

Understanding the Latest Vitrectomy Machines

Getting Familiar With EVA

Early experience with a high-speed vitrectomy system is promising.



**BY NICHOLAS D. CHINSKEY, MD;
AND GUARAV K. SHAH, MD**



We have had the EVA vitrectomy system (DORC) in our practice for roughly 3 months at the time of this writing, and we have learned a lot about the machine, including ways to modify it to maximize its efficiency. This article reviews some of this instrument's key features and offers tips that we have found valuable.

USEFUL FEATURES

Twin Duty Cycle

EVA's twin duty cycle (TDC) technology (Figure) provides a high cut rate of 16 000 cpm with a constant open duty cycle of 92%. It significantly reduces the time to complete a core vitrectomy when compared with the Associate (DORC) and other non-TDC machines. A complete core vitrectomy with the 23-gauge system and TDC technology takes an average of 3 to 4 minutes.

At a Glance

- The EVA's VacuFlow VTi includes adjustable settings for flow and vacuum control.
- A complete core vitrectomy with the EVA's 23-gauge system and TDC technology can be performed in 3 to 4 minutes.
- The increased cutting efficiency has allowed wider use of 27-gauge technology.

Given this improvement in efficiency, we have been doing significantly more 27-gauge surgeries with this system. The time to complete a core vitrectomy with the 27-gauge TDC platform comes close to that of a standard 23-gauge procedure with a non-TDC vitrectome. We have found that using 27-gauge instruments requires much less adjustment than initially predicted. As is common with small-gauge surgery, we had an issue with some of the 27-gauge instruments bending, but we resolved the problem with minor adjustments, such as small changes in hand position and the use of a finger on the shaft of the instrument to stabilize it.

The limiting factor in converting more cases to 27-gauge is the finite number of options for forceps, scissors, and other instruments for the 27-gauge ports. Although 27-gauge forceps are evolving, they are not quite as good as our current 23- and 25-gauge forceps. This is more evident when teaching fellows to peel the ILM and ERM, as they have a harder time learning a new skill with more flexible instrumentation. Our solution has been the use of a hybrid system with two 27-gauge ports for the infusion and the light pipe and one 23-gauge port for the dominant hand (Video 1; eyetube.net/v.asp?f=elude). With the 23-gauge port we are able to use the 27-gauge cutter that comes in the pack to perform the vitrectomy, but we can also peel using our standard 23-gauge instruments. The company has stated that it plans to create hybrid packs to fit this model in the future. This will allow us to open a single pack of trocars, so as not to make the hybrid system cost-prohibitive.

Fluid Control

Another particularly useful feature of the EVA is its fluid control system, called VacuFlow VTi, which

Video 1: Hybrid System



includes adjustable settings for both peristaltic (flow) control (0-90 cc/min and 0-680 mm Hg at sea level) and venturi (vacuum) control (0-680 mm Hg at sea level). VacuFlow VTi delivers the necessary flow and vacuum without risk of unwanted pulsation or flow.

The EVA software allows the user to create multiple presets, which can be toggled through using the footpedal. We have used the different settings to perform entire vitrectomies for retinal detachments safely and efficiently, all on flow mode. Over an attached retina we can use a flow of 10 cc/min, and the TDC behaves nearly as efficiently as in the vacuum control setting. By switching to a flow of 3 cc/min with a click of a button for a different preset condition, we can easily perform vitrectomy over a detached retina with little mobility (Video 2; eyetube.net/v.asp?ifahe). We have even created a flow rate setting of 1 cc/min, which we use over particularly mobile retina. This setting allows us to move the cutter right up to the retinal surface with minimal movement of the detached retina.

Software

The EVA software is simple to use, includes voice feedback, and features easy-to-understand graphics on a 19-inch touch screen. Our surgical staff had little difficulty adjusting to the software and was comfortable using it after just a few cases. Additionally, it is easy to program and toggle between unique surgeon settings, such as those described above with regard to multiple flow control settings.

Laser

The EVA vitrectomy system comes with an integrated 532-nm laser tool, which we find offers consistent operation. The settings for the laser are easy to adjust, and the machine includes a wireless laser pedal that can be moved around using a toe hole in the supporting

safety guard without having to rely on the circulator. The pedal includes integrated buttons that the surgeon can use to modify the power settings. The EVA also has a setting that allows an indirect laser to be plugged in. This is convenient because it eliminates having to purchase a second laser for the indirect in the OR.

Illumination

There are three independent light output channels with the EVA's LEDstar technology. This allows surgeons to vary not only the light intensity, but also the color of the light from white to yellow. Some surgeons find operating under gas easier while using a yellow light, but we prefer the white setting for all cases.

MIND THE SETTINGS

When we first began using the EVA, we found that, in some cases, the vitrectomy was not as efficient as predicted. There are many TDC and non-TDC options from which to choose when priming the machine. We learned later that the machine was primed in a non-TDC cutting setting, thus diminishing the efficiency of the cutter. Although it is possible to modify this setting mid-case, the infusion defaults to "off" when this is done, requiring careful attention to the machine at this point in surgery. The TDC cutter is quite efficient, and it is therefore

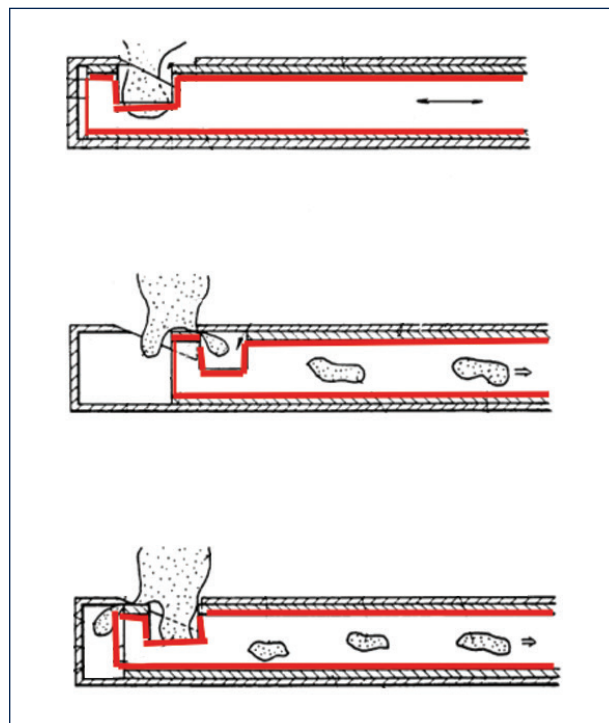
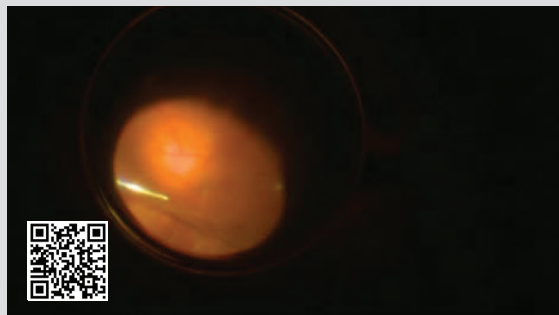


Figure. Forward and reverse movements with the EVA's TDC technology double the cut rate.

Video 2: Vitrectomy Over Detached Retina



important to keep an eye on the infusion because the port is always open on the cutter. This might lead to using more balanced salt solution than one has used previously; however, it has not been an issue for us.

CONCLUSION

Although we have had the EVA at our surgery center for only a little more than 3 months, we find that it has significantly increased our efficiency and safety in the OR, thanks to the fluidics of the TDC cutter. We have used the EVA in more than 150 cases and we will continue to add to that number with this 27-gauge platform. We also look forward to more innovative features in terms of hardware and software. ■

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Maximizing Surgical Efficiency With the Stellaris PC

Anterior and posterior segment capabilities make this an appropriate machine for busy surgery centers.



BY CARL C. AWH, MD

Whether in a hospital OR or in an ambulatory surgery center (ASC), efficiency is critical. More than just increasing procedure speed or number of cases per day, efficiency is about

achieving the best possible outcomes for patients while minimizing the time, resources, and effort necessary to achieve those results. For me, it is also about making sure my staff has a positive work experience, leaving each day with a sense of satisfaction and accomplishment. Therefore, in addition to evaluating the use of physical space and human, material, and financial resources, I also consider ergonomic and control features that aid the effectiveness and comfort of my staff and me.

The choice of surgical equipment can affect all of these factors, and it plays a significant role in maximizing surgical efficiency. When our practice began operating in an ASC, we needed a vitrectomy machine that would allow us to do the most complex cases in an efficient and cost-effective manner. It was also desirable that the platform have the capability to perform cataract surgery. Using these criteria, we selected the Stellaris PC Vision

Enhancement System (Bausch + Lomb). After 5 years and more than 1000 cases, I have found that the Stellaris PC offers a number of advantages that have considerably enhanced surgical efficiency in my practice.

KEY FEATURES

Combined Surgical Ability

The Stellaris PC is a combined vitrectomy and phacoemulsification system with an integrated 532-nm laser

At a Glance

- With the Stellaris PC, surgeons can perform anterior, posterior, and combined surgery on a single platform.
- Two continuous functions can be simultaneously controlled with the system's wireless, dual-linear footpedal.
- These and other features help maximize space and efficiency and minimize time.

that allows the surgeon to perform anterior, posterior, and combined surgery using a single platform. All of its functionality is controlled by one software program (Activate Plus) with a consistent, user-friendly graphical interface for both anterior and posterior surgery.

The Stellaris PC platform also has a compact design, making it a good choice for our multispecialty ASC; its small footprint makes it easy to move into and out of the OR. Taken together, these features offer efficiencies in cost, the use of space and materials, and the time and effort that would otherwise be spent switching machines or configurations between cases. For combined surgery, eliminating the need for multiple machines and packs also helps minimize cost and complexity.

Footpedal

The Stellaris PC platform features a wireless, dual-linear footpedal (Figure 1) with four fully programmable buttons and integrated laser control, which means fewer pedals and fewer cords than with previous systems, reducing clutter. The dual-linear feature allows the surgeon to independently control two continuous functions simultaneously—for example, fragmentation power and vacuum—in contrast with the typical pedal that allows linear control of only one function (typically vacuum).

I find dual-linear control particularly useful when employing the fragmatome to remove dislocated lens fragments. I engage the lens fragment with gradually increasing vacuum, and, once I am sure I have good purchase, I slowly increase fragmentation power to emulsify the lens material without repelling the fragment.

The footpedal includes an integrated laser firing switch, which is unique to Stellaris PC. This allows me to engage the laser without having to search for another footpedal, as the laser-ready screen is automatically activated upon opening the safety cover.



Figure 1. The Stellaris PC Vision Enhancement System and wireless, dual-linear footpedal.

The redesigned pedal with ergonomic foot rest improves surgeon comfort and provides enhanced control, particularly for long procedures. The angle of the pedal has been modified to help keep the foot in a more relaxed, neutral position in the “off” position.

Software

The Stellaris PC platform software interface is straightforward and easy for the OR staff to master. Settings for the programmable footpedal and for each step of the procedure can be customized for each surgeon. These settings can be modified easily during the case and stored in the memory of the Stellaris PC. Furthermore, the Activate Plus software allows the user to save the “end of case” screens to the hard drive or export them to a memory stick.

Light Source

The Stellaris PC comes with a dual light source and multiple surgeon-selected color filters that allow differentiated viewing. The surgeon can change color filters using the footpedal

(Figure 2). Alternatively, a surgical assistant can make the adjustments on screen. In a recent survey, a significant percentage of surgeons reported that certain color filters made it easier to perform particular parts of cases (eg, amber light for fluid-air exchange, green light for membrane peeling).¹

ACCESSORIES

Valved Cannulas

The easy-to-insert Entry Site Alignment (ESA) valved cannulas help maintain stable intraocular pressure during surgery, and the tapered trocar blade creates an excellent wound that seals nicely. Microtexturing on the outer surface of the cannulas helps to keep them secure in the wound, but it does not interfere with removal at the end of the case.

The cannula design also facilitates instrument exchange. Beneath the valve is a funnel-shaped opening that helps direct instruments into the central lumen. The valve is removable, which is helpful when using instruments that cannot be introduced easily through a valve or if one desires unrestricted flow through the cannula. The translucent valve material transmits a bit



Figure 2. Multiple surgeon-selected color filters allow differentiated tissue visualization.

of light, creating a subtle glow that makes for easier instrument exchange in dim lighting.

Chandelier Lighting

The Stellaris PC offers an adjustable chandelier in both 23 and 25 gauges that integrates with the ESA valved cannulas. The chandelier provides improved diffuse lighting and efficient light control. It fits into the ESA ports and facilitates bimanual surgery.

Fragmentation Needle

A 23-gauge fragmentation needle allows surgeons to

perform pars plana lensectomy or to remove dislocated lens fragments through 23-gauge wounds. This enables surgeons to perform sutureless lensectomy, which means faster recovery times and happier patients (and referring surgeons).

CONCLUSION

The Stellaris PC is an excellent system for the retina ASC or for any OR seeking a relatively compact but full-featured machine. It incorporates Bausch + Lomb's phacoemulsification technology, making it a good choice for facilities in which combined vitrectomy and phacoemulsification procedures or routine cataract surgeries are performed.

My experience with the Stellaris PC has been excellent. My staff finds the machine easy to set up and use, and the other surgeons and I at the facility can perform the most complex cases without compromise. It is a platform designed for incremental improvements, and I anticipate that future enhancements to the Stellaris PC will keep it at the forefront of vitreoretinal surgical technology. ■

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1. Chow D. Effect of filters on tissue visualization in vitreoretinal surgery. Poster presented at: World Ophthalmology Congress; April 2014; Tokyo, Japan.

Get Behind the Wheel of the Constellation

Knowing the bells and whistles of a particular vitrectomy platform widens surgical potential and increases confidence and safety.



BY S. K. STEVEN HOUSTON III, MD

I recently completed a vitreoretinal surgery fellowship at Wills Eye Hospital in Philadelphia, Pa., where I had the privilege to operate 5 days a week over the past year with 15 talented vitreoretinal surgery attendings. Never again will I get the chance to perform 1200 surgical cases in 1 year and gain surgical proficiency so exponentially. The lessons, techniques, and skills learned have been indispensable to my career. Much like my car, I got behind the wheel of the Constellation Vision System (Alcon) for 8 to 10 hours each day, getting to know the ins and outs of the machine.

KEY FEATURES

An often-overlooked feature of the Constellation is the machine's user-friendly interface (Figure). The Constellation's easy-to-read screen allows surgeons to choose among the device's various functions and clearly indicates when the user has switched from, for example, core vitrectomy to shave vitrectomy. Although retina surgeons often first consider the technical aspects of the device (such as those detailed below) the most important functions, such as the clarity an interface provides cannot be ignored.

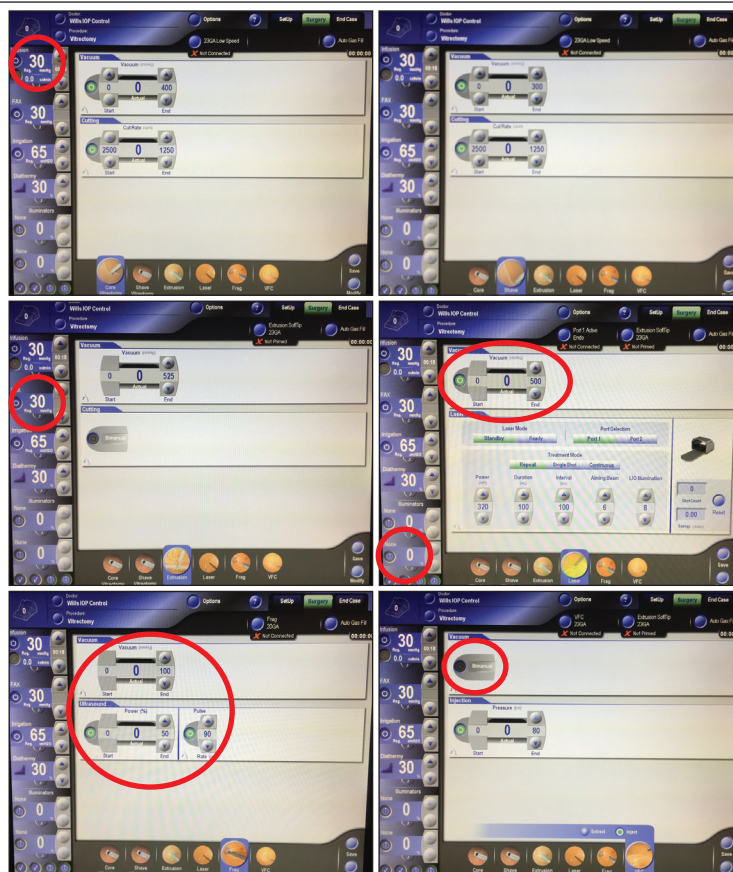
Intraocular Pressure Control

Intraocular pressure (IOP) control is one feature that

Infusion pressure with IOP control. Toggle with the footpedal to increase IOP to 50-60 mm Hg as needed and return to set level. Toggle with footpedal to switch between 3-D, proportional, and momentary vitrectomy.

Extrusion. Toggle with footpedal to switch from fluid to air and back as needed.

Adjust fragmatome vacuum, ultrasound power, and pulse rate for lens removal.



Shave vitrectomy. Duty cycle primarily closed. Allows shave of vitreous close to retina without significant underlying retina movement.

While on laser, extrusion can be used without changing settings. This can be beneficial when combining lighted laser with soft-tip extrusion. Bottom left shows areas for illuminators. The RFID automatically detects when plugged in. Switch lighted lasers, chandeliers, and illuminators on and off here.

Toggle with the footpedal to switch between viscous fluid inject and extract. Bimanual allows silicone oil injection and simultaneous extrusion (ie, for direct PFCL-oil exchange).

Figure. The Constellation's user-friendly interface provides a plethora of information.

sets the Constellation apart from other vitrectomy machines. This control allows surgeons to keep IOP within 2 mm Hg of a preset level. Unlike older platforms, the Constellation, combined with valved trocars, becomes a controlled, predictable system. The IOP control utilizes flow sensors at the bottom of the cassette that directly compensate to maintain a set pressure. Predictable IOP is paramount in cases involving patients with diabetic tractional membranes, in which high IOPs are often intermittently required for hemostasis. IOP control is also important in patients with glaucoma, as such control ensures safe operating pressures to minimize damage to the optic nerve.

Additionally, cases involving perfluorocarbon liquid (PFCL) are predictable when performed with the Constellation and valved cannulas, as this configuration minimizes dispersion of small PFCL droplets and reduces the risk of PFCL entering the subretinal space.

When performing vitrectomy with high aspiration, surgeons rarely outrun the infusion. However, there are situations where infusion issues can occur.

Spatial factors play a role in IOP control: The patient's eye level must be at the same height as the bottom row

of connectors on the cassette. If the patient is lower than those connectors, increases in IOP will occur. IOP increases at a rate of approximately 1.87 mm Hg for every inch the patient's eye is below the cassette connectors, and such unevenness results in decreased aspiration by the same factor. For example, if you have IOP settings for 25 mm Hg and the patient's eye level is 10 inches below the cassette, the eye's actual IOP will be 43.7 mm Hg ($25 + 18.7 = 43.7$). To correct for the desired level of the patient's head during surgery, the Constellation has a patient eye level setting, allowing the surgeon to make this adjustment so that the pressure he or she sets is the actual pressure in the eye.

Infusion Cannula

Prior to unclamping the infusion, direct visualization of the infusion cannula in the vitreous cavity is critical to prevent complications, including infusion under the retina or in the suprachoroidal space. In cases that preclude direct visualization, 6-mm trocars may be beneficial. Inadvertent infusion into the suprachoroidal space is not a good way to start the case, and air infusion into the choroid could result in fatality due to air embolism.

Infusion issues can also develop if the infusion cannula

is directed anteriorly behind the lens. This issue can be avoided by taping the infusion line to maintain the infusion's angle toward the posterior pole. If the infusion is correctly positioned and IOP stability remains an issue, clearing vitreous from the infusion cannula area usually resolves these problems.

Vitreous Cutter

Another key advantage of using the Constellation is the dual pneumatic vitreous cutter, which relies on independent airflow to drive closing and opening of the cutter itself. Improved design with the Constellation includes optimized port location placed closer to the tip, allowing improved dissection of preretinal membranes, which proves particularly helpful in cases of tractional retinal detachment (TRD) secondary to proliferative diabetic retinopathy.

Thanks to the dual pneumatic system, vitreous cutters offer superior cutting forces and cut rates up to 7500 cpm without affecting efficiency and port flow; compared with older vitrector models, in which increased cut rates came at the expense of port flow, this is a massive improvement. Flow through the port is maintained despite higher cut rates, thus decreasing the cone of influence on the vitreous, resulting in less traction when working close to the retina.

Duty cycle, which is the amount of time the port is open during the cutting cycle, can be controlled by the surgeon independent of the aspiration and cut rate. The three settings available are core (port biased open), 50/50, and shave (port biased closed). An additional setting is called *momentary*, which allows footpedal-controlled aspiration with side pedal-controlled cutting at low cut rates. The momentary setting is ideal for removing lens fragments that do not require the fragmatome.

The cutting settings can be quickly changed during a case with footpedal control, thus allowing enhanced surgeon control for all situations encountered. Shave vitrectomy works well over detached retina, often cutting vitreous with little underlying movement of the retina. These features are available in 23-, 25-, and 27-gauge cutters. All gauges have a full complement of surgical adjuncts including forceps (eg, max grip, internal limiting membrane), soft-tip extrusion tips, and lasers. As a result, there is a full armamentarium available to accommodate to the surgeon's preferences.

Lighting

Of utmost importance during vitrectomy surgery is proper lighting to illuminate vitreous and visualize membranes during peeling. However, light toxicity and retinal damage are concerns. The Constellation uses a xenon light source that has a radio frequency identification

(RFID) probe that automatically regulates light intensity based on the probe gauge size, thus minimizing the likelihood of inadvertent light toxicity. The RFID also allows easy connection of chandeliers and lighted lasers that can be individually selected and controlled on the platform without needing to unplug other lights.

Auto Air-Fluid Switch, Integrated Gas Fill, and Integrated Laser

Use of air and gas with the Constellation is straightforward. The surgeon has automatic air-fluid switch control with the footpedal, allowing seamless transition from fluid to air. The IOP control continues to function, maintaining a closed, stable system under air much the same as under fluid. The vitrectomy platform also has an integrated gas fill for SF₆ and C₃F₈. The machine automatically purges the gas to ensure pure gas, and the surgeon or scrub technician then dilutes to the desired gas concentration. This feature allows fully integrated gas fill without the need for the circulator to assist in pulling the gas.

Continuing the integrated concept, the Constellation also contains a laser, which can be selected with the main footpedal, as part of the platform. A separate laser pedal allows surgeon control of changing the power up or down and enabling and disabling the laser. The options for lasers include straight and curved, illuminated and nonilluminated. A significant benefit of the curved illuminated laser is the ability for surgeon-independent scleral depression with simultaneous laser for peripheral retinal breaks, even in phakic patients across the eye. During retinal detachment repairs (Video; eyetube.net/v.asp?f=enome), the curved illuminated laser allows the surgeon to adequately treat all breaks, including the anterior portions of a tear.

ADDITIONAL FEATURES

Trocars

I already alluded to the importance of valved cannulas combined with the advanced IOP control in the Constellation platform. Additional features of the EdgePlus trocars include advanced blade design to create linear wounds. The trocar cannulas also easily detach from the blade after insertion, often eliminating the need to use a second instrument to hold the trocar cannulas, instead allowing the second hand instrument to stabilize the eye. The cannula design also enhances instrument rigidity and ease of instrument movement within the cannula. The hubs are low profile, and the valves allow easy access to instruments. Wound construction is paramount for creating a self-sealing wound and should include conjunctival displacement and a beveled approach at approximately 30°.

Viscous Fluid Injection

The Constellation has a viscous fluid injection setting to allow the insertion and removal of silicone oil. The silicone oil cannula attaches to the vitrectomy platform, and the settings allow controlled extrusion (up to 650 mm Hg aspiration) and infusion (up to 80 mm Hg). Silicone oil infusion is a crucial step in many diabetic TRD and proliferative vitreoretinopathy cases. Of key importance is venting the air at the highest point to ensure that all air is removed prior to topping off the silicone oil. In pseudophakic patients, the soft tip with active extrusion can aid in removing the final air in the anterior vitreous cavity.

Removal of silicone oil is also easily performed with the Constellation with the same cannula. Silicone oil (1000 cs) can be removed with the 23-gauge or 25-gauge system quickly, with longer times needed to remove higher viscosity silicone oil (5000 cs). Insertion is even faster, usually taking less than 3 minutes. A key step to ensure removal of all silicone oil is to perform two or three air-fluid exchanges while keeping the vitreous cutter on aspiration-only with the port facing down at the air-fluid interface. You will see the “oil slick” on the surface, and this will aid in determining the presence of any retained silicone oil and need for further rinses. Retained oil in the capsular bag or anterior chamber will require further steps such as anterior chamber washout, but the above technique will be beneficial.

The viscous fluid injection cannula and tubing can also be used to perform subretinal tissue plasminogen activator (tPA) injection in cases of massive subretinal hemorrhage or submacular hemorrhage. The tPA can be placed in the viscous fluid cannula with the attachment of a 41-gauge subretinal tip. The infusion settings should be adjusted to between 8 mm Hg and 14 mm Hg, or until the tPA has a fast drip out of the

41-gauge instrument. This allows controlled infusion of subretinal tPA without the dependence on an assistant manually pushing a syringe with unknown infusion pressure.

EFFICIENCY

Fundamental aspects of the Constellation vitrectomy platform are its ease of use and efficiency. With the RFID plugs, the correct settings are automatically populated when each instrument is plugged in. As a result, setup is straightforward and can be performed by the scrub technician or surgeon. The circulator needs only to spike the bottle, select the doctor, and press the prime button. This frees him or her to perform other tasks and speeds room turnover, allowing for shorter time between cases and overall improved efficiency.

CUSTOMER SUPPORT

When we buy expensive electronics or a car, customer service and support are key features that result in overall satisfaction with the product. The Constellation provides nothing short of excellence in this department. The surgical representatives are valuable sources of information new and seasoned vitreoretinal surgeons. For everything from initial demos and programmed settings to real-time troubleshooting, the company's representatives reliably serve surgeons using their platform. I can think of several instances when I had a question before, during, or after a case and I could count on our regional surgical representative to answer a call on the weekend to walk step-by-step through the issue.

SUMMARY

I liken using the Constellation to driving my favorite car: I love getting behind the wheel. The platform is compact and efficient, providing an all-in-one machine. The dual pneumatic cutter allows cut rates as high as 7500 cpm and independent duty cycle control, thus providing the utmost safety and efficiency. As a surgeon, I have full control during surgery and can easily switch between settings with clicks on the footpedal. Furthermore, everything has voice confirmation, so, with every setting change, a pleasant voice confirms my actions. I know the Constellation will serve me well and get me to 250 000 miles—just like my first car. ■

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Video: Retinal Detachment Repair With the Constellation

