Supplement to RETINA TODAY Summer 2013

# EVA

## A STATE-OF-THE-ART SURGICAL SYSTEM FOR PHACO-VITRECTOMY


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The EVA Surgical System

# New Vitrectomy System Enhances Safety and Efficacy

Aspiration flow control system on the EVA offers surgeons a new, advanced option.

BY TIMOTHY NORRIS, CONTRIBUTING EDITOR

A new vitrectomy machine using a fluid control system allows safer and more precise surgery, with considerably lower failure rates, a study shows.

Vitrectomy is a fundamental surgery for patients affected by retinal detachment, retinopathies, macular diseases, and vitreous hemorrhage. Although more than 500 000 vitrectomy procedures are performed every year by physicians worldwide, vitrectomy is still considered a delicate surgery that can lead to severe intraoperative and postoperative complications.

According to Didier Ducournau, MD, although there has been a large shift toward vitrectomy in the past 2 decades, evidence-based data proving that vitrectomy is a superior technique to the older scleral buckling are still lacking.

"Until now, the largest study was the Scleral Buckling Versus Primary Vitrectomy in Rhegmatogenous Retinal Detachment (SPR) study on 681 cases treated by 46 surgeons of 5 countries.[1] They spent 6 years of work to compare and analyze these cases, and no definitive conclusion was achieved. Why was no definitive conclusion achieved? Because, statistically, we cannot prove anything out of 681 cases. To have a statistically significant result, we should work on 5000 cases, and a randomized study of 5000 cases costs several million euros. Who would sponsor such a study?" he said.

New studies, in his opinion, should not concentrate purely on the results, but rather, compare the effect of any data to find the key factors for improving safety, efficacy, and standardization.

**EVA FEATURES**

- VacuFlow VTi technology fluidics system
- LED light source
- Built-in 523 nm laser system
- 8000 cpm vitrectomy module (Q4 2013)
- Automated Infusion Compensation (AIC)
- Phaco module with tresholding
- Wireless dual linear foot pedal
- Modular serviceable

In a meeting organized by Dr. Ducournau at the Clinique Sourdille in Nantes, France, surgeons discussed the central role of vitrectomy machines, particularly of the new-generation flow-based systems, in ensuring the safety and efficacy of the procedure.

The goal of the congress was to explain why aspiration flow control vitrectomy is a safer, faster, and more reliable technique for all of the different pathologies and conditions involving the vitreous.

In the live surgery session, a prototype of the new

**VacuFlow VTi.**

EVA vitrectomy system (DORC) was shown to have the potential to enhance precision and control during the procedure, minimizing the risk of poor outcomes and complications.

At the heart of EVA is a revolutionary fluid control system, the VacuFlow VTi, which overcomes the limitations of both the venturi and peristaltic pumps. The system provides precise flow and fast vacuum, eliminating the risk of unwanted pulsation or flow and putting the surgeon in absolute control of the procedure.

The EVA system received Conformité Européenne approval on 3 March 2013.

## VENTURI VS PERISTALTIC

The meeting was inspired by the results of the EVRS RD Study,[1] which demonstrated that retinal detachment surgery performed with vacuum-based venturi systems had a 2.9 higher failure rate compared with the same surgery performed with a flow-based peristaltic system ($P = .006$). Multivariate analysis was conducted on 7678 retinal detachment surgery cases performed by 180 surgeons from 48 countries. Collected data were integrated with the technical findings of Badet and Collin who, in their experimental work, provided tests on the performance of vitrectomy machines. Pump characteristics, the different gauge used, and the cutting speed were considered.

"This study sparked controversy among surgeons because, for the first time, we proved that the venturi pump creates blind eyes, while patients operated with flow-control machines have a statistically lower chance of failure. The French National Institute of Statistics calculated that the switch from venturi pump to flow control pump would allow us to save 42 000 blind eyes every year," Dr. Ducournau said.

According to Keith A. Warren, MD, flow control allows for faster, more efficient cutting, maintaining a high safety profile.

"Peripheral vitrectomy and smaller gauge now means that I have to understand the flow better. If I am in the periphery and I control the flow, it is much less likely for the patient to have a retinal tear caused by my surgery because I have more accurate control of how the vitreous is leaving the eye," Dr. Warren said. "I can control the speed and control the rate it goes away from the eye, and this allows me now to use my cutter more efficiently: I can use it as a scissor, for aspiration to flatten the retina, and to cut the vitreous. I can control the cutting rate because I am controlling the flow. With the venturi system, there is no accurate way to know the flow. Flow can be estimated by changing how fast you cut, how long the cutter is open, and by reducing the aspiration, but uncertainty is still present," he said.

## FLOW CONTROL

According to this study, the main problem related to vacuum-based venturi pumps in vitrectomy comes from the control of the vacuum generated by the pump itself, which affects the aspiration flow.

At the heart of EVA is a revolutionary fluid control system, the VacuFlow VTi, which overcomes the limitations of both the venturi and peristaltic pumps.

"A venturi pump is like a car where you control the RPM but you cannot know the gear that is engaged, so you are driving only controlling the turns per minute, not controlling your speed," Dr. Ducournau said.

"Because the pump maintains a constant level of vacuum, as the vitreous enters the tube the flow slows down, forcing the surgeon to push on the pedal in order to keep up the pace. If, at this point, a fluid of lower viscosity like BSS is aspirated, the flow suddenly accelerates, with obvious surgical consequences," he said.

The venturi pump can only create vacuum, thus increasing the gradient of pressure. With a venturi pump, there is a minimum outflow according to the infusion pressure, making it almost impossible to create a lower controlled aspiration flow. A venturi pump cannot work with positive pressure at pump level. To compensate the effects of too high of an aspiration flow, many surgeons set the cut rate as high as possible.

"Six hundred cpm with a venturi pump is dramatic because you take the risk to aspirate the retina. But with 6000 cpm you don't leave the time for the vitreous to enter," said Dr. Ducournau. With a peristaltic system, the flow remains stable independent of the fluid's viscosity, said Dr. Ducournau. "With the flow control system, when you aspirate 2 cc, you will aspirate exactly 2 cc."

The EVRS RD Study showed a failure rate of 0.7% with 23 gauge and 1.1% with 20 gauge when used with a peristaltic pump. Failure rate raised to 1.4% with 23 gauge and 2.5% with 20 gauge when a venturi system was used.

"Twenty-three gauge decreases the risk of failure with the venturi pump because a smaller lumen leads to decreased flow rate. It is safer, as if you were a car with smaller tires," Dr. Ducournau said.

"In the study, the difference between venturi and peristaltic pumps turned out to be significant only with 20 gauge. However, with the venturi pump the risk of failure remains more than twice that with peristaltic also when using the 23 gauge," he said.

## CUTTING SPEED AND DUTY CYCLE

Cut rate and duty cycle are critical elements for the control of flow when using a venturi pump. As confirmed by the EVRS RD study, a high cutting speed increases the safety of venturi pumps.

"The high speed reduces the aspiration flow and the

maximum aspiration, so the worst thing to do with venturi is the low cutting. Surgeons want to cut fast because if they cut slowly, they will aspirate the retina. But if they cut too fast, they may not aspirate the vitreous," Dr. Ducournau said.

In order to aspirate the vitreous, enough time must be allowed for the vitreous to enter the cutter, he explained. A fast cutting speed of 6000 cuts/minute allows only 1% of a second between each cut, and the quantity of vitreous that enters the cutter will be minimal.

"You'll aspirate the water around the vitreous, but not the vitreous itself. Some surgeons say that they have a higher aspiration flow with high speed, but this is because they aspirate the water," said Dr. Ducournau.

The EVRS RD study showed that the combination venturi plus high speed is still worse than peristaltic, whatever the cutting frequency. With the peristaltic pump, the flow does not change with the speed of cutting, and the cut rate and duty cycle can be varied without an effect on flow .

"With the venturi system, when you increase the time of the occlusion of the cutter you decrease the aspiration flow," said Dr. Ducournau.

## CONVERTING TO PERISTALTIC

In the United States, vitrectomy has been dominated for the past 30 years by venturi pump systems.

"I trained using the venturi system, and so it is all I have known," Dr. Warren said.

However, Dr. Warren said that once he experienced the advantages of flow control, he progressively converted to it and found that it was better suited to the latest advances in vitrectomy techniques.

"Two very important things have changed in vitrectomy," said Dr. Warren. First, we have a wide-angle viewing system that allows us to see out in the periphery, and we perform more peripheral dissections. Second, we have progressed to smaller-gauge cutters that require a higher level of understanding as to flow characteristics because all material now travels through a smaller tube. Vacuum-based systems can only approximate the flow, while peristaltic pumps provide accurate control of the flow."

In addition, venturi pumps must be connected to a vacuum, which is generated by a nitrogen gas supply appliance. Peristaltic pumps were originally invented to transport blood in cardiac surgery and dialysis. They only need to be plugged to the wall for electric power supply, making them more easily transportable and versatile, Dr. Warren explained.

## A STEP FORWARD WITH EVA

The VacuFlow VTi technology employed by the EVA represents a further evolution of peristaltic pump machines, inducing the aspiration flow effect thanks to the implementation of a diaphragmatic pump.

"The flow control system of EVA is an invention. There is a system of pistons that acts like a syringe, attracting the liquid and eliminating it at the same time. It is not exactly a peristaltic, however, it is functioning in a similar way," Dr. Ducournau said.

Precision is greatly enhanced by this particular pump. Other pumps proposed in the vitrectomy machines that are currently on the market allow surgeons to control 1 cc/min, while the EVA VacuFlow VTi allows them to control 0.1 cc/min. "You obtain exactly the aspiration that you want," Dr. Ducournau said.

EVA also implements a whole range of functions to ensure better comfort for surgeons during vitrectomies.

"The EVA has a sound system that speaks to the surgeon. This sound allows us to understand what we are doing and allows us to save time and to be more precise. For example, the sound tells the surgeon when there is no more vitreous in the tube or when the pressure at the pump level is positive. Another advantage is a laser integrated in the machine, so we don't need another laser in the OR. Finally, the foot pedal can be adapted to the needs of individual surgeons: You can ask for a personalized set of functions according to whether you move your foot on the left or on the right," he said.

Dr. Ducournau is actively collaborating with DORC and testing EVA to ensure a perfect match between technical performances and surgeons' needs.

"When I tested it, I asked them to enhance some details and to make a few small additions. This is the great advantage of working with DORC: They are open to suggestions and reacted positively whenever I asked them to make changes. Small details can sometimes make the difference and have a great impact on how comfortable a surgeon feels with a machine. Attention to the surgeon's point of view is key in the success of a new technology. The more a machine is tailored to surgeons' needs, the more surgeons will like it and find their way to work with it," Dr. Ducournau said. ■

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2. EVRS RD study. Available at: http://www.evrs.eu/evrs-rd-study/. Accessed April 20, 2013.

# EVA: A State-of-the-art Surgical System for Phaco-Vitrectomy

## A Roundtable Discussion

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### CASES WITH THE EVA SURGICAL SYSTEM

***Retina Today:* For what types of procedures have you used the EVA (DORC) system?**

**Prof. Stalmans:** I have used EVA for 19 cases of macular pucker, 6 macular holes, 17 retinal detachments, 5 diabetic vitrectomies, 4 floater removals, 19 oil removals, and 33 other posterior segment surgeries. I have performed 43 cataract cases with EVA, both combined and isolated.

**Dr. Pertile:** I have used the EVA system for many different posterior segment procedures, from simple cases to very difficult cases such as trauma.

**Prof. Eckardt:** I have used EVA for all of my cases.

**Dr. McCannel:** We do not currently have the EVA available in the United States, but for the past few months, I have been using the LEDStar (DORC) illumination system for all of my cases.

### FLUIDICS

***Retina Today:* What is your experience with the new VacuFlow fluid control system?**

**Prof. Stalmans:** The Associate (DORC) has a combined pump system that can be used in either venturi (vacuum) or peristaltic (flow) mode. The EVA's fluid control system is novel in that it is neither venturi- nor peristaltic-based, but can be used in flow or vacuum mode. The fluidics system does not need to be switched; rather, the software causes it to behave differently.

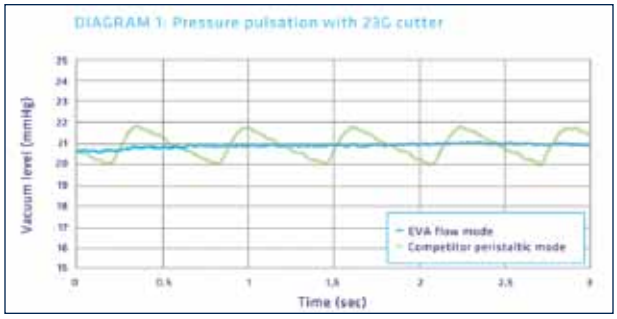
This fluidics system has the major advantage of a faster rise time to obtain vacuum mode compared with venturi, which, in phaco, results in increased attraction of the lens fragments. For vitrectomy, the VacuFlow fluid control system allows me to perform delicate work close to the retina in a safe manner, maintaining constant flow and minimizing movement of the retina.

***Retina Today:* When do you switch from vacuum mode to flow mode in vitrectomy?**

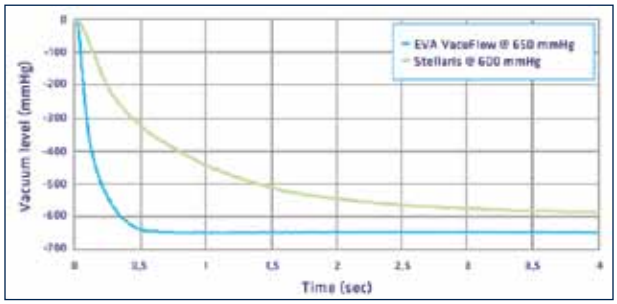
**Prof. Stalmans:** I perform core vitrectomy in vacuum mode because my goal is to remove the bulk of the vitreous as quickly as possible. As I come closer to the retina, I switch to flow mode, which is slower, but lowers the risk of traction.

**Prof. Eckardt:** For cataract surgery, I use vacuum mode exclusively with the EVA. The vacuum mode makes it easy to remove cortical remnants in a controlled and manner. With the DORC Associate, I found the flow-controlled peristaltic pump to be too slow. With the EVA, however, you can come close to the posterior capsule, and I have not experienced any ruptures, even when engaging the capsule with the port.

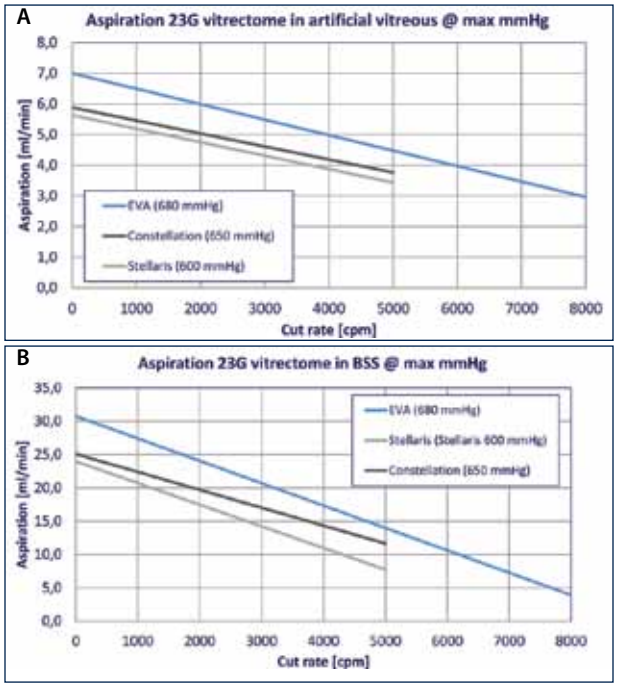
**Dr. Pertile:** Previously I have used flow control with the peristaltic pump, which was slow, but the flow control on the EVA, in my opinion, has many advantages. I still use vacuum control for core vitrectomy, but I switch to flow control for peripheral vitrectomy. The combination of flow control with a high cut rate allows me to more safely approach the retina. My initial impression with the EVA is that it allows fast vitreous removal in a controlled fashion and little risk of traction, even in a detached retina.




**Pressure pulsation with the 23-gauge cutter.**




**Vacuum response time.**




**Aspiration with 23-gauge vitrectome in artificial vitreous (A) and balanced salt solution (B).**

**Prof. Eckardt:** I also use vacuum for core vitrectomy. I do not start my vitrectomy in the middle of the vitreous, rather, I go immediately down to the optic nerve head because this is where I look to see if the vitreous is still attached. Vacuum control is necessary for detaching adherent vitreous, particularly in patients with high myopia who tend to have unusual attachment of the vitreous at the mid-point in the retina, where the vitrectome can be used as forceps for removal. This maneuver can only be performed with high vacuum or flow control.

**Dr. Pertile:** In my opinion, when you use flow control with the EVA, you get maximum aspiration more quickly than with the Associate. If your setup is high enough, you can achieve vitreous detachment, even just using the flow control. I usually use vacuum, but it should be noted that on the EVA flow mode can also be use for vitreous detachment.

**Prof. Stalmans:** Is it true to say that we are all using vacuum to perform core vitrectomy and then switching to flow mode for work in the periphery?

**Prof. Eckardt:** Not necessarily. I still use vacuum control mode in the periphery unless the periphery is detached because I think that although vitreous shaving takes longer in flow mode, it is safer.

**Dr. Pertile:** Another advantage to the EVA system is that it allows me to program in all my settings, and I can switch between them with the foot pedal so I can go from high vacuum to lower vacuum and to flow control with just my foot. I no longer need a nurse to switch settings and overall have more control.

I have 2 flow control programs on my machine—1 is low flow, 4 cc/min, and the other is 15 cc/min. My vacuum settings are 150 mm Hg and 350 mm Hg.

## HIGH-SPEED CUTTING RATES

***Retina Today:* What is your experience with the cutting rates with the EVA system for core vitrectomy, detached retina shaving, and shaving the vitreous base?**

**Dr. Pertile:** I am impressed with the efficiency of this cutter. Previously, I had the impression that when cut rates exceed 2000 cpm, efficiency is compromised. With this new cutter, however, I can go up to 6000 cpm and still perform an efficient and rapid vitrectomy.

**Prof. Eckardt:** A core vitrectomy at 6000 cpm may present an advantage for retinal detachments in which the retina is mobile because there is less traction. In addition, I do think that the higher cut rate increases safety.

**Dr. Pertile:** I had expected surgery to be slower at higher cut rates, which it was not. When you have a polarity attraction of the periphery in the setting of detached vitreous, and you are cleaning the central part of the posterior vitreous membrane, you can prevent peripheral tears if you can control the traction.

**Prof. Stalmans:** I was surprised that when I first used the 6000 cpm cutter, it did make a difference compared

with 2500 cpm. Using the high-speed cutter with the EVA in core vitrectomy, I reduce the cutting speed to 2000 cpm to 3500 cpm because of the higher duty cycle (the port is open 60% of the time), making the procedure faster. When I switch to flow mode to shave the vitreous base, I raise the cutting speed to the maximum—6000 cpm—which pairs with a lower duty cycle (open 40%), which is ideal for vitreous removal close to the retina.

**Dr. McCannel:** I have used high-speed cutting on the Constellation (Alcon), and although the speed has clear advantages in terms of reducing traction, there is still unexpected movement in the vitreous and the retina because it is powered by a venturi pump system. A higher margin for error, however, is needed out in the periphery, where the retina can tent up and the cutter is more likely to unintentionally cut it. So, although high-speed cutting contributes to safer surgery, it does not represent the full solution.

## SMALL-GAUGE INSTRUMENTATION

### *Retina Today:* What is your preferred gauge of instrumentation?

**Prof. Stalmans:** Ninety-nine percent of the time, I use 23-gauge instrumentation. I recently switched to 27 gauge for some cases such as floater removals and puckers.

**Dr. Pertile:** I also typically use 23-gauge instrumentation, but I like to use 25-gauge cutters for select cases of proliferative diabetic vitreoretinopathy, because the smaller gauge gets under the membranes more easily. Additionally, it is easier to enter through valved 23-gauge trocars with 25 gauge. In general, most of my instruments are 23 gauge because I like that they mimic the rigidity of 20 gauge.

**Prof. Eckardt:** I use 23-gauge instrumentation 95% of the time. I use 25 gauge for some pediatric cases, but these are a small part of my case load. I have tried using 27-gauge instruments, but I do not think that I will adopt this instrumentation.

For the past 2 years, however, my colleagues and I have been using a hybrid technique, in which we use 2 23-gauge trocars for the instruments and a 27-gauge trocar for high-flow infusion. The risk of losing intraocular pressure (IOP) is greatest when the last trocar (for infusion) is removed. We have found that using a 27-gauge trocar for infusion has reduced this risk by one-third. The only disadvantage to this approach is that you cannot switch hands and insert your instruments through the 27-gauge trocar, but we have rarely found this to be a problem.

**Dr. McCannel:** I use a combination of 23- and 25-gauge instrumentation. I was using 25-gauge instruments almost exclusively until about 2 years ago, when I started using 23-gauge more commonly. I still use 20-gauge forceps for complex proliferative vitreoretinopathy (PVR) cases, but even with these, I am gravitating toward 23 gauge. I have not found that there is any case that I cannot handle with 23 gauge.

> "In PVR membrane cases, I insert an Eckardt Twinlight 27-gauge chandelier into the eye, and I work bimanually with forceps in 1 hand and a spatula or scissors in the other hand."
>
> -Peter Stalmans, MD, PhD

### *Retina Today:* What is your preferred surgical technique for PVR membranes?

**Prof. Stalmans:** In PVR membrane cases, I insert an Eckardt Twinlight 27-gauge chandelier (DORC) into the eye, and I work bimanually with forceps in 1 hand and a spatula or scissors in the other hand.

**Dr. Pertile:** I use a similar bimanual approach.

**Prof. Eckardt:** I use a bimanual approach as well. It is almost the fashion to say that we no longer need scissors because we can do everything with the precise cutters that are available, but I do not think this is true, particularly for complex membrane procedures. The scissor technique should still be taught in training programs so that younger surgeons are ready to use scissors if necessary, and with an approach that teaches using them with either hand. A one-handed technique with a cutter is fine for most cases, but in diabetic cases, this approach can pose a higher risk to the retina.

**Dr. McCannel:** I perform a fairly high-volume of PVR surgeries, and I have found that I achieve good results with a 1-handed technique using forceps. I like to use trypan blue when I have difficulty identifying membranes that I know are present because it helps to define the edges. I now use 23-gauge instrumentation without a chandelier.

When training fellows, I have found that the nondominant hand in a bimanual approach often does not have the instrument control that is required to perform the surgery well. We have an Eyesi Surgical Simulator (VR Magic) at Jules Stein, and it is excellent for training nondominant hand coordination, but if a surgeon is not interested in learning a bimanual approach, training is difficult. I do think that bimanual is a good approach for complex posterior vitreous detachment cases.

**Prof. Stalmans:** When you work bimanually, what type of illumination do you use?

**Dr. McCannel:** I like the dual-port 27-gauge Eckardt Twinlight. I have tried many of the single-port illuminators, such as the Tornambe Torpedo (Insight Instruments), but it always seems that shadows appear where I want to see. With Twinlight sources, there are still some shadows, but I find that the odds are better that they will not appear where I am working.

## AUTOMATIC INFUSION CONTROL

***Retina Today:* Prof. Stalmans, can you explain the principles and benefits of automatic infusion control (AIC)?**

**Prof. Stalmans:** In vitrectomy, the IOP cannot rise too high because this will compromise vascularization in the eye. I typically set the IOP to 20 mm Hg; however, when you start aspirating with your vitrector in vacuum mode at relatively high vacuum of 350 mm Hg, the volume of fluid removed from the eye will be larger than the volume of fluid flowing into the eye, which will cause the eye to collapse. The AIC compensation on the EVA progressively elevates the pressure settings as the aspiration of the vitrector increases.

For example, if the baseline pressure is set at 20 mm Hg, when the vitrector aspiration increases from 0 mm Hg to 350 mm Hg, the bottle pressure will increase to 40 mm Hg. This creates a higher infusion flow and compensates for the amount of fluid that is removed with the vitrector, preventing collapse. When aspiration is discontinued from the vitrector, the bottle pressure is automatically lowered back to 20 mm Hg.

## ILLUMINATION

***Retina Today:* What are the differences between xenon, metal-halide, mercury vapor, and light-emitting diode (LED) light sources?**

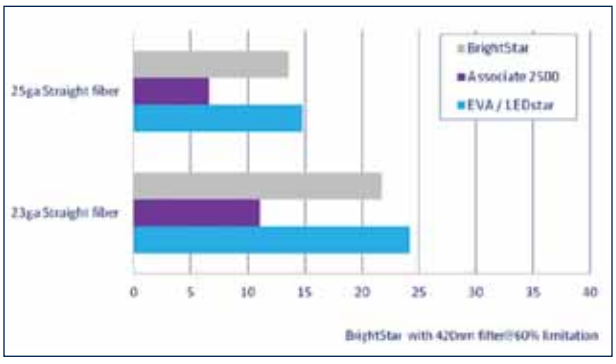
**Dr. McCannel:** The principal difference between all of these is spectral output. Each light source has a different "temperature" of light due to the varied mix of colors, which not only contributes to the brightness but also to safety. The blue and infrared lights are not as safe as other colors but can be managed well with light filters.

Mercury vapor light has some advantages in that it minimizes the blue-light component; however, it has 2 spikes in its spectral distribution that result in a greenish-white light that cannot be managed with filters.

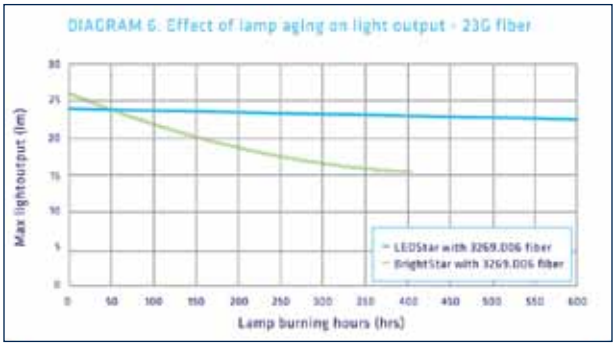
The xenon light has a broader plateau of spectral output so the lower wavelengths can be cut off. They still, however, have a fairly large area under the curve in terms of blue, and this is where light filters are useful in increasing the safety. However, there is still a fair amount of blue light, and if the light source must be held close to the retina for a long period of time, a phototoxic event may occur.

The LEDStar (DORC) technology uses an LED light source, which has a nice white light, and one of its curves to the spectral sensitivity of the eye.

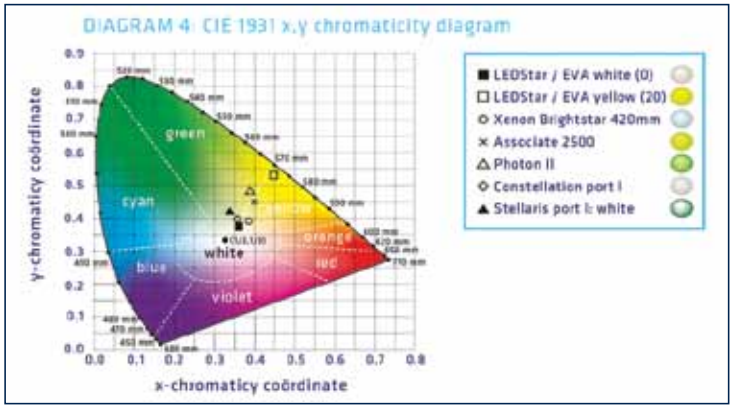
The LED bulbs are very robust and do not break easily. The LED lights last a long time—from 10 000 to 20 000 hours. The metal-halite bulbs are good, but they fade after 400 hours or so and must be replaced, so the longevity of the LED lights is a significant advantage in terms of maintenance and cost.




**The maximum light output of the LEDStar is greater than with the BrightStar or the Associate 2500.**




**The effect of lamp aging on light output with a 23-gauge fiber.**




**Chromacity scale showing the LEDStar as falling in the whitest, brightest coordinates.**

# Safety of Vitreoretinal Illumination

**BY COLIN MCCANNEL, MD**

With regard to safety, a light's spectral output curve should overlap as little as possible with the photochemical hazard curve (Figure 1). There should be more spectral energy at lower wavelengths to decrease the risk of retinal photoxicity.

The new LEDStar light without additional filters emits a white light that overlaps little with the phototoxicity curve (Figure 2). Used with a yellow setting of 20, the light source presents virtually no photochemical toxicity and emits a light that is distinctly yellow (Figure 3). If the yellow color is dialed down to 10, there is minimal risk of phototoxicity (Figure 4).

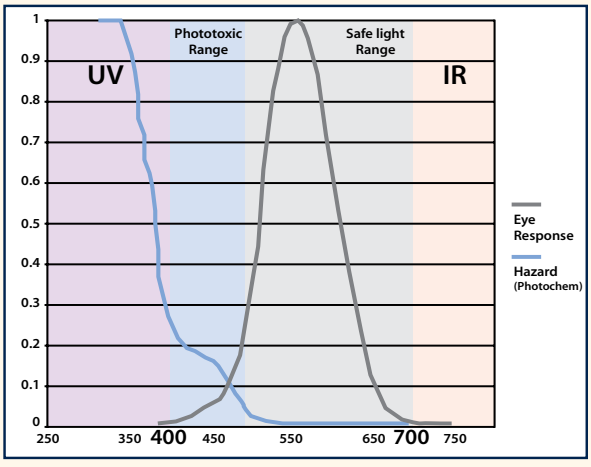



**Figure 1. Photochemical toxicity (red) and eye response curve (white).**

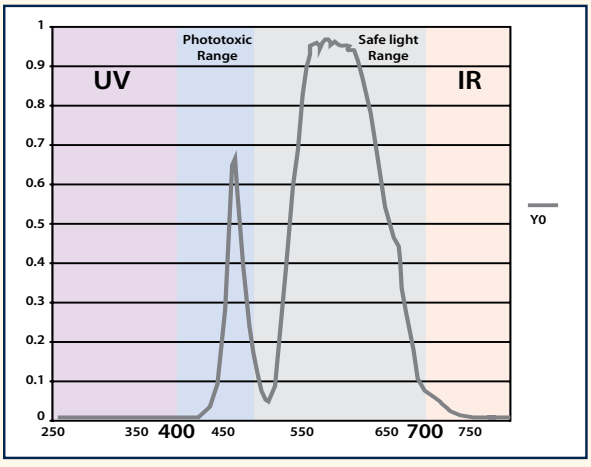



**Figure 2. LEDStar: White light.**

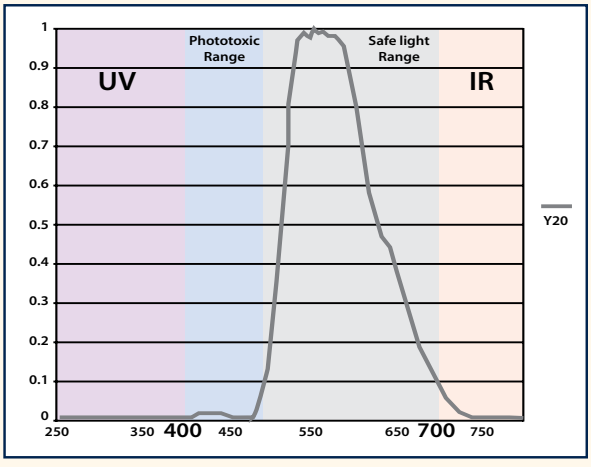



**Figure 3. LEDStar: Yellow (20) light.**

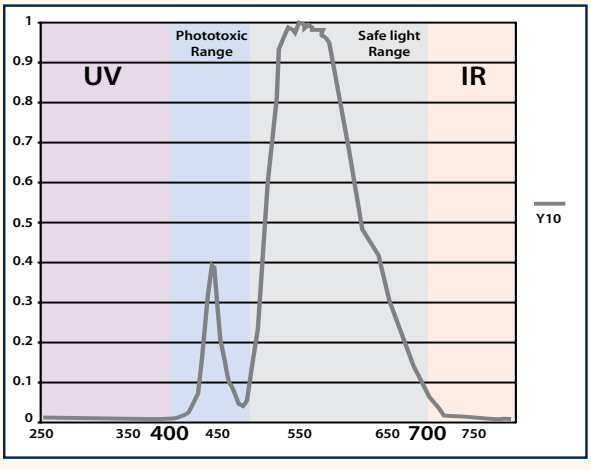



**Figure 4. LEDStar: Yellow (10) light.**

**Prof. Eckardt:** I have used the Xenon BrightStar (DORC) illumination system since it was available 5 years ago. The LEDStar lighting on the EVA is even brighter, which is particularly important when using 27-gauge fibers.

**Dr. McCannel:** I use the LEDStar at 30% to 40% of its maximum output for 23-gauge vitrectomy, and it is very bright.

**Prof. Stalmans:** I use the widefield fibers, which require approximately 70% to 80% ouput. It is possible to balance the color of the light because there are 3 outputs, each with a white and yellow light that allows you to choose the amount of white and yellow light that is desirable. When I mix the LED light with a mix of 18% yellow light, I find that it is safe and good for visualization and video recording.

***Retina Today:* What style of light probe do you prefer to use in surgery?**

**Prof. Eckardt:** I use the shielded widefield light probe in combination with a 27-gauge chandelier for approxi-

mately one-third of my cases. I do not like the standard light fiber because it does not illuminate the eye as well.

**Dr. Pertile:** I use an unshielded widefield light probe with the 27-gauge Eckardt Twinlight chandelier.

**Prof. Stalmans:** I also use an unshielded widefield light probe.

**Dr. McCannel:** I usually only use a shielded widefield light probe because I tend to work with very little light.

## INTEGRATED LASER

***Retina Today:* What are your experiences with the laser on the EVA?**

**Prof. Stalmans:** The laser on the EVA system is an integrated 532 nm laser. I use an extendable probe that can be inserted as a straight probe and then becomes a curved probe in the periphery. The ergonomics of the integrated laser are excellent, and it is controlled via the foot pedal.

> "The ability to control the power on the integrated 532 nm laser from a foot pedal is a definite advantage in surgery."
> -Grazia Pertile, MD

**Prof. Eckardt:** The integrated laser is beneficial because it is 1 less instrument on the floor of the OR.

**Dr. McCannel:** I am a big fan of integrated equipment. It reduces the complexity for the OR staff.

**Dr. Pertile:** Yes, I agree. Also, the ability to control the power on the integrated 532 nm laser from a foot pedal is a definite advantage in surgery. I prefer to use the nonretractable curved fiber probe, which is easy to use in the periphery.

# RPE Tears in Wet AMD: Natural History vs a Surgical Approach

**BY GRAZIA PERTILE, MD; ANTONIE POLITO, MD; MAURIZIO METE, MD; AND ANTONIO PEROGLIO, MD**

Retinal pigment epithelial (RPE) tears have been an ongoing issue in wet age-related macular degeneration (AMD), but new developments in drug therapy as well as surgical management have offered retina specialists alternatives for treatment.

The role of anti-VEGF therapy in RPE tears associated with AMD has been explored in many different studies, and in general, it has been shown that there is a low incidence rate of RPE tears among eyes injected with anti-VEGF drugs.[1-4] However, it has been shown that there appears to be a higher rate of RPE tears in eyes with vascularized pigment epithelial detachments (PED), so when injecting eyes with an anti-VEGF agent, this is an important factor to consider.[5,6]

## PREDICTORS AND PROGNOSES OF RPE TEARS WITH ANTI-VEGF THERAPY

The classic predictors of RPE tears include a large PED basal diameter on fluorescein angiography (FA)[5] and elevated pre-injection PED height of greater than 400 µm.[5,6] More recently, it has been found that small folds in the RPE and sub-RPE tissue across the chord diameter of the PED can also predict the incidence of an RPE tear. When associated with anti-VEGF injections, the hypothesis is that after injection, further contraction of the choroidal neovascularization beneath the PED occurs. The natural history of RPE tears after repeated injection with anti-VEGF agents in eyes with PED reveals a poor prognosis, particularly when there was foveal involvement of the central RPE and morphologic transformation of the RPE tear.[7] The prognosis appears to be better when there is no foveal involvement.[8]

In 2010, Sarraf et al[9] proposed a new grading system for RPE tears following anti-VEGF injections to help predict how eyes would respond to further injections of anti-VEGF agents. They found that the lower-grade tears, smaller than 200 µm or less than 1 disk diameter, had a better response to repeated anti-VEGF therapy, but higher-grade tears, greater than 1 disk diameter with central foveal involvement, had poor prognoses with or without anti-VEGF treatment.

## SURGICAL APPROACH TO RPE TEARS

We conducted a study to evaluate the prognoses of patients who underwent surgical procedures to address RPE tears compared with anti-VEGF therapy. There were 40 patients with RPE tears in our study. Eleven of these patients underwent anti-VEGF treatment (group 1), 12 underwent macular translocation surgery (group 2), and 7 underwent autologous choroidal graft surgery (group 3). Using the

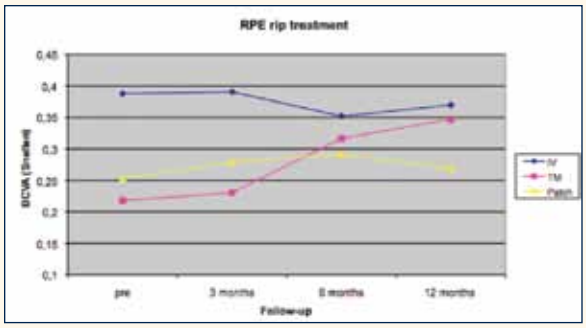



**Figure 1. Results for far BCVA between groups.**

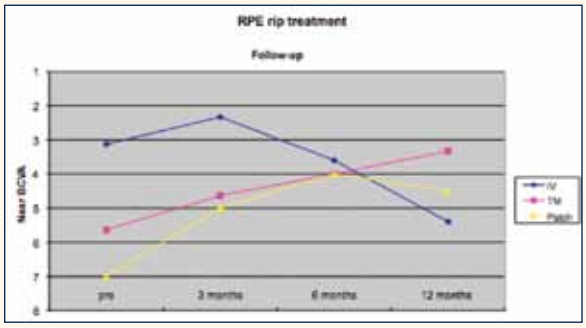



**Figure 2. Results for near BCVA between groups.**

grading system for RPE tears proposed by Sarraf et al, we determined that the mean grade of RPE tears was 2.9 in group 1, 3.5 in group 2, and 3.6 in group 3.

## STUDY FINDINGS

Our results are shown in Figures 1 and 2. The mean far, as well the near, best corrected visual acuity (BCVA) at baseline was better in group 1 than in group 2 and 3. We found that treatment with anti-VEGF agents for AMD complicated by RPE tear resulted in a substantial stabilization of the far BCVA during 12-month follow up. Group 2, the patients that undergone a macular translocation, had a significant improvement in BCVA, while patients treated with autologous choridal graft transplantation showed only a slight increase.

The near BCVA decreased throughout the follow-up period in Group 1 (anti-VEGF therapy) but improved significantly both in Group 2 and 3.

It should be noted that there was a bias that existed in the functional results in Group 1. Some patients who experienced visual loss after initial injections of anti-VEGF agents were switched to the surgery groups. Therefore, those patients who were counted in the results of Group 1 had the best results from anti-VEGF injections. Even with this advantage, there was still a significant decrease in near BCVA in Group 1.

## SUMMARY

In summary, it appears that macular translocation surgery may prove to be a reasonable approach to RPE tears in AMD, particularly for higher grade tears.

1. Ronan SM, Yoganathan P, Chien FY, et al. Retinal pigment epithelium tears after intravitreal injection of bevacizumab (avastin) for neovascular age-related macular degeneration. *Retina.* 2007;27(5):535-540.
2. Chan CK, Meyer CH, Gross JG, et al. Retinal pigment epithelial tears after intravitreal bevacizumab injection for neovascular age-related macular degeneration. *Retina.* 2007;27(5):541-551.
3. Smith BT, Kraus CL, Apte RS. Retinal pigment epithelial tears in ranibizumab-treated eyes. *Retina.* 2009;29(3):335-339.
4. Cunningham ET Jr, Feiner L, Chung C, Tuomi L, Ehrlich JS. Incidence of retinal pigment epithelial tears after intravitreal ranibizumab injection for neovascular age-related macular degeneration. *Ophthalmology.* 2011;118(12):2447-2452.
5. Chiang A, Chang LK, Yu F, Sarraf D. Predictors of anti-VEGF–associated retinal pigment epithelial tear using FA and OCT analysis. *Retina.* 2008;28(9):1265-1269.
6. Chan CK, Abraham P, Meyer CH, et al. Optical coherence tomography–measured pigment epithelial detachment height as a predictor for retinal pigment epithelial tears associated with intravitreal bevacizumab injections. *Retina.* 2010;30(2):203-211.
7. Gutfleiscsh M, B Heimes B, Schumacher M, Dietzel M, Lommatzsch A, Bird A, Pauleikhoff D. Long-term visual outcome of pigment epithelial tears in association with anti-VEGF therapy of pigment epithelial detachment in AMD. *Eye.* 2011;25:1181-1186.
8. Moreira CA Jr, Arana LA, Zago RJ. Long-term results of repeated anti-vascular endothelial growth factor therapy in eyes with retinal pigment epithelial tears. Retina. 2013;33(2):277-281.
9. Sarraf D, Reddy S, Chiang A, Yu F, Jain A. A new grading system for retinal pigment epithelial tears. *Retina.* 2010;30(7):1039-1045.

**Dr. McCannel:** I prefer the directional laser probe in straight position posteriorly, and then I pull back the shaft, and the probes curves for peripheral work.

## COMBINED PROCEDURES

### *Retina Today:* What percentage of your cases are combined phaco-vitrectomy?

**Prof. Stalmans:** Thirty-seven percent.

**Dr. Pertile:** Approximately 40% of my cases are combined.

**Prof. Eckardt:** At least 50%.

**Dr. McCannel:** I do perform combined cases when patients have such limited insurance that they are unable to find a cataract surgeon. I am very comfortable performing cataract surgery, but in the United States, most retina surgeons do not perform combined procedures.

**Prof. Stalmans:** When a patient is 50 years of age or older, I will automatically remove the lens prior to vitrectomy. For patients with severe diabetes or when I am using silicone oil, I will also remove the lens.

### *Retina Today:* Do you use flow or vacuum mode for phaco?

**Prof. Stalmans:** In a typical phaco procedure, I switch between flow and vacuum 4 times. I perform sculpting in flow mode, my lens removal in vacuum mode, cortex removal again in flow mode, and then I polish in vacuum mode, and then raise the vacuum to remove the viscoelastic.

**Prof. Eckardt:** You polish the capsule in vacuum mode?

**Prof. Stalmans:** Yes. I block the vacuum at 60 mm Hg and use diamond-dusted cannulas. Because of the low vacuum, I never have traction or rupture of the fibers.

# A New Cutter to Quickly Remove Vitreous

**BY CLAUS ECKARDT, MD**

A consistent goal of retina surgeons has been to increase the efficiency and safety of our surgical procedures. There have been several advancements to technology over time that have helped in this regard, including improvements to our vitreous cutters and smaller-gauge instrumentation. Some surgeons have independently proposed alterations to the available technology that have proved novel and interesting.

In 2010, Lima et al[1] evaluated 5 modified 20-gauge dual-port cutter tips vs a standard 20-gauge single-port tip and found that a dual-port configuration modified outer-tube design resulted in improved flow, leading to more efficient removal of vitreous in porcine eyes.

In 2011, Rizzo et al[2] proposed a modification to 23-gauge vitreous cutters, whereby opening in the internal guillotine blade of the cutter was added to increase flow in small-gauge surgery, increasing overall efficiency. The removal time of porcine vitreous in this study was decreased by 35%.

## TWIN DUTY CYCLE

We have developed a new design (TDC vitrectome, DORC) that uses a larger rectangular aperture in the inner tube of the cutter, and a blade with 2 sharp cutting edges. This idea builds on an older concept, for which Hayafuji et al, received a US patent in 1992. The vitreous is brought into the inner aperture and cut in a forward and then backward motion, increasing the amount of vitreous that is cut in a single motion (Figures 1 and 2). The port on this new cutter is larger than previous designs, which, in theory, would result in a greater amount of material taken in per cut and a faster surgery overall.

We compared the aspiration flow rate in balanced salt solution and porcine vitreous with this new 23-gauge double-port vitrectome (DORC, patent pending) to that of a standard 23-gauge vitrectome and found that, even as the cut rate increased from 0 to 8000 cpm, the flow rate remained fairly constant. In contrast, with the standard vitrectome, as the cut rate increased, the aspiration flow rate decreased steadily (Figure 3). Additionally, the amount of vitreous removed was between 30% and 40% more than with a standard cutter.

## SUMMARY

The aperture in the inner tube results in an almost constant aspiration flow into the port, thus removal of the vitreous can be done more quickly, resulting in a more efficient surgery. In clinical use, the TDC vitrectome worked well and shows promise for a faster vitrectomy both with 23 and 25 gauge.

1. Lima LH, DeBoer C, McCormick M, Kerns R, Bhadri P, Humayun M. A new dual port cutter system for vitrectomy surgery. *Retina*. 2010;30(9):1515-1519.
2. Rizzo S. Performance of a modified vitrectomy probe in small-gauge vitrectomy. *Retina Today*. 2011;6(6):40-42.

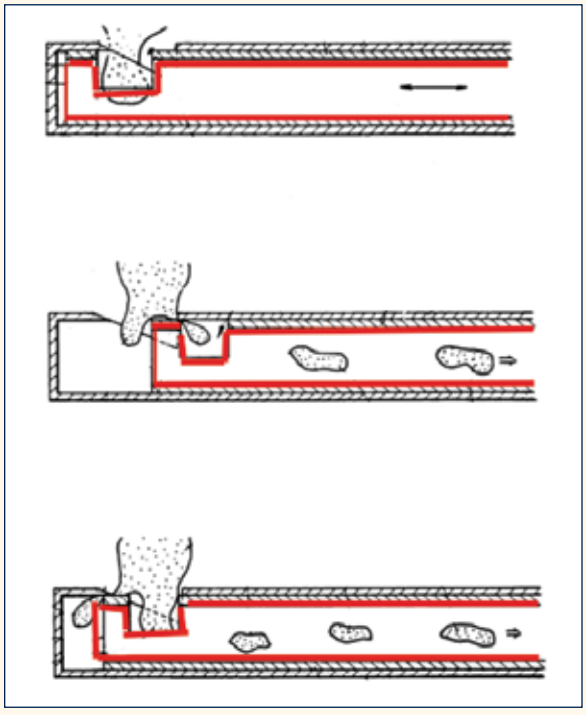


**Figure 1. Design of TDC vitrectome based on that of Hayafuji.**

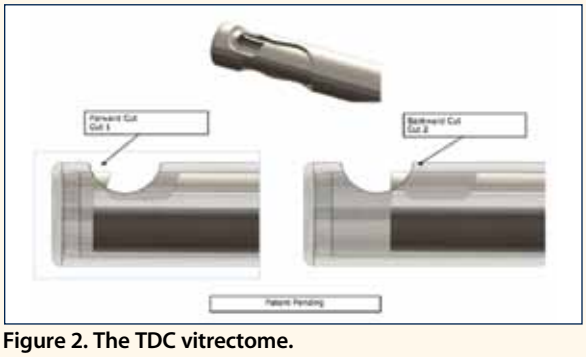


**Figure 2. The TDC vitrectome.**

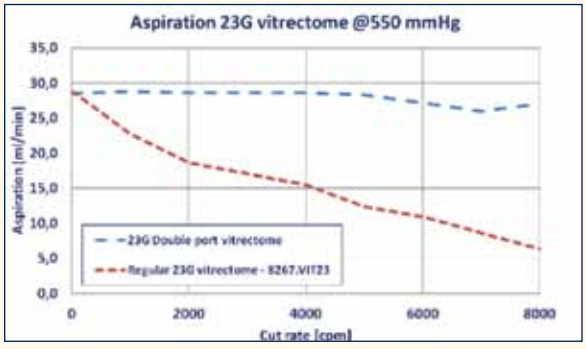



**Figure 3. Aspiration stays more constant with new design.**

***Retina Today:* How does the EVA effect anterior chamber stability?**

**Prof. Stalmans:** The vacuum threshold feature is built into the EVA. If when you begin phaco, the foot pedal is depressed and there is no occlusion at the phaco tip, the machine will only go up to 200 mm Hg. Only when the phaco tip is occluded will the machine allow a vacuum of 400 mm Hg, which will bring the piece of lens toward the tip. After the lens particle is emsulsified and the occlusion breaks, the vacuum automatically returns the vacuum to 200 mm Hg, stabilizing the anterior chamber. Using higher vacuum will also allow for a reduced use of phaco power for lens removal, which is safer for the endothelium.

**Prof. Eckardt:** The EVA is very effective for sculpting, but the most important factor to me is the stability of the anterior chamber, and, for this the EVA is superior to the Associate.

**Prof. Stalmans:** The superiority of the EVA is because of the pump reaction time.

## FOOT PEDAL CONTROL

***Retina Today:* Are you using dual-linear, single-linear, or 3-D control from your foot pedal?**

**Prof. Stalmans:** It depends upon the task. For example, in a phaco procedure, when I am making a groove in the lens, I use single-linear control, and when I extract the lens fragments, I work in dual-linear mode. For core vitrectomy, I work in dual-linear mode so that I can control the aspiration in 1 direction vertically and the cut speed horizontally. For shaving, I work in single-linear mode the entire time at the highest cutting speed. I can control the flow in a vertical direction with my foot pedal. I never use 3-D mode.

**Dr. Pertile:** I use single-linear mode for phaco and dual-linear mode for vitrectomy.

**Prof. Stalmans:** A major improvement to the foot-pedal on the EVA is that it is now wireless on both the phaco/virectomy machine and the laser. Also, the machine requires that when the nurse is priming, he or she must press on the foot pedal, so that it cannot be forgotten.

## THE EVA COMPARED WITH OTHER TECHNOLOGY

***Retina Today:* With which vitrectomy systems do you have experience?**

**Dr. McCannel:** We primarily use the Stellaris PC (Bausch + Lomb) and the Constellation Vision System, and we also have an Accurus (Alcon) at 1 of our county hospitals, so I use a variety of systems. All of these systems, however, are venturi pump-based, and I am very keen on having access to a flow-controlled system because I think that it will make shaving the peripheral retina easier and safer. I attend European meetings, and I hear that flow-based systems that are not available in the United States have a significant advantage for shaving close to the retina. It probably does not make much of a difference in core vitrectomy, but when operating in the periphery, an incredibly fast rise time of the venturi vacuum becomes more of an enemy than a friend.

> "I am very keen on having access to a flow-controlled system because I think that it will make shaving the peripheral retina easier and safer."
>
> -Colin McCannel, MD

I have used the peristaltic pump on the Associate, and I did like it for peripheral vitrectomy—there was a noticeable difference compared with venturi. I am looking forward to trying the EVA with this hybrid technology that essentially cancels out the disadvantages of both venturi and peristaltic systems.

***Retina Today:* In general, how does the EVA compare to other phaco/vitrectomy systems?**

**Prof. Stalmans:** I have worked with the Constellation a few times, but the many tweaks and changes that were required on the system hindered my potential use.

As I stated previously, the AIC is extremely simple on the EVA—more pressure is injected into the bottle as more fluid is aspirated. The Constellation measures the flow in the infusion and attempts to compensate, but, in some cases, if there is some silicone oil trapped in the infusion line during oil removal, the machine almost completely stops generating flow during infusion. This will not happen with the EVA. In my opinion, the Constellation is over-engineered and has so many built-in components that the surgeon actually loses some control.

**Dr. Pertile:** In my opinion, the flow control and IOP AIC control on the EVA is a major improvement over other systems. My experience includes the Constellation and the OS3 (Oertli). Per Prof. Stalman's comment: I do not necessarily think that I lose control with the Constellation because over time, I have learned how the machine is going to react. However, I prefer how the EVA reacts to such things such as when I switch from vacuum to flow. I also like the AIC on the EVA because it is simple compared with the complex system on the Constellation.

**Prof. Eckardt:** I find it difficult to compare technologies, particularly when I am very familiar with a particular platform. I tested the Constellation almost 3 years ago for 2 weeks and was never completely comfortable with it.

**Prof. Stalmans:** I agree with Dr. Pertile that becoming accustomed to new technology will often take time, but I clearly remember that, when performing my first cases with the EVA, I felt as if I had been using the system for years. I was so used to performing surgery with the Associate, and using the EVA was like driving a newer model of the same car.

**Dr. Pertile:** That is interesting because this was not the case between the Accurus and the Constellation—the learning curve was steep.

***Retina Today:*** **We would like to thank the panel for their participation. This has been an informative conversation regarding advanced phaco-vitrectromy systems.** ■


**EVA Surgical System**

## Unique Components on the EVA

**Mayo surgical stand flexible arm**

**Wireless footswitch**


**Front-loaded cartridge with color and form-coded connectors**

## Vitrectomy Packs for the EVA Surgical System

Available packs: 20/23/25/27Gauge
Also available: EVA Vitrectomy Pack Gravity 20/23/25/27Gauge

8300.20G02 EVA Vitrectomy Pack VGPC 20G

8300.23G02 EVA Vitrectomy Pack VGPC 23G

8300.25G02 EVA Vitrectomy Pack VGPC 25G

8300.27G02 EVA Vitrectomy Pack VGPC 27G

## Phaco Instrumentation for the Eva

The flared angled phaco needle for EVA

The flared straight phaco needle for EVA

The straight phaco needle for EVA