Supplement to
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Clinical Experience With the CONSTELLATION Vision System

Vitreoretinal surgeons discuss new features and concepts in vitreoretinal surgery.

Sponsored by Alcon Laboratories, Inc.

Introduction

The CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX) is an integrated vitreoretinal system that not only has advanced cutting capabilities, but also highly efficient flow and intraocular pressure control, an embedded 532 nm thin-disc laser system, and intelligent efficiency features that improve every aspect of a vitrectomy procedure.

The development of this system has been a long time in the making. Along with Alcon, the physicians who have been involved with the design of the CONSTELLATION Vision System have put a great deal of thought into the technology and how it would respond to many different surgical scenarios.

This supplement to *Retina Today* offers insight directly from those closest to the development of the CONSTELLATION system. Kirk Packo, MD, discusses the new cutter on the system and explains the importance of duty cycle to improved patient outcomes and efficient vitreoretinal surgery. Steve Charles, MD, explains how the flow control on the cutter functions for more efficient cutting. Roger Novack, MD, outlines how this new system has improved on illumination for small-gauge surgery while minimizing risks for light toxicity. David Dyer, MD, provides his clinical experience with the IOP control and fluidics on the CONSTELLATION system. Timothy G. Murray, MD, FACS, describes the new, highly efficient embedded 532 nm thin-disc PUREPOINT laser and finally, Pravin U. Dugel, MD, defines surgical efficiency and explains how the V-LOCITY Efficiency Components work in an integrated manner on the system to increase surgeon control of the system and make the surgical procedure easier. We also include panel discussions on clinical experience with the CONSTELLATION system featuring David Boyer, MD; Dr. Dugel; Peter K. Kaiser, MD; Dr. Murray; and Stanislao Rizzo, MD.

As vitreoretinal surgery has evolved, there has been an increased focus on not only the quality of patient care, but also on surgical efficiency. Many of us remember the days when four cases would take up an entire day on our surgical schedule. The expanding pathology that is amenable to surgical manipulation, however, has changed the volume of our cases and in turn, our procedures in the OR. The surgeons who have presented articles in this supplement all have asked the question, "Wouldn't it be great if we could be even more efficient?"

The integrated components of the CONSTELLATION Vision System improve our surgical capabilities and allow us to be more efficient surgeons in the care of our patients. Elegant and effective surgeons are those who are most efficient in their surgical maneuvers, and the CONSTELLATION system affords us the opportunity to be the best we can be for those who put their vision in our hands.

-Allen C. Ho, MD
Chief Medical Editor, *Retina Today*

Contents

High-speed Cutting and Duty Cycle Control

BY KIRK H. PACKO, MD

The main goal of every retina surgeon when removing vitreous is to not tear the retina. Vitrectomy and vitreous loss are not synonymous. There are two scenarios in removing vitreous: in the first, the surgery is controlled and the result is an eye with less vitreous; in the second, the surgery in uncontrolled and the result is a torn retina.

There are four principles to removing vitreous in a controlled fashion. First, do not pull the vitreous too close to the probe. Second, do not pull vitreous too far up the probe. Third, remove the vitreous in tiny pieces. Fourth, use as low a flow as possible. Regardless of the cut rate, vacuum, or duty cycle selected, it is important to maintain these four principles to avoid putting traction on the retina and cutting unintentionally.

> "Vitrectomy and vitreous loss are not synonymous."

THE RELATIONSHIP OF DUTY CYCLE AND CUTTING SPEED

Poiseuille's law explains the relationship between viscosity and length, but it only addresses a tube that is open all the time. In vitreoretinal surgery, we are operating with a tube that is opening and closing continuously. Duty cycle is essentially the ratio of open time to total time. A closed cycle is when the port is mainly closed and open for a short time, and conversely, an open cycle is when the port is open for most of the time. A 50/50 cycle is when the port is open in direct proportion to the time that it is closed.

The standard probes that have been available to us include an electric probe (ie, MILLENNIUM, Bausch & Lomb, Rochester, NY), which operates on a constant duty cycle, and a spring-pneumatic probe (ie, ACCURUS, Alcon Laboratories, Inc., Fort Worth, TX), which has a variable duty cycle. At a slower cut rate, the electric probe slows the time between the time port open and port closed, but the ratio between the two is equal, which means that the flow at fast cut rates vs high cut rates is the same. The only thing that changes between low and high cut rates is that the size of the pieces taken at higher rates is smaller. The pneumatic probe with the spring return has a variable duty cycle, meaning that the dwell time between each cut decreases at higher cut rates. The relationships between duty

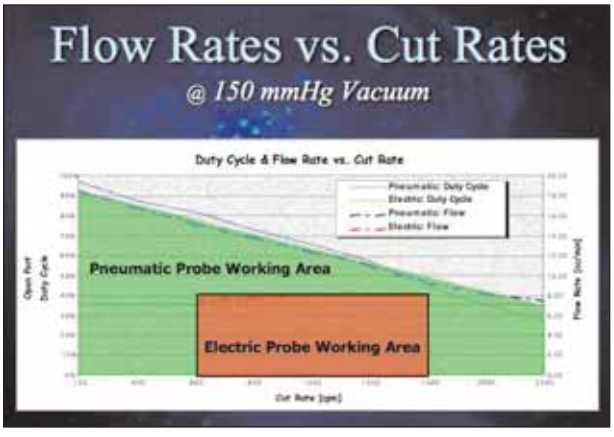

Figure 1. The relationship between duty cycle flow rates and cut rates.

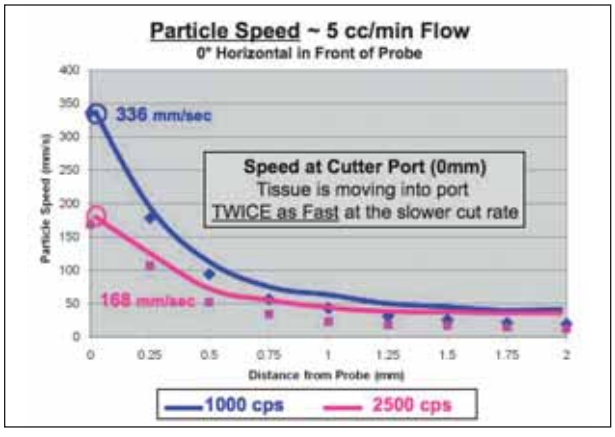

Figure 2. A slower cutting rate actually results in tissue moving more quickly to the port.

Figure 3. Ultraslow motion shows the stretch of the vitreous fiber.

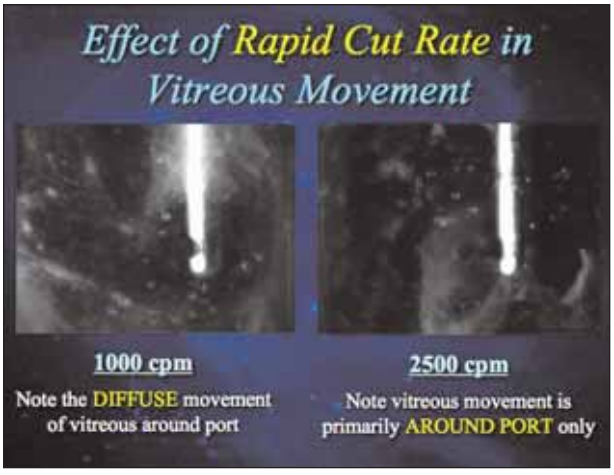

Figure 4. There is far more turbulence in the frame showing 1000 cpm than in the frame showing 2500 cpm.

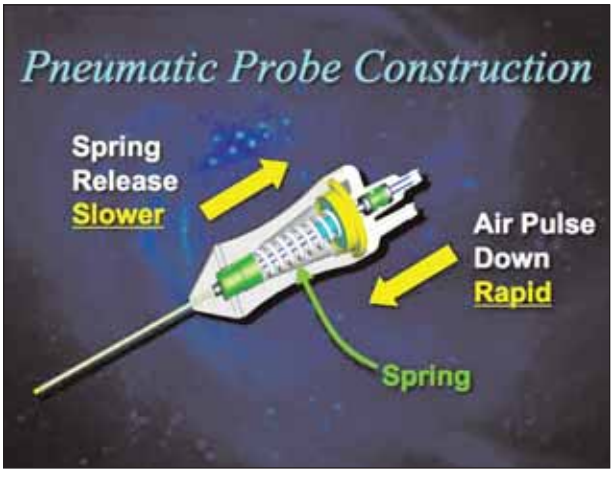

Figure 5. The spring-release mechanism slows cutting speed in the earlier pneumatic probe design.

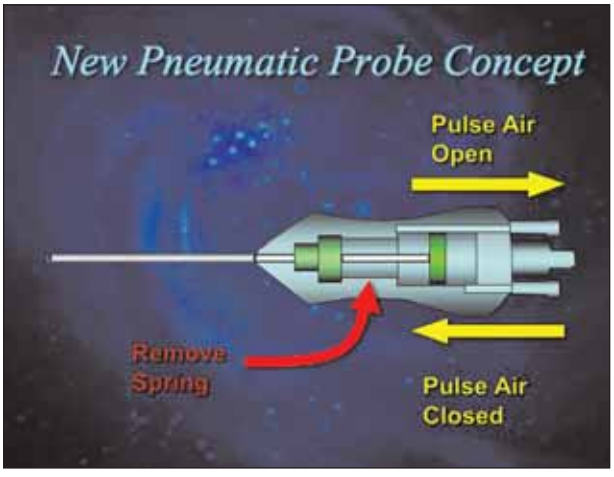

Figure 6. The new pneumatic probe eliminates the spring-release mechanism and uses pulsed air to control duty cycle.

cycle, flow rates, and cut rates are seen in Figure 1.

NEW PNEUMATIC PROBE

The CONSTELLATION Vision System (Alcon Laboratories, Inc.), has a newly designed ULTRAVIT pneumatic probe that operates on a variable duty cycle, but adds the ability to control the bias of the cycle to keep it primarily open or primarily closed.

Although it has been a goal for many years to create faster probes, it has been established that this is only significant for pneumatic probes because, as earlier stated, the electric probes merely cut smaller pieces at higher speeds with no change in flow.

Viewing the movement of particles in slow motion to the probe at various cut rates allowed us to see how fast tissue is moving to the probe and make a frame-by-frame assessment. At 5 cc's of isotonic flow, we looked at 1000 cpm vs 2500 cpm with the vacuum at various levels to ensure constant flow. In fact, we discovered that tissue was moving twice as quickly into the port at the slower cut rate (Figure 2). The action is all at the port—there is a significant difference in speed and the way that material is pulled.

Flow patterns are much more complex in real vitreous. Individual vitreous fibers are pulled "on stretch" to the port. When cutting occurs, the fiber snaps away, redistributing the remaining fibers. At ultraslow motion, the stretch of the vitreous fiber is apparent (Figure 3). The vitreous cuts cleanly, allowing remaining vitreous to snap away. When looking in slow motion with the same parameters as in the isotonic model (1000 cpm vs 2500, same flow and vacuum) there is far more turbulence in

FLOW CONTROL WITH THE CONSTELLATION

By Steve Charles, MD

The design of the new CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX) expands on the ACCURUS Surgical Systems (Alcon Laboratories, Inc.) integration theme. The CONSTELLATION system builds on the ACCURUS platform and has improved cutting, better fluidics, an advanced illumination system, and enhanced tool performance. Additional significant improvements on the CONSTELLATION system include new component technologies, an integrated laser system (PUREPOINT, Alcon Laboratories, Inc.), and efficiency components (V-LOCITY, Alcon Laboratories, Inc.).

The aspiration control system not only provides control of vacuum, cutting, and variable duty cycle, but also has flow-sensing capabilities. Thus, the surgeon can operate in a true flow mode or flow limiting mode. There is a distinct difference when you can push the foot pedal down and know that flow can be controlled to an exact level through the port. Flow control utilizes a digital feedback loop and an actual flow sensor.

Flow Limiting

Peristaltic pumps produce pulsatile vacuum and work without a feedback loop or flow sensing capabilities. They produce slower vacuum rise times as well as footpedal-commanded flow and/or vacuum decrease. The CONSTELLATION system utilizes a peristaltic pump and allows for 3-D cutting and proportional vacuum control. Additionally, the CONSTELLATION can utilize both flow limiting mechanisms and true flow control.

In addition to flow control the 5000 cpm high-speed cutting rate of the ULTRAVIT probe (Alcon Laboratories, Inc.) coupled with variable duty cycle control produces port-based flow limiting, which I have presented numerous times as a vehicle to decrease pulsatile vitreoretinal traction on both detached and attached retina.

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the frame showing 1000 cpm than in the frame showing 2500 cpm (Figure 4). There is a large amount of diffuse movement around the port at the slower cut rate, while the vitreous movement is primarily at the port at the faster cut rate.

Low cutting rates on a standard pneumatic probe result in a lengthy dwell open time for the port, resulting in high flow. If you cut at a higher rate, however, you are essentially stealing from the dwell time. The cutting time is the same, but the flow is even lower. Eventually, the machine will cap out as flow continues to decrease, minimizing the ability to cut effectively at higher speeds.

The new pneumatic cutter design removes the spring release (Figure 5) and replaces it with a pulse mechanism, which operates by using air to pulse the port open and pulse the port closed (Figure 6). The most important result of this new design is that dwell time is adjustable because either side of the pulse equation is changeable.

The advantages to the ULTRAVIT probe include the ability to cut at much higher rates and that duty cycles are easily controllable. The surgeon can keep the port biased open, biased closed, or even biased.

The working area with the ULTRAVIT probe is larger because of the ability to adjust duty cycle for a given cut rate and as a result, the surgeon has the ability to operate in any location efficiently.

SUMMARY

Duty cycle is an innovation that allows surgeons to control flow. The open-bias duty cycle, like our current ACCURUS probe, decreases flow with increasing cut rate. The closed-bias duty cycle on the ULTRAVIT cutter is new technology that allows surgeons to increase flow with increasing cut rate; once the cut rates reach high levels, such as 5000 cpm, the cut and flow become sinusoidal. Duty cycle is an inseparable parameter from cut rate and the improvements to the ULTRAVIT cutter have increased surgeons' capability to efficiently control flow during surgery. ■

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DISCUSSION

The discussions featured in this supplement to *Retina Today* are based on panel discussions held during the 2008 American Academy of Ophthalmology meeting in Atlanta.

David S. Boyer, MD, is a Clinical Professor of Ophthalmology at the University of Southern California Keck School of Medicine, Department of Ophthalmology in Los Angeles. Dr. Boyer is a member of the Retina Today *Editorial Board.*

Timothy G. Murray, MD, MBA, FACS, is Professor of Ophthalmology and Radiation Oncology at the Bascom Palmer Eye Institute, University of Miami Miller School of Medicine.

Stanislao Rizzo, MD, is at the Eye Surgery Clinic, Santa Chiara Hospital, in Pisa, Italy. Dr. Rizzo is a member of the Retina Today *Editorial Board.*

Pravin U. Dugel, MD, is Managing Partner of Retinal Consultants of Arizona and Founding Member of the Spectra Eye Institute in Sun City, AZ. Dr. Dugel is a member of the Retina Today *Editorial Board.*

Peter K. Kaiser, MD, is in the Vitreoretinal Department at the Cole Eye Institute, Cleveland Clinic. Dr. Kaiser is a member of the Retina Today *Editorial Board.*

David S. Boyer, MD: Key features of the CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX) that distinguish this system from other technology for vitreoretinal surgical procedures include high-speed cut rate and duty cycle control. How do these features translate to practice?

Stanislao Rizzo, MD: High cutting speed is important for safety because it should translate to less traction on the retina. Duty cycle is important because it allows me a new variable to control flow.

Timothy G. Murray, MD, MBA, FACS: For higher-volume vitreoretinal surgeons, the CONSTELLATION system is revolutionary. For the first time in my experience, technology is not an impediment in surgery. I prefer to cut at high rates, taking small pieces of tissue and minimizing the translational forces on the peripheral tissue. The limitation with previous technology is primarily the inability to maintain good flow at high cut rates. In core vitrectomy, I will use an open-bias cutter operating at 5000 cpm, and I can now switch to a closed duty cycle and shave tissue off the retinal surface with no movement to the detached or attached retina. So, for the first time, we are able to maintain 5000 cpm with the ability to have the flow characteristics for both core vitrectomy and those consistent with detached retina manipulation.

Dr. Boyer: Dr. Dugel, can you explain duty cycle control and its importance to complication prevention?

Pravin U. Dugel, MD: Duty cycle is an important parameter, albeit a newer concept to retina surgeons. By definition, duty cycle is the percentage of time that the cutter is open compared to the overall cut cycle time. Although there are specific percentages that can be assigned to the duty cycle, we usually refer to three: closed bias, open bias, and 50/50. In closed bias, the cutter mouth is closed most of the time and flow is reduced; in open bias, it is open and flow is increased. In 50/50, as one would assume, the amount of open-time and closed-time is equal and flow is moderate.

Duty cycle allows the surgeon to change flow without changing cut rate or vacuum, which is a significant improvement over the spring technology we have been using. As cutting rates were increasing, the limits of the spring-loaded cutter were maximized and the port was unable to stay open long enough for such fast cut rates. For example, with the ACCURUS (Alcon Laboratories, Inc.) at 2500 cpm, the port is only open approximately 30% to 40% of the cutting time. The new design of the ULTRAVIT cutter contains no springs, so there are two separate air lines, which means that duty cycle is completely in the control of the surgeon. One can cut at 5000 cpm and keep an open-bias duty cycle, eliminating the problem of decreasing flow.

Finally, duty cycle allows for excellent followability when dealing with fibrous tissue or retained lens material.

(Continued on page 10)

Advances in Illumination

BY ROGER NOVACK, MD, PHD, FACS

In the past 5 years, there have been significant advancements made to illumination for vitreoretinal procedures. The illumination on the ACCURUS system (Alcon Laboratories, Inc., Fort Worth, TX) has improved from using a halogen bulb to xenon light source technology. In this article, I will describe the illumination technology on the new CONSTELLATION Vision System (Alcon Laboratories, Inc.).

SYSTEM IMPROVEMENTS

The CONSTELLATION system has four ports for illumination, although the system allows the use of only two ports at any given time. A surgeon retains an advantage from the additional ports, because a combination of any two of these can be used simultaneously.

The improvements to the illumination system on the CONSTELLATION include: brightness and color that enhance visualization and enables surgeons to have visibility in corners of the retina that were previously unable to be viewed; a longer bulb life than on the ACCURUS, which could decrease costs because the bulb needs to be changed less frequently; and the ENGAUGE Radio Frequency Identification (RFID) probe recognition, which makes setup much easier and regulates the initial light output based on gauge and type of fiber optic.

XENON TECHNOLOGY

The new xenon bulb on the CONSTELLATION system provides bright, white xenon light to the maximum level allowed under current FDA irradiance limits.

The halogen light on the original ACCURUS was fairly faint and yellowish, and provided limited visibility. The xenon bulb on the ALCON AHBI (ACCURUS High-Brightness Illuminator), provided improvement in brightness and was filtered toward blue. The chromaticity diagram in Figure 1 shows the color spectrum of the ACCURUS halogen light, the ACCURUS xenon, the CONSTELLATION xenon, and the MILLENNIUM (Bausch & Lomb, Rochester, NY) metal-halide light source.

The xenon light source on the CONSTELLATION has moved away from blue light, retaining the white light, which has high-energy wavelengths that are easily absorbed by the retina.

The design of the illuminator (Figure 2) is different from other systems in that there is not a beam splitter, which can degrade the quality and intensity of the light. Rather, the CONSTELLATION illuminator uses a whole mirror system so that that same image is reflected to two separate pathways. The collimating lenses focus all light into the ports.

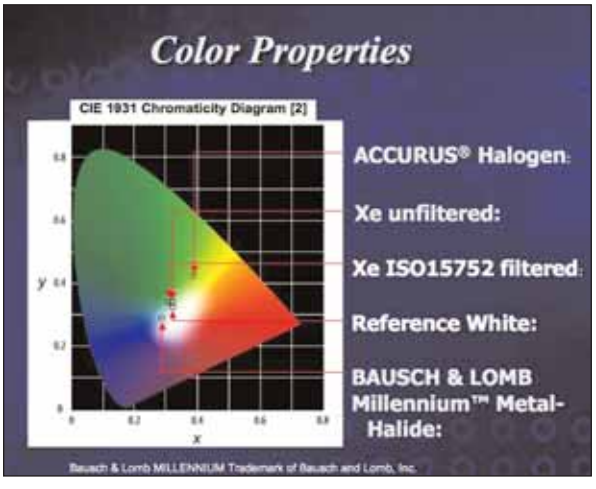

Figure 1. The color spectrum of the ACCURUS halogen light, the ALCON AHBI xenon, the CONSTELLATION xenon, and the MILLENNIUM metal-halide, the ACCURUS xenon.

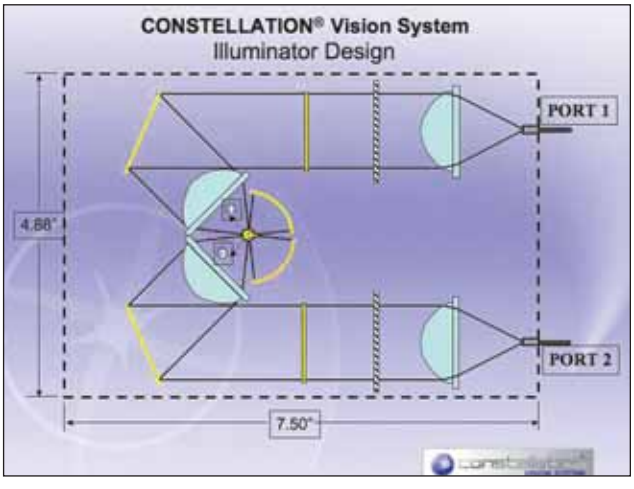

Figure 2. The illuminator design on the CONSTELLATION system.

BULB LIFE

The CONSTELLATION has been designed for more consistent light output over time. In the first 200 hours, the light output is extremely stable. The orientation of the lamp produces highly uniform illumination and the precise design and alignment of the fiber and bulb capture more light for better uniformity and efficiency.

The CONSTELLATION system indicates how many hours of illumination have been used. The life of the long-lasting xenon bulb is tracked by the system and provides total lamp hour and colored indicator ring feedback on lamp life: the green ring indicates from 0 to 200 hours; the yellow ring indicates from 201 to 400 hours; and the orange ring indicates from 401 to 800 hours.

RFID SYSTEM

The ENGAUGE RFID system automatically recognizes the type of Alcon device that is being connected, and populates the proper probe and gauge size into the system. The ENGAUGE RFID also provides a standard default setpoint feature that utilizes the probe and gauge information and automatically puts the surgeon at the default. For example, if the surgeon is using a straight or BULLET Wide-Angle Illuminator (Alcon Laboratories, Inc.), the system will default to a consistent 8 to 10 lumens light output. The surgeon maintains the ability to override the system and increase illumination, if needed, to the maximum US Food and Drug Adminstration-allowed output.

FIBER OPTICS

One of the challenges of 25-gauge surgery using halogen illumination was that the fiber itself is half the size of a 20-gauge system, reducing light by approximately 70%. In 20-gauge surgery, the halogen output is 10 lumens, whereas with 25 gauge, the output is reduced to 3 lumens, which is inadequate for surgery. Even with the use of illuminated instruments, it is difficult to see at that power. The new SAPPHIRE Wide-Angle Illuminator (Alcon Laboratories, Inc.) has a 750-µm fiber that goes from the machine all the way into the handle of the light pipe. The viewing angle on the SAPPHIRE is greater than 106º for 20-, 23-, 25-gauge surgery, and the light fiber can be used with any of the Alcon light sources.

SUMMARY

The improved illumination on the CONSTELLATION Vision System, in terms of brightness, quality, stability, and ease of use has answered many of the difficulties of visualization that surgeons have experienced with small-gauge surgery. The retina can now be viewed with more clarity, and the improved angle of the light will now allow surgeons to see a wider area of the retina when operating. ■

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DISCUSSION

Dr. Boyer: Do you routinely use triamcinolone for visualization?

Dr. Kaiser: I have used triamcinolone acetonide injectable suspension (TRIESENCE, Alcon Laboratories, Inc.). I use TRIESENCE only for cases of posterior hyaloid traction with diabetes, where the vitreous is difficult to see. When I am working with fellows, I frequently inject Triesence—it is a great teaching tool because it enables clear visualization of the vitreous.

Dr. Rizzo: There are some cases, such as when a surgeon must differentiate an eye with vitreous schisis from a case of posterior vitreous detachment, for which triamcinolone must be used.

Dr. Boyer: Dr. Murray, can you discuss illumination?

Dr. Murray: The light source on the CONSTELLATION Vision System has four ports available for illumination. The new RFID technology recognizes a light probe when plugged into the system, so that when you plug an instrument into the port, the system prepopulates the settings for the correct light output. The ideal technology, in my opinion, is advanced, but I also want simplicity in the delivery, both of which the CONSTELLATION delivers.

Dr. Kaiser: Having multiple ports for lighting is a significant advantage because you can add a chandelier or another light source if needed, and the RFID ensures that the light output will be appropriate for 20-, 23-, or 25-gauge surgery.

Integrated Infusion Pressure and IOP Control

BY DAVID S. DYER, MD

When performing vitrectomy, one of the challenges that surgeons have faced is controlling intraocular pressure (IOP) in relation to the pressure of the fluid that is infused through the cannula during surgery. Improvements in the CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX) include a new integrated infusion pressure and IOP control system, which represents a significant advancement in safety for vitrectomy. This article will describe the features on the CONSTELLATION system that work to control fluidics during surgery.

IOP CONTROL

IOP control is a significant advancement in vitrectomy surgery. IOP control can assist with sudden bleeding in patients with diabetes due to pressure changes, and makes it easier for the surgeon to control bleeding during surgery. Additionally, this feature has allowed me to set a lower IOP during surgery because the lag time in adjustment is eliminated.

The ACCURUS Surgical System (Alcon Laboratories, Inc.) utilizes gravity as fluidics control with an automated IV pole or vented gas forced infusion (VGFI) to control IOP. In VGFI, gas is driven by pressurizing the bottle via low-pressure air pump. The stopcock is controlled manually, and the IOP must be offset artificially at 35 mm Hg to 45 mm Hg to ensure globe stability during aspiration. Pressure in static condition is consequently higher than needed. Conversely, the pressure might be set at 32 mm Hg for a static eye, but if there is a leak or aspiration along the tubing, the pressure drops unexpectedly.

The IOP control on the CONSTELLATION system automatically adjusts for the infusion tubing and pressure drop that occurs when fluid is flowing through the cannula by measuring and checking the infusion cannula and tubing resistance during priming. With the CONSTELLATION, the IOP is maintained to within ±2 mm Hg of the surgeon's setpoint. Figure 1 shows the IOP compensation calculation that is used for the CONSTELLATION. If I want to maintain 32 mm Hg, I need more infusion coming out of the system. The compensation calculation that takes place at 20 cc/min with a 23-gauge cannula and a pressure tubing and cannula drop of 22 mm Hg uses the pressure set point plus the pressure drop to determine the infusion pressure.

AUTO INFUSION VALVE

Another useful feature that has been included on the CONSTELLATION fluidics system is the auto-infusion valve, which allows the surgeon to control an automated air:fluid exchange. The stopcock does not need to be manually switched; the surgeon activates using the footpedal or pushes a button on the display to initiate air:fluid exchange, reducing errors or delays.

BOTTLE MONITORING

New efficiency features on the CONSTELLATION system include the ability to change the balanced salt solution bottle during surgery with no need to stop, plug, and

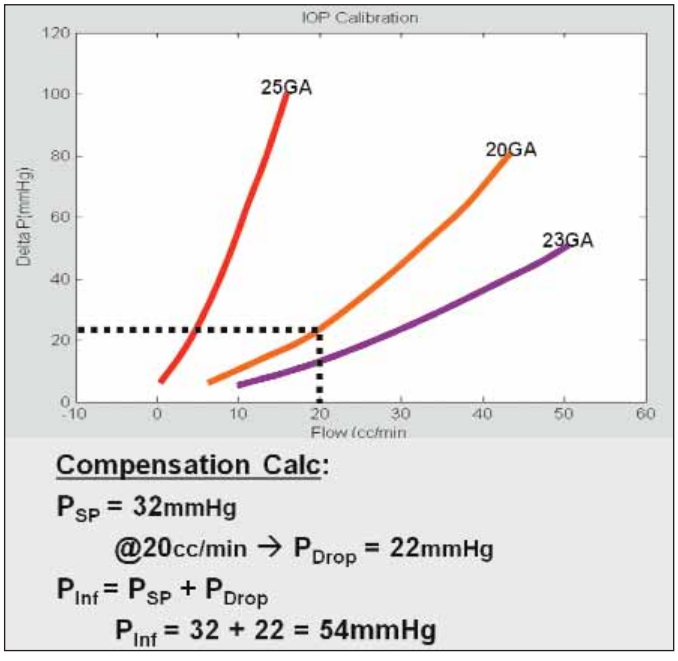

Figure 1. More infusion is required to maintain pressure.

clamp. Additionally, the CONSTELLATION calculates fluid use, estimates how much fluid is in the bottle, and issues a warning when the fluid is low.

SUMMARY

The CONSTELLATION fluidics represent a significant advancement over previous technology. The more accurate and responsive IOP management enhances surgeon control and the automated features on the system save time and reduce errors that are inherent in manual procedures. ■

David S. Dyer, MD, is in private practice in Shawnee Mission, KS. Dr. Dyer states that he is a member of the Retina Advisory Council for Alcon Laboratories, Inc. He can be reached by e-mail at davidsdyer@aol.com.

DISCUSSION

Dr. Boyer: The intraocular pressure (IOP) control with the CONSTELLATION system is phenomenal. In the past, we routinely experienced hypotony as the scleral depression was relaxed; however, the fluidics on the CONSTELLATION system help maintain IOP within approximately 2 mm Hg. With previous technology, I typically perform vitreoretinal procedures beginning with an IOP of approximately 40 mm Hg to allow for fluctuation and to lower the risk of hypotony. With the CONSTELLATION, I set the IOP at 20 mm Hg.

Dr. Kaiser: Another factor that has a role in IOP control is fragmatome placement. When there is an occlusion with a nuclear fragment, breakage can cause a massive sudden surge of fluid out of the eye and subsequent hypotony. For older patients, there can be a high risk of choroidal hemorrhage, but this is not an issue with the CONSTELLATION system and its excellent IOP control. The system constantly monitors the IOP so that if an occlusion break occurs, the fluidics automatically adjusts to protect against hypotony.

Dr. Rizzo: The IOP control system on the CONSTELLATION works quickly. I found that drops in pressure lasted merely milliseconds before the IOP returned to the original level. ■

DISCUSSION

(Continued from page 6)

Dr. Boyer: When converting from 20-gauge vitrectomy to 23- or 25-gauge surgery, are there cases you would avoid?

Dr. Rizzo: I might avoid cases of macular pucker because the vitreous can be unpredictable.

Dr. Dugel: I have performed 23-gauge surgery for 2 years, and would not avoid any cases with this technology. In fact, I would propose that it is the hardest cases in where the features on the CONSTELLATION become most useful. For example, a combined traction and rhegmatogenous retinal detachment can begin with a core-mode setting at 4000 cpm to 5000 cpm, and open-bias duty cycle, and vacuum of 400 mm Hg to 500 mm Hg. The detached retina can then be addressed in shave mode, keeping the cut speed at 5000 cpm, with an open duty cycle to reduce the flow. After shave mode is complete, the cut rate can be decreased to 3000 cpm, and the duty cycle can be adjusted to open-bias, allowing the surgeon to address the fibrous tissue.

The cutter on the CONSTELLATION is specifically designed for small-gauge surgery, as opposed to previous technology that basically took large-gauge instrumentation and shrunk it down to fit, using the same basis for fluidics.

On the CONSTELLATION, the cutter is not just a cutter anymore. Port optimization, which moves the port closer to the tip of the probe enables me to have better flow control with duty cycle, but also makes the cutter a multifunctional tool, reducing my need for horizontal and vertical scissors.

Peter K. Kaiser, MD: The CONSTELLATION Vision System also offers the ability to micropulse and proportionately control reflux. The cassette on the CONSTELLATION allows an increase of fluid that is proportional to the circumstances. For example, if you are operating on a patient with diabetes who begins to bleed, you can switch to proportional reflux mode and the fluid will increase to the extent where it effectively pushes the blood out of the way. ■

Clinical Experience With the PUREPOINT Laser

BY TIMOTHY G. MURRAY, MD, MBA, FACS

The embedded PUREPOINT 532 nm photocoagulator on the CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX; Figure 1) is both complex in design and function yet extremely simple to use. The features on the laser increase overall surgeon control and precision and help to streamline surgical procedures for better efficiency and safety.

In my opinion, there are three critical benefits to PUREPOINT laser: increased surgeon control, decreased reliance on surgical staff, and enhanced delivery of quality care. In this article, I describe the key features on the PUREPOINT and how each improves my surgical procedure.

Figure 1. The embedded PUREPOINT laser.

> "This next generation of Alcon laser probes represent intelligent design and a significant step forward in vitreoretinal surgery."

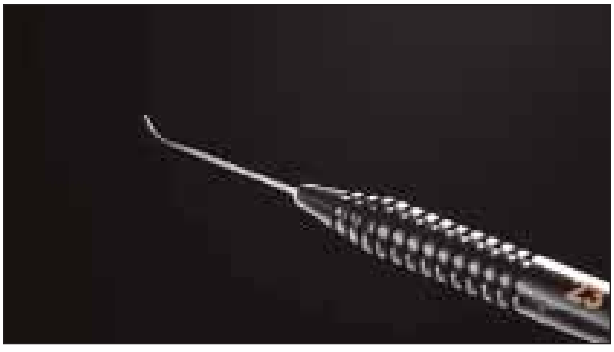

Figure 2. The Flexible Tip Laser Probe (FLP).

SYSTEM FEATURES

ENGAUGE Radio Frequency Identification (RFID) allows the laser to automatically recognize the device that is being plugged in and immediately populate the parameters accordingly.

With the footpedal on the PUREPOINT laser, the surgeon can switch the laser from standby to ready and power delivery can be altered up and down on the laser. Additionally, voice confirmation occurs when parameters are changed.

There are two ports on the PUREPOINT laser, which enable the endolaser and the laser indirect ophthalmoscope (LIO) to be simultaneously plugged in. The switch from endolaser to LIO, and vice versa, can be performed on the same platform without any alterations required from staff.

The ports also have color ring indicator lights that act as insertion accuracy tools for the person who is plugging in the laser delivery devices.

THE ENDOLASER PROBE

The endolaser probe that I use with the PUREPOINT laser system is the curved Flexible Tip Laser Probe (FLP; Figure 2). The FLP has a 33-gauge nitinol tip with a 40°-bend angle and a 6-mm bend radius. The overall length of the probe is approximately 26 mm and the construction is a rigid, thick-walled, tapered cannula.

The nitinol tip on the FLP can be straightened to go through the trocar and reassumes its curvature once the probe has entered the eye. The small-tip diameter

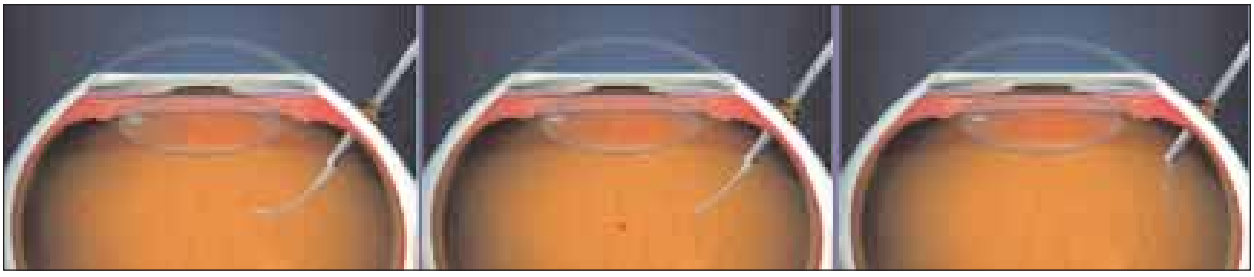

Figure 3. With a compact tip radius and shorter overall tip length, the FLP provides broad access to the peripheral retina.

and tapered cannula allows for easier insertion into the trocar and, once in the eye, the flexible curved tip allows for greater access to the periphery (Figure 3). The configuration of the FLP minimizes retina touch and contact with the crystalline lens, reducing the risk of secondary cataract.

The laser probe that I used previously was the Stepped Angle Probe (Iridex Corporation, Mountain View, CA). The Stepped Angle Probe has a larger entry diameter and a fixed angle that is not continuously curved. The angulation of this probe increases the likelihood that it will have contact with the lens. I have also used a directional laser probe which has a separate fiber that extends from the end. Although this is a more difficult probe to use, it remains an excellent tool when used correctly.

My idea of superior surgical instrument design, however, is that which takes into account all users. In my opinion, the best design results in instrumentation that, if put into the hands of a retina fellow, would enhance his or her ability to achieve the surgical goal and increase the overall safety profile. This next generation of Alcon laser probes represent intelligent design and a significant step forward in vitreoretinal surgery.

PLATFORM STABILITY

I have been most impressed with the stability of Alcon's laser platform throughout the evolution of the technology. The stability of the new-generation PUREPOINT photocoagulator is further improved to significantly increase the quality of the laser burn that it delivers. The PUREPOINT laser has a high-energy capacity, multiple mode settings, and micropulse and continuous laser modes. In summary, the PUREPOINT laser delivers reproducible, targeted, and precise laser energy. ■

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Surgical Efficiencies on the CONSTELLATION Vision System

BY PRAVIN U. DUGEL, MD

Webster's Dictionary defines efficiency as "the safe production of the desired effects or results with minimum waste of time, effort or skill." Safety is the primary component in the surgical efficiencies that are delivered by the V-LOCITY Efficiency Components on the CONSTELLATION Vision System (Alcon Laboratories, Inc., Fort Worth, TX). This article will review the V-LOCITY Efficiency Components, focusing on how each feature increases the safe delivery of care to our patients.

PREOPERATIVE COMPONENTS

A common concern among vitreoretinal surgeons is the shortage of experienced and educated surgical staff. To that end, the V-LOCITY system incorporates two different avenues for staff education: V-LOCITY Help and Wizard Help. V-LOCITY Help allows for a detailed review of procedures, with step-by-step instruction and surgical videos. Wizard Help goes even further by allowing stop and start setup, which provides similar instruction and videos, but that can be paused so that technicians can perform the actions described and then continue the video instruction as they move along in the process. These features, embedded into the CONSTELLATION system, can be used as either a primary resource or as a refresher.

> "The bar-code scanner enables technicians to scan the disposable vitrectomy pak and the system will automatically recognize whether it is 20, 23, or 25 gauge."

Additional smart components on the CONSTELLATION system are ENGAUGE Radio Frequency Identification (RFID) and a bar-code scanner which works to simplify setup of the system. The bar-code scanner enables technicians to scan the disposable vitrectomy pak and the system will automatically recognize whether it is 20, 23, or 25 gauge. The ring lighting system indicates whether the probes have been plugged in correctly (initially blue, the light will change to green with proper insertion or amber for improper insertion). Additionally the RFID system will automatically normalize the light output for the technology being used.

The other function of the bar code scanner is to

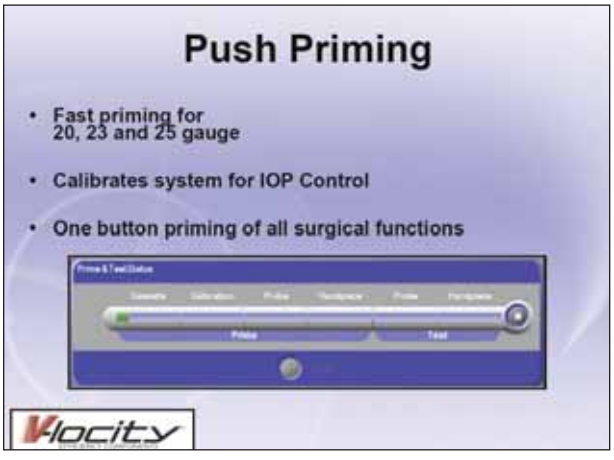

Figure 1. Push priming on the CONSTELLATION system allows for fast priming, IOP control, and one-button priming.

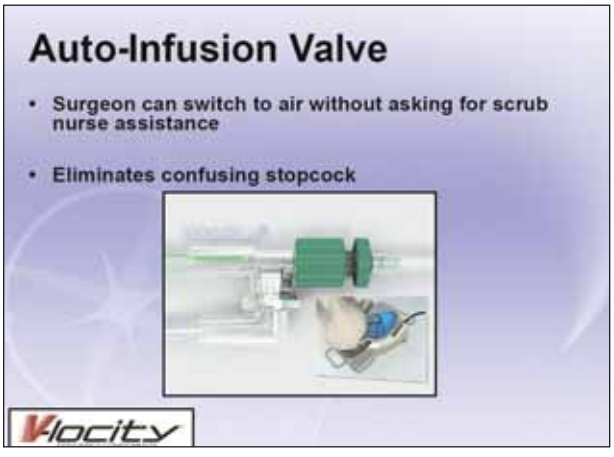

Figure 2. The auto-infusion valve allows the surgeon to easily switch to air without assistance from surgical staff.

Figure 3. The auto gas fill mechanism is practical in terms of accuracy and cost savings.

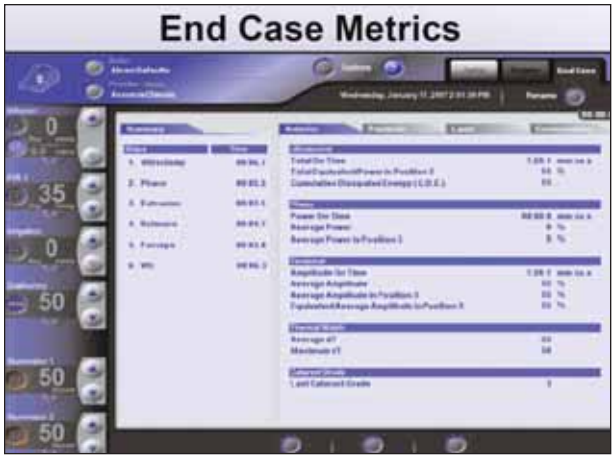

Figure 4. End-case metrics provide a summary of the procedure, including surgical times and materials consumed.

monitor and record the vitrectomy packs or consumables that are being used at any time during a procedure with automatic population of the consumables list window, which is a useful function for inventory control and billing.

Push priming on the CONSTELLATION system allows for fast priming for 20-, 23-, and 25-gauge vitrectomy. The system is automatically calibrated for intraocular pressure (IOP) control and allows one-button priming of all surgical functions. This feature is critical in improving efficiency of OR turnover. As seen in Figure 1, a green bar runs along each station, and if there is a problem at any point, the bar becomes amber and stops the machine, so the scrub tech can locate the problem and correct it immediately.

Another feature of the V-LOCITY Efficiency Components that I find to be important is the articulating arm. The arm is completely maneuverable, flexible, draped for sterility, and can be easily adjusted with one hand.

These preoperative components allow surgery to be set up by one individual, and the surgeon merely sits down and starts operating.

OPERATIVE COMPONENTS

During surgery, there are several components that improve efficiency. The first is the auto-infusion valve (Figure 2). The auto infusion valve allows the surgeon to switch from fluid to air with a simple toggle of the switch on the foot pedal, eliminating the need for a scrub tech or the circulator to be involved. The embedded PUREPOINT laser (Alcon Laboratories, Inc.) with voice recognition and multifunction foot pedal, is also a vast improvement over older systems.

Although I prefer not to use diathermy in my procedures, Alcon has improved on this technology with proportional diathermy, which allows full surgeon control. The surgeon can increase the diathermy to control bleeding. The higher frequency in proportional diathermy translates to a more confined treatment that has a lower amount of penetration.

The reflux options allow for microreflux, which is short duration of pressure that is provided to the suction port to blow away the blood from the top of the retina, and to which most surgeons are accustomed. Proportional reflux, however, is an entirely new innovation that provides power to the suction port that works more like a windshield wiper—it enables the surgeon to gradually and slowly wipe the blood away in a controlled manner, using pressure from 0 mm Hg to 120 mm Hg.

The V-LOCITY autogas fill component (Figure 3) allows the scrub tech to completely fill the syringe with pure intraocular gas, either C_3F_8 or SF_6. This component both improves efficiency and reduces waste of a significantly expensive surgical tool.

POSTOPERATIVE COMPONENTS

At the end of surgery, the V-LOCITY Efficiency Components produces end-case metrics (Figure 4), which summarize the procedure, how much vitrectomy and phaco time was used, the power used, among other factors. An equally powerful postoperative tool is the operative record (Figure 4), which generates a list of all the consumables used during a procedure and that can be transmitted to a wireless printer. In one report, inventory control, billing, and dictation are simplified.

CASE REPORTS

To illustrate how the V-LOCITY Efficiency Components fit into surgery, I will describe one of the first cases that I performed with the CONSTELLATION Vision System. A young, poorly compliant patient with diabetes presented with a combined traction and rhegmatogenous retinal detachment. For this patient, I performed a core vitrectomy with a speed of 4000 cpm, vacuum of 400 mm Hg, and an open-bias duty cycle to allow high flow. When I went close to the retina, I switched to shave mode at 5000 cpm, vacuum of 400 mm Hg, and a closed-bias duty cycle to limit flow.

Upon encountering thick adherent tissue in the detached retina with all the vitreous removed, I was comfortable decreasing my cut rate to 3000 cpm, and keeping vacuum constant with an open-bias duty cycle for increased followability. An open-bias duty cycle is useful not only for fibrous tissue, but also for retained lens material.

I set my IOP control higher, at about 40 mm Hg, and although I did not have to use diathermy for this case, the proportional component was there if I had needed it.

I initiated fluid-air exchange with the pedal, toggling it myself, and then used the PurePoint laser and finished with a gas fill. What is critical about the V-LOCITY Efficiency Components in this case, is that, except for the gas fill, all steps in the procedure can be completed by the surgeon. We have never before had a machine that concentrates solely on the surgeon and with the CONSTELLATION, all that is required for a safe and efficient procedure is the surgeon and a good scrub tech.

WHERE EFFICIENCY MATTERS

Whether you are operating in an ambulatory surgery center setting or a hospital setting, the V-LOCITY Efficiency Components on the CONSTELLATION system increase safety and efficiency, allowing vitreoretinal surgeons more control than has ever been available. This machine has fewer steps to get the job done than ever. ■

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