This smallest of gauges requires good habits and precision surgery

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Recent advances in microincisional vitrectomy surgery include the introduction of 27-gauge vitrectomy platforms. There are many advantages to this small gauge instrumentation (the smallest to date): the ability to create consistently self-sealing sclerotomies, the reduction of the number of episodes of postoperative hypotony, the maneuverability of the small instruments into the narrowest surgical planes, the ability to use the 27-gauge vitreous cutter as a multipurpose instrument, and the exertion of the smallest sphere of influence to minimize vitreous traction on the retina.

There is no sunshine without rain, however. Among the drawbacks of 27-gauge instrumentation are limited availability of instrumentation, instrument flexibility with associated potential difficulties working anteriorly, and relative inefficiencies in removing vitreous due to reduced flow through the small diameter of the vitreous cutter.

However, these drawbacks can be overcome by employing techniques that emphasize precision and careful handling of the eye. We believe that, in learning techniques that allow them to conquer 27-gauge cases, fellows are forced to become better surgeons.

PRECISE AND PURPOSEFUL MOVEMENT

A significant change in 27-gauge vitrectomy, compared with larger-gauge systems, stems from the altered fluidic dynamics in the eye. The flow through the vitreous cutter depends significantly on the internal diameter of the instrument, as defined by Poiseuille’s law (flow is proportional to the radius to the fourth power). As such, flow through the 27-gauge lumen (diameter 0.41 mm) is reduced compared with that through 23-gauge (0.75 mm) and 25-gauge (0.50 mm) lumen, resulting in relatively inefficient removal of vitreous gel.

To our benefit, however, this means that the sphere of influence of the vitreous cutter (the regional distance of tissue that is attracted to the port of the cutter) is also reduced. This has the advantage of reducing traction on the retinal surface, thereby lowering risk for iatrogenic retinal breaks and allowing us to work closer to the retinal surface. This introduces opportunities to shave the vitreous base more completely and to cut close to the retinal surface within surgical planes in complex cases.

We believe that the small sphere of influence of the 27-gauge cutter represents an excellent opportunity to...
improve surgical skills. We can overcome the inefficiency of flow by optimizing machine settings and by precisely and purposefully moving the vitreous cutter so that it is constantly immersed within—or, even better, right at the edge of—the vitreous gel. This is also important in larger gauges, but, with 27-gauge, the need for purposeful cutter movements is accentuated (Figure 1).

In 27-gauge surgery, the gel does not come to you; you must go to the gel. Otherwise, you are just cutting irrigation fluid (or performing “BSS-ectomy” as Demetrios G. Vavvas, MD, PhD, of Massachusetts Eye and Ear likes to say). Once this skill is mastered, vitreous gel can be efficiently removed, regardless of the gauge (Figure 1).

**WITHOUT THE EYE KNOWING YOU ARE THERE**

Even though the rigidity of small-gauge instruments has improved since the introduction of smaller gauges,\(^1\) 27-gauge instrumentation is substantially more flexible than the latest 25- and 23-gauge instruments.\(^8\) It is more similar to the flexibility of 25-gauge instruments when they were first released. With this decreased rigidity, instruments may bend when pressure is applied on the cannula.

We can overcome this by operating in the eye without it knowing that we are working on it. By this, we mean keeping the eye in primary position, navigating within the eye without moving the globe, sliding in and out of the cannulas smoothly, and only gently rotating the eye with minimal force. It also helps to place the superior cannulas close to 3 o’clock and 9 o’clock if the facial anatomy allows.

**Keep the eye in primary position.**

Inadvertent movement of the eye away from the preferred primary position is a common habit among learning vitreoretinal surgeons because visualization is the most difficult of the initial learning steps for retina fellows. Using the flexible 27-gauge instrumentation, we are forced to keep the eye in primary surgical position to prevent instrument bending, and this may be a desirable side effect of operating with 27-gauge.

**Move the eye gently with both hands.**

Varying degrees of eye rotation are, however, necessary during vitrectomy. For every case, removal of the far peripheral vitreous requires moving out of the primary position and shifting the microscope when using non-contact viewing systems. Other maneuvers that require eye rotation include, for example, rotating the eye nasally during fluid-air exchange to avoid multiple bubbles, and when perfluorocarbon liquids are used in surgery for giant retinal tears.

With stiffer instruments, surgeons can easily move the eye by applying more force with one hand. With 27-gauge, however, that will cause bending of the instruments and result in less controlled eye movements. Instead, the surgeon should use both hands to synchronously rotate the eye to its desired position, with equal force between the hands. The least amount of force required should be used. These precautions prevent instrument bending, and the surgeon decreases the strain on the sclerotomies (which may result in better sealing at the end of surgery) and the cornea (corneal edema can develop from torqueing or distorting the eye).

**Use the cannulas as fulcrums.**

Keeping the eye in primary position and pivoting the instruments using the cannulas as fulcrum points is key (Figure 2). This requires careful attention to the locations of the cannulas. Use purposeful hand movements to slide in and out of the cannulas without applying pressure on the cannulas, and pivot at the cannulas rather than above them. These are trademarks of elegant retinal surgeons. These habits are desirable with any gauge vitrectomy platform, but the flexibility of 27-gauge instruments accentuates the value of these good surgical habits.

**PEEL LIKE A PRO: NO WASTED MOVEMENTS**

Peeling epiretinal membranes (ERMs) and internal limiting membranes (ILMs) can be relatively challenging with the smaller features of 27-gauge forceps, especially ILM forceps. ERM shreds more easily and ILM fractures more frequently when grasped by the small platforms of these instruments (Figure 3).
Is it worth using 27-gauge, then? One of the authors, Dr. Yonekawa, uses 27-gauge ILM forceps for almost all macular cases now, both because of the surgical benefits mentioned above and also because this teaches fellows how to carefully plan each maneuver on the macula without wasted movements.

Knowing where and how to hold the tissues, and being able to visualize the vector forces at work, allows successful peeling with 27-gauge forceps for the vast majority of macular peels. For example, holding a membrane at the middle of an edge, pulling 90° away with equal force on both sides, and keeping the forceps close to the retinal surface usually allows creation of a nice sheet. When tension develops at one corner due to a stronger focal adhesion, however, it is time to lift an edge from that corner to prevent fracturing.

The direction of the ILM forceps is also key. You want to maximize purchase by using the forceps parallel to the edge. For example, if there is a vertical edge, you should rotate the forceps vertically to utilize the entire platform. The small tips of the 27-gauge forceps will also allow you to move easily “scoop” one tooth under an ILM/ERM edge.

The diameter of the cone of light from the light pipe is also smaller with 27-gauge, and we believe this makes you realize sooner if the light pipe is too close, and it forces you to hold the light in the midvitreous, where it will create a wider cone of light and prevent phototoxicity.

These are all basic ideas, but the 27-gauge instrumentation forces the surgeon to adhere to basic principles to ensure surgical success.

Figure 3. Successful peeling by visualizing the vectors. ERM can easily shred and ILM can frequently fracture if peeling occurs without consideration of where and how the membranes are held by the 27-gauge forceps.

PERFECTING THE CRAFT OF OUR TRADE

Use of 27-gauge vitrectomy platforms may be appealing to vitreoretinal surgeons who are constantly trying to perfect their surgical skills—and that is a universally shared desire among all retina fellows. Every move of the surgeon’s hands counts, and each move must be purposeful and precise. Those who master 27-gauge instrumentation and overcome the inherent disadvantages of increased flexibility and decreased sphere of influence may potentially become more skilled, elegant, and safer surgeons—whether using 27-, 25-, 23-, or 20-gauge instruments. For vitreoretinal surgery fellows, 27-gauge platforms present the opportunity to learn things the right way from the start.

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27-Gauge Instrumentation: Advantages to Going Smaller
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