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STELLARIS PC VISION ENHANCEMENT SYSTEM: COMPLEX CASES AND INSIGHTS TO INNOVATION

WITH YANNICK LE MER, MD; FAISAL FAYYAD, MD;
RICHARD SHEARD, FRCOPHTH; AND BARBARA PAROLINI, MD

STELLARIS PC VISION ENHANCEMENT SYSTEM: COMPLEX CASES AND INSIGHTS TO INNOVATION

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Stellaris PC Vision Enhancement System: Complex Cases and Insights to Innovation

Based on a symposium held during Euretina 2012, Milan, Italy.

INTRODUCTION



BY YANNICK LE MER, MD

The Stellaris PC (Bausch + Lomb) is a versatile microsurgical system that facilitates both anterior and posterior segment surgery. The Stellaris PC gives surgeons *procedural choice*, offering in a single system the capability for transconjunctival sutureless vitrectomy with 20-, 23-, and 25-gauge instrumentation and 1.8-mm microincision cataract surgery. The robust and reliable hardware and software support surgical procedures from the lens to the retina, and even beneath the retina. Settings and hardware can be configured to match the surgeon's preferences for anterior and posterior segment procedures. The procedural choice that is offered by the Stellaris PC is enhanced by the ability to perform combined procedures with this platform.

The Stellaris PC comes with a dual light source incorporating both xenon and mercury vapor lamps, as well as surgeon-selectable color filters that allow differentiated viewing to enhance the ability to see ocular structures under a variety of surgical conditions. The small footprint helps to conserve valuable space in the operating theater, especially considering the dual capabilities of the system. A wireless foot pedal with dual linear control allows a greater degree of surgeon autonomy.

The system received CE Mark approval in May 2010 after several years of gestation both in the laboratories of Bausch + Lomb and in our collaboration with surgeons. Recent and forthcoming innovative developments applied to the Stellaris PC are based on the direct feedback from customers of Bausch + Lomb.

To discuss some of the advantages and advances incorporated into the Stellaris PC, this supplement includes information from 3 surgeons who have been instrumental in the design and beta-testing of the new system. Faisal Fayyad, MD, will discuss the versatility of the Stellaris PC in managing complex cases; Richard Sheard, FRCOphth, will address the innovative illumination and filtering features of the device; and Barbara Parolini, MD, will present some examples of innovation in challenging cases.

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Versatile Approaches for Managing Complex Cases

BY FAISAL FAYYAD, MD

Modern small-gauge vitreoretinal surgery allows us to perform complicated cases with better control than in the past. In my practice, I employ small-gauge instruments for vitreous surgery in nearly all cases. The Stellaris PC (Bausch + Lomb) allows me to address even complex cases with excellent control and maneuverability using small-gauge instrumentation. This article describes some complex cases in which I have been able to use the features of the Stellaris to achieve excellent outcomes.

PDR, PVR WITH CATARACT

Frequently, posterior segment pathology is accompanied by concomitant cataract, making the Stellaris PC (PC for *procedural choice* of anterior or posterior segment functionality) a plus in the OR. In a recent case, the patient had proliferative diabetic retinopathy (PDR) with cataract. There was no posterior vitreous detachment (PVD), and the eye had not received previous laser treatment. Visibility of the retina was poor, and there was a chance of peeling up the retina, causing iatrogenic retinal breaks, in an attempt to create a PVD.

Before entering the vitreous cavity, we removed the cataract (Figure 1) and implanted an intraocular lens. With the cataract out of the way, I could begin care-



Figure 1. Phacoemulsification is performed before addressing posterior segment pathology.

fully creating a PVD without damaging the underlying retina. The dual linear footpedal on the Stellaris PC, controlling both cutting and aspiration, allowed me to do everything with the vitrectomy probe, performing as both forceps and cutter without a second instrument (Figures 2 and 3).

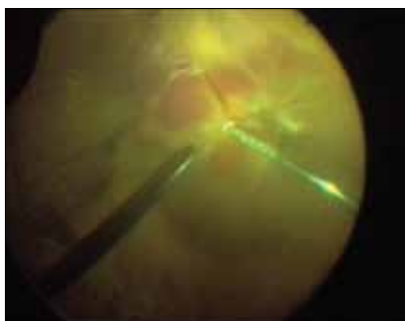


Figure 2. Using dual linear control, the vitreous cutter dissects tissue.



Figure 3. The vitreous probe serves as forceps for separating tissues.

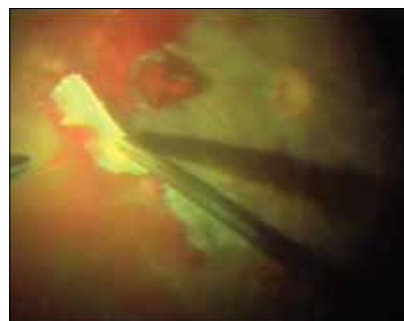


Figure 4. The probe is used to remove remaining islands of fibrovascular attachment between the vitreous and the retina.



Figure 5. The cutter is used to aspirate subretinal fluid through the macular hole.

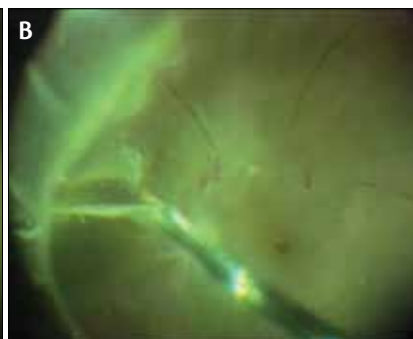


Figure 6. Bimanual technique is used to delaminate and peel the posterior hyaloid and proliferative tissue (A). Subretinal fibrosis removal (B).

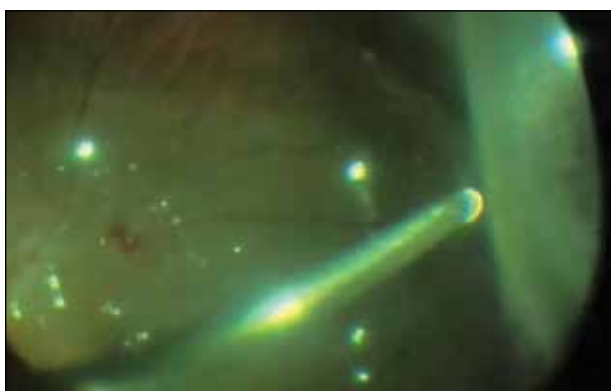


Figure 7. Peripheral and anterior small controlled retinotomy.



Figure 8. The ILM was peeled in order to ensure that all proliferative membranes were removed.

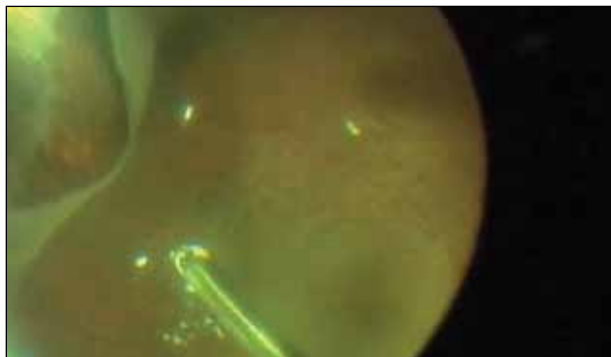


Figure 9. After trimming the edge of the retina, laser was applied peripherally.

As the surgery progressed, islands of fibrovascular attachment remained between the vitreous and the retina. With the cutter alone, without the help of any additional instrument except the light pipe, I was able to remove these attachments without damaging the retina (Figure 4).

In another case, the patient had cataract with PDR, complicated with tractional and rhegmatogenous retinal detachment with subretinal proliferation, as well as a macular hole. Again, no previous laser treatment had been performed. After cataract surgery and lens implantation, the cutter was used for core vitrectomy, and then the subretinal fluid was aspirated through the macular hole using the cutter probe (Figure 5). Because the tissue was ischemic and there was risk of retinal tear, a bimanual technique was used to delicately delaminate and peel the posterior hyaloid and proliferative tissue (Figure 6A) in order to give the retina the mobility to go back into place. With the epiretinal proliferation and the subretinal fibroses removed (Figure 6B), the retina was flattened around the macular hole, and I was able to perform a controlled retinotomy to drain subretinal fluid (Figure 7).

In another eye with posterior proliferative vitreoretinopathy (PVR), peeling the membrane was not pos-



Figure 10. A 70-year-old man was referred for posttraumatic repair.

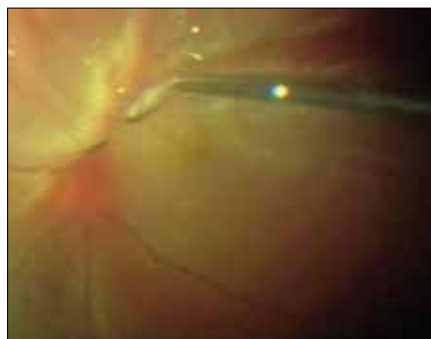


Figure 11. Membrane peeling under silicone oil.

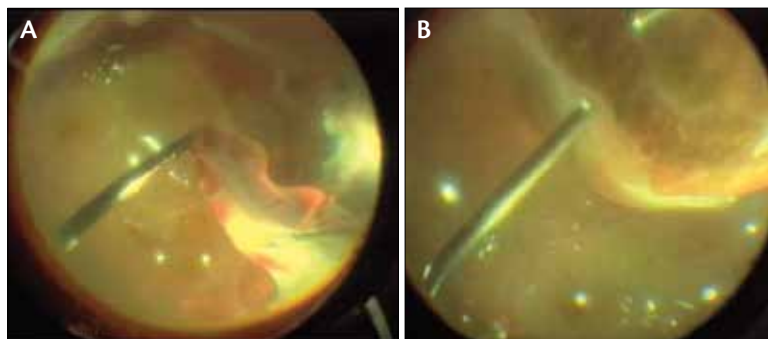


Figure 12. Bimanual removal of subretinal organized fibrovascular proliferation (A). Peripheral inferior 180° retinotomy using the Stellaris PC vitrectomy probe (B).

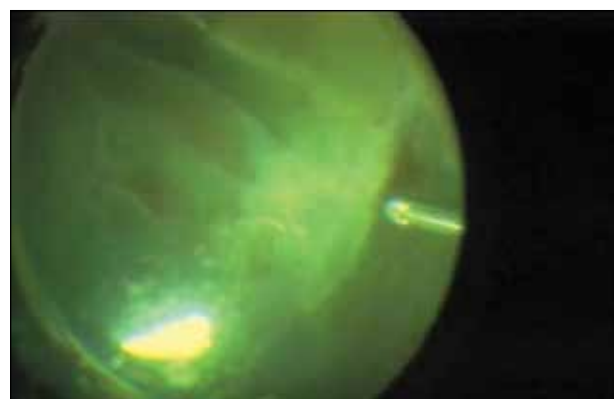


Figure 13. An inflammatory proliferative membrane covers the inverted retina in a traumatized pediatric eye.

sible, so I decided to remove the internal limiting membrane (ILM). This is a way to be sure all the PVR membranes are removed (Figure 8), and also helps to prevent the re-formation of PVR membranes postoperatively.

This approach is especially helpful if immature membranes are present, because in those cases it is difficult to tell whether all membranes have been removed. By removing the ILM up to the equator or even more anteriorly, you can be sure all membranes are gone.

After trimming the edge of the retinal tear (Figure 9), laser was applied in the periphery.

TRAUMA CASES

A 70-year-old man who had 2 previous surgeries with 5000 centistoke (CS) silicone oil injection due to ocular trauma was referred for surgery (Figure 10). The eye was aniridic. In a trauma case like this and in the presence of silicone oil, I prefer to peel membranes under silicone oil because I think it is easier to perform membrane peeling under silicone oil (Figure 11) than under balanced salt solution. Once posterior peeling was completed, I inserted the infusion line and removed the silicone oil. After I performed bimanual peeling and removal of proliferative membranes with removal of subretinal organized fibrovascular proliferation (Figure 12A), I created a 180° inferior retinotomy with the Stellaris cutter to remove a large subretinal bubble of silicone oil (Figure 12B). When all proliferative membranes had subsequently been removed, the retina was flattened with 5700 cs silicone oil exchange.

A 5-year-old girl was referred to me after multiple surgeries. Her other eye was lost, and she was referred for her highly traumatized right eye. I was confronted with a view of her retina, covered by an inflammatory

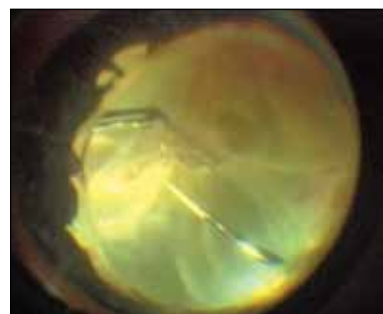


Figure 14. Separating the inflammatory membrane from the back of the retina bimanually.

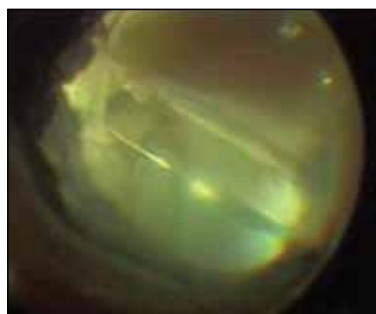


Figure 15. Careful membranectomy.

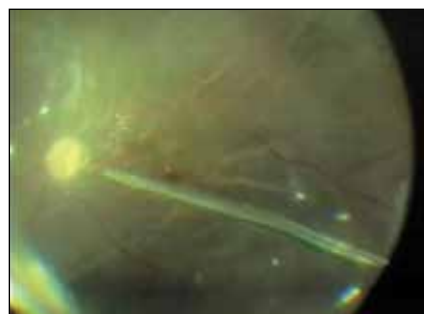


Figure 16. Flattened retina with silicone oil heavy liquids exchange.

Not only is the Stellaris PC able to facilitate efficient and controlled posterior segment surgery, but it is also designed to accommodate combined phaco and vitrectomy cases where warranted.

proliferative membrane (Figure 13). It is vital to have excellent illumination to address a situation like this—to even find a place to start. I began to bimanually separate the thick inflammatory membrane from the retina (Figure 14).

With dual linear foot pedal control, I was able to delaminate the membrane carefully (Figure 15). In general, performance of the Stellaris PC allows surgeons to safely work in close proximity to the retina. After a great deal of work, we were able to flatten the retina, and finally see the optic disc, a welcome sight (Figure 16). At 6 weeks after surgery, some sight has been

restored to this little girl's eye, which is of course a gratifying outcome.

CONCLUSION

Some manufacturers offer instruments that may be compatible with Stellaris PC should the desired instrument not be available from Bausch + Lomb. This is particularly useful when a challenging case demands specific illumination and instrumentation to achieve the best outcome. Complex surgeries are made easier than in the past by using modern vitreoretinal machines such as the Stellaris PC.

Cataract surgery is often necessary before or during surgery in managing complex posterior segment cases. Not only is the Stellaris PC able to facilitate efficient and controlled posterior segment surgery, but it is also designed to accommodate combined phaco and vitrectomy cases where warranted. ■

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Highlights and Contrast: Insights in Illumination

BY RICHARD SHEARD, FRCOPHTH

The use of illumination during vitreoretinal surgery is a double-edged sword: Although it allows us to see the fundus and other structures of the posterior segment, at the same time we must be concerned about the potential for phototoxicity to these structures. The Stellaris PC (Bausch + Lomb) offers several features that help to improve retinal illumination while at the same time minimizing the potential for damage due to phototoxicity.

In order to appreciate these illumination features, it is helpful to understand the interactions of light with posterior segment tissues. This article discusses those interactions, followed by explanation of the illumination options of the Stellaris PC, their theoretical benefits, and some experimental evidence.

LIGHT-TISSUE INTERACTIONS

Light's interaction with tissue takes a number of forms. When light passes through tissue without being attenuated, this is called transmission of light, and it is the basis for transparency. Even where tissues are transparent to particular wavelengths of light, the photons can interact with macromolecules in the tissue, causing changes in the direction of the photons. This scattering is most pronounced with short wavelengths of light, at the blue end of the spectrum, and less pronounced for longer wavelengths.

In the eye, scattering is produced by macromolecules in the clear media—the cornea, the lens, and the vitreous. Ophthalmologists exploit this phenomenon when visualiz-

ing the cornea at the slit lamp and assessing aqueous flare.

Refraction occurs where 2 tissues that interface have different refractive indices, such as the cornea and the aque-

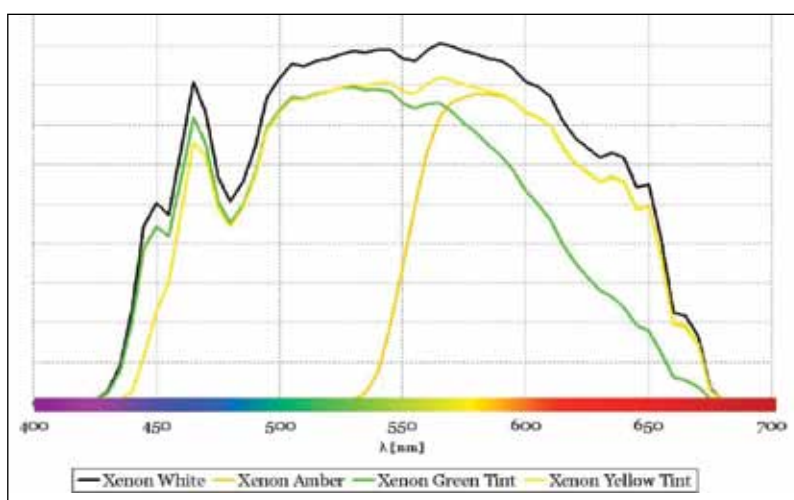


Figure 1. A comparison of the emission spectra of 4 options on the Stellaris PC.

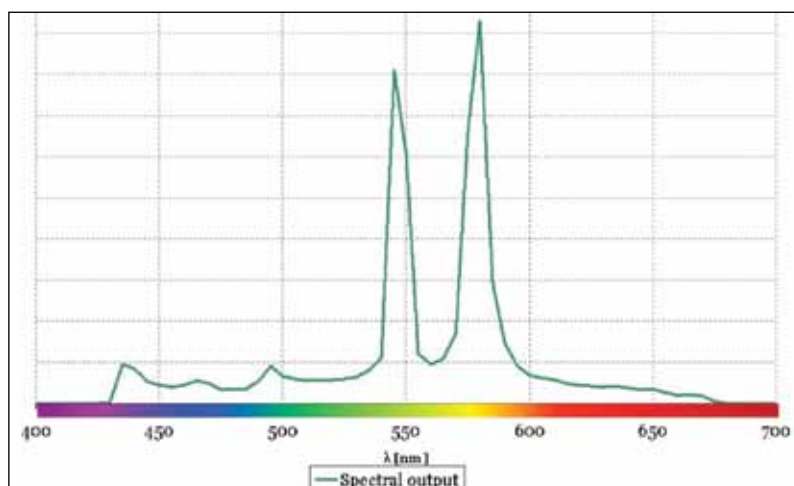


Figure 2. The emission spectrum of the Stellaris PC mercury vapor-xenon light source, with 2 peaks of emission in the green/yellow part of the spectrum and relatively little elsewhere.

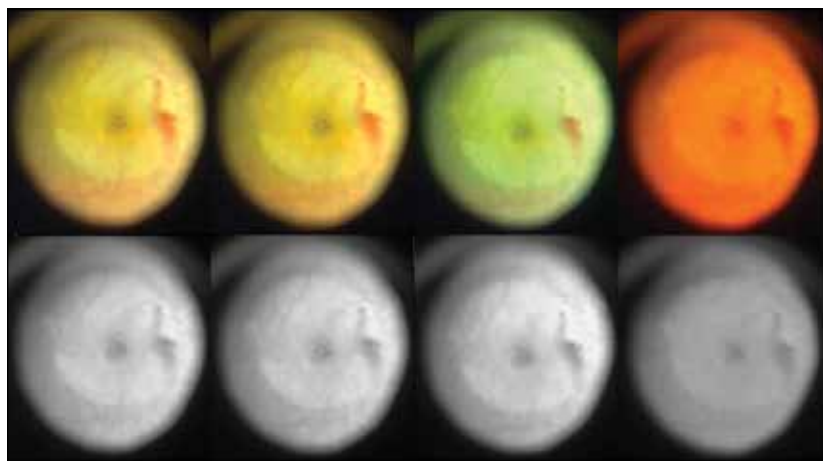


Figure 3. A comparison of the internal limiting membrane (ILM) field in the same eye with different filters; left to right: (unfiltered) white, yellow, green, and amber. Bottom row shows same images with the chrominance extracted, showing just the luminance.

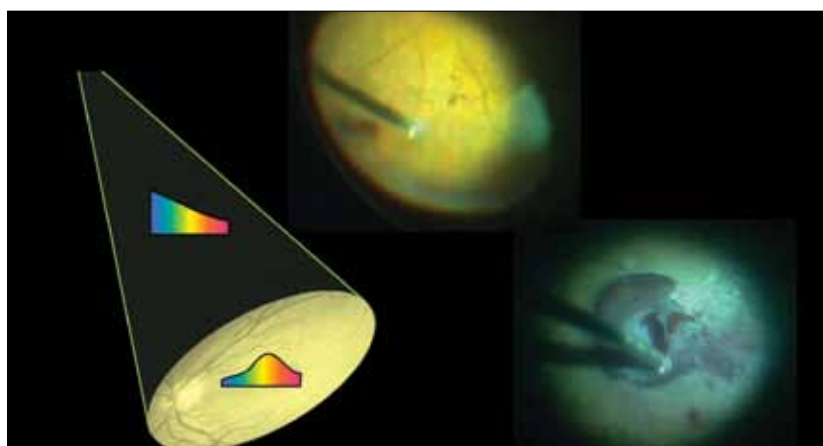


Figure 4. The green filter filters out some of the red wavelengths to improve contrast between the vitreous and the fundus.

Tissue visualization is primarily a matter of contrast between tissues in the foreground and the background.

ous. This phenomenon does not usually cause difficulty for vitreoretinal surgeons.

Diffuse reflection is back-scattering of incident light by microscopic irregularities in tissue at the cellular, subcellular, and macromolecular levels. This back-scattering is uniform in all directions, so that the tissue appears evenly illuminated from whichever direction it is viewed. Diffuse reflection is distinct from specular reflection, the mirror-like reflection

seen from a smooth surface such as a body of water.

Finally, absorption occurs when photons are absorbed by chromophores within tissue. Absorption can lead to a variety of effects in tissue that may be desirable or undesirable, depending on the circumstances.

UNDESIRABLE EFFECTS

The 2 main types of undesirable light effects that are relevant to retinal surgeons are the blue-light hazard and retinal hazard. The blue-light hazard is caused by short-wavelength, high-energy light at the blue end of the spectrum. When this is absorbed in the outer retina, it can cause damage to the retina with potential loss of vision that may be clinically unapparent. Retinal hazard is related to the power of the light source used and other factors. In retinal hazard, light absorbed in the retinal pigment epithelium causes pigmentary changes that are clinically detectable.

Van den Biesen and colleagues¹ evaluated the safety of several commercially available light sources for vitreoretinal surgery in relation to retinal phototoxicity standards set by the International Commission on Non-Ionizing Radiation Protection (ICNRP). For all the light sources evaluated, the exposure times leading to retinal damage were alarm-

ingly short, at less than 1 minute for the blue-light hazard with the light pipe at 10 mm from the retina, and less than 1 second for retinal hazard with the light pipe in contact with the retina.

Fortunately, as vitreoretinal surgeons know, phototoxic effects are fairly rare in vitreoretinal surgery, so these results appear puzzling. The main reason for the discrepancy may be that the ICNRP standards have a 33-fold safety threshold. Even taking that into account, however, it is possible to exceed that safety threshold within 30 minutes, the duration of many vitreoretinal procedures.

TISSUE VISUALIZATION

Tissue visualization is primarily a matter of contrast between tissues in the foreground and the background. Contrast arises mainly as a result of differences in color

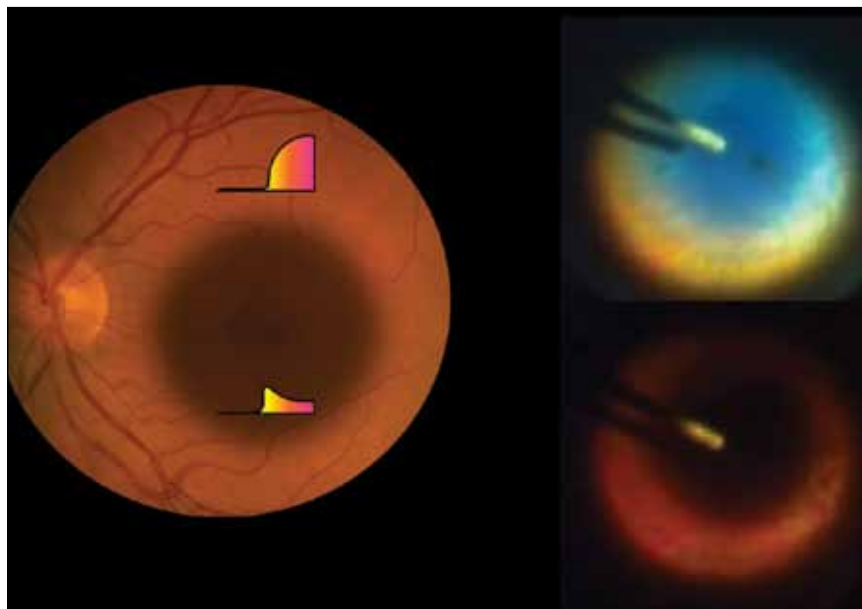


Figure 5. The amber filter is useful with blue dyes. When blue light is filtered out, the dye appears almost black against the background of the fundus.

Enhancing tissue visualization is a matter of maximizing chrominance and luminance contrast between tissues.

(chrominance contrast), differences in brightness (luminance contrast), and to a lesser extent differences in texture and movement of tissues.

Enhancing tissue visualization is a matter of maximizing chrominance and luminance contrast between tissues. This can be achieved through the selection of illumination sources with emission spectra complementary to the absorption spectra of chromophores and dyes in the eye.

Chromophores are molecules that absorb some part of the visible spectrum and allow us to perceive a tissue as a color. The color we see is the part of the spectrum that is reflected back by the chromophore; that is, the reflection spectrum of the chromophore is essentially the inverse of its absorption spectrum. The principal biologic chromophores in the eye are melanin (brown) and hemoglobin (red).

Dyes can be used to enhance the visualization of tissues, and in vitreoretinal surgery this is referred to as chromovitrectomy.² Two dyes in common use are brilliant blue G (BBG) and trypan blue, which absorb red light and reflect blue light.

To exploit the luminance characteristics of these chromophores and dyes, the Stellaris PC offers 5 illumination options with different emission spectra. The xenon light source can provide broad-spectrum white light when unfiltered, or it can be modified with yellow, green, or amber filters. A comparison of the emission spectra of these 4 options is seen in Figure 1. A fifth option is a mercury vapor-xenon light source, which has an emission spectrum with 2 peaks of emission in the green/yellow part of the spectrum (Figure 2). Because of this narrow spectrum, the mercury vapor-xenon light source does not benefit from the use of filters.

A comparison of the internal limiting membrane (ILM) field

in the same eye with different filters can be seen in Figure 3.

Relative to the discussion of contrast above, the vitreous is the foreground and the retina is the background. Under white light, the vitreous scatters blue light more than red, and the fundus reflects red and absorbs blue. To darken the background, thus enhancing contrast, a green filter can be used to filter out red wavelengths (Figure 4). The green filter also helps improve visualization of the vitreous.

The amber filter can be useful when blue dyes are used. The fundus reflects red and absorbs blue, and for the blue dye it is the reverse. When blue light is filtered out by the amber filter, the dye appears almost flat against the background of the fundus (Figure 5).

EMERGING EVIDENCE

In a prospective randomized case series, Henrich and colleagues³ assessed the potential of intraoperative light filters on the Stellaris PC to enhance contrast following intraoperative BBG staining of the ILM. They found that the use of filters did not significantly alter the contrast between the ILM and the underlying retina compared with white xenon light, although there was a trend toward improved contrast with the amber filter ($P = .13$), while green and yellow filters produced slightly inferior contrasts ($P = .37$ and $.64$, respectively). Contrast recognizability was better with the amber compared to the green filter ($P = .04$).

The study authors concluded that, among the available filters, the best results were achieved using the

amber filter, and they recommended use of the amber filter during BBG chromovitrectomy. This study looked only at chrominance contrast, not luminance contrast.⁴

There is little clinical data on the effect of filter use on outcomes. Coppola et al⁵ assessed outcomes in 10 patients undergoing 23-gauge epiretinal membrane surgery, 5 with the amber filter and 5 without. They found no difference in clinical outcomes in terms of visual acuity or autofluorescence, but there was a significant difference in reduction of retinal thickness with the amber filter. The clinical significance of these findings is unknown.

IDEAL ILLUMINATION

What, then, is the ideal illumination for the vitreoretinal surgeon? The ideal illumination exploits the visual properties of chromophores and dyes with the use of complementary emission spectra. The ideal illumination should maximize the contrast in luminance and chrominance between foreground and background. It should minimize phototoxicity risk in terms of emission spectrum, power, and duration of surgery. Ultimately, it should help to improve patient outcomes.

There is a sound theoretical basis for the use of colored filters to help visualize tissues in vitreoretinal surgery. While there is emerging evidence for a clinical benefit, it is far from complete, and more effort is needed in determining the optimum illumination spectra for these light sources, their luminance contrast performance, and their effect on clinical outcomes. ■

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Innovation in Challenging Cases

BY BARBARA PAROLINI, MD

I have had the opportunity to evaluate a number of machines designed to facilitate both anterior and posterior segment surgery, and this has allowed me to develop criteria for judging their effectiveness. It is important for phaco-vitrektomy machines to exhibit the following characteristics:

- Efficiency of the vitrectomy probe at every cutting rate;
- Reliable control of infusion pressure to the eye;
- Flexibility to address both anterior and posterior segments;
- Reliable injection and extraction of fluid.

After recently using the Stellaris PC in a range of challenging and complex cases, I can confirm that this phaco-vitrektomy surgical platform demonstrates efficiency in all of these areas. I especially appreciate its flexibility to select anterior or posterior segment functionality, as I find myself performing combined surgery with increasing frequency.

The dual linear footpedal of the Stellaris PC is extremely helpful in vitreoretinal surgery. It allows the surgeon to control all the parameters of the machine, for example simultaneously regulating cutting and aspiration levels independently. This allows the surgeon to use the probe as forceps and scissors simultaneously, grasping membranes and cutting them without losing the grip on the tissue. The pedal's wireless operation helps to prevent clutter in the operating room. Also advantageous on the Stellaris PC is its dual xenon and mercury-xenon light source and filters.

This article describes some of the capabilities I have found helpful when using the Stellaris PC in a number of challenging surgical cases.

VITRECTOMY MANEUVERS

Peripheral vitrectomy with scleral indentation in phakic eyes is feasible with either 25- or 23-gauge instrumentation. Peripheral shaving of vitreous can be performed without bending the probe or losing cutting efficiency, while looking with direct view through the

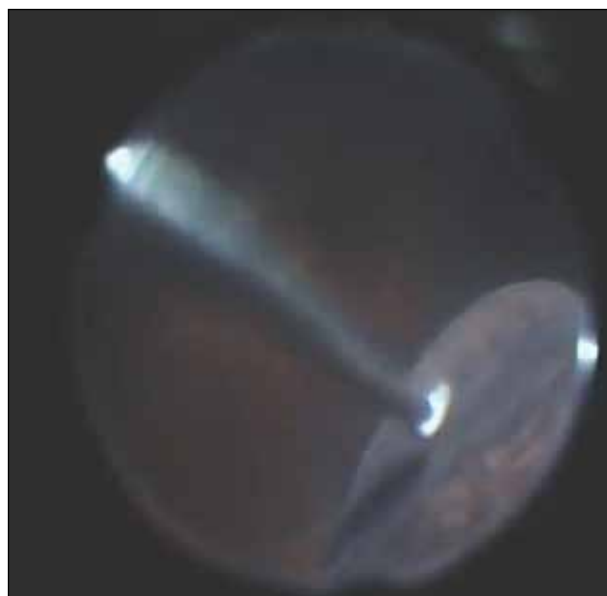


Figure 1. Peripheral vitrectomy and indentation in phakic eyes can be performed without bending the 25-gauge probe: here, under direct view in the operating microscope.



Figure 2. Peripheral vitrectomy seen through the BIOM.



Figure 3. Even in extremely anterior maneuvers, such as removing a capsular bag, the 25-gauge vitrectomy probe does not bend or lose efficiency.

operating microscope (Figure 1) or through the binocular indirect ophthalmomicroscope (BIOM; Figure 2).

Even in extremely anterior maneuvers, such as removing a capsular bag (Figure 3), the 25-gauge vitrectomy probe does not bend or lose efficiency.

During exchange of fluids, for instance heavy perfluorocarbon liquid (PFCL) with silicone oil, the probe can be used to aspirate subretinal PFCL bubbles without aspirating the edge of an adjacent retinotomy. Indentation can be performed while at the same time maintaining good control of intraocular pressure (IOP) in what can be an extremely stressful, complication-threatening situation.

In an eye with total retinal detachment and total attachment of the vitreous to the retina, I was able to use the vitreous cutter alone to separate the vitreous,



Figure 4. In an eye with total retinal detachment and attachment of the vitreous to the retina, the vitreous cutter is used to aspirate PFCL bubbles without damaging the retina.

Even in extremely anterior maneuvers, such as removing a capsular bag, the 25-gauge vitrectomy probe does not bend or lose efficiency.

and to aspirate PFCL bubbles (Figure 4), without damaging the retina. These delicate maneuvers were possible both at the posterior pole and in the periphery. To dissect the vitreous cortex from the detached retina, I stabilized the posterior retina with PFCL. By balancing the cutting rate and aspiration, it was then possible to dissect the vitreous cortex just using the vitrectomy probe.

During combined phaco-vitrectomy, an unwanted luxation of the crystalline lens may occur. When this takes place, the lens can be removed fairly quickly with only the 25-gauge vitrectomy probe, without the need for a fragmatome (Figure 5).

ILLUMINATION OPTIONS

I have also had the opportunity to evaluate a number of illumination options on the Stellaris PC. Several types of light fibers can be connected directly to the light source of the Stellaris PC, including chandelier lights.

The chandelier, which allows the use of bimanual techniques, provides more than enough light to perform peripheral vitrectomy (Figure 6), as well as maneuvers at the posterior pole. The green filter on the xenon

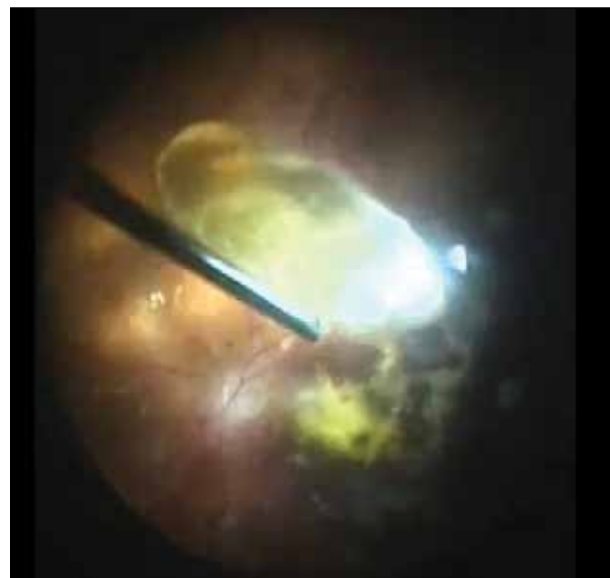


Figure 5. Removal of a luxated crystalline lens with the 25-gauge vitreous cutter, without the need for a fragmatome.



Figure 6. The chandelier light provides more than enough light to perform peripheral vitrectomy.

light source of the Stellaris PC can be used to enhance contrast for posterior pole maneuvers (Figure 7).

CONCLUSION

My experience in these cases and others demonstrates that any challenging surgical maneuver can potentially be performed with the Stellaris PC due to its versatility. ■



Figure 7. The green filter on the xenon light source of the Stellaris can be used to enhance contrast for posterior pole maneuvers.

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