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27-Gauge Vitrectomy

The Future of Posterior Segment Surgery?

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• Small gauge vitrectomy

Key points

- 27-Gauge vitrectomy instrumentation offers smaller wound construction, increasing the probability of sutureless closure, as well as decreased postoperative trauma and inflammation.
- Small-caliber approaches still pose engineering challenges relating to reduced flow rates and instrument capabilities.
- Given the continuing trend in posterior segment surgery toward smaller-caliber instruments, it is prudent to understand the current capabilities of the 27-gauge system and to determine whether the transition to 27-gauge surgery represents a natural, inevitable evolution of ongoing advances in surgical technology.

INTRODUCTION

The road to minimally invasive vitreous surgery

Contemporary small-gauge vitrectomy, also known as minimally invasive vitreous surgery (MIVS), reflects decades of innovation by ophthalmic surgeons who continuously improved on milestone advances in surgical instrumentation and technique. Robert Machemer and colleagues [1] first developed closed globe pars plana vitrectomy in the 1970s, which required passing a vitreous

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infusion suction cutter through a 17-gauge sclerotomy port. The initial cut rate was a mere 60 cuts per minute (cpm). It was not long, however, before other surgeons began improving on Machemer's system. Twenty-gauge surgery developed a few years later, and in 1996, Chen [2] described for the first time a transconjunctival approach that allowed for sutureless, self-sealing sclerotomies that shortened surgical time and decreased traumatic injury. Then, Fujii and colleagues [3] introduced a complete 25-gauge sutureless vitrectomy system in 2002 that better facilitated instrument exchange using microtrocar cannulas. Although the infusion and aspiration rates of the 25-gauge instruments could not match those of the 20-gauge vitrectomy system, the mean operative time decreased by 9 minutes. 25-Gauge also had the further advantage over 20-gauge of hastening postoperative recovery, thanks to decreased overall surgical time and postoperative inflammation [4].

Despite these advantages, however, 25-gauge was not without its critics. In particular, some surgeons objected to the excessive flexibility of the instruments that precluded performing more complicated tasks in the peripheral retina. In 2005, Eckhardt [5] introduced 23-gauge instrumentation that provided increased instrument stiffness and stability along with the potential for sutureless incisions. Unfortunately, multiple reports of increased postoperative hypotony rates with 23-gauge and 25-gauge systems compared with 20-gauge were published, effectively questioning whether these incisions were truly "sutureless" [6].

Further advances in 23-gauge and 25-gauge vitrectomy instrumentation allowed for the development of higher flow rates, faster vitrectomy cutter speeds, and improved duty cycles. In addition, because 23-gauge and 25-gauge instruments featured longer probes, with the cutting mouth positioned more toward the tip of the vitrector, it became easier for surgeons to use the vitrector directly to dissect the membrane, using high cutting speed and low suction [7]. Surgeons also turned their attention to achieving actual sutureless wound construction of the pars plana through using multiplanar incisions and single-step trocar insertion techniques, and displacing the external conjunctival wound from the internal sclerotomy to promote self-sealing [8]. With sutureless sclerotomies, the risk of corneal topographic changes and associated astigmatism also is reduced [7]. These advances paved the road for 27-gauge vitrectomy, which is the smallest vitrectomy system commercially available today.

Twenty-seven gauge vitrectomy

Oshima and colleagues [9] in 2010 described 31 surgical cases involving the posterior segment, including macular holes, diabetic vitreous hemorrhages, tractional retinal detachments, epiretinal membranes (ERMs), and vitreous opacifications that were operated on with 27-gauge instrumentation. Not only was anatomic success achieved in all cases without the need for sclerotomy enlargement, but no cases of hypotony were reported. The mean case time was 34 minutes. The smaller diameter of the instruments resulted in reduced infusion and aspiration rates compared with 25-gauge, however the