surgery and 30 underwent vitrectomy. Fifteen eyes were pseudophakic and 69 were phakic, whereas 20 eyes received combined cataract surgery and vitrectomy. In the scleral buckling group, SF_6 gas was injected in 2 patients (13.3%), and subretinal fluid drainage was performed in 9 patients (30.0%). In the vitrectomy group, 20% SF_6 gas was injected in all patients.