Journal of Medicine in Scientific Research

Volume 5 | Issue 3 Article 6

Subject Area:

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Original Article

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Abstract

Background

Over the past two decades, the surgical treatment of full-thickness macular holes (MHs) has advanced significantly, with current hole closure rate increasing more than 95%.

Aim

To assess the visual and anatomical outcomes of combined macular detachment and macular massage techniques for large MHs.

Patients and methods

The current work involved 12 eyes of 12 patients with large full-thickness idiopathic or traumatic MH. All participants were subjected to full ophthalmic assessment and measurement of best-correctable Snellen visual acuity, intraocular pressure, fundus photograph, and spectral-domain ocular coherence tomography at preoperative and postoperative periods. All surgeries were done by two surgeons and followed up at least 6 months.

Results

Outcomes of our techniques showed that there were nine (75%) patients with complete closure, whereas other three (25%) patients with a partial closure. Improvement of vision occurred in eight (66.7%) patients, and one patient showed a retinal tear temporal to macula as an intraoperative complication. Mean postoperative macular thickness in these closed MHs was 166 ± 54 μm. In the nonclosed MHs, the mean diameter of the aperture was 611 ± 218 and the mean diameter of the base was 726 ± 265 μm. Moreover, ocular coherence tomography showed that there was retinal pigment epitheliopathy with different degrees in almost our cases.

Conclusion

Combination of macular detachment and macular massage techniques showed a satisfactory anatomical and functional outcome in cases of large MHs.

Keywords: Large macular hole, macular detachment, macular massage

Introduction

Over the past two decades, the surgical treatment of full-thickness macular holes (FTMHs) has advanced significantly, with the current hole closure rate increasing more than 95% [1]. Surgery to induce posterior vitreous detachment and peel the internal limiting membrane (ILM) eliminates the pathogenic anteroposterior and tangential tractional pressures that cause macular holes (MH) [2].

Larger MHs with a basal diameter of more than 400 μm are still difficult to manage despite advances in studying the disease pathophysiology and surgical advancements with small gauze vitrectomy [3,4].

For large MHs, many designs of this approach have been reported, including the use of an inverted temporal flap [5], free ILM flap insertion [6], and others, such as retinal

Access this article online

Quick Response Code:

Website: www.jmsr.eg.net

DOI: 10.4103/jmisr.jmisr_20_22

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Submitted: 27-Feb-2022 **Revised:** 07-Apr-2022 **Accepted:** 08-Apr-2022 **Published:** 23-Nov-2022

How to cite this article: Elnashar HA. Combined macular detachment and macular massage in large macular hole. J Med Sci Res 2022;5:237-41.

approaches [7], and the use of autologous blood [8], retinal graft [9], and amniotic membrane [10] as macular plugs. All of these procedures rely on the same proposal: inserting tissue, such as ILM, retinal grafts, or amniotic membrane, into the MH to serve as a scaffold for glial proliferation to cover the tissue defects and, eventually, close the MH. These strategies result in a small gain in visual quality [11].

Large, chronic, and recurring MHs may be treated in a variety of ways that do not involve covering the MH with any graft. It was suggested in 2011 by Oliver and Wojcik [12] to use a 41-G needle to induce a macular detachment by injecting fluid into the subretinal region. It is hoped that by injecting a balanced saline solution into the retina, it would become more pliable, allowing for the realignment of the borders of the FTMH, which will also be assisted by the dissection of the strong adhesions between the retina and retinal pigment epithelium (RPE) at the edge of a persistent FTMH [13]. Another method for closing MHs is called 'retinal massage' and involves joining the borders of the hole together to form a seal [14]. Our goal was to examine the visual and structural effects of combined macular detachment and massage procedures for patients with large MHs.

Patients and methods

A prospective cohort study was conducted at Memorial Institute for Ophthalmic Research (MIOR), Giza, Egypt, during the period from January 2019 to April 2020. The current work involved 12 eyes of 12 patients with large full-thickness idiopathic or traumatic MH. Informed consent was obtained from all patients, and ethical committee of the institute approved the study.

Patients with large MH with a diameter more than or equal to 700 μm and attached posterior pole were enrolled in this study, whereas patients with vision less than HM, hole smaller than 700 μm, and detached posterior pole were excluded.

Methods

All participants were subjected to full ophthalmic assessment and measurement of best-correctable Snellen visual acuity, intraocular pressure (IOP), fundus photograph, and spectral-domain ocular coherence tomography (OCT by Cirrus, Carl Zeiss, Dublin, USA) at preoperative and postoperative periods. Calipers were placed on the MH's furthest diametrically opposed sides to measure its diameter in microns on OCT. All surgeries were done by two surgeons and followed up at least 6 months.

Surgical procedure

The surgical procedure performed was as follows: standard 23-G three-port pars plana vitrectomy was performed, followed by induction of posterior vitreous detachment (if incomplete). ILM peeling after staining was done. A 41 G needle was used to inject saline subretinal to cause posterior pole detachment through multiple punctures posterior to temporal arcades avoiding papillomacular bundle and two-disc diameter from MH edge. The detached retina was massaged from periphery to center using a diamond-dusted scraper or finesse flex loop to approximate edges of the macula and change hole into the transverse slit. Air-fluid exchange was performed using a soft-tip cannula to drain subretinal fluid completely through MH, which helps in the complete closure of MH. Injection of tamponade was done, followed by facedown positioning for 3 days.

Statistical analysis

Statistical analyses were performed using statistical package for social sciences (SPSS) version 21.0 (SPSS Inc, Chicago, USA) for Windows, version 21.0. Data were provided as mean ± SD and percent. We used the Wilcoxon test and paired sample *t* test to compare between two different periods. Values of *P* value less than 0.05 were considered statistically significant.

Results

A total of 12 eyes of 12 patients (six males and six females) enrolled in this work. Their mean age was 49 ± 22 years and ranged from 11 to 71 years. Regarding history, there was one patient with choroidal rupture temporal to the macula, one patient with a history of macular surgery, and three patients with a history of ocular surgery. Regarding the etiology of MH, there were eight (66.7%) patients with idiopathic MH and four (33.3%) patients with traumatic MH. The mean follow-up period was 13 ± 3 months and ranged from 10 to 16 months (Table 1).

Considering preoperative assessment, the mean spherical equivalent was 0.31 ± 1.77 D, best-corrected visual acuity (BCVA) was 0.03 ± 0.02 (2/60), IOP was 13 ± 3 mmHg,

Table 1: Demographic and clinical data of studied patients

	Cases (*n*=12)
Age (year)	
Mean±SD	49±22
Minimum–maximum	11-17
Sex [*n* (%)]	
Male	6 (50)
Female	6 (50)
Ocular comorbidities [*n* (%)]	
Yes	1 (8.3)
No	11 (91.7)
Previous ocular surgery [*n* (%)]	
Yes	3 (25)
No	9 (75)
Previous macular surgery [*n* (%)]	
Yes	1 (8.3)
No	11 (91.7)
Etiology [*n* (%)]	
Idiopathic	8 (66.7)
Traumatic	4 (33.3)
Follow-up (month)	
Mean±SD	13±3
Minimum–maximum	10-16

the basal diameter of the MH was 1401 ± 318 µm, and aperture diameter of MH was 887 ± 126 µm (Table 2).

Regarding the outcome of our techniques, there were nine (75%) patients with complete closure, whereas other three (25%) patients with a partial closure. Improvement of vision occurred in eight (66.7%) patients. One patient showed a retinal tear temporal to macula as an intraoperative complication. Mean postoperative macular thickness in these closed MHs was 166 ± 54 µm. In the nonclosed MHs, the mean diameter of the aperture was 611 ± 218 and the mean diameter of the base was 726 ± 265 µm. Moreover, OCT showed that there was RPE with different degrees in almost all of our cases (Table 3).

Repeated measurements of visual acuity were done and showed that mean preoperative BCVA (0.029 + 0.02) was improved nonsignificantly at 1 month (0.067 + 0.092) and 3 months (0.090 + 0.112), whereas a significant improvement occurred at 6 months (0.114 + 0.107) and 9 months (0.130 + 0.113) ($P = 0.012$) (Table 4 and Fig. 1). Preoperative IOP was significantly increased at 1 month postoperatively ($P < 0.001$) then gradually significantly decreased at 3 and 6 months during follow-up ($P = 0.001$ and 0.011, respectively) (Table 5).

Discussion

Ophthalmologists still have difficulties with large, recurring, or chronic MHs, despite the excellent success rate of recent MH treatment [15].

For MH surgery, the currently accepted standard procedure is pars plana vitrectomy, posterior hyaloid excision, ILM peeling, gas tamponade, and positioning after surgery [16]. The visual acuity and closure incidence of a FTMH are influenced by the persistence and diameter of the hole [17]. So, the closure incidence of large MHs by the stranded approach (pars plana vitrectomy plus ILM peeling) is 56% [18].

To our knowledge, it was the first time in which this technique was used in idiopathic cases as primary treatment. We used this technique for large MH more than 700 µm (aperture diameter) and 1000 µm (basal diameter), whatever the cause, either idiopathic (eight patients) or traumatic (four patients), as a primary treatment (11 patients) and for persistent cases (one patient). The incidence of closure of these large MH using this technique was 75% and improvement in vision was 66.7%, which is an acceptable percentage as large MH was reported to have a wide range of success rates as reported in various studies. The study by Ip *et al.* [18] reported a success rate of 56%, Michalewska *et al.* [19] reported 88%, and Gupta *et al.* [17] reported a success rate of 67.6% if the size of MH was more than 500 µm.

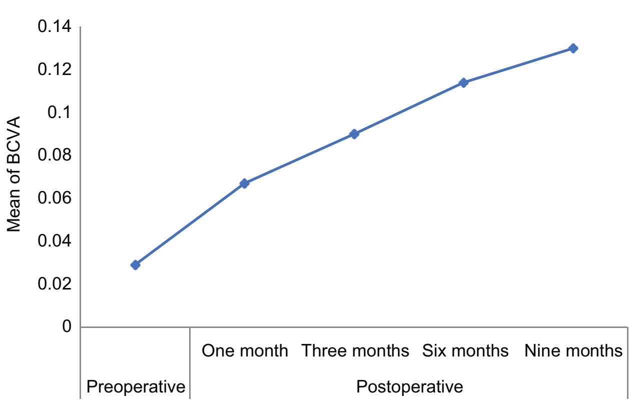

Figure 1: Visual acuity at preoperatively and 1, 3, 6, and 9 months postoperatively.

Table 2: Basal preoperative ophthalmic characteristics of studied patients

	Cases (n=12)
Lens status [n (%)]	
Phakic	9 (75.0)
Pseudophakic	3 (25.0)
Spherical equivalent	
Mean±SD	0.31±1.77
Minimum–maximum	−2.00 to 3.25
Preoperative BCVA	
Mean±SD	0.03±0.02
Minimum–maximum	0.005-0.05
Preoperative IOP	
Mean±SD	13±3
Minimum–maximum	10-20
Basal diameter of macular hole	
Mean±SD	1401±318
Minimum–maximum	1020-2170
Aperture diameter of macular hole	
Mean±SD	887±126
Minimum–maximum	700-1070

BCVA, best-corrected visual acuity; IOP, intraocular pressure.

Table 3: Outcome of our surgical approach in studied patients

	Cases (n=12)
Closure of macular hole [n (%)]	
No	3 (25)
Yes	9 (75)
Improvement of vision [n (%)]	
No	4 (33.3)
Yes	8 (66.7)
Intraoperative complications [n (%)]	
No	11 (91.7)
Yes	1 (8.3)
Macular thickness in closure holes	
Mean±SD	166±54
Minimum–maximum	102–277
Residual macular hole size in nonclosed holes (mean±SD)	
Aperture diameter	611±218
Basal diameter	726±265

Table 4: Measurements of visual acuity at preoperatively and 1, 3, 6, and 9 months postoperatively

	Visual acuity	
	Mean	SD
Preoperative	0.029	0.020
Postoperative		
1 month	0.067	0.092
3 months	0.090	0.112
6 months	0.114	0.107
9 months	0.130	0.113
P		
*P*1	0.182	
*P*2	0.109	
*P*3	0.012*	
*P*4	0.012*	

*P*1: comparison between preoperatively and 1 month postoperatively.
*P*2: comparison between preoperatively and 3 months postoperatively.
*P*3: comparison between preoperatively and 6 months postoperatively.
*P*4: comparison between preoperatively and 9 months postoperatively.
**P* value was significant.

Table 5: Measurements of intraocular pressure at preoperatively and 1, 3, and 6 months postoperatively

	IOP	
	Mean	SD
Preoperative	13.17	2.89
Postoperative		
1 month	18.58	2.84
3 months	16.25	2.63
6 months	15.17	2.33
P		
*P*1	<0.001*	
*P*2	0.001*	
*P*3	0.011*	

IOP, intraocular pressure. *P*1: comparison between preoperatively and 1 month postoperatively. *P*2: comparison between preoperatively and 3 months postoperatively. *P*3: comparison between preoperatively and 6 months postoperatively. **P* value was significant.

Although the overall success rate in this study was 75%, we noticed that the best results were achieved in young age patients (11, 13, and 22 years old). All of them achieved complete closure of MH and BCVA 6/18 (0.3). Chakrabarti and Roufail [20] explained that posterior pole detachment allows the use of elastic properties of the retina during the macular massage, and this can explain the best results in young age in which retinal elasticity is more than in old age.

Centripetal migration of retinal tissue to the fovea is the primary etiology of MH closure [21–23]. It was observed that MH with a subretinal fluid cuff was more likely to close. A cuff of subretinal fluid will prevent adhesion between the MH margins and the RPE. For this reason, the odds of the hole closing are significantly reduced when MH is used without the subretinal fluid cuff [24]. One of the goals of macular detachment is to dissect the retina from the underlying RPE and to remove adhesion between the MH margins and the RPE; therefore, we merged these two principles into a single approach to close the large MH with an adherent posterior pole. Similar research utilizing a different methodology for hydrodissecting the macula found that 85% of traumatic MHs can be repaired using this method [25].

In 66.7% of patients, visual acuity improved despite effective structural closure, but Oliver and Wojcik [12] found no subjective improvement in visual acuity in their research. Similar to the research by Wong *et al.* [26], none of our patients had pre-existing vision deterioration.

In the current work, there were no major or long-term problems during or after the procedure. Szigiato *et al.* [13] also showed no complications in their study.

A common finding in almost all cases of this study is the RPE. Alpatov *et al.* [14] explained this by mechanical trauma during the macular massage. Wong [27] had another explanation that the epitheliopathy occurred due to fluid injection to detach the retina that causes trauma and degeneration of RPE and photoreceptors. However, Guerin *et al.* [28] described the photoreceptor regenerated after retinal detachment. Doyle *et al.* [29] explained another proof of photoreceptor regeneration after macular detachment that the visual acuity in patients with macula-off retinal detachment reached 6/12 or better in more than 44% of eyes.

Our study limitations were a small sample size and short-term follow-up. So, the long-term implications of this technique will need to be studied in future research with a wider sample and longer follow-up.

Conclusion

The combination of macular detachment and macular massage techniques showed a satisfactory anatomical and functional outcome in cases of large MHs. Further studies are needed to compare different techniques to establish the best one for large MH.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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