Microincision vitrectomy surgery (MIVS) is one of the most significant innovations in vitreous surgery since the modern vitrectomy was developed by Robert Machemer, MD, in the early 1970s. MIVS is defined as a combination of 25- or 23-gauge instrumentation and a transconjunctival sutureless procedure. The indication of MIVS was limited in macular surgery for several years after its introduction because of several disadvantages, including flexible instruments, lower aspiration rate, and dim illumination. The stiffness of instruments, cutting rates, and aspiration rates have been improved and the introduction of brighter light sources, such as xenon lamps, has improved illumination. As a result of these improvements, the indications for MIVS have expanded to include complicated cases with proliferative diabetic retinopathy.

Improvements to instrumentation and illumination have also influenced surgical techniques. For example, xenon and chandelier illumination allows the surgeon to perform true bimanual techniques. A small-gauge vitreous cutter on which the port is positioned closer to the tip allows for membrane delamination.

As most surgical techniques vary from region to region, so does utilization and operating style with MIVS. For this installment of Global Perspectives, I have asked Yusuke Oshima, MD, PhD, who is one of the opinion leaders in small gauge vitrectomy in Japan, to introduce the current status of MIVS in Japan.

-Masahito Ohji, MD

Microincision vitrectomy surgery (MIVS) with 25- or 23-gauge instrumentation is undoubtedly one of the most impressive evolutions in the surgical retina field of the past decade. Similar to the trend toward minimally invasive intervention in phacoemulsification for cataract surgery, smaller incisions in vitrectomy without peritomy and suturing have the potential to facilitate early visual recovery, diminish ocular surface irregularities, and decrease patient discomfort, operating time, postoperative inflammation, and surgically-induced astigmatism. Therefore, MIVS is also known as “minimally-invasive” vitrectomy surgery. In contrast to the above-described benefits of MIVS, however, wound-sealing–related complications, such as hypotony, choroidal detachment, and a higher incidence of endophthalmitis, are major concerns of small-gauge vitreous surgery. Are MIVS techniques really simple and minimally invasive? Are the rates of complications with MIVS similar across the globe? How can we prevent and manage MIVS-specific problems?

Transconjunctival MIVS with 25-gauge instrumentation was first introduced in Japan in 2003. Along with recent development of rigid instrumentation and a bright light source, Japanese retinal specialists have increased their use of MIVS procedures, either with 25- or 23-gauge systems, and are currently among the most frequent users of MIVS in the world. Surgeries in Japan

Figure 1. Current distribution of MIVS in Japan. More than 50% of retina specialists use 23- or 25-gauge MIVS system for routine vitrectomies; 28% of surgeons prefer to use 23-gauge instrumentation, 18.5% of surgeons prefer 25-gauge instrumentation, and the rest (3.5%) choose 23- or 25-gauge depending on retinal pathologies.
TREND AND PREFERENCE IN MIVS IN JAPAN

According to the preliminary 2008 members’ survey from the Japan MIVS study group, more than 50% of retina specialists have experience with a 23- or 25-gauge MIVS system for routine vitrectomy. Of those surgeons, 56% prefer to use 23-gauge instrumentation, 37% of surgeons prefer 25-gauge instrumentation, and the remainder (7%) report that their preference depends upon the retinal pathology being addressed (Figure 1). Most surgeons recognize that the smaller 25-gauge wound is more likely to be self sealing, not requiring the sutures that are sometimes necessary with 23-gauge surgery, especially in patients after extensive peripheral vitreous shaving or thin sclera in myopic eyes. The similar rigidity and surgical performance of 23-gauge and 20-gauge instruments, however, may be the reason why more 20-gauge users have shifted to 23 gauge rather than 25 gauge. Because of the larger incision size, most of the 23-gauge users in Japan prefer to perform two-step entry by use of a MVR for advance incision rather than one-step oblique incision to facilitate complete self-sealing wounds.2 The flow rate in 23-gauge system is a little bit lower but almost similar to that of 20-gauge system. Therefore, when using a trocar-cannula system without closure valve, the intraocular irrigation fluid will burst out through the cannula during the instrument exchanges. This may cause a turbulent infusing current to the retina and collapse of the eyeball during surgery. Many Japanese 23-gauge users have come to use a closure valve equipped trocar-cannula system (Figure 2; DORC, Zuidland, the Netherlands) to prevent intraocular turbulence and keep gentler inflow and outflow during surgery. An endoscope is another device sometimes used, especially in cases with dense corneal opacities. A 23-gauge endoscope (FiberTech Co., Ltd., Tokyo, Japan) has recently been developed and will soon be commercially available. An endoscope is also useful to investigate inner wound structure and vitreous incarceration to the entry site during surgery (Figure 3).

The transconjunctival 25-gauge system is another well-employed MIVS system. Although reduced illumination and cutting efficiency were concerns with 25-gauge early on, brighter light sources, such as xenon (Accurus High Brightness Illuminator, Alcon Laboratories Inc., Fort Worth, TX; Photon, Synergetics, Inc., St. Charles, MO; BrightStar, DORC, Zuidland, the Netherlands), mercury vapor (Photon II, Synergetics Inc., St. Charles, MO), and chandelier illuminating sys-
tems have addressed these concerns. The 25-gauge vitreous cutter on the Accurus (Alcon Laboratories, Inc.) is highly efficient and is capable of 2,500 cpm. The high duty cycles and a port closer to the tip of the cutter have allowed surgeons to use 25-gauge for more challenging cases such as diabetic tractional retinal detachment. During diabetic vitrectomy, a smaller gauge vitreous cutter can function as a cutter, aspirator, forceps-spatula-scissors for peeling and separating, and/or as an instrument for removal of fibrovascular membrane. The multifunctionality of the 25-gauge cutter for these cases allows for greater efficiency by reducing the need for instrument exchange.

Recent improvements to create stiffer instruments via shortening the shaft length and increased availability of accessories, such as diamond-dusted membrane scraper and directional laser probes, will further expand the surgical indications of 25-gauge MIVS in Japan.

SURGICAL INDICATIONS, PROCEDURES, AND IMPACT ON QUALITY OF VISION

Current indications for MIVS in Japan are listed in a Table 1. Although the standard indication of MIVS for beginners remains limited to macular diseases, more challenging cases, such as rhegmatogenous retinal detachment, proliferative diabetic retinopathy, dislocated lens fragments or intraocular lens (IOL) dislocation, and selected cases of proliferative vitreous retinopathy, are being treated with 23- or 25-gauge MIVS by more experienced users. The combination of a powerful light source with chandelier illumination and a wide-angle viewing system will make it easier to perform MIVS in cases requiring complex intraocular manipulation at the peripheral region. Improved lighting and visualization will also enable us to perform bimanual surgery with even smaller gauge instruments and to apply current MIVS technology to more challenging pathologies.

Cataract progression, a major postoperative complication of vitrectomy, has a high incidence of presentation (80%), even with MIVS. Phacovitrectomy with simultaneous IOL implantation is one of the options to deal with this bothersome complication and has been frequently performed for elderly patients in Japan. To enhance the advantage of conjunctiva-preserved vitrectomy, retina surgeons have also come to perform phacoemulsification and aspiration through a clear corneal wound (Figure 4). Foldable acrylic IOL insertion through a 2.2-3.0 mm clear corneal incision is well compatible to MIVS, either with 23- or 25-gauge system. An IOL fixated in the capsular bag keeps up the integrity of anterior chamber postoperatively, even with gas tamponade (Figure 5).

Several studies have shown MIVS has a significant impact on the speed of postoperative visual recovery.
Several studies have shown MIVS has a significant impact on the speed of postoperative visual recovery in a variety of vitreoretinal diseases.

PREVENTION AND MANAGEMENT OF MIVS-RELATED COMPLICATIONS

With increasing use of small incision surgery, the MIVS-specific intra- and postoperative complications, such as suprachoroidal infusion and breakage of surgical instruments during surgery, postoperative hypotony, choroidal detachment, and bacterial endophthalmitis, have been well recognized. To prevent suprachoroidal infusion, which may more easily occur in a 23-gauge system than in a 25-gauge system, we prefer to use an infusion line with a longer tip because it is able to pass through the closure valve-featured 23-gauge cannula and capable of directly locking to the 25-gauge cannula. To facilitate self-sealing efficiency, we use the two-step cannula entry with 23-gauge and a one-step oblique insertion with 25-gauge. Regardless of the wound entry technique, transconjunctival suture placement to the sclerotomies can be performed at any time if wound leakage is encountered.

Bacterial endophthalmitis is a critical concern with MIVS. A higher incidence of bacterial endophthalmitis related to MIVS has recently been reported in the United States. In contrast to their results, the incidence of postoperative endophthalmitis in MIVS (0.028%) in Japan is almost equal to that in conventional 20-gauge system (0.030%). In addition to the above-described techniques to improve wound structure to prevent postoperative hypotony, thorough preoperative preparation is important. We use topical antibiotics 3 days before surgery, 1.25% povidone-iodine immediately before surgery, and we irrigate the conjunctiva with diluted povidone-iodine solution or saline solution to wash out flora on the ocular surface and the conjunctiva sac throughout the vitrectomy.

After surgery, we are careful to confirm wound sealing, with or without sutures. We administer antibiotic drops postoperatively and apply ointment with an eye patch. These steps may contribute to the reduction of bacterial contamination due to the flora on the ocular surface during surgery, thus leading to the lower incidence of MIVS-induced bacterial endophthalmitis in Japan.

PERSPECTIVE ON FUTURE MIVS

Although transconjunctival MIVS using 25- or 23-gauge instrumentation has been adopted by many users over the past several years, complex techniques to facilitate self-closing wounds and sensitive wound adaptation care are still required to prevent unexpected MIVS-associated complications. Further refinement of small-gauge instruments and surgical techniques are expected to eventually resolve these wound-sealing-related problems in 25- or 23-gauge surgery.

Additionally, 27-gauge instrumentation for vitrectomy has been demonstrated as feasible for macular surgery and for some other selected cases. The use of 27-gauge instrumentation has the potential to resolve wound-sealing issues. We have experience using a
27-gauge needle for postoperative management. For example, we have used 27-gauge for transconjunctival fluid-fluid exchange or fluid-air exchange with no wound-related complications. A 27-gauge chandelier fiber, a vitreous cutter, a membrane spatula, laser probes and various types of microforceps have now been developed for a 27-gauge system. More 27-gauge instruments are being developed for more complicated procedures. Thus, customized vitrectomy with a variation of 23-, 25- or 27-gauge system will be available to surgeons in the future.

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