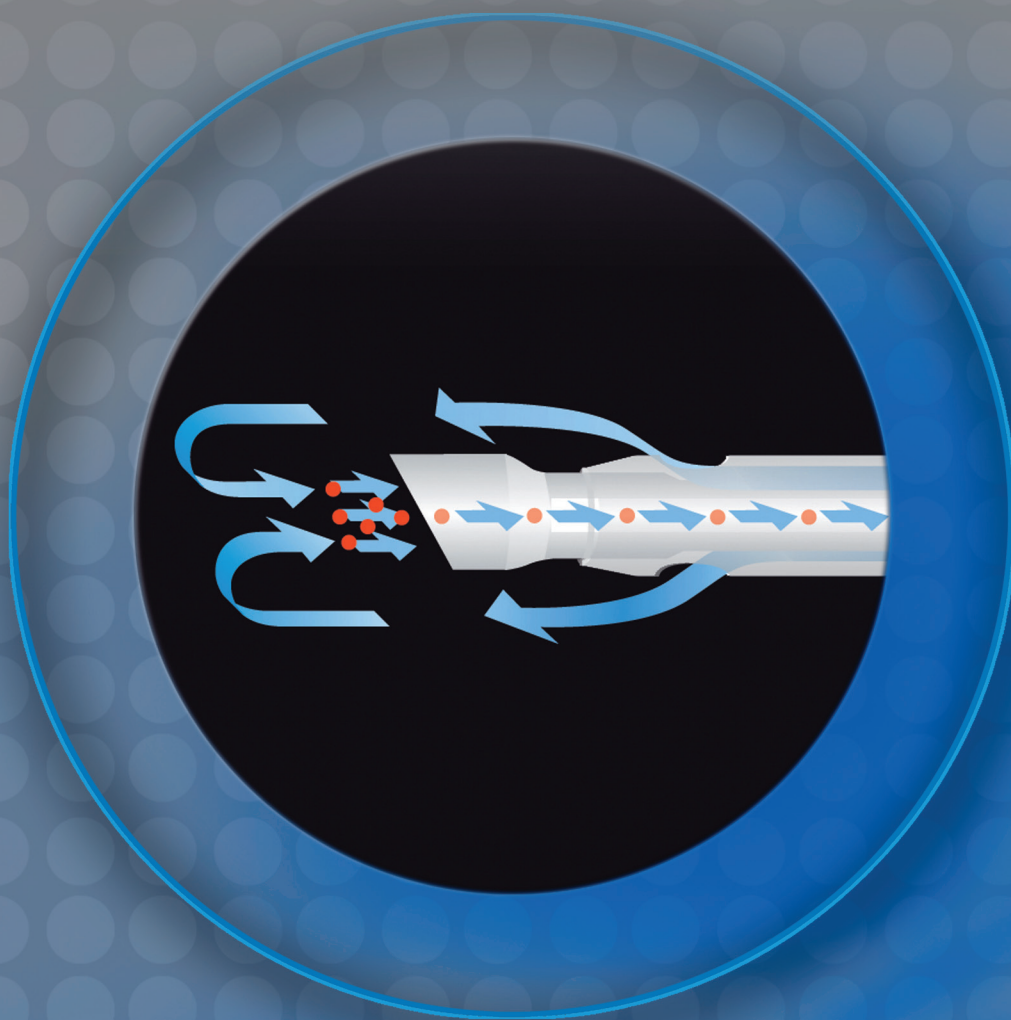


Updates in Cataract Surgery

A new and easy approach to phaco surgery



Introduction

Until recently, chamber stability and ultrasound energy in the eye were main concerns for the average cataract surgeon. These concerns led to various technological developments that aimed to maintain chamber stability and reduce the amount of ultrasound energy in the eye.

This roundtable discussion will focus on new phaco technologies and the role of fluidics in modern cataract surgery. Topics include high fluidics, ultrasound emulsification, irrigation and aspiration, and incision size. Panel members gathered in Zurich, Switzerland to discuss how each of these factors impacts chamber stability, phaco time and patient outcomes.

I thank the faculty members for their participation and Oertli Instruments AG, for sponsoring this OCULAR SURGERY NEWS Europe Edition supplement.

Richard L. Lindstrom, MD
Global Chief Medical Editor
OCULAR SURGERY NEWS Europe Edition



Top row left to right:
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Manfred Tetz, MD,
Suhaz Haldipurkar, MD

Bottom row left to right:
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Fernando Aguilera, MD,
Rupert Menapace, MD

Cover Image Courtesy of Oertli Instruments AG

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Surgeon Experience: 3,000 total surgeries each year; 2,400 cataract surgeries or refractive lens exchanges

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Surgeon Experience: 1,500 cataract, glaucoma and reconstructive surgeries each year

New phaco technology: The role of fluidics in modern cataract surgery

Manfred Tetz, MD: Phacoemulsification has evolved over the past decade from a technology that focused mainly on sheer power, high flow and high vacuum to a sophisticated methodology that complements small-incision cataract surgery. As incision size decreases, safety, efficiency and ease of the procedure become more important to surgeons. The renowned international faculty members will discuss their experiences with current technologies that incorporate the use of high fluidics to increase efficiency while maintaining chamber stability.

Instrumentation

Tetz: What phaco tip and incision size are you currently using for the range of cataract densities?

Rupert Menapace, MD: I use the easyTip (Oertli Instruments AG) because it allows me to increase vacuum while maintaining a stable chamber. In the past, when I increased vacuum to 300 mm Hg using a standard phaco tip, I experienced chamber instability. In addition, with the intense power-coupling provided, chatter is minimized and ultrasound energy is transmitted axially and is fully absorbed by the nuclear fragment thus sparing the endothelium.

I use a mini phaco tip with a 2.2-mm limbal corneal incision when implanting standard IOLs and a coaxial microincision cataract surgery (COMICS) tip with a 1.6 mm to 1.8 mm incision when using MICS IOLs. I also have recently started using the standard 2.8-mm easyTip.

John Bolger, FRCS: I use CO-MICS with a sub-2-mm easyTip for all patients, including approximately 10% to 20% of patients who have hard cataracts. The main advantage of the sub-2-mm tip is that it allows surgeons to perform the entire surgery within the capsular bag and behind the iris, even if the patient has a small pupil. When using a sub-2-mm tip, fewer events such as endothelial touch occur in front of the iris and, in my experience, that improves endothelial cell survival rates.



“With the different easyTips available, I am comfortable using high fluidics for the full range of incision sizes from 1.8 mm to 2.8 mm, but my preferred tip size is 2.2 mm, especially when working on dense nuclear cataracts.”

— SUHAS HALDIPURKAR, MD

Suhas Haldipurkar, MD: The selection of the tip size is primarily influenced by the astigmatic considerations. With the different easyTips available, I am comfortable using high fluidics for the full range of incision sizes from 1.8 mm to 2.8 mm, but my preferred tip size is 2.2 mm, especially when working on dense nuclear cataracts. I enjoy the chamber stability offered by the easyTip.

Detlev Breyer, MD: I consider many factors when selecting a tip size, including cataract density, astigmatism correction, peripheral corneal conditions and IOL type. I use the easyTip 2.8 mm for rock hard, red,

dark or brown cataracts because it sufficiently emulsifies and removes the lens. I mainly use a standard mini tip through a 2.2-mm incision to correct astigmatism if neutral astigmatism is the goal of surgery. I sit at the 12-o'clock position when performing surgery with either my right or left hand and make the incision in the steep meridian. The easyTip 2.2 mm works well for patients with standard cataracts.

I reserve the 1.6-mm easyTip CO-MICS for premium IOLs. The 1.6-mm easyTip CO-MICS fits through a sub-2-mm incision and using a smaller incision can reduce surgically-induced astigmatism (Figure 1).¹ It is important to minimize surgically-induced astigmatism in patients receiving premium IOLs because it can result in poor postoperative refractive outcomes.

If the tip creates an incision through which the IOL cannot fit, then I use a dock-on technique, ie, the cartridge does not enter the incision, but attaches to the corneal incision.

I also use CO-MICS tips for patients with a small pupil diameter because I can gain good visibility without having to stretch the pupil. CO-MICS tips also work well in patients who have flat anterior chambers, ocular surface disorders or who have had glaucoma surgery. For the most part, I use limbal incisions but, using this tip, I can perform a 1.6-mm, absolutely watertight, straight clear corneal incision.

Tetz: Is incision size dependent on lens hardness?

Fernando Aguilera, MD: I prefer to use a 2.2-mm incision for all cataracts, regardless of lens hardness. However, in my experience, using a 2.8-mm incision with a multimodal feature on the Faros (Oertli Instruments AG) phaco foot pedal increases efficiency and improves endothelial cell counts when performing surgery on hard cataracts. I can switch between different settings and ultrasound delivery modes, e.g., pulse mode/longitudinal ultrasound, using each at a different power and percentage of cool phaco with a quick kick on the foot pedal.

Tetz: What machine and pump are you using and what are your phaco settings?

Breyer: I select a pump system based on the patient's lens hardness. The advantage of the OS3 (Oertli Instruments AG) system is the foot pedal feature that allows surgeons to switch between a venturi and peristaltic pump while performing surgery. I prefer the remote effect of the venturi pump for hard nuclei because it easily attracts hard lens material to the tip and I gain occlusion faster. I prefer to use a peristaltic

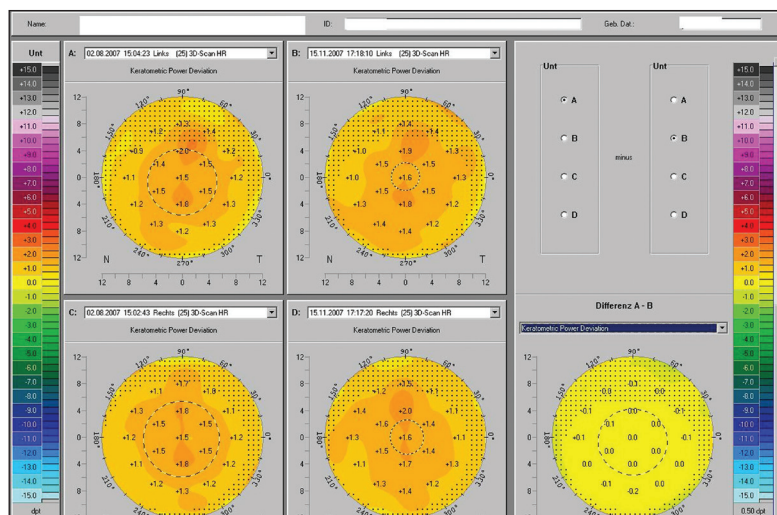


Figure 1: Keratography pictures taken by a pentacam that shows results of OS (left eye) and OD (right eye) pre- and post-CO-MICS surgery.

Source: Breyer D

pump for soft nuclei because vacuum builds as occlusion occurs and reaches its highest level when complete occlusion is attained. My standard power settings are 600 mm Hg for the venturi pump using 30% ultrasound and a 100% venturi rise. I use linear mode on the foot pedal to raise and lower values.

Aguilera: I use the easyPhaco Tip (Oertli Instruments, AG) with a 2.2-mm incision. Since I transitioned to the easyPhaco technology, I have experienced increased chamber stability. Using this machine, I can increase flow rate and vacuum without the concern of chamber instability or chamber collapse. When using 1.6-mm incisions, I use a flow rate of 20 cc/min and 500 mm Hg of vacuum with coaxial irrigation.

The phaco power used depends on the hardness of the nucleus. Approximately 80% of my patients have hard nuclei, so I use between 85% and 100% of phaco power using cool phaco mode at 70%. The cool phaco setting determines that the phaco energy is supplied with 70% off time, which induces less delivered energy and heat production.

Bolger: I use high fluid settings because it allows me to move a similar volume of fluid through the smaller channel of a 1.6-mm tip. The main advantage to using coaxial easyPhaco technology is improved followability and holdability of nuclear fragments within the capsular bag, which increases the safety and efficiency of the procedure.

Fluidics

Tetz: Surgeons have transitioned to using smaller incisions in an effort to perform safer surgery. However, small incisions may introduce such risks as wound deterioration, wound stress, improper wound closure and wound burn. Cool phaco was developed to reduce the risk of wound burn by delivering ultrasound energy in a pulse manner, using high energy and intermittent rest periods that dissipate heat and cool the phaco tip. Although cool phaco reduced the risk of wound burn, it did not eliminate it. Is cool phaco necessary when using high fluidics?

Menapace: Using high fluidics creates a power coupling so intense that cool phaco is no longer necessary. I only use standard, continuous phaco power and do not use pulse phaco.

Aguilera: Pulse and specially continuous torsional phaco induced much more corneal wound stress compared to traditional anterior/posterior longitudinal

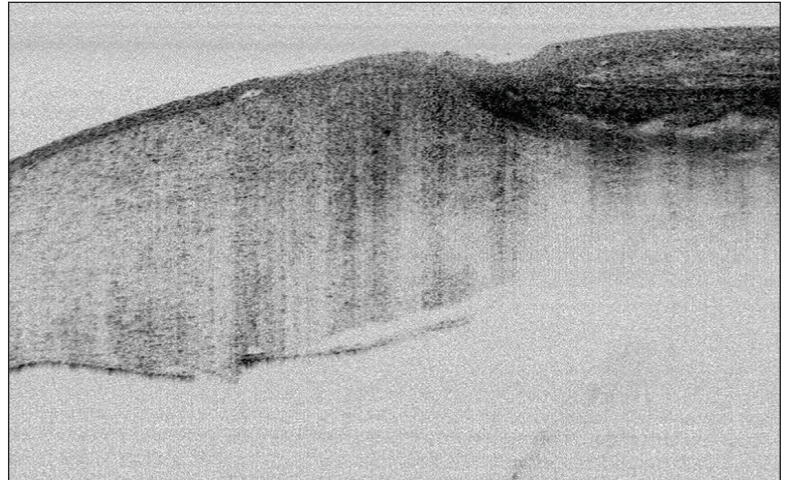


Figure 2: An OCT taken immediately after torsional phaco shows evidence of corneal burn.

Source: Aguilera F

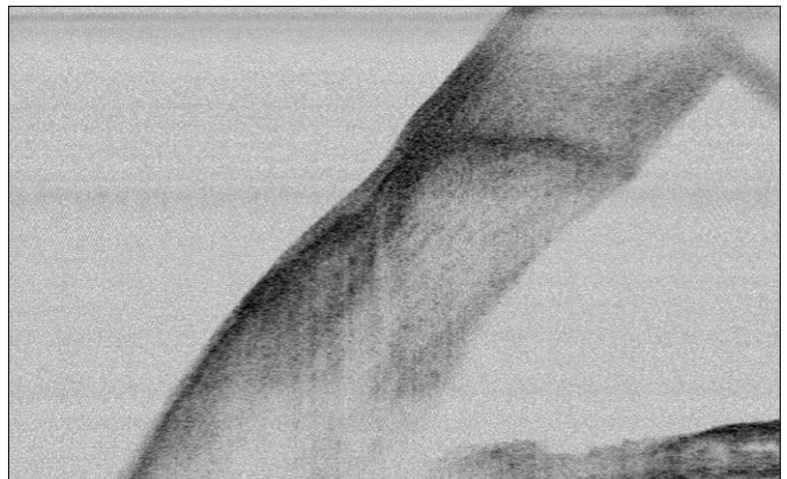


Figure 3: An OCT taken immediately after longitudinal phaco using a 1.6-mm CO-MICS tip shows no evidence of wound stress.

Source: Aguilera F

phaco. This was shown in optical coherence tomographies (OCT) corneal images where microburns and subincisional descemetocles were almost always present in torsional phaco (Figures 2 and 3).²

We also compared wound stress induced by torsional phaco and microcoaxial 1.6-mm easyPhaco by studying OCTs taken immediately after surgery. Results showed no wound stress when using easyPhaco technology compared to wound stress observed in 100% of patients when using torsional phaco (unpublished data).

Tetz: What are your clinical impressions of using high fluidics in small tips? What, if any, effect does it have on the corneal endothelium?

Haldipurkar: The easyTip works more efficiently at higher vacuum and flow rates than at normal settings without disturbing the chamber stability and corneas are consistently clear on postoperative day 1. I am more confident using this technology in a brunescant cataract without the fear of causing damage to the corneal endothelium.

Menapace: The use of high fluidics maximizes the potential of the slim-shaft strong-bevel easy-Tip design. Some surgeons believe that increasing

Menapace: Surgeons may use flow rates up to 40 cc/min, but there is a risk of chamber collapse with sudden occlusion loss at high vacuum levels.

Tetz: What is your average BSS consumption when using a 2.2-mm tip in a standard patient with average lens hardness?

Breyer: I use approximately one-third or one-half of a 250 mL BSS bottle. BSS consumption relates more to surgical factors than fluidic factors. I experienced no difference in BSS consumption when I transitioned to using high fluidics in phaco. The amount of fluid necessary does not depend on high fluidics, but rather on phaco technique, wound leakage and whether occlusion is gained prior to performing phaco.

Haldipurkar: My average BSS is about 80 cc for an average dense cataract, but the BSS consumption can be kept to a minimum by ensuring that the tip remains occluded through most of the procedure.

Menapace: Surgeons can also conserve BSS consumption by running the pump only when they are ready to occlude the tip.

Tetz: Lens emulsification occurs inside the tip rather than outside the tip; therefore, occluding the tip as often as possible may increase efficiency.

Followability

Tetz: How does the followability compare between CO-MICS and standard phaco?

Bolger: In my experience, followability with CO-MICS is as good, if not better, than standard phaco when using a flow rate of 35 mL/min.

Tetz: If a surgeon uses a flow rate of 20 mL/min in a sub-2-mm incision, is the followability markedly lower than in a standard incision?

Menapace: The followability would be unchanged because the flow rate is the same.

Aguilera: The flow rate used with a 1.6-mm incision depends primarily on lens hardness and not fluidics. Fluidics react differently to hard materials compared to soft materials. For example, brunescant cataracts are not deformable and may require the surgeon to drastically twist the tip to gain occlusion.

“In my experience, followability with CO-MICS is as good, if not better, than standard phaco when using a flow rate of 35 mL/min.”

— JOHN BOLGER, FRCS



fluidics leads to endothelial cell loss, making the procedure more dangerous. However, when using high fluidics, particles are immediately aspirated into the tip. When using high flow, the preset vacuum level is more readily reached and power coupling occurs when the tip is occluded. When using a slow turning peristaltic pump or low vacuum settings with a venturi pump, it is more difficult to gain occlusion and it takes longer to reach desired vacuum levels.

Aguilera: In my opinion, use of a dispersive ophthalmic viscosurgical device (OVD) and correct use of fluidics have a protective role in endothelial cell loss. The location of phaco energy delivered in the eye is as important as the use of dispersive ovd and fluidics, and performing phaco in the anterior chamber may increase endothelial cell loss.³

My colleagues and I measured balanced salt solution (BSS) consumption during phaco and found that increased BSS consumption was associated with increased endothelial cell loss. Similarly, increased ultrasound usage was also associated with increased endothelial cell loss. These factors, combined with performing phaco in the anterior chamber, result in poor corneas, especially during the first weeks after surgery.⁴

Tetz: Can a surgeon use 30 cc flow rates in a sub-2-mm incision without using additional infusion?

Tetz: Some phaco machines use oscillating movements to prevent repulsion of nuclear fragments from the tip. In my experience, fluid movement may draw nuclear fragments to the tip, but it does not improve holdability. Using easyPhaco technology, nuclear pieces follow the tip and occlude more easily.

Breyer: When easyPhaco was introduced 2 years ago, Arnd Gandorfer (professor of ophthalmology at Ludwig Maximilian University Eye Hospital, Munich, Germany) concluded from his research that easyPhaco is also safe phaco.⁵ I think that every surgeon who uses the easyPhaco technique is surprised by the level of safety it provides. I experience excellent followability, occludability, holdability and less post-occlusion surge in all three tip sizes.

Bolger: Selecting an appropriate incision size is an important part of followability. I have found that lens fragments flow along the fastest current. If there is a leak in the sideport incision and the surgeon uses a low aspiration rate, then the fragment will be equally drawn to the sideport incision as to the tip. Therefore, I use a high aspiration rate to draw nuclear fragments to the tip and use vacuum to hold them once I have gained occlusion.

When using a peristaltic pump, vacuum is not activated until occlusion occurs. Once the nuclear fragments occlude the tip, vacuum increases and holds the fragments to the tip for emulsification. Chatter and turbulence are rare when using moderately high aspiration and vacuum. For the average nuclear sclerotic lens, I emulsify the nucleus in its original position to avoid the risk of chatter or turbulence. I then switch to lower phaco settings to emulsify mobile fragments, which are often epinucleus and cortex fragments, because they are softer and easier to emulsify.

Surgical technique

Tetz: Do you modify your surgical technique such as chopping, direct chop, divide and conquer, etc., based on lens hardness?

Aguilera: I modify the phaco tip depending on the type of cataract, but I do not modify my surgical technique. Chamber collapse is no longer a concern when using the easyPhaco system because the fluidics maintains chamber stability. I mechanically crack hard nuclei and use ultrasound to aspirate nuclear fragments.

Menapace: I rotate the sleeve until the sleeve openings are in the same plane as the bevel. I pull the

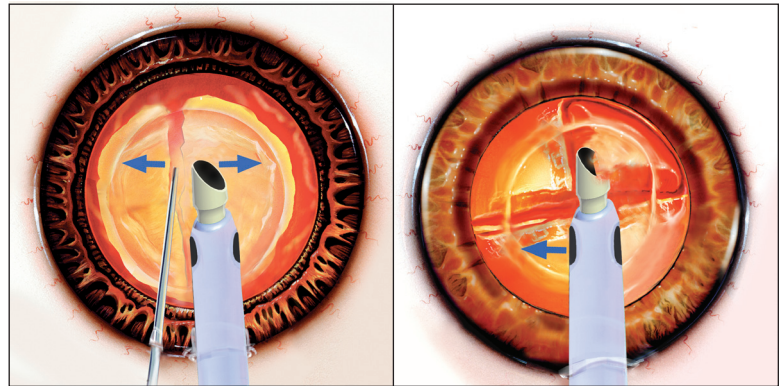


Figure 4: Infusion-assisted or hybrid phaco using a high-capacity infusion spatula. Surgeons can point the bevel at an angle to achieve the best occlusion.

Source: Oertli Instruments AG

sleeve back until it is flush with the base of the tip head. Turning the bevel to my right, I use it as a spear to dig into the center of the nucleus for one or two passes. I use a spatula to crack the nucleus into two pieces, and then split those pieces to create four quadrants (Figure 4). Once I have four separated quadrants, I use 50 mL/min flow and 600 mm Hg vacuum with the bevel pointed at an angle where I achieve the best occlusion, and then I activate the pump.



“Once I have four separated quadrants, I use 50 mL/min flow and 600 mm Hg vacuum with the bevel pointed at an angle where I achieve the best occlusion and activate the pump.”

— RUPERT MENAPACE, MD

Haldipurkar: I prefer to use a direct chop technique for most of my cases and try to make multiple small pieces and emulsify them at the end, preferably in the bag.

Breyer: I routinely use a stop and chop technique and bury the phaco tip into the nucleus. For beginners, it may be more important to use pulsed phaco mode than for high-volume surgeons because they are often struggling with fluidics and occlusion. In very soft nuclei, such as with clear lens exchange, I aspirate the entire nucleus with high aspiration and nearly no phaco power.

Haldipurkar: When using a 1.8-mm incision, I hold the beveled tip sideways as I dig into the nucleus. In my experience, keeping the tip sideways allows me

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Key characteristics of phaco tip design

Rupert Menapace, MD

High Fluidic Phaco Principles

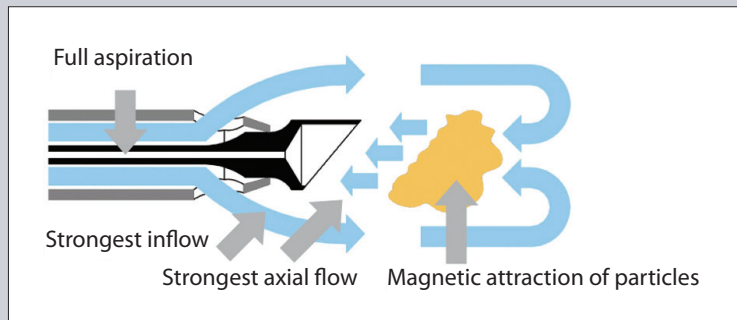


Figure 1: High vacuum settings of easyPhaco technology (Oertli Instruments AG) combined with a wide infusion path reduces turbulence and floating fragments while improving followability.

Source: Oertli Instruments AG

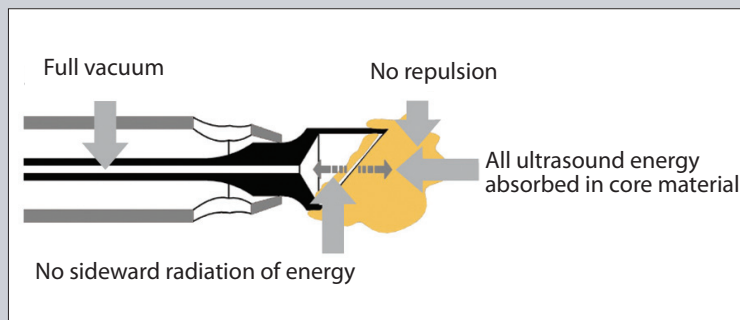


Figure 2: When using easyPhaco Technology (Oertli Instruments AG), ultrasound energy is applied axially and fully absorbed by the nuclear materials instead of radiating laterally and potentially affecting the endothelium.

Source: Oertli Instruments AG

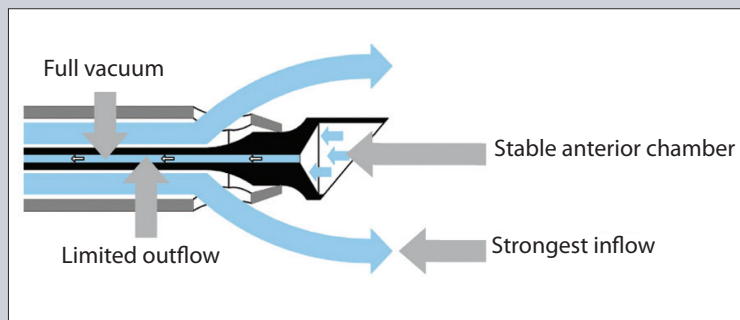


Figure 3: The anterior chamber remains stable when an occlusion break occurs with easyPhaco technology (Oertli Instruments AG). The capillary aspiration channel prevents sudden flow and the wide infusion path provides constant IOP.

Source: Oertli Instruments AG

The four key characteristics of phaco tips that impact the efficiency and safety of the phaco procedure are: energy output, holdability, followability and surge suppression. Simple downsizing of a standard phaco tip design results in a loss of efficiency and chamber stability. When downsizing a coaxial phaco tip to fit through a sub-2-mm incision, the design must be modified in order to compensate for the loss of energy output, followability, holdability and surge suppression.

Energy output

Energy emission is a function of the area of frontal projection of the needle. When the phaco tip is downsized without modifying the design of the needle, the frontal projection area is reduced and, therefore, the output of energy decreases. The actual energy transfer is additionally dependent on the vacuum level or “power coupling.”

Followability

Followability is a function of the pump speed. The aspiration flow is limited by the inflow capacity, which is a function of the bottle height defining the infusion pressure and the tubing, and specifically the area between sleeve and phaco needle (“infusion mantle”) defining the infusion flow resistance. Followability requires that the surgeon uses high flow. If the surgeon uses an excessive pump speed where the amount of fluid transported out of the eye exceeds that supplied through the infusion line, the chamber will collapse. The broad infusing mantle provided by easyPhaco tips (Oertli Instruments AG) allows for higher flow rates by decreasing infusion resistance (Figure 1).

Holdability

Holdability is a function of the area of the needle orifice. When the phaco tip is downsized without adjusting its design, the area of the orifice is reduced, and thus, holdability is also reduced. Holdability allows for better transfer of the energy emitted from the needle to the lens material, reducing overall phaco energy requirement (Figure 2).

Surge suppression

Surge at a given vacuum is a function of the bore diameter of the phaco needle and the infusion supply which is proportional to the area of the infusion mantle. Downsizing the tip will

inherently increase surge. The slim shaft design decreases the bore diameter while increasing the infusion mantle (Figure 3). Both help in suppressing the surge.

Slim-shaft strong-bevel design

With the easyTip (Oertli Instruments AG) or slim-shaft strong-bevel design, the transition from a wider tip head into a waisted shaft significantly increases the area of projection as compared to a standard tip, which compensates for the loss of energy output when downsizing the tip. In addition, increasing the bevel angle increases the size of the orifice, which results in the same area of orifice as that of a standard 19-gauge 30° phaco tip when the bevel angle of a sub-2-mm CO-MICS tip is increased to 53°. By using a slim shaft while retaining the sleeve size, the area of the infusion mantle is per se increased. This augments infusion influx, which again allows for a higher pump speed and thus followability.

Combining these design criteria lead to additional advantages of the easyTip. By using the slim shaft design, the sleeve is flush with the funnel-shaped tip head and thus prevents anteriorly directed axial infusion influx while avoiding chamber efflux by better sealing the incision. This minimizes chamber turbulences and better directs the lens material toward the orifice of the phaco needle. The reduced overall bulk of the phaco tip minimizes the incision size required for inserting the phaco tip.

One downside of the strong bevel design is that a large orifice is more difficult to occlude. Thus "occludability" is another important characteristic of a phaco needle. To compensate for that difficulty, surgeons must use higher aspiration flow to pull the lens chunk in to the opening. Once occluded, the high flow speeds up the vacuum rise to the preset high levels where power coupling and emulsification efficiency are maximal. However, high aspiration flow requires high influx capacity which, apart from an adequate bottle height, is allowed for by the augmented infusion mantle of the easyTip.

Infusion-assisted phaco

With the Oertli sub-2-mm easyTip CO-MICS, infusion supply is insufficient for high fluidics in spite of its easyPhaco design. The solution is "infusion-assisted" or "hybrid phaco," which is

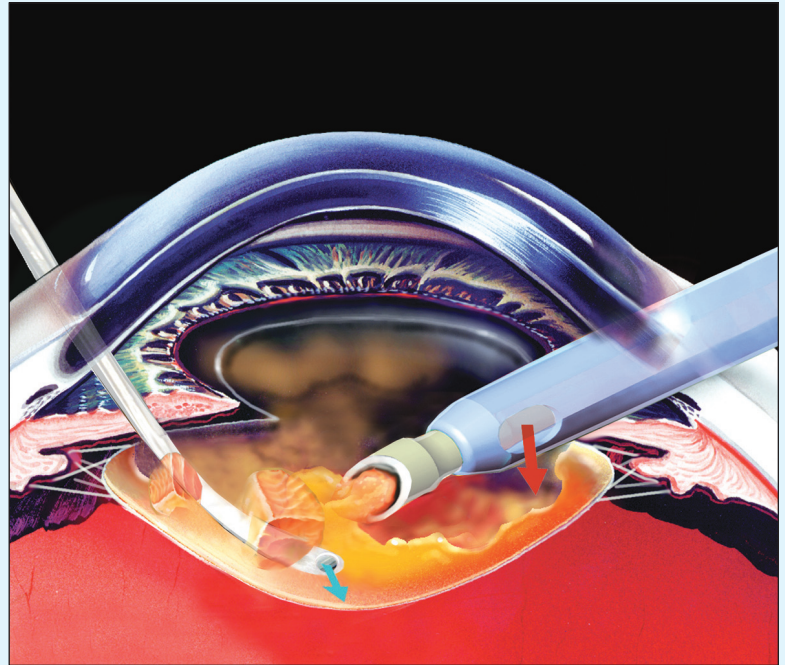


Figure 4: Using the easyTip CO-MICS (Oertli Instruments AG) and supplying additional infusion via an infusion spatula, surgeons can use full flow and vacuum settings.

Source: Oertli Instruments AG

derived from biaxial phaco with the exception that a sleeved easyTip CO-MICS is used instead of a sleeveless standard tip. Using such a tip and supplying additional infusion via an infusion spatula, surgeons can use full flow and vacuum settings (Figure 4). Surge is suppressed because there is enough fluid supply to counterbalance the surge that can occur when occlusion breaks. This technique only requires low-cost standard infusion tubing and an infusion handpiece of an adequate biaxial irrigation and aspiration set with no need for additional or special instrumentation.

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to gain better penetration and faster occlusion. This way, fluid consumption is kept to a minimum and the viscoelastic is retained in the eye.

Ultrasound emulsification

Tetz: Another concern for cataract surgeons is the amount of ultrasound energy in the eye. Prolonged exposure to ultrasound energy may cause endothelial damage. Theoretically, occluding the tip for the majority of the cataract procedure should reduce the amount of phaco energy in the eye. What are your preferred phaco energy settings? Have you experienced any change in phaco energy since transitioning to a 2.2-mm incision?



“The easyPhaco technology allows surgeons to use incisions from 1.6 mm to 3.2 mm to handle a wide range of cataracts, including soft, hard and refractive.”

— MANFRED TETZ, MD

Aguilera: My phaco settings are 85% to 100% of linear power. I use 40 pulses per second and then switch to continuous phaco for dense parts of the nucleus. For 2.2-mm and 2.8-mm incisions I use 400 mm Hg vacuum and a 30 mL/min flow rate. When using a 1.6-mm incision, I use a flow rate of 30 mL/min and 500 mm Hg vacuum.

Bolger: My standard setting is bimodal mode. I use a large amount of ultrasound energy to sculpt the nucleus before I crack it. I use 80% linear power in pulsed phaco mode. When I have a section of cataract that is extremely hard, I switch to continuous phaco for five or six strokes, remove that part, and switch back to cool phaco.

Haldipurkar: I normally prefer 60% power in linear fashion for most of my procedures. I prefer pulsed energy with 40 pulses per second of 40% cooling.

Menapace: Chatter occurs with longitudinal phaco at higher energy levels only when power coupling is inadequate due to lacking occlusion or low vacuum. Chatter is not an issue when using high fluidics because nuclear fragments stick to the tip and low levels of phaco energy are required to emulsify the fragments. The procedure becomes ultrasound-assisted phaco aspiration rather than phacoemulsification.

I do not modulate the ultrasound because wound burn and chatter are no longer a concern since I started using high fluidics. I believe that modulating phaco in high fluidic conditions reduces efficiency. I find that I am more efficient when I use standard phaco power at low levels without modulation. I occasionally pulse using the foot pedal to clear a blocked tip.

Tetz: It is important to differentiate between breaking apart the nucleus and removing nuclear fragments from the eye. A surgeon uses an individual technique to break the nucleus, whether it be cracking, impaling or sculpting. Surgeons use ultrasound energy to break apart a hard nucleus. Once the nuclear pieces are separated, minimal phaco energy is needed to remove them from the eye. Phaco energy is only needed when a micro-occlusional break occurs.

The easyPhaco technology allows surgeons to use incisions from 1.6 mm to 3.2 mm to handle a wide range of cataracts, including soft, hard and refractive. Is it necessary for surgeons to use low phaco power or is phaco power no longer a concern when performing phaco on a patient with standard cataracts?

Menapace: The amount of energy used should mirror the surgical technique and efficiency. The location of the phaco tip, the orientation of the bevel and power coupling of ultrasound all impact the amount of ultrasound energy dispersed in the eye and the impact on the endothelium.

Haldipurkar: For soft to medium cataracts, the fluidics plays a more important role than ultrasound. Placement of the bevel direction and foot switch position is important in improving the efficiency of the technique.

Bolger: Some brunescient lenses require brute ultrasound power and cannot be emulsified using fluidics alone. These lenses must be disintegrated using ultrasonic energy, and the amount of ultrasound energy required depends on lens hardness.

Tetz: Does cystoid macular edema correlate with high ultrasound energy?

Bolger: In my practice there is no correlation between the surgical event and the development of cystoid macular edema. I have patients who have endured long surgeries for difficult cataracts and have had no postoperative cystoid macular edema.

On the other hand, some patients with simple lenses develop cystoid macular edema after using almost no ultrasound energy.

Breyer: I perform cataract surgery at two locations: my clinic and another hospital. I perform approximately 40 cataract surgeries per day at the hospital using torsional phaco, and those patients tend to have more interior inflammation, whereas patients who have surgery in my clinic where I use the Oertli easyPhaco machine, tend to have less inflammation. I may have to hydrate the incision more when using the machine at the hospital (2.8-mm incision) than with the easyPhaco machine (2.2-mm incision).

Irrigation and aspiration

Tetz: Femtosecond phaco is a new technology that uses a laser to soften the lens prior to cataract emulsification. However, even if the surgeon softens the lens, turning a 3+ cataract to a 1+ cataract, it must still be removed from the eye. Irrigation and aspiration (I&A) will continue to be an integral part of lens removal even if the lens is softened and small amounts of phaco are necessary.

When performing phaco on a lens of average hardness, is I&A a limiting factor? Does I&A influence the entire procedure?

Aguilera: It depends on the height of the dissection. A perfectly executed dissection will require minimal aspiration. Personally, I have had two capsular ruptures in the past year and they have occurred during I&A. Tip material is an important consideration. Using a soft, silicone I&A tip will reduce the risk of capsule rupture.

Bolger: Most of my capsular ruptures occur during I&A, which is why I try to avoid doing I&A by using cortical cleavage under hydrodissection.

Menapace: Capsular rupture does not happen often but, in my opinion, the capsular bag is at a higher risk of rupture during I&A than during phaco.

Haldipurkar: With regard to posterior capsular rupture, bimanual I&A has a higher safety profile compared to coaxial I&A.

Breyer: The risk for capsular rupture depends on the case. During a difficult I&A case — e.g., a patient with pseudoexfoliation syndrome, small pupil, thin capsular bags or flat anterior chambers and a “sticky” cortex — I switch from I&A to a forced

hydro jet and continue with I&A. This way, I do not have to apply excessive traction on the capsule with I&A, but can use the safe water flow of the hydro jet to loosen the cortex if not completely remove it.

Tetz: Capsular ruptures do not occur often, but when they do, they occur during I&A. This is an important point because even if surgeons use a laser to soften the lens, I&A is still necessary, and during I&A, the risk for capsular rupture may be increased. Does I&A take more time?

Breyer: It depends on whether the hydrodissection was perfect. One Japanese study showed that rotating a freely mobile nucleus three times resulted in fewer problems removing the cortex and less posterior capsular opacification (PCO).⁶

Haldipurkar: After nucleus removal I repeat hydrodissection to loosen the periphery cortex, which makes cleaning the capsule at the end of the procedure easier. I use a combination of suction polishing and water jet cleaning to polish the posterior capsule.



“Capsular rupture does not happen often, but, in my opinion, the capsular bag is at a higher risk of rupture during I&A than during phaco.”

— RUPERT MENAPACE, MD

Menapace: I rotate the lens and hydrodissect as well as I can. Depending on the individual patient, I sometimes have strands of fibers adhering to the capsule. I use an aspiration probe with a 0.2-mm opening that can be occluded with a single strand of fiber. With many of the current bimanual and coaxial phaco probes, the bore is too wide to gain occlusion. The same occlusion, flow and surge principles that apply to phaco apply to I&A as well.

Additionally engaging the anterior capsule to assist occlusion with aspirated capsular fibers destroys the anterior layer of lens epithelial cells, which can weaken the barrier effect of the optic edge.⁷ For removal of residual lens fibers I, therefore, use a tip with a small 0.2-mm bore positioned at the apex of the tip.

Tetz: Is there any difference in I&A efficiency between different phaco machines?

Bolger: I use a bimanual I&A because it opens the bag and allows access to the equator without the risk of catching the posterior capsule.

Menapace: Some machines have constant flow and a foot pedal to control the vacuum level. Other machines, such as the Oertli peristaltic machines, use flow control, preset vacuum and a vacuum function



“With the fluidics available, I think it is easier to perform cataract surgery through a 2.8-mm incision and enlarge it if necessary, or create a new incision in the sclera to implant 5- or 6-mm IOLs.”

— FERNANDO AGUILERA, MD

that sets the vacuum level at maximum when fully pressing down on the foot pedal. I prefer to have continuous vacuum control for I&A. Also, the surgeon can lower the vacuum to control surge. When using flow control with a preset vacuum level, clearing the blocked aspiration bore by vacuum override may result in significant surge. This can catch the capsule, particularly when using coaxial subincisional I&A.

Tetz: Some suggest that surgeons learning I&A should remove the cortex in a patient with small pupils and then begin subincisional cortex removal because the cortex at the other sites will maintain an open back.

Considering the costs involved, are YAG rates of 20% to 30% acceptable from an economical standpoint? Should surgeons use technology to reduce secondary cataracts?

Haldipurkar: Present day IOLs with edge design and well-centered overlapping rhexis has reduced my YAG rates to nearly 5% of patients after 3 years.

Bolger: My YAG rate is 4% per year. I would expect a high percentage of patients to require YAG capsulotomy because it is a consequence of cataract surgery, especially as the average age of patients undergoing cataract surgery declines and life expectancy increases. Many young patients may require YAG laser capsulotomy in their lifetime.

Breyer: The incidence of significant PCO that requires YAG capsulotomy is increasing rather than

decreasing because more and more patients elect to receive multifocal IOLs and they recognize PCO much earlier than patients with monofocal IOLs.⁸

Case examples

Haldipurkar: I used the easyPhaco technology on an eye with a grade 4 cataract. Using a 2.8-mm tip, I turned the bevel posteriorly to gain quick occludability. I used 450 mm Hg vacuum and a 40 cc flow rate.

Using a horizontal chopping technique with a blunt tip, I fragmented the nucleus into smaller pieces, which is an important part of the surgery. I performed phaco in the mid-cavity and used ultrasound energy only when the tip was occluded.

When using coaxial phaco, leakage through the side port is not a concern, and the followability dramatically improves. Turning the tip in the long axis further improves the followability and the fragments are magnetically attracted toward the center. During this step I prefer fluidic parameters to 550 mm Hg and 45 cc flow. The chamber remains stable when using easyTip technology.

Menapace: Using a spatula above the nuclear fragment being emulsified helps prevent pieces from turning up and jeopardizing the endothelium.

Haldipurkar: In the second patient, I used a 1.8-mm tip and moderately high settings on an eye with a grade 4+ cataract. Halfway through surgery, I switched to enhanced fluidics using an anterior chamber maintainer and was able to emulsify the nucleus. I prefer to keep the bevel sideways, using the tip as a spear, and pierced into the nuclear mass. Turning the bevel sideways increases the occludability and efficiency of emulsification.

Menapace: I use the same technique, but I dig deeper into the nucleus on the first movement.

The future of incision size

Tetz: Will the 3-mm incision size disappear or will it be the next step in incision size for certain regions?

Aguilera: With the fluidics available, I think it is easier to perform cataract surgery through a 2.8-mm incision and enlarge it if necessary, or create a new incision in the sclera to implant 5- or 6-mm IOLs.

Menapace: I do not see a need for a 3-mm or larger phaco tip because the 2.8-mm tip allows efficient and safe emulsification of even the hardest cataracts.

Table. Recommended Settings for easyPhaco

		Minimum			
		Venturi Pump		Peristaltic Pump	
		Vacuum (mm Hg)	Vacuum effect (%)	Flow (mL/min)	Vacuum (mm Hg)
easyTip CO-MICS for incisions 1.6–1.8 mm	Phaco 1 (Grooving)	80	60	18	50
	Phaco 2	250	60	20	250
easyTip 2.2 mm for incisions of 2.2– 2.6 mm	Phaco 1 (Grooving)	80	60	18	50
	Phaco 2	400	60	40	400
easyTip 2.8 mm for incisions of 2.8– 3.2 mm	Phaco 1 (Grooving)	80	60	18	50
	Phaco 2	400	60	40	400

		Maximum			
		Venturi Pump		Peristaltic Pump	
		Vacuum (mm Hg)	Vacuum effect (%)	Flow (mL/min)	Vacuum (mm Hg)
easyTip CO-MICS for incisions 1.6 – 1.8 mm	Phaco 1 (Grooving)	100	80	18	50
	Phaco 2	350	100	28	350
easyTip 2.2 mm for incisions of 2.2– 2.6 mm	Phaco 1 (Grooving)	100	80	18	50
	Phaco 2	500	100	50	500
easyTip 2.8 mm for incisions of 2.8–3.2 mm	Phaco 1 (Grooving)	100	80	18	50
	Phaco 2	500	100	50	500

*Recommended bottle height: 100 cm above patient eye
 *Recommended additional settings: pulse mode, 40 Hz, 60% cool for Phaco 2
 Source: Oertli Instruments AG

Surgeons always have the option to increase the incision size to allow, for example, implantation of a rigid lens or an accommodative lens.

Tetz: If accommodative IOLs were available that only fit through 4- or 4.5-mm incisions, would you use a standard 2.8-mm incision and enlarge it rather than use a larger tip?

Aguilera: I would use a small tip and create a separate incision for IOL implantation.

Tetz: Will there be a need for incision sizes larger than 3 mm?

Bolger: The next technological breakthrough will be a truly accommodating IOL. If that happens, surgeons may have to enlarge the incision size to fit a larger IOL or the IOL would have to be designed to fit through a small incision and be assembled in the bag.

Tetz: EasyPhaco is a good technique for beginners; it is just a matter of which size incision and tip to start them on. This technique makes surgery safer, which may make it preferable for beginners under supervision. How would a phaco surgeon using standard phaco transition to easy-Phaco (Table)?



“A phaco surgeon should be comfortable using easyPhaco after the first 10 patients.”

— DETLEV BREYER, MD

Breyer: A surgeon performing standard phaco will find that easyPhaco is not only easier, but also safer because of the fluidics. The surgeon can start safely on a 2.4-mm incision using a 2.2-mm tip. Starting with a 2.2-mm incision may be more difficult because it is more obstructive. Using a 2.4-mm incision, the surgeon will have no leakage, no obstruction of the sleeve and will be able to move the tip easily.

Transitioning to high fluidics

Tetz: What are your recommendations for surgeons who are considering transitioning to using high fluidics and easyPhaco technology?

Menapace: I started by using a flow rate of 35 mL/min and vacuum of 500 mm Hg. This ensures a broad margin of safety while providing sufficient efficiency. Use of high fluidics reduces the ultrasound energy required because the nuclear fragments are more easily attracted and more firmly attached to the tip.

Bolger: I instruct students in the wetlab to hold the tip and feel the difference in how quickly it heats up between cool phaco and continuous phaco. Surgeons transitioning to this new technology should be aware that continuous phaco heats up quickly. I suggest that beginners use cool phaco until they feel comfortable and then switch to continuous phaco only when dealing with a very hard lens.

Menapace: I teach beginners to use phaco for cleaning the tip only.

Tetz: What incision size would be a good starting point for a surgeon learning the easyPhaco technique?

Aguilera: A 2.8-mm incision is a good starting point for surgeons learning easyPhaco because it can handle every grade of nuclear hardness.

Menapace: Chamber instability is the main concern for surgeons learning phaco and they require a tip that

provides maximum chamber stability. Using a 2.2-mm tip with high fluidics is a safe, effective tool for beginners. A 2.8-mm tip can also be used without the concern of surge or chamber flattening. I would not recommend that a beginner start with a CO-MICS because it requires enhanced fluidics, which can result in chamber flattening or surge problems and, thus, would not be the appropriate tool for a beginner.

Haldipurkar: In India, small-incision cataract surgery (SICS) is a popular procedure. Surgeons learn this technique and then transition to phaco. This gives them confidence because if a complication occurs during phaco, they can fall back on SICS.

Breyer: A 2.2-mm incision is optimal for beginners because it has different fluidics than the 1.8-mm and 2.8-mm incisions. The 2.8-mm tip is relatively large in a patient with a small anterior chamber, flat anterior chamber and small eye. A medium size tip is a good compromise.

Tetz: What kind of learning curve can surgeons transitioning from standard phaco to easyPhaco expect?

Breyer: A phaco surgeon should be comfortable using easyPhaco after the first 10 patients. Viewing easyPhaco videos supplied by the faculty members in advance should be of great help.

Haldipurkar: For a phaco surgeon who already uses high fluidics, the learning curve when transitioning to easyPhaco will be negligible. However, two important aspects of easyPhaco are that it is optimized when using high settings and surgeons should pay attention to wound and side port leakage.

Menapace: A surgeon transitioning to easyPhaco should get accustomed to turning the bevel sideways and positioning the sleeve in a manner that allows fluid to exit horizontally. If the surgeon already uses high fluidics, the transition to easyPhaco would make surgery safer and more efficient. If the surgeon is accustomed to using low fluidics, he must overcome his anxiety to increase fluidics.

Tetz: I have seen surgeons move the sleeve too far down to the end of the phaco tip and the sleeve impedes occlusion. The easyTip has a true position; it is made to fit at the point where the metal part of the tip widens. If the surgeon watches the tip under the microscope, it will never be in the wrong position. The easyTip shows the surgeon where to place the

sleeve. However, standard sleeves can be positioned anywhere, including toward the end of the tip.

Bolger: When I transitioned to easyPhaco, I made the mistake of using a tunnel that was the same size as the larger incision, which was 2.8 mm or 3 mm. I have shortened the incision so the entry into the eye is at the exact same position. The position of the beginning of the incision on the outside of the eye is closer because the wound is smaller. Previously, I made the scleral tunnel in the normal position, making the same incision length and entering the eye at the same position, which resulted in an incision that was too long. My current incision has the same proportions as my old, larger incision, which was 2.8 mm wide and just less than 2 mm long and entered just anterior to Schwalbe's line.

Conventional capsulorrhexis forceps and capsular scissors are too large to open in a 1.8-mm incision, so surgeons should consider switching to forceps and scissors that are similar to vitrectomy tools. When I transitioned to easyPhaco I had to change the settings. It is not a daunting transition, but a very worthwhile one.

Menapace: When a surgeon begins using high fluidics, he or she must remember to increase both flow and vacuum. If the vacuum present is too low, the surgeon will not reach the flow rate shown on the surgical display when using high flow only because of the high resistance created by the small bore. The pump will stop prematurely as soon as the preset vacuum level has been reached before the chosen flow rate displayed by the machine will be attained.

Aguilera: The mental aspect of transitioning to easyPhaco is more important than the technical aspect, and the part that I found to be most difficult. Surgeons are sometimes bombarded by the theory that large phaco machines that include all of the bells and whistles yield the best results, so initially surgeon confidence may be lower when working on a small machine. However, after using easyPhaco on the first two or three patients, they will forget about the old phaco machine.

Menapace: Surgeons are currently using two primary methods for cataract surgery: low flow, nonocclusion transversal phaco and high fluidic longitudinal phaco. Some support the notion that high fluidic longitudinal phaco is dangerous, but studies show that those claims are false and that this phaco technique is not dangerous when using an appropriately designed

phaco tip that guarantees chamber stability under both free flow and surge conditions.⁹

Conclusion

Tetz: I think we would all agree that there is more to phaco than power. Fluidics and improved capabilities, including better followability and holdability, can help surgeons attract lens material to the tip and remove it from the eye. Surgeons can achieve this using easyPhaco for three different sizes: sub-2-mm, 2.2-mm to 2.4-mm and standard 2.8-mm incisions. The panel members have experience removing lenses of varying hardness and they can remove hard lenses safely and efficiently through a 2.2-mm incision. Surgeons can also use 1.8-mm incisions for certain situations, such as to gain better astigmatic control.

A surgeon transitioning from standard phaco to easyPhaco would not have a long learning curve if a couple of simple rules are followed. Beginners can start using high fluidics on a more controlled coaxial mini-incision cataract surgery. In some parts of the world, it may be wise to learn an extracapsular procedure but, in general, new surgeons can start by using advanced technology.

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