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Short-Term Surgical Outcomes of 25-Gauge Vitrectomy for Epiretinal Membrane with Good Visual Acuity

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Abstract

Background: Reportedly, 25-gauge (G) vitrectomy offers the advantage of faster visual improvement in cases with epiretinal membrane (ERM). However, metamorphopsia does not completely resolve in most cases even after ERM removal. Early removal of ERM is considered to have the advantages of better recovery of visual acuity (VA) and resolution of metamorphopsia.

Purpose: To evaluate the efficacy and safety of ERM removal in patients with good visual acuity.

Subjects and methods: We performed a retrospective chart review of patients who underwent 25-G vitrectomy for ERM and whose preoperative VA was better than 0.046 logMAR (0.9 in decimal units). Eighteen eyes of 18 patients (age 62.11 ± 10.9 years, mean ± standard deviation) observed for at least 3 months after surgery were included in this study. Mean logMAR VA and vertical and horizontal metamorphopsia scores before and 3 months after vitrectomy were measured. The metamorphopsia scores were calculated using M-CHARTS.

Results: Postoperatively, a significant improvement in mean logMAR VA was observed (P=0.001). The horizontal metamorphopsia score decreased significantly (P=0.04). No surgical complications occurred.

Conclusions: 25-G Pars plana vitrectomy for ERM in patients with good visual acuity is safe and effectively improves metamorphopsia and mean logMAR VA.

Keywords: Epiretinal membrane (ERM); Pars plana vitrectomy; Metamorphopsia; M-CHARTS; Good visual acuity

Introduction

The symptoms of idiopathic epiretinal membranes (ERM) of the macula are blurred vision caused by the retinal dysfunction including photoreceptor dysfunction and metamorphopsia caused by retinal distortion. Surgical removal of ERM is reportedly associated with few complications, and surgical results are generally good [1-5]. Furthermore, we reported treating ERM and internal limiting membrane (ILM) peeling using brilliant blue G staining to be effective and safe in reducing the risk of recurrence [6]. Currently, conjunctival microincision vitrectomy surgery (MIVS) with 25-gauge (G) or 23-G instrumentation is safe, effective and significantly reduces surgical time [7]. The advent of MIVS achieved these advantages of ERM surgery [7,8].

The typical ERM patient sometimes experiences mild or severe metamorphopsia even when good visual acuity is maintained, often followed by periods of relative stabilization of visual function. Despite complaints of metamorphopsia, it is common practice for doctors to advise patients with good visual acuity to wait until their vision has deteriorated to 0.7 or worse in decimal units before considering surgery. In fact, vision will usually stabilize at a visual level at or near that noted on initial presentation. Since better visual results were reportedly obtained in patients with better preoperative vision and shorter symptomatic durations [4], it is advisable to make a decision on surgical intervention at the first visit, if patients have apparent symptoms or are experiencing, inconvenience due to visual impairments.

We report the efficacy and safety of ERM removal in patients with good visual acuity.

Methods

Patients

We included 18 eyes of 18 patients with primary idiopathic ERM who were undergoing 25-G pars plana vitrectomy at Surugadai Hospital of Nihon University. Their preoperative best-corrected visual acuity (BCVA) was better than 0.046 logMAR (0.9 in decimal units) with metamorphopsia. ERM surgeries were performed by 1 surgeon (HN). There were 5 males and 13 females, and with an average age of 62.1 ± 10.9 years (mean ± standard deviation). Patients who had previously undergone vitrectomy or any other ocular surgery were excluded. Exclusion criteria also included secondary ERM, moderate or severe cataracts that affected visual acuity, glaucoma, retinal degeneration, or optic nerve neuropathy.

This study was approved by our Institutional Review Board. Data were retrospectively retrieved from medical records.

The preoperative symptom duration was estimated from patient reports. The parameters recorded included BCVA and metamorphopsia, both preoperatively and at 3 months postoperatively. BCVA measured using the Japanese Landolt visual acuity chart, and the decimal visual acuity was converted to the logarithm of the minimal angle of resolution (logMAR) units for statistical analyses. Metamorphopsia was evaluated using M-CHARTS (Inami Co., Tokyo, Japan). The method of metamorphopsia score determination reported

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by Matusmoto et al. [9] was used. M-CHARTS consist of 19 dotted lines with the dot intervals ranging from 0.2 to 2.0 of the visual angle. If a straight line is substituted with a dotted line and the dot interval is changed from fine to coarse, the distortion of the line decreases with the increasing dot interval, until the dotted line appears straight. At first, a vertical straight line (0°) on the first page of M-CHARTS is shown to the patient, and the patient then focuses on a fixation point on the center of the line. If the straight line is recognized as a straight line, the score is 0. If the straight line is recognized as an irregular or curved line, then the dot intervals of the dotted line are changed from fine to coarse sequentially. When the patient recognizes a dotted line as straight, its visual angle is taken as the metamorphopsia score for a vertical line (MV). Then, M-CHARTS are rotated 90 degrees and the same test is performed to evaluate the metamorphopsia score for a horizontal line (MH). In our present study, the examinations were conducted twice for each subject to evaluate the reproducibility of the test, and the mean was used for data analyses. The examination was performed at 30 cm under exactly corrected refraction for this distance and the examiner was completely blinded to the patient's fundus information during the examination.

Central foveal thickness (CFT) was measured using Optical Coherent Tomography (Spectralis, Heidelberg Engineering, Inc, Germany). Foveal thickness was measured by placing calibrated calipers between the vitreoretinal interface and the anterior surface of the retinal pigment epithelium. Preoperative and 3-month postoperative foveal thicknesses were evaluated.

We performed a retrospective chart review of patients and statistical analysis of the data was carried out using SPSS Statistics version 21 (IBM, Armonk, NY, USA). All tests of association were considered statistically significant if $P<0.05$.

Epiretinal membrane surgery and postoperative follow-up

A standard, subtotal, 3-port pars plana vitrectomy was performed using the Accurus 800CS (Alcon Surgical, Fort Worth, TX, USA) and a 25-G system (Medical Instrument Development Laboratories, San Leandro, CA, USA) by a single surgeon (HN). ERM peeling was performed using a 25-G needle and 25-G intraocular ILM forceps (Inami). After ERM peeling, 0.1 mL (0.025%) of brilliant blue G solution was applied to the macular area for about ten seconds. The ILM, if present, was stained and peeled off around the macular area. Then, the peripheral vitreous was removed almost completely with the scleral indentation technique. If a retinal tear or hole was found, endolaser treatment was performed. At the completion of surgery, air-fluid exchange was fully performed in ERMs with pseudo macular hole (PMH) and the prone position was maintained for one night to prevent postoperative macular hole formation. In other cases, about one-fifth of the vitreous cavity was filled with air to promote wound self-sealing of sclerotomies without suturing. However, if the closure of sclerotomies was insufficient, they were sutured with 8-0 vicryl. Patients underwent clinical examinations daily for one to four days, and then at 2 weeks, and at 1and 3 months postoperatively.

Results

The baseline demographic data are shown in Table 1. In two cases less than 50 years of age, lens-sparing vitrectomy was performed, and in all others cataract surgery was performed concomitantly to avoid cataract formation following vitrectomy. This study included 7 patients of ERM combined with PMH. The symptom duration in ERM with PMH cases was significantly longer than that of ERM without PMH cases ($P=0.015$, Mann-Whitney U test). The changes in preoperative and postoperative data are demonstrated in Table 2 and a scatterplot of preoperative and postoperative BCVA in decimal units is shown in Figure 1.

Sex	13 women/5 men
Age (years), mean±SD (range)	62.1 ± 10.9 (41-79)
Presence of pseudomacular hole, n (%)	7 (38.9)
Duration of symptoms (month), mean (range)	26 ± 21.7 (2-80)
ERM without PMH (n=11)	18.5 ± 13.9
ERM with PMH (n=7)	44.1 ± 23.0 *P*=0.015†

ERM: Epiretinal membrane
PMH: Pseudo macular hole
†: Mann-Whitney U test

Table 1: Baseline demographic data.

	Preoperative	Postoperative	*P* value
BCVA			
logMAR, mean ± SD	0.002 ± 0.077	-0.092 ± 0.078	**0.001**
decimal, mean (range)	1.00 (0.9-1.5)	1.24 (0.9-1.5)	
MV, mean ± SD	0.95 ± 0.69	0.67 ± 0.49	0.145
MH, mean ± SD	1.08 ± 0.71	0.76 ± 0.73	**0.041**
CFT (µm), mean ± SD			
Total	337.0 ± 119.8	318.9 ± 94.1	0.248
ERM without PMH (n=11)	393.6 ± 81.2	342.3 ± 68.2	**0.016**
ERM with PMH (n=7)	248.0 ± 120.7	282.1 ± 121.4	0.398

BCVA: Best Corrected Visual Acuity; MV: Metamorphopsia score for a vertical line; MH: Metamorphopsia score for a horizontal line; CFT: Central Foveal Thickness; ERM: Epiretinal Membrane; PMH: Pseudo Macular Hole
Values in bold indicate statistical significance

Table 2: Preoperative and postoperative data (Wilcoxon signed-ranks test).

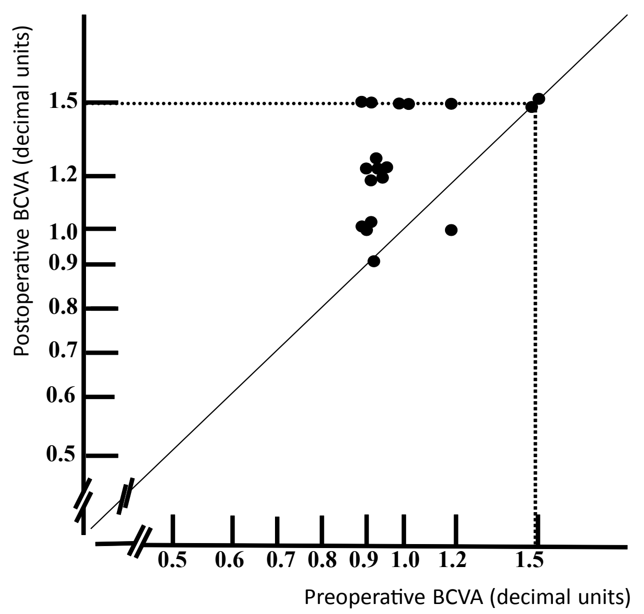

Figure 1: Scatter plot of preoperative and postoperative best-corrected visual acuities (BCVA) in decimal units. Seventeen cases maintained or improved BCVA. In the one exception, the postoperative BCVA at 3 months deteriorated from 1.2 to 1.0 in decimal units, however it had recovered to 1.5 at the next visit.

BCVA improved significantly from 0.002 ± 0.077 logMAR units before surgery to -0.092 ± 0.078 at 3 months after surgery (*P*=0.001, Wilcoxon signed-ranks test). All but one case maintained or improved BCVA. In the one exception, the postoperative BCVA at 3 months deteriorated from -0.079 logMAR to 0 logMAR (from 1.2 to 1.0 in decimal units), however it had recovered to -0.179 logMAR (1.5 in decimal units) at the next visit. The mean baseline MH score was larger than the mean baseline MV score, although the difference was not significant (*P*=0.51, Wilcoxon signed-ranks test). The MV score improved from 0.95 ± 0.69 before surgery to 0.67 ± 0.49 at 3 months after surgery (*P*=0.145, Wilcoxon signed-ranks test). The MH score improved significantly from 1.08 ± 0.71 before surgery to 0.76 ± 0.73 at 3 months after surgery (*P*=0.041, Wilcoxon signed-ranks test). The mean MH score was larger than the mean MV score at 3 months after surgery, although the difference was not significant (*P*=0.48, Wilcoxon signed-ranks test). There was no significant decrease in CFT overall, while ERM without PMH cases achieved a significant reduction in CFT (*P*=0.016, Wilcoxon signed-ranks test). The correlation between BCVA and the metamorphopsia score before and after surgery is shown in Table 3. The baseline BCVA correlated significantly with BCVA at 3 months (r=0.504, *P*=0.033, Spearman's correlation coefficient). The baseline MV score correlated significantly with the MH score after surgery (r=0.613, *P*=0.007, Spearman's correlation coefficient). The baseline MH score correlated significantly with the MV score after surgery (r=0.529, *P*=0.024, Spearman's correlation coefficient) and the MH score after surgery (r=0.493, *P*=0.038, Spearman's correlation coefficient). There was significant correlation between the MH score and MV score before and after surgery respectively (Preoperative: r=0.675, *P*=0.002, Postoperative: r=0.866, P<0.001, Spearman's correlation coefficient). We detected no correlations between CFT and other parameters.

Compared to case of long-symptom duration for more than one year, four cases undergoing surgery within 6 months after symptom onsets were significantly younger (*P*=0.046, Mann-Whitney U test), and had significantly better preoperative and postoperative BCVA (*P*=0.046, *P*=0.018, Mann-Whitney U test) and improved the change in MH scores after 3 months following surgery (*P*=.025, Mann-Whitney U test). The change in the MH score was defined as the postoperative value at 3 months subtracted from the baseline value (Table 4).

Complications

The operative and postoperative complications are shown in Table 5. In the four cases in which retinal tear or holes were documented in the peripheral retina during surgery, endolaser treatment was performed. There were no cases with cystoid macular edema and hyper increased ocular pressure that developed after membrane peeling. Furthermore, no severe complications, such as retinal detachment and endophthalmitis, occurred after surgery.

	BCVA at 3 months		MV at 3 months		MH at 3 months	
	r	*P*	*r*	*P*	*R*	*P*
Baseline BCVA	**0.504**	**0.033**	0.122	0.631	0.089	0.727
Baseline MV	0.310	0.211	0.453	0.059	**0.613**	**0.007**
Baseline MH	-0.048	0.851	**0.529**	**0.024**	**0.493**	**0.038**

BCVA: Best Corrected Visual Acuity; MV: Metamorphopsia score for a vertical line; MH: metamorphopsia score for a horizontal line
Values in bold indicate statistical significance

Table 3: Correlations of BCVA and metamorphopsia scores before and after surgery (Spearman rank correlation coefficience).

	Short symptom duration ≦6months (n=4)	Long symptom-duration >6months (n=14)	*P* value
Age	53.0±6.8	64.7±10.6	**0.046**
Preoperative BCVA			
logMAR,	-0.096±0.105	0.030±0.04	**0.046**
decimal, mean (range)	1.25 (0.9-1.5)	0.93 (0.9-1.5)	
Postoperative BCVA			
logMAR,	-0.176±0.000	-0.068±0.072	**0.018**
decimal, mean(range)	1.50 (1.5-1.5)	1.17 (0.9-1.5)	
Change in MV	0.28±0.82	0.28±0.60	0.505
Change in MH	0.90±0.52	0.15±0.63	**0.025**

BCVA: Best Corrected Visual Acuity; MV: Metamorphopsia score for a vertical line; MH: metamorphopsia score for a horizontal line
The change in each score was defined as the postoperative value at 3 months subtracted from the baseline value
Values in bold indicate statistical significance

Table 4: The differences between short symptom-duration and long symptom-duration after onset (Mann-Whitney U test).

Complications	Incidence
Retinal tears or holes	4/18 (22.2%)
High intraocular pressure (> 21mmHg)	0/18 (0%)
Cystoid macular edema	0/18 (0%)
ERM recurrence	0/18 (0%)
Postoperative RD	0/18 (0%)

RD: Retinal detachment; ERM: Epiretinal membrane

Table 5: Intraoperative and postoperative complications.

Discussion

Idiopathic ERM has a wide range of severities. They may be quite subtle with minimal symptoms. Traction exerted by the membrane which results in perifoveal capillary leakage can cause only minimal visual loss or distorted vision. Therefore, surgery was previously advised only after a significant reduction in visual acuity. Even in recent reports of surgical treatment for ERM, the averages of preoperative visual acuity ranged from 0.38 to 0.7 logMAR units [10-14]. However, patients with better preoperative visual acuity tend to have a better final acuity even though the degree of improvement may be less dramatic [15]. Furthermore, Okamoto et al. [12] reported the severity of metamorphopsia to strongly influence the vision-related quality of life (VR-QOL), and in light of VR-QOL, more attention must be paid to the degree of and changes in metamorphopsia in patients with ERM. Taking this viewpoint into account, we performed surgery for ERM with good visual acuity, i.e. better than 0.046 logMAR (0.9 in decimal units), if patients had symptoms such as metamorphopsia and blurred vision.

We found mean BCVA to be significantly improved at 3 months after ERM removal, and MH scores improved significantly at 3 months after surgery. Although the change in BCVA was only 0.095 logMAR units, since the preoperative BCVA was good, all cases showed improvement or maintenance of BCVA. In this study, symptom durations were relatively long at 26 months on average, especially in cases of ERM with PMH who tend to maintain good visual acuity and be less symptomatic. Therefore, the preoperative symptom duration of ERM with PMH was significantly longer than that of ERM without PMH. Massin et al. [16] reported that PMH has no adverse prognostic impact after surgery for idiopathic ERM combined with PMH. In our view, ERM with PMH cases also shouldbe included among the indications for early treatment of ERM.

Though the degree of improvement in metamorphopsia scores after surgery was not entirely satisfactory overall, the four cases in which the surgery was performed less than 6 months after symptom onset exhibited significantly greater improvement in BCVA and more change in MH scores 3 months after surgery than those having long-term symptom duration. This may indicate that earlier surgery after symptom onset is needed to effectively reduce metamorphopsia. Kinoshita et al. [10] recommended that if the goal was a postoperative metamorphopsia score less than 0.5°, vitrectomy should have been performed when the preoperative metamorphopsia score was less than 1.7° for MH and 0.9°MV. Arimura et al. [17] reported that metamorphopsia scores correlated well with measurements of retinal contraction due to ERM. Ooto et al. [18], also reported that the presence of microfolds identified on adaptive optics scanning laser ophthalmoscopy images might be involved in the formation of metamorphopsia due to photoreceptor disarray. These reports suggest that early removal of ERM may improve metamorphopsia.

Our results revealed baseline MH scores to be related not only to postoperative MH scores but also to postoperative MV scores. MH scores reportedly tend to increase more than MV scores with progression of ERM [9] and improvement in MH scores with surgery is greater than that inMV scores [10]. The baseline MH score may be the most important prognostic factor for ERM cases with good visual acuity.

Performing surgery on patients with good visual acuity carries a risk of causing deterioration of visual acuity due to operative complications. However, our study demonstrated good visual recovery, confirming the safety of early treatment of ERM. We attribute the low incidence of postoperative complications and earlier visual improvement to the 25-Gvitrectomy system.

To our knowledge, this is the first report showing the results of early treatment for ERM with good visual acuity. 25-G Pars plana vitrectomy for ERM in patients with good visual acuity is safe and effectively improves metamorphopsia and mean logMAR BCVA. To fully elucidate the relationship between early treatment and visual functional recovery, further studies with a larger sample size and longer follow-up period are needed.

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