The Impact Of Internal Limiting Membrane Peeling On Retinal Microvascular Parameters After Epiretinal Membrane Surgery: A Comparative Study

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ABSTRACT

Purpose: To compare the microvascular changes after pars plana vitrectomy for idiopathic epiretinal membrane (ERM) whether internal limiting membrane (ILM) peeled or not.

Methods: In this retrospective study, total of 25 eyes in only ERM group and 26 eyes in ILM group were evaluated. Best corrected visual acuity (BCVA), central macular thickness (CMT) were compared. In optical coherence tomography angiography (OCTA), foveal vessel density (VD), parafoveal VD and perifoveal VD of superficial capillary plexus (SCP) and deep capillary plexus (DCP) and foveal avascular zone were compared. Foveal herniation was also evaluated.

Results: There was no different in terms of BCVA, CMT, OCTA parameter change and recurrence rate, between ILM and only ERM groups. In OCTA parameters, DCP parafoveal VD of ILM group was significantly increased, postoperatively. (44.91±6.34, 49.52±5.74, p=0.024) SCP perifoveal VD and DCP foveal VD of only ERM group was significantly decreased, postoperatively. (SCP perifoveal VD: 44.67±4.89, 42.4±5.07, p=0.041; DCP foveal VD: 43.61±6.09, 39.44±5.99, p=0.045) According to having foveal herniation (FH), increase in SCP and DCP perifoveal VD was significant in ILM group. (SCP perifoveal VD change: FH(+): 4.86±9.46, FH(-): -1.8±5.48, p=0.036; DCP perifoveal VD change: FH(+): 12,26±9,39, FH(-):0,3±13.3, p=0.048)

Conclusion: There is no difference between two technique in terms of BCVA, CMT and any OCTA parameters at 1 year follow-up. However, in a small subgroup analysis including FH, significant changes were observed in OCTA parameters.

Keywords: epiretinal membrane, pars plana vitrectomy, internal limiting membrane peeling, foveal herniation, optical coherence tomography angiography

INTRODUCTION

Idiopathic epiretinal membrane (ERM) is a common pathology, usually seen in elderly population. It causes metamorphopsia in early stage and slow visual loss also occur. (1) Proliferative cells migrating along the surface of the internal limiting membrane (ILM) cause wrinkling and consequently retinal traction in the macular area. (2) Prevalence of ERM increases in the population older than 60 years.

The treatment depends on the patient's symptoms and particularly visual loss, and it consists of pars plana vitrectomy with ERM peeling. (3) ERM recurrrence is seen in approximately at 10%~21% of patients. (4) As the basal lamina of Müller cells, the ILM plays an important role in the recurrence of ERM. ILM peeling during ERM surgery is tought to prevent the recurrence of ERM. (5) According to a recent meta-analysis, visual acuity did not differ between groups of ILM peeling or not. However, the

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Received: 03.10.2025
Accepted: 21.07.2026
J Ret-Vit 2026; 35: 239-246
DOI:10.37845/ret.vit.2026.35.30

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recurrence and reoperation risk was lower in ILM peeled patients. (6)

Optical coherence tomography (OCT) is a useful method for discovering microscopic retinal changes and has been applied extensively to assist in the diagnosis of ERM. (7)

Optical coherence tomography angiography (OCTA) is a novel method that generates three-dimensional images of vasculature in vivo and without dye injection. Another advantage of OCTA is that it allows resolution of both the superficial and deeper capillary plexuses networks. (8) Distortion of microvascular layers in eyes with ERM was evaluated with OCTA in previous studies. (9,10) Given that tangential forces from ERM induce vascular displacement and bending within the inner retina, OCTA represents a promising modality for assessing the extent of retinal distortion. (11)

Tha aim of our study is to compare the microvascular changes after pars plana vitrectomy in ERM patients depending on whether the ILM was peeled or not.

MATERIAL AND METHODS

This is a retrospective study which conducted in Bursa Yüksek İhtisas Training and Research Hospital, Department of Ophthalmology. The data of the patients with idiopathic epiretinal membrane who had pars plana vitrectomy and ERM and/not ILM peeling, between June 2021 and June 2023 was evaluated.

Exclusion criterias were ≤ 18 years, having corneal opacities, a refractive error ≥ 6 diopter, axial length ≥ 26 mm, trauma, retinal diseases such as diabetic retinopathy, hypertensive retinopathy, central serous chorioretinopathy, and macular degeneration, and optic nerve diseases such as glaucoma or optic neuropathy. In addition, the patients with poor quality OCT and OCTA images were excluded. This study adhered to the tenets of the Declaration of Helsinki and was approved by Bursa Yüksek İhtisas Training and Research Hospital's Institutional Review Board and Ethics Committee (Project no:2011-KAEK-25 2022/03-24).

All surgeries was performed by one surgeon. (MOU) Pars plana Vitrectomy was performed using DORC's EVA 23- gauge vitrectomy platform (DORC, Zuidland, the Netherlands). Firstly cataract surgeries were performed to all phakic patients. Epiretinal membranes were stained with a combination of 0.025% Brilliant Blue G and 0.15% trypan blue (Membrane Blue-Dual, DORC, Zuidland, the Nederlands) and then removed according to the protocol using a 23 -gauge microforceps. After the ERM was peeled of, fovea was re-stained to detect the defect on ILM. In the absence of any detect on ILM, the peeling was finished. In double peeling group ERM and ILM peeled in order.

All patients' data were analyzed, including measurement of Snellen best-corrected visual acuity (BCVA), slit-lamp examination, tonometry, and dilated fundus examination with +90D lenses. We also evaluated preoperative and postoperative OCT and OCT-A images (RTVue XR AVANTI; AngioVue, Optovue Inc, Fremont, CA). The measurements were obtained by one experienced technician. OCTA images (3x3 mm and 6x6 area) centred at the fovea were acquired. Images with a signal strength index lower than 6, those of low quality or those with unclear layer segmentation were excluded. Segmentations of the superficial capillary plexus (SCP) and deep capillary plexus (DCP) in each image were manually inspected and adjusted. The software automatically measured the foveal VD (FVD), parafoveal VD (PRVD) and perifoveal VD (PERVD) of the retinal capillary plexus. Foveal avascular zone measurements were based on the retina slab (ILM to outer plexiform layer + 10 mm) and FAZar (mm2), FAZp (mm), FAZai (the ratio between the measured perimeter and the perimeter of the same size circular area), and FAZvd (vessel density within a 300-mm ring surrounding the FAZ [%])obtained automatically by using AngioVue software.

Statistical Analysis

Statistical data were analysed using SPSS version 21.0 (SPSS, Chicago, IL, USA). Values were expressed as mean ±standard deviation. The normality of the values was analysed using the Kolmogorov-Smirnov test. Student's *t* test was used according to the Kolmogorov Smirnov test results. Paired t test was used for the parameters before and after surgery. Categorical variables were evaluated with Pearson Chi-Square test. Differences were considered significant at $p<0.05$. Correlations between the variables were investigated based on the Pearson or Spearman correlation coefficient.

RESULTS

Twenty-five eyes in only ERM group and 26 eyes in ILM group were recruited in our study. The mean age and the sex ratio were same between two group. (72.67±6.43 in only ERM group and 73.7±4.54 in ILM group, p=0.74; M/F: 9/16 in only ERM group and 8/18 in ILM group, p=0.64) In only ERM group, cataract surgery was applied to 20 patients and in ILM group to 21 patients. (p=0.57) Preoperative foveal herniation in OCT figures was 6/19 in only ERM group and 6/20 in ILM group. (p=0.66) Postoperative last control time was same between two groups. (Only ERM group 12.92±6.02 months, ILM group 11.15±4.54 months, p=0.76) (Table 1)

Preoperative and postoperative visual acuity between the groups show no statistically significant difference. (Preop in LogMAR; only ERM group 0.74±0.92 and ILM group 0.76±0.95, p=0.84; Postop in LogMAR: only ERM group 0.28±0.67 and ILM group 0.25±0.61, p=0.76) In both groups, the BCVA was increased significantly, postoperatively. (ILM group: 0.76±0.95, 0.25±0.61, p<0.001, only ERM group 0.74±0.92, 0.28±0.67, p<0.001) BCVA change was also not statistically significantly different between groups. (ILM group: 0.34±0.21, only ERM group 0.34±0.23, p=0,93) (Table 1)

Preoperative and postoperative central macular thickness (CMT) between two groups were not statistically significantly different. However, the thickness were shifted to ILM group side from preoperative to postoperative. (Preop CMT: only ERM group 401.79±97.07µ and ILM group 376.7±150.15, p=0.48; postop CMT: only ERM group 293.92±101.21µ and ILM group 303.56±120.31, p=0.76) In addition, in only ERM group, the CMT decrease is more than ILM group, but not significant. (ILM group: -70.58±140.12, only ERM group: -109,16±88.22, p=0.24) (Table 1)

In OCTA parameters, DCP parafoveal VD of ILM group was increased postoperatively. (44.91±6.34, 49.52±5.74, p=0.024) SCP perifoveal VD and DCP foveal VD of only ERM group was decreased postoperatively. (SCP perifoveal VD: 44.67±4.89, 42.4±5.07, p=0.041; DCP foveal VD: 43.61±6.09, 39.44±5.99, p=0.045) The change of SCP and DCP, foveal, parafoveal and perifoveal VD was not statistically significantly different between two groups. (Table 2)

FAZ area (ILM group: 0.15±0.12, only ERM group, 0.13±0.08, p=0.5), FAZ perimeter (ILM group: 1.53±0.62, only ERM group, 1.41±0.43, p=0.45), FAZai (ILM group: 1.13±0.08, only ERM group, 1.13±0.05, p=0.67) and FAZ VD (ILM group: 49.32±6.22, only ERM group, 47.97±4.69, p=0.38) were not different between groups, postoperatively. (Table 3)

According to having foveal herniation (FH), increase in perifoveal VD of SCP and DCP was different in ILM group. (Perifoveal VD of SCP change: FH(+): 4.86±9.46, FH(-): -1.8±5.48, p=0.036; perifoveal VD of DCP change: FH(+): 12,26±9,39, FH(-):0,3±13.3, p=0.048) In only ERM group, none of the OCTA parameters change was different between FH (+) and (-) patients. Postoperative FAZ values are not differ between FH (+) and (-) patients in both ILM and only ERM groups. In both ILM and only ERM group, CMT was significantly decrease in FH(+) more than FH(-) patients. (ILM group: FH(+):-177.17±149.85, FH(-): -38.6±123.54, p=0.03, only ERM group: FH(+): -180.67±59.74, FH(-): -86.58±84.52, p=0.019) BCVA change was not different between FH (+) and (-) patients in both groups. (ILM group: FH(+):0.42±0.28, FH(-): 0.31±0.21, p=0.32, only ERM group: FH(+): 0.35±0.19, FH(-): 0.34±0.22, p=0.99)

The recurrence rate was not different between groups. (ILM group 0.11±0.32, only ERM group 0.16±0.37, p=0.65) There was no correlation detected between postoperative BCVA and any OCTA and OCT parameters in both groups.

Table 1: *Comparison of demographic parameters of the groups.*

	ILM group (n=26)	Only ERM group (n=25)	p
Age (years)	73.7±4.54	72.67±6.43	0.74
Gender (M/F)	8/18	9/16	0.64
Preoperative BCVA	0.76±0.95	0.74±0.92	0.84
Preoperative IOP (mmHg)	15.24±3.54	16.31±3.78	0.76
Lens Status (Phakic)	21/26	20/25	0.57
ERM Grade 1/2/3/4	5/5/8/8	0/2/12/11	0.55*
Preoperative CMT (µm)	376.7±150.15	401.79±97.07	0.48
Foveal Herniation	6/26	6/25	0.66
Postoperative BCVA	0.25±0.61	0.28±0.67	0.76
Postoperative IOP (mmHg)	14.45±2.98	14.52±2.78	0.91
Postoperative CMT (µm)	303.56±120.31	293.92±101.21	0.76
Postoperative Follow-up Period (month)	11.15±4.54	12.92±6.02	0.76

BCVA: Best corrected visual acuity, (LogMAR) IOP: Intraocular pressure, CMT: Central macular thickness, ILM: Internal limiting membrane, ERM: Epiretinal membrane, * Fisher'exact test, $p<0.05$

Table 2: *Comparison of the Vessel Densities between two groups.*

	ILM group (n=26)	Only ERM group (n=25)	p
Preop SCP Foveal VD	38.05±9.61	38.08±8.71	0.98
Postop SCP Foveal VD	37.34±9.69	33.69±8.65	0.16
p (Preop vs Postop)	0.77	0.052	
Preop SCP Parafoveal VD	44.11±6.2	44.51±5.75	0.81
Postop SCP Parafoveal VD	46.31±6.62	43.67±5.51	0.12
p (Preop vs Postop)	0.25	0.56	
Preop SCP Perifoveal VD	42.48±5.26	44.67±4.89	0.13
Postop SCP Perifoveal VD	42.17±4.88	42.4±5.07	0.86
p (Preop vs Postop)	0.82	**0.041**	
Preop DCP Foveal VD	43.81±8.36	43.61±6.09	0.92
Postop DCP Foveal VD	39.85±7.58	39.44±5.99	0.83
p (Preop vs Postop)	0.11	**0.045**	
Preop DCP Parafoveal VD	44.91±6.34	46.88±6.71	0.28
Postop DCP Parafoveal VD	49.52±5.74	49.08±4.57	0.76
p (Preop vs Postop)	**0.024**	0.21	
Preop DCP Perifoveal VD	41.71±8.5	45.08±6.81	0.12
Postop DCP Perifoveal VD	44.77±7.08	45.69±5.77	0.61
p (Preop vs Postop)	0.25	0.71	

SCP: Superficial capillary plexus, DCP:Deep capillary plexus, VD: Vessel density, ILM: Internal limiting membrane, ERM: Epiretinal membrane, $p<0.05$

Table 3: *Comparison of tha FAZ parameters of two groups.*

	ILM group (n=26)	Only ERM group (n=25)	p
FAZ area	0.15±0.12	0.13±0.08	0.5
FAZ perimeter	1.53±0.62	1.41±0.43	0.45
FAZ ai	1.13±0.08	1.13±0.05	0.67
FAZ VD	49.32±6.22	47.97±4.69	0.38

ILM: Internal Limiting Membrane, ERM: Epiretinal Membrane, FAZ: Foveal Avascular Zone, p<0.05

DISCUSSION

In our study, perifoveal VD of DCP in ILM group was significsantly increased and perifoveal VD of SCP and foveal VD of DCP were significantly decreased in only ERM group. There is no difference between two groups in terms of OCTA parameter changes. In addition, patients with foveal herniation in ILM group, change of the perifoveal VD of SCP and DCP is found to be more than without foveal herniation group.

The treatment method of the ERM is removal of membrane with the method of pars plana vitrectomy. (12) The main indication of this surgery is vision loss or metamorphopsie symptoms affecting the patient's daily activities. (13) Removal of the ILM with ERM is preferred method due to the suspect of ILM is infrastructure for ERM development. (14)

The benefit of the ILM peeling may be cleaning the retinal surface from ERM completely. (15) However, in a recent study, the authors showed the thinning on inner retinal layers with ILM peeling after ERM surgery. (16)

The difference of this two techniques were analyzed in terms of structure and function, in previous several studies. (17) Most of these studies are optical coherence tomography studies. In a 2 years follow-up study, they did not find any statistically significant difference in terms of central macular thickness (CMT) and BCVA between two groups. (18) In another OCT study, the authors did not found any advantage of double peeling in any thicknesses of retina and also in BCVA in three years follow. (19) In a review of the studies that compared these techniques, none of the studies showed any superiority of ILM peeling in BCVA. (20) In a recent meta-analysis, long term BCVA and CMT changes were found similar between two technique. (21) In compatible with these studies, we did not find statistically significantly difference in CMT and BCVA, at approximately 1 year follow up.

The main purpose of our study was evaluating the retinal microvasculature with OCTA due to suspicious damage of ERM to vascular layers. (22) In a recent OCTA study, that evaluated the microvasculature 3 months after surgery, foveal and parafoveal vessel density (VD) was found as decreased in SCP but parafoveal VD increased in SCP. According to grades of ERM, parafoveal VD in DCP was increased at all grades, however foveal VD in SCP was decreased at only grade 2 patients. BCVA was increased at all grades, however only at grade 2 patients was statistically significant. (23) In another study, the authors suggested that parafoveal VD was increased in both SCP and DCP after surgery. In addition, BCVA was increased significantly. (24) In another similar study, foveal and parafoveal VD in SCP was reported as increased however not changed in DCP. (25) In all these articles, the preferred surgery technique was PPV with double peeling. The changes in microvasculature after surgery was attributed to the probable release of epiretinal membrane's traction on retinal surface. In addition, they suggested that the damage on DCP is more related with the visual function in these patients. There is few article that compared the difference of effect of single or double peeling to retinal microvasculature. In one of these recent studies, which compared the some postvitrectomy OCTA parameters

between ERM and healthy controls, was showed there is no difference between these groups in vascular densities and flow area. In a subgroup analysis of this study, due to presence of ILM peeling, they did not find any difference between groups. The follow up time was 6 months and the sample size was small for subgroup analysis. (26)

In another recent study which compared the results of single and double peeling ERM vitrectomy with OCTA, the authors reported that parafoveal VD and FAZ at SCP was significantly increased in only ERM peeling group. Mean BCVA change did not differ between groups postoperatively. However, these results are from short follow period as 3 months. The authors suggested that, the main reason of the difference in only ERM group was removal of pathologic tissue but not touch to the nature of the retina. Because, the ILM/Müller cell complex can work as a recovery center of retina after this surgery or some same situations. (27) In our study, DCP perifoveal VD in ILM group was significantly increased and SCP perifoveal VD and DCP foveal VD were significantly decreased in only ERM group. However, none of the OCTA parameters' change and postoperative OCTA parameters was different between two groups. Besides, postoperatively FAZ parameters were not different between groups. BCVA in both groups was statistically significantly increased after surgery, however there is no difference between groups. There was no correlation between BCVA and none of OCTA parameters. The reason for the lack of correlation in our study and inconsistency of correlation between studies may be the different levels of ERMs. One of the superiority of our study is the follow up period was approximately 1 year, even with almost same results.

Foveal herniation in ERM patients was first described by Francis et al. at the ARVO meeting in 2011 and than Özdemir et al. reported a case. (28,29) The possible development way of the foveal herniation was described by Bringmann et al. as the ERM-mediated centripetal displacement of the inner foveal layers and in other eyes anterior hyaloidal traction cause a disappearance of the foveal pit and an anterior stretching of the foveola with a thickening of the central outer nucleer layer. After the edges of the thickened inner layers of the foveal walls moved towards each other, continuous centripetal displacement of the inner foveal layers causes a pressure which pushes the foveal tissue towards the vitreous resulting in foveal herniation. They also suggested that contraction of Müller cell processes in the OPL contributes to the development of foveal herniation. (30) Özkaya et al. evaluated the effect of ERM surgery on patients with foveal herniation and they found that the BCVA was increased and CMT was decreased postoperatively. They also compared only ERM and ILM peeled cases, however they have limited patients to compare. (31) Özdemir et al. was compared the surgical outcomes of ERM patients with and without foveal herniation. They preferred not to peel ILM in their study and they did not find any difference in final BCVA and CMT change between groups. (32) In our study, we evaluated the postsurgery microvasculature of the patients with FH in both only ERM and ILM gorup. Perifoveal VD of SCP and DCP of FH (+) patients was statistically significantly more increased than FH (-) patients in ILM group. However we did not see any difference in only ERM group in terms of FH. Although, the number of the FH patients is not enough for definitive results, the significant change of VD in ILM group may indicate the ILM peeling may increase the effectiveness of surgery. Due to the Bringmann et al.'s suggestion about contribution of Müller cell to the development of FH, with ILM peeling more relief may be provided in tissues. (30)

The main reason for ILM peeling in ERM surgery is low recurrence rate. This reality is shown with several studies especially after the OCT came into widespread use. (33) Low recurrence rate in ILM peeled patients was also shown recent meta-analysis and literature review. (20,21) However, not all of these recurrences has clinically significant consequences. (34) In contrast to this advantage, eccentric or paracentral macular hole development was reported in 0.6 to 2.6% of cases. Besides, macular microscotomata, inner retinal dimpling, and ERG abnormalities have been associated with ILM peeling. (20) In our study, there was no difference in OCT based recurrence rate between two groups and no complications were seen due to ILM peeling.

Our study has some limitations as a retrospective study. Small study group is one of them, especially group of FH patients. Preoperative FAZ values were very poor quality because of most of the patients have high grade ERM so we can not compare the pre and postoperative change. We can not evaluate the patients according to ERM levels, because

of the very small subgroups. Follow up period may be longer to find out recurrence ratio more precisely.

CONCLUSION

In conclusion, we found some significant changes in VDs however postoperatively none of the OCTA parameters were different between groups. In both groups BCVA increase and CMT decrease, however there is no difference between groups, again. According to the results, although OCTA parameter changes are in favor of the only ERM group, final outcomes do not differ tremendously. Although it was a very smal subgroup, ERM patients with FH shows significant OCTA changes with ILM peeling. Therefore, studies with larger sample groups are needed for this subgroup in order to strengthen these results..

REFERENCES

1. Scheerlinck LM, van der Valk R, van Leeuwen R. Predictive factors for postoperative visual acuity in idiopathic epiretinal membrane: a systematic review. Acta Ophthalmol. 2015 May;93(3):203-12.
2. Georgopoulos M, Geitzenauer W, Ahlers C, Simader C, Scholda C, Schmidt-Erfurth U (2008) [High-resolution optical coherence tomography to evaluate vitreomacular traction before and after membrane peeling]. Ophthalmologe 105: 753–760
3. Bu, S.-C.; Kuijer, R.; Li, X.-R.; Hooymans, J.M.M.; Los, L.I. Idiopathic Epiretinal Membrane. Retina 2014, 34, 2317–2335.
4. Park DW, Dugel PU, Garda J, Sipperley JO, Thach A, Sneed SR, et al. Macular pucker removal with and without internal limiting membrane peeling: pilot study. Ophthalmology. 2003; 110(1):62–4..
5. Sandali O, El Sanharawi M, Basli E, Bonnel S, Lecuen N, Barale PO, et al. Epiretinal membrane recurrence:

incidence, characteristics, evolution, and preventive and risk factors. Retina (Philadelphia, Pa).

2013; 33(10):2032–8.
6. Mihalache A, Huang RS, Ahmed H, Patil NS, Popovic MM, Kertes PJ, Muni RH. Pars Plana Vitrectomy with or without Internal Limiting Membrane Peel for Epiretinal Membrane: A Systematic Review and Meta-Analysis. Ophthalmologica. 2024;247(1):30-43.
7. Suh MH, Seo JM, Park KH, Yu HG. Associations between macular findings by optical coherence tomography and visual outcomes after epiretinal membrane removal. American journal of ophthalmology. 2009; 147(3):473–80.e3.
8. Magrath Gn, Say Ea, Sioufi K, Ferenczy S, Samara Wa, Shields Cl. Variability in Foveal Avascular Zone And Capillary Density Using Optical Coherence Tomography angiography Machines in Healthy Eyes. Retina. 2016;37:2102-2111.
9. Miyazawa K, Sakimoto S, Kanai M, Shiraki A, Takahashi S, Shiraki N, Maruyama K, Sakaguchi H, Nishida K. Vascular tortuosity analysis in eyes with epiretinal membrane imaged by optical coherence tomography angiography. BMC Ophthalmol. 2022 May 2;22(1):198.
10. Sül S, Karalezli A. Evaluation of Macular Microvascular Structure in Eyes With Idiopathic Epiretinal Membrane. Ret-Vit 2019; 28: 265-269
11. Kim J, Park KH. TEMPORAL CHANGES OF PARAFOVEAL MICROVASCULATURE AFTER EPIRETINAL MEMBRANE SURGERY: An Optical Coherence Tomography Angiography Study. Retina. 2021 Sep 1;41(9):1839-1850.
12. Reilly G, Melamud A, Lipscomb P, Toussaint B. Surgical outcomes in patients with macular pucker and good preoperative visual acuity after vitrectomy with membrane peeling. Retina 2015;35:1817–21.
13. Folk JC, Adelman RA, Flaxel CJ, Hyman L, Pulido JS, Olsen TW. Idiopathic epiretinal membrane and vitreomacular traction preferred practice pattern (R) guidelines. Ophthalmology. 2016;123(1):152-181
14. Fung AT, Galvin J, Tran T. Epiretinal membrane: A review. Clin Exp Ophthalmol. 2021 Apr;49(3):289-308.
15. Jung JJ, Hoang QV, Ridley-Lane ML, Sebrow DB, Dhrami-Gavazi E, Chang S. Long-term retrospective analysis of visual acuity and optical coherence topographic changes after single versus double peeling during vitrectomy for macular epiretinal membranes. Retina. 2016;36(11): 2101-2109
16. Kabataş N, Çalışkan S. Outcomes of Internal Limiting Membrane Peeling in Epiretinal Membrane Surgery. Ret-Vit 2021; 30: 33-38
17. Bovey EH, Uffer S, Achache F. Surgery for epimacular membrane: impact of retinal internal limiting membrane removal on functional outcome. Retina 2004;24:728–735.)
18. Schechet SA, DeVience E, Thompson JT. THE EFFECT OF INTERNAL LIMITING MEMBRANE PEELING ON IDIOPATHIC EPIRETINAL MEMBRANE SURGERY, WITH A REVIEW OF THE LITERATURE. Retina. 2017 May;37(5):873-880.

19. Jung JJ, Hoang QV, Ridley-Lane ML, Sebrow DB, Dhrami-Gavazi E, Chang S. LONG-TERM RETROSPECTIVE ANALYSIS OF VISUAL ACUITY AND OPTICAL COHERENCE TOPOGRAPHIC CHANGES AFTER SINGLE VERSUS DOUBLE PEELING DURING VITRECTOMY FOR MACULAR EPIRETINAL MEMBRANES. Retina. 2016 Nov;36(11):2101-2109.

20. Díaz-Valverde A, Wu L. TO PEEL OR NOT TO PEEL THE INTERNAL LIMITING MEMBRANE IN IDIOPATHIC EPIRETINAL MEMBRANES. Retina. 2018 Sep;38 Suppl 1:S5-S11.

21. Huang Q, Li J. With or without internal limiting membrane peeling during idiopathic epiretinal membrane surgery: A meta-analysis. PLoS One. 2021 Jan 19;16(1):e0245459.

22. Liu J, Qian Y, Yang S, Yan L, Wang Y, Gao M, Liu L, XiaoY, Mo B, Liu W (2017) Pathophysiological correlations between fundus fluorescein angiography and optical coherence tomography results in patients with idiopathic epiretinal membranes. Exp Therapeutic Med 14(6):5785–5792

23. Mao J, Xu Z, Lao J, Chen Y, Xu X, Wu S, Zheng Z, Liu B, Shen L. Assessment of macular microvasculature features before and after vitrectomy in the idiopathic macular epiretinal membrane using a grading system: An optical coherence tomography angiography study. Acta Ophthalmol. 2021 Nov;99(7):e1168-e1175.

24. Kim YJ, Kim S, Lee JY, Kim JG, Yoon YH. Macular capillary plexuses after epiretinal membrane surgery: an optical coherence tomography angiography study. Br J Ophthalmol. 2018 Aug;102(8):1086-1091.

25. Yuce B, Cinar E, Aslan F, Kucukerdonmez C. Evaluation of retinal vascular structure after epiretinal membrane surgery by optical coherence tomography angiography. Int Ophthalmol. 2021 Feb;41(2):621-627.

26. Isik-Ericek P, Sizmaz S, Esen E, Demircan N. The effect of epiretinal membrane surgery on macular microvasculature: an optical coherence tomography angiography study. Int Ophthalmol. 2021 Mar;41(3):777-786.

27. Gabriel M, Djavid D, Innauer F, Ivastinovic D, Seidel G, Mayer-Xanthaki C, Ansari-Shahrezaei S, Wedrich A, Haas A. CHANGES OF OPTICAL COHERENCE TOMOGRAPHY ANGIOGRAPHY PARAMETERS AFTER INTERNAL LIMITING MEMBRANE PEELING COMPARED WITH NONPEELING IN EPIRETINAL MEMBRANE SURGERY. Retina. 2022 Oct 1;42(10):1867-1873.

28. Francis JH, Tatyana Milman SR, Hu DN, Gentile RC. Epiretinal membranes with foveal herniation: clinicopathological characteristics, optical coherence tomography and surgical outcomes. Invest Ophthalmol Vis Sci 2011;52:4490.

29. Ozdemir H, Karacorlu M. Epiretinal membrane with foveal herniation. Retina 2017;3:e71–e72.

30. Bringmann A, Unterlauft JD, Barth T, Wiedemann R, Rehak M, Wiedemann P. Foveal configurations with disappearance of the foveal pit in eyes with macular pucker: Presumed role of Müller cells in the formation of foveal herniation. Exp Eye Res. 2021 Jun;207:108604.

31. Ozkaya A, Erdogan G, Demir G (2018) The outcomes of epiretinal membrane peeling in patientswith foveal herniation. Int J Retin Vitr 4:1–7

32. Ozdemir H, Karacorlu M, Elbay A, Kirik F. Effect of foveal herniation on surgical outcomes in patients with idiopathic epiretinal membrane. Arq Bras Oftalmol. 2022 Sep-Oct;85(5):472-477.

33. Chang S. Controversies regarding internal limiting membrane peeling in idiopathic epiretinal membrane and macular hole. Retina 2012;32:S200–S203; discussion S3–S4.

34. Roh M, Eliott D. Internal limiting membrane peeling during idiopathic epiretinal membrane removal: literature review. Int Ophthalmol Clin 2015;55:91–101.