Retina

Foveal Contour Changes Following Surgery for Idiopathic Epiretinal Membrane

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Purpose. We evaluated the change in foveal contour in eyes with idiopathic epiretinal membrane (ERM) before and four months following pars plana vitrectomy with internal limiting and epiretinal membrane peeling, and correlated foveal contour with best corrected visual acuity (BCVA) and optical coherence tomography (OCT) parameters.

Methods. Retrospective chart review of consecutive patients undergoing surgery with pre- and postoperative OCT. Foveal contour grading was devised according to the thickness of the fovea relative to the surrounding macula from OCT radial line scans: Grade 0, foveal depression relative to surrounding macula; Grade 1, relative flatness; and Grade 2, fovea thicker than surrounding macula. Baseline and follow-up grades were compared for change and correlated with BCVA, central retinal thickness (CRT), central subfield thickness (CST), central subfield volume (CSV), and integrity of the ellipsoid zone (EZ).

Results. Among 41 eyes of 41 patients, mean follow-up was 125 days. No eyes were Grade 0 at baseline; 7 of 41 eyes were Grade 0 at follow-up. Baseline Grade 1 eyes improved CRT ($P < 0.001$), CST ($P < 0.001$), CSV ($P = 0.002$), and BCVA ($P = 0.022$). Baseline Grade 2 eyes improved CRT ($P < 0.001$), CST ($P < 0.001$), and CSV ($P < 0.001$), but not BCVA ($P = 0.369$).

Conclusions. We developed a novel foveal contour grading method to assess retinal contour in ERM eyes before and after surgery. In eyes with ERM and no foveal depression, the majority did not regain foveal depression following surgery even though retinal thickness improved.

Keywords: epiretinal membrane, foveal contour, ellipsoid zone, internal limiting membrane

Epiretinal membrane (ERM) results from fibrocellular proliferation over the internal limiting membrane (ILM) which may progress to retinal traction.[1,2] This retinal disorder can be nicely visualized on optical coherence tomography (OCT) by the appearance of a hyperreflective band over the ILM and may be accompanied by inner retinal wrinkling. The traction on the inner retinal layers can be distributed to the outer retinal layers, disturbing the photoreceptor ellipsoid zone (EZ), formerly referred to as the inner segment/outer segment (IS/OS) junction.[3,4] Such anatomic disturbances often manifest clinically as symptoms of metamorphopsia, monocular diplopia, and decreased visual acuity.[5]

A foveal depression is present in normal retina. The loss of the foveal depression and the underlying morphological abnormalities can be visualized with OCT, a commonly used imaging modality for assessing the morphology of the retina.[6,7] Various OCT imaging protocols can be used to examine the retina in two and three dimensions. The OCT imaging allows assessment of the degree of retinal traction and underlying morphologic disturbance as a result of ERM. Correction of anatomical disturbances, such as retinal striae and inner retinal wrinkling, often can be achieved with surgical removal of the ERM using pars plana vitrectomy (PPV), and improvement in visual acuity is commonly observed.[8] However, some eyes do not regain normal foveal contour with foveal depression even after successful membrane peeling. This may result in misinterpretation of postsurgical OCT as macular edema. This confusion may be even more frequent when patients are imaged after cataract surgery and may be mistaken for pseudophakic macular edema. Furthermore, the literature on the incidence of return to normal foveal contour following ERM surgery is limited.

Kinoshita et al.[9] characterized the macular contour of eyes with ERM as diffuse type, cystoid macular edema type, pseudolamellar hole type, and vitreomacular traction type. Other methods for characterizing the foveal contour are ambiguous in the literature. Grading systems have ranged from describing the presence or absence of foveal depression to a three-tiered grading system of normal, mild, or severe distortion.[3,10,11] However, these are qualitative grading schemes and a reproducible method to characterize the contour has not been described. Additionally, conflicting results between the impact of the foveal contour on improvements in visual acuity following ERM removal have been reported.[10–12]

In this study, we developed a grading system using OCT images to categorize the foveal contour in a reproducible manner. The primary aim of this study was to use this quantitative method to characterize the foveal contour to determine the baseline foveal contour and change in contour following surgery for ERM, including the incidence of return to normal contour. The secondary aim was to correlate foveal

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contour changes with OCT parameters and best corrected visual acuity (BCVA).

Methods

A retrospective chart review was performed to identify consecutive patients who underwent PPV for idiopathic ERM between January 2009 and May 2012, and had baseline and follow-up OCT at 4 ± 1 months. Institutional review board approval was obtained. This research adhered to the tenets of the Declaration of Helsinki. Exclusion criteria included macular hole, lamellar hole, traction retinal detachment, diabetic macular edema, and previous retinal surgeries or procedures. Surgery was performed with 23-gauge PPV with indocyanine green staining to peel ILM and ERM en bloc. This double-membrane peel technique was used as it has been demonstrated to reduce the recurrence of ERM without negatively affecting visual acuity when compared to ERM peel alone.[13–15]

The OCT imaging was performed in 224 separate patient visits. Of these 224 visits, the majority were completed on a Heidelberg Spectralis (Heidelberg Engineering, Heidelberg, Germany) and 18 were completed on a Zeiss Cirrus HD-OCT (Carl Zeiss Meditec, Inc., Dublin, CA, USA) device. A radial line scan (RLS) protocol centered on the fovea and spaced every 30° radially was used for Spectralis, providing a total of six RLS per visit. A custom MatLab (MathWorks, Natick, MA, USA) program was used to analyze the Cirrus 512 × 128 protocol in a RLS fashion.

Grading the Foveal Contour

We considered the depression of the fovea relative to the surrounding macula (resembling the normal foveal configuration) to be Grade 0. Grade 1 contours consisted of retinas of relatively equal thickness at the fovea relative to the surrounding macula, while Grade 2 contours were thicker at the fovea relative to the surrounding macula (Fig. 1).

Analysis of the foveal contour was conducted quantitatively using the OCT software to measure the thickness of the retina between the ERM and RPE preoperatively, and between the innermost retina and RPE postoperatively. Three measurements were taken on each radial line scan: one at the middle centered on the fovea and two at the periphery, each 1 mm from the center measure (Fig. 1). A distance 1 mm in each direction from the fovea was chosen as it closely approximates the natural radius of the foveal pit in a healthy eye.[16]

The ratio of the thickness of the retina at the fovea to the thickness of the retina 1 mm away in each direction was recorded, resulting in two ratios per line scan. As there were a total of six radial line scans, 12 ratios were recorded per visit. A healthy eye with normal foveal depression would have 12 such ratios each less than 1.00 (a ratio of 1.00 represents a perfectly flat retina). Using data derived from Early Treatment Diabetic Retinopathy Study (ETDRS) mean macular thickness plots, the fovea generally is thinner than the surrounding retina by a factor of 0.77 to 0.83, depending on race and sex.[17]

Stratifying the range of ratios into grades was done by observation of what could be reasonably discernible between "flat" and "elevated" or "depressed." A factor of 0.08 on either side of 1.00 was used as the cutoff. Ratios in which the fovea was thicker than the surrounding retina at 1 mm by a factor of 1.08 or greater were considered elevated or Grade 2. Ratios in which the fovea was thinner than the surrounding retina at 1 mm by a factor of 0.92 or less were considered depressed or Grade 0. Ratios that fell between 0.92 and 1.08 were considered flat or Grade 1 (Fig. 1).

The resulting 12 ratios for each RLS were converted to grades. The majority grade was declared the overall grade of the foveal contour. For example, the overall topography of the retina was considered elevated (Grade 2) if at least 7 of the 12 ratios were 1.08 or greater. In the event of a tie between the grades, the overall grade fell to the lower of the two grades (e.g., six Grade 2 ratios and six Grade 1 ratios would be Grade 1 overall).

The central retinal thickness (CRT) was calculated from the mean of the six radial line scans at the fovea. Central subfield thickness (CST) and central subfield volume (CSV) values were obtained from ETDRS plots generated by the onboard OCT software. The CSV data were not available for visits recorded on Cirrus.

Qualitative grading of the foveal contour also was completed for comparison to the quantitative method described above. Two observers (NRM, D-GK) independently graded the foveal contour of each OCT RLS as depressed (Grade 0), flat (Grade 1), or elevated (Grade 2), and a third grader (JEK) adjudicated when there was a discrepancy between the two observers. Interobserver agreement using pairwise κ analysis was performed between qualitative and quantitative methods (see Table 2).

Grading the Status of the Ellipsoid Zone

The continuity of the EZ was graded by two observers (NRM, D-GK) working independently, with a third grader serving as tiebreaker (JEK). The EZ was graded as either continuous or discontinuous on each radial line scan within a 500-µm radius from the fovea on the basis of hyporeflectivity. The EZ was deemed disrupted overall for the visit if three or more of the six radial line scans demonstrated disruption.

Statistical Methods

Statistical analysis included McNemar's test for testing significance in the change of the proportion of subjects demonstrating Grade 1 foveal contour between baseline and follow-up. Paired 2-sampled *t*-tests were performed to investigate significance of change in CRT, CST, CSV, and BCVA within different groups based on baseline foveal contour grade (Grades 1 and 2), as well as to assess change in mean BCVA based on baseline EZ status. The Wilcoxon rank-sum test and Welch 2-sample *t*-test were used to compare baseline to follow-up changes in CRT, CST, CSV, and BCVA between baseline grade groups.

Results

Among 18 women and 23 men, the mean age (±SD) was 69.4 ± 10.8 years. Of 41 eyes of 41 patients, 23 were right and 18 were left eyes. Mean baseline visit time before surgery was 45.61 days (range, 15–107; SD, ±24.51). Mean postoperative follow-up time was 125.31 days (range, 79–195; SD, ±31.96). Preoperatively, 28 (68.3%) eyes were phakic and 13 (31.7%) eyes were pseudophakic with posterior chamber intraocular lenses. Postoperatively, 19 (46.3%) eyes were phakic and 22 (53.7%) eyes were pseudophakic. At baseline, 3 of 14 (21.4%) Grade 1 eyes and 10 of 27 (37.0%) Grade 2 eyes were pseudophakic. At follow up, there were similar proportions of pseudophakic eyes among the two groups: 57.1% of Grade 1 and 51.9% of Grade 2 eyes. Mean BCVA at baseline was 0.56 logMAR (Snellen equivalent [SE], 20/73); range, 0.14 to 1.30 (SE, 20/28–20/400), and mean postoperative BCVA was 0.49 logMAR (SE, 20/62); range, 0.08 to 1.18 (SE, 20/24–20/303).

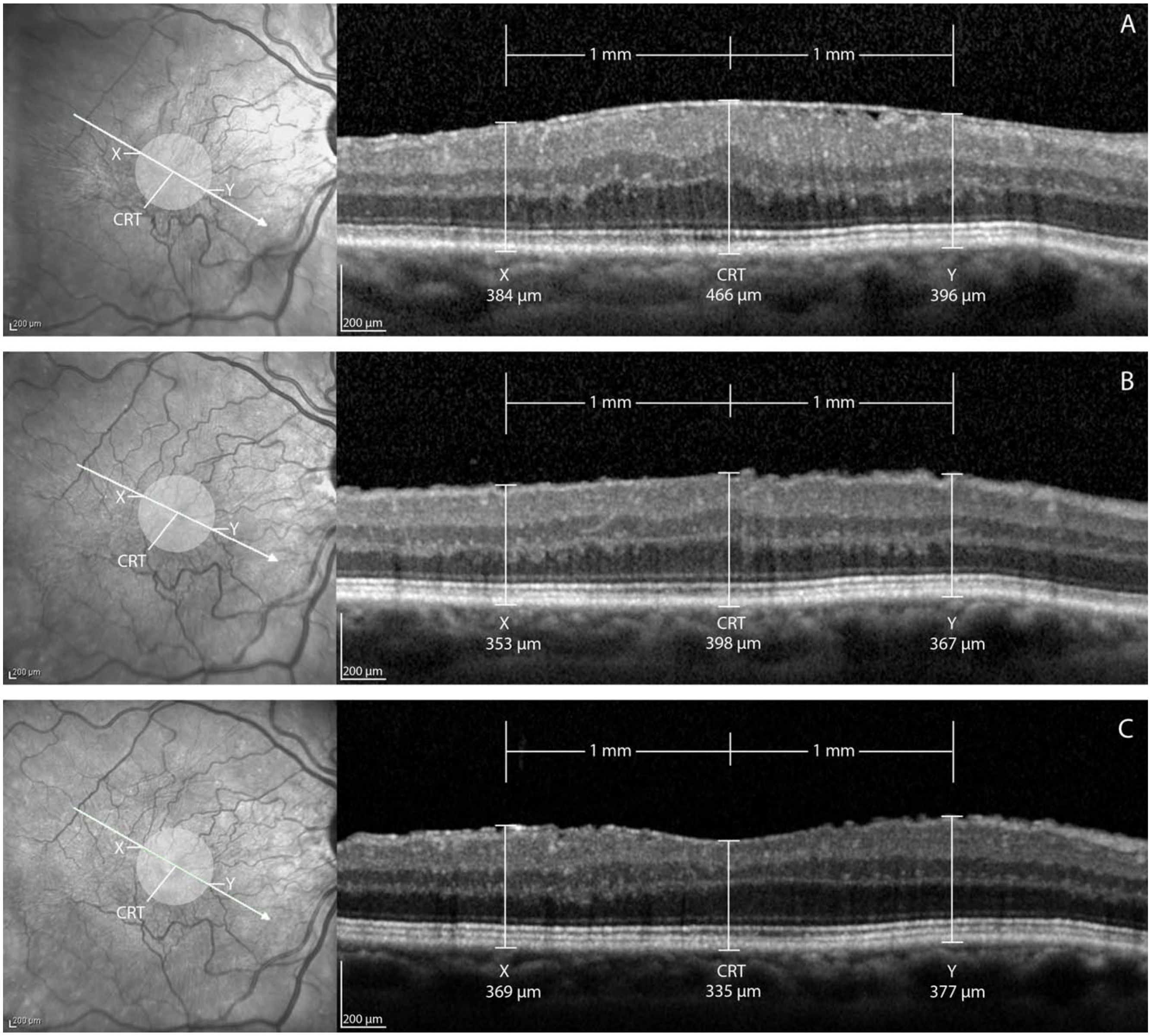

Figure 1. Representative OCT images of the foveal contour grades. This series of images was recorded in the same subject across time at the 120° radial line scan. Thicknesses were recorded at the fovea and 1 mm in each direction from the fovea on six radial line scans spaced 30° radially. (**A**) Preoperative OCT image. The retina is thicker at the fovea (CRT) than at the surrounding macula (*X* and *Y*). The ratio of CRT to *X* and *Y* is 1.21 and 1.18, respectively, and are considered Grade 2. (**B**) Same subject imaged 12 days following surgery for epiretinal membrane removal. CRT, *X*, and *Y* have all thinned to approximately the same level (ratios of 1.13 and 1.08, respectively). The CRT:*X* is considered Grade 2, while CRT:*Y* is considered Grade 1. This subject had eight ratios between 0.92 and 1.08 (Grade 1) and four ratios greater than 1.08 (Grade 2) at this visit and, thus, was Grade 1 overall. (**C**) Same subject imaged 96 days following surgery. CRT has continued to thin while *X* and *Y* have actually thickened. Ratios of 0.91 and 0.89 are each Grade 0. All 12 of the ratios were less than 0.92 (Grade 0) at this visit and, thus, was Grade 0 overall.

Table 1. Change in Foveal Contour Grade Between Baseline (Preoperative) and Follow-up (Postoperative)

	Postoperative Grade 0	Postoperative Grade 1	Postoperative Grade 2
Preoperative grade 0	0	0	0
Preoperative grade 1	3	6	5
Preoperative grade 2	4	7	16

A total of 41 eyes had OCT imaging available at baseline and the follow-up period.

Foveal Contour Grade

Baseline foveal contour before surgery was as follows: none with Grade 0, 14 of 41 (34.2%) eyes with Grade 1, and 27 of 41 (65.9%) eyes with Grade 2.

The number of eyes changing grades between baseline and follow-up is described in Table 1. When Grades 0 and 1 were combined to become Grade 0/1 for additional statistical power, McNemar's test did not show a significant change in the number of eyes moving from baseline Grade 2 to follow-up Grade 0/1 and vice versa ($P = 0.211$).

Among 14 eyes that were Grade 1 at baseline, five (35.7%) demonstrated disruption of the EZ. Baseline Grade 1 contours

TABLE 2. Interobserver Agreement Between Human Qualitative Grading and Computer Quantitative Grading of Foveal Contour

	Qualitative Grade 0	Qualitative Grade 1	Qualitative Grade 2
Quantitative grade 0	7.3%	2.5%	1.3%
	86	28	15
Quantitative grade 1	2.4%	11.7%	18.0%
	28	138	213
Quantitative grade 2	0.2%	3.4%	53.5%
	2	40	632

A κ analysis was performed to assess agreement between qualitative versus quantitative agreement on contour grade on 1182 radial line scans derived from OCT. Agreement was achieved among 72.4% of images ($\kappa = 0.468$; SE = 0.023; 95% confidence interval, 0.423–0.513). The strength of this agreement is considered moderate.

demonstrated significant improvement in CRT from 492.14 to 398.18 μm ($P < 0.001$), in CST from 494.71 to 405.50 μm ($P < 0.001$), in CSV from 0.39 to 0.31 mm^3 ($P = 0.002$), and in BCVA from 0.54 to 0.43 logMAR (SE, 20/69–20/54; $P = 0.022$).

Among the 27 eyes that were Grade 2 at baseline, 9 (33.3%) demonstrated disruption of the EZ. Baseline Grade 2 contours demonstrated significant improvement in CRT from 578.52 to 424.02 μm ($P < 0.001$), in CST from 563.11 to 424.76 μm ($P < 0.001$), in CSV from 0.45 to 0.34 mm^3 ($P < 0.001$), but not BCVA (0.57–0.53 logMAR, $P = 0.369$, Fig. 2). Comparison between the delta values representing improvement in CRT, CST, CSV, and BCVA was made between those eyes that were Grade 1 at baseline and those that were Grade 2. No significant difference in the level of improvement was found between baseline Grade 1 and baseline Grade 2 contours ($P > 0.05$).

Seven of the 41 eyes (17.1%) demonstrated foveal depression, Grade 0, at follow-up and were analyzed for differences in CRT, CST, CSV, and BCVA between baseline and follow-up. The CRT improved from mean 500.55 to 296.08 μm ($P < 0.001$), CST from 499.00 to 343.71 μm ($P < 0.001$), and CSV from 0.41 to 0.28 mm^3 ($P = 0.002$). Mean preoperative BCVA was 0.50 logMAR (SE, 20/63) and 0.43 (SE, 20/54) at follow-up ($P = 0.188$).

Agreement between qualitative and quantitative methods of grading the foveal contour is outlined in Table 2.

Ellipsoid Zone Status

The change in photoreceptor status at the EZ was analyzed between baseline and follow-up. Of 41 eyes, 27 were intact and 14 had EZ disruption at baseline. Mean preoperative BCVA among those with intact EZ at baseline was 0.52 logMAR (20/66; range, 0.14–1.00; SE, 20/28–20/200). Postoperative BCVA among this group was 0.47 logMAR (20/59; range, 0.14–1.00; SE, 20/28–20/200; $P = 0.342$). Mean preoperative BCVA among those with EZ disruption at baseline was 0.64 logMAR (20/87; range, 0.20–1.30; SE, 20/32–20/400). Postoperative BCVA among this group was 0.53 logMAR (20/68; range, 0.08–1.18; SE, 20/24–20/303; $P = 0.163$). Three of the 27 (11.1%) eyes with intact zones at baseline became disrupted at follow-up, while 6 of the 14 (42.9%) eyes with disrupted zones at baseline improved EZ status and were intact at follow-up, such that 30 eyes had intact EZ and 11 eyes had disrupted EZ at follow-up. A κ analysis was performed to determine agreement between independent observer grading of EZ status (intact or disrupted). Concordant assessments between two observers (DK and NM) was 90.2% (202 of 224 visits, $\kappa = 0.771$).

Discussion

This study's primary objective was to determine the percentage of eyes regaining foveal depression following PPV with ILM peel for idiopathic ERM repair at follow-up according to the grading scheme devised to describe OCT retinal contour.

None of the eyes had foveal depression before surgery in this study. Of 41 eyes, only seven (17.1%) were Grade 0 at follow-up, suggesting that a return of foveal depression is the exception rather than the rule after ERM removal. Therefore, lack of foveal depression should not be misinterpreted as cystoid macular edema in the eyes that underwent vitrectomy for ERM. This study also evaluated the prognostic utility of the foveal contour for anticipating change in CRT, CST, CSV, and BCVA following surgery. While the majority did not regain foveal depression, there was improvement in retinal thickness.

This study is unique in that it characterized the contour of the inner retina in an objective, reproducible, and novel manner. A reproducible method for describing the foveal contour has previously been described as "desirable."[18] Essentially, this system characterizes the topography of a 2-mm diameter circle of retina centered on the fovea as a valley (Grade 0), a flatland (Grade 1), or a mountain (Grade 2). In addition, the majority of contours were analyzed from spectral domain OCT (SD-OCT) with registration, enabling consistent analysis of the fovea at follow-up visits. While the methods described in this study relied on an objective measure of characterizing the contour using radial line scans, application of this grading scheme in the clinical setting remains feasible even with alternative OCT imaging protocols. This is possible provided the grader takes into account that it is the thickness between the ERM (innermost retina at follow-up) and RPE at the fovea relative to the surrounding macula that determines the contour. Due to the curvature of the eye wall and the retina in the parafoveal regions, there may be the illusion that a flat Grade 1 contour appears to be an elevated Grade 2 contour. Indeed, comparison in assessment of contour grade between the human graders' qualitative observation and quantitative grading suggests a bias toward declaring a contour elevated rather than flat (Table 2). An example is illustrated by Figure 3: human grading characterized this contour as elevated, Grade 2. However, thickness measurements at the fovea and periphery reveal ratios of 1.05 and 1.04, Grade 1. Therefore, quantitative measures of retinal thickness at the regions of interest may provide more accurate and consistent grading of foveal contour than qualitative assessment.

Postoperative cataract formation is an unfortunate side effect of vitrectomy. At the time of follow-up, we found a similar prevalence of pseudophakia between Grade 1 and Grade 2 eyes. However, a greater proportion of Grade 1 eyes had cataract surgery during the follow-up period. This may be partly responsible for why Grade 1 eyes showed significant improvement in BCVA.

The prognostic utility of the preoperative foveal contour was found to be limited to ascertaining the expected within-group improvement in CRT, CST, CSV, and BCVA (Fig. 2). Baseline Grade 1 eyes showed significant improvement in BCVA which was not observed in baseline Grade 2 eyes, which may be due to differences in cataract surgery during follow-up. Additionally, this difference may be related to the baseline thickness of the fovea and not photoreceptor status at the EZ as baseline Grade 2 eyes were thicker overall but did not demonstrate an increased incidence of EZ disruption (33.3% in baseline Grade 2 eyes versus 35.7% in Grade 1 eyes). This is in agreement with previously published findings that the degree of improvement in BCVA in eyes following ERM surgery is correlated with the preoperative thickness.[19–21] However, the impact of central retinal thickness on visual acuity is

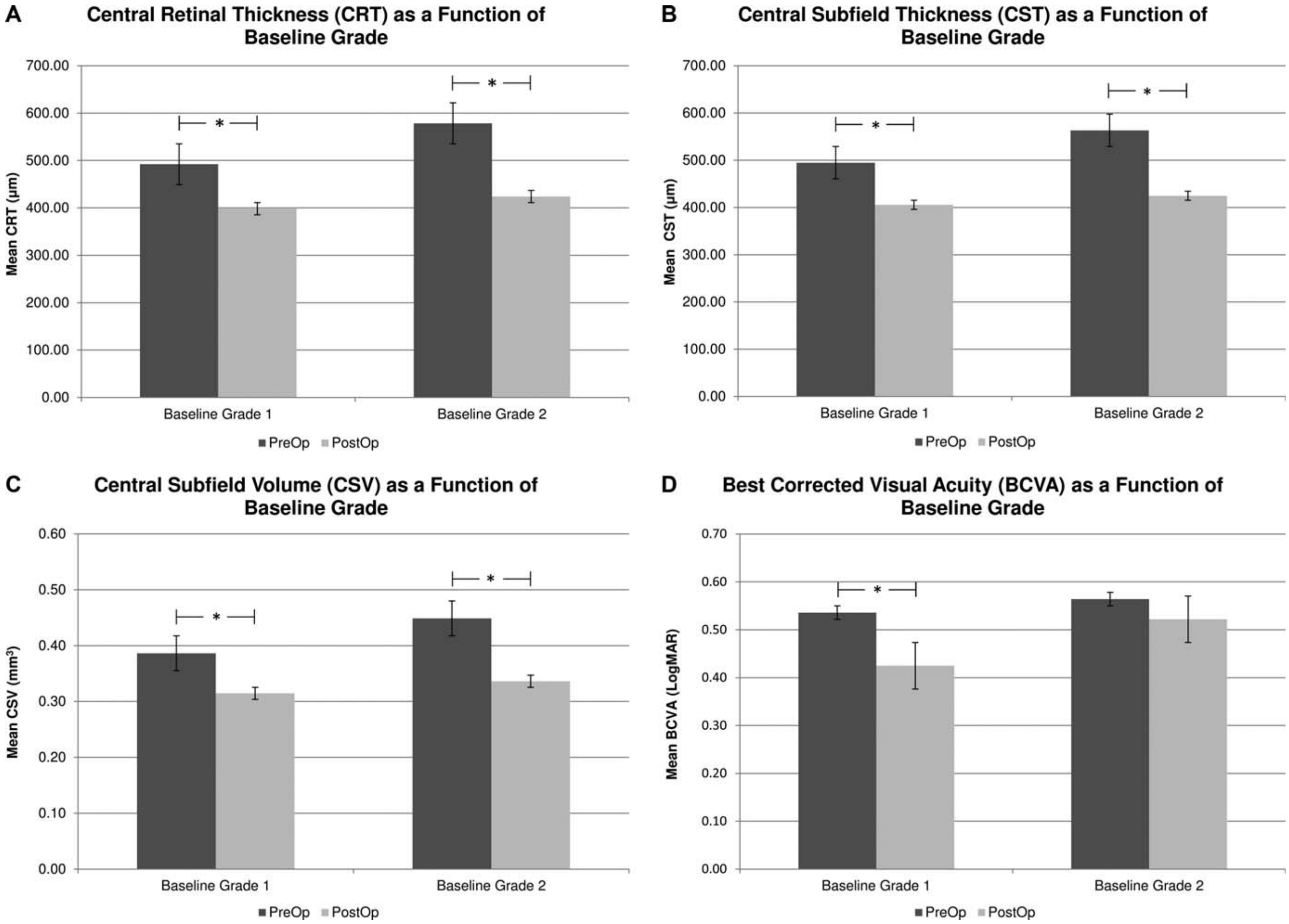

FIGURE 2. Preoperative and postoperative outcomes based on preoperative foveal contour grade. (**A**) The improvement in CRT after surgery for ERM based on preoperative contour. Contours that were Grade 1 and Grade 2 at baseline saw significant improvements in CRT. (**B**) The improvement in central subfield thickness following surgery for ERM in Baseline Grade 1 and Grade 2 contours. (**C**) The CSV changes observed following surgery for ERM. Baseline Grade 1 and Grade 2 contours significantly improved CSV. (**D**) The improvements in BCVA following surgery for ERM. Contours that were Grade 1 at baseline improved BCVA significantly, while baseline Grade 2 contours did not demonstrate significant improvement. Mean values plotted. *Error bars* represent SEM. *Statistical significance ($P < 0.05$) using Student's 2-tailed paired *t*-test.

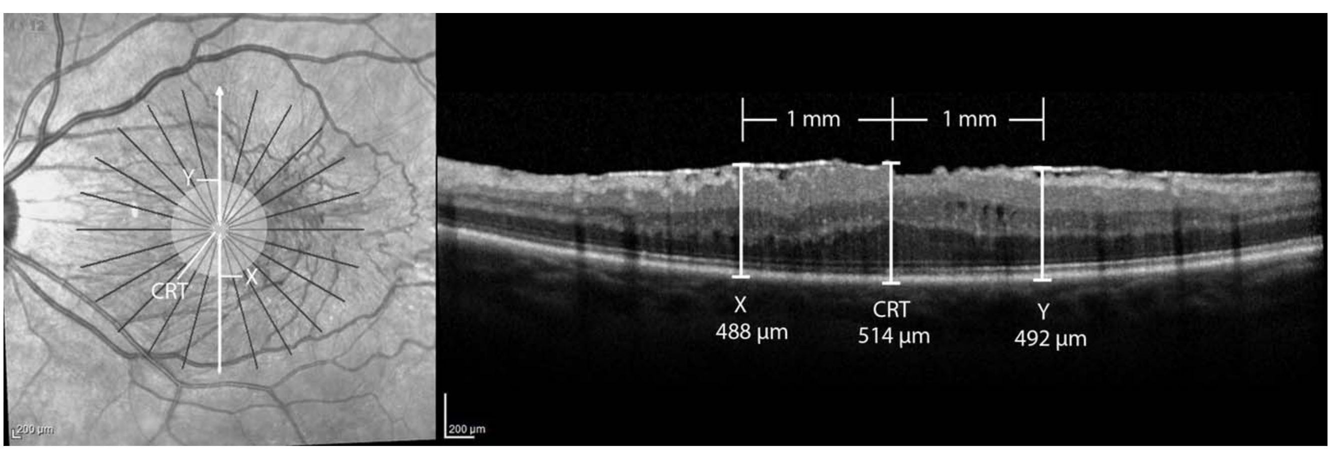

FIGURE 3. Example of bias toward Grade 2 over Grade 1 of qualitative versus quantitative grading. This particular OCT image was characterized as Grade 2, elevated, by subjective observation and is representative of the bias toward characterizing the contour as elevated. The quantitative method relies on the ratio CRT:*X* and CRT:*Y*. In this particular image, these ratios are 1.05 and 1.04, respectively, and are characterized as Grade 1.

controversial. Michaelewski et al.,[20] and Koford and la Cour[21] reported negative correlation between preoperative retinal thickness and visual acuity, while Suzuki et al.[22] found no correlation. In contrast to within-group improvements between baseline and follow-up, there was no statistically significant difference in between-group improvement with respect to baseline contours; that is, while baseline Grade 1 contours improved significantly among themselves between baseline and follow-up, the delta among baseline Grade 1 contours was not significantly different from that among baseline Grade 2 contours.

Conflicting results between the association of the postoperative contour and visual acuity outcomes have been reported.[10–12] While the present study was most concerned about the utility of the preoperative contour as a prognostic factor, we did specifically analyze the seven eyes that regained foveal depression at follow-up for comparison to previously published findings. The present study found that seven eyes were Grade 0 at follow-up, but no significant improvement in BCVA was demonstrated within these eyes, supporting prior reports that a favorable postoperative contour is not related to visual acuity outcomes.[10–12]

We found characterization of the foveal contour to be a useful proxy for describing the traction placed on the inner retina by glial cell proliferation. The progression of the contour in a subject with Grade 2 foveal contour at baseline is depicted in Figure 2. The traction resulted in an elevation where the foveal depression should be located. The foveal contour of this subject flattened to Grade 1 by postoperative day 12, and regained its foveal depression by day 96. With nearly two-thirds of all eyes undergoing surgery for ERM removal being classified as Grade 2, the symptomatic manifestations of ERM may not be evident until significant traction has already occurred.

A small number of eyes transitioned from Grade 1 at baseline to Grade 2 at follow-up. Three explanations are available to explain this phenomenon: eccentric off-centered ERM location, ERM recurrence, and imperfection of the grading system. The preoperative ERM location in one subject was located primarily in the superonasal and superotemporal quadrants near the superior arcade and extended to the fovea. The resulting traction caused more thickening of the superior macula relative to the fovea and inferior macula. Since the grading concentrated on the fovea, the overall grade was Grade 1, even though the retina was elevated superiorly. Following release of traction with removal of the ERM, the superior, nasal, and temporal retina thinned to a greater extent than the fovea and, thus, the follow-up contour was Grade 2.

Recurrence of ERM is noted in one case of Grade 1 to Grade 2 conversion, but reoperation was not performed given improved metamorphopsia and visual acuity by one line. Additionally, in this case and in the remaining three cases, either the preoperative or postoperative grades were decided by one or two scans that swung the overall contour grade one way or the other. Some cases hover closely around these margins such that any calculated differences may not have clinical significance. Therefore, we recommend subjective evaluation in addition to the calculated data.

Previous reports have suggested that photoreceptor disruption secondary to retinal pathology is slow to recover and may be irreversible. Suh et al.,[12] using time-domain OCT, suggested that vitrectomy for ERM can lead to new disruption of the EZ. However, our study, analyzing the continuity of the EZ across six radial line scans with the improved resolution of SD-OCT and relying on three independent graders for agreement, suggests that there is improvement in the integrity of EZ in the majority of cases. Of 27 eyes with no disruption of EZ before PPV, only three (11.1%) displayed photoreceptor disruption at follow-up, while of the 14 eyes with disruption before PPV, six (42.9%) showed recovery to an intact state at follow-up. Across baseline groups, the incidence of EZ disruption at baseline, 14 of 41 (34.2%), is comparable to other study findings in idiopathic ERM.[12,23] Interestingly, the three patients displaying new photoreceptor disruption at follow-up were all Grade 2 at baseline. Of note, while this study chose four months as the cut-off for data consistency, some eyes were followed for a longer period. One of these three subjects with new-onset EZ disruption at postoperative day 96 showed resolution of the disruption by day 145 and this was maintained at the subject's final visit on day 356. Additionally, another subject with baseline disruption of the EZ as well as disruption during the follow-up window showed resolution of this disruption at postoperative day 257 and this was maintained at day 502. These findings suggested that not only is disruption of the EZ reversible, but the repair process may take some time in some cases and may continue to improve. Future studies should aim for extended periods of follow-up for monitoring the EZ status beyond the mean of four months used in this study.

It is possible that the peeling of ERM with or without ILM peeling may contribute to the development of EZ disruption and the rate of EZ disruption may differ between the two techniques. However, the rate at which the double-peel impacts photoreceptor status at four months follow-up is unlikely to be significantly different from peeling the ERM alone based on a recent study by Ahn et al.[24] in which the investigators investigated the impact of peeling the ILM in addition to the ERM versus peeling the ERM alone on photoreceptor integrity. Greater defects in cone outer segment tips and worst visual acuity one month after surgery were noted in the group with ILM peel versus the group without; however, no difference in photoreceptor status or visual acuity was observed between the two groups at 3-, 6-, and 12-month postoperative visits.[24]

The present study is limited by the retrospective nature with a small sample size. While there were more cases with ERM that were operated on during the study period, not all had postoperative OCT at three to four months and were excluded from the study. Although on par with similar studies of prognostic factors for ERM outcomes, a larger sample size would be useful to counter the drop-off in data we observed as patients return to their primary eye care professional in this referral setting. Future studies should focus on longer follow-up with repeat OCT imaging to determine whether additional patients recover foveal depression at later timeframes.

In conclusion, failure to achieve foveal depression following surgery for ERM repair should not be alarming as only a minority actually regain foveal depression four months after surgery. Macular thickening with lack of foveal depression in these eyes after ERM removal should not be confused with cystoid macular edema. Additionally, the absence of foveal depression at follow-up does not translate to failure to improve BCVA. Visual improvement differences between Grades 1 and 2 may be affected by the differences in proportion that had cataract surgery during the follow-up period. Even when foveal contour does not return, most eyes improved in retinal thickness following surgery. Finally, while pars plana vitrectomy with membrane peeling may result in photoreceptor disruption, we did not find it to occur to a significant degree and surgery may in fact reverse the photoreceptor disruption present at baseline.

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