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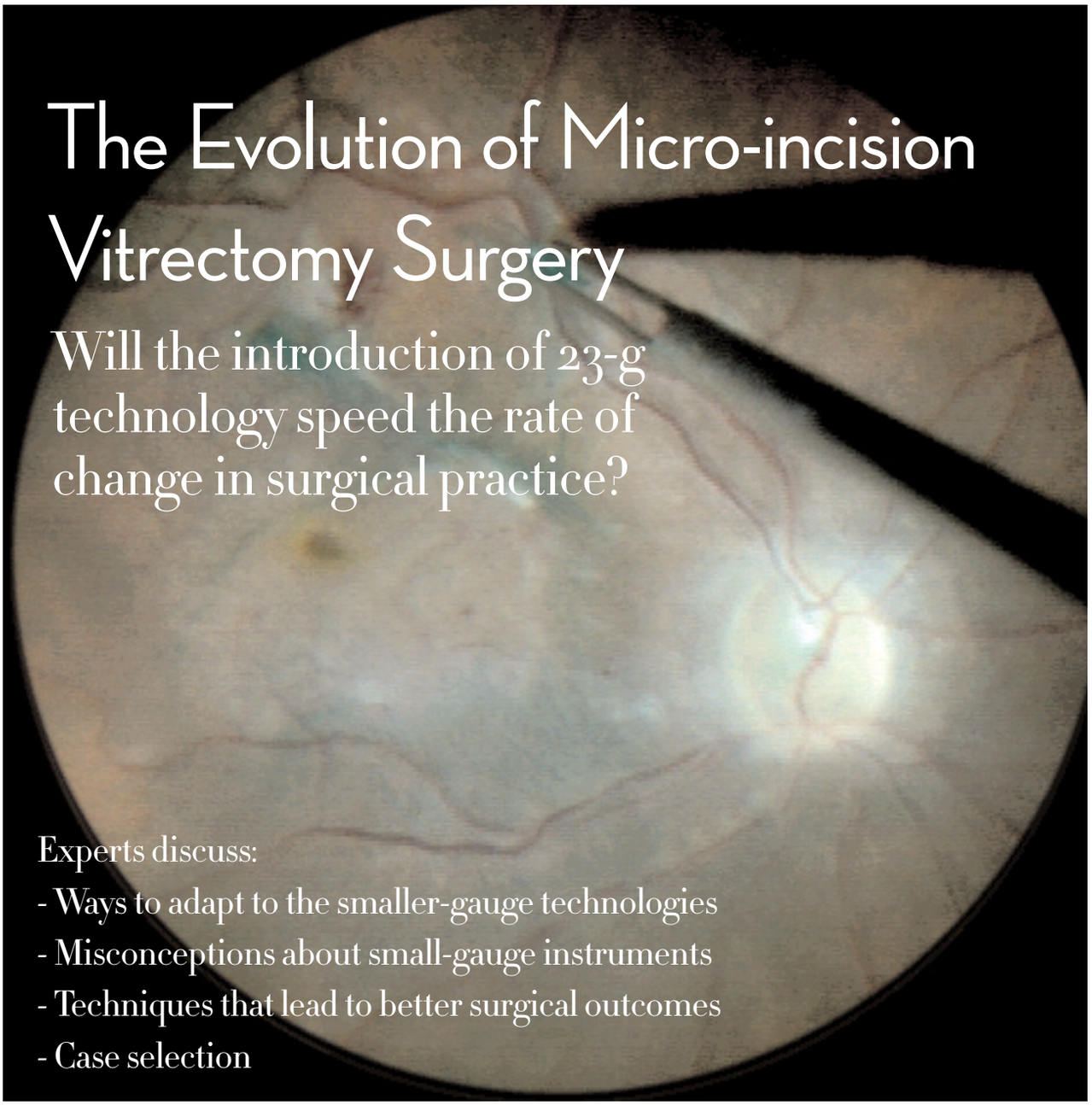


The Evolution of Micro-incision Vitrectomy Surgery

Will the introduction of 23-g technology speed the rate of change in surgical practice?

Experts discuss:

- Ways to adapt to the smaller-gauge technologies
- Misconceptions about small-gauge instruments
- Techniques that lead to better surgical outcomes
- Case selection

Migrating to Micro-incision Vitrectomy Surgery

Learn how leading vitreoretinal surgeons are adapting to the smaller-gauge technologies.

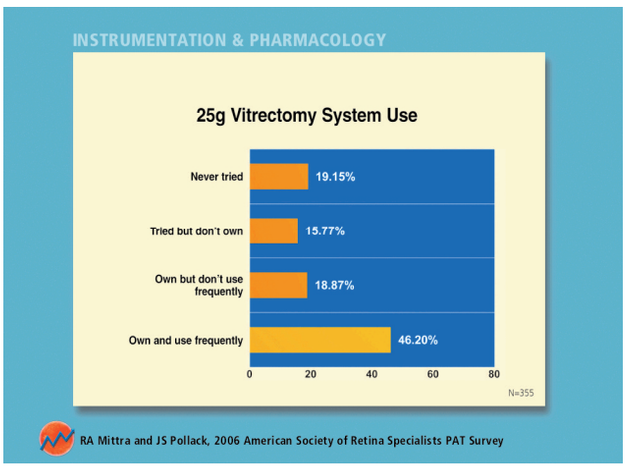
Kirk H. Packo, MD: Micro-incision vitrectomy surgery is changing with the introduction of new technologies, such as the instrumentation involved in the 23-g procedure. Today, we'll talk about how you are using this technology in your practices, including specific techniques to improve outcomes. We will also review the challenges surgeons face when trying new approaches to micro-incision surgery.

HOW INNOVATION BEGINS

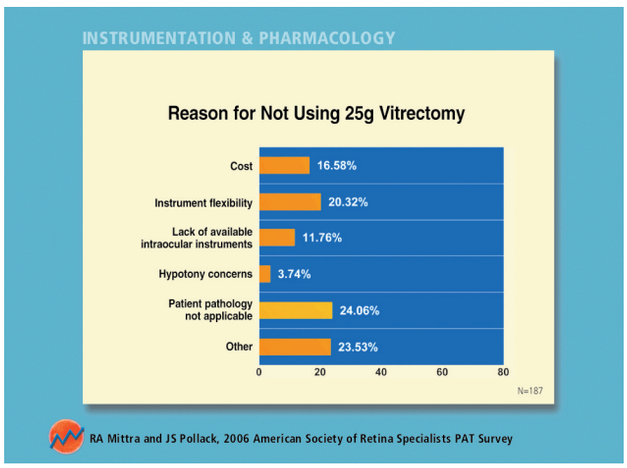
Dr. Packo: As we typically see with any new technology, a small group of surgeons try the potentially advantageous technique, and then it is released to the larger community to determine how others will use it. During the past 5 years, we have seen increased interest in 25-g vitrectomy. This trend has been confirmed in the 2006 Preferences and Trends (PAT) Survey by the American Society of Retina Specialists (ASRS) that showed 80% of respondents have tried 25-g procedures at least once. A smaller number have incorporated the technique into their surgical routines. We have also seen that surgeons become more comfortable with 25-g instrumentation the more they use it.

"Micro-incision vitrectomy surgery is changing with the introduction of new technologies, such as the 23-g procedure. ... During the past 5 years, we have seen increased interest in 25-g vitrectomy." — *Kirk H. Packo, MD*

When evaluating any new technology such as this, we review its strengths and limitations, and then we work to minimize the limitations and maximize the strengths. As the process of refining 25-g instrumentation continues, we now have one more change on the horizon to consider: the intro-



Eighty percent of respondents surveyed by the American Society of Retina Specialists said they have tried 25-g procedures at least once.



Twenty-four percent of respondents surveyed by the American Society of Retina Specialists said they don't use 25-g vitrectomy because patient pathology was not applicable.

duction of 23-g surgery, which represents yet another new form of micro-incision vitrectomy surgery.

Claus Eckardt, MD, Paul E. Tornambe, MD, and others, deserve credit for their revealing work with 23-g. They are urging us to start using that technique. Before we focus on this latest approach, I want to talk about the current evolution of 25-g, which will help us understand how prepared we are for these surgical innovations. How many of you have made a significant transition to 25-g?

GOING SLOW WITH FELLOWS

Peter K. Kaiser, MD: I work in a teaching institution where I train fellows, so I've been relatively slow in adopting 25-g surgery. Only about 20% of my cases involve the use of 25-g instrumentation. A lot of challenges are magnified dramatically with the use of 25-g instrumentation in our training environment. For example, there is the lack of friction on the instruments and the difficulty involved in moving the eye around, which hinders the instrument's function and limits lighting. I believe these challenges discourage widespread acceptance of small-gauge surgery. However, many of these challenges have been addressed with newer instruments and systems and are no longer issues.

Dr. Packo: Dr. Charles, please comment on your early experience with 25-g instrumentation.

Steve Charles, MD: Before trying 25-g, I was concerned about the fluidics associated with a small lumen. I thought I would not be able to use it for dense epiretinal membranes or dense vitreous hemorrhages. However, my assumptions were wrong. I have used 25-g instrumentation for virtually 100% of my cases. I was also concerned about wound leaks, so I first developed the idea of using fluid-air exchange to prevent wound leaks. Now, I'm realizing that I do not need fluid-air exchange unless the sclera is thin and the patient is a high myope. I have not experienced the wound leaks that I expected with the use of 25-g instruments. Recently, I've begun angulated wound construction because of the compelling laboratory data concerning wound leaks at high intraocular pressure.

Dr. Packo: Dr. Ho, what has your experience been with 25-g instrumentation? I know that you also teach residents.

Allen C. Ho, MD: Yes, we train a lot of retinal fellows, but we have taken a different approach with them. My 25-g caseload is about 90%, and that includes 20-g and 25-g cases in which we enlarge one wound. Our fellows seem to have adapted quite easily. Occasionally, I do sew on a 20-g infusion cannula — in a foreign body case, for example. Besides foreign body, the indications for enlarging a wound usually arise when a patient needs a silicone oil procedure or a lensectomy.

You may be wondering how we manage to use the newer technology at such a high rate. With the exception of the types of cases I just mentioned, almost all of the surgical maneuvers we can do with 20-g were not achievable using first-generation 25-g. However, more surgeons are adopting 25-g because the second-generation instrumentation is stiffer and provides better illumination, two of the original main barriers to widespread use for most surgeons.

"About 20% of my cases involve the use of 25-g. ... A lot of challenges are magnified dramatically with the use of 25-g in our training environment." — *Peter K. Kaiser, MD*

SUTURELESS WOUNDS

Dr. Packo: Before we continue, I would like to focus on the teaching aspects of this technology. Showing ophthalmology residents how to perform an effective extracapsular cataract extraction is already difficult. Everyone is using phacoemulsification now, leaving little opportunity to teach general and comprehensive ophthalmology residents how to suture wounds. Everyone around this table is old enough to remember how challenging it was to perform an air-fluid exchange before we had the air pump. We take so many things for granted now because of the benefits of advanced instrumentation. With these trends in mind, I wonder if we will lose even more training techniques if we move away from 20-g surgery.

"My 25-g caseload is about 90%. ... More surgeons are adopting 25-g because the second generation instrumentation is stiffer and provides better illumination." — *Allen C. Ho, MD*

Dr. Ho: Every new surgical platform shares common characteristics. First and foremost, it has to be better for the patient. If it is better for the surgeon as well, then that is a plus. However, as you pointed out, all of our ophthalmology trainees are less adept at suturing. That is the technique we give up teaching, but the principles in vitreoretinal surgery, whether you are using a smaller-gauge instrument or a larger-gauge instrument, essentially remain the same.

Dr. Charles: I agree with Dr. Ho. I teach fellows 25-g from the beginning.

"I use 25-g ... for about 75% to 80% of my cases. These cases involve posterior pathology, including epiretinal membranes, macular holes, diabetic vitreous hemorrhages and tractional retinal detachments." — *John S. Pollack, MD*

Dr. Packo: Dr. Williams, in your Detroit practice, I know your transition to 25-g surgery has been different from our experiences. Have you adopted it 100% yet?

USAGE IN COMPLEX CASES

George A. Williams, MD: Due to the nature of our cases, I have not adopted 25-gauge surgery in all cases. I'm using 25-g in nearly 100% of cases involving macular puckers and holes and related problems. For relatively complex detachments, however, I am still using 20-g instrumentation primarily. I should note that I do not have access to the 23-g technology, which I think would be very useful for more complex cases.

Dr. Packo: Dr. Pollack, how much more micro-incision surgery have you adopted in your practice over the past 5 years in terms of numbers and case selection?

John S. Pollack, MD: I use 25-g instrumentation for about 75% to 80% of my cases. These cases involve posterior pathology, including epiretinal membranes, macular holes, diabetic vitreous hemorrhages and tractional retinal detachments. For the remaining anterior pathology, I have begun using 23-g technology because I find I am more effective and efficient when using instruments that are stiffer than the current 25-g instruments.

"I'm using 25-g in nearly 100% of cases involving macular puckers and holes and related problems. For relatively complex detachments, however, I am still using 20-g instrumentation primarily." — *George A. Williams, MD*

For example, when performing a vitrectomy in a retinal detachment case, I typically place the anterior laser 360 degrees to reduce the risk of new tears that can develop in the future. While I can do that with a 25-g laser, despite the reduced stiffness of the probe, I find that it takes longer and is more frustrating. I have had the same experience with anterior proliferative vitreoretinopathy and anterior diabetic tractional detachments. The 25-g forceps work well, but the 23-g forceps are significantly stronger. So I find myself working more efficiently when performing anterior procedures with the 23-g instruments.

Dr. Packo: When considering any new technique, it is natural for us to first choose what we think will be the ideal, simplest cases. After that, we expand our reach and determine how extensively we can use the technique. Many times, we will cycle back and decide not to continue using the technique on those simpler cases because we realize through experience that they are not best suited for the technique. Dr. Ho, has your case selection for 25-g gone up and down?

Dr. Ho: We are expanding our use of 25-g instruments for a wider spectrum of cases. We have not cycled back. The Xenon illuminators have helped us expand. They allow us to get more light into the eye with a 25-g endoilluminator than we could with a 20-g halogen lighting system. I think the wide-angle viewing systems help. Certainly, I must give credit to our fellows, who make highly trained assistants during surgery. For example, they improve access to anterior pathology with skilled scleral depression.

WHAT IS THE FEAR?

Dr Packo: Dr. Ho's experience seems to be the exception rather than the rule right now. Dr. Kaiser, why do you think some surgeons have not tried 25-g instruments? Are surgeons who tried these instruments before the much brighter Xenon illuminators were introduced still concerned that the lighting is inadequate?

Dr. Kaiser: They are still concerned. You mentioned the PAT Survey, which shows that almost all surgeons have tried 25-g, but many of them only once. Most of these one-time users probably were operating in the dark with very flexible instruments. The differences associated with 25-g moved them out of their comfort zone, leading to a low adoption rate.

Now, however, the second- and third-generation instruments have improved tremendously. They are more than 50% stiffer, and lighting is not an issue. And the earlier concerns about the possible increased risks of hypotony and endophthalmitis have proved unfounded. A lot of surgeons who tried 25-g only once are thinking it would be nice to benefit from the advantages of 25-g, but they are reluctant to try it again because of their initial experiences.

That is one of the reasons why they will be pleased with 23-g. Many of the features we had to give up when we first tried 25-g are available in these newer 23-g systems. The experience for most people will be identical to using 20-g. So my guess is that the adoption rate for 23-g technology will be greater. RP

The Lure of 23-g Vitrectomy Surgery

Surgeons look at the strengths and limitations of 23-g and 25-g instrumentation.

Dr. Packo: Taking a snapshot of 2006, we see that surgeons are expressing an increasing interest in 25-g surgery and adopting it more into their practices. However, doctors are also moving toward 23-g. Dr. Ho, what has sparked your interest in 23-g even though you have been satisfied with 25-g?

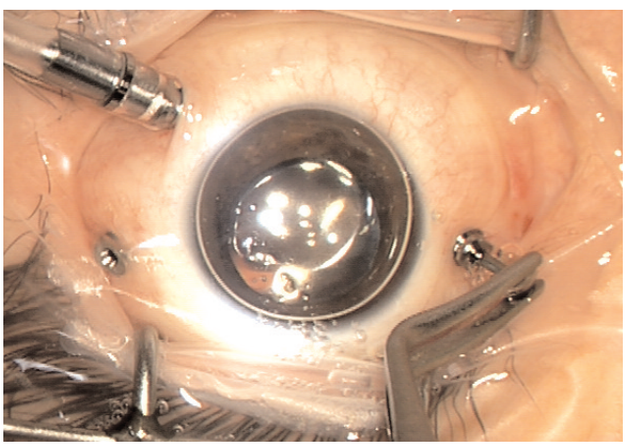
Dr. Ho: All surgical systems come with compromises. With 25-g surgery, the compromises relate to the bore of the instrumentation. For example, silicone oil placement tends to be an issue, particularly if you use 5000-centistoke silicone oil. When removing lens fragments, I have performed a straight 25-g lensectomy without converting to a larger bore instrument. If I encounter a harder piece of nucleus, however, I often have to convert to a larger bore 20-g system. I like the idea of a micro-incision-based system that may not be 20-g but is sutureless. These are some of the reasons why 23-g will be beneficial.

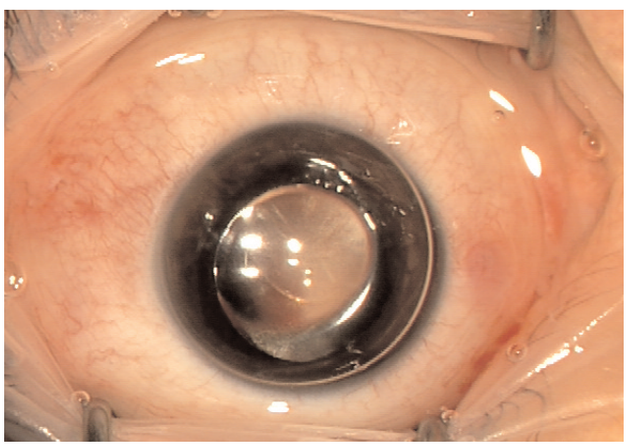
Dr. Packo: The introduction of the Xenon illuminators was a huge advance in the evolution of these instruments, removing a major frustration we experienced in the early days of 25-g. Although the 25-g instruments have become stiffer, they certainly don't match the stiffness of 20-g. As a result, many surgeons will continue to struggle with 25-g flexibility, which is a big factor driving more of us toward 23-g.

"Although the 25-g instruments have become stiffer, they ... don't match the stiffness of 20-g. As a result, many surgeons will ... struggle with 25-g flexibility, which is a big factor driving more of us toward 23-g." — *Kirk H. Packo, MD*

Dr. Pollack, you have adapted to the flexibility of 25-g instrumentation. Do you think using 23-g would make adapting to a more flexible instrument less challenging for surgeons, therefore eliminating flexibility concerns?

Dr. Pollack: The 2006 PAT survey, which was presented at the ASRS meeting in Cannes, showed that more than 60% of respondents believed 25-g was useful for fewer than





Left: Micro-incision vitrectomy surgery performed with 23-gauge instrumentation that surgeons consider stiffer and easier to use than 25-gauge instruments. Right: The eye after 23-gauge vitrectomy surgery.

"Most of the retina specialists in this country who have not adopted 25-g for most of their cases due to flexibility issues will have a much easier time with 23-g vitrectomy."
— John S. Pollack, MD

51% of all their cases. That is a fairly high percentage of surgeons who are not using it for most of their cases.

Informally, I surveyed surgeons from around the world whom I believe are aggressive and eager to try new technology. Many of them do not use the second-generation 25-g instruments for macular holes, epiretinal membranes and other complex cases because of the flexibility issue.

They say, "Okay, I know you like it, but in my hands I like something stiffer." I believe that most of the retina specialists in this country who have not adopted 25-g for most of their cases due to flexibility issues will have a much easier time with 23-g vitrectomy. The greater stiffness will make it easier for them to incorporate 23-g into their practices. **RP**

How Patients React to Smaller-Gauge Surgery

Kirk H. Packo, MD: We have been talking about the advantages of micro-incision instruments for vitrectomy surgery and how these instruments affect our case selection. Let's talk about the patient. What differences have you seen in how patients react to 25-g vs. 20-g surgery?

George A. Williams, MD: Whatever is best for the patient should always be our most important consideration. My primary goal is to make people see better. If I can do that in a manner that is as atraumatic as possible, then that is an additional benefit.

It is nice if the patient has a quiet conjunctiva and is happy with the outcome 1 day post-op. The other issue is speed of visual recovery. Some small studies suggest that the smaller diameter probes are associated with faster recovery times. We measure the speed of recovery in weeks. Three to 6 months after the procedure, we probably would not notice any difference in outcomes associated with 20-g and 25-g procedures. However, we should not lose sight of the short-term value to the patient, who wants his vision back as quickly as possible.

Steve Charles, MD: I have used 25-g surgery for nearly all of my cases since the appropriate tools have become available. I prefer 25-g for the following reasons:

1. The patient experiences less damage to the conjunctiva, Tenon's capsule and sclera, resulting in less inflammation and discomfort. Reduced conjunctival damage is also better from the perspective of pre-existing or future glaucoma filtering procedures.

2. The 25-g fluidics are safer than 20-g because small lumens coupled with high cutting rates produce port-based flow limiting, which lowers the incidence of iatrogenic retinal breaks by reducing pulsatile vitreoretinal traction.

3. Endophthalmitis rates have not been proven to be higher with 25-g surgery. Physicians who believe they are may leave vitreous wicks in the wound and/or unwisely eliminate the use of subconjunctival antibiotics.

4. You can produce a complete vitrectomy with 25-g surgery. The extent of vitreous removal is entirely technique driven. You must take the port to the vitreous, not use suction to pull the vitreous to the port.

Addressing the Art of Wound Construction

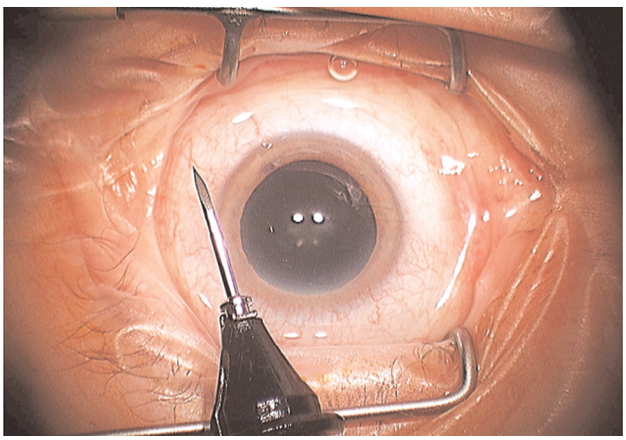
Surgeons discuss how 23-g can help with different approaches to constructing the wound.

Dr. Packo: Let's talk about wound construction. Based on your experience with 23-g instrumentation, can you compare wound construction using the Dutch Ophthalmic system to wound construction using the Alcon system?

FUNDAMENTAL DIFFERENCES

Dr. Kaiser: The two systems offer two different approaches to inserting a cannula into the eye. The Dutch system uses an MVR blade that is bent almost at a 90° angle. You enter the eye in a very oblique fashion with the MVR, and then insert the cannula with a blunt-tipped trocar through that MVR incision.

The problem with this approach is that is a two-step process. You enter the eye with the MVR blade and then, while holding the eye still, you enter the eye with the blunt-tipped inserter. If your nurse is not right there with you to hand you the cannula immediately, or if the conjunctival incision moves even slightly, the insertion can become difficult because the Dutch system inserter is blunt, and it will not find its way into the eye. You have to find the hole that you just created.



This trocar cannula system allows you to enter the eye at an oblique angle with a sharp inserter in one step versus two.

"The Alcon system uses a sharp, solid bore trocar to insert the cannula. ... This sharp inserter already has the cannula already on it, so you do not have to perform a two-step procedure."

— *Peter K. Kaiser,* MD

In contrast, the Alcon system uses a sharp, solid bore trocar to insert the cannula similar to insertion of 25-g cannulas. This sharp inserter already has the cannula on it, so you do not have to perform a two-step procedure. You can just enter the eye at an oblique angle with the sharp inserter in one step. It is much easier because you do not have to worry about the location of the incision you made with the MVR.

Dr. Packo: You mentioned the similar cannulas that are on a sharp trocar for the 23-g and 25-g instruments, allowing you a one-step entry into the eye. Do you angle your 25-g entry?

Dr. Kaiser: I do, even though it is not required. I choose to angle 25-g because I have found that leakage and hypotony almost never occur. We have done animal wound studies that show a dramatic difference in hypotony and wound closure rates with an angled entry compared with straight incisions.

"I use an angled incision for both 25-g and 23-g [vitrectomy surgery], and I use a very shallow tunnel approach. It's the same angle approach I use when placing a buckle suture."

— John S. Pollack, MD

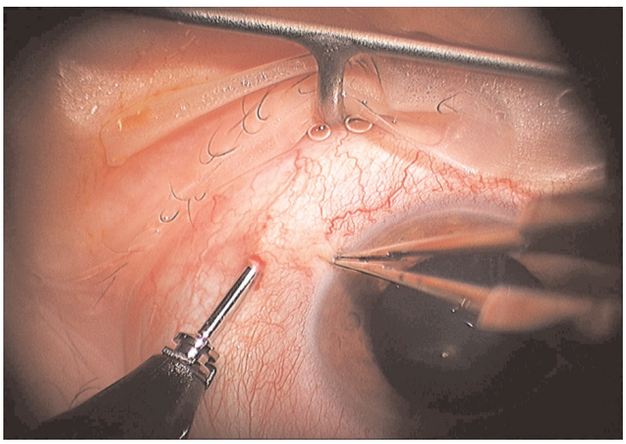
MANAGING WOUND CONSTRUCTION

Dr. Packo: Obviously, wound construction also requires us to pay attention to the conjunctiva. I think Dr. Kaiser's observations apply to both 25-g and 23-g, maybe more so in one than the other. Dr. Pollack, how do you handle the conjunctiva? Also, how do you stabilize the eye when you make your entry?

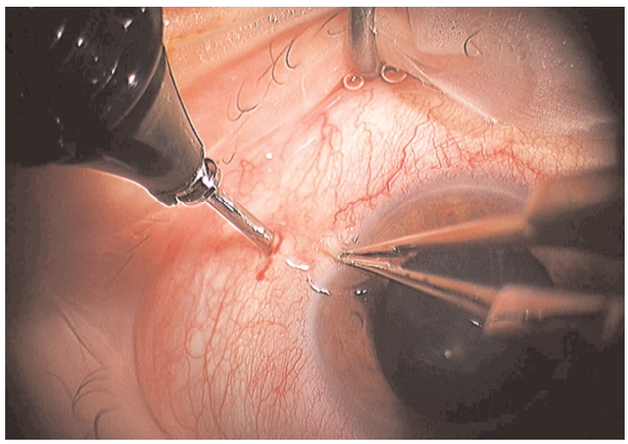
Dr. Pollack: I use an angled incision for both 25-g and 23-g, and I use a very shallow tunnel approach. It's the same angle approach I use when placing a buckle suture. When I do a tunnel incision with the sharp trocar, it is shallow enough to cause a visible ridge in the sclera. When I get to the tip of the cannula, I raise the trocar handle 90° and insert the trocar/cannula assembly into the eye.

Stabilizing the eye is much more important with this scleral tunnel style insertion than with a straight entry, and I have tried several different approaches. I have tried stabilizing the limbus at 12 o'clock as well as at 3 o'clock or 9 o'clock. When stabilizing the eye at the limbus, you will typically encounter a lot of rotational movement that requires you to "chase" your tunnel as the eye rotates. The most reliable solution for me has been to use 0.12-mm forceps to grasp both the conjunctiva and the superficial sclera just inferior to the mark I have made on the eye. This mark is where I want the sharp trocar to enter the vitreous cavity.

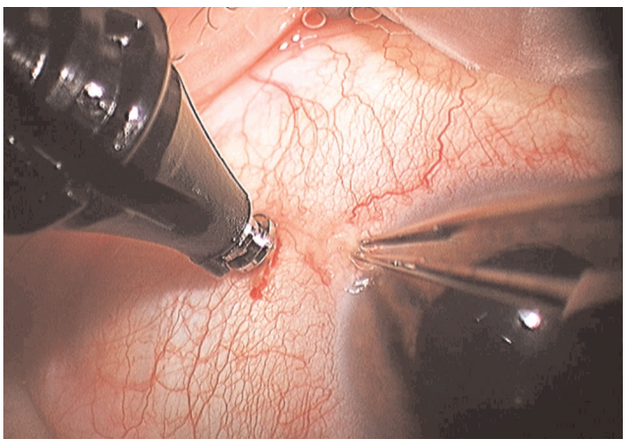
I start my scleral tunnel superior to the mark and tunnel inferiorly. I hold the conjunctiva and the superficial sclera just inferior to this area to benefit from the effect of opposite forces. I rotate the eye superiorly with the forceps while



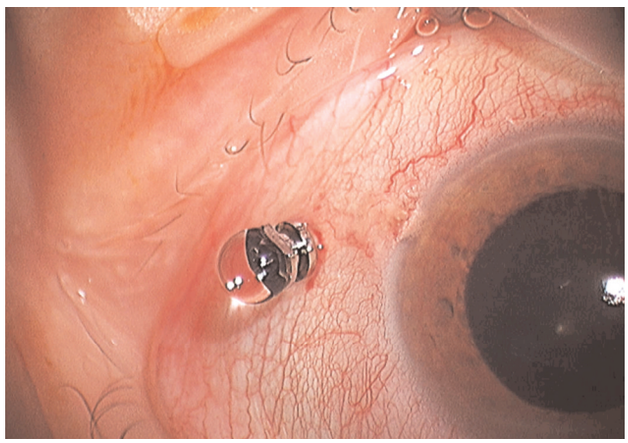
A) Start an incision in a direction parallel to the limbus. Angle the incision about 20 to 30 degrees from the scleral plane.



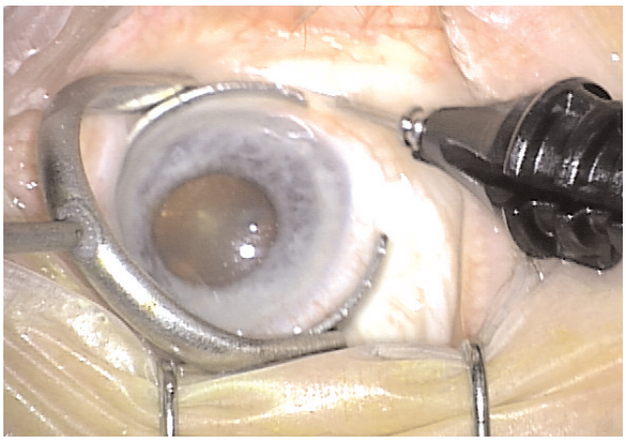
B) Before the trocar/cannula interface, immediately supinate the trocar and advance it toward the posterior pole.



C) No rotation is required if continuous insertion is used, and the transition from A to C is one fluid motion.



D) Remove the trocar.



A 13.5 mm, swiveled Thorton Fixation Ring (a circular handheld instrument) stabilizes the globe for beveled incisions.

tunneling toward the forceps with the sharp trocar. This provides excellent stabilization.

Dr. Packo: So you move in an anterior-posterior direction with your bevel. Are you going parallel to the limbus?

Dr. Pollack: Yes, I am still going parallel to the limbus. I do not move perpendicular to the limbus.

Dr. Kaiser: That is an important point. When I do an angle incision, I go parallel to the limbus. Some surgeons, when they describe this approach, go toward the lens or the posterior pole. Obviously, we are not talking about inserting in these two directions when we are angling the incision.

"When I do an angle incision, I go parallel to the limbus. Some surgeons ... go toward the lens or the posterior pole. Obviously, we are not talking about inserting in these two directions." — *Peter K. Kaiser,* MD

Dr. Packo: Does anyone have a different approach to stabilizing the eye when making the incision?

Dr. Ho: I use the 13.5 mm, swiveled Thorton Fixation Ring to stabilize the globe for beveled incisions (see photo above). It achieves circumferential globe fixation at the surgical limbus to counterbalance the rotational forces generated by the tocar cannula incision technique. The Thorton ring has small teeth that project from the circular ring and distribute the fixation forces over many points, thereby reducing the chance of conjunctival tear.

CHOOSING THE RIGHT ANGLE

Dr. Packo: Dr. Williams, you said you have made several changes to your technique: Initially, you did not angle 25-g. Later, you concluded that angling 25-g wasn't necessary. We believe the 23-g incision needs to be angled. What is the angle we should use? Is there a sweet spot?

Dr. Williams: There is certainly a sweet spot. With the Alcon system, I place the bevel of the blade down on the sclera, and I let it slide through the wall of the sclera until I meet the trocar/cannula interface. When the cannula hits the sclera, I elevate the trocar and drive perpendicularly into the eye. This approach seems to work well.

Dr. Packo: Why don't you angle the trocar all the way in? Or, do you feel that your path has already been created with the trocar that extends past the cannula?

Dr. Williams: The pathway has already been established through the sclera. You do not want the cannula to be too flat. When you pull out the instruments, the cannula settles back to its natural position. That is good because we are using a metal cannula, which rotates back away from the lens. This is important to keep in mind in phakic eyes.

Dr. Packo: Is there any advantage to angling a cannula in one direction over another? Do you have the choice of angling it against a patient's lids, for example? And what about pointing the opening away from the lids? If you point a cannula away from you superiorly, does it make inserting your instrument into the eye more difficult? Do you angle it toward you? Which direction do you prefer?

Dr. Williams: I angle inferiorly unless the pathology is difficult to manage superiorly. For example, it can be difficult to address superior pathology if the cannula is too high, which makes it difficult to move the eye superiorly. If I am working close to the midline with three ports, it's easier to have the openings pointing up toward me to provide access to the instruments.

Dr. Ho: I use an angled incision with the 23-g in a similar fashion. The trocar extends approximately 4 mm beyond the cannula. In most cases, I have used the entire 4-mm sharp beveled trocar to create the initial angled incision. I also have raised the instrument to a vertical, perpendicular position to insert the cannula.

But the farther you go with the sharp 4-mm trocar, the more force you generate and the more destabilized the eye becomes because of increased circumferential torque. This is disconcerting if you always make your bevel circumferential or parallel to the limbus. As a result, I have tried different bevel lengths to address this issue. Shorter bevel lengths result in less destabilization of the globe during trocar cannula entry with 23-g instrumentation.

I have tried to use less than the entire 4-mm sharp bevel. These incisions seem to have worked out well. RP

Comparing 23-g to 25-g Vitrectomy Surgery

Unique characteristics may influence your choice of instrumentation.

Dr. Packo: Let's focus on the important differences between 25-g and 23-g surgery. We'll start with the vitrectomy cutter itself. Can we contrast 25-g and 23-g cutters, aside from the fact the 23-g probe is stiffer?

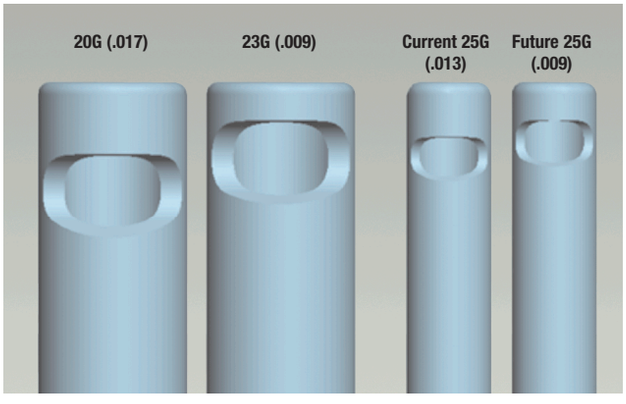
Dr. Ho: The cutter is important. The Alcon port optimization project has moved the cutter mouths for all its systems closer to the end of the cutter. This is desirable because it allows the cutter to remove tissue from the surface of the retina. The 23-g cutter mouth is closer to the end of the cutter than it is on the current 20-g or 25-g probes.

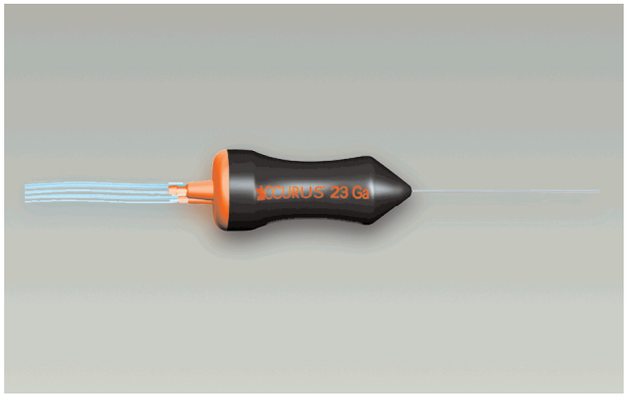
In addition, a major difference exists in the cut rate of the vitrectomy cutter. The new Alcon 23-g cutter can achieve cut rates up to 2500 cuts per minute, similar to its current 20-g system. This compares to 1500 cpm for 25-g.

Dr. Packo: Illumination is also an important issue. Dr. Pollack, in the past you have discussed your use of chandelier lights. When we had poor illumination for 25-g surgery, we struggled. Then, as mentioned earlier, Xenon illumination improved visibility at the same time many surgeons were starting to embrace chandelier lighting as an adjunct to 25-g surgery. Since the 23-g light pipe is now brighter, are chandeliers still useful in 23-g surgery?

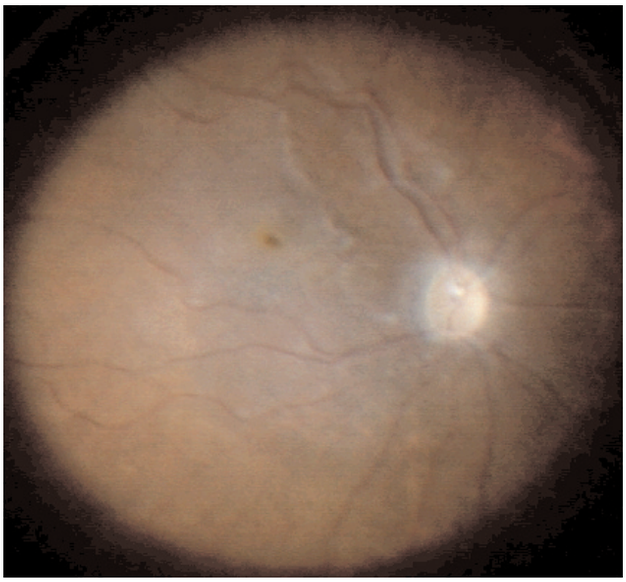
"The Alcon port optimization project has moved the cutter mouths for all its systems closer to the end of the cutter. This ... allows the cutter to remove tissue from the surface of the retina. The 23-g cutter mouth is closer to the end of the cutter than it is on the ... 20-g or 25-g probes" — *Allen C. Ho, MD*

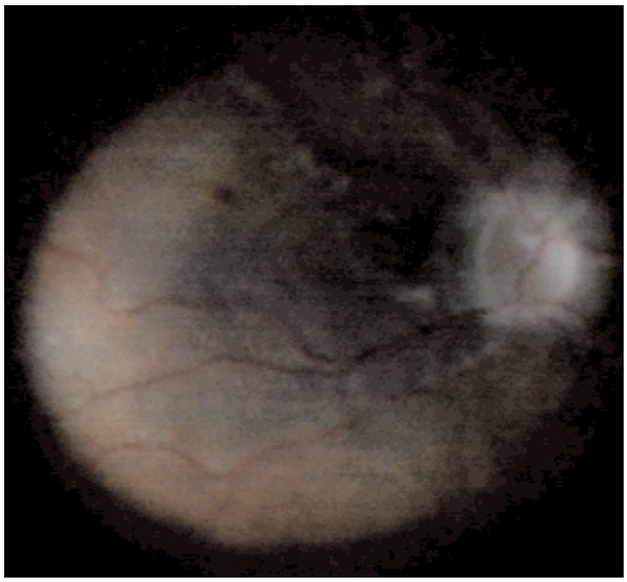
Dr. Pollack: Chandelier lighting enables me to be a





Left: The port of the current 23-g probe is 50% closer to the distal end than the 20-g port. The new "closer port to tip" location will soon be available for the 25-g probes. Right: A 23-g vitrectomy cutter.





Left: An intraocular view of the eye using a Xenon illuminator lighting system to increase visibility during 25-g vitrectomy surgery. Right: An intraocular view using a halogen lighting system as an adjunct to 25-g surgery. Xenon illuminators allow surgeons to get more light into the eye to enhance surgical outcomes.

much more efficient surgeon, because it allows me to use a bimanual technique that I believe improves my effectiveness and speed. I'm considering using the chandelier lighting and the bimanual technique more rather than less.

PORT-BASED FLOW LIMITING

Dr. Packo: Dr. Charles, you have discussed the flow-limiting advantages made possible by the 25-g port. You have said the 25-g port helps us control removal of vitreous and tissue more safely than the 20-g port. If the other advantages of small-gauge surgery did not exist — such as patient acceptance and speed of visual recovery — would you still prefer smaller-gauge instrumentation? With the ability of 23-g to go faster, do you feel you have achieved a true degree of equal flow control? In other words, are you willing to give up the degree of flow control you have with the 25-g system for the control provided by the 23-g probe?

Dr. Charles: Fast cutting produces port-based flow limiting and reduces uncut vitreous going through the port. The cutting rate always should be set at the highest level and the vacuum increased until tissue is removed. Port-based flow limiting reduces fluid surge and iatrogenic retinal breaks after sudden elastic deformation of dense tissue through the port. In terms of limiting port-based flow, 23-g at 2500 cpm has exactly the same flow rate as 25-g, which produces 1500 cpm. Therefore, port-based flow-limiting is exactly the same for 23-g as it is for 25-g.

Besides a faster cutting rate, another distinct advantage of 23-g instrumentation is having the port closer to the tip, which improves probe delamination. The position of the port allows access to the retinal surface and makes removal of flaps much easier.

Since you are also closer to the retina, however, you need to be careful if you get a surge of fluid to the port. It is important to always use the maximum cutting rate. Furthermore, if you have the bad habit of pulling away as you cut, as many surgeons do, you risk pulling on the vitreous because you are sectioning the collagen fibers into shorter sections. You are applying less traction. I always implore people to engage the vitreous and always advance, never pull the probe back and never draw the vitreous to the port.

"Fast cutting produces port-based flow limiting and reduces uncut vitreous going though the port. The cutting rate ... should be set at the highest level and the vacuum increased until tissue is removed." — *Steve Charles, MD*

Dr. Packo: Can you change the numbers, though, even with 20-g? Can you find some parameters that mimic the amount of fluid you need to remove?

Dr. Charles: You would have to achieve 6000 to 7000 cpm in 20-g to achieve the same port-based flow limit that you get in 23-g. That is the problem. Why do we have port-based flow limiting? We want to control potentially damaging surges. We want to reduce iatrogenic retinal breaks due to

When to Suture

Kirk H. Packo, MD: Dr. Charles, you have stressed how important it is to move cannulas on the fulcrum of the sclerotomy with your instruments rather than move the eye. Does that motion tear or weaken the sclera?

Steve Charles, MD: The sclera varies widely in thickness and toughness — from very thin in high myopes to very thick in most patients. Unless they are high myopes, our macular surgery diabetic patients will not pose problems. Yet, you will encounter challenges in the more difficult retinal detachment cases. You may end up having to suture a few of these patients.

surge from sudden elastic deformation of epiretinal membrane through the port. We also want to avoid iatrogenic breaks in a detached retina, which can occur when the retina moves to the port as you try to remove peripheral vitreous. In addition, we want to eliminate pulsatile traction on attached retina each time the port opens and closes.

STAYING ORIENTED

Dr. Packo: Let's discuss other safety issues. We experience less friction going in and out of the eye with 23-g

"I always tell beginning surgeons to keep their instruments in view. They tend to get distracted by whatever instrument is active and forget about the instrument that is inactive." — *George A. Williams, MD*

cannulas because they are made of metal vs. polyamide like the 25-g cannulas. As a result, we may not always realize how deep we are in the eye with our instruments. Are there dangers involved? How do we keep ourselves oriented? Dr. Williams, have you noticed any difference in maintaining the orientation of your instruments inside the eye?

Dr. Williams: I have not noticed any differences. You are absolutely right, though. The instruments are sliding in the eye more easily. I always tell beginning surgeons to keep their instruments in view. They tend to get distracted by whatever instrument is active and forget about the instrument that is inactive.

Dr. Pollack: You have to pay attention. You must look very carefully for where you've placed the tips of your instruments. With some experience, it becomes second nature as with 20-g surgery.

"My general rule is to pull out the cannula slowly. I try to support the wall of the eye around the cannula as I am removing it. As I remove it slowly, the wall of the eye, the sclera, begins to seal itself to some extent." — *Allen C. Ho, MD*

REMOVING CANNULAS

Dr. Packo: Imagine that you have completed a case. Now you want to remove the cannulas and, at the same time, make sure you avoid complications and wound leaks. What approach do you use? And does it change from 25-g to 23-g?

Dr. Ho: My general rule is to pull out the cannula slowly. I try to support the wall of the eye around the cannula as I am removing it. As I remove it slowly, the wall of the eye, the sclera, begins to seal itself to some extent. I use a cotton-tip applicator to move tissue around over the scleral hole to help seal the area.

Dr. Packo: Do you have the infusion turned on or off when you do this?

Dr. Ho: I usually have the infusion turned on. I like to maintain the eye at the pressure I have selected.

Dr. Charles: I agree with Dr. Ho. Support the eye wall to avoid everting the wound or overpressurizing the eye. Supporting the eye wall is crucial as well as pulling the instruments out slowly.

I would add this point: I pull the instruments out of the cannulas as slowly as I pull the cannulas out of the eye, remembering that both the cannulas and the instruments function like a syringe barrel. If you are pulling back, you tend to suck vitreous through the hole.

When performing 23-g and 25-g micro-incision surgery, you tend to think about efficiencies — speed, rushing and so forth — to the extent that you tend to hurry at certain points when you should not. You should not rush when pulling out instruments or cannulas at the end of the case. You have to discipline yourself to be slow and deliberate at that time.

Dr. Pollack: When I first started performing 25-g surgery, I was inclined to pull the cannula straight out of the eye, perpendicular to the sclera, just like a 20-g plug. However, now I pay more attention to maintaining wound integrity during removal of the cannula. I consciously

remove the cannula by pulling it in a direction that is opposite the direction of insertion. My goal is to reduce the chance of wound gape as much as possible.

Dr. Packo: I learned another useful way to pull out cannulas from David Boyer, MD. When we turn off the infusion, the eye is pressurized, of course. Dr. Boyer inserts the light pipe into the cannula, and the light pipe functions as a solid plug, with no lumen.

He then gently pulls the cannula out of the eye while it is still on the light pipe, as if the light pipe is along the trocar. The cannula leaves the eye while the light is still in the eye. He then slowly backs the light pipe out. The technique serves as a nice, gentle way of pulling out the cannula while plugging the sclerotomy with a solid object. It works nicely for me.

USING ANTIBIOTICS

Dr. Packo: In the past, surgeons have varied their approaches when it comes to subconjunctival antibiotics. Do we still need subconjunctival antibiotics? Anterior segment surgeons have moved away from using them. Is there any risk in putting subconjunctival medications in an eye that has an unsutured sclerotomy?

Dr. Charles: We should continue to use subconjunctival antibiotics. There is a tendency to follow the approach of cataract surgeons and eliminate subconjunctival antibiotics, but the situation is different in those procedures. The cataract surgeon's instrumentation is in the anterior chamber, where drops will achieve sufficient minimum inhibitory concentration levels to reduce the chances of endophthalmitis.

However, there is a 100-to-1 gradient in the two-compartment eye, between the anterior chamber and the vitreous antiobiotic level. You cannot instill any drop that will reach an adequate concentration in the vitreous cavity of a pseudophakic or phakic eye. You are misinformed if you rely on drops to treat the vitreous cavity. Our instruments are in the back of the eye. So I would continue to use subconjunctival antibiotics.

Dr. Packo: Dr. Kaiser, do you still give subconjunctival antibiotics? Have you changed any of your postoperative medications when moving from 25-g to 23-g surgery?

Dr. Kaiser: I routinely use subconjunctival antibiotics. I do not use an aminoglycoside, though, because I want to protect my patients from retinal damage in the event of inadvertent leakage. As far as postoperative care for 25-g vs. 23-g procedures, I have not changed anything. I use a combination steroid-antibiotic drop postoperatively.

"We should continue to use subconjunctival antibiotics. There is a tendency to follow the approach of cataract surgeons and eliminate subconjunctival antibiotics, but the situation is different in those procedures." — *Steve Charles,* MD

SMALL GAUGE HERE TO STAY

Dr. Packo: We currently have three gauges — 20-g, 23-g and 25-g. How do you think the use of these technologies will play out for the average retinal surgeon?

Dr. Williams: There is no question that small-gauge incisions are here to stay. In my preliminary experience, 23-g has hit the sweet spot for the vast majority of my patients. I believe we will see a decrease in 20-g surgeries. However, we will see a split between 25-g and 23-g usage. The 23-g technology will help us address more complex pathologies, as we have discussed today. It will provide us with all the benefits of a transconjunctival micro-incision approach. RP

Creating More Options

Kirk H. Packo, MD: Does small-gauge surgery give you more freedom for infusion placement? Is anyone on our panel routinely placing the infusion at 12 o'clock?

Steve Charles, MD: Blebs and prior incisions are possible with this technology. If a patient has been sent to me for proliferative vitreoretinopathy revision surgery that already has involved three or four buckles, I will find an appropriate place in the conjunctiva and for the infusion port as well as the other incisions. Flexibility of position is very important.

Dr. Packo: Dr. Charles, I learned from you a few years ago how to put the finger down the shaft of the instrument, even to the point of touching the hub on the outside of the eye, when using the 25-g approach.

Allen C. Ho, MD: That makes sense. It follows the principle of choking up on a bat in baseball. You are making the end of the instrument stiffer. Even with stiffer instrumentation that has been developed for 25-g, you will experience counterintuitive intravitreal instrument motion because of how the instruments bend. This bend is created because of the small bore and because you are working through a trocar system that is longer than the wall of the eye.

Dr. Packo: Do you need to choke up on the 23-g instrument, or is it stiff enough that you can go back to the method you used for 20-g?

Dr. Ho: With 23-g, I need to choke up much less. The surgical maneuvers and movements of your fingers and wrists are similar to those used during 20-g surgery. I would encourage the 20-g surgeon to retry 25-g because of the improvements that have been made to the instrumentation. However, I think 23-g surgery provides a more natural evolution of technique.

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