

## CLINICAL PROFILE AND VISUAL OUTCOME AFTER ERM REMOVAL- AN EXPERIENCE FROM A TERTIARY CARE REFERRAL CENTER IN NORTH INDIA.

Parvez Ahmad Handoo<sup>1</sup>, Shabnum Nabi<sup>1</sup>

<sup>1</sup> Department of Ophthalmology, Government Medical College Srinagar.

### Abstract

**Introduction:** Epiretinal membrane(ERM) is a cellular proliferation on the inner retinal surface and possesses contractile properties which leads to variable visual symptoms. There is dearth of literature regarding epiretinal membrane from Kashmir and to our knowledge, there is hardly any study from Kashmir which has examined epiretinal membrane. Moreover, most of the study is done on idiopathic cause of epiretinal membrane. In our study we have included idiopathic as well as secondary cause of epiretinal membrane. The aim of this study was to assess the clinical profile and visual outcome after epiretinal membrane removal surgery.

**Methods:** Thirty-four patients affected with epiretinal membrane were enrolled in this study. All patients underwent standard three port pars plana vitrectomy using standard 23-gauge instruments. Both ERM and Internal limiting membrane (ILM) peels were performed in a circumferential pattern around the fovea. Patients were followed for 6 months. The visual outcome measures included postoperative logMAR(logarithm of the minimum angle of resolution) visual acuity. The anatomical outcome was measured as decrease in foveal thickness on spectral domain optical coherence tomography (SD-OCT).

**Result:** We used descriptive statistics and paired t-test in this study. The mean age of the patients in this study was  $60.25 \pm 17.5$  years with a range of 16 to 80 years. 19 patients (56%) were males. 33 patients had a unilateral ERM and 1 patient had an ERM in both eyes. Diminution of vision was the most common symptom in 34 patients, distortion of vision (metamorphopsia) was seen in 20 (58.8%) patients. In paired t-test, mean pre-operative log MAR best corrected visual acuity (BCVA) was  $1.4 \pm 0.77$  and the mean post-operative log MAR best corrected visual acuity (BCVA) was  $0.9 \pm 0.63$ . Out of 34 patients in our study, 31 (91.2%) had improvement in VA(Visual acuity), and the remaining 3 (8.82%) patients had no improvement and none of the patients had decreased vision. 16 patients had  $\geq 2$  lines of improvement in visual acuity. 15 patients had less than 2 lines of improvement.

**Conclusion:** ERM poses a significant risk to compromise the vision and affect varied age groups. ERM removal through standard three port pars plana vitrectomy offers an effective and safe procedure with better post operative visual outcomes.

**Keywords:** ERM, OCT, LOG MAR, VITRECTOMY, VISUAL ACUITY

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## INTRODUCTION

Epiretinal membranes (ERM) is a contractile membrane that occurs on the inner surface of the retina. It is also known as premacular fibroplasia, macular pucker, cellophane maculopathy, and premacular gliosis<sup>1</sup>. ERM proliferation was first described by Iwanoff<sup>2</sup>. It is caused by the proliferation of avascular cellular sheets on the inner retinal surface and along the internal limiting membrane (ILM), which possesses contractile properties and as a result, leads to variable visual symptoms and visual impairments, primarily due to the mechanical distortion of the macular area.

Correspondence to:  
Shabnum Nabi,  
Government Medical College  
Srinagar  
shabnumnabi@gmail.com

The variable effect an ERM has on vision is determined primarily by the severity of the retinal distortion and the location of the membrane. Epiretinal membranes (ERM) have been classified according to their underlying etiology into a) idiopathic ERM (iERM)<sup>3</sup> if no underlying causative factor or ocular pathology can be associated with the formation of the membrane: b) secondary ERM,<sup>2</sup> if a preexisting or coexisting condition that has had a significant impact on its development, commonly found in retinal breaks and retinal detachment (RD), diabetic retinopathy, retinitis pigmentosa, retinal vascular disease, vascular occlusion, intraocular inflammation, ocular trauma, telangiectasias; c) iatrogenic<sup>4</sup> if they occur following medical or surgical intervention like postoperative cataract, postoperative retinal detachment, retinopexy, laser, cryotherapy etc.

ERM can be diagnosed with fundus biomicroscopy as a glistening light reflex from the inner retina in mild cases or wrinkling and/or striae of the retinal surface and distortion of retinal vessel if the ERM is advanced. Optical coherence tomography (OCT) is the most sophisticated imaging modality in the diagnosis of ERM, and can be seen as a hyperreflective layer over the retinal surface. Vitrectomy and membrane peels with or without ILM removal<sup>5</sup> are considered the treatment of choice for patients with symptomatic ERM. Removal of the internal membrane with ERM peeling may help decrease the risk of ERM recurrence<sup>5</sup>.

We undertook this study that we believe is a first of its kind from our valley. We undertook this study

to assess the various etiologies of ERM present in our population and effect of ERM on vision in them. We also assessed the outcomes after ERM removal in terms of visual acuity and any complications thereof, if any.

## METHODS

This was a prospective observational study. Patients with informed consent and meeting the inclusion criteria were taken for the study. The study was conducted for a period of one and half year. This study was approved by the institutional ethical board of GMC Srinagar in November 2018.

The inclusion criteria were all patients with symptoms of distortion of vision and decreased visual acuity with epiretinal membrane diagnosed on Slit Lamp Biomicroscopy and documented by SD-OCT; patient who can be followed at least 6 months after surgery; The exclusion criteria were patients with rubeotic and angle closure glaucoma; extensive ERM extending outside arcades; corneal opacity; patients with prior vision limiting ocular conditions such as amblyopia, optic neuropathy.

In preoperative examination a careful detailed history was taken from the patient. Parameters recorded were patients medical history including age, gender, symptoms and their duration, previous surgery, and history of any ocular inflammation like uveitis. The patients were categorized as idiopathic ERM (When no underlying causative factor or ocular pathology was associated with the formation of the membrane) and secondary ERM (when a preexisting or coexisting condition that has had a significant impact on its development, retinal breaks and retinal detachment (RD), diabetic retinopathy, retinitis pigmentosa,

retinal vascular disease, vascular occlusion, intraocular inflammation, post cataract surgery etc). BCVA (best corrected visual acuity) was assessed by Early treatment Diabetic retinopathy Study charts(ETDRS) and recorded as log MAR units. All patients underwent Direct and Indirect ophthalmoscopic examination of fundus for assessment of macula, optic nerve head, blood vessels. On funduscopy examination ERM appears as a fine transparent membrane to dense opaque tissue. Pre-operative fundus examination was also done to know the etiology of ERM and to diagnose the associated ocular conditions like diabetic retinopathy, vascular occlusion, retinitis pigmentosa, retinal detachment. SD-OCT (Spectral domain optical coherence tomography) using Cirrus H-D OCT, Model 5000 Carl Zeiss Meditech was done in all patients preoperatively for ERM diagnosis. Post-operative macular thickness was also recorded at one week, 1 month, three month, and six months by using SD-OCT. On OCT, epiretinal membranes are seen as a highly reflective layer on the inner retinal surface. The macular thickness was measured as combined thickness of the ERM and the sensory retina (from the inner surface of the ERM to the inner surface of the highly reflective band which corresponds to the retinal pigment epithelium). IOP (intraocular pressure) was measured at preoperative

examination using a handheld tonometer (ICARE IC100) tonometer. IOP measurement was done at each post-operative visit. Fundus Fluorescein angiography (FFA), was performed to demonstrate the extent of retinal wrinkling, degree of retinal vascular tortuosity and presence of macular edema. Fluorescein angiography was performed to rule out other lesion that may mimic epiretinal membrane. The preoperative and post operative examination was done by the two ophthalmologist to minimize the chance of any subjective interpretations of results(bias)

All vitreoretinal surgeries were performed by the same experienced surgeon who used the technique of standard three-port pars plana vitrectomy. using standard 23-gauge instruments (ALCON CONSTELLATION). A core vitrectomy was performed followed by posterior vitreous detachment (PVD) induction in case where posterior hyaloid was attached using triamcinolone acetate 40mg injection to assist in visualization and removal. After PVD, brilliant blue G (BBG 0.05%w/v-ocublue plus) dye was then slowly injected (Figure 1) towards the macular area to stain internal limiting membrane (ILM) with ERM seen as an area free of stain (negative stain). Both ERM and ILM peels were performed in a circumferential pattern around the fovea.

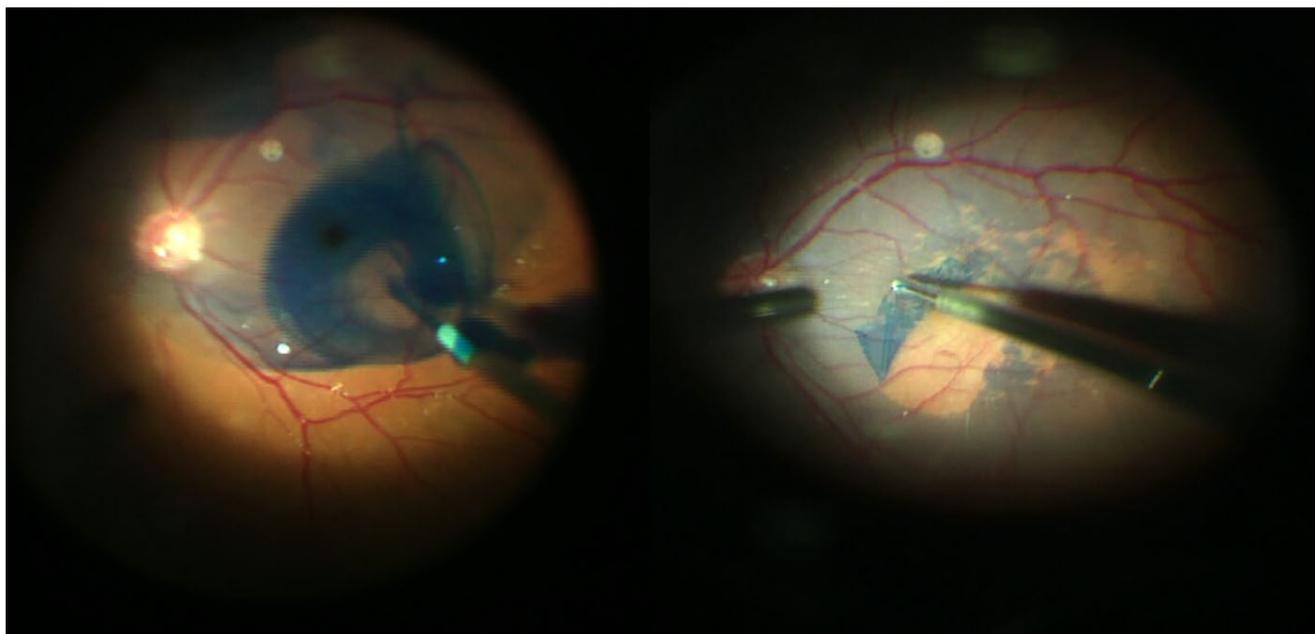


FIGURE 1: Operating microscope view demonstrating injection of BBG dye and membrane peeling

In some patients who had cataract on pre-operative evaluation along with ERM, phacoemulsification and intraocular lens implantation with ERM removal was performed in the same sitting. SF6 was used as tamponade agent in majority of cases. However in cases with Retinal Detachment silicon oil was used. Patients were advised against air travel and high altitude climbing after surgery for minimal of 2 weeks. The patients were followed for 6 months for functional outcomes (visual acuity), anatomical features (OCT-macular thickness) and post-operative complications if any.

The improvement in visual acuity was measured as increase in number of lines of improvement in best corrected visual acuity after epiretinal membrane removal surgery and the anatomical improvement was measured as decrease in the central macular thickness on postoperative OCT as compared to the preoperative OCT findings

### **Statistical Analysis.**

After completion of data collection, data was entered and coded for descriptive and inferential statistical analysis. In descriptive analysis percentage, median, mean, Interquartile deviation, and standard deviation was applied. Further, in inferential statistics, paired t-test and one-way ANOVA with effect size was applied to meet the objectives of the current study namely best corrected visual activity (pre-op and post-op) and comparison between pre-op and post-op foveal thickness.

### **RESULTS**

The mean age of the patients in this study was  $60.25 \pm 17.5$  years with a range of 16 to 80 years. The median age was 65 years and majority (85%) of the patients were more than 60 years old. Among 34 patients included in this study 19 patients (56%) were males. 33 patients had a unilateral ERM - 21 of them had involvement of right eye and 12 with left eye involvement. 1 patient had an ERM in both eyes. Diminution of vision was the most common symptom in 34 patients, distortion of vision

(metamorphopsia) was seen in 20 (58.8%) patients, floaters were present in 10 (29.4%) and photopsia was complained by 7 (20.5%). 15 (44.1%) had symptom duration of <1 year and the rest of patients (n=19) complained of symptoms from >1 year.

Out of the 34 patients with ERM, 24 (70.5%) cases had secondary ERM and 10 (29.5%) cases had idiopathic ERM. Secondary ERMs included 4 patients with old vascular occlusion, 7 patients with previous cataract surgery, 4 with both previous cataract surgery and vascular occlusion, 4 with ocular trauma (vitreous hemorrhage), 1 with retinal detachment and 1 patient with diabetic retinopathy. A history of both previous cataract extraction surgery and trauma (vitreous hemorrhage) was present in 1 patient. 2 patients also had a history of both cataract extraction and retinal detachment. Out of 34 patients, 13 (38.20%) were pseudo phakic preoperatively 16 (47%) had clear lens before surgery 4 (11.8%) had cataract on presentation and 1 (2.94%) patient was aphakic. All the eyes underwent pars plana vitrectomy. In some patients (n=4) who had cataract on pre-operative evaluation along with ERM, phacoemulsification and intraocular lens implantation with ERM removal was performed in the same sitting. SF6 was used as tamponade agent in majority of cases. However in cases (N=2) with RD silicon oil was used.

There was no intraoperative complication associated with the vitrectomy and ERM removal surgery.

In the follow up period two patient showed progression of cataract formation in the first 3 months of pars plana vitrectomy and was treated surgically with phacoemulsification and implantation of intraocular lens.

At the end of follow up 31 (91.2%) had improvement in VA, and the remaining 3 (8.82%) patients had no improvement and none of the patients had decreased vision. Figure 2.1 and 2.2 are the fundus and OCT images of the same patient pre-operatively and post-operatively.

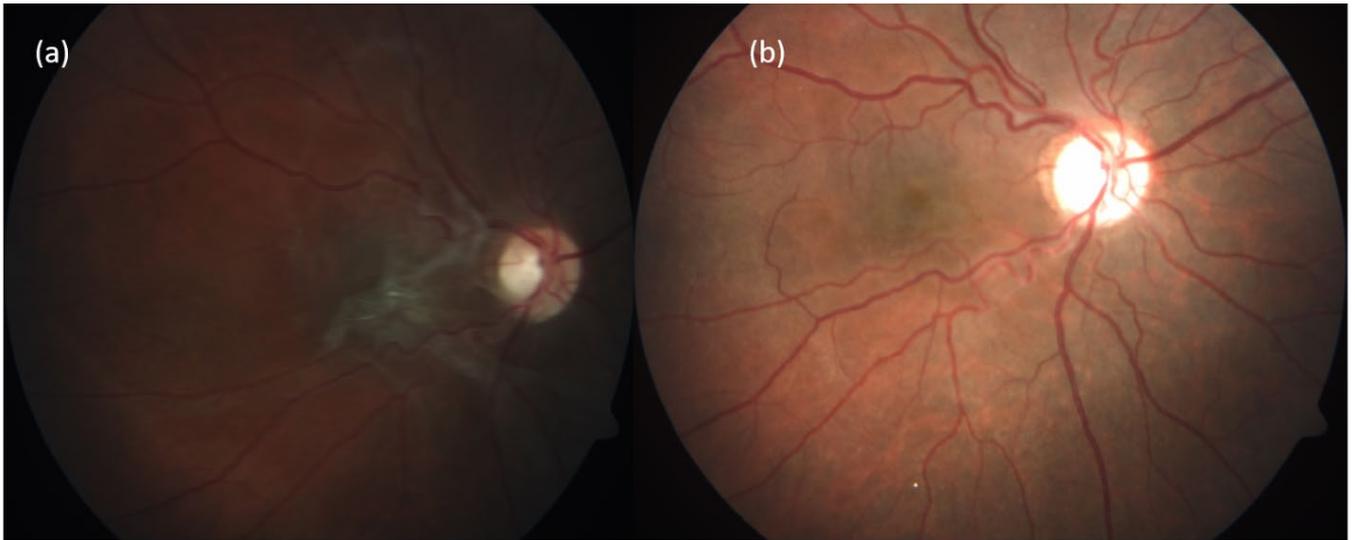


Figure 2.1 - (a) and (b) represent pre-op fundus image showing ERM, (b) represents post-op image of the same patient after ERM removal.

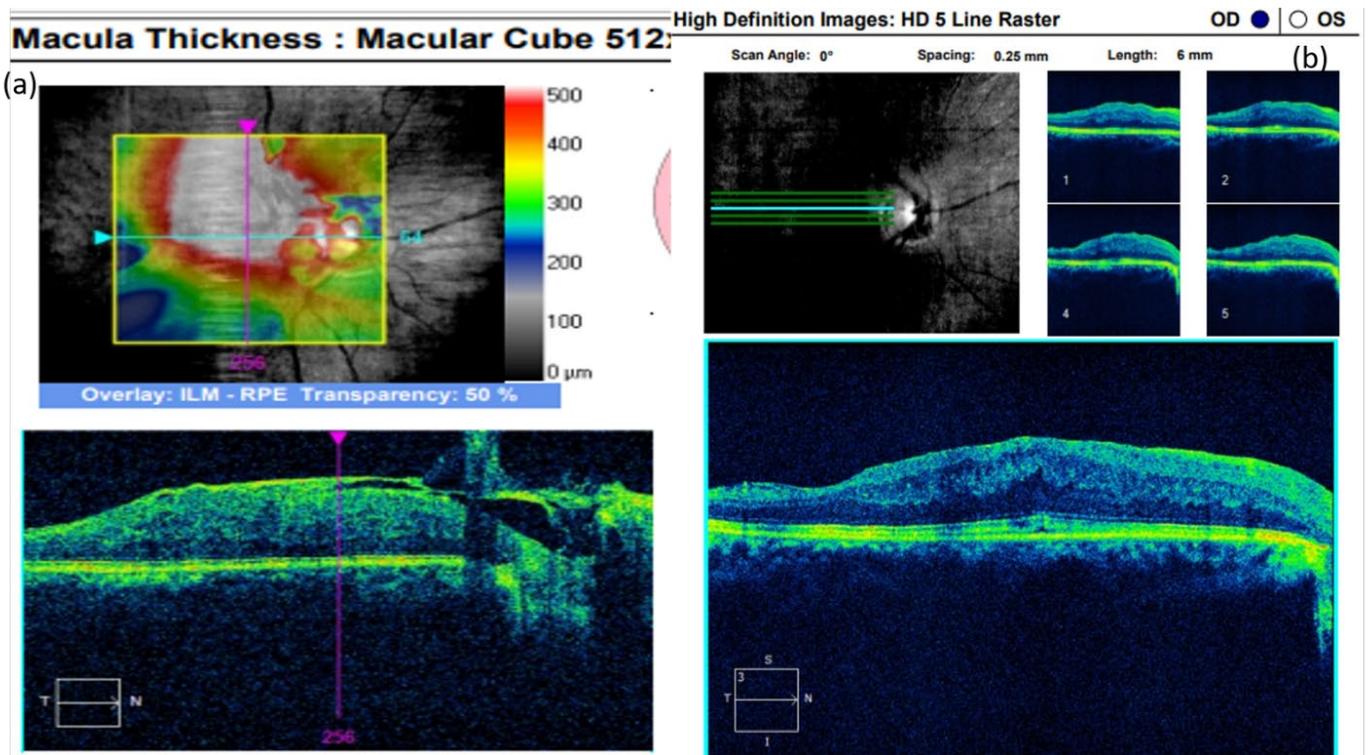


Fig.2.2-(a)OCT picture showing ERM with distorted retina (b)showing postoperative OCT picture of the same patient after surgery

The mean pre-operative log MAR best corrected visual acuity (BCVA) was  $1.4 \pm 0.77$  and the median (Inter Quartile Range -IQR) was 1.04 (2). The mean post-operative log MAR best corrected visual acuity (BCVA) was  $0.9 \pm 0.63$  and the median (IQR) was 0.6 (1.01). Out of 34 patients in our study, 16 patients had  $\geq 2$  lines of improvement in visual acuity. 15 patients had less than 2 lines of improvement as shown in table 1:

Table 1. VISUAL ACUITY IMPROVEMENT

	≥2 LINES	<2 LINES	NO IMPROVEMENT
Number of patients (%)	16(47%)	15(44%)	3(9%)

Mean preoperative foveal thickness was  $427.64 \pm 141.5 \mu\text{m}$  with disappearance of the foveal pit, whereas mean postoperative thickness was  $327.46 \pm 129.5 \mu\text{m}$  (decrease in foveal thickness of  $100.18 \mu\text{m}$  on average). There was a significant difference (P value  $< 0.001$ ) between the preoperative and postoperative foveal thickness on OCT

The pre-operative and post-operative mean visual acuity in log mar and Central Macular thickness(CMT) is shown in table 2:

Table 2: Preoperative and post-operative findings (BCVA and central macular Thickness)

Pre-Op BCVA	Post-OP BCVA (Log MAR)	t=6.556
(Log MAR)	Median (IQR)=0.6 (1.01)	P value= <.001
Median (IQR)=1.04(2)	Mean = $0.931765 \pm .6499859$	Cohen's d = 0.78
Mean= $1.464 \pm 0.711$		
Pre-Op central macular thickness	Post-OP central macular thickness	t= 4.585*
Mean± SD = $427.65 \pm 141.519 \mu\text{m}$	Mean± SD= $328.23 \pm 131.582 \mu\text{m}$	P value=<.001
		Cohen's d =0.72 <sup>‡</sup>

\*t= paired t test.

<sup>‡</sup>= Cohens' d = is a measure of the effect size which is a quantitative measure of the magnitude of the experimental effect i.e., how large an effect of something is Value 0.72 is medium effect size and is big enough to be discerned.

### **Post-operative complications**

In the follow up period, only 2 eye showed cataract progression at an average period of 3 months after vitrectomy. Recurrence of ERM was not found in any case during follow up. Cystoid macular edema was found in 6 patients. There was no other postoperative complication like vitreous hemorrhage, post-operative endophthalmitis, or inflammation.

## DISCUSSION

The procedure of vitrectomy and membrane peeling has become an established surgical procedure for the treatment of epiretinal membrane. Surgical indications for epiretinal membrane peeling have changed with the advent of newer and safer techniques. Initially the surgery was confined to the patients with very poor vision, large thick membranes or membranes with distinct peelable edges. Some authors now suggest the VA below 6/18 and considerable symptoms of metamorphopsia or declining vision as indication for surgery<sup>2,6</sup>. We operated 34 eyes of 34 patients who had ERM diagnosed on OCT with visual acuity  $\leq 6/18$ . Out of the 34 patients, majority (n= 29) were > 60 years (85%). The range in our study was 16 to 80 years. The median age was 65 years and mean age was  $60.25 \pm 17.5$  years. The mean age of patients reported by Rice TA et al<sup>7</sup> was 58 years and a range of 4 to 85 years in his study on 264 number of patients of ERM where he evaluated prognostic factors in vitrectomy for ERM. Shahzadi B et al<sup>8</sup> in his study on visual and anatomical outcomes following macular epiretinal membrane surgery, had included 30 patients with an average age of  $72 \pm 5$  years with a range of 61 to 84 years.

10 (29.5%) patients had idiopathic ERM with no associated ocular disease. 24 patients had a secondary ERM which could be attributed to following ocular abnormalities present in these patients: vascular occlusion, previous cataract surgery, trauma, retinal detachment and diabetic retinopathy, vascular occlusion. In the Blue Mountains Study, the prevalence of ERM was significantly increased following cataract surgery (16.8%) and retinal vein occlusion (12.5%); 9.1% of patients with no retinal abnormality at baseline developed an ERM following cataract surgery.<sup>9</sup> In our study all the patients had diminution of vision as the presenting complaint; other complaints being metamorphopsia, floaters, flashes of light with majority of our patients having duration of symptoms for more than a year (n=19; 56%). In our series we observed that the patients with longer duration of symptoms had poor visual acuity at presentation and had less improvement in visual outcomes after surgery measured in terms of number of lines of improvement in vision as

compared to the patients who had symptom duration of less than a year. The mean Log MAR pre-operative visual acuity of the patients who had symptom duration less than 1 year was  $1.14 \pm 0.617$  and their mean log MAR Post-operative visual acuity was  $0.67 \pm 0.45289$ . For patients with symptom duration of more than 1 year, the mean log MAR pre-operative and post-operative visual acuity was  $1.62 \pm 0.835$  and  $1.125 \pm 0.694$ , respectively. A significant statistical difference was seen in terms of improvement in vision post-operatively between these two groups of patients (p=0.028). Rice TA et al<sup>7</sup> also made the similar observation that eyes with a longer history of blurred vision had poorer visual acuity after surgery and also less improvement in vision. Michels RG et al<sup>10</sup> also has made a similar observation in his study. Luliano L et al (2019)<sup>11</sup> also has made similar observation.

In our study we operated on patients with very low VA, that ranged from FC (finger counting) to 6/18. Out of 34 patients in our study, 31 (91%) had improvement in VA, and the remaining 3 (9%) patients had no improvement. None of the patients had worst or decreased vision post-procedure. The pre-operative BCVA (Log MAR) Mean was 1.4 which corresponds to 6/152 (Snellen's equivalent)<sup>12</sup> and the post-operative BCVA (Log MAR) Median was 0.9 which corresponds to 6/48. This shows that majority of the patients in our study had visual improvement after the surgery. In our study patients with poor vision pre-operatively and symptom duration of less than 1 year improved most in terms of lines of improvement (p=0.028) but this was still lower than those with better preoperative good vision. Michels RG<sup>13</sup> in his study on a clinical and histopathologic study of epiretinal membranes affecting the macula and removed by vitreous surgery and has observed a similar relation between duration of symptoms and improvement in vision post ERM removal. He observed eyes with long standing ERM had somewhat less favorable visual results than those in which the membrane had occurred more recently. His study included 21 eyes with ERM duration  $\geq 12$  months and 39 eyes with ERM duration of  $\leq 6$  months and he observed that visual acuity in the former group improved 6/12 or better in 14%, 6/15 to 6/30 in 52% and 6/60 or worse in 33% eyes.

In the later group the final visual acuity was 6/12 or better in 41%, 6/15 to 6/30 in 54% and 6/60 or worse in 5% eyes. Previous studies have also shown similar results. The study carried by Shahzadi B et al<sup>8</sup> showed improvement of vision in 76% of cases, 6.6% of cases showed worsening and 16% of cases showed no change in vision

Kwok AKh et al<sup>14</sup> reported an improvement in visual acuity in both ILM and non ILM peeling groups after ERM surgery. Another study conducted by Wong JG et al<sup>15</sup> showed improvement of visual symptoms in 83% of patients, 16% having unchanged acuity and 1% having worst acuity.

In our study postoperative macular thickness on OCT shows a significant decrease in thickness 99.45  $\mu$ m on average (Mean pre-op-427.65 $\pm$ 141.519  $\mu$ m and Mean Post-op CMT thickness= was 328.23 $\pm$ 131.582). Similar results were observed by Shahzadi B et al<sup>8</sup> in his study. They reported significant decrease in central macular thickness of 87 $\mu$ m on average. Similarly, Pournaras CJ et al<sup>16</sup> in their study on 39 eyes showed that OCT measurement of postoperative foveal thickness had a significant decrease; however, no correlation was observed between postoperative BCVA and postoperative foveal thickness (Pearson's correlation coefficient = 0.139;  $p > 0.1$ ). Kwon S Il et al<sup>17</sup> reviewed the records of 30 patients (30 eyes) with ERM and found that foveal thickness and visual acuity improved until seven months after the vitrectomy in patients with idiopathic ERM. Cubuk MO et al (2020)<sup>18</sup> in their study also found that Visual improvement and the amount of decrease in macular thickness was statistically significant. Cataract formation was seen in only two patient after surgery. Wong JG<sup>15</sup> in his study, observed cataract formation in 52 cases of phakic eyes postoperatively compared with 19 cases preoperatively. Shahzadi B et al<sup>8</sup> et al also observed cataract formation in 21 eyes after surgery. de Brustos S et al<sup>19</sup> observed that progressive nuclear sclerotic lens developed in 38 of 60(63%) aphakic eyes.

### Limitation

In our study surgical indications and outcome measures have been based solely on VA parameters. Many patients who undergo surgery complain of

symptoms other than blurred vision, such as loss of binocularity (functional vision measures) which may be inadequately reflected by assessment of VA alone and hence further formal validation is required. We believe that this may be a useful tool in preoperative surgical planning and monitoring of postoperative outcomes. Another limitation of our study is a smaller sample size( $n=34$ ).

### CONCLUSION

Our study suggests that vitrectomy with ERM removal and ILM peeling is beneficial in improving vision in majority of patients with symptoms from ERM. Patients with secondary ERM also showed improvement following surgery. It is a safe procedure with minimum complications. However, there is no consensus concerning an optimal time for surgery. Early intervention may prevent non-reversible damage to the outer retina; however, follow-up with SD-OCT and clinical examination for recording visual acuity and metamorphopsia is imposed in early cases prior to decision-making.

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