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ORIGINAL RESEARCH

Long-Term Visual Acuity and Optical Coherence Tomography Changes After Vitrectomy for Idiopathic Epiretinal Membranes

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Objective: To evaluate the long-term visual acuity and retinal thickness changes after pars plana vitrectomy (PPV) for idiopathic epiretinal membranes (ERM).

Methods: We performed a retrospective analysis of 72 patients who underwent PPV for idiopathic ERM in a tertiary hospital over 5 consecutive years. The main outcome measurement was change in visual acuity and macular thickness as recorded with optical coherence tomography (OCT).

Results: Medical records of 239 patients with a diagnosis of ERM who underwent PPV with or without internal limiting membrane (ILM) peeling were reviewed; of these, 72 patients with idiopathic ERM were included in the final analysis. All patients completed at least one year of follow-up, and 23 patients (30%) had 5 or more years of follow-up. The mean preoperative best corrected visual acuity (BCVA) was 20/65, and mean preoperative central macular thickness (CMT) on OCT was 434 microns (μm). Mean post-operative BCVA and CMT at one year were 20/40 and 303 μm, respectively ($p<0.0001$). A total of 42 patients (58%) improved by 2 or more lines; BCVA and CMT continued to improve postoperatively for up to 5 years of the follow-up period. There was no significant difference in BCVA or CMT between phakic and pseudophakic patients, and ILM peeling was performed in 67% of patients. Improved BCVA at 1 year was associated with younger age ($p<0.0001$) and ILM peeling ($p=0.020$).

Conclusion: PPV is an effective treatment for idiopathic ERM, and ILM peel may be of benefit. BCVA continues to improve up to 2 years and beyond after surgery regardless of the duration of symptoms.

Keywords: idiopathic epiretinal membrane, pars plana vitrectomy, optical coherence tomography, central macular thickness

Introduction

Epiretinal membranes (ERM) are cellular avascular membranes that form on the surface of the retina causing visual distortion and a decrease in the best corrected visual acuity (BCVA).[1] The prevalence of ERM ranges from 7% to 29% in the general population, and while many are idiopathic they may also be associated with proliferative diabetic retinopathy, cataract surgery, retinal detachment, and retinal detachment surgery.[2–5] Patients with ERM are usually monitored by measuring the BCVA and retinal morphology. Optical coherence tomography (OCT) is a valuable tool in diagnosing ERM and in assessing surgical success. OCT can demonstrate the presence of ERM, degree of traction, and the amount of associated cystoid macular edema (CME).[6]

ERM may remain stationary with minimal effect on visual performance. However, some cases may progress with worsening of symptoms, increasing retinal thickness and traction.[7] In those symptomatic cases, surgical peeling of ERM through pars plana vitrectomy (PPV) is the treatment of choice.[8] Previous studies have shown significant improvement in quality of life, visual symptoms, and visual acuity of patients after surgery.[9–11] Prognostic factors have been identified that predict the outcome of PPV for ERM, including preoperative visual acuity and OCT measurements,[8,12,13] but most

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previous studies have limited follow-up. We report in this study the long-term functional and anatomical outcome of PPV for idiopathic ERM.

Patients and Methods

A retrospective chart review was conducted for all patients who had the diagnosis of ERM at a tertiary hospital in our institution between August 2011 and September 2016. The study was performed after obtaining approval from the Institutional Review Board (IRB) of Hashemite University. All patients included completed at least 12 months of follow-up. We excluded patients with ocular conditions severe enough to account for the loss of visual acuity from other conditions such as diabetic macular edema, age-related macular degeneration, macular hole, and macular scarring. Patients with concurrent retinal disease such as proliferative diabetic retinopathy, central retinal vein occlusion, and central retinal artery occlusion were also excluded. Finally, patients with ERM secondary to previous scleral buckling, vitrectomy surgery, and trauma were also excluded.

For all patients, demographic data including age, sex, and race were collected. Preoperative and postoperative best corrected visual acuity (BCVA) and central macular thickness (CMT) as measured by Stratus OCT (Stratus OCT III, Zeiss-Humphrey, Dublin, CA, USA) were recorded at 1, 6, and 12 months, then yearly until the last follow-up visit. Snellen fraction was converted to decimal fraction acuity for statistical analysis. For patients in which a different OCT machine was used, CMT values were converted to equivalent Stratus OCT values using the conversion table proposed by Giani et al.[14] Lens status and the presence of cataract before and after the surgery were also noted. The details of the surgical technique including vitrectomy gauge (20-g vs 25-g), peeling of internal limiting membrane (ILM), and the use of air or gas tamponade were also recorded. The main outcome measure was the mean visual acuity at one year of follow-up. The secondary outcome measure was the mean CMT change at one year postoperatively.

Statistical analysis was performed using SPSS software (SPSS Inc., ver. 24, Chicago, Illinois). Methods used included the Student paired *t*-test with 0.05 significance level and confidence interval of 95% to compare difference in means. Multivariate analysis in a linear regression model was used to study the effect of different preoperative variables on the study outcome measures.

Surgical Technique

The indication for surgery was decreased BCVA or significant visual distortion. PPV was performed by 3 different surgeons using different vitrectomy machines. The procedure involved standard 3-port vitrectomy, either 20- or 25-gauge, with complete core vitrectomy initially. Intravitreal triamcinolone acetonide (Kenalog®-40, Bristol-Myers Squibb Co, NJ, US) was used in some cases to visualize the residual vitreous and assist in detaching the posterior hyaloid. Epiretinal membrane peeling was then achieved with either end-grasping intraocular forceps or diamond-dusted Tano scraper. Indocyanine green (ICG) was used to stain ILM in cases where it was peeled. At the end of surgery, fluid-air exchange was performed at the discretion of the surgeon; patients were left with either air or 20% sulfurhexafluoride (SF_6) gas mixture.

Results

Two hundred and thirty-nine patients with the diagnosis of ERM who underwent PPV were identified. Of these, 167 patients were excluded from further analysis because ERM was secondary to or associated with other conditions (macular hole, 22; retinal detachment, 31; postoperative cystoid macular edema, 17; diabetic macular edema, 33; retinal vein occlusion, 16; age-related macular degeneration, 25; others, 9), and 14 of 86 patients (16%) with idiopathic ERM were excluded for not having the minimal one year of follow-up. The remaining 72 patients were included, and their demographic data are shown in Table 1. All patients included completed one year of follow-up, and 23 (30%) patients completed 5 or more years, with the average duration of follow-up being 36 months (range, 12–116 months). Thirty-nine patients (54%) were phakic at the time of PPV, and 24 of these patients (66%) underwent cataract surgery during the first year of follow-up. Twenty-gauge PPV was performed in 53 patients (74%), and ILM peeling was attempted in 48 patients (67%); air-fluid or 20% SF_6 gas exchange was used at the end of surgery in 52 (72%) and 5 (7%) patients, respectively. Four out of the 72 patients (5%) developed recurrent ERM during the follow-up period.

Table 1 Demographic Data of Patients

Number of patients	**72**
Age (mean ± SD)	72 (± 8 y)
Sex *n* (%)	
Male	45 (63%)
Female	27 (37%)
Duration of symptoms (months) *(mean ± SD)*	14 months (±15)
Duration of follow-up (mean (range))	36 months (12–116)
Lens status *n* (%)	
Phakic	39 (54%)
Pseudophakic	33 (46%)
Type of surgery *n* (%)	
20-Gauge	53 (74%)
25-Gauge	19 (26%)
ILM peeling *n* (%)	
Performed	48 (67%)
Not performed	24 (33%)
Air/gas-fluid exchange *n* (%)	
None	15 (21%)
Air	52 (72%)
SF_6 gas	5 (7%)

The mean preoperative BCVA was (20/65), and mean preoperative CMT was 434 µm. Postoperatively, mean BCVA and OCT at one year of follow-up were (20/38) and 303 µm, respectively. The mean improvement in BCVA was 2.5 Snellen lines ($p<0.0001$), and reduction in CMT was 138 µm ($p<0.0001$) at one year of follow-up. BCVA continued to show statistically significant improvement at year 2 of follow-up, and there was a steady trend of improvement until the end of follow-up period. The maximum change in CMT was noticed at year one of follow-up, with an ongoing trend of improvement afterwards (Figure 1). Forty-two patients (58%) had 2 lines or more improvement in BCVA at 2 years of follow-up.

No significant difference was noticed in BCVA or CMT between phakic and pseudophakic patients (Table 2). The mean postoperative BCVA was better in the 48 patients (67%) where ILM was peeled (20/34) in contrast to the 24 patients (33%) in whom ILM peeling was not attempted (20/45), ($p=0.026$, Table 2). The use of 20- or 25-gauge instruments was not associated with any significant difference in postoperative BCVA or CMT values at any point of the follow-up (figure 2). Improved postoperative BCVA at one year of follow-up was dependent on younger age ($p=0.037$), better preoperative BCVA ($p=0.031$), and ILM peeling during surgery ($p=0.026$) as shown by univariate and multivariate analysis; however, no relationship was observed linked to the patient's sex, duration of symptoms, or type of surgery. Regarding OCT findings, univariate analysis showed that improved postoperative CMT was related to better preoperative CMT ($p<0.0001$) and female sex ($p<0.0001$), but neither parameter was a predictor for postoperative CMT values on multivariate analysis (Table 3).

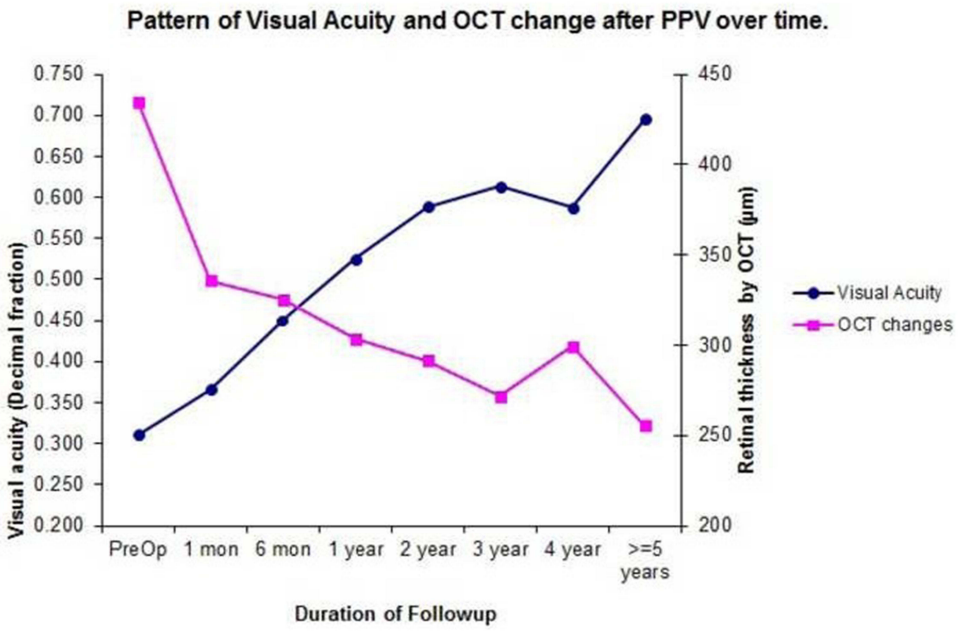

Figure 1 Visual acuity changes and retinal thickness changes after vitrectomy during 5 years of follow-up.

Discussion

PPV is a well-established technique with proven efficacy and safety for removal of ERM. Previous studies showed that 40–83% of patients gain on average of 2 or more lines of BCVA after ERM surgery.[9,10,13,15] In our series, 58% of patients had 2 or more lines of improvement in BCVA, which is consistent with previous reports. There was also a significant improvement in the mean BCVA and CMT values after surgery. The most significant improvement was observed within the first postoperative year, reaching the peak at 2 years for BCVA and 1 year for OCT measurements. It should be noted that BCVA and retinal thickness in patients followed for longer periods of up to 5 years showed a trend for further improvement, but this was not statistically significant (Table 4).

Table 2 Visual Acuity and Retinal Thickness Differences at One-Year Follow-Up According to Lens Status and Internal Limiting Membrane (ILM) Peeling

	Mean BCVA (Decimal Fraction)		**Mean CMT (µm)**	
	Preoperative	**Postoperative**	**Preoperative**	**Postoperative**
Lens Status				
Phakic	0.308	0.528	437	305
Pseudophakic	0.312	0.521	430	300
p-value	0.880	0.944	0.805	0.861
ILM peeling				
Performed	0.312	0.567	438	303
Not performed	0.304	0.430	431	305
p-value	0.787	0.020	0.840	0.928

Abbreviations: BCVA, best corrected visual acuity; CMT, central macular thickness.

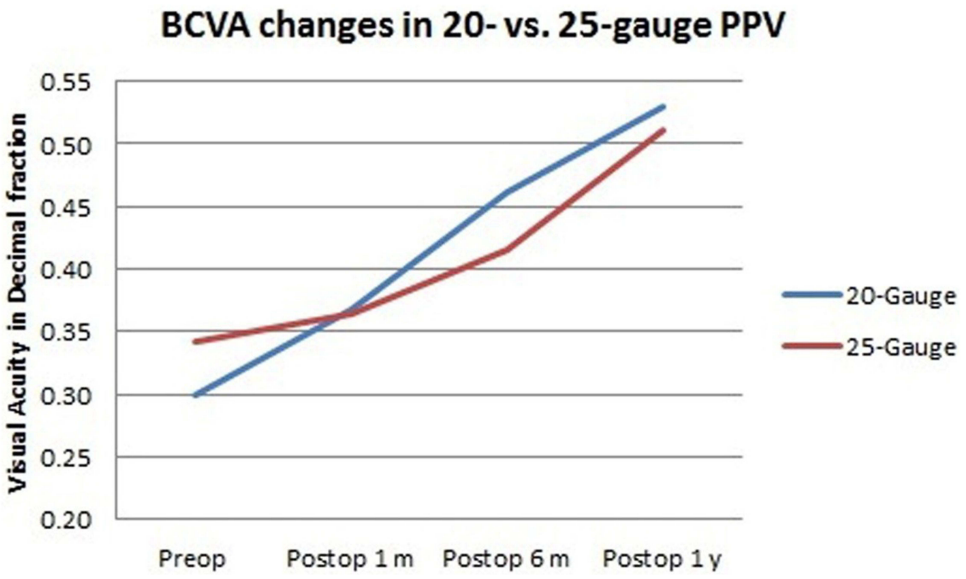

Figure 2 Comparison between 20-gauge and 25-gauge in terms of visual acuity improvement at 1 year postoperatively.

Kim et al reported a similar trend in progressive improvement in BCVA and OCT measurements even at the final follow-up visit which was at 48 months.[12] Bouwens et al also reported that the mean BCVA at five years of follow-up was one line better than at one year.[16] In our series, 46% of patients were pseudophakic at the time of surgery, and 66% of the phakic patients had cataract surgery by the end of the first year. Our patient population mostly became pseudophakic after the first year, and it is likely that the improvement in vision was not only related to the removal of ERM but also linked to cataract surgery. However, there was no statistically significant difference in mean postoperative values of BCVA or CMT when comparing phakic and pseudophakic patients.

Several prognostic factors have been reported to predict the functional and anatomical success of surgery for idiopathic ERM. Those factors include shorter duration of symptoms, better preoperative BCVA, lower preoperative CMT, and younger age.[8,10,13] In our series, preoperative BCVA, younger age, and performing ILM peeling were associated with significantly better BCVA at one year. In contrast to the previous reports, we did not find a statistically significant relationship between the duration of symptoms and our final surgical outcome. These findings

Table 3 Summary of the Univariate and Multivariate Analysis Predicting Factors for Postoperative BCVA and Retinal Thickness

Parameter	Postoperative BCVA at 1 y			Postoperative CMT at 1 y		
	Univariate	Multivariate	95% CI	Univariate	Multivariate	95% CI
Age	0.037	0.034	−0.019, −0.001	0.261	0.760	−0.327, 6.161
Sex	0.359	0.284	n/a	0.001	0.422	n/a
Duration of symptoms	0.07	0.272	−0.006, 0.002	0.377	0.955	−1.417, 1.340
Preoperative BCVA	0.031	0.019	0.102, 1.084	0.366	0.500	−126.6, 253.9
Preoperative CMT	0.478	0.782	−0.001, −0.001	0.001	0.072	0.305, 0.838
Type of surgery	0.955	0.996	n/a	0.618	0.882	n/a
ILM peeling	0.026	0.017	n/a	0.933	0.147	n/a
Gas injection	0.605	0.577	n/a	0.156	0.481	n/a

Abbreviations: BCVA, best corrected visual acuity; CMT, central macular thickness; CI, confidence interval; ILM, internal limiting membrane; n/a, not available.

Table 4 Mean BCVA at Each Point of Follow-Up with Number of Patients Who Were Included in the Analysis

	BCVA	
	No. of Patients	**Mean (SD)**
Preoperative	72	0.31 (0.12)
1 month postop	70	0.36 (0.20)
6 months postop	67	0.45 (0.22)
1 year postop	72	0.52 (0.24)
2 years postop	40	0.59 (0.26)
3 years postop	21	0.61 (0.28)
4 years postop	18	0.59 (0.26)
5 years postop	23	0.69 (0.25)

Abbreviations: BCVA, best corrected visual acuity; SD, standard deviation; No., number.

should be taken with caution as visual changes that occur with ERM are often gradual in onset, making accurate assessment of the duration of symptoms difficult.

Several studies have shown the efficacy and safety of 25-gauge PPV compared to 20-gauge PPV in various retinal conditions.[17–21] It has been suggested that 25-gauge PPV is associated with faster visual recovery postoperatively after vitrectomy for ERM.[22–24] We did not find any significant difference in the final visual and OCT outcomes between 20- and 25-gauge vitrectomy in our group of patients.

ILM peeling was associated with better visual outcome in our series. This is consistent with results from previous reports which showed that ILM peeling at time of surgery is associated with better visual acuity.[25–28] However, there are also other studies showing no such correlation.[29–31] Park et al showed that ILM peeling during ERM surgery reduces the recurrence rate.[25] In our study, the overall recurrence rate of ERM was low (4/72), making such a comparison difficult.

There are certain limitations for the current study. This study was retrospective, and BCVA measurements along with times of data collection were not standardized. Fourteen patients (16%) with idiopathic ERM were lost to follow-up within the first postoperative year. The sample size after the first year of follow-up progressively decreased, which limited more effective statistical analysis. In addition to that, we used a time-domain OCT available at our center at that time, which also limited the quality of OCT images, and limited evaluation of retinal microarchitecture especially the ellipsoid zone, interdigitation zone, and inner retinal layers, which have important correlations with functional improvement after ERM surgery.

In conclusion, our study shows that BCVA and retinal thickness improves significantly after PPV for idiopathic ERM. This improvement was most significant in the first 12 months after surgery, although an ongoing trend could be seen up to 5 years into the postoperative period. ILM peeling at the time of ERM surgery was also associated with significant visual improvement. Future prospective studies with a larger sample size and longer follow-up period are needed to expand on these findings.

Data Sharing Statement

Data analyzed during this study are included in this published article, and detailed data are available upon request from the corresponding author (MSA).

Ethics Approval

The study protocol insured full patient data confidentiality and complied with the Declaration of Helsinki.

Consent to Participate

No informed consent was required by IRB since this is a retrospective study.

Consent for Publication

No patient identification data included in the study.

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Disclosure

The authors report no conflicts of interest in this work.

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