

تقشير الغشاء المحدد الباطني ودوره في جراحة ثقب اللطخة الكبير

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الملخص

خلفية البحث وهدفه: تحديد فعالية إزالة الغشاء المحدد الباطني في علاج ثقب اللطخة الكبيرة. مواد البحث وطرائقه: دراسة تقدّمية متتابعة على 13 عيناً (12 مريضاً) مصابة بثقب لطفة كبير "أكبر من 400 ميكرون" إنتخِبَتْ لإجراء عملية قطع زجاجي وتقشير الغشاء المحدد الباطني. يتكون العمل الجراحي من قطع زجاجي قياسي ثلاثي المداخل، وفصل زجاجي خلفي تام، وتقشير الغشاء المحدد الباطني بمنطقة اللطفة، ومبادلة سائل-هواء ووضع غاز داخل القسم الخلفي للعين كدكة (12% بيرفلوروبروبان (C3F8) خليط غازي) متبوعة بوضعية انحناء الرأس للأسفل مدة 15 يوم على الأقل. قُيِّمَت القدرة البصرية قبل الجراحة وبعدها ، بعد شهر، بعد 3 أشهر ثم كل ستة أشهر. فضلاً عن الفحص السريري أُجْرِيَ تصوير مقطعي بصري (OCT) للطفة قبل العمل الجراحي، وخلال كل زيارة بعد العمل الجراحي.

النتائج: تم الحصول على انغلاق تشريحي تام لثقب اللطفة في 9 (69.2%) من أصل 13 عيناً، وانغلاق جزئي في 2 عينين (15.4%)، ولم يحصل انغلاق في 2 عينين (15.4%). أظهرت ثمانى أعين (61.5%) تحسناً في القدرة البصرية "بمقدار سطرين على الأقل على لوحة سنلن". لم تتحسن القدرة البصرية في ثلاث أعين (23.1%)، وتدننت القدرة البصرية في عينين (15.4%).

الاستنتاج: إن تقشير الغشاء المحدد الباطني لمساحة كبيرة في علاج ثقب اللطفة الكبير يؤدي دوراً مهماً في كل من الانغلاق التشريحي لثقب اللطفة، وفي استرجاع الرؤية.

كلمات مفتاحية: ثقب اللطفة - قطع الزجاجي - تقشير الغشاء المحدد الباطني - تقشير الغشاء المحدد الباطني بمنطقة اللطفة.

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Internal Limiting Membrane Peeling and its impact on Large Macular Hole Surgery

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Abstract

Background & Aim: To determine the effectiveness of removal of the internal limiting membrane in the treatment of large macular holes.

Material & Methods: 13 consecutive eyes (of 12 patients) with large macular hole “greater than 400 microns” were prospectively recruited for vitrectomy and ILM peeling. Surgery consisted of a standard three-port vitrectomy, induction of a posterior hyaloid detachment, internal limiting membrane maculorhexis, fluid-air exchange and intraocular gas tamponade (12% perfluoropropane (C3F8) gas mixture) followed by head-down positioning for at least 15 days. Visual acuity was evaluated before and after surgery, at one month, then at three months, and every six months. In addition to the clinical examination, macular optical coherence tomography (OCT) was performed preoperatively and during follow up visits.

Results: Complete anatomic closure of macular holes was achieved in 9 (69.2%) of 13 eyes, partly closed in 2 eyes (15.4%), and had not closed in 2 eyes (15.4%). Eight of the eyes (61.5%) showed an improvement in visual acuity “of at least two Snellen letter chart lines”. Visual acuity did not improve in 3 eyes (23.1%) and fell down in 2 eyes (15.4%).

Conclusions: Peeling of the internal limiting membrane of a large area in the treatment of large macular hole plays an important role in both anatomical closure of macular holes and recuperation of vision.

Key Words: macular hole – vitrectomy - internal limiting membrane peeling - internal limiting membrane maculorhexis.

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Introduction:

The Pathogenesis of idiopathic macular holes (MH) is not clearly understood. Trauma^{1,2} and cystic degeneration of the retina^{3,4} have been implicated as causes of macular holes. Presently, most investigators consider that tangential⁵ vitreoretinal traction is the principle cause of idiopathic macular hole formation. Gass^{6,7} defined and reappraised the clinical stages of macular holes.

Idiopathic macular holes (MH) appear to form from contraction of the prefoveal vitreous, and the hole enlarges because of contraction of myofibroblasts on the inner surface of the internal limiting membrane.⁸ On the basis of the mechanical mechanisms of idiopathic macular hole formation, removal of the internal limiting membrane and adherent epiretinal tissue surrounding and overlying the macular hole is a reasonable surgical approach to close idiopathic macular holes.⁸

Traditionally, macular holes (MH) have been considered nontreatable.⁹⁻¹¹ It has been suggested that the surrounding tissue has degenerated¹² and is not capable of supporting good acuity. Eyes fellow to idiopathic macular holes are at risk for the development of sight-threatening macular holes.^{13,14}

Macular holes (MH) are now surgically treated.¹⁵ Since the initial report of vitreous surgery for an idiopathic macular hole by Kelly and Whendle,¹⁵ various surgical techniques and adjuvant therapies have been proposed to increase the success rate of macular hole closure.^{16,17} Recently, some investigators have reported that the removal of internal limiting membranes (ILMs) is an effective surgical approach to close an idiopathic macular hole, leading to improve closure rate.^{8,18,19}

As said above, MH has now become a surgically treatable disease with standardized techniques incorporating vitrectomy, induction of posterior vitreous detachment, internal limiting membrane (ILM) peeling, and gas tamponade.⁸ ILM peeling has been established to improve surgical success rates.²⁰⁻²³ In addition, retinal ILM peeling has been facilitated by staining dye such as trypan blue and indocyanine green.^{24,25}

The rationale for ILM peeling is that MH can occur and enlarge owing to contraction of perifoveal vitreous and cellular constituents with myofibroblastic differentiation on the surface of the ILM.^{8,26} Although ILM has no inherent contractile properties, it does act as a scaffold for

contractile tissue to exert tangential traction on the fovea.

Several studies using optical coherence tomography (OCT) have reported the dynamic sealing process after MH surgery.²⁷⁻³⁰ In addition, there is a significant correlation between these morphologic changes and visual function such as metamorphopsia.³¹

Although ILM peeling has become a widely accepted surgical technique, the purpose of this study was to investigate the

influence of this surgery on large MH anatomically and functionally.

Patients and Methods:

From February 1, 2016, through April 10, 2018, we studied a consecutive series of 13 eyes of 12 patients with a large macular hole “greater than 400 microns” (Table 1), who underwent vitreous surgery and removal of the ILM using a technique for staining the ILM.

Table 1: summarizes the basic data of patients. MH: Macular Hole. VA: Visual Acuity. CF: Counting Fingers.

N	Age	Sex	Time of diagnosis	MH size (micron)	VA initial	Results	VA final
1	64	Female	1 year	1450	CF 4 m	Closed	0.9
2	70	Male	3 months	1400	CF 3 m	Closed	0.4
3	52	Female	2 months	1443	CF 5 m	Closed	0.2
4	68	Male	1 year	1430	LP	Closed	0.16
5	70	Male	1 month	626	CF 2 m	Closed	0.16
6	65	Male	1 month	670	0.1	Closed	0.3
7	56	Female	1 year	1500	CF 5 m	Partly closed	CF 5 m
8	51	Female	1 year	1700	CF 2 m	Not closed	CF 2 m
9	50	Female	1 year	1420	CF 5 m	Closed	0.2→ HM
10	63	Female	1 year	1445	CF 4 m	Closed	CF 1 m
11	52	Female	1 year	1821	CF 4 m	Not closed	CF 4 m
12	58	Female	2 years	1254	CF 3 m	Partly closed	0.1
13	80	Female	1 year	1275	CF 2 m	Closed	0.4

Of the 12 patients who were studied, 8 were women and 4 were men. One women had a bilateral macular hole (MH). The average age

of the patient was 61.4 years, ranging from 50 to 80 years. (Diagrams 1,2).

The size of the MH ranged between 626 and 1821 μm . (Diagram3).

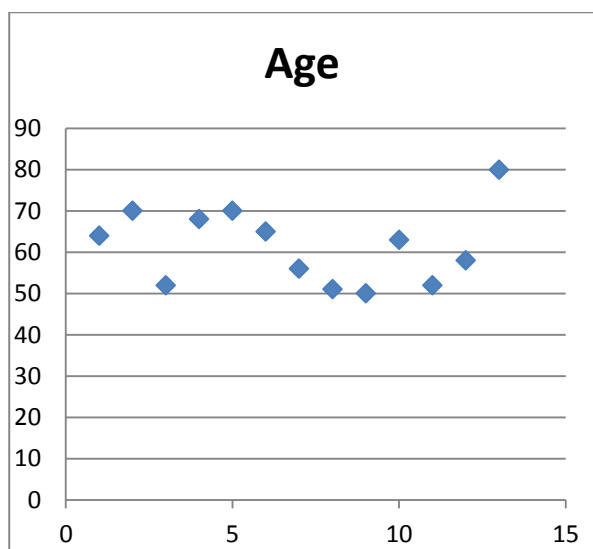


Diagram 1. Age distribution of patients

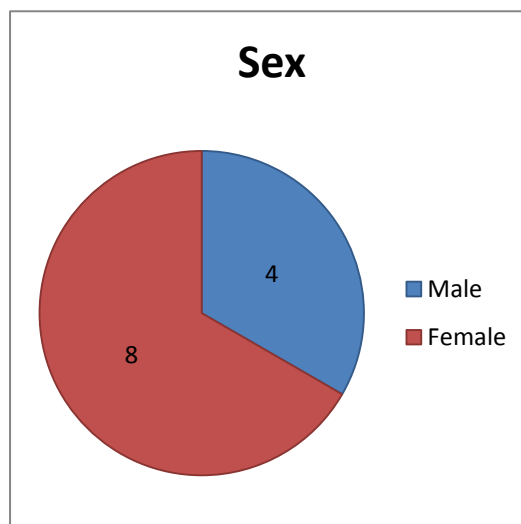


Diagram 2. Sex of patients

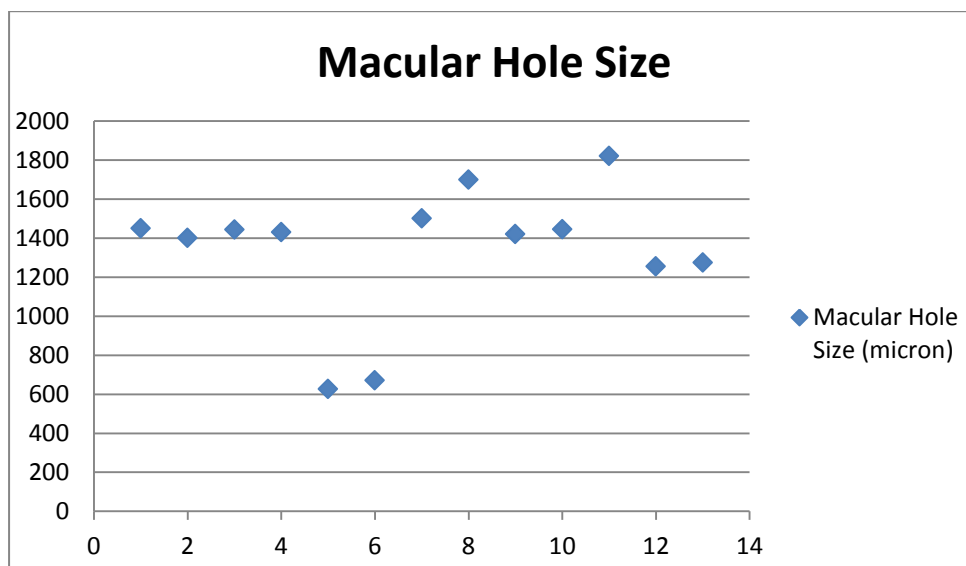


Diagram 3. Macular Hole Size (micron).

The MH was idiopathic large in 7 eyes, accompanied by an epimacular membrane in 2 eyes, with total retinal detachment and inferior retinal break in 3 eyes, above wet age related macular degeneration in one eye, and with mild non proliferative diabetic retinopathy in one eye.

The preoperative evaluation included, among other measures, taking of an extensive history, determination of the Snellen visual acuity, and a thorough slit-lamp examination with the use of a 78-diopter or a 90-diopter lens. In addition to the clinical examination, macular optical coherence tomography (OCT) was performed. A detailed informed consent was obtained in every case.

The situation was discussed with all the patients. We explained to them about the surgical operation, the possible complications and in addition to stress on the need of commitment of the head position "prone position". Informed consent was obtained from each patient.

Surgery consisted of a standard three-port pars plana vitrectomy, followed by surgical separation of the posterior cortical vitreous from the optic nerve head and posterior retina using cutter tip. A total vitrectomy was then performed. A small amount of viscomaterial containing trypan blue (TB) was placed on

the retina around the macular hole for 20 seconds. After removal of the viscomaterial containing TB, the ILMs became clearly visible because they were stained blue. A small slit was primarily made in the ILM inside the superior arcade and a small stained flap of ILM could be easily raised by a membrane pick. Then the ILM and the epiretinal tissue overlying and surrounding the macular hole were grasped and peeled with vitreous forceps with angled grasping tips. A continuous curvilinear peel was completely created around the macular hole, followed by fluid-air exchange and intraocular gas tamponade (12% perfluoropropane (C3F8) gas mixture) followed by head-down positioning for at least fifteen days.

ILM peeling has been established to improve surgical success rates. In addition, retinal ILM peeling has been facilitated by staining with trypan blue.

Whereas there were retinal detachment, the surgery included 4 quadrants scleral fixation 2.5 mm silicon band and silicon oil 1000 sc tamponed. When there was cataract it had been removed.

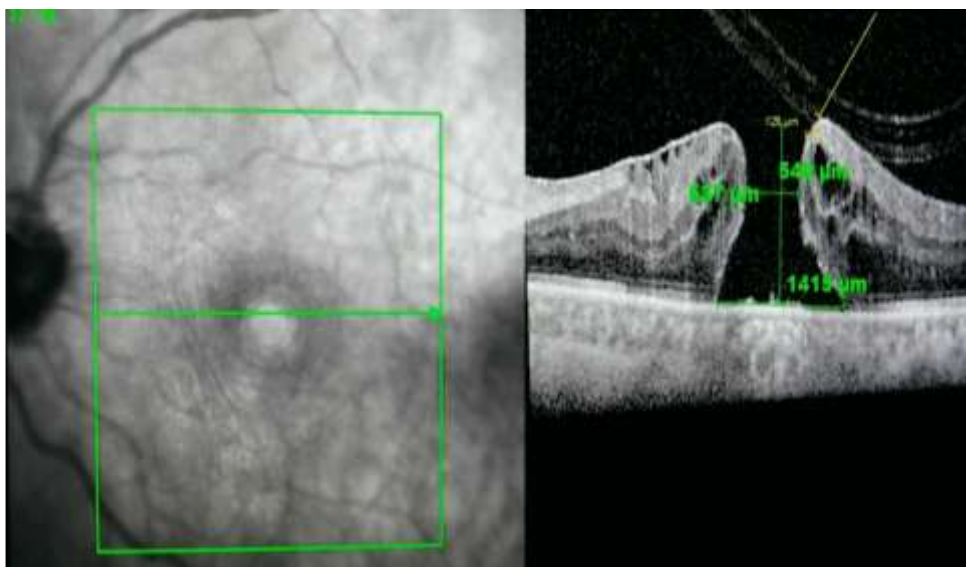
The PPV was done with (20G) in 6 patients and with (23G) in 7 patients. The surgeon was the same for all patients. The surgery

was done in Al-Mouasat University Hospital for 7 patients and in a private hospital for 6 patients.

Postoperative examinations were performed at day 1, one month post-op, three months, six months later, and then every six months. All patients were evaluated for visual acuity, a thorough slit-lamp

examination and macular OCT had been performed in each visit.

The MH size was measured manually by measuring the diameter horizontally in the section passing from the center of the fovea at the junction of the sensory retina with the pigment epithelium nasally and temporally. (picture1).



Picture 1. MH measurement with epiretinal membrane ERM.

Results

The ratio of large MH closure was as following: 9 with complete closure (approximately 70%), 2 partially closed, and 2 was not closed. (diagram 4)

The final visual acuity was improved for at least two Snellen letter chart lines in 8 patients (61.5%), was not changed in 3 patients (23.1%), and declined in 2 (15.4%) other patients. (diagram 5).

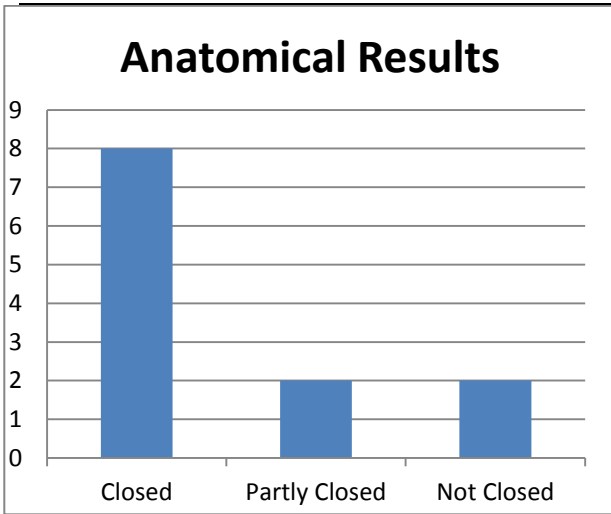


Diagram 4. Anatomical results of MH closure.

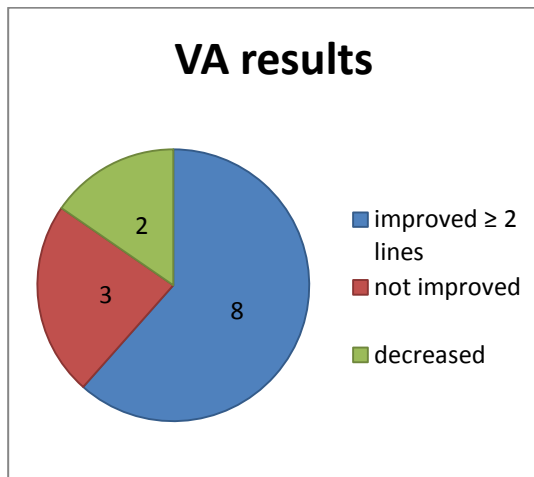


Diagram 5. Visual acuity results.

The retinal detachment was treated in the two patients accompanied with retinal detachment.

Two patients developed severe vitreoretinal proliferation (PVR) affected by C3F8 gas, the first case developed in the first postoperative day, and the second case three months later which had led to huge retinal fibrosis and breaks.

Discussion:

Since Kelly and Wendel¹⁵ introduced their way of Macular hole surgery, subsequent research and studies have progressed to evaluate the surgery, the role of the internal limiting membrane (ILM) peeling for a small or large area, and the difficulties in removing ILM because of poor visibility of the ILMs. Inappropriate removal of the ILM risks damage to the retina, eg, retinal edema or retinal pigment epithelium alterations.³² To obtain better visibility of the ILM and to peel all the macular surface, we have stained the ILM using the trypan blue.

Yoon et al⁸ proposed to understand the mechanism of MH and its enlargement is owing to contraction of perifoveal vitreous and cellular constituents with myofibroblastic differentiation on the surface of the ILM. The ILM itself has no shrinkage property, it does act as a scaffold for contractile tissue to exert tangential traction on fovea, It is known that this traction increase the size of MH and by peeling the ILM we eliminate this contractile properties and aid the retina to re-expand and return to its normal position, so it is recommended to do surgery with no delay.

Although the role of ILM peeling has not been confirmed for the visual acuity improvement, it is certain that ILM peeling

has a role in accelerating the closure of the MH and reducing the recurrence and reopening rate of the MH.³³

Recently other studies showed a new surgical technique by covering the refractory MH with autologous flap of the ILM.^{34,35}

We performed surgery for large MH for diameters greater than 600 microns, most of them more than 1200 microns and at an oldest diagnostic time for the largest diameter size.

Our surgical technique included, pars plana vitrectomy (PPV) and induction of posterior vitreous detachment, internal limiting membrane (ILM) peeling for the whole macular region, and C3F8 non expanded gas injected as a tamponed. ILM peeling has been established to improve surgical success rates. In addition, retinal ILM peeling has been facilitated by staining with trypan blue. Whereas there were retinal detachment the surgery included 2.5 mm silicon band fixated in 4 quadrants of the sclera and silicon oil 1000 sc injected as a tamponed, this oil had been removed 6 months later for all three patients. Whereas there was a cataract it had been removed and an intra ocular lens (IOL) had been implanted.

The peeling of the ILM may harm the retinal nerve fiber layer which lead to defects in the visual field, these defects were not annoying to our patients.

The eye filled with gas is more risky for developing an inflammatory reaction, vitreoretinal proliferation (PVR). Two eyes of our patients developed this reaction, the first early post-surgery as the patient travelled immediately after the surgery to another province. This reaction treated by increasing the steroid treatment but with ischemic retinal fibrosis and no improvement of vision although the hole was completely closed. The second case developed six weeks post-surgery in the context of severe pneumonia, led to endophthalmitis, though PPV had been done and silicon replaced the gas and however no good vision was recuperated although the MH still closed too.

One special case was that the MH developed above wet age related macular degeneration (wet AMD), we discussed the case with the patient, then the same surgical technic was applied, with excellent anatomic results and the VA gained two Snellen lines. Here at the end of the surgery, 1.23 mg avastine was injected intra posterior segment of the eye. (Figure 2).

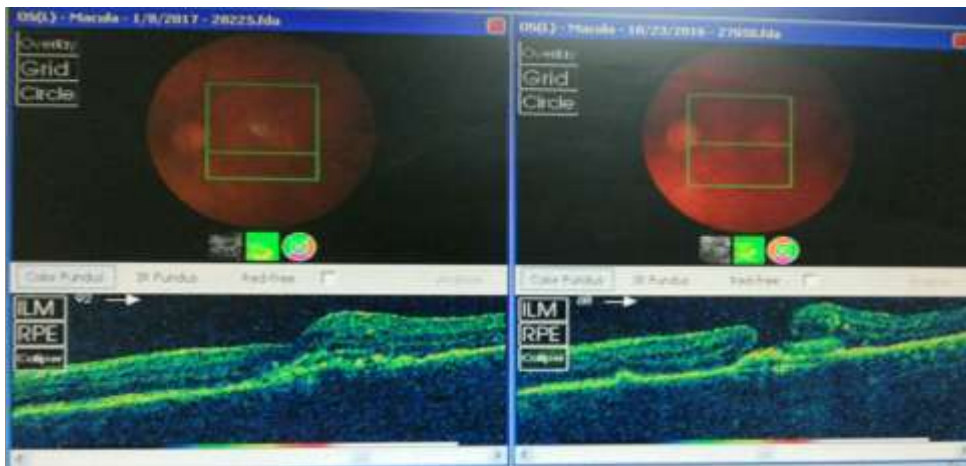


Figure 2. Macular Hole (MH) on wet age related macular degeneration (wet AMD) before surgery (right photos), and two months after surgery with complete MH closure (left photos).

Three other patients had large old neglected MH with total retinal detachment with inferior breaks. All the three were operated with the same surgical technic of large MH in addition to encircle the sclera with silicon

buckle and the retina tamponed with 1000 sc silicon oil which was removed six months later with closing two of three MH (67%) and the two gained 1 Snellen line improved VA. (Figure 3).

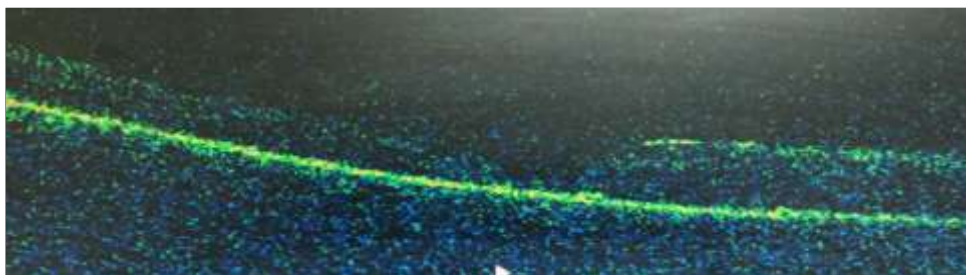


Figure 3. Closed macular hole was accompanied with total retinal detachment, generalized retinal atrophy is noticed in the macula.

The head-down positioning “prone position” was annoying for the patients, but it was remarkable that the patient with two large

MH, while in the first surgery she was completely committed to position with MH closure, in the second surgery she did not

respect the head position and therefore came with bad MH closure.

The phases of MH closure were similar for all patients, first the convergence of the edges of the hole on its surface to reform as a cyst after complete release of tangential traction,

then the intra-retinal fluids move out of the photoreceptor layer similar to central serous retina (CSR), and finally this fluids was absorbed and then gradual recovery of the IS/OS. (Figure4).

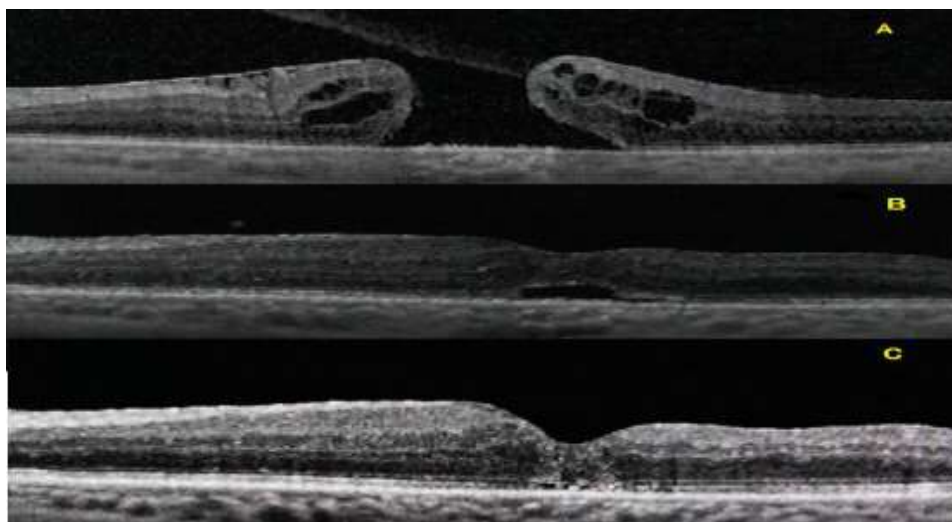


Figure 4. The phases of MH closure. A, centrifugal epi-retinal traction forming MH. B, the convergence of the edges of the hole on its surface to reform as a cyst after complete release of tangential traction . C, then the intra-retinal fluids move outer the photoreceptor layer similar to central serous retina(CSR), and finally this fluids was absorbed and then gradual recovery of the IS/ OS.

Visual acuity improvement was obvious in (61.5%) of the eyes and was proportional to the anatomical restoration of the hole. This study assure that the results of the surgery by peeling the internal limiting membrane for all the macular region is better for the large macular hole than leaving it with no surgery whereas it continue enlargement in size and

even may complicated with retinal detachment. It is recommended to do the surgery early to avoid the increasing centrifugal contractile properties of the myofibroblastic glial differentiated cells on the internal limiting membrane, and to reverse its negative effects on the restoration of the photoreceptors layer.³⁶

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