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Original Article

Evaluation of Vitrectomy with or Without Internal Limiting Membrane Peeling in Management of Macula off Rhegmatogenous Retinal Detachment

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Abstract

Background: The visual outcomes of adjuvant internal limiting membrane [ILM] peeling as compared with conventional vitrectomy without ILM peeling in Rhegmatogenous retinal detachment [RRD] are controversial**.**

Aim: This study aimed to assess the role of the internal limiting membrane peeling in macular reattachment and prevention of macular complications after vitrectomy in cases of macula off rhegmatogenous retinal detachment.

Patients and Methods: The present study is prospective and comparative. The study involved 30 eyes with macula off primary RRD and pars plana vitrectomy [PPV] with silicon oil injection was done. The eyes were divided into two groups: Group 1 consisted of 15 eyes without ILM peeling, and Group 2 consisted of 15 eyes with ILM peeling. Following silicone oil removal, the best corrected visual acuity and epiretinal membrane [ERM] formation was assessed.

Results: Thirty eyes from thirty individuals were enrolled in the present study; the average age of those who participated in Group 1 was 57.66 years, and in Group 2, it was 55.27 years. Eight men [53.3%] and seven women [46.7%] were in Group 1, while seven men [46.7%] and five women [33.3%] were in Group 2. When comparing the two groups pre and postoperative BCVA [Decimal] values, there was a noticeable improvement in both groups. Also, we revealed improvement of BCVA [Decimal] in group 1 at one week [P =0.006], three weeks [P= 0.011*], 3monthes [P =0.027], and six months [0.014] after PPV and SO in comparison with group 2. The final visual acuity at one month after SOR [P =0.01] was significantly improved in group 1; ERM was developed in group 1 in 4 cases [26.7%] and not developed in any case in group 2; there was a significant relation between ERM formation and size of the tear.

Conclusion: PPV is an effective procedure and has a high success rate in cases of macula off RRD, helping in successful retinal and macular reattachment. According to this study, ILM peeling can even lower the reoperation rate in eyes underwent PPV for macula off RRD by preventing ERM formation.

Keywords: Rhegmatogenous; Retinal detachment; Peeling; Vitrectomy.

INTRODUCTION

The detached neurosensory portion of the retina from the retinal pigment epithelium [RPE] layer as a result of retinal tears is known as RRD. These tears typically result from vitreous traction on the retina, which permits fluid to build up in the subretinal area [1]. The most prevalent type of RD is RRD, which affects about 1 in 10,000 people annually [2]. The Muller cell footplates compose the lowest layer of the inner retina, known as the ILM. Comprising of collagen fibers, glycosamino-glycans, laminin, and fibronectin, it serves as the structural contact between the vitreous and the retina. The ILM is thickest in the outer foveal area, measuring 1.5 μm in thickness [3]. Myofibroblasts, fibrocytes, and RPE cells proliferate on the surface of ILM which act as a scaffold [4]. RPE cells escape into the vitreous space in cases of RRD. This is believed to induce the development of PVR-related ERM. Based on previous publications, the frequency of these membrane formations varies between 6 and 48% [5].

It has been demonstrated that removing the ILM reduces formation of ERMs [6]. A prolonged period with macular detachment and large, multiple and posterior retinal tears increase the risk of post-PPV ERM formation [7, 8]. Retinal dimpling and macular thinning are morphological abnormalities that have been described on optical coherence tomography [OCT] after ILM peeling in RRD [8].

There is debate regarding the relative benefits of visual findings between adjuvant ILM peeling and vitrectomy without ILM peeling in RRD [9,10]. This study aimed to assess the role of the internal limiting membrane [ILM] peeling in macular reattachment and prevention of macular complications after vitrectomy in cases of macula off rhegmatogenous retinal detachment

PATIENTS AND METHODS

The research project was permitted to proceed by the Al-Azhar University Faculty of Medicine's medical ethics council. Every subject in the research provided written informed consent after being told about the nature of the surgery and its potential complications. Thirty eyes with primary RRD participated in the present study. The included participants were divided into two groups: Group [1]: fifteen eyes of non-ILM peeling eyes; Group [2]: fifteen eyes ILM peeling eyes.

The **Inclusion** criteria were: cases of primary RRD with macula off.

The Exclusion criteria were: perforating ocular trauma, tractional RD, combined macular hole and retinal detachment, recurrent retinal detachment, old standing retinal detachment with proliferative vitreo retinopathy, significant postoperative media opacities interfering with the SD-OCT imaging, eyes with uveitis or retinal vascular occlusive diseases, and diabetic retinopathy.

Preoperative ophthalmological examination: best corrected visual acuity [BCVA] was evaluated by decimal scale, IOP, anterior segment examination, fundus examination using non-contact 90 Diopter lens and indirect ophthalmoscope with an emphasis on the extent of RD [total, subtotal], site and size of a retinal break, and macula and optic disc. Preoperative ophthalmological investigation: B-scan ultrasound and A-scan biometry were done for all phakic cases.

Operative steps and technique: Operations were done under general or local anesthesia. All patients were managed using constellation system [Alcon, USA] and by the same surgeon. The operative steps were as follow: **1].** Dilatation of the pupil, the operations were done under general or local anesthesia. **2].** Sterilization and draping of the operative scene. All patients were treated using constellation system [Alcon, USA] by the same surgeon. **3].** Phacoemulsification with foldable IOL implantation in a patient with significant cataract. **4].** Three port Sclerotomies and insertion of the trocar system. **5].** Visualization of the fundus using a noncontact wide-angle viewing system during vitrectomy. Binocular indirect Ophthalmic microscope system [Zeiss RESIGHT®700] held on microscope [Opmi- Lumera Zeiss ®Microscope] with use of a wide-field lens in core vitrectomy and in the periphery and the high magnification lens while ILM peeling at the macular area was done. **6].** Core vitrectomy was done using a high cutting rate of 5000 cuts per minute [cpm] and 300 mmHg linear vacuum. **7].** The posterior hyaloid detachment was done to guarantee total separation of the posterior hyaloid, and a mild injection of triamcinolone acetonide was made into the middle vitreous cavity. **8].** In the ILM peeling group, the infusion was stopped, and the BBG dye was injected slowly. Then, the infusion was opened after a few seconds, and the dye was aspirated. Either under PFCL or not, pinching technique Using 23-gauge ILM forceps, ILM peeling was completed in the macular area and to the extent of vascular arcades. **9].** PFCL injection to flatten the already mobilized retina over the posterior pole. Diathermy was used for marking retinal breaks and sharpening its edges. **10].** Vitreous base shaving was done meticulously 360 degrees with scleral indentation. **11].** Fluid-air exchange and subretinal fluid drainage, Endo-laser photocoagulation either localized or 360 degrees. 12] PFCL aspiration by flute needle in front of the optic disc. **13].** Silicon oil 5000-Centistoke injection. **14].** Trocars were removed, and sutures were taken only in case of leakage by vicryl 8/0.

Post-operative follow-up: First post-operative day, first week, third week, sixth week and then every month till silicon oil removal. This included BCVA, anterior segment examination, assessment of IOP, and fundus examination. Six months following vitrectomy, silicone oil was removed. OCT was done six weeks following pars plana vitrectomy and one month after silicon oil removal.

Statistical analysis: The statistical package of social science [SPSS] or Windows [Standard version 26] was used to analyze the data. Using the Shapiro test, the data's normality was initially examined. Numbers and percentages were used to describe the qualitative data. The Chi-square test was used to investigate the relationship between categorical variables, and the Fisher exact test and the Monte Carlo test were employed when the predicted number of cells was below five. Quantitative data were presented as mean and standard deviations and were compared by the independent t test. As a result, the p-value were considered significant at the level of <0.05.

RESULTS

As regard baseline characteristics, the mean age of patients in the present work in group 1 was 57.66 years and in group2 was 55.27 years. In group 1, there were 8 males [53.3%] and 7 females [46.7%]. In group 2 there were 7 males [46.7%] and 5 females [33.3%] with no statistically significance between two groups.

The preoperative best corrected visual acuity [BCVA] was hand movement [0.005] [Decimal] in both groups. there was significant improvement of BCVA which consistent with increase of numerical values of BCVA [Decimal] at all postoperative measurements when compared to preoperative value in two groups. When comparing postoperative BCVA between two groups at different points of time there was significant improvement of BCVA in group 1 which consistent with increase of numerical values of BCVA at one week [P =0.006], three weeks [P= 0.011], 3 months [P =0.027] and six months [0.014] after PPV and SO. The final visual acuity at one month after SOR [P =0.01] was significantly improved in group 1 [Table 1].

As regard characters of tears at examination, in group 1 single tear observed in 60% of cases and multiple in 40%, less than 1o clock hour sized tears observed in 20%, 1o clock hour sized tears in 53.3% and 2 o clock hours sized tears in 26.7%. The most common site of tears is upper temporal 60 %. In group 2 single tear was in [73.3%] of cases and multiple in [26.7%], less than 1o clock hour sized tears in [13.3 %] 1o clock hour sized tears in [80.0 %] and large tears in 2 o clock hours sized tears [6.7 %]. The most common site of tears is upper temporal 60%. Our study not included giant retinal tears.

As regard anatomical outcome, ERM was developed in group 1 in 4 cases [26.7%] and not developed in any case in group 2. As regard average of duration from development of symptoms in group 1 was [2.27±1.16] weeks and in group 2 was [3.07±1.43] weeks [Table 2, Figure 1].

As regard comparing central macular thickness before and after SOR there was significant decrease in CMT in group 2 and no significant change in group 1. As regard other OCT finding: Retinal dimpling occurred in 2 cases [13.3%] in group 1 and 6 cases [40.0%] in group 2. Foveal thinning occurred in 2 cases [13.3%] in group 1 and in 7 cases [46.7%] in group 2 which was significant. Macular deformation not occurred in group 1 and occurred in 4 cases [26.7%] in group 2 which was significant. RPE folds not observed in group 1 and observed in 2 cases [13.3%] in group 2. Sub retinal PFCL not observed in group 1and observed in 1 case [6.7%]in group 2.

As regard Recurrence of detachment after SOR occurred in 1 case [6.7%] in group 2 after one and half month and not occurred in group 1 with no significant correlation.

As regard factors influence ERM formation as number and size of tears, duration of RD, and usage 360 laser, there was significant relation between ERM formation and size of tear, the larger the tear the higher the risk of ERM formation and other factors didn't affect ERM formation [Table 3].

Table [1]: Best corrected visual acuity [BCVA] [decimal] among the studied groups

BCVA	Group [1] without peeling [n=15]	Group [2] with peeling [n=15]	Test	P value
BCVA Preoperative	0.005±0.0	0.005±0.0	0.001	1.0
BCVA_1week	0.085±0.04	0.053±0.01	2.96	**0.006***
BCVA_3 weeks	0.123±0.07	0.071±0.03	2.71	**0.011***
BCVA_6 weeks	0.124±0.09	0.080±0.02	1.83	0.077
BCVA_3 month	0.132±0.08	0.08±0.02	2.33	**0.027***
BCVA_6 month	0.148±0.09	0.084±0.03	2.62	**0.014***
BCVA_1 week_SOR	0.145±0.09	0.091±0.04	2.14	**0.041***
BCVA_1-month SOR	0.194±0.10	0.114±0.04	2.77	**0.01***
Repeated ANOVA test	**P≤0.001***	**P≤0.001***	-	-

t: Independent t test, *significant p ≤ 0.05

Table [2]: Incidence of ERM among studied groups

	Group [1] without peeling [n=15]	Group [2] with peeling [n=15]	Test of significance	P value
ERM				
Yes	4 [26.7%]	0 [0%]	χ^2 =4.61	**0.032***
No	11 [73.3%]	15 [100%]		

χ2 : Chi square test, *significant p≤0.05

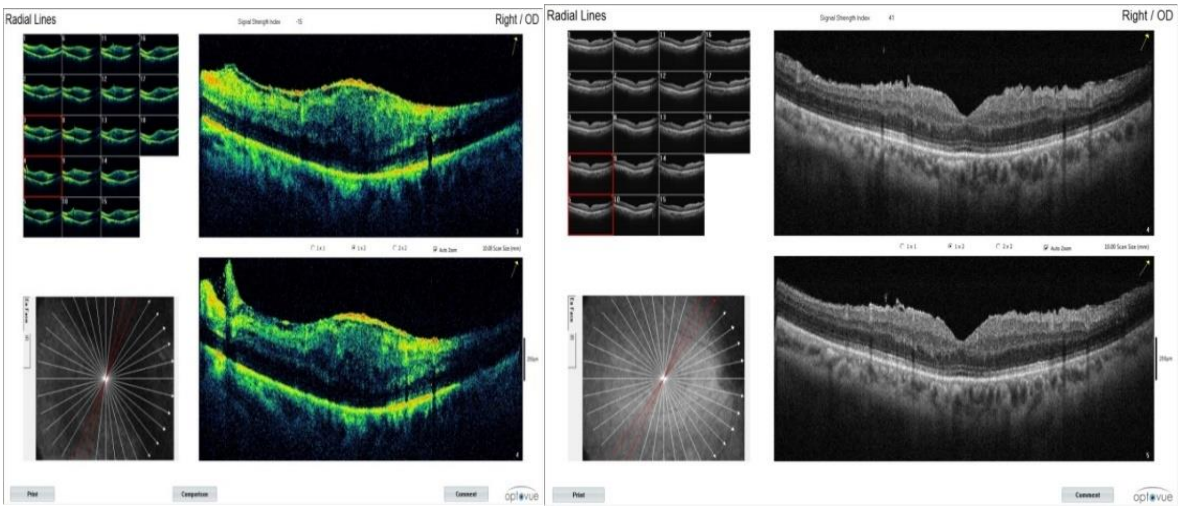

Figure [1]: ERM formation 1,5 m post op. After ERM, ILM peeling during SOR

Table [3]: factors influence ERM formation

	Group [1] without peeling		P value
	ERM [n=4]	No ERM [n=11]	
Number of tears			0.604
Single	3 [75.0 %]	6 [54.5 %]	
Multiple	1 [25.0 %]	5 [45.5 %]	
Size of tears			**≤0.001***
less than 1clock	0 [0%]	3 [27.3 %]	
1 clock hour	0 [0%]	8 [72.7 %]	
2 clock hours	4 [100.0%]	0 [0%]	
Duration of RD	2.75±1.50	2.09±1.04	0.350
Laser 360	2 [50.0%]	1 [9.1%]	0.154

DISCUSSION

The study was carried out from January 2021 to November 2023 on 30 eyes belonging to 30 individuals who visited Al-Azhar University Hospital [Damietta] outpatient ophthalmology clinic with macula off primary RRD and PPV with SO injection was done. The cases subdivided into Two groups: Group 1 consisted of 15 eyes without ILM peeling, while Group 2 consisted of 15 eyes with ILM peeling. OCT was carried out six weeks following pars plana vitrectomy and one month following the removal of silicon oil.

Regarding visual outcome, we revealed improvement in BCVA, consistent with the increase of numerical value of BCVA [Decimal] at all postoperative measurements than preoperative value in the two groups. When comparing postoperative BCVA [Decimal] between two groups at different points of time, there was significantly improvement in BCVA in Group 1. the final visual acuity One month after SOR [P =0.01] was improved considerably in Group 1.

This was consistent with the findings of previous studies conducted by **Obata *et al* [11], Eissa *et al.* [12], Awny *et al.* [13]** and contradicted with that observed by **Nam *et al.* [14],** who proposed that ILM peeling improved VA by inhibiting the formation of postoperative pucker [14]. The reason behind low VA linked to ILM peeling in our research and related studies might be related to retinal injury brought on by the ILM peeling process. Retinal detachment makes ILM peeling more challenging than retinal attachment.

In eyes with a macula-off RRD, this could result in further retinal injury. When observing the anatomical outcomes in this study, both groups achieved successful retinal and macular reattachment with no difference between the two groups; recurrence occurred only in one case, [5.9 %] in Group 2. After PPV for RRD, among the most frequent complications after the procedure is ERM formation. ERM may not cause any symptoms, or it may cause metamorphopsia and reduced vision, which may need to be treated surgically [15].

In our study, ERM was developed in Group 1 [without ILM peeling] in 4 cases [26.7%] and not developed in any case in Group 2 [with ILM peeling]. Only three of these four cases underwent ERM peeling during SOR, and other was unnecessary. These results are consistent with that observed by **Nam *et al.* [14], Castillo *et al.* [8] and Abdullah *et al.* [16].**

Other studies observed ERM development in the ILM peeling group by different percentages, as O**bata *et al.* [11], Blanco *et al.* [10], Fallico *et al.* [5], Forlini *et al.* [9] and Akiyama et al. [17].**

Nam *et al.* [14] reported that while there was an ERM in those without ILM peeling [21.5%], there was none in the group that had ILM peeling.

Castillo *et al.* [8] study reported that 8.97% of patients experienced ERM after surgery.

Abdullah *et al.* [16] discovered that although an ERM had been identified in 13.3% of eyes with no ILM peeling [p = 0.04], there was no ERM in eyes with ILM peeling.

Obata *et al.* [11] revealed that an ERM formed in 3.5% of cases with ILM peeling and 7.8% of those without [p = 0.40]. However, the variation was not of statistical importance. In the eyes with ILM peeling, surgical intervention for ERM was not required; in the four eyes [1.3%] without ILM peeling, it was [p > 0.99].

According to **Blanco *et al.*** [10], the frequency of ERM was 10% in the category that had ILM peeling and 31.25% in the one that did not [p = 0.004].

Forlini *et al.* [9] revealed that 9% of eyes that had ILM peeling and 31% of eyes that did not get ILM peeling experienced ERM.

According to research by **Akiyama *et al.*** [17], post-operative ERM was present in 47.7% of those who underwent vitrectomy without ILM peeling.

In our study, we observed more than 75% of ERM formed between six weeks and 3 months after PPV. This is consistent with that observed by **Martinez-Castillo *et al.*** [8], **Nam *et al.*** [14] **and Akiyama *et al.*** [17], who showed that over half of patients experienced the development of ERM one to three months following their initial vitrectomy.

As regard cases with ERM that required surgery, **Martinez-Castillo *et al.*** [8] **and Akiyama *et al.*** [17] found that 71.42% of those with postoperative ERM needed surgical intervention, while **Nam *et al.*** [14] found that 47.6% of those with postoperative ERM needed surgical intervention. This is consistent with our study, where 75% of patients with post-operative ERM required surgery.

Blanco *et al.* [10] reported that none of cases required surgical treatment.

As regard the duration of RRD in our study, there is no significance between the two groups. The duration didn't affect ERM formation or post-operative BCVA as the average duration in both groups was nearly equal, and we didn't have cases of long duration or very short duration.

This is consistent with that observed by **Eissa *et al.*** [12], while **Obata *et al***. demonstrated that, in eyes with a macula-off RRD, an extended period of RD was substantially linked to a lower VA at six months [11].

According to **Kim *et al.*** [18], surgery completed within 6 days of the onset of symptoms had better visual results than surgeries done later, while surgical correction after 7 days had no effect on the visual outcome.

We also investigated potential risk variables that could lead to the occurrence of postoperative ERM, such as the number and size of tears, duration of RD, and usage 360 laser; there was a significant relation between ERM formation and size of the tear, the larger the tear the higher the risk of ERM formation and other factors didn't affect ERM formation.

According to **Castillo *et al.*** [8], large retinal tears are associated with increase in ERM formation, also if the location of retinal breaks is near the equator.

According to **Akiyama *et al.*** [17], the preoperative variables did not significantly correlate with the formation of postoperative ERM.

According to **Blanco *et al.*** [10], there was an association [p = 0.036] between the number of preoperative retinal braks and a higher probability of postoperative ERM formation.

According to **Abdullah *et al.*** [16], peripheral 360 endolaser did not seem to raise the risk of ERM.

In our study, we observed several anatomical features related to the ILM peeling group as Retinal dimpling, also described by **Hisatomi *et al.*** [8], **Abdullah *et al.*** [16], **Eissa *et al.*** [12], **Fukukita et al.** [19].

It is thought that diffuse damage to Müller cell foot plate causes retinal dimples. It is yet unknown how these changes may affect macular function [20].

In our study, when comparing central macular thickness before and after SOR, there was a significant decrease in CMT in group 2 and no significant change in Group 1 [P=0.016].

Eissa *et al.* [12] **and Abdullah *et al.*** [16] revealed that no noticeable variation in postoperative CMT between the two groupings.

Conclusion:

PPV is an effective procedure and has a high success rate in cases of macula off RRD, helping in successful retinal and macular reattachment. According to this study, ILM peeling can even lower the reoperation rate in eyes underwent PPV for macula off RRD by preventing ERM formation. There was an Adverse effect of ILM peeling in the form of foveal thinning, macular deformation, and retinal dimpling. There was a significant relation between ERM formation and the tear size; the larger the tear, the increased risk of ERM formation, and other factors, such as the number and size of tears, duration of RD, and usage of 360 laser did not affect ERM formation.

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