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Anatomical and functional outcomes of idiopathic macular hole surgery with fovea-sparing versus conventional internal limiting membrane peeling

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Purpose: *To compare fovea-sparing and conventional internal limiting membrane (ILM) peeling in idiopathic macular hole (IMH) surgery in terms of IMH closure type, hole closure incidence and visual outcome.*

Material and Methods: *The ILM was peeled around the IMH in the conventional ILM peeling group. In the fovea-sparing ILM peeling group, an ILM flap was created temporally to the IMH (with an ILM remnant left attached to the margins of the IMH), folded over the hole and stabilized with viscoelastic. Gas tamponade with 20% SF6 or 15% C3F8 was used. In the postoperative period, IMH closure pattern was assessed. Thicknesses of the outer retinal layers, inner retinal layers and retinal nerve fiber layer in the macular region were measured at 1 and 3 months.*

Results: *Totally, 70 patients (15 males and 55 females) had an IMH surgery in 71 eyes. The mean age (SD) was 65.7 (6.8) years. The median IMH duration (interquartile range (IQR)) was 3.0 (1.0-6.0) months, and the mean preoperative BCVA (standard deviation (SD)), 0.19 (0.16). Thirty-four eyes had an IMH surgery with conventional ILM peeling, and 37 eyes, an IMH surgery with fovea-sparing ILM peeling. The two groups were matched in terms of preoperative visual acuity and macular hole duration. IMH closure was achieved in 30/34 eyes (88.2%) in the conventional ILM peeling group and 33/37 eyes (89.2%) in the fovea-sparing ILM peeling group. Particularly, IMH closure was achieved in 13/17 eyes that received gas tamponade with 20% SF6 and 20/20 eyes that received that with 15% C3F8 in the latter group. The rate of correct IMH closure pattern was substantially higher (64% versus 47%) and median postoperative BCVA (IQR), significantly better (0.55 (0.35-0.7) versus 0.43 (0.35-0.6), p = 0.039) in the fovea-sparing ILM peeling group than in the conventional ILM peeling group. An analysis of variance found a significant effect of the type of IMH surgery and IMH closure pattern on the postoperative BCVA (F1 = 5.06, p = 0.027; F2 = 7.9, p = 0.0001). In both groups, we found a significant thinning of the total retinal thickness in the central 1-mm foveal zone at 3 months compared to 1 month after surgery. There was a significant thinning of the outer and inner retinal layers in the conventional ILM peeling group, and no significant thickness changes in the retinal layers in the fovea-sparing group.*

Conclusion: *Our fovea-sparing ILM peeling technique is an effective treatment option for IMHs, and when used with gas tamponade with 15% C3F8, enabled a primary surgery IMH closure rate of 100%.*

Keywords:

vitrectomy, optical coherence tomography, idiopathic macular hole, internal limiting membrane, fovea-sparing technique, vitreoretinal surgery

Introduction

An idiopathic macular hole (IMH) is a central retinal pathology characterized by an impairment of all retinal layers, excepting the retinal pigment epithelial (RPE) layer, and is accompanied by reduced visual acuity. It occurs almost three times more often in women than in men and develops usually in the seventh decade of life [1-3]. In 1991, Kelly and Wendel [4] reported the first series of patients undergoing vitrectomy and gas tamponade for an IMH. They obtained a closure rate of 58% and an improvement of two or more lines of vision in 73 % of the eyes that had closed holes. Complications related to surgery were observed in eight patients (15%) and included increase in the size of the macular hole, mottling of the retinal pigmented epithelium, and a vascular occlusion [4]. In 1997, Eckardt and colleagues [5] reported on clinical results of vitrectomy with posterior hyaloid removal and internal limiting membrane (ILM) peeling for an IMH. Given that the ILM is rather dense, ILM removal around the hole increases the elasticity of the retina, contributes to anatomical hole closure, and prevents macular hole recurrence [6, 7, 8]. Others [9-11] have reported that ILM removal is not safe and can be accompanied by complications like a dissociated optic nerve fiber layer, dimples on the retinal surface, cysts in the inner retina and the loss of the integrity between the outer and inner segments of the photoreceptor layer.

A primate study [12] used light microscopy and transmission and scanning electron microscopy to investigate ultrastructural changes 3 years after ILM peeling and demonstrated that the site of maculorhexis could be distinguished even 3 years after ILM peeling. The exposed Müller cell processes were partially damaged, while regenerative spindle-shaped Müller cell processes developed, covering most of the retina. Notably, the nerve fiber layer was found to be uncovered by glial elements. The glial cells produced basement membrane materials around their processes, although they did not restore the ILM as a flat sheet [12].

In this connection, recently, various fovea-sparing techniques [13-16] have been developed and used to preserve the ILM immediately around the macular hole, with reduced damage to foveal Muller cell injury.

The purpose of this study was to compare fovea-sparing and conventional ILM peeling in IMH surgery in terms of IMH closure type, hole closure incidence and visual outcome.

Material and Methods

This prospective, open-label, interventional study was conducted at the Vitreoretinal and Laser Microsurgery Department of the Filatov institute and conformed to the Declaration of Helsinki. Written informed consent to surgery (vitrectomy) was obtained from all study subjects. Inclusion criteria were stage-2 to stage-4 holes as per the classification by Gass [17], ability to follow recommendations, and clear ocular media. Exclusion criteria were history of vitrectomy, myopia exceeding -6 diopters, wet age-related macular degeneration, glaucoma, diabetic retinopathy or other vascular choroidal and retinal disorders.

A preoperative examination included visual acuity assessment, refractometry, tonometry, biomicroscopy, dilated fundus examination with a slit-lamp and 90 D lens, binocular indirect ophthalmoscopy with a 20 D lens, and macular optical coherence tomography (OCT; OPTOPOL Technology, Zawiercie, Poland) with the estimation of the maximal and minimal diameters of the macular hole (Fig. 1). In addition, early and late (one-month and three-month) postoperative macular OCT maps were examined with software to estimate the thickness of the total retina (from the ILM to the RPE), inner retinal layers (from the ILM to the inner plexiform layer), outer retinal layers (from the outer nuclear layer to the RPE layer), and retinal nerve fiber layer (RNFL). These measurements were performed in 5 sites: central, temporal, nasal, inferior and superior retina (Fig. 2).

All patients underwent a 25-G three-port pars plana vitrectomy (Constellation, Alcon, Switzerland) with the use of a wide-angle observation system (BIOM, Oculus, Weltzer, Germany). Surgeries were performed by three experienced staff surgeons of the Vitreoretinal and Laser Microsurgery Department. All eyes had a natural lens, but phacoemulsification was not performed because visualization was sufficient for vitrectomy. After the posterior hyaloid was removed in a circul fashion, the ILM was exposed to the vital dye TWIN (Alchimia srl, Padova, Italy; Trypan blue 0.18% and Blulife 0.03%) for 20-30 minutes.

In a conventional surgery, the ILM (1.5-2.0 disc diameters) was removed from around the macular hole. In a fovea-sparing surgery, an ILM flap was formed about 1.5 disc diameters temporally from the MH edge, with a 0.3-0.5 disc diameter ILM remnant left attached to the margins of the MH. The flap was folded to cover the hole. A drop of viscoelastic was applied to stabilize the position of the flap over the hole, if required. Gas tamponade with 20% SF6 was performed in almost all patients undergoing a conventional ILM peeling surgery. The exception included 4 patients having not only a macula hole but also peripheral vitreoretinal degeneration or peripheral retinal

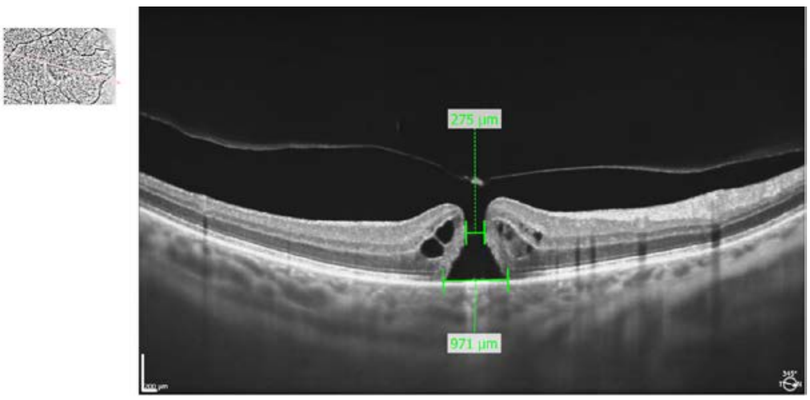

Fig. 1. Maximal and minimal diameters of the macular hole

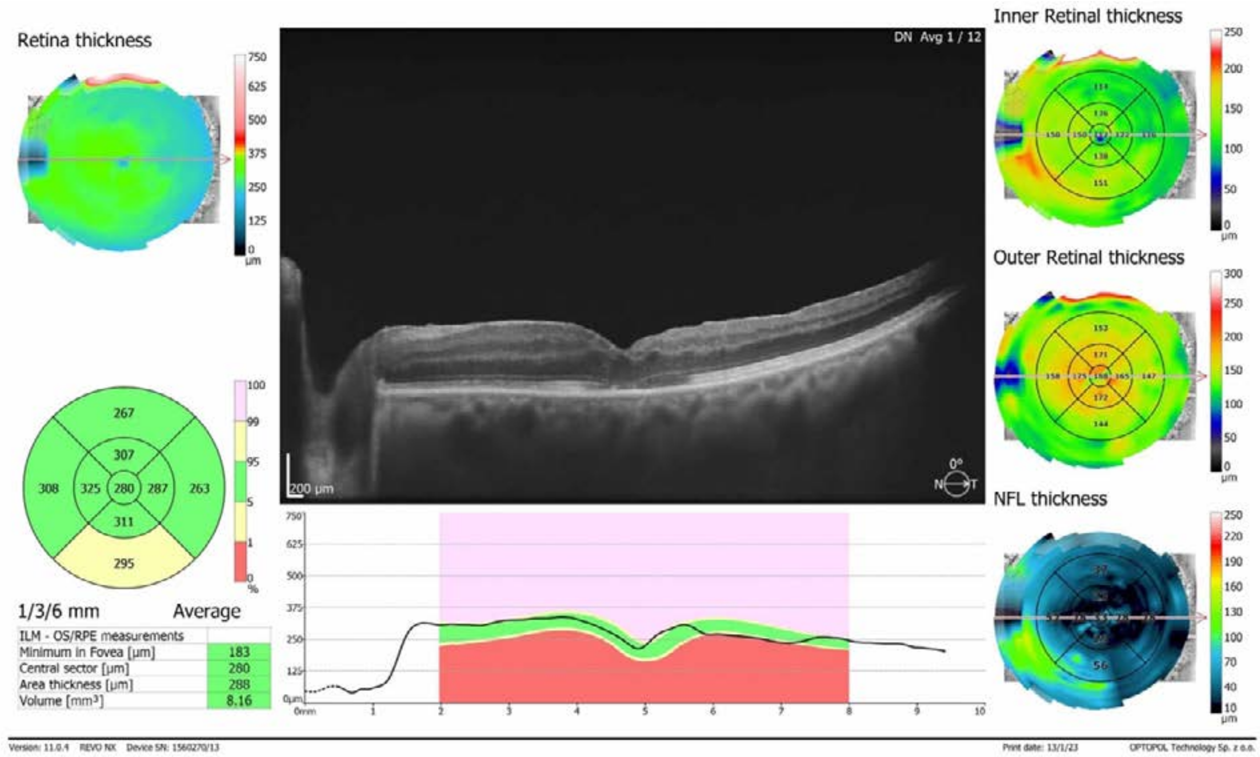

Fig. 2. Measuring inner retinal thickness, outer retinal thickness and retinal nerve fiber layer (NFL) thickness

tear; these patients received preventive retinal endolaser photocoagulation and gas tamponade with 20% C3F8 as the final phase of surgery. Of the 37 eyes that received fovea-sparing ILM peeling, 17 received gas tamponade with 20% SF6, and 20, gas tamponade with 15% C3F8. Patients maintained a prone position for one to two weeks depending on the type of gas tamponade. At 1 to 2 months after surgery, we checked whether the hole was closed or not, and assessed the visual acuity. A recent (2020) Rossi et al classification [18] was used to assess macular hole closure patterns (MHCPs).

Type 0 are "open" MHs, type 1: closed MHs (1A: reconstitution of all retinal layers; 1B interruption of the external layers; 1C interruption of internal layers); and type 2: MH closed with autologous or heterologous filling tissue interrupting the normal foveal layered anatomy (2A: filling tissue through all layers; 2B reconstitution of normal inner retinal layers; 2C reconstitution of normal outer retinal layers; 2D H-shaped bridging of filling tissue). Because Rossi et al [18] reported that MHCPs 1A and 1C performed better than others in terms of improvement in BCVA, and indicate reconstitution of the retinal banded anatomy, either throughout all retinal layers (1A) or with residual interruption of the internal (1C) layers, we believe these MHCPs to be correct. In addition, these MHCPs correspond to U-shaped and V-shaped types of macular hole closure, respectively, as assessed by Michalewska and colleagues [19].

Statistical analyses were conducted using Statistica 10.0 (StatSoft, Tulsa, OK, USA) software and spreadsheets. Nominal data are presented as absolute numbers and percentages. The normal distribution of data was tested using the Kolmogorov–Smirnov test. Mean (M), standard deviation (SD), and 95% confidence interval (CI) values were calculated for normally distributed data. Student's t test was used to compare mean values of normally distributed data. The median (interquartile range (IQR)) values were calculated for non-normally distributed data. Mann-Whitney U test was used for the comparison of two samples when the underlying distributions were not normal. The level of significance $p \leq 0.05$ was assumed. Spearman or Pearson correlation coefficients were calculated to assess correlations. A one-way analysis of variance (ANOVA) was used to identify the factors with the strongest influence on the outcome. Frequency contingency tables were analyzed using Chi-square tests to determine the relationship between the risk factor and the outcome.

Results

Totally, 70 patients had a macular hole surgery in 71 eyes. There were 15 male and 55 female patients. The mean age (SD) was 65.7 (6.8) years. The median duration of macular hole (IQR) was 3.0 (1.0-6.0) months, and the mean preoperative BCVA (SD), 0.19 (0.16). Thirty-four patients (9 men, 25 women) had a conventional ILM peeling. Their mean age (SD) was 67.5 (6.7) years and median duration of macular hole (IQR), 3.0 (1.0-6.0) months. Thirty-six

Table 1. Median values of minimum and maximum diameters of the idiopathic macular hole (interquartile range (IQR)) for the conventional ILM peeling group and fovea-sparing ILM peeling group

Group	Number of eyes (n)	BCVA	Minimum diameter of the IMH (μm)	Maximum diameter of the IMH (μm)
		Median (Q_{low}-Q_{Up})	Median (Q_{low}-Q_{Up})	Median (Q_{low}-Q_{Up})
Conventional ILM peeling	34	0.14 (0.07-0.25)	421 (287-459)	805 (520-1048)
Fovea-sparing ILM peeling	37	0.17 (0.1-0.25)	376 (261-520)	654 (568-806)
Significance of difference		p=0.89	p=0.68	p=0.36

Note: BCVA, best-corrected visual acuity; IMH, idiopathic macular hole

patients (6 men, 30 women) had a fovea-sparing ILM peeling. Their mean age (SD) was 64.14 (6.5) years and median duration of macular hole (IQR), 2.0 (1.0-8.0) months. There were no significant differences between the groups in terms of gender (p1=0.3) and duration of macular hole (p2=0.3). In addition, although there was a significant difference in age (p3=0.03), in both groups, the median age was in the seventh decade of life. Moreover, there were no significant differences between the groups in terms of BCVA, minimum macular hole diameter and maximum macular hole diameter (Table 1).

Our correlation analysis of preoperative values of total study eyes found no correlation between the preoperative BCVA and the duration of the disease, but a significant negative correlation of the preoperative BCVA with the minimum macular hole diameter (r= - 0.53 p<0.05) and the maximum macular hole diameter (r= - 0.6 p<0.05).

At the 1 to 2-month follow-up, macular hole closure was seen in 63 of 71 eyes (88.73%), and, in most cases in both groups, median BCVA (IQR) improved from 0.14 (0.07 – 0.25) to 0.5 (0.12 – 1.0). In addition, there were no significant differences between the groups in terms of macular hole closure rate (Table 2).

Table 2. Rates of anatomic success and failure for the conventional ILM peeling group and fovea-sparing ILM peeling group

Group	Number of eyes (n)	Macular hole closure	
		Yes	No
		n (%)	n (%)
Conventional ILM peeling	34	30 (88.2%)	4 (11.8%)
Fovea-sparing ILM peeling	37	33 (89.2%)	4 (10.8%)
Significance of difference		p=0.6	

The macular hole did not close in 4 eyes that had a conventional ILM peeling, and 4 eyes that underwent a fovea-sparing ILM peeling. It is noteworthy that, among the eyes that underwent a fovea-sparing ILM peeling, the macular hole did not close in 4 of the 17 eyes that received gas tamponade with 20% SF6, the tamponade that had been used at the initial phase of the study. It is this fact that made us change from gas tamponade with 20% SF6 to that with 15% C3F8 in subsequent 20 eyes of the fovea-sparing ILM peeling group, and macular hole closure was achieved after primary surgery in all these 20 eyes. In the fovea-sparing ILM peeling group, the macula hole closure rate was significantly higher among eyes that underwent gas tamponade with 15% C3F8 than among eyes that underwent gas tamponade with 20% SF6 ($\chi 2$ = 5.28, p = 0.02).

An additional gas tamponade with 15% C3F8 and a prone position for two more weeks were used for the eyes of the conventional ILM peeling group in which macular hole closure was not achieved after primary surgery. This resulted in macular hole closure, with an improvement in mean BCVA (SD) from 0.1 (0.13) at baseline to 0.34 (0.17) (p = 0.0015). Of the four eyes in which the MH had failed to close after primary fovea-sparing surgery, two received a gas fluid exchange gas tamponade with 15% C3F8, and these patients were advised to maintain a face down position for 2 more weeks. In addition, in another two eyes, the vitreous cavity was revised, and the ILM was removed by a conventional technique with 15% C3F8 gas tamponade. This resulted in MH closure, with an improvement in BCVA (SD) from 0.11 (0.09) to 0.35 (0.04) in the four eyes (p = 0.02).

MHCPs 1A and 1C were seen in 47% of eyes in the conventional ILM peeling group and 64% of eyes in the fovea-sparing ILM peeling group, and the difference was statistically significant (p=0.03; Table 3).

Correspondingly, the final BCVA was significantly better in the fovea-sparing ILM peeling group than in the conventional ILM peeling group (Table 4).

Analysis of variance (ANOVA) found a relationship between the type of hole closure and postoperative BCVA (F=7.9, p=0.0001; Table 5, Fig. 3).

Receiver operating characteristic curve (ROC) analysis was used to build a model of the relationship between the type of gas endotamponade and postoperative BCVA in the fovea-sparing ILM peeling group (Fig. 4). The area under curve (AUC) for the BCVA after macular hole surgery with different types of gas tamponade was 0.84 ± 0.07 (95% CI,

Table 3. Percentages attributed to different idiopathic macular hole (IMH) closure patterns in the conventional ILM peeling group and fovea-sparing ILM peeling group

IMH closure pattern	Number (percentage) of eyes with a particular IMH closure pattern in the conventional ILM peeling group	Number (percentage) of eyes with a particular IMH closure pattern in the fovea-sparing ILM peeling group
1A+1C	14 (47%)	21(64%)
1B	7 (23%)	8 (24%)
Other	9 (30%)	4 (12%)
Open hole	4 (0%)	4 (0%)

Table 4. Median postoperative best-corrected visual acuity (interquartile range) values in the conventional ILM peeling group and fovea-sparing ILM peeling group

Group	Number of eyes (n)	Postoperative best-corrected visual acuity values	
		Median	(Q_{low}-Q_{Up})
Conventional ILM peeling	30	0.43	0.35-0.6
Fovea-sparing ILM peeling	33	0.55	0.35-0.7
Significance of difference			p=0.039

Table 5. Relationship of the idiopathic macular hole (IMH) closure pattern and postoperative best-corrected visual acuity

Group	IMH closure pattern	Number of eyes (n)	Visual acuity		p
			M±SD	(95% CI)	
1	1A+1C	35	0.59±0.19	0.51 - 0.65	P_{1-2}= 0.02 P_{1-3}= 0.008 P_{1-4}= 0.001 P_{2-4}= 0.004 P_{3-4}= 0.001
2	1B	15	0.47±0.19	0.36 - 0.58	
3	Other IMH closure patterns	13	0.44±0.20	0.31 - 0.56	
4	Open IMH	8	0.21±0.14	0.08 - 0.34	

Note: M, mean value; SD, standard deviation; CI, confidence interval; p, significance of difference

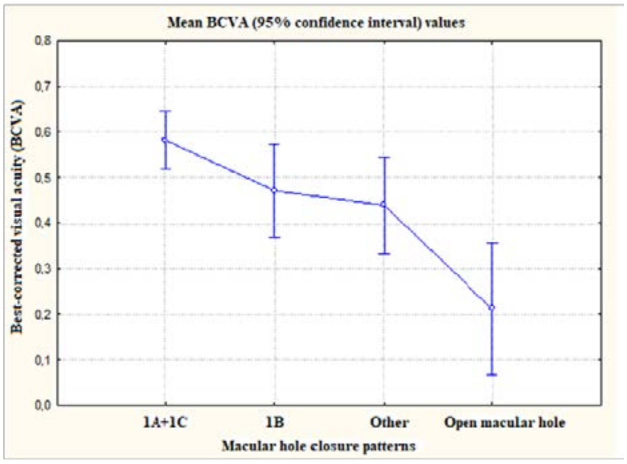

Fig. 3. The best-corrected visual acuity (BCVA) as a function of the macular hole closure pattern

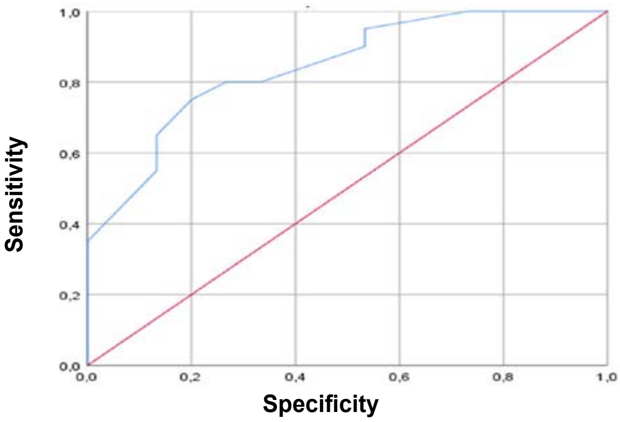

Fig. 4. Receiver operating characteristic (ROC) curve for the association between the type of gas tamponade and postoperative best-corrected visual acuity

0.71 – 0.97). We obtained a model with a sensitivity of 75% and a sensitivity of 80%. A postoperative BCVA of 0.55 (a cut-off value) or better was associated with 15% C3F8 gas tamponade in the fovea-sparing ILM peeling group. Our univariate analysis of the type of surgery and postoperative BCVA revealed that the type of surgery had an impact on the final BCVA in the operated eye (F = 5.06, p = 0.027).

Table 6 shows the results of early and late postoperative thickness measurements in the macula region and various retinal layers. Central retinal thickness decreased by 10% in the conventional ILM peeling group (p = 0.02) and by 6.7% in the foveal-sparing ILM peeling group (p = 0.04) with time after surgery. There was, however, no significant difference in the sectoral thickness of any retinal layer in the early or late postoperative period between the groups. In the conventional ILM peeling group, the

Table 6. Comparing ILM peeling techniques in terms of mean retinal thicknesses (standard deviation) for different retinal layers and subfields in the early and late postoperative period

Groups	Period	n	Central retina	Upper retina	Lower retina	Temporal retina	Nasal retina
Total retinal thickness							
Conventional ILM peeling	Early	17	312.1±97.2	326.1±45.5	342.4±76.5	310.0±62.4	348.2±56.5
	Late	7	280.5±59.9 $*_1$	300.4±27.9	302.0±27.3	291.4±37.7	310.6±27.6
Fovea-sparing ILM peeling	Early	16	311.1±86.1	327.5±40.2	333.3±66.6	315.8±59.3	336.6±47.7
	Late	10	290.1±33.6 $*_2$	319.8±21.0	330.5±25.6	307.1±22.1	336.6±24.2
Outer retinal layer thickness							
Conventional ILM peeling	Early	10	165.1±22.8	155.9±10.2	164.7±34.4	161.7±15.4	174.5±27.8
	Late	5	151.6±17.2 $*_3$	153.0±8.4	158.0±5.3	156.9±7.2	158.4±7.6
Fovea-sparing ILM peeling	Early	16	169.5±17.1	164.5±14.8	163.3±18.9	163.6±10.2	170.0±19.7
	Late	9	165.4 ±19.3	157.8±16.0	161.8 ±4.6	165.6±6.3	164.5±22.7
Inner retinal layer thickness							
Conventional ILM peeling	Early	10	130.8±46.6	150.5±15.5	162.1±42.8	131.0±14.7	165.5±26.2
	Late	5	105.6±40.1 $*_4$	134.2±17.3	131.2±22.6	118.4±20.4	141.6±26.8
Fovea-sparing ILM peeling	Early	14	126.7±29.5	161.3±18.6	158.4±25.0	139.7±18.4	162.1±26.2
	Late	9	120.3±20.6	160.4±21.0	169.4±19.1	140.7±13.2	169.6±25.2
Retinal nerve fiber layer thickness							
Conventional ILM peeling	Early	10	30.8±13.3	25.0±5.4	30.8±8.8	24.8±7.9	30.5±12.0
	Late	5	24.6±5.4	27.6±4.1	24.8±7.5	22.4±12.6	22.0±9.5
Fovea-sparing ILM peeling	Early	16	25.5±9.0	36.5±15.0	35.3±11.2	24.2±9.3	30.9±11.4
	Late	9	32.1 ±6.8	36.1 ±6.8	39.8±9.5	30.4 ±7.2	35.5±12.6

Note. $*_1$ p=0.02, $*_2$ p=0.04, $*_3$ p=0.04, $*_4$ = 0.04

central thickness of the outer retinal layers decreased by 8.5% in the late postoperative period, and this thinning was statistically significant (p = 0.04), but no significant difference in the central thickness of the outer retinal layers was observed between the groups. In addition, in the conventional ILM peeling group, the central thickness of the inner retinal layers significantly decreased by 19% (p = 0.04), and mean total retinal thicknesses (SD) in quadrants significantly decreased from 741 ± 126 μm to 630 ± 121 μm (p = 0.04) in the late postoperative period. No such changes were observed in the fovea-sparing ILM peeling group. Moreover, there was no significant difference in the RNFL thickness between the groups, but macular RNFL thickness in the fovea-sparing ILM peeling group tended to increase in the late postoperative period. The postoperative BCVA correlated with the total retinal thickness in the superior quadrant in the later postoperative period ($r1 = 0.55$, $p < 0.05$) and the inner retinal thickness in the superior quadrant ($r2 = 0.69$, $p < 0.05$).

Discussion

Studies vary with regard to the reported macular hole closure rates for fovea-sparing ILM peeling techniques. In a study by Murphy and colleagues [13], 34/34 holes were successfully closed with surgery in the foveal-sparing group and 32/34 in the standard ILM peeling (control) group. Those authors used 25% SF6 or 20% C2F6 gas tamponade, which were comparable in terms of duration with those used in the current study.

In a study by Morescalchi and colleagues [15], anatomical closure of MH occurred in 22 of the 23 eyes in the complete ILM peeling group and 22 of the 22 eyes in the foveal-sparing ILM peeling group. In addition, although MHs closed completely, 14 of the 22 eyes in the latter group exhibited shallow detachment of the neuroepithelium from RPE that persisted for several months (3–12 months). Ho and colleagues [14] used 15% C3F8 to tamponade the retina, with all the MHs in both groups being closed after operation. A recovered foveal microstructure in the photoreceptor layer was found in all (14) eyes of the foveolar ILM non-peeling group and half of eyes of the group with total peeling of foveal ILM. Restoration of the umbo light reflex was found in 12 of 14 eyes in the former group (86 %) but none in the latter group (0 %).

In a recent study by Tyagi and colleagues [20], the median basal diameter of 22 holes was 1054 µm, while the median minimal linear diameter was 697 µm. A 0.5 disc diameter rim of ILM was left around the MH margins, 20% SF6 tamponade was used, and patients maintained a face down position for 7 days after surgery. Out of 22 eyes that underwent fovea-sparing ILM peeling, successful anatomic closure was achieved in nine eyes. One eye had an iatrogenic break in an attempt to reinitiate peeling and create a fovea-sparing flap, and one of the eyes had an epiretinal membrane formation at end of 3 months.

The aforementioned studies differed in the technique of fovea-sparing ILM peeling.

In the current study, IMH closure was achieved in 30/34 eyes (88.2%) in the conventional ILM peeling group and 33/37 eyes (89.2%) in the fovea-saving ILM peeling group. It should be, however, noted that IMH closure was achieved in all the 20 eyes (100%) that received 15% C3F8 endotamponade in the latter group. In addition, the fovea-sparing ILM peeling group showed a higher rate of correct MH closure pattern (i.e., with restoration of all the retinal layers or all the outer retinal layers) and higher BCVA after MH closure than the conventional ILM peeling group. That is why we believe that our fovea-sparing ILM peeling technique (with forming an inverted ILM flap while leaving some ILM around the MH) is effective.

In the late period after MH surgery with conventional ILM peeling, we noted thinning of the inner retinal layers, especially in the temporal retina, and thickening of the outer retinal layers at the expense of stretching of the photoreceptor outer segments, which is believed by others to correlate with postoperative BCVA. They [21-23] noted that the ILM peeling does not affect only the thickness of the inner retina but also the middle and outer retinae in the parafoveal region. In addition, the chronological changes of the thickness after surgeries varied among the retinal layers and macular regions. In both groups, we found only a significant thinning of the total retinal thickness in the central 1-mm foveal zone in the late postoperative period. It should be, however, noted that the thinning of the inner retinal layer in the central foveal zone was significant only in eyes in the group of conventional ILM peeling. It is also important that, in the current study, retinal thickness changes were correlated with the postoperative BCVA in both groups. No statistically significant changes in the RNFL thickness were observed in the group of conventional ILM peeling. RNFL thickness after ILM peeling for MH tended to decrease in all sectors in the group of fovea-sparing ILM peeling, but there was no significant difference in the RNFL thickness between the groups. Given that the current study and the studies we referred to here had a small sample size, we believe that our data are not contradictory to those reported in these studies.

Conclusion

First, our fovea-sparing ILM peeling technique is an effective treatment option for IMHs, and when used with gas tamponade with 15% C3F8, enabled a primary surgery IMH closure rate of 100%.

Second, the rate of correct IMH closure pattern was significantly higher in the group with fovea-sparing ILM peeling than in the group with conventional ILM peeling (64% versus 47%).

Finally, the mean postoperative BCVA was higher in the eyes that received an MH surgery with fovea-sparing ILM peeling than in those that received an MH surgery with conventional ILM peeling.

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Disclosures

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Abbreviations: *BCVA, best-corrected visual acuity; ILM, internal limiting membrane; IMH, idiopathic macular hole*