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LATEST UPDATES IN MODERN VITREORETINAL SURGERIES

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Latest Updates in Modern Vitreoretinal Surgeries

This supplement summarizes topics discussed during an educational symposium on vitreoretinal surgeries with the Oertli OS4 surgery platform.

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The Benefits of Microinvasive Combined Surgery

Advancements in technology and techniques for cataract and vitrectomy surgeries let surgeons go small, adding safety without sacrificing efficiency.

BY ANDREA MERCANTI, MD

Several benefits of combined phacoemulsification with IOL placement with vitrectomy procedures have been described in the literature, including decreased visual rehabilitation and increased convenience to the patient because a second procedure is avoided. There may be additional advantages of performing phacovitrectomy in patients with complicated retinal pathology where clear visualization is of great benefit. As well, the risk of developing a cataract after vitrectomy has been well documented, especially when a tamponade has been used.[1-3] Some authors have described the development of cataract after vitrectomy as an inevitability,[4] thus suggesting a prophylactic role in some cases for removing the lens in conjunction with posterior segment surgery.

The increasing popularity of phacovitrectomy is incidental with advances in cataract and retinal surgery techniques and technology that have made it possible to perform meticulous and precise surgeries through small openings to reduce the risk of inducing trauma or complications. The Oertli OS4 surgical platform introduces new possibilities for surgeons interested in phacovitrectomy to perform microinvasive combined surgery (Table 1). The greatest benefit of this functionality with the OS4 is the outstanding chamber stability even when using high fluid values, resulting in a reduced rate of side effects and faster visual recovery.

EASYPHACO TECHNOLOGY

An advanced cataract removal modality available only on Oertli platforms, *easy*Phaco describes the way in which several features work together to provide the surgeon the ability to gain great holding strength at the tip via concentrated axial phaco energy, but with minimal turbulence and thorough fragment aspiration, even with dense nuclei. The result is minimal trauma to the eye, faster healing, and less chance of inducing astigmatism. Moreover, the incision remains stable and the cornea clear so that the surgeon can work in the posterior chamber if necessary.

An important component of *easy*Phaco is the *easy*Tip CO-MICS, which is ideal for sub-2.0 mm surgeries (Figure 1). It has been specifically designed for operating through 1.6 to 1.8 mm incisions without compromising efficiency and chamber stability, and it is safe for use with vacuum rates up to 550 mmHg and flow of up to 30 ml. Compared with traditionally designed phaco tips, the *easy*Tip CO-MICS delivers more irrigation flow without increasing the size of the tip through the use of larger internal lumen of the irrigation path that surrounds a slightly smaller aspiration path. Versions of the phaco tip are also available in a 2.2-mm size (for use with 2.2 to 2.4 mm incisions, vacuum up to 650 mmHg, and flow up to 60 ml) and a 2.8-mm size (for use with 2.8 to 3.2 mm incisions and maximum vacuum and flow).

TABLE 1. FEATURES OF MICROINVASIVE COMBINED CATARACT SURGERY WITH IOL PLACEMENT WITH VITRECTOMY
Features: • Corneal tunnel ≤ 1.8 mm • Use of an IOL (monofocal, toric, or multifocal) that is injectable through a 1.8-mm incision • 25-gauge trocars or smaller (ensures sutureless scleral wounds)
Benefits: • Smaller incision size mitigates the importance of wound construction • Reliable chamber stability even with high fluidic values • Reduced rate of side effects • Faster visual recovery

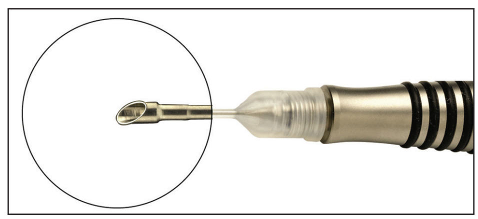

Figure 1. An important component of *easy*Phaco is the *easy*Tip CO-MICS, which is ideal for sub-2.0 mm surgeries.

When combined with the advanced High Definition Dynamic Direct Control (HDC) fluidics and other features of the OS4 platform, *easy*Phaco provides distinct benefits: reductions in turbulence, repulsion, and laterally radiating energy, with corresponding improvements in emulsification and more efficient fragment aspiration, but with minimal surge (Table 2).

DIFFERENT PUMPS FOR DIFFERENT SURGICAL SITUATIONS

The OS4 is equipped with three different pump modes: peristaltic, Venturi, and SPEEPMode. Surgeons are likely already familiar with peristaltic and Venturi pumps. Many have already staked their preference for one or the other. In truth, each of these pumps may be useful for different purposes, and surgeons may benefit from the ability to quickly switch between them. In addition, the OS4 provides surgeon the ability to use a third modality called SPEEPMode (Speed + Precision).

The SPEEPMode is based on a peristaltic pump, in which vacuum rate is relative to flow. However, in SPEEPMode, the flow is adjustable and vacuum is controlled with the pedal. Additionally, the machine reduces flow rate before maximum vacuum is achieved, thereby creating a strong—but also gentle and precise—aspiration.

The advanced HDC fluidics on the OS4 includes an active infusion feature, which I use in almost every surgery, even in phacoemulsification because it delivers additional safety. During retinal surgery, active infusion helps prevent sudden collapse of the chamber during vitrectomy or when the globe is depressed.

A VERSATILE SYSTEM

The sum total of the features of the OS4 and the equipment used with it is a comprehensive and versatile system that is useful for any kind of surgery. Its best features make it possible to safely and effectively perform microinvasive combined cataract surgery with IOL placement and vitrectomy. The availability of three different pump systems and the fact that the surgeon can change the pump system based on preference, and even during the same surgery, adds an unparalleled degree of flexibility.

Every surgeon has his or her own preferences and settings, but the value of having such a versatile platform is that one does not need to relearn surgery to use the OS4. Instead, the platform can be adjusted to the needs of the surgeon. When I am performing combined microinvasive surgery, I perform the phaco step with the Venturi pump, aspiration of the cortex with SPEEPMode (especially if there are weak zonules), the core vitrectomy with Venturi, and then I switch to SPEEPMode for work in the peripheral vitrectomy.

CONCLUSION

The bottom line is that combined procedures with the OS4 results in tight incisions that heal completely, regardless of the incision size—and there is tremendous benefit for postoperative recovery when sub-2.0 mm incisions are employed. For the vitrectomy portion of the procedure, Oertli sharp trocars help maintain the integrity of the incision, preventing leakage both during and after surgery. ■

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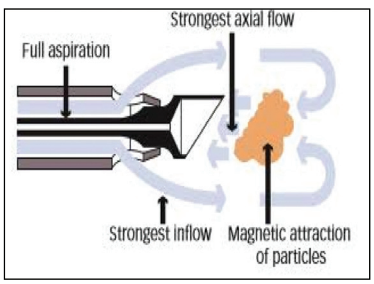
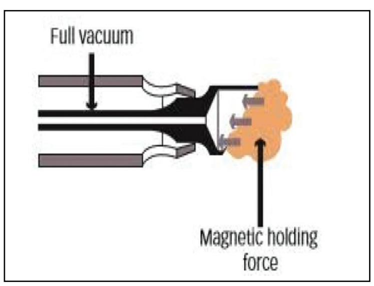
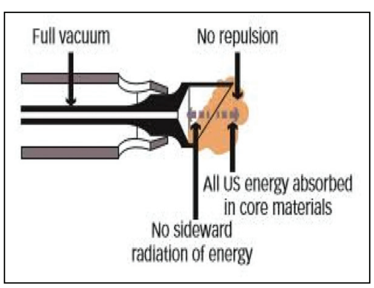
TABLE 2. EASYPHACO TECHNOLOGY



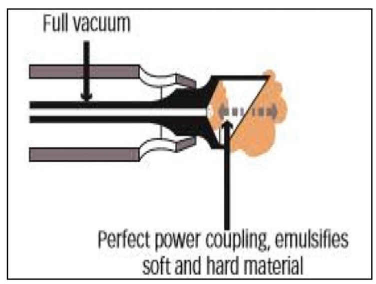
1. REDUCED TURBULENCE
High flow rate combined with a wide infusion path yields strong axially directed flow, which provides strong attraction of material to the tip and enhanced followability, but with minimal turbulence and a reduction in floating fragments.



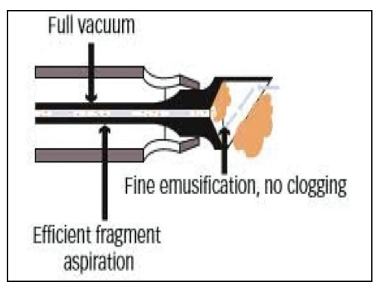
2. REDUCED REPULSION
The beveled edge of the phaco tip used with high vacuum settings locks fragments to the tip, reducing repulsion.



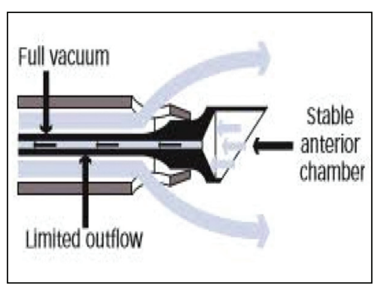
3. REDUCED LATERALLY RADIATING ENERGY
Axial direction of ultrasound energy minimizes distribution to surrounding tissue when high vacuum locks the tip to the aspirate.



4. IMPROVED EMULSIFICATION
The proprietary tip design and high vacuum settings create a strong coupling of ultrasound energy to the core material, thus increasing transfer of energy to the material by a factor of six. Even hard and dense nuclei can be emulsified without an issue.



5. EFFICIENT FRAGMENT ASPIRATION
The finely chopped nuclear material is smoothly aspirated without clogging the port.



6. MINIMAL SURGE
Because infusion capacity is seven times that of the aspiration volume, if tip occlusion occurs, the capillary aspiration channel resists a sudden flow while the wide infusion path provides a mechanism to maintain the IOP and the anterior chamber remains stable.

Gaining Surgical Confidence Through Greater Surgical Control

Advanced fluidics and a Continuous Flow-Cutter differentiate the OS4 platform from other vitrectomy machines.

BY CHRISTIAN PRÜENTE, MD

The equipment the surgeon uses in the OR should feel like an extension of his or her hands. Not only should it be comfortable to use, it should also be reliable, stable, and capable of precise maneuvers. This is especially true for retinal surgery, where careful micromovements are needed to dissect and operate on delicate tissue, and where the surgeon often has to make critical adjustments based on the anatomy he or she encounters. Thus, there is another element that is essential to surgical confidence: the degree of control the surgeon has over the equipment and whether it is responsive and adaptable to one's personal preferences.

I have had personal experience using several of the vitrectomy platforms available on the market. Each has its benefits and downsides. In my view, many of the technologies require the surgeon to learn a certain way of performing surgery, either because of the onboard settings or because they are limited in their functionality. I find the opposite to be true of the Oertli OS4 surgical platform (Figure 1). Not only does the OS4 come with several advanced features, it is also responsive and is capable of doing exactly what I need to provide patients the best possible outcome. Instead of having to retrain myself to use the OS4, the platform is versatile enough that I can maintain my surgical preferences while still being confident that I am performing excellent surgeries.

The OS4 is responsive and is capable of doing exactly what I need to provide patients the best possible outcome.

ADVANCED HDC FLUIDICS

The OS4 is designed with several advanced features, but its most important element is its High Definition Dynamic Direct Control (HDC), which functions as a brain, monitoring and controlling all onboard functions and intuitively adjusting parameters. Yet, the interface is easy to use and user friendly, thus minimizing the time it takes to reprogram and recalibrate between OR sessions. If this feature is a brain, it is a natural extension of the surgeon's brain, putting two "minds" to work during every case.

Perhaps the most innovative aspect of the OS4 platform is its next generation fluidics, including the ability to quickly switch between three different pump modes: peristaltic, Venturi, and SPEEPMode. Understanding the principles of pump and fluid dynamics will help explain why having these options can be beneficial.

Figure 1. The OS4 platform is versatile and responsive, which helps surgeons provide patients with the best possible outcomes.

In posterior segment surgery, the surgeon is manipulating delicate tissue in a tight space with limited visibility. When he or she is removing vitreous, the dynamics of the pump and its relationship to vacuum and aspiration are critical for safe maneuvers. The peristaltic pump creates a relative vacuum when the aspiration port is occluded; the operator controls flow rate with the foot pedal but cannot adjust the vacuum. In practical terms, when the tip is not occluded, the fluid level in the eye is maintained, and the vacuum engages at the lowest level required to remove the vitreous when the tip becomes occluded. Such a system may have distinct advantages at the start of surgery during the core vitrectomy, in the periphery where tractional forces are more consequential, or when dissecting near fragile vitreomacular adhesions.

With Venturi, the vacuum is controlled by pedal and the flow by preset parameters, meaning that the fluid turnover in the eye depends on the vacuum power, size of the aspiration port, and the condition of the material being aspirated. Such systems require less movement of the tip to engage and remove vitreous; however, they also attract material less discretely than peristaltic pumps, and thus, may create unwanted tractional forces.

Fundamentally, with the peristaltic pump, the pedal determines flow, vacuum occurs when the tip is occluded until the preset

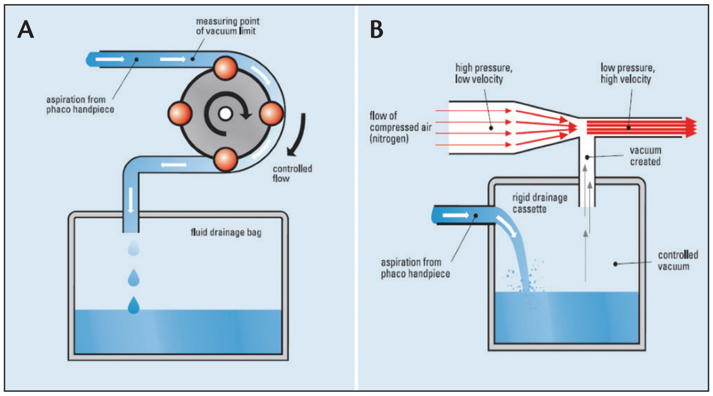


Figure 2. Peristaltic pumps (A) employ rollers to compress the tubing system to create flow while a preset vacuum level is engaged when the port is occluded. As the port becomes occluded, the rollers slow down, yielding decreased outflow. Venturi systems (B) operate on a different principle, where the flow is generated by compressed air, the air nozzle is connected to a closed drainage bag, and vacuum is constantly on.

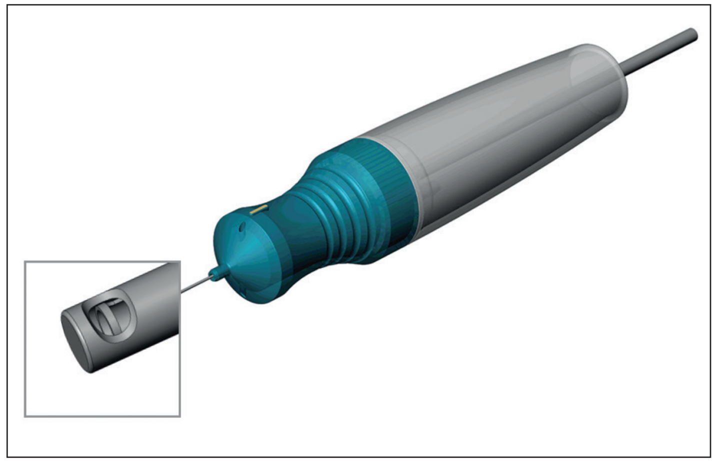


Figure 3. The Continuous Flow-Cutter has a cutting speed of up to 10,000 cuts per minute.

The dynamics of the pump and its relationship to vacuum and aspiration are critical for safe maneuvers.

Using the SPEEPMode, I am able to maintain the holding force of the vacuum, enabling the highest degree of efficacy while also assuring safety and control of flow.

value, and there is a possibility to work with low flow at high vacuum. With the Venturi pump, the pedal determines vacuum, flow results from vacuum and the resistance of the tubing, vacuum level remains constant when the tip is occluded, and there is no independent control of flow and vacuum. Additional differences are seen in the Table 1 and Figure 2.

Within the dynamics of surgery, there is not much difference when the tip is not occluded. However, tip occlusion with a peristaltic pump results in a high vacuum surge, often to uncontrollable levels. With Venturi, the surgeon gains greater control over the vacuum, but flow drops to zero when the tip is occluded.

What differentiates the OS4 platform from others is the availability of a third option, SPEEPMode, which gives surgeons access to the best features of peristaltic and Venturi. Using this mode, which offers controlled flow and vacuum, I am able to maintain the holding force of the vacuum, enabling the highest degree of efficacy while also assuring safety and control of flow. In my hands, this is the ideal setting for controlled lifting of epinucleus; aspiration of cortex, especially when zonulas are weak; creating a posterior vitreous detachment or detaching posterior hyloid; and for working precisely and controlled in the periphery with or without detached retina.

TABLE 1. KEY DIFFERENCES BETWEEN PERISTALTIC PUMP, VENTURI PUMP, AND SPEEPMODE

	Peristaltic	Venturi	SPEEPMode
Basic	Flow control	Vacuum control	Vacuum control Flow control
Practical possibilities	• Vacuum by occlusion • Low flow/high vacuum possible	• Quickly available vacuum without occlusion • No flow control • Low flow/high vacuum not possible	• Vacuum by occlusion • Fast vacuum control under occlusion • Low flow/high vacuum better controllable
Practical application	• Good for delicate work • Little rests difficult to grasp • Low traction • Release of particles means loss of occlusion	• High efficiency for fast core removal • Traction • Turbulence	• High efficiency and still safe • Low traction • Precision in delicate work • Little rests can be grasped well • Controlled manipulation and release of particles without loss of occlusion

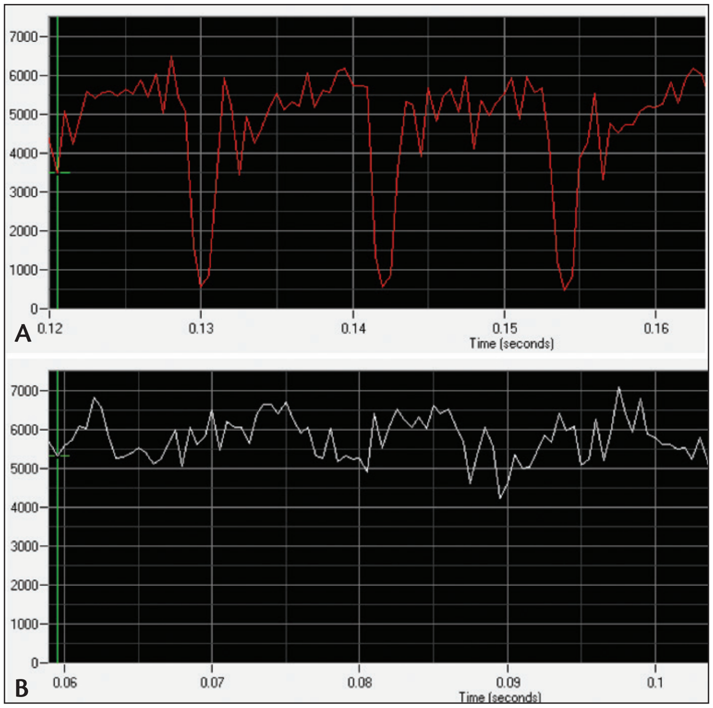


Figure 4. Graphs depicting flow rates in traditional guillotine-style cutters (A) and the Continuous Flow-Cutter with the OS4 platform (B). Whereas the flow is intermittently interrupted by the closed action of the blade in graph A (identified as zeroing of the flow), the flow is relatively stable in graph B.

The Oertli OS4 system provides an unprecedented level of precision, control, and responsiveness to adjustments to the foot pedal.

CONTINUOUS FLOW-CUTTER

The advanced flow dynamics available with the OS4 platform are important on their own, but they also complement and enhance other performance features. For example, the Continuous Flow-Cutter with cutting speeds up to 10,000 cuts per minute (Figure 3). Yet speed is only one aspect of the performance of the vitrector. In theory, a faster cut speed reduces turbulence because it is performing smaller cuts with each pass of the blade. With traditional guillotine-style vitrectors, material enters the port during the "open" phase, which is then cleaved while the blade action moves to the "closed" position. At faster speeds, less material is cleaved with each blade action compared with slower speeds, which should mean less repulsion of vitreous in the periods when the blade is fully closed.

However, even at very high cut rates, the closed action of a guillotine cutter results in an intermittent disruption of flow. This results in a wavelike action in the material being cut—in this case, the vitreous—as a result of the stop and start of flow during open and closed blade action phases (Figure 4). There may be minimal

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to no consequence for this loss of holding force when operating in most parts of the retina; over delicate tissue and especially in the peripheral regions, it may be a different story. The OS4 changes this by allowing the surgeon the ability to use continuous flow, meaning that cutter port is constantly open. With a classic guillotine cutter, the port is open only half of the action time, resulting in interruption of flow and consequential loss of vacuum and holding force at the tip. With the Continuous Flow-Cutter, the port is continuously open almost 100% of the time, meaning continuous flow and no loss of vacuum or holding force at the tip.

PERSONAL EXPERIENCE

I prefer to use 25-gauge instrumentation for most of my surgeries, and in my hands, I find the Oertli OS4 system to be absolutely reliable and stable. It provides an unprecedented level of precision, control, and responsiveness to adjustments to the foot pedal. Overall, since bringing this technology into my OR, I have gained more confidence while performing more efficient surgeries with reduced vitrectomy time.

More recently, I have had the opportunity to try 27-gauge surgery with this platform and I was pleasantly surprised with the stiffness of the instruments. I would have expected more flexibility, especially as I maneuvered out to the periphery. Instead, the instruments maintained their shape and did not bend or become lax. While the vitreous removal was understandably slower compared with larger gauge systems, it was still very efficient and the constant flow contributed to better performance.

CONCLUSION

The OS4 has several features that contribute to "quiet" surgeries where the vitreous and retina are only minimally disrupted. It is a stable and reliable platform that is supported by well-designed and manufactured instrumentation that provide the surgeon with the tools necessary for careful manipulation of delicate tissue of the retina, macula, and vitreous. These features are evident in other integrated functionalities. For example, the OS4 can automatically maintain the IOP within the globe during a gas or oil fill when this step is done under air, resulting in added safety and reliability.

All of these things are very useful features and they add up to make the OS4 a high-technology, versatile surgical platform for use in every kind of posterior segment surgery. What I find most impressive about the system, however, is that it seems to adapt to the way I want to perform surgery, and I have not had to compromise the way I want to perform because of the settings of the machine. ■

How the Physics of Light Changes Our Perception and Applications for Vitreoretinal Surgery

Having the ability to adjust the light source enhances surgical visualization and affords the potential to reduce phototoxic exposure.

BY ARMIN WOLF, MD, FEBO

Vitreoretinal surgery requires delicately balancing the light source, providing enough illumination to aid visualization without inducing phototoxic exposure. On the one hand, full illumination with the complete light spectrum provides the best opportunity for the surgeon to see what he or she is doing. Yet, too much light may cause damage to the retina, especially with regard to certain light spectrums.

There are different forms of phototoxicity that can occur on the retina (Table 1). In vitreoretinal surgery, we are most concerned about phototoxicity due to nonionizing radiation to the retina, which depends on a number of factors, the most important of which are the wavelength of light used, exposure time, and the distance from the retina. Other factors, including the flux density of radiation, the character of the beam (ie, focused vs nonfocused), and radiance, also play a role.

The science of inducing damage to the retina is actually quite sophisticated and well characterized. What is less clear is how humans perceive light and why two different surgeons may see the same image differently.

TABLE 1. FORMS OF PHOTOTOXICITY OCCURRING ON THE RETINA

Type:	**Photomechanical Disruption**	**Photothermal Due to Rise in Energy Level**	**Photochemical Inducing a Chemical Reaction**
Caused By:	Very high energy (kW-mW)	mW energy, Warming ca 10°C, Denaturation	Low energy, Visible light, Oxidative stress (lipid oxidation)
Exposure Time:	Short (ns to ps)	Short (µs to s)	Long (s to hrs)
Wavelengths:	All	600-1400 nm	Short more than long wavelengths

PRINCIPLES OF PHOTOTOXIC EXPOSURE

Phototoxicity is most associated with long exposure to blue light due to a photochemical process referred to as photoreversal bleaching. At a very fundamental level, the higher the energy used for illumination, the higher the energy of the photon beam, resulting in increased damage to the retina. Blue light causes chemical regeneration of rhodopsin; there are increased levels of rhodopsin following extended blue light exposure. Yet, as rhodopsin accumulates, it causes oxidative stress. Additionally, blue light inhibits the activity of essential chromophores, such as cytochromoxidase A2E, that play a central role in the visual cycle.

The human eye has developed several mechanisms to prevent or mitigate damage due to light exposure. Almost 90% of exposure is reduced by simple eye movements. In addition, the cornea, lens, and pupil function as filters to reduce the amount of blue light reaching the retina. However, during vitrectomy, the light source bypasses these natural defense mechanisms, leading to increased risk due to the surgery.

Long exposure to blue light, principally in the 400 to 550 nm range, can induce the photochemical injury described previously. However, in an aphakic eye, the relevant range for the blue light hazard widens to include wavelengths as short as 310 nm and all the way up to 550 nm. This becomes especially relevant for retinal surgery, because, as noted, we are bypassing the natural light filters of the eye—and so, whether or not the patient has a crystalline lens, the eye is essentially aphakic for purposes of the light source. The associations of potential aphakic hazard with toxicity in vitreoretinal surgery have been described in the literature as early as 1978.[1]

Several solutions have been proposed to counteract this phenomenon. According to the American National Standards Institute, photoexposure should not exceed 10 joules/cm2 with a maximum illumination time of 30 minutes.[2] Many retinal surgeries might exceed that time frame, and it appears that the light emitting from most endoilluminators far exceeds these guidelines. According to the conclusion of one study looking at the absolute power and spectral distribution from various light sources and filter combinations, "Commercially available light sources for endoillumination during vitrectomy are not safe with respect to photochemical retinal damage. Even with maximal precautions macular phototoxic damage remains a factual danger during vitrectomy."[3]

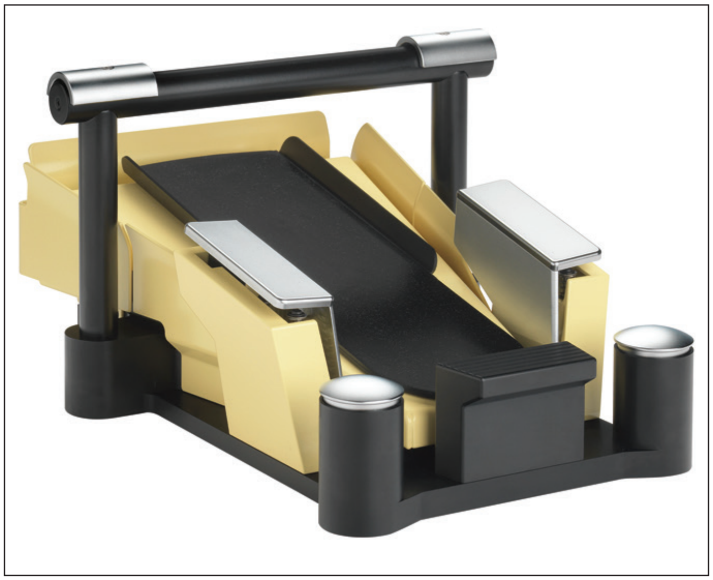

Figure 1. The surgeon can change color during surgery using the wireless pedal.

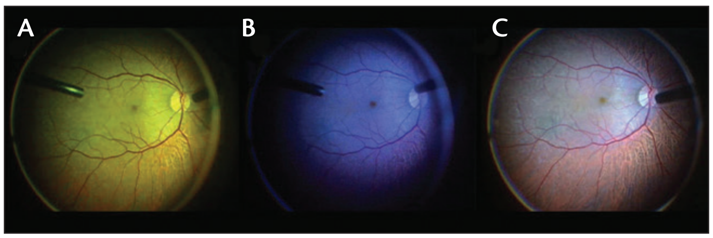

Figure 2. Different lighting options available: predominantly yellow (A), predominantly blue (B), and white lighting (C).

AVOIDING PHOTOTOXICITY

While there is very real risk of inducing phototoxicity in retinal surgery, it is not an inevitability if certain precautions are taken. For example, shorter surgery and maintaining distance from the retina with the light source lower the potential exposure. I am currently involved in research to see if a chemical supplement can be introduced to prevent phototoxic effects in the retina. Another option would be to use different wavelengths of light, either for the whole procedure, or for certain functions, where in either case doing so reduces the exposure to blue light wavelengths.

Several different kinds of light sources are available for vitreoretinal surgery, including halogen, xenon, and metal halid. Each has advantages and disadvantages that have been described. The most recent innovation in light sources involves the use of light emitting diodes, or LED light. In terms of balancing the need for optimal illumination while reducing the potential to induce phototoxicity, perhaps the greatest advantage of LED endoilluminators is that its wavelengths can be split, thus allowing the operator to customize the spectral composition of the light.

With the Oertli OS4 platform, the surgeon can change color during surgery using the pedal switching between three programmable presets for light color, thus permitting the ability to apply light according to specific situation (Figure 1).

But choosing the composition of light is about more than reducing the risk of phototoxicity. Studies are starting to show that different spectrums of light may be assistive in visualizing certain aspects of vitreoretinal surgery. For instance, amber or yellow light may amplify the appearance of Brilliant Blue staining, and other spectrums may be more relevant for other surgical steps (Figure 2).[4] Despite concerns in this area, use of spectral filters does not appear to have any effect on contrast sensitivity.[5]

Figure 3. Every individual perceives light differently. For example, some perceive this dress as blue and black, others as white and gold.

INTERINDIVIDUAL VARIABILITY IN LIGHT PERCEPTION

An additional benefit for the ability to switch between different light compositions during vitreoretinal surgery is that every individual perceives light differently. Readers may recall a popular image of a dress that circulated in popular culture attached to a challenge to identify its color. Some perceived it as blue and black, others as white and gold (Figure 3). Other than positing interesting metaphysical questions about perception and reality, the dress color challenge demonstrated that each individual perceives light differently.

These principles add additional significance to the ability to change color composition using the footpedal while performing surgery with the Oertli OS4. Different parts of the retina, macula, and vitreous will appear differently to different surgeons using different compositions of light—especially if the tissues are differentiated using staining mediums.

There is another optical principle that comes into effect during retinal surgery that becomes relevant. Rayleigh scattering, named for British physicist Lord Rayleigh, describes the scattering of light when the particles are smaller than the wavelength. The shorter the wavelength, the more the light scatters. This phenomenon, which can be overcome by the potency of the wavelength, explains why the sky is seen as blue, but also why white light in the vitreous is only seen as a scatter effect. But we can take advantage of this principle if the diodes in the light source are adjustable; remnant vitreous is much easier to see with blue versus amber light, whereas amber light overcomes the reflections that are often apparent during fluid-air exchange. During membrane peeling, switching between different compositions of light changes what the surgeon sees, especially if epiretinal membrane, which has a wrinkled surface, is present.

CONCLUSION

How light is perceived is highly individualized, and, therefore, there is rationale for being able to adjust how light is used during

TABLE 2. MY PERSONAL LIGHT SETTINGS FOR DIFFERENT PORTIONS OF VITREORETINAL SURGERY

Core vitrectomy:

- White light, avoid blue light if possible
    - Reduces phototoxic exposure, enhances visualization

Peripheral vitreous removal:

- Minimal blue light
- Blue light enhances visualization, but exposure time should be limited to reduce phototoxic exposure

Perifoveal vitreous removal:

- Blue light
    - Enhances visualization of delicate, hard-to-see tissue
- Depends on membrane of interest
    - PVR:
        - Blue light increases reflections, enhances visualization
    - Unstained ERM:
        - Amber or Blue
    - ERM stained with Brilliant Blue:
        - Amber

Fluid-air exchange:

- Amber

a surgery (Table 2). The light can be adjusted by a number of factors, including the microscope used, the aperture, and the use of filters. But because every individual perceives light differently, it is important for every surgeon to be able to find his or her personal light settings (Figure 4). Of course, to be able to do that requires the advanced functionality built into the surgical platform enabling the operator to do so, and this feature is only available on the OS4 platform. ■

Figure 4. Yellow or blue can be added and mixed, the intensity increased or decreased.

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Surgical Case Review

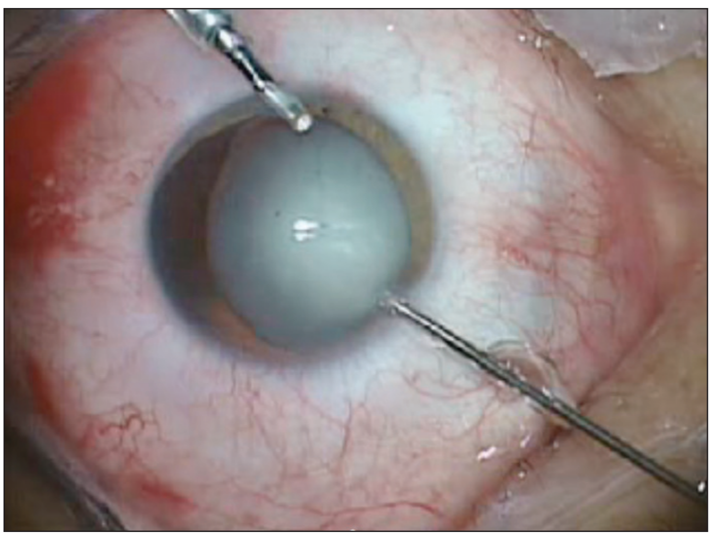
Demonstrating the benefits of OS4 in challenging cases.

BY LEVENT V. KARABAS, MD

In this monograph, my colleagues have written about many of the proposed benefits of the Oertli OS4 platform. As the saying goes, however, a picture is worth a thousand words. That is to say that while the advantages of the OS4 can be understood on a theoretical level by reading about the various settings and hardware and software offerings, they are best understood when they are demonstrated during surgery.

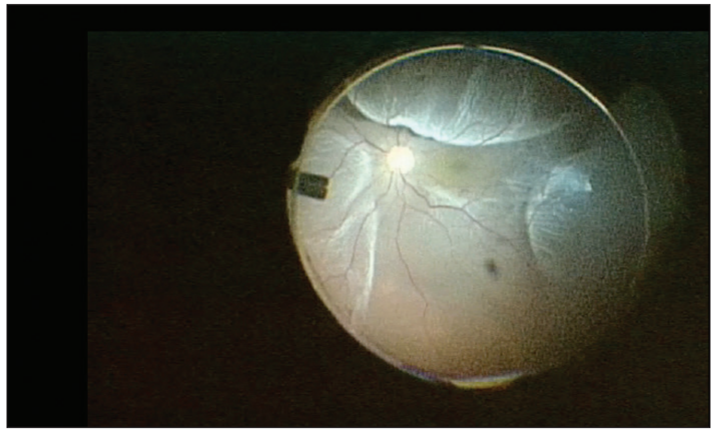
The following article contains several cases that I think help demonstrate the advantages my colleagues have highlighted so far. Because I feel that the differences with other platforms is most evident in difficult cases, I will present a series of complicated cases with a brief overview of why the use of the OS4 helped me perform a surgery that was safer for the patient and achieved a successful outcome.

CASE NO. 1: SURGERY FOR A TRAUMATIC SUBLUXATED CATARACT USING SPEEPMODE AND EASYTIP



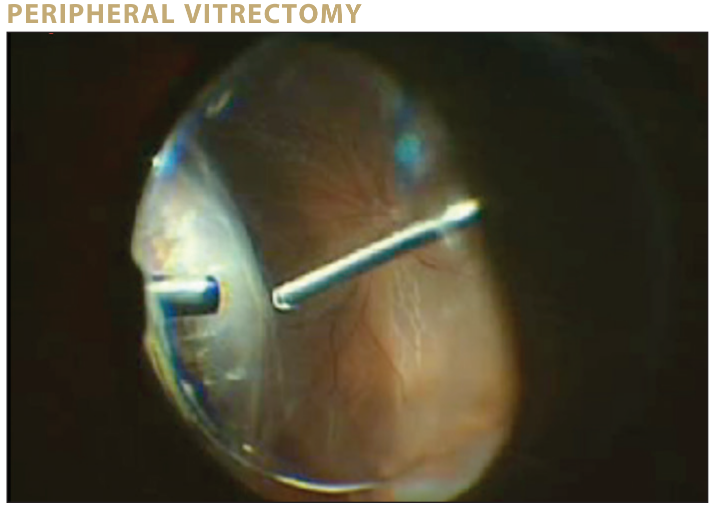
In this case, I performed an anterior vitrectomy to remove prolapsed vitreous using SPEEPMode. A chamber maintainer was used and left in place after vitreous removal and before going after the lens, as there is often a need to repeat vitrectomy in these cases. However, the use of an *easy*Phaco tip avoids oscillating energy, and the anterior chamber remained very stable through the entire surgery. As a result, there was no need to repeat vitrectomy. An additional benefit of using the OS4 in this case is that I was able to perform a posterior capsulorhexis in the presence of a capsular tension ring using SPEEPMode without being concerned about inducing an iatrogenic tear.

CASE NO. 2: CORE VITRECTOMY IN AN EYE WITH DETACHED RETINA



Here I demonstrate my typical settings for core vitrectomy in an eye being operated for a detached retina. Most surgeons will use a Venturi pump for such a case to minimize traction in the periphery. However, as demonstrated in the case when I briefly switch to the Venturi setting, the entire retina is under traction. When I switch to SPEEPMode, I am able to perform core vitrectomy without inducing tractional forces, thereby reducing the risk of equatorial breaks.

CASE NO. 3: SURGICAL PREFERENCES FOR PERIPHERAL VITRECTOMY



When using SPEEPMode and the Continuous Flow-Cutter, it is possible to gently shave vitreous in the periphery without inducing traction. Peristaltic pumps are often used so that the operator can use lower cutting speeds. However, coupling the Continuous

Flow-Cutter with SPEEPMode allows me to safely use much faster cut rates. If I use Venturi in the periphery, I hold the cutter opening away from the retina to be safe. With SPEEPMode, it is possible to hold the opening to face the retina.

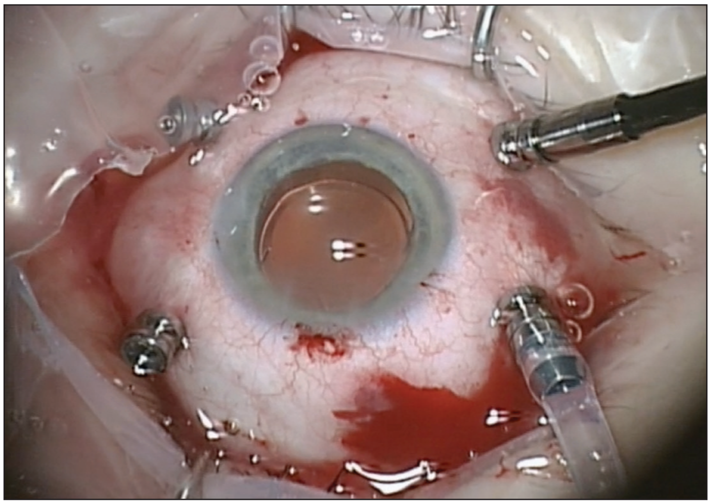
My preferred settings on the OS4 platform for 23G vitrectomy are as follows:

- Core vitreous: with SPEEPMode Flow 20 ml, Vacuum 300 mmHg, Cut Rate 3,000
- Peripheral shaving: with SPEEPMode Flow 5 ml, Vacuum 250 mmHg, Cut Rate: 4,000

CASE NO. 4: CORRECT POSITIONING WITH THE 25G CHANDELIER

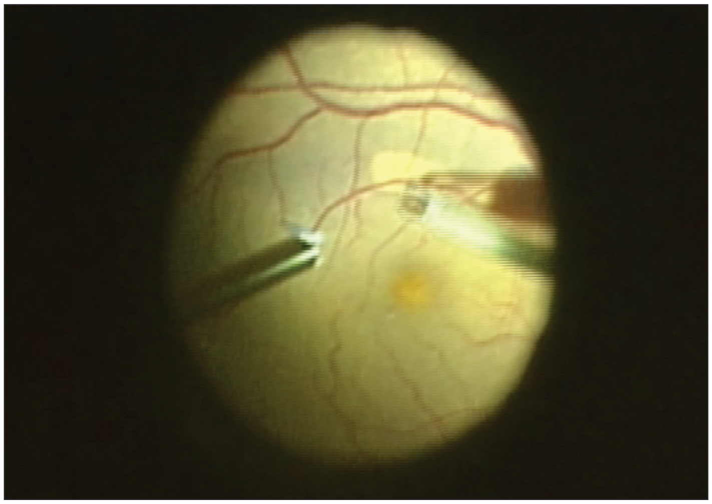
In this case, I demonstrate the correct positioning for using a chandelier in bimanual cases. The new Oertli 25G Chandelier provides perfectly bright and stable 360° illumination.

CASE NO. 5: REPOSITIONING THE LIGHT PIPE TO GAIN BETTER VISUALIZATION



Repositioning of the chandelier from one trocar to the opposite trocar allows best visualization for shaving at the 12 o'clock position.

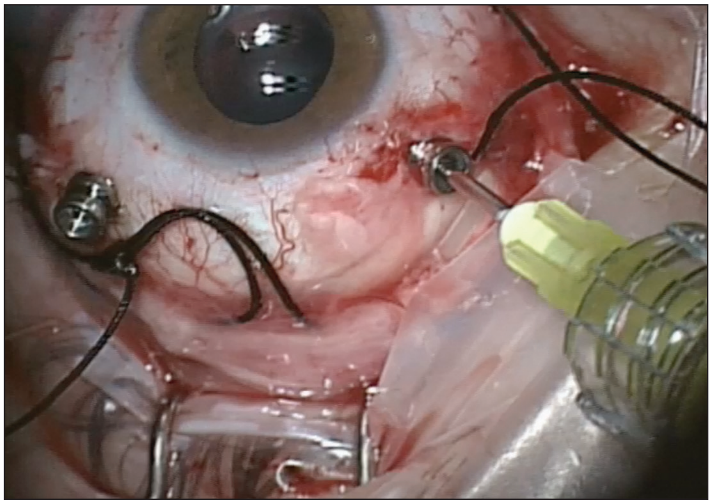
CASE NO. 6: MACULAR HOLE TECHNIQUE WITH INVERTED FLAP



In this case involving a macular hole, I am using a novel forceps, the Membrane FEELceps. This instrument has advantages:

- Strong holding capability at the tip
- No sticking of tissue on the tip, making it the perfect tool to perform an "inverted flap technique" for macular holes

CASE NO. 7: TECHNIQUE FOR OIL INJECTION



The Oertli trocar system is another highlight of the platform: the knife design is very smart. The incisions are perfectly tight; it is almost impossible to find the wound after removal. Additionally, I really like the fact that silicon oil can be filled with a 20G cannula place in the trocar head at maximum speed, because the complete lumen of the trocar is used to fill the oil. ■