MANAGING MACULAR HOLES

Common questions associated with this anomaly are addressed.

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The success rate of macular hole repair has steadily improved since Kelly and Wendel first described vitrectomy and posterior hyaloid peeling as a method of surgical treatment.[1] However, questions still arise regarding the optimal management of idiopathic full thickness macular holes. This article reviews current literature on idiopathic macular holes to address some of these common questions.

WHEN IS IT TOO LATE TO OPERATE?

The duration of a patient's symptoms is an important predictor of anatomic macular hole closure and visual improvement. Kelly and Wendel reported that visual outcomes were best for those with symptoms existing for less than 6 months.[1] Thus, the question often arises whether it would be beneficial to operate on patients with longstanding macular holes.

Thompson et al reviewed visual and anatomic outcomes of eyes with macular holes existing for 2 years or more and reported a hole closure rate of 71% (32 of 45 eyes) at 3 months and an average visual acuity gain of 6.6 letters. They noted that eyes with macular hole duration of 2 to 2.99 years had slightly better visual and anatomic outcomes than those with hole duration of 3 to 14 years. The differences did not reach statistical significance.[2]

Jaycock et al reviewed 55 cases of patients undergoing macular hole repair over a 2-year period and noted that hole closure rates were 94% among patients undergoing surgery within 1 year of symptom onset.[3] The rate dropped sharply to 47% among those for whom surgical repair was delayed longer than a year.[3]

Surgical repair of longstanding macular holes may yield limited anatomic and functional benefits. Patients in whom the chronicity of the macular hole is uncertain or in whom a macular hole has been present for longer than 1 year should be advised of the guarded prognosis for visual recovery even if anatomic success is achieved.

AT A GLANCE

- The length of time a patient has experienced symptoms is key to predicting likelihood of visual improvement.
- To facilitate macular hole closure, all tractional forces surrounding the open hole should be removed.
- Vitrectomy for macular hole repair has proven highly successful through a number of techniques. Pharmacologic vitreolysis with ocriplasmin is another treatment option, although the effects of ocriplasmin on visual acuity may be unpredictable.

SHOULD THE INTERNAL LIMITING MEMBRANE BE PEELED IN ALL MACULAR HOLE REPAIRS?

It is key to remove all tractional forces surrounding an open macular hole in order to facilitate hole closure. The posterior hyaloid should be completely separated and removed from the posterior pole, and all epiretinal membranes (ERMs) surrounding the macular hole should be completely dissected from the borders of the hole. After these maneuvers are performed successfully, necessity for removal of the internal limiting membrane (ILM) remains debatable.

The ILM is the basal lamina of the inner retina and is thought to be a scaffold for proliferation of fibrocytes, myofibroblasts, and retinal pigment epithelial cells.[4] ILM peeling increases the likelihood of successful macular hole closure, but, because the ILM also plays a role in the structural integrity of the retina, it has been postulated that removal of this membrane could be functionally damaging to the retina.

Electrophysiologic studies using focal macular electroretinogram showed that recovery of the b-wave 6 months after macular hole surgery was delayed in eyes that underwent ILM peeling versus those that did not.[5] Another study identified dissociated optic nerve fiber layer appearance in 36 of 67 eyes that underwent ILM peeling.[6] There was no associated functional abnormality detected on visual acuity. The dissociated optic nerve fiber layer appearance is commonly noted on spectral-domain optical coherence tomography (SD-OCT) following routine ILM peeling (Figure).

A Cochrane review addressed the question of whether ILM peeling improved anatomic and functional outcomes in patients with idiopathic full thickness macular holes.[7] The authors reviewed four controlled trials that included 317 participants randomly assigned to ILM peeling versus no peeling. There was no statistically significant difference in visual acuity outcome at 6 or 12 months between the groups.[7] The odds of primary macular hole closure were

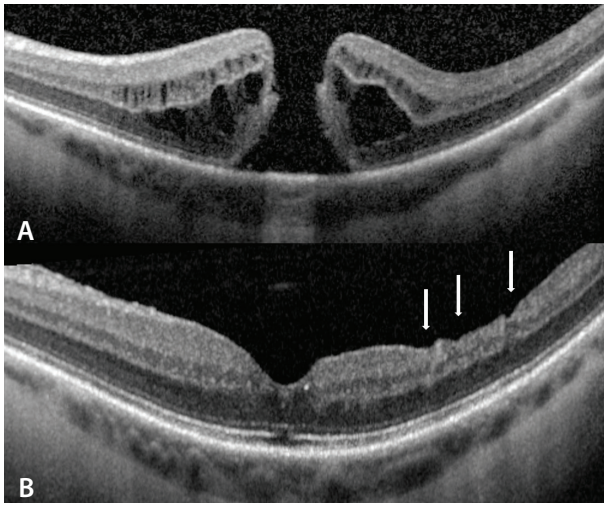

Figure. SD-OCT in a patient with a full thickness macular hole of approximately 1 year's duration; visual acuity measured 20/150 (A). SD-OCT of the same patient following vitrectomy, ILM peeling, and sulfahexafluoride tamponade, followed by 5 days of prone positioning (B). ICG-assisted ILM peeling was performed with the flap initiated by the Tano Diamond Dusted Membrane Scraper and completed by end-gripping forceps. The white arrows indicate dissociated optic nerve fiber layer pits seen postoperatively. Corrected visual acuity measured 20/25 at 1.5 years after surgical repair.

9.27 times higher in the group that underwent ILM peeling compared with the group that had no peeling. The results favored ILM peeling for all stages of macular holes. When stratified by stage, the odds of hole closure after ILM peeling were progressively higher at each of stages 2, 3, and 4. Importantly, rates of intraoperative and postoperative complications were similar in both groups, and there was no difference in scores on the VFQ-25 visual function questionnaire between the groups at 6 months.[7]

The odds of primary macular hole closure are higher with ILM peeling, but the long-term consequences of ILM peeling are still not well established. Dyes such as indocyanine green (ICG) that are used to facilitate ILM peeling are potentially toxic to the retina.[8] Although adverse events from ILM peeling are likely to be infrequent, they are nevertheless possible. Risks and benefits of ILM removal should be carefully assessed for each patient and reviewed with the patient as part of the preoperative decision-making process.

WHAT IS THE PREFERRED ILM PEELING TECHNIQUE?

The ILM can be directly removed without the use of adjuvant dyes, but many surgeons employ dyes to highlight the ILM in order to facilitate its removal. In addition to ICG, infracyanine green, trypan blue, brilliant blue, and triamcinolone acetonide have also been used to improve visualization of the ILM.

Following staining of the ILM, an initial flap can be created with ILM forceps using the pinch-and-peel technique, with a bent microvitreoretinal blade, or with a blunt instrument such as the Finesse FlexLoop (Alcon) or the Tano Diamond Dusted Membrane Scraper (Synergetics). The preferred technique differs among surgeons.

After a flap is created, the ILM is peeled off the retinal surface in a circular fashion, similar to the maneuver used in cataract surgery for capsulorrhexis (maculorrhexis), using forceps (Video). No consensus exists regarding the extent of ILM that must be peeled in order to optimize the chance of hole closure. Steel and colleagues used electron microscopy to compare samples of ILM peeled with the Tano Diamond Dusted Membrane Scraper with those peeled with the pinch-and-peel technique.[9] Large patches of cellular debris were noted on the retinal side of peeled ILM in three of four cases in the scraper group and one of 12 cases in the forceps group, but no significant differences in 3-month visual acuity or macular hole closure were reported between the groups.[9]

IS GAS TAMPONADE WITH FACEDOWN POSITIONING NECESSARY?

Facedown positioning can be burdensome for patients, and its necessity has been questioned. Hu et al conducted a meta-analysis including four clinical trials that compared the effect of facedown positioning versus no facedown positioning on closure rates of macular holes following surgery.[10] A total of 251 cases of macular hole surgery were included. This meta-analysis found overall lower macular hole closure rates in eyes without facedown positioning versus those with positioning. However, when the size of the macular hole was taken into consideration, it was noted that facedown positioning was not necessary for macular holes smaller than 400 µm. The authors recommended caution in drawing conclusions from their meta-analysis for holes larger than 400 µm and recommend additional studies to determine whether facedown positioning is necessary for larger holes.[10] Iezzi and Kapoor reported a 100% single-surgery macular hole closure rate in a retrospective study of 68 eyes of 65 patients, using broad ILM peeling (8000 µm diameter), 20% SF_6, and no facedown positioning.[11] Their patients were asked to maintain 3 to 5 days of reading position, defined as eye position of 45˚ below the horizontal. A multicenter randomized control trial is under way to determine whether facedown positioning improves closure rates of large (> 400 µm) macular holes.[12]

WHAT IF PRIMARY MACULAR HOLE CLOSURE FAILS?

Anatomic success rates of macular hole surgery have been reported to be up to 89% without ILM peeling and

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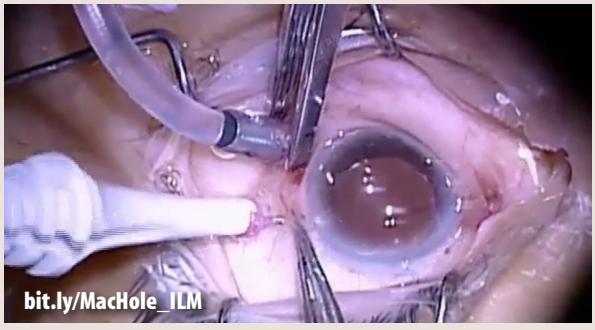
27-Gauge Vitrectomy of a Full Thickness Macular Hole

ILM peeling is performed during the repair.



up to 92% to 97% with peeling. This suggests that, despite ILM peeling, 3% to 8% of macular holes will remain persistently open.[13] Given the small number of patients in whom primary closure fails, there are limited data on what to do when initial surgery is unsuccessful. If the ILM *was not* peeled in the initial macular hole surgery, then it should be peeled in a subsequent procedure. If the ILM *was* peeled in the initial surgery, then a wider ILM peel outside the circumference of the macular hole should be performed to relieve any residual tractional forces. There is limited evidence for additional procedures that may help with hole closure.

Techniques proposed to improve closure rates include laser photocoagulation on the foveal pigment epithelium, surgical retreatment with transforming growth factor–beta 2 or autologous platelet concentrate.[14-16] Many surgeons also manipulate the edges of the macular hole with a Tano Diamond Dusted Membrane Scraper or similar instrument in an attempt to mobilize the hole edges toward closure or free them from any remaining ERM.

Cillino et al conducted a prospective, randomized study of 21 consecutive patients with large idiopathic macular holes (average diameter: 680 µm in group A and 740 µm in group B) that remained persistently open despite previous surgery.[17] Patients were randomly assigned to undergo repeat vitrectomy with 20% perfluoroethane (C_2F_6) gas tamponade (group A) or tamponade with a mixture of silicone oil and perfluorohexyloctane (F_6H_8; group B). At 12 months, macular hole closure was noted using SD-OCT in 30% (3/10) of patients in the C_2F_6 group versus 82% (9/11) in the F_6H_8 group. Significant visual acuity improvement was noted only in the group receiving F_6H_8 tamponade.[17]

TO INJECT OR NOT TO INJECT?

Ocriplasmin intravitreal injection 2.5 mg/mL (Jetrea, ThromboGenics) is an option for enzymatic vitreolysis for small (< 400 µm) full thickness macular holes associated with vitreomacular traction. Stalmans and colleagues reported nonsurgical macular hole closure in 40.6% of eyes injected with ocriplasmin compared with 10.6% of placebo-injected eyes.[17] In a subgroup analysis, success of macular hole closure was most commonly seen in phakic patients without associated ERMs.[18] By contrast, in a retrospective chart review in a small number of patients, Alberti and LaCour reported a lower primary macular hole closure rate in ocriplasmin-treated eyes with macular holes than eyes treated with primary vitrectomy.[19] Although median visual acuities were similar after successful macular hole closure in these groups, visual acuity was slightly worse in eyes that had been primarily treated with ocriplasmin. Vitrectomy has also been reported to be more cost-effective than ocriplasmin.[20]

SHOULD WE OPERATE ON LAMELLAR HOLES?

Witkin et al presented four criteria for the diagnosis of lamellar holes using optical coherence tomography (OCT):[21]

- Irregular foveal contour;
- Break in the inner fovea;
- Dehiscence of inner foveal retina from outer retina; and
- Absence of a full thickness foveal defect and presence of intact foveal photoreceptors.

Most patients have good, stable visual acuity with minimal change over time, so it is possible to observe most lamellar holes. In a case series of 41 eyes with mean follow-up of 37 months, visual acuity was stable in 78% of patients, and deterioration in 22% of patients ranged from 2 to 15 letters.[22] In cases in which a patient's visual acuity worsens, surgical intervention may be indicated.

In a study of 26 eyes with lamellar macular holes diagnosed with SD-OCT and treated with pars plana vitrectomy, ERM peeling, and ILM peeling without intraocular tamponade, almost all (24 of 26) eyes had improvements of at least 2 lines of Snellen visual acuity. Preoperative OCT showed that about 10 of 26 eyes had disruption of the photoreceptor layer, and ERM was present before surgery in all cases.[23]

Given this information, in the management of lamellar holes, OCT findings must be carefully reviewed before surgery, specifically to assess the presence of ERM to evaluate integrity of the photoreceptors. Evidence of anatomic or functional worsening should lead to a discussion with the patient regarding surgical options. Given the rare situations in which lamellar holes warrant surgery, it is not yet known whether ILM peeling and intraocular tamponade are truly needed.

CONCLUSION

Vitreoretinal surgeons are fortunate to have a wide variety of surgical and pharmacologic techniques at our disposal for the repair of macular holes. As with most medical procedures, macular hole repair must be tailored to the individual patient; there is no one right approach. The best technique for macular hole surgery is the one that provides the greatest probability of single-surgery success and the best visual outcome for the patient. ■

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