WHEN TO SPARE AND NOT TEAR THE TRABECULAR MESHWORK

MIGS interventions that preserve the tissue of the trabecular meshwork leave future options open while maintaining a physiologic mechanism to counteract IOP changes.

BY CONSTANCE OKEKE, MD, MSCE

Resistance within the trabecular meshwork (TM) is a significant contributing factor in glaucoma pathophysiology. In particular, resistance in the juxtacanalicular area immediately adjacent to the Schlemm canal (SC) is thought to account for the majority of reduced outflow facility in eyes with primary open-angle glaucoma (POAG).[1] Intuitively, then, treatments aimed at preserving, maintaining, and/or improving function of the TM would seem an important strategy for counteracting resistance at a critical point in the conventional outflow pathway. Perhaps less well appreciated, however, is that preserving the structure and restoring the function of the TM also has implications for resetting an important physiologic mechanism for counteracting IOP fluctuations and elevations.

Research dating to the 1960s suggests that the TM is not a passive filter, but instead it is active in regulating pressure dynamics.[2] In cases of glaucomatous eyes, a build-up of extracellular matrix proteins and banded fibrillar elements in the TM compromise its filtering capacity, thereby leading to pathologic changes that contribute to increased outflow resistance.[3,4] Endothelial cells of the TM help to regulate levels of hyaluronic acid (HA),[5] which in turn activates matrix metalloproteinases 2 and 9 to clear the deposition of extracellular matrix in the TM.[6] Furthermore, in the absence of HA, its receptor, CD44, is converted to sCD44, which is cytotoxic to TM cells.[7] Interestingly, HA levels are reduced in eyes with POAG compared to healthy controls.[8] A reduction in the number of functioning TM endothelial cells compromises the ability to regulate HA levels, and thus IOP.[9-11] Following procedures in which the TM is stripped, low levels of HA are a risk factor for postoperative inflammation with angle scarring.[12]

Taken together, this evidence suggests a strong rationale for preserving the TM whenever possible to maintain its role in responding to IOP changes. There is an additional reason to favor interventions that preserve the TM, especially early in the disease course: Surgeries that avoid removing the TM leave future options open, which may be particularly consequential for younger patients for whom future surgeries may be required.

MATCHING PATIENTS WITH A MIGS DEVICE OR PROCEDURE

Selecting the right MIGS procedure or device for any given patient depends on a wide range of factors, including glaucoma stage, mechanism of the disease, the anatomy, degree of IOP control relative to the number of medications used, and even the patient's insurance. That said, if the goal of the intervention is to preserve the tissue of the TM and restore its capacity to function in physiologic aqueous dynamics, *ab interno* canaloplasty with iTrack (Nova Eye Medical) may be a consideration. During the iTrack procedure, 360° microcatheterization of the SC with the iTrack canaloplasty microcatheter mechanically breaks and removes adhesions within the canal. Next, a process of pressurized viscodilation dilates the SC to 2 to 3 times its size, as well as pushes herniations out of the collector channel ostia to reduce outflow resistance and mechanically remove debris from the TM tissue. As well, injection of synthetic HA via the delivery of an ophthalmic viscosurgical device during viscodilation has been postulated to improve the balance of HA levels within the TM.

We know at present that we do not have the diagnostic capacity to pinpoint the exact points of outflow resistance. We can postulate that the resistance likely resides over the entire outflow pathway. However, as the iTrack procedure addresses the TM, SC, and the collector channels, it treats all potential points of outflow resistance in both the proximal and distal portions of the outflow pathway. This is in contrast to stent-based MIGS such as microtrabecular bypass stents, which are focal in their approach and only address a portion of the conventional outflow pathway.

"RESTORING THE STRUCTURE AND FUNCTION OF THE TM ALSO HELPS RESET A PHYSIOLOGIC MECHANISM FOR COUNTERACTING IOP INCREASES AND FLUCTUATIONS."

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THE 'IDEAL' PATIENT FOR TISSUE-SPARING MIGS OPTIONS

There are inevitably some patients in whom TM stripping may be necessary. In eyes with moderate to moderate-advanced disease that is not well controlled on three or more medications, for example, it is likely that there is significant blockage within the proximal portion of the conventional outflow pathway and thus a procedure such as *ab interno* trabeculotomy is a highly effective approach. In some cases, it may be advantageous to combine a 180° or 360° *ab interno* trabeculotomy with *ab interno* canaloplasty to add an additional mechanism for maximizing outflow capacity. Others have reported implanting a Hydrus Microstent (Ivantis) after an iTrack procedure, which would seem to have the advantage of treating the outflow pathway over 360°, and then placing a scaffold-type implant in the canal to mechanically expand the area.

Moreover, because the iTrack procedure leaves the anatomy in place to reestablish natural aqueous flow dynamics with minimal damage to the corneal endothelium (D.M. Lubeck, MD, and R.J. Noecker, MD, unpublished data, 2021; presented at ASCRS 2021), it is a great standalone option for a wide range of patients and may be particularly suitable for early stage disease. In addition to restoring natural outflow capacity, reducing damage to the TM leaves future treatments available, makes iTrack potentially repeatable if necessary, and extends the life of the natural drainage system for as long as possible before more aggressive manipulation is needed, either via the removal of tissue or via a subconjunctival MIGS.

CONCLUSIONS

The wide array of MIGS devices and surgeries provides clinicians a broad armamentarium of options for individualizing treatment choices. In early stage disease, there may be distinct advantages to preserving the TM whenever plausible. Glaucoma is a chronic, progressive disease that has no cure, and so minimizing tissue damage enables future treatment options. As well, restoring the structure and function of the TM also helps reset a physiologic mechanism for counteracting IOP increases and fluctuations. In the case of iTrack *ab interno* canaloplasty, the ability to re-establish natural aqueous flow and reduce IOP and medication burden, without damaging or removing tissue and without the need for an implant, supports its role in the MIGS treatment armamentarium. ■

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