Advanced Technology Expands the Role of Microincisional Vitrectomy Surgery

By Manish Nagpal, MS, DO, FRCS(UK)

There are several components to successful vitreoretinal surgery, and of course, surgeon skill is at the top of that list. Having the best surgical tools and technology, however, enhances any surgical technique, and the newer generation of vitrectomy equipment has raised the bar for surgical outcomes. I use the CONSTELLATION® Vision System (Alcon Laboratories, Inc.) with microincisional instrumentation for my vitreoretinal procedures and have experience with some of the latest technological advances with this system.

ULTRA HIGH-SPEED CUTTING RATES

Ultra high-speed cut rates (5000 and 7500 cpm) create smaller bites and reduced resistance to flow which results in less pulsatile traction on the retina.[1,2] This reduced amount of pull on the vitreous can increase safety at any given point in surgery, because the area of influence at the port is localized to a much smaller zone, reducing the risk of inadvertent traction.

The reduced risk of traction with ultra high-speed cut rates is particularly important when operating on a mobile retina, retinal detachment, proliferative vitreoretinopathy, and giant retinal tear, as the high speed reduces the risk of iatrogenic breaks.[3] Having 7500 cpm capability raises the already high benchmark that was previously set by 5000 cpm rates. The 7500 cpm ULTRAVIT® probe provides the benefit of faster cutting and smaller vitreous bites without fluidic compromise.[1,2]

One of the most important features with the CONSTELLATION® Vision System has been its variable duty cycle. With any speed of cutting, the surgeon has the options of core (longer port-open time) and shave modes (shorter port-open time). The duty cycle curves for 7500 cpm have been widened (Figure 1), allowing more flexibility and options to use the probe as a multifunctional tool. Studies have shown the relationship between faster cutting, smaller bites, and less traction,[1,2] and many surgeons prefer to use the probe at the fastest available speed. When I am using 7500 cpm, I complete core vitrectomy at this speed and then switch to

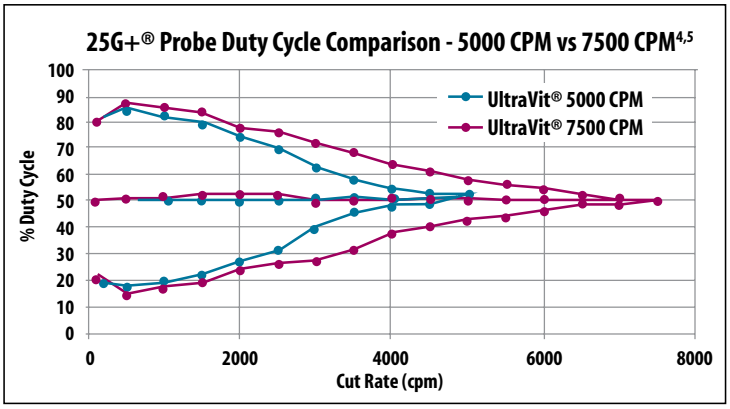

Figure 1. Dual pneumatic drive probe provides efficient cutting up to 7500 cpm and is designed for reduced pulsatile traction without fluidic compromise. The 7500 cpm ULTRAVIT® probes do not compromise flow and maintain efficient vitreous aspiration compared to 5000 cpm probes.

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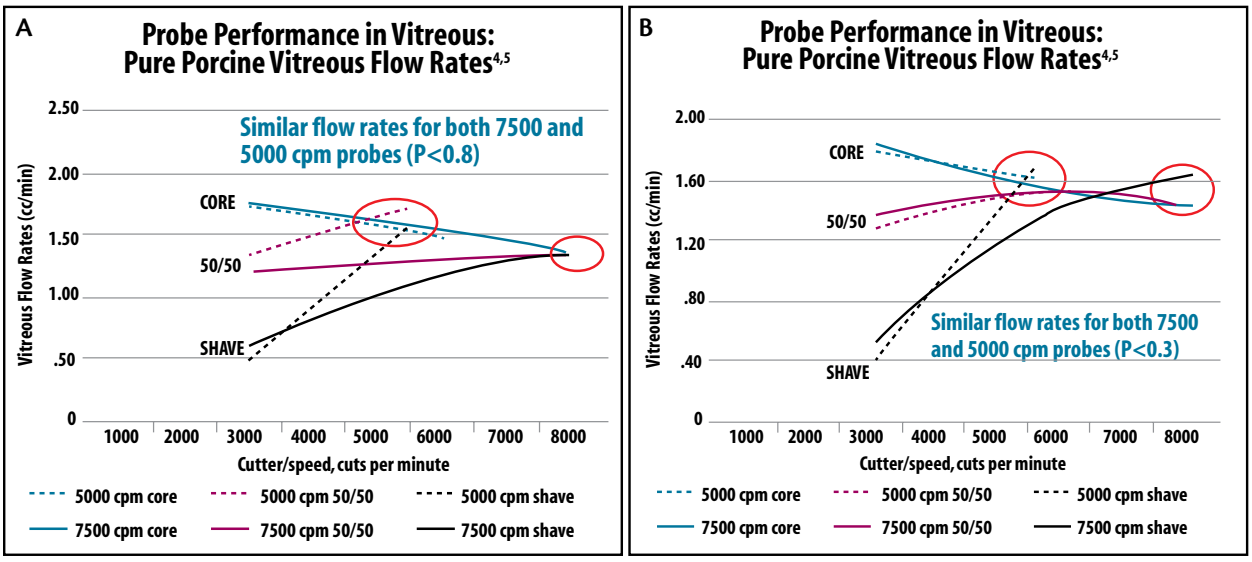

Figure 2. At maximum cut rate, 7500 cpm probes do not compromise flow and maintain efficient vitreous removal. Vitreous flow comparison for 23-gauge probes (A) and 25-gauge probes (B).

shave mode for the rest of peripheral clean up, making the procedure very efficient. The flow rates are basically the same for 5000 and 7500 cpm, so the efficiency of vitreous removal (Figure 2) is not degraded. This capability, I believe, will bring about a paradigm shift in the way that surgeons have interacted with this new technology since its inception.

27-GAUGE TECHNOLOGY

The availability of 27-gauge technology, in my opinion, will have the greatest impact on macula-specific cases, such as macular holes, puckers, cases of vitreomacular traction, and floaterectomies, as these cases could be easily transitioned to 27 gauge. As this technology is more widely adopted, however, the indications will expand based on the behavior of the overall fluid dynamics with this smaller gauge, similar to what we experienced in the transition from 20 gauge to 23- and 25-gauge surgery.

Once a surgeon has been routinely performing 23- and/or 25-gauge surgery, there should not be any specific hurdles to the conversion to 27-gauge surgery because all the parameters are the same apart from the smaller gauge. In my experience, as incisions become smaller, wound integrities become stronger.

Also, there will be a complete 27-gauge portfolio to support many different types of pathologies. (Figure 3).

Figure 3. The 27+ product portfolio.

GRIESHABER® DSP INSTRUMENTATION

I routinely use GRIESHABER® DSP internal limiting membrane (ILM) forceps. Disposable instruments have the obvious advantage of not requiring expensive sterilization that can also result in damage to the delicate surgical tools. They are relatively inexpensive and the overall burden to the staff and faster OR turnover times are more desirable.

The precision and consistency in craftsmanship of disposable instrumentation are the most important characteristics that retina surgeons look for. Vitrectomy involves very fine intraoperative manuevers and surgeons constantly need to make quick decisions to

For Important Safety Information about the Alcon products described in this article, please refer to page 89.

approach different surgical scenarios. Predictability in our surgical instrumentation is critical to improving our procedures. We want to be able to always presume that an instrument will be consistent and present no surprises. Further, our surgical instruments should be precise in their functioning and I believe that the GRIESHABER® DSPs offer all of these qualities.

VALVED CANNULAS

The intraocular pressure (IOP) control feature on the CONSTELLATION® Vision System is designed to provide a constant and instant compensation of infusion fluid at any given point of the surgery. This means that if the surgeon is using higher vacuum, the machine compensates by pushing more fluid in proportion to maintain a con-

Vitrectomy for Giant Retinal Tear Using Ultra High-speed Cutting

By Manish Nagpal, MS, DO, FRCS(UK)

For this case of giant retinal tear, 23-gauge valved cannulas are inserted along with a 25-gauge chandelier light source (Figure 1). The cut rate on the 23-gauge ULTRAVIT® cutter is at 7500 cpm at the core mode of duty cycle, which means that the port open time is longer is useful for clearing up the core vitreous (Figure 2). After clearing the core vitreous, the duty cycle is changed to shave mode, which means that the port open time of the cutter is relatively shorter, allowing the ability to work close to the retina, especially mobile retina. Very low turbulence is noted while using the small-gauge cutter. The chandelier lighting enhances the visualization of the vitreous base and allows the surgeon to indent the periphery and shave the vitreous comfortably (Figure 3). Once the vitreous is removed, perfluorocarbon heavy liquid is injected to invert the flap of the giant retinal tear and flatten the retina. Endolaser is carried out posterior to the edges of the giant retinal tear. After this air-fluid exchange is carried out, the edges of the tear are kept dry by aspirating the fluid. A vent is placed into the valved cannula before injecting silicone oil to avoid inadvertant pressure rise. The residual air seal is gently aspirated under the silicone oil.

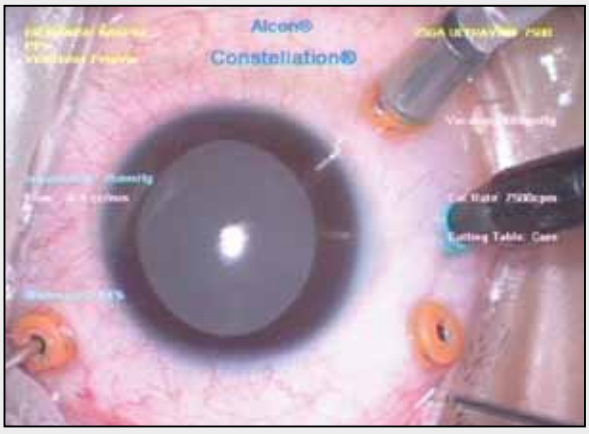

Figure 1. External view of valved cannulas along with chandelier light insertion.

Figure 2. View of the core mode setting in case of a giant retinal tear with chandelier light illumination.

Figure 3. View of the shave mode setting working close to vitreous base with external indentation.

stant IOP during surgery. With non-valved cannulas, the fluid egress is much higher when any instrument comes out of the eye, increasing the IOP compensation proportionately, which may cause some turbulence within the eye. This turbulence may lead to movement of mobile retina and bubbling of perfluorocarbon liquid. Valved cannulas, on the other hand, are designed to offer true closed chamber surgery with accurate preset pressure maintenance in the eye during surgery for both 5000 and 7500 cpm vitrectomy probes.

My insertion technique with the valved cannulas is as follows:

- **Pre-incision:** Prior to making the incisions, I instill povidone-iodine to address any conjunctival flora.
- **Wound construction:** The conjunctiva can be retracted with forceps prior to the creation of a biplanar incision. The valved cannulas remain stable on their own when the trocars are pulled out instead of requiring an additional plate or forceps to hold them, one simply can pull out the trocar without the need for a secondary instrument, saving instrument exchanges.
- Initially, the trocar blade is inserted obliquely into the sclera at an angle of approximately 45° to the sclera up to the tip of the cannula, and the blade is angled perpendicular to the sclera for insertion into the vitreous cavity. The biplanar incision not only holds the cannula in place but also prevents egress of fluid in the postoperative period. I use a biplanar incision for both 23- and 25-gauge procedures, as this type of incision reduces the chance of inadvertent slippage of cannula during instrument withdrawal.
- **Use of vents:** The vents on the valved cannulas are very useful when injecting silicone oil at the end of a case. Because the valved cannulas maintain a closed chamber, air cannot passively escape as the oil is injected, and so to avoid an inadvertent pressure rise, air is allowed to vent during the injection.
- **Cannula removal:** After the vitrectomy, I remove the valved cannulas by holding them with plain forceps. After cannula removal, I massage the wound area with a blunt tip applicator for few seconds so that the stretched scleral fibers regain elasticity, but I have found that by using the new EDGEPLUS® blades, I do not need to massage the wound as long. After the cannulas are removed, I instill a drop of povidone-iodine.
- **End of procedure antibiotic:** At the end of the procedure, I administer subconjunctival antibiotic in the inferonasal quadrant to prevent any accidental entry of antibiotics into vitreous cavity leading to retinal toxicity. The next day, the incision sites are also examined for any leakage.

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SUMMARY

In vitreoretinal surgery, we have the ability to cut tissue at rates that are higher than ever before and operate with the smallest, most reliable equipment, all of which makes for more consistent, and efficient surgery. The patient benefits with small gauge are significant with faster visual recovery and improved patient comfort.[6] As I stated earlier, precision and consistency are the most important factors in surgical instrumentation, and I believe that the CONSTELLATION® Vision System with valved cannulas, ultra high speed cut rates at 7500 cpm, and GRIESHABER® DSP instrumentation delivers these qualities.

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1. Hubschman JP, Gupta A, Bourla DH, Culjat M, Yu F, Schwartz SD. 20-, 23- and 25-gauge vitreous cutters performance and characteristics evaluation. *Retina*. 2008;28(2):249-257.
2. Teixeira A, Chong L, Matsuoka N, et al. An experimental protocol of the model to quantify traction applied to the retina by vitreous cutters. *Invest Ophthalmol Vis Sci*. 2010;51(8):4181-4186.
3. Rizzo S, Genovesi-Ebert F, Belting C. Comparative study between a standard 25-gauge vitrectomy system and a new ultrahigh-speed 25-gauge system with duty cycle control in the treatment of various vitreoretinal diseases. *Retina*. 2011;31(10):2007-2013.
4. Novack R, Zhou J, Abulon D, Buboltz D. Relationship of duty cycle vs. cut rates for two commercially available vitrectomy systems. Poster presented at the American Society of Retina Specialists Annual Meeting; August 2010; Vancouver, BC.
5. Alcon Data on File TP 954-8120-060, Forthcoming manuscript in Dec. 2012.
6. Nagpal M, Wartikar S, Nagpal K. Comparison of clinical outcomes and wound dynamics of 20, 23, and 25 gauge vitrectomy. *Retina*. 2009;29(2):225-231.

For Important Safety Information about the Alcon products described in this article, please refer to page 89.

One Surgeon's Experience With Advanced MIVS Technology

An interview with Professor Young Hee Yoon, MD

Retina Today: What is your preferred gauge for MIVS?

Professor Yoon: I use 25+ for most of my cases. I'm looking forward to trying 27 gauge.

Retina Today: What advice would you offer to a surgeon who is considering transitioning to 27-gauge technology?

Professor Yoon: The most important thing with 27-gauge technology is to practice careful case selection. Start with simpler cases such as ERM, vitreous opacity, and macular hole, less severe vitreous hemorrhage, or vitreous opacity.

Retina Today: What is your trocar entry technique?

Professor Yoon: I insert the 25+ EDGEPLUS® trocars (Alcon Laboratories, Inc.) at as flat an angle as possible.

Retina Today: What are the benefits of faster cutting speeds?

Professor Yoon: Faster cut rates increase surgical safety and reduce the risk of traction, particularly in cases of rhegmatogenous retinal detachment or diabetic traction detachment.

Retina Today: In your opinion, what are the benefits of valved cannulas used in conjunction with IOP control on the CONSTELLATION® Vision System (Alcon Laboratories, Inc.)?

Professor Yoon: The valved cannulas may be helpful to decrease instrument exchanges, because we avoid plugging/unplugging time to increase efficiency. It is a nuisance to plug/unplug the cannulas during surgery, particularly under a BIOM viewing system.

Retina Today: How do GRIESHABER® DSPs (in 23 and 25+ gauge) help support your surgical practice for fine membranes, heavy membranes, and more difficult cases?

Professor Yoon: The GRIESHABER® DSP ILM forceps are good for fine membrane tissue removal, epiretinal membranes (EMRs), macular holes, and myopic foveoschisis. For heavy membranes, I tend to utilize the 25+ vitrectomy probe together with scissors.

The consistent precision craftsmanship of the instruments improve the overall surgical procedure by making it more efficient—I do not have to worry that the instruments on the surgical tray are damaged from sterilization or improper care. DSPs also make it easier for the staff to turn over the surgery room for the next case.

Young Hee Yoon is Professor and Chairman of Ophthalmology at Asan Medical Center in Seoul, Korea. Professor Yoon states that she has served as an advisor to Alcon Laboratories, Inc. Professor Yoon can be reached at yhyoon@amc.seoul.kr.

MIVS Important Safety Information

Caution: Federal law restricts this device to sale by, or on the order of, a physician.
Indications for Use: The CONSTELLATION® Vision System is an ophthalmic microsurgical system that is indicated for both anterior segment (i.e., phacoemulsification and removal of cataracts) and posterior segment (i.e., vitreoretinal) ophthalmic surgery.
The ULTRAVIT® Vitrectomy Probe is indicated for vitreous cutting and aspiration, membrane cutting and aspiration, dissection of tissue and lens removal. The valved entry system is indicated for scleral incision, canulae for posterior instrument access and venting of valved cannulae. The infusion cannula is indicated for posterior segment infusion of liquid or gas.
Warnings and Precautions:
- The infusion cannula is contraindicated for use of oil infusion.
- Attach only Alcon supplied products to console and cassette luer fittings. Improper usage or assembly could result in a potentially hazardous condition for the patient. Mismatch of surgical components and use of settings not specifically adjusted for a particular combination of surgical components may affect system performance and create a patient hazard. Do not connect surgical components to the patient's intravenous connections.
- Each surgical equipment/component combination may require specific surgical setting adjustments. Ensure that appropriate system settings are used with each product combination. Prior to initial use, contact your Alcon sales representative for in-service information.
- Care should be taken when inserting sharp instruments through the valve of the Valved Trocar Cannula. Cutting instrument such as vitreous cutters should not be actuated during insertion or removal to avoid cutting the valve membrane. Use the Valved Cannula Vent to vent fluids or gases as needed during injection of viscous oils or heavy liquids.
- Visually confirm that adequate air and liquid infusion flow occurs prior to attachment of infusion cannula to the eye.
- Ensure proper placement of trocar cannulas to prevent sub-retinal infusion.
- Leaking sclerotomies may lead to post operative hypotony.
- Vitreous traction has been known to create retinal tears and retinal detachments.
- Minimize light intensity and duration of exposure to the retina to reduce the risk of retinal photic injury.

ATTENTION: Please refer to the CONSTELLATION® Vision System Operators Manual for a complete listing of indications, warnings and precautions.

GRIESHABER® DSP Instrumentation Important Safety Information

Indications for Use: GRIESHABER® DSP instruments are a line of single-use vitreoretinal micro-instruments which are used in ophthalmic surgery, for cases either in the anterior or the posterior segment.
Caution: Federal (USA) law restricts this device to sale by, or on the order of, a physician.
Warnings and Precautions:
- Verify correct tip attachment, function and tip actuation before placing it into the eye for surgery.
- For light fiber instruments: Minimize light intensity and duration of exposure to the retina to reduce risk of retinal photic injury. The light fiber instruments are designed for use with an ALCON® Illumination source.
- Potential risk from reuse or reprocessing include reduced cutting or grasping performance and foreign particle introduction into the eye.

Attention: Reference the Directions for Use for a complete listing of indications, warnings, and precautions.

CONSTELLATION® System with PUREPOINT® Important Safety Information

Caution: Federal law restricts this device to sale by, or on the order of, a physician.
Indications for Use: The CONSTELLATION® Vision System is an ophthalmic microsurgical system that is indicated for both anterior segment (i.e., phacoemulsification and removal of cataracts) and posterior segment (i.e., vitreoretinal) ophthalmic surgery.
The ULTRAVIT® Vitrectomy Probe is indicated for vitreous cutting and aspiration, membrane cutting and aspiration, dissection of tissue and lens removal. The valved entry system is indicated for scleral incision, canulae for posterior instrument access and venting of valved cannulae. The infusion cannula is indicated for posterior segment infusion of liquid or gas.
The PUREPOINT® Laser is indicated for use in photocoagulation of both anterior and posterior segments of the eye including:
- Retinal photocoagulation, panretinal photocoagulation and intravitreal endophotocoagulation of vascular and structural abnormalities of the retina and choroid including: Proliferative and nonproliferative retinopathy (including diabetic); choroidal neovascularization secondary to age-related macular degeneration; retinal tears and detachments; macular edema, retinopathy of prematurity; choroidal neovascularization; leaking microaneurysms.
- Iridotomy/Iridectomy for treatment of chronic/primary open angle glaucoma, acute angle closure glaucoma and refractory glaucoma.
- Trabeculoplasty for treatment of chronic/primary open angle glaucoma and refractory glaucoma.
- And other laser treatments including: internal sclerostomy; lattice degeneration; central and branch retinal vein occlusion; suturelysis; vascular and pigment skin lesions.

The FlexTip laser probe is intended to be used with Alcon 532nm laser systems.
Contraindications:
- Patients with a condition that prevents visualization of target tissue (cloudy cornea, or extreme haze of the aqueous humor of the anterior chamber of vitreous humor) are poor candidates for LIO delivered laser treatments.
- The infusion cannula is contraindicated for use of oil infusion.

Complications: Corneal burns, inflammation, loss of best-corrected visual acuity, loss of visual field and transient elevations in intraocular pressure can occur as a result of ophthalmic laser treatment. Unintentional retinal burns can occur if excessive treatment beam power or duration is used.
Warnings and Precautions:
- The disposables used in conjunction with Alcon instrument products constitute a complete surgical system. Use of disposables and handpieces other than those manufactured by Alcon may affect system performance and create potential hazards.
- Attach only Alcon supplied consumables to console and cassette luer fittings. Do not connect consumables to the patient's intravenous connections.
- Mismatch of consumable components and use of settings not specifically adjusted for a particular combination of consumable components may create a patient hazard.
- Vitreous traction has been known to create retinal tears and retinal detachments.
- The closed loop system of the CONSTELLATION® Vision System that adjusts IOP cannot replace the standard of care in judging IOP intraoperatively. If the surgeon believes that the IOP is not responding to the system settings and is dangerously high or low, this may represent a system failure. Note: To ensure proper IOP Compensation calibration, place infusion tubing and infusion cannula on a sterile draped tray at mid-cassette level during the priming cycle.
- Leaking sclerotomy may lead to post operative hypotony.
- Back scattered radiation is of low intensity and is not harmful when viewed through a protective filter. All personnel in the treatment room must wear protective eyewear, OD4 or above at 532nm, when the system is in Standby/Ready mode as well as during treatment. The doctor protection filter is an OD greater than 4 at 532nm.

Attention: Please refer to the CONSTELLATION® Vision System Operators Manual for a complete listing of indications, warnings, and precautions.