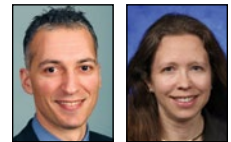


27-Gauge Vitrectomy Surgery: Smaller is Better

BY SHLOMIT SCHAAL, MD, PhD; AHMET OZKOK, MD; AND BROOKE NESMITH, MD, JD

In this issue of Retina Today, Shlomit Schaal, MD, PhD; Ahmet Ozkok, MD; and Brooke Nesmith, MD, JD, discuss pearls for performing 27-gauge vitrectomy.

We extend an invitation to readers to submit pearls for publication in Retina Today. Please send submissions for consideration to Dean Elliott, MD (dean_elliott@meei.harvard.edu); or Ingrid U. Scott, MD, MPH (iscott@hmc.psu.edu). We look forward to hearing from you.



— Dean Elliott, MD; and Ingrid U. Scott, MD, MPH

Since its introduction in 1971, 3-port 20-gauge vitrectomy has been the gold standard for pars plana procedures.¹ Drawbacks of the 20-gauge vitrectomy system, such as the need for conjunctival dissection and exploration, suturing of sclerotomies, and sclerotomy healing times, have led to the widespread use of small-gauge vitrectomy.

In 2002, Fujii et al introduced a 25-gauge sutureless vitrectomy system.² The 25-gauge vitrectomy creates a smaller, self-sealing incision 0.55 mm in diameter, almost half the size of the 1.15 mm incision created during 20-gauge vitrectomy. Twenty-five-gauge vitrectomy is indicated chiefly for procedures not requiring extensive vitreous dissection, such as vitrectomy for simple vitreous hemorrhage or epiretinal membrane peeling. However, limitations of 25-gauge vitrectomy included high flexibility and increased fragility of instruments, as well as the relative difficulty of performing complicated surgical maneuvers.

As an alternative, Eckardt introduced a 23-gauge vitrectomy system in 2005, with an incision size of

0.72 mm in diameter.³ The larger relative diameter of 23-gauge instrumentation permitted higher illumination and flow rates with 23-gauge instruments compared with 25-gauge instruments. The 23-gauge system was initially used for less complex cases, such as simple vitreous hemorrhages, macular holes, or macular puckers.

In 2010, Oshima et al introduced 27-gauge vitrectomy with an incision size of 0.40 mm.⁴ Oshima et al questioned whether the insertion technique used in 23- or 25-gauge vitrectomy (ie, 2-step entry or angled insertion) is appropriate in certain cases, specifically in patients with thin sclera, which is common in young patients and patients with myopia. The 1-step, nonbeveled insertion technique used in 27-gauge vitrectomy resolved this problem.

Wound leakage, tool fragility, and unavailability of corresponding instrumentation were early concerns in small-gauge vitrectomy. Refinements in insertion technique and trocar-cannula systems and the availability of a stiffer and wider range of corresponding instruments have largely eliminated these concerns. In a systematic review with

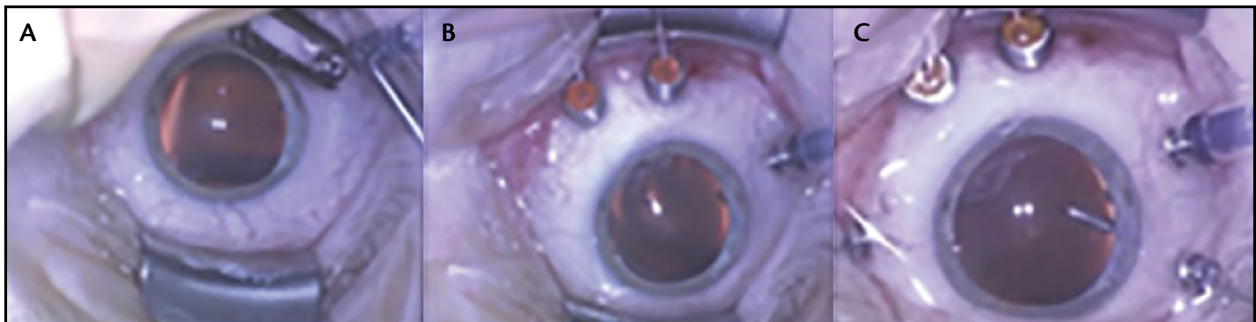


Figure 1. A 27-gauge vitrectomy using the Synergetics system. A 27-gauge infusion line is connected to the inferotemporal cannula (A) and a 29/30-gauge dual-chandelier fiber system is used to augment the view (B). Finally, 27-gauge vitrectomy is performed (C).

Bayesian meta-analysis of 21 studies comprising 148 643 cases, Govetto et al reported no significant increase in endophthalmitis in patients who underwent small-gauge vitrectomy compared with patients who underwent 20-gauge vitrectomy.⁵ The authors also reported a better safety profile with beveled sclerotomies than with straight sclerotomies.

The percentage of vitreoretinal surgeons who prefer to use small-gauge vitrectomy continues to increase. According to the 2013 Preferences and Trends Survey conducted by the American Society of Retina Specialists, small-gauge vitrectomy systems (either 23- or 25-gauge) were the vitrectomy systems most often utilized by over 90% of the participants.⁶ Twenty-gauge vitrectomy was most often used by 3.7% to 7.2% of participants, and 5.9% to 11.3% of participants had tried 27-gauge vitrectomy. The low proportion of 27-gauge vitrectomy users is unsurprising given the technology's relatively recent introduction.

TECHNIQUE

Twenty-seven-gauge cannulas are placed using a 1-step nonbeveled technique with a trocar-cannula system. The conjunctiva is displaced anteriorly from the intended sclerotomy site with forceps. A trocar is inserted at an angle of approximately 90° to the sclera, facing directly toward the vitreous cavity, parallel to the limbus (Figure 1). The angle is kept perpendicular to the surface as the cannula is inserted into the eye and a scleral tunnel incision is made. The cannula is held in place with forceps and the trocar is removed. The first sclerotomy is made in the inferotemporal region, and a 27-gauge infusion cannula is attached. Its position inside the vitreous cavity is verified using a 27-gauge light pipe. After the infusion line is opened, cannulas are placed in the superotemporal and superonasal regions. The reduced internal diameter of the 27-gauge system results in a decreased flow rate, as illustrated by Poiseuille's law, which states that flow through a tube is directly proportional to the product of the pressure of the liquid and the fourth power of the radius and is inversely proportional to the product of the viscosity and tube length. The reduction in flow can be overcome using higher aspiration rates and higher infusion rates. If using the DORC system, the surgeon can choose to replace the infusion line with a high-flow cannula (Figure 2).

Poiseuille's Law:

$$\text{Flow Rate} = \Delta P \times r^4 / v \times l$$

Because of the smaller gauge, diminished endoillumination is a concern. Using bright light sources (xenon or mercury vapor bulbs) resolves this issue. Both DORC and

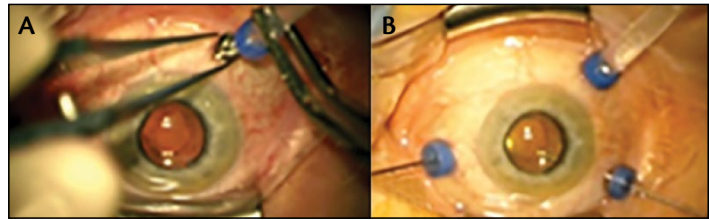


Figure 2. A 27-gauge vitrectomy using the DORC system. A 27-gauge high infusion line is connected to the inferotemporal cannula to assist fluidics (A), and 27-gauge vitrectomy is performed (B). Light pipe is connected to DORC Bright Star illumination, which provides a clear and bright view.

The underlying rationale for performing 27-gauge vitrectomy is that smaller is better.

Synergetics supply 27-gauge endoilluminators. Twenty-seven-gauge light pipes with different illumination patterns, such as midfield and focal, are also available.

DISCUSSION

The underlying rationale for performing 27-gauge vitrectomy is that smaller is better. Scleral incision sizes for 20-, 23-, 25-, and 27-gauge vitrectomy systems are 0.9 mm, 0.6 mm, 0.5 mm, and 0.4 mm, respectively. Thus, 27-gauge incisions are 20% smaller than 25-gauge incisions.

Wound construction is simplified with the 27-gauge system, with a simple 1-step incision vs the angled-incision technique or 2-step entry method commonly used with 23- and 25-gauge instrumentation. This difference gives 27-gauge surgery an advantage over 23- and 25-gauge surgery because there is a greater likelihood that the wound will self-seal quickly, because of both smaller wound diameter and simpler, neater wound architecture, reducing the risk for vitreous prolapse, and permitting faster wound healing.

In addition, the microarchitecture design of the 27-gauge vitrectomy system is different from the 25-gauge vitrectomy system. Compared with the 25-gauge vitrectomy port, the 27-gauge vitrectomy port is larger (0.079 mm² vs 0.066 mm²) and closer to the cutter tip (0.211 mm vs 0.330 mm).⁴ These features aid the surgeon in performing complex maneuvers such as vitrectomy-assisted membrane segmentation and delamination. To address the concern of increased flexibility with 27-gauge instrumentation, Oshima et al shortened the shaft length of the 27-gauge vitreous cutter from 32 mm

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to 25 mm, resulting in comparable stiffness to the 25-gauge vitrectomy system.⁴

Furthermore, due to the smaller wound sizes, 27-gauge vitrectomy may be associated with less inflammation and less postoperative pain compared with 25-gauge vitrectomy. Although indications for 27-gauge vitrectomy are expanding, there are no definite criteria regarding proper case selection, and each vitreoretinal surgeon should develop his or her own preferences according to personal experience and expertise. It is becoming evident, however, that more procedures can be performed safely and efficiently using 27-gauge vitrectomy techniques. These latest advances in technology have transformed our capabilities and improved our methods for performing vitrectomies. ■

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