Macular Hole Surgery Technique

Techniques for operating on macular holes vary, but to optimize surgical outcomes certain principles should be considered.

BY WILLIAM E. SMIDDY, MD

Macular hole surgery (MHS) has emerged as one of the most common indications for vitrectomy.[1] Although it can be highly successful in a number of settings with a variety of technique modifications, some considerations may maximize results. Case selection is important; poorer prognosis cases include those involving larger holes,[2] chronic holes,[3] reoperations,[4] high myopia,[5] and association with retinal detachment or trauma.[6] The technique component that likely has had the most positive effect on outcomes is peeling of the internal limiting membrane (ILM).[7-9] The duration and degree of internal tamponade has also recently been subject to debate. This article surveys these and other considerations that may affect MHS outcomes.

PREOPERATIVE CONSIDERATIONS

Eyes with shorter duration holes, smaller holes, better preoperative vision, and lack of other extenuating circumstances have long been recognized to carry a better prognosis with MHS. Although the surgeon cannot change these factors, preoperative counseling in their presence creates more accurate postoperative expectations and may even factor into the decision for or against surgery. Features now ascertainable by optical coherence tomography (OCT) imaging increasingly influence such evaluations.[10-12]

Visual acuity, macular hole size, and duration are most likely confounding factors, but the size may be the single most reliable factor. The duration of the hole can be difficult to identify, not only because patients are commonly inaccurate historians in determining unilateral visual loss, but because there may be a variable prodrome or other conditions that confound the actual macular hole occurrence. In general, the prognosis with a macular hole of much more than about a year duration, especially if large, probably does not merit surgical intervention. Recent studies with OCT have demonstrated the size and area of the inner segment/outer segment junction defect to be important determinants of pre- and post-operative visual acuity.[10-12] The preoperative visual acuity may also vary based on factors such as intraretinal edema or extent of subretinal fluid, which are possible signs of chronicity and may also influence the visual prognosis.

INTRAOPERATIVE CONSIDERATIONS

In recent years there has been a general trend toward smaller gauge vitrectomy instrumentation. Although it is the author's bias to use 20-gauge instrumentation, several studies have reported equivalent success with both 23- and 25- gauge systems.[13,14] A potential limitation of small gauge instrumentation for MHS, however, is the

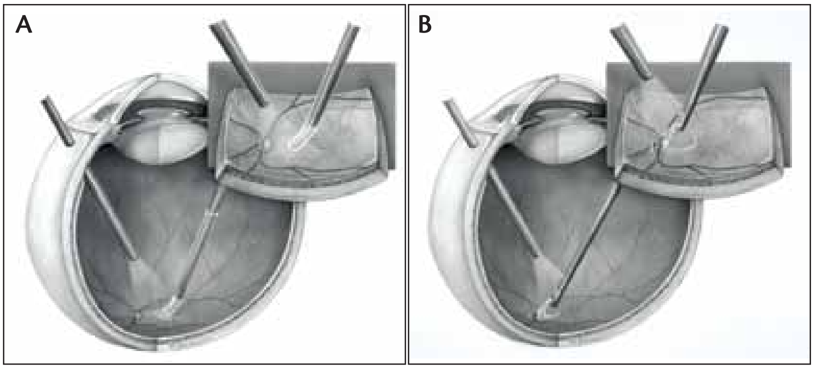

Figure 1. Posterior hyaloid removal. After a core vitrectomy, a flexible extrusion needle is used to identify the attached posterior hyaloid (evidenced by its deviation during aspiration: "fish strike sign") and gently elevated (A). The vitreous cutter on aspiration mode is used to remove the anchor point of the posterior hyaloid at the optic disc, visually evidenced by the separation of the Weiss ring (B).

constricted spectrum of instrument options to peel the ILM; improved disposable forceps quality may alleviate this concern. The author prefers to initiate ILM peeling with a barbed 20-gauge MVR blade, which does not have a suitable small-gauge counterpart. Others have expressed this same concern (Robert Wendell, personal communication) and some use one 20- gauge sclerotomy to circumvent this limitation.

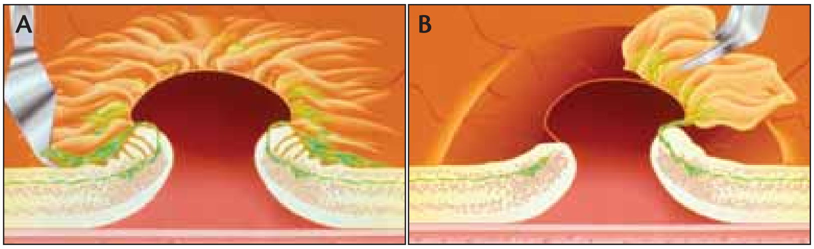

Figure 2. Internal limiting membrane incision and peeling. The barbed MVR blade, or similar instrument, is used to incise the ILM ,which may be impregnated by glial cell proliferation (A). The vitreoretinal pick is used to elevate the ILM more broadly (not illustrated). The ILM peel is completed by using fine forceps (B). The ILM is characteristically more adherent at the margin of the macular hole.

SURGICAL TECHNIQUE

There are two maneuvers for MHS that engender special consideration: posterior hyaloid separation and ILM peeling. Unless it is preexisting, posterior hyaloid separation is a crucial step that must be performed after the core vitrectomy. It can be deceiving to ascertain posterior hyaloid separation, as vitreoschisis is probably more widespread than intuitively suspected.[15] The most reliable way of inducing the separation is to use a flexible-tipped extrusion needle with automated aspiration control to search for and engage an invisible, residual posterior hyaloid, manifested by the characteristic "fish-strike sign" (Figure 1A).[16] The posterior hyaloid is engaged and lifted between the temporal vascular arcades with posterior-to-anterior movements fairly broadly and contiguously, regrasping and utilizing a massage-like, teasing motion. Although for some instances this same technique can be utilized to peel the Weiss ring off the nerve head, the author finds that using the vitreous cutter on aspiration mode is more reliable and avoids confusion of the Weiss ring with other vitreous cortex (Figure 1B). Once the Weiss ring is mobilized, the rest of the hyaloid usually separates readily into the periphery by aspirating with the cutter and can be removed in standard fashion. This technique confirms that the posterior hyaloid has been completely removed. Excessive movements while aspirating with the vitreous cutter should be avoided to minimize retinal break formation.[17] Maximal removal of vitreous allows smother fluid-air exchange later and avoids unwanted and uncontrollable postoperative peripheral retinal traction by the bubble postoperatively.

The second key maneuver is to peel the ILM. While substantial closure rates have been reported without ILM peeling,[1,2,18-20] it probably increases the success rate,[7,8,21] so the author attempts to peel the ILM in all cases. This involves three steps. First, the ILM is incised and one edge is lifted to give a purchase site to dissect it from the retina. The second step involves dissecting (usually with a vitreoretinal pic) the ILM from the surface more broadly, and the third step completes the process with forceps by removing the rest of the ILM from the retinal surface and from the eye. Other instruments are effective for these maneuvers and are preferred by some.[7,22]

The ILM is incised and an initial edge is lifted by making a short, shallow, continuous, curvilinear, laceration-like movement with a barbed MVR blade through the ILM to develop a rather flat, only slightly elevated, somewhat scrolled edge (Figure 2A). This is generally initiated approximately two disc diameters from the hole, usually superotemporally (right eye) or supernasally (left eye), but may it be adjusted to wherever the ILM sheen seems to be most visible. The MVR blade is convenient for this because of its acute point. The blade is then passed perpendicularly to the original direction to plow up the scrolled edge sufficiently to insinuate a vitreoretinal pick under the ILM. Visualizing the ILM can be challenging, and constant adjustments in the orientation of the endoilluminator help the surgeon monitor the progress. Staining is usually not necessary for standard cases but will be described below.

Once the edge has been distinctly developed, the pick is used to extend the dissection with gentle side-to-side motions punctuated by shallow posterior-to-anterior lifting motions, successively advancing around the circumference of macular hole. Frequently it is not possible to circumnavigate the hole completely without the ILM-rhexis rupturing, so the dissection may have to be reinitiated in the opposite direction at the initiation point. The characteristic whitening of the underlying retinal surface that occurs within 30 seconds of ILM removal is a good marker for where the ILM has been peeled, as there can be difficulty visualizing the advancing edge of the peel. At some point, ideally after the pick has been used to separate the ILM around the complete circumference, fine forceps are used to remove the specimen or extend any incompletely separated areas. Usually, the entire ILM cannot be widely separated with the pick, but switching to the forceps may be necessary at this or preferably a much earlier stage in some cases. The rhexis should be advanced with the forceps around the perimeter rather than near the margin of the hole to optimize the peeling. Most commonly, the mobilized ILM remains firmly attached at the internal margins of the macular hole, leaving a funnel-shaped ILM separation. When peeling ILM with the forceps, a continuous rhexis can only be reliably carried out for about 2 clock hours at each grasp or the fragile ILM will fragment, and the progress of the ILM peel becomes more difficult to monitor and complete. Thus, regrasping at the advancing edge of the peeled ILM allows the most efficient removal. The forceps are then used to remove what remains of the ILM from either the funnel-shaped attachment at the hole (pulling centrally to leave the smallest possible remnant) or more peripherally (Figure 2B). Not uncommonly, superficial, petechia-like hemorrhages occur because the ILM inserts directly onto the superficial retinal vessels, which are naked of inner nerve fiber layer. These do not appear to be of any clinical consequence.

A sometimes overlooked step is the inspection of the peripheral retina with indirect ophthalmoscopy for any iatrogenic or previously unrecognized retinal breaks.[17] Using a wide-angle viewing system, systematic scleral indentation accomplishes the same goal. The surgery is concluded with a fluid-air exchange. The macular hole commonly seems to get smaller at this stage. This may be due to reapproximation of the hole edges,[23] but it may be an illusion due to the minification effect of air exchange.

The differential value of one gas used for tamponade over another is unproven. The earliest reports utilized an SF_6 mixture, which gives substantial tamponade for about 1 week and resolves by about 2 weeks.[1] Others have advocated the use of longer-acting, C_3F_8 gas mixtures, which provide substantial internal tamponade for at least 4 weeks and resolve after 8 to 9 weeks.[24] One study found better results with longer-acting mixtures.[25] Still others have recommended air only[25-27] and some, in selected cases, have even recommended that no internal tamponade is necessary.[28]

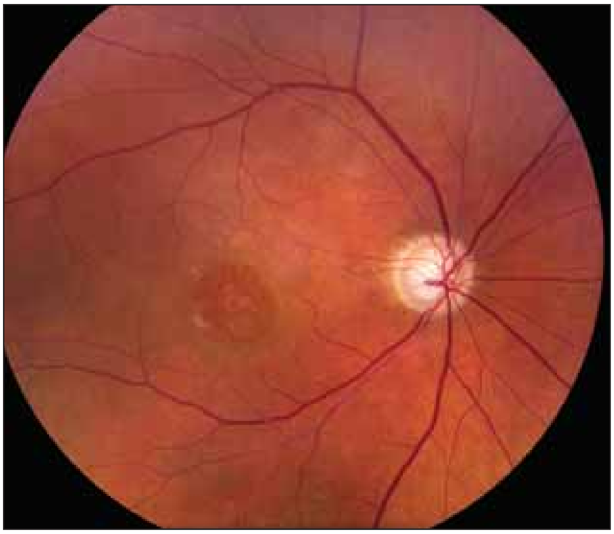

Figure 3. Large macular holes, such as this one in which previous macular hole surgery had failed to induce closure, engender a much poorer anatomic and visual prognosis, and more aggressive surgical maneuvers may be necessary to effect closure.

POSTOPERATIVE FACTORS

Just as the selection of gas type varies widely, the recommended postoperative regimen of face-down positioning varies widely in degree and duration and has not been specifically proven. While some do not recommend face-down positioning,[29] most would recommend approximately 1 week of face-down positioning, although many recommend longer positioning, probably based on earlier series protocols.[24] OCT studies performed through air provide convincing evidence that the macular hole usually closes within 2 days following surgery, suggesting that long face-down positioning is unnecessary.[30,31]

SPECIAL CIRCUMSTANCES

There are certain special circumstances that augur a poorer anatomic prognosis and, accordingly, may suggest the need for some additional considerations, especially ILM peeling.[32-34] These include reoperations (Figure 3), especially for large holes, eyes with either extremely blonde fundi or severe underlying RPE depigmentary changes (as with high myopia), and those with coexisting abnormalities such as retinal detachment, proliferative diabetic retinopathy, and myopic traction maculopathy. Trauma, by virtue of its other associated residual of commotio retinae, or larger macular hole size may make for a worse prognosis but, at least for selected case series, results approximating standard idiopathic macular hole results have been widely reported.[35,36]

Although it is not the author's preference to utilize ILM staining routinely,[37-40] visibility to ensure more complete ILM removal may be more important in these special cases. Indeed, with certain high myopes, the dye pooling in the hole might be the only way that one can even detect the hole intraoperatively. Indocyanine green (ICG) is the author's preference, but good experience has been reported with trypan-blue,[41] brilliant blue,[42] and a suspension of triamcinolone acetonide.[43] The exposure of the dye to the retina and pooling at the macular hole should be minimized to minimize concerns of retinal toxicity.[44-46]

Some have considered using silicone oil[47,48] or other options[49] for "different" cases, but these have not been well proven.[50,51] It is widely assumed that silicone oil obviates the need for face-down positioning and, hence, may be suited for patients with neck or back constraints. Its lower surface tension relative to gas, however, may undermine this unproven hypothesis. Because the presumed purpose of ILM removal is to eliminate traction and to stimulate gliosis,[52] the author often makes two to four short incisions at the margin of the hole to augment this stimulatory effect for especially large holes, such as are encountered with reoperations.

CONCLUSION

The nuances of macular hole surgery technique are probably as varied as individual driving techniques. Just as most driving techniques are successful, most macular hole surgical techniques are successful. Certain principles remain, however, that may provide better MHS results and that should be considered by the vitreoretinal surgeon. ■

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