

Small-gauge Vitrectomy:

Not Just Smaller – BETTER



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in cutting, fluidics, and more

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Small-gauge Vitrectomy

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Benefits and Challenges of Small-gauge Vitrectomy

>> *Significant advances achieved in less than 10 years*

Innovations in instrumentation — many resulting from feedback from early adopters in the field — have led to expanded indications for small-gauge vitreoretinal surgery. Driving acceptance of microincision techniques is the potential for several key benefits, among them improved wound construction, less vitreous hemorrhage, faster healing with less postoperative inflammation, improved comfort for patients, and faster visual recovery.

Intraoperatively, these fine-gauge instruments can be safely introduced into small spaces between membranes and retina, serving as multifunctional tools and facilitating tissue dissection. Using the latest generation technology, vitreoretinal surgeons are seamlessly managing more complex cases with the expectation of achieving self-sealing sclerotomies in most cases with no postoperative hypotony or endophthalmitis.

In this supplement, surgeons share their experiences with this rapidly evolving technology, from early challenges to innovative new instrumentation and techniques.

Benefits of Small-gauge Vitrectomy

How does small-gauge instrumentation improve vitreoretinal surgery? Chicago surgeon Yannek Leiderman, MD, PhD, reports three main advantages.

“First, the reduced diameter of the instrumentation in small-gauge vitrectomy systems enables us to access more pathology and operate ever closer to the retina and other structures, particularly when we are working in small spaces, trying to remove vitreous in a controlled fashion,” Dr. Leiderman says. “Second, the smaller instrumentation affords us greater fluidic stability, thereby reducing the turbulence that causes retinal motion in cases of detachment. Third, smaller incision sizes appear to induce less inflammation, more rapid recovery, and less discomfort postoperatively for patients.”

Benefits to patients are also important, as not-

ed by Colin A. McCannel, MD, Los Angeles. “One of the key advantages of small-gauge vitrectomy instrumentation is that the smaller the holes are, the less tissue damage there is, and the less healing has to take place,” he says. “This provides significant benefits to patients in terms of recovery time and discomfort during and after recovery.”

Dr. McCannel also appreciates the advantages of sutureless, self-sealing wounds. “All of the small-gauge instrumentation has been deployed to the marketplace with the idea that it can be used in a sutureless fashion,” he says. “We can insert the trocars in such a way that the holes seal themselves, obviating the need to place sutures to seal the holes to prevent leakage and pressure drops. With each subsequent generation of even smaller gauge instrumentation, the proportion of eyes with low pressures on post-op day 1 has decreased, because the smaller the hole, the easier it is for the tissues to re-approximate and seal well.”

Another benefit of small wounds that heal faster is a reduced potential for infection, says Asheesh Tewari, MD, Ann Arbor, MI. “The trend is definitely toward smaller-gauge instrumentation for all of these reasons,” he says. “That is the future.”

The transition from 20- to 25-, 23-, and now 27-gauge vitreoretinal surgery has not been without its challenges, as early adopters discovered.

Early Limiting Factors

“Some of the challenges we encountered during the development of the initial small-gauge instrumentation — 25-gauge in 2003 — were that the instruments were fairly flexible, the flow through the instruments was considered inadequate by many, and our traditional light sources, which were mainly halogen, were not powerful enough to provide sufficient illumination through the small instrumentation,” Dr. McCannel says.

These disadvantages seemed a fairly logical result of finer-gauge instruments, says Brian C.

Joondeph, MD, Denver. “We are accustomed to using our instruments to move and torque the eye,” he says. “The smaller-gauge instruments — cutter, light pipe, and so on — tend to bend during these maneuvers, which makes moving the eye and gaining access to the peripheral retina a little trickier.”

Dr. Leiderman concurs. “In spite of the refinements in the materials used to make vitrectomy needles, probes, forceps, and other instruments, flexibility remains a challenge,” he says. “These instruments are like oars in oarlocks in the eye in that they are inserted through the cannulas and we are pivoting them. As we apply force to the handles of the instruments externally — the smaller the diameter of the instrument, the more apt it is to flex or bend — changing the position of the tip in the eye and making it much more difficult to be precise in the eye.”

As for fluid flow, Dr. Joondeph notes, “Smaller incisions and ports mean less fluid flowing into the eye and less fluid and material flowing out of the eye. According to Poiseuille’s Law, flow is inversely proportional to the fourth power of the radius of the tube through which you are aspirating or infusing, meaning that small changes in the diameter of the vitreous cutter or infusion port lead to very large changes in flow rates. Simply put, you sacrifice flow the smaller you go.”

Similarly, surgeons sacrificed light as gauges decreased in size. “We illuminate our surgical field with a handheld fiber-optic light comprised of many tiny fibers; the smaller the gauge the fewer the fibers that can fit in the light pipe,” Dr. Joondeph says. “That is particularly an issue if a patient has some preexisting cataract that already acts as a filter. Even with the light at full power, I would like it to be brighter. That less-intense illumination was an inherent disadvantage with earlier small-gauge systems.”

Addressing Shortcomings

While early adopters tested the boundaries of small-gauge surgery, most surgeons continued to use 20-gauge instrumentation, which, although large by today’s standards, offers the rigidity and control favored in vitreoretinal surgery, as well as good fluidics because of its fairly large bore.

According to Dr. McCannel, improvements in fluidics and instrument rigidity were realized during the development of 23-gauge instrumentation.

“One of the early adaptations of 23-gauge instrumentation was developed by Dutch Ophthal-

mic Research Center (DORC) in collaboration with Claus Eckardt, MD, in Germany,” Dr. McCannel says. “It was a major boon at the time, because, to many, it represented a nice compromise between the traditional, familiar 20-gauge and the too flexible, unfamiliar 25-gauge instrumentation. While the 23-gauge addressed some of the challenges related to flow and instrument rigidity, more powerful light sources were also being developed so that the smaller diameter of the fiber optic became less important; however, it was still a limitation.

“Fast forward a few years, when DORC was interested in facilitating smaller-gauge vitrectomy surgery,” Dr. McCannel continues. “The company developed an excellent light-source that is powered by high-intensity LED lights that address some of the issues of output with an incredibly high lumen rating. Immediately, that became more than adequate for 23- and 25-gauge surgery. Furthermore, newer 25-gauge instrumentation was being manufactured with better metals and improved fluidics for slightly better flow than the first generation instrumentation. Small-gauge vitrectomy was getting more sophisticated with continuing interest in even smaller gauge instruments, giving birth to the idea of 27-gauge vitrectomy procedures.”

By 2010, when 23- and 25-gauge vitreoretinal surgeries were becoming the norm, Oshima and colleagues were pushing the small-gauge envelope further, testing the theory that smaller is better in terms of incision size.¹ They developed and evaluated a 27-gauge system that included an infusion line, a high-speed vitreous cutter, an illumination system, and a variety of vitreoretinal instruments.

While the fluid dynamics and cutting efficiency of this prototype system were not on par with 25-gauge surgery at that time, the authors reported no need to transition to a larger gauge, no need for sutures, and no postoperative hypotony. They concluded that 27-gauge vitrectomy surgery was feasible and had the potential to reduce concerns about complications related to wound sealing in selected cases.

A mounting body of evidence along with positive clinical experience with 23- and 25-gauge surgery set the stage for the development of a 27-gauge vitrectomy system. ■

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Pushing the Envelope in Small-gauge Surgery

>> *The impact of 2-dimensional cutter technology*

Most vitreoretinal surgeons today routinely use 25- or 23-gauge vitrectomy systems, but when the conversation turns toward the next stage in the small-gauge evolution — 27-gauge vitrectomy — concerns about flexible instruments, slow procedures, and inadequate illumination tend to resurface.

In response to these concerns and with an eye toward future advancements in vitreoretinal surgery, Dutch Ophthalmic Research Center (DORC) incorporated innovative new technology into its Enhancing Visual Acuity (EVA) surgical system, most notably a novel 2-dimensional cutting (TDC) vitrectomy probe, a VacuFlow valve timing intelligence (VTi) pump system, a high-flow infusion cannula, a high-powered LED light source, and several new instruments specifically designed for 27-gauge surgery.

While the EVA platform is best assessed in its entirety as a fully integrated surgical system, we asked early adopters to describe the advantages of the individual components, starting with the TDC vitrectomy probe.

A First: 2-dimensional Cutting

Designed by Mitrofanis Pavlidis, MD, Cologne, Germany, and developed for the market by DORC, the TDC vitrectomy probe was engineered specifically for use with the EVA surgical system. Unlike conventional cutters, the TDC probe cuts both forward and backward (Figure 1), effectively doubling the maximum cut rate to 16,000 cuts per minute (cpm).

While other systems allow surgeons to adjust duty cycle for port-biased open (core vitrectomy mode) and port-biased closed positions (proportional vacuum/shave mode), the EVA TDC vitrectomy system produces a constant duty cycle of 92% biased-open position and maintains aspiration even when the blade is in the “closed” position. In other words, the port is open 92% to 100% of the time, creating constant aspiration flow independent of cutting speed (Figure 2). These functions, along with other features of the EVA system, combine to create faster, more efficient surgeries.

In a comparative case series reported by Pavlidis in 2016, the mean duration of core vitrectomy procedures using 25-gauge and 27-gauge TDC vitrectomy probes was statistically significantly shorter than the mean duration for core vitrectomies performed with standard single-cut probes of the same gauge.¹ Procedures performed using a 27-gauge TDC probe were 34% shorter (–83.0 seconds) than those performed using a standard 27-gauge single-cut probe. Similar results were reported for 25-gauge vitrectomies: procedures performed using a TDC vitrectomy probe were 50% shorter

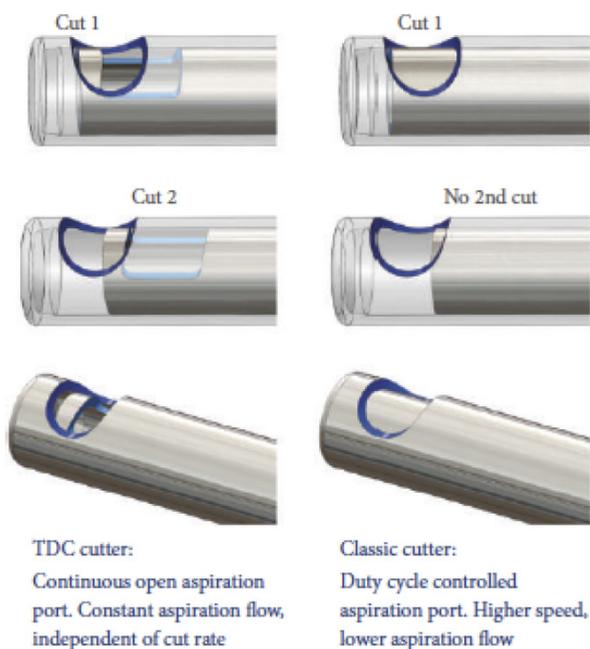


Figure 1. Two-dimensional cutter (left) compared with traditional single-cut design.

(-74.39 seconds) than those performed with a standard probe.

According to the study's author, these findings suggest that the TDC vitrectomy probe provides greater operating efficiency than conventional instrumentation during sutureless, small-gauge vitrectomy. Surgeons who are using this technology concur.

TDC's Impact on 27-gauge Surgery

Speed, efficiency, and safety are most often cited by surgeons as the most important features of any vitrectomy system, and advancements in these areas have made the transition to 27-gauge not only feasible but preferable for many surgeons.

"The TDC vitrectomy probe really shines in 27-gauge surgery," says Asheesh Tewari, MD, Ann Arbor, Mich. "The main sticking point for 27-gauge surgery before the introduction of 2-dimensional cutting was the time required to complete the vitrectomy. With a cutter capable of operating at 16,000 cpm and the advanced fluidics of the EVA system, that is no longer a concern."

Dr. Tewari's transition to 27-gauge surgery was driven mainly by its utility for diabetic cases.

"Surgical repair of tractional retinal detachment is a fairly delicate procedure, requiring us to navigate through tight spaces and around blood vessels to remove scar tissue from the retinal surface," he says. "If we get too close to blood vessels, they bleed. If we get too close to the retina, we can cut it, which changes the whole dynamic of the case."

"Traditionally, when using 23-gauge instrumentation, membrane dissections would be time-consuming," Dr. Tewari says. "I would often have to use several different instruments to enter into the various surgical planes. Twenty-seven gauge has changed that quite a bit, because the cutter port is so small that I can easily access those planes with the vitrectomy cutter alone."

Dr. Tewari also appreciates that the TDC probe acts as a multifunctional device, often replacing scissors and sometimes forceps, minimizing the number of instruments going in and out of the eye. "In my opinion, 27-gauge instrumentation has a distinct advantage over traditional larger-gauge instrumentation, which

TDC continuous open port allows for increased tissue removal efficiency independent of cut speed

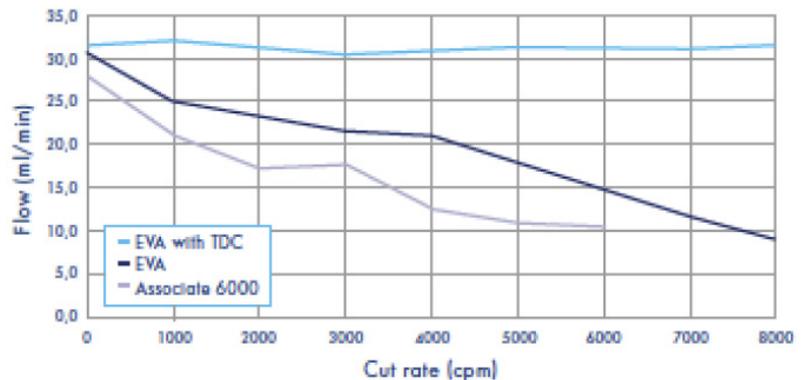


Figure 2. The continuous open port is designed to reduce turbulence and increase control.

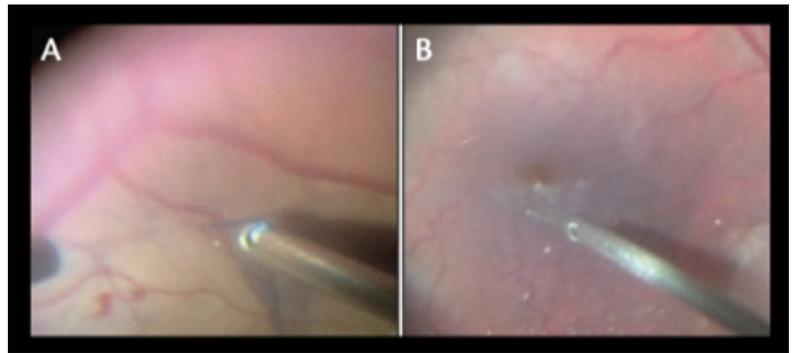


Figure 3. Smaller probe size with higher cutting rates afford surgeons greater control while minimizing potential for complications during delicate maneuvers, such as peeling the hyaloid and epiretinal (A) and internal limiting membranes (B).

is why I am transitioning to 27-gauge in the vast majority of my diabetic cases," Dr. Tewari says.

Using the 27-gauge cutter as a multifunctional tool is also high on the list of benefits related by Gaurav K. Shah, MD, St. Louis. "Being able to use the cutter to peel membrane, to get into tight spaces, and to have better control in the eye saves time in the OR," he says. "In addition, the smaller the cutter, the less chance of iatrogenic complications caused by engaging tissues that we do not want to engage."

Twenty-seven gauge has become Dr. Shah's predominant gauge for most if not all of his cases. He attributes his nearly complete conversion to 27-gauge to the TDC vitrectomy probe.

"Small-gauge instrumentation — whether you use 23-, 25-, or 27-gauge — has made a big impact on what we do," Dr. Shah says. "For me,

Minimizing Discomfort

“One of the reasons why I have embraced 27-gauge vitrectomy technology with open arms is because my patients remark on post-op day 1 that they do not feel like they had eye surgery at all,” says Colin A. McCannel, MD, Los Angeles. “They have zero discomfort, and instances of borderline low pressures are extremely rare. The tradeoff in the OR of longer vitreous removal times — which are really no longer with 27-gauge TDC than with 25-gauge non-TDC instrumentation — are really obviated by the comfort advantage. It has been a wonderful tradeoff. Patients very much appreciate it.”

Gaurav K. Shah, MD, St. Louis, agrees that minimally invasive vitreoretinal surgery with small-gauge instrumentation has had a positive impact on patients’ comfort, with shorter procedure times, smaller self-sealing wounds, less postoperative inflammation, and quicker recoveries.

“In retina, we have paid little attention to comfort when it comes to surgery, assuming that retina surgery hurts,” Dr. Shah says. “Well, no. Surgery should not hurt, unless it has to. While we are focused on fixing the anatomy, we need to do so in the least invasive way possible. I have learned that pain is minimal to nonexistent when patients have had 27-gauge vitrectomy.”

For the same reasons laparoscopic surgeries are preferred over open surgeries in other areas of medicine, so too are minimally invasive retina surgeries, Dr. Shah says.

“With minimally invasive surgeries, patients are more comfortable, they recover faster, and they have better outcomes,” Dr. Shah says. “Can every case be done that way? Of course not. But if we use the skills that we have, augment them, and have an open mind, we can do a very good job for our patients in the least invasive fashion.”

27-gauge with the TDC vitrectomy probe has made the biggest difference, particularly compared with 27-gauge surgery with a non-TDC probe. It would be akin to eating with a fork with three tines versus a fork with one tine. Both are forks, but using the former is faster and more efficient. In my opinion, the TDC vitrectomy probe is one of the best improvements in terms of making 27-gauge viable for most of my cases.

Brian C. Joondeph, MD, Denver, who uses predominantly 23-gauge instrumentation, appreciates the versatility of the 27-gauge cutter for certain situations. “It is small enough that I can get underneath membranes and use the cutter to engage, peel, and cut membranes that I might not be able to do with a 23-gauge cutter, particularly in diabetic patients,” he says. “For me, that is a big advantage.”

The 27-gauge instrument is also ideal for quick cases, such as vitreous hemorrhage and floaters, that require little to no retinal work, according to Dr. Joondeph. “I can get into the eye via a small incision, get my work done, and get out, and the eyes are white, quiet, and comfortable the next day,” he says.

According to Colin A. McCannel, MD, Los Angeles, the unique design of the TDC vitrectomy probe contributes not only to the speed with which procedures can be completed, but also to overall safety.

“Because the port of the TDC vitrectome is not completely occluded, we are achieving higher flow rates for quicker vitreous removal and fluid aspiration,” Dr. McCannel says. “In addition, because the blade is cutting in both directions, we are doubling the cut rate, which minimizes any traction that either flow control or vacuum control might have on the vitreous. The EVA can be turned down to 8,000 cpm, but it works perfectly well at the highest cut rate while minimizing vitreous traction. In addition, frequently disconnecting the aspirated vitreous from the vitreous that is still attached to the retina at a clip of 16,000 times a minute gives us another measure of safety in addition to the improved fluidics.”

A Simple Concept

“This is one of those times when you say to yourself, ‘Why didn’t I think of that?’ Dr. Tewari says. “Two-dimensional cutting is such a simple concept. Put a blade on both sides of the cutter

>> *Continued on page 12*

Vacuum Mode or Flow Mode?

>> *With the EVA system, there's no need to choose*

Any discussion of vitreoretinal surgery must include fluidics, specifically how the integrity of the eye is maintained while fluid flows through it during complex surgical maneuvers. With the introduction of ever smaller gauge instrumentation, the role of fluidics has become critical for safe and efficient surgeries.

“The most significant advances we have had over the last decade have been not only the implementation of smaller gauge vitrectomy instrumentation but also the engineering advances that have allowed for progressively improved control of fluidics,” says Yannek Leiderman, MD, PhD, Chicago. “Compared with previous generations of vitrectomy systems, we now have vastly improved abilities to precisely control the rate of fluid flow in the eye. Some platforms do that by modulating the vacuum and some by directly modulating flow.”

The Enhancing Visual Acuity (EVA) surgical system with VacuFlow valve timing intelligence (VTi) pump system (Dutch Ophthalmic Research Center) simulates the characteristics of either Venturi or peristaltic pumps, enabling surgeons to adjust settings to achieve either vacuum (Venturi) or flow (peristaltic) control. By combining the functionality of two types of pumps in one machine, surgeons can transition seamlessly between vacuum and flow mode without changing pumps, optimizing the fluidics according to each surgeon's preference and surgical demands.

Fast Fluidics Facts

Fluidics refers to the properties of fluid flow, and applied fluidics in engineering usually refers to fluid flow in closed systems, Dr. Leiderman explains. In the context of vitreoretinal surgery, fluidics refers to the flow rate — how quickly surgeons can remove and replace fluid and other tissues in the eye — and the differential, meaning how quickly surgeons can start and

stop fluid flow.

“In vitreoretinal surgery, we are always trying to balance the efficiency of removing vitreous while not disturbing the neurosensory tissues and other delicate structures that are intimately associated with the vitreous,” Dr. Leiderman says. “We aspirate in a controlled fashion, and we must be able to ‘apply the brake’ as close to instantaneously as possible.”

Dr. Leiderman notes a challenge all surgeons encounter frequently during retinal detachment repair is mobile retina, which is subject to turbulence created during surgery.

“When we are removing vitreous, aspirating with our instrument and simultaneously replacing fluid, turbulence is induced, causing the retina to flap around like a sail in the wind,” he says. “Ideally, what we want in terms of fluidics is a system that creates the least amount of turbulence in the eye, while maintaining flow at the probe port sufficient for efficient removal of vitreous.”

Versatility in the OR

Valve timing intelligence technology (Figure 1), a series of sensitive computer-controlled operating pistons and closure valves, is incorporated into the EVA surgical system and offers 2 distinctly different methods for surgeons to manage fluidics: flow control, whereby the fluid movement itself controls the amount of vacuum that is generated at the instrument tip, and vacuum control, whereby the flow is driven by vacuum.

“Vacuum control will make quick work of a vitrectomy, but if the tip of the instrument occludes, the vacuum builds up instantaneously so that the tissue is drawn into the port with great force,” says Colin A. McCannel, MD, Los Angeles. “Flow control is a slower, more controlled way of removing fluid from the eye. It can function at very low flow rates and still have aspiration.

“These two different fluidic controls offer dif-



Figure 1: The VacuFlow pump system offers 2 different methods for surgeons to manage fluidics: flow control and vacuum control.

ferent advantages in different situations,” Dr. McCannel continues. “Dutch Ophthalmic recognized that and built a machine that has both. Physicians who want to optimize surgery can use vacuum control for the portions of the surgery where vacuum control is most efficient, such as core vitrectomy, and they can switch to flow control when the instrument is getting closer to the retina, such as while shaving or trimming vitreous at a retinal break or working at the edge of a retinectomy. Working in flow control mode, we avoid the surges and turbulence that are possible in vacuum mode. The flow control is a gentle vacuum, and if tissue occludes the tip, you can quickly take your foot off the pedal and nothing bad happens. Whereas in the vacuum control situation, if the tissue occludes the tip, you almost always end up with a hole in the retina in that location.”

Benefits of Flow Control

Most U.S. surgeons are accustomed to using vitrectomy systems with vacuum-controlled fluidics, which have dominated the market here, while the trend among European vitrectomy machine

manufacturers seems to be toward flow-controlled systems, Dr. McCannel says. As U.S. surgeons become more familiar with flow control, they are coming to appreciate its utility.

Brian C. Joondeph, MD, Denver, now performs flow-based vitrectomy exclusively. “The EVA is the only system that has a flow-based aspiration system, which is a big advantage, particularly when working near detached retina,” Dr. Joondeph says. “While I am aspirating vitreous, blood, and saline, the flow is constant. I do not experience sudden surges of fluid into the eye when I encounter less resistance, as is the case with vacuum mode.

“Other vitrectomy systems allow me to adjust the duty cycle, which helps somewhat, but still perpetuates the challenges and disadvantages of vacuum-based vitrectomy. I prefer the flow-based control, because the amount of material flowing into the cutter is the same, regardless of what the material is. That makes it safer to work near detached retina, which is quite mobile, and if one is not careful, it is easy to engage retina in the cutter.

“Although I have the option of using vacuum-based control with the EVA system, I never use it, because the flow control works so well. It is predictable, reliable, and efficient,” Dr. Joondeph says.

Surgeons consistently mention efficiency and safety when discussing the benefits of the EVA system.

“In flow mode, as opposed to vacuum mode, we can precisely control what we remove from the eye,” says Gaurav K. Shah, MD, St. Louis. “There is no danger of the eye collapsing, because the machine senses the pressure and automatically adjusts the flow to compensate. This is an important safety feature, and the manner in which it functions is unique to the EVA system. Safety leads to better outcomes and more efficient surgeries.”

Asheesh Tewari, MD, Ann Arbor, MI, also appreciates the level of safety afforded by flow control. “VacuFlow technology controls flow so well that it allows me to work very close to the surface of the retina to perform procedures such as vitreous shaving,” he says.

Renewed Interest in 27-gauge

Dr. Tewari credits the EVA system, specifically the VacuFlow VTi pump, along with the 2-dimension-

High-flow Infusion Line Adds Value to EVA System

Dutch Ophthalmic Research Center recently introduced an over-the-cannula, high-flow infusion line designed to manage the increased flow generated by the 2-dimensional cutting (TDC) and 92% open-biased duty cycle that are hallmarks of the EVA surgical system. It is available in 23-, 25-, and 27-gauge.

“This is another one of those inventions where you say, ‘Why didn’t I think of that?’” says Asheesh Tewari, MD, Ann Arbor, MI. “The high-flow infusion line works in tandem with the TDC vitrectomy probe. If you are cutting in both directions at up to 16,000 cuts per minute and your port is open 92% of the time, you are aspirating a fair volume of fluid. The high-flow silicone infusion line delivers fluid into the eye at an appropriate rate without it tapering down into a smaller cone of fluid, which happens with traditional infusion lines.”

Colin A. McCannel, MD, Los Angeles, considers the high-flow infusion line another positive step in the evolution of the Dutch technology. “I am particularly fond of this advancement,” he says. “Typically in small-gauge vitrectomy, the infusion cannula fits inside the trocar cannula, occupying more lumen and restricting flow at the tip of the infusion line. With the high-flow infusion line, the tubing covers the trocar cannula — I call it a ‘hoodie’ — so that the full diameter is available for fluid to flow into the eye.

The utility of the high-flow infusion line becomes immediately apparent during a typical procedure.

“Traditionally, when you are aspirating fluid at maximum vacuum during core vitrectomy, you almost always outstrip the inflow when working at a constant pressure,” Dr. McCannel says. “The EVA system has flow compensation, whereby the pressure automatically increases to compensate for that difference. With the new high-flow tubing, however, you can stay at the same pressure and the infusion will keep up at that same pressure without causing hypotony and scleral in-folding, even at very high vacuum levels. Amazing.

“With the traditional cannula placed inside the trocar cannula, a narrow stream of fluid shoots out at a high pressure,” Dr. McCannel says. “With the high-infusion cannula, a larger bore delivers fluid into the eye at an appropriate rate without this very narrow jet shooting in, and it keeps the eye inflated constantly regardless of how much aspiration is being used during vitrectomy. It’s a way to maintain intraocular volume without having a high-pressure fluid jet shooting into the eye and causing who knows what problems in some cases. For instance, in the past it has been speculated that temporal visual field deficits following vitrectomy may be due, at least in part, to nerve fiber layer trauma from fluid jets hitting the retina near the optic nerve head.”

al cutting (TDC) technology developed by DORC for increasing interest in 27-gauge vitrectomy.

“One of the early criticisms of small-gauge vitrectomy was that it was too slow, and the flow was inefficient,” Dr. Tewari says. “That is one of the reasons why many surgeons did not jump on the 27-gauge bandwagon. But with the EVA machine, we can use a 27-gauge TDC vitrectomy probe — with a maximum cut rate of 16,000 cuts per minute and an open port 92% of the time — and it is aspirating all of the time. When I use the TDC probe for 27-gauge surgery, the fluidics

feels more like 23- or 25-gauge surgery than 27-gauge surgery. If not for the TDC vitrectomy probe and the fluidics of this system, I would not be interested in 27-gauge surgery.”

Summary

The idea of a surgical system with adaptable fluidics, one that combines a peristaltic-type pump for flow control with a Venturi vacuum pump, is a new concept in vitreoretinal surgery.

“The EVA system is predicated on peristaltic control, but the engineers have developed a

EVA BENEFITS

- EVA VTi fluidics is the ideal partner for the 2-dimensional cutting technology
 - Enhanced control with three times faster vacuum rise time than traditional Venturi
 - Designed to reduce the traditional pulsatile characteristics of peristaltic systems
- TDC + 27-gauge vitrectomy delivers the performance of 25-gauge vitrectomy with all of the outcome benefits of minimally invasive 27-gauge surgery.

novel way of inducing and controlling the flow of fluid,” Dr. Leiderman says. “A number of factors influence vitreous traction and turbulence during vitrectomy. Cutting rate, the frequency at which the guillotine blade is opening and closing on the cutter, is an important factor. The geometry of the port, the size as well as the shape of the opening in the vitrectomy probe needle, and duty cycle, the tempo of the opening and closing of

the blade, all affect the dynamics of retina and vitreous during surgery.

“As surgeons performing complex cases, it is advantageous for us to minimize the motion of retina and other tissues in the eye as we perform vitrectomy,” Dr. Leiderman says.

According to Dr. McCannel, the versatility of the EVA system creates opportunities for surgeons to tackle complex cases, knowing that they can adapt the fluidics to each individual case as well as their preferences.

“An increasing number of surgeons are recognizing the advantage of using the different fluidics for different situations, and the EVA machine makes this available to us, enabling us to choose the fluidic parameters that seem to be the safest and most efficacious for a given portion of the surgery,” Dr. McCannel says. “For me, that would be vacuum control for core vitrectomy and bulk vitreous removal. When I get close to the retina and I am dissecting vitreous from the retinal surface or performing a retinectomy, I value the opportunity to use flow control, because I find I have far more control than I do with the vacuum control in those situations.” ■

Pushing the Envelope

>> *Continued from page 8*

so that as it moves forward and backward, it is always cutting vitreous. If it is always cutting vitreous, the port is never really closed, and if the port is never closed, you are still aspirating fluid. This cutter really changes the whole game of fluidics.”

In addition, Dr. Joondeph notes, because the cutter port is always open, fluid is constantly flowing, and surges do not occur. “When I began using the 23-gauge TDC vitrectomy probe, I was amazed how quickly I could complete a vitrectomy,” he says. “All of a sudden it was done. The time it usually took just to remove vitreous from the eye before doing anything else was much faster. That is a big plus of the TDC probe.”

According to Dr. Shah, early concerns that small-gauge vitrectomy probes were too small and too flexible to have value have gone by the wayside.

“The maneuverability and the safety of the

TDC probe now works to its advantage,” he says. “For me, 23-gauge is still going to be useful for certain cases, such as foreign body cases and very anterior pathology, but even those cases I have tackled with 27-gauge because it works. Certainly, a bit more initial skill is involved, but we teach it, and our fellows are able to do it. Sometimes, people are too quick to give up on new technology just because it ‘doesn’t feel like what I am using.’ Well, it’s not supposed to feel like what they were using. This is something new.” ■

References

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A User-friendly System

>> *Easy operation, company support, unexpected growth*

The simplicity and ease-of-use of a vitrectomy system contributes to the overall positive atmosphere in the OR. According to Brian C. Joondeph, MD, Denver, nowhere are these synergies more important than in an ambulatory surgery center (ASC), particularly one that is not dedicated solely to retina or even ophthalmic surgeries.

“I operate at several multispecialty ASCs, and I don’t always have the same staff assisting me,” Dr. Joondeph says. “In fact, the nurses and technicians who assist with colonoscopies and total joint replacements are the same people who assist with my retina cases. Having an intuitive vitrectomy system, such as the EVA, which has a user-friendly interface that is easy to set up and navigate, is a must.”

Asheesh Tewari, MD, operates at St. Joseph Mercy Hospital in Ann Arbor, MI, another setting where OR staff must be able to shift gears for vastly different surgeries.

“Retina surgery is quite different from any other surgery, including cataract surgery,” he says. “Our equipment has many moving pieces that must be set up exactly to specifications for it to work properly.”

“We rotate a staff of five scrub technicians in the OR, and they have commented to me that the EVA machine is exceptionally user-friendly, with its touch screen and large color multifunction display.

“Even though there are many connections, tubing, and so on, the manufacturer has simplified it nicely, combining it with a touch screen that guides you through all of the installation steps and the different modes. The staff adapted to the machine quickly.”

When staff members are comfortable with the OR equipment, the surgeon’s stress level is reduced, Dr. Tewari says. “I know that if I need them to adjust machine settings, for example, they are right on top of it.”

Company Support

In terms of set-up, training, and trouble-shooting, Dr. Joondeph says Dutch Ophthalmic provides excellent customer support. “Being able to reach somebody who will help if something is not working properly or if we get an error message

“Retina surgery is quite different from any other surgery, including cataract surgery. Our equipment has many moving pieces that must be set up exactly to specifications for it to work properly.”

— Asheesh Tewari, MD

and we are not sure what to do is a big plus,” he says. “That is good and proper customer service. With any complex machine, nothing works perfectly all of the time, so to be able to reach a company representative in a timely manner is very important.”

Dr. Tewari has had a similar experience. “From a service perspective, the company has performed very well,” he says. “The hospital is quite satisfied and also uses many of the peripheral components, including forceps and microscissors.”

An Unexpected Benefit

Having made a commitment to retina by bringing in an EVA surgical system, administrators at St. Joseph Mercy Hospital are finding that this technology is helping to grow the business. “The hospital has been at the forefront and very supportive,” Dr. Tewari says. “As a result, it is becoming a retina hub, with other retina surgeons from the community bringing surgical cases to the hospital because of the EVA.” ■

Not Just Smaller – Better

>> *The latest vitrectomy systems integrate advances in cutting, fluidics, and more*

Rapid advances in small-gauge vitrectomy tools and techniques have contributed to efficiency, safety, and ultimately better surgical outcomes.

“It has been a complete revolution, starting with patient comfort to having smaller gauge instrumentation that more precisely matches the pathology,” says Colin A. McCannel, MD, Los Angeles. “If we put a 20-gauge instrument in the eye today, it looks like a stone-age club in terms of its size relative to the problem that we are trying to address. Back in the day, we were using gigantic 20-gauge scissors to cut tiny blood vessels between proliferative membranes and the retina, and we used to accidentally create many more holes than we do now. With

today’s smaller gauge vitrectomy systems, the scissors are so short, that it’s difficult to cause any collateral damage.

“Better yet, we don’t need to deploy additional instrumentation in many cases,” Dr. McCannel says. “For example, we can use the vitreous cutter for large portions, if not all, of the dissection in diabetic cases, where the pathologies are complex and sometimes difficult. In addition, we have more control over the fluidics with the modern machines, and certainly the EVA is a good example of that.”

What the EVA Brings to the OR

“The two major features I appreciate about the EVA machine are, number one, the TDC cutter

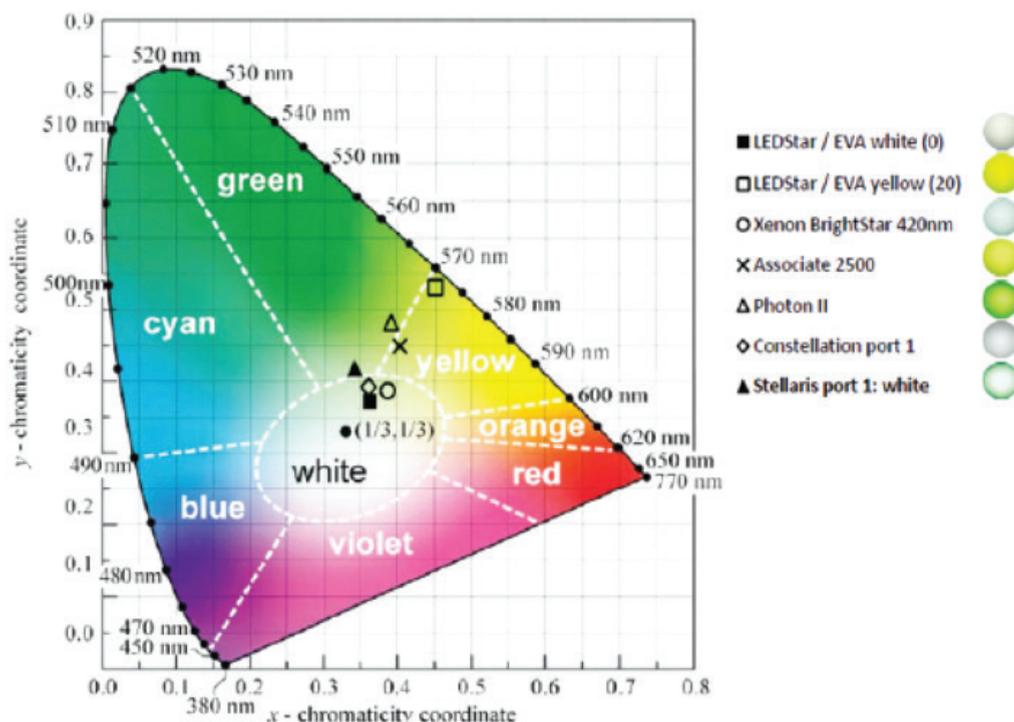


Figure 1. With the LEDStar illumination system, surgeons can control color from white to yellow and light intensity according to their preferences.

with its high flow rate and high cut rate, minimizing vitreous traction in cases where I do not want vitreous traction, and number two, the fluidics to support that minimization of vitreous traction,” Dr. McCannel says. “With the EVA, I can toggle between vacuum control and flow control so that I can use flow control when I’m getting close to the retina and I don’t want to have sudden tissue jumps into my cutting port causing holes that didn’t intend to make.”

Brian C. Joondeph, MD, Denver, uses 23-gauge instrumentation for most of his surgeries and 27-gauge in select cases, such as non-clearing vitreous hemorrhage, floaters, and some complex diabetic cases. He appreciates that the TDC cutter and various peripheral tools for the EVA system are available in 23-, 25-, and 27-gauge.

“All of the gauges have their roles, and the good surgeon will know what to use in each situation to get the best outcome,” Dr. Joondeph says. “The EVA trocars allow me to make sutureless incisions regardless of which gauge I use, and we use the DORC high-flow infusion line exclusively on all gauges in our surgery centers.”

When discussing fluidics, Yannek Leiderman, MD, PhD, Chicago, notes the VacuFlow technology of the EVA system comes into play when there is a potential mismatch between outflow and inflow. “One example is when we are performing surgery in an air-filled eye,” Dr. Leiderman says. “The EVA vitrectomy system allows us to precisely match the inflow of air with the outflow of tissue or air, thereby preventing any changes in the size of the compartment.

“Another advantage of small-gauge vitrectomy is the ability to remove tissue using the vitrectomy probe at the retinal surface where we need precise control to preserve underlying retinal tissue, such as in cases of complex diabetic tractional retinal detachments,” Dr. Leiderman says. “I have to emphasize that the experience and preferred tactics of the surgeon are significant in terms of being effective with these types of surgical maneuvers in complex cases, but I and other surgeons are excited about developing new tactics and exploring how to best harness these technologies.”

Asheesh Tewari, MD, Ann Arbor, MI, says

Safe, Powerful Visualization With LEDStar Illumination

- Utilizes light-emitting diode technology with long life span (>10,000 hours)
- Has high power threshold before potential for light toxicity
- Allows for color or light temperature adjustments (Figure 1)
- Facilitates bimanual surgical techniques with chandelier illumination*
- Provides up to 40 lumens without degradation of light output
- Delivers more than adequate illumination to differentiate tissues during microincision vitrectomy of all gauges.

**The EVA surgical system has 3 separate LED light ports to accommodate chandelier lighting systems.*

the EVA features and functions combined help create a smoothly running operating room.

“Our productivity in the OR has definitely improved,” he says. “The TDC cutter is fast and efficient, and the LED light source allows me to perform bimanual surgery, which also helps improve my efficiency.

“Our actual operative time — from the time I sit down at the microscope and begin the surgery to when I make my final closure and pull the microscope away — has decreased compared with when we were using the older technology,” Dr. Tewari says. “Also, from a safety perspective, the VacuFlow technology minimizes the risk of iatrogenic breaks while shaving vitreous during retinal detachment repair.”

Bottom Line: Benefits for Patients

“At the end of the day, the most important deciding factor is how our patients are doing,” Dr. Tewari says. “Are we providing better outcomes? I think the EVA machine helps make surgery safer and more efficient, which are the two goals that we expect from innovation.” ■