Phaco Tips for MICS

Surgeons describe their phaco techniques using various platforms for microincision surgery.

BY AMAR AGARWAL, MS, FRCS, FRCOphth; DHIVYA ASHOK KUMAR, MD; JORGE L. ALIÓ, MD, PhD; ALEXANDRE DENOYER, MD, PhD; AND RUPERT MENAPACE, MD

Microphakonit Tips and Techniques

By Amar Agarwal, MS, FRCS, FRCOphth; and Dhivya Ashok Kumar, MD

In 2005, we reported the creation of the smallest cataract incisions to date using 700-µm surgical instruments. The procedure, developed with the help of Larry Laks of MicroSurgical Technology, was coined *microphakonit* to differentiate it from 0.9-mm phakonit, which we previously reported in 1998. Incisions used for microphakonit are smaller than those used for phakonit.[1-3] Additionally, microphakonit has shown faster wound healing and less postoperative wound leakage than larger incisions.[2-4] For a video demonstration, visit eyetube.net/?v=tefoq.

SURGICAL TECHNIQUE

In microphakonit, a sideport incision is made, and an ophthalmic viscosurgical device is injected through this port. The main and sideport incisions are made with a 0.8-mm microphakonit knife. A 5- to 6-mm capsulorrhexis is created with a 26-gauge needle bent to form a cystotome or with 25-gauge capsulorrhexis forceps (MicroSurgical Technology). A globe stabilization rod held in the nondominant hand can be used to control eye movement.

Cortical cleaving hydrodissection is performed, watching for the fluid wave passing under the nucleus. The surgeon should also verify the ability to rotate the nucleus. It is of note, however, that because there is little escape of fluid, one should be careful during hydrodissection. If too much fluid is passed into the eye, a complication such as a posterior capsular rent may occur, and therefore it is necessary to decompress the anterior chamber during this maneuver by applying slight posterior pressure on the scleral lip.

The 22-gauge (0.7-mm) irrigating chopper (MicroSurgical Technology) is connected to the infusion line of the phaco machine and introduced with the footpedal in position 1. The phaco probe is connected to the aspiration line, and the 0.7-mm phaco tip, without an infusion sleeve, is introduced through the clear corneal incision (CCI). Using moderate ultrasound power, the phaco tip is embedded in the center of the nucleus, starting from the superior edge of the capsulorrhexis with the phaco probe directed obliquely downward

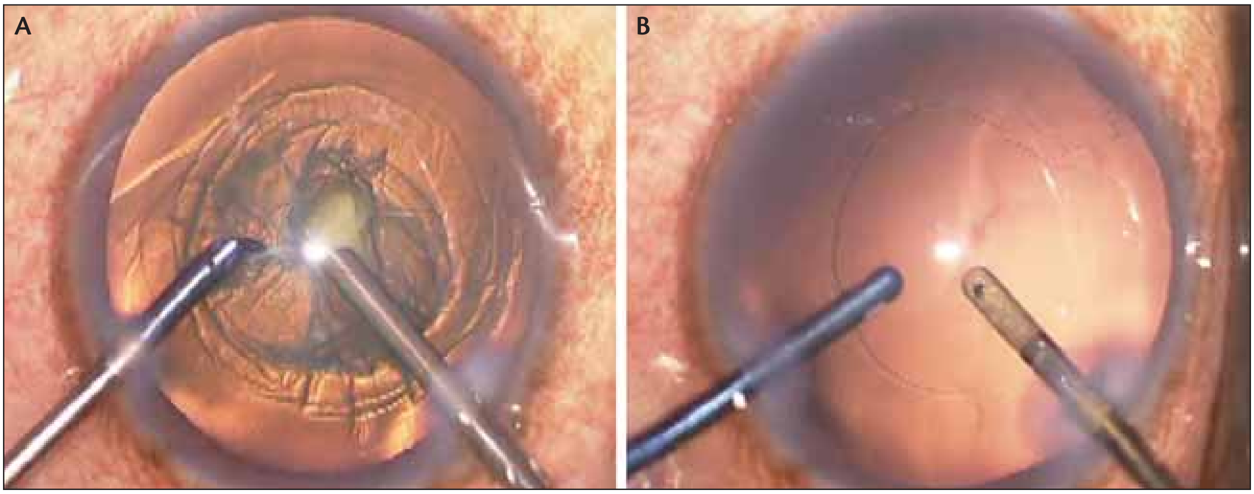

Figure 1. (A) Microphakonit performed with a 700-µm phaco needle and a 700-µm irrigating chopper. (B) Bimanual irrigation and aspiration performed with a 700-µm bimanual I/A set.

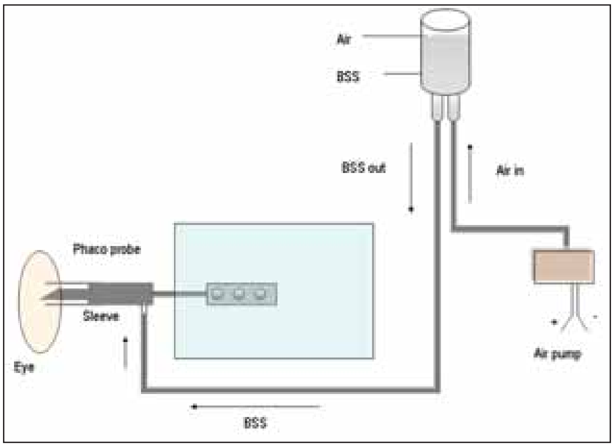

Figure 2. Schematic diagram of gas-forced infusion

toward the vitreous. At this stage, phaco power is 20% to 50% (depending on the density of the nucleus), aspiration flow rate is 20 cc/min, and vacuum is 100 to 200 mm Hg. Using the karate chop technique (Figure 1A), the nucleus is chopped and removed. Cortical clean-up is then performed using a bimanual I/A technique with a 0.7-mm I/A set (Figure 1B). Gas-forced infusion with the air pump is used throughout the procedure.

SURGICAL TIPS

An anticipated problem with the 0.7-mm microphakonit needle compared with the 0.9-mm phakonit needle is a decrease in the speed of surgery due to the lower aspiration flow rate. This issue has been tackled, however, by the development of a tip with thinner walls, resulting in a relative increase in the inner diameter of the tip. This modification has allowed the speed of surgery to increase.

The microphakonit chopper is a 0.7-mm open-ended irrigating chopper, and the bimanual I/A handpiece is also designed for the 0.7-mm diameter small incision used for microphakonit. Both the microphakonit needle tip and microphakonit irrigating chopper can fit onto the handles of the Duet system (MicroSurgical Technology).

It is necessary to decompress the anterior chamber by applying slight posterior pressure on the scleral lip while performing hydrodissection and hydrodilineation. Gas-forced infusion with the air pump (Figure 2) has been found to be safe[5,6] and effective in controlling surge and increasing intraoperative safety. An IOL is implanted by extending the main incision with a keratome, as an IOL that can pass through a sub–1-mm incision is not yet available.

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Instruments for MICS

By Jorge L. Alió, MD, PhD

In 2003, I created and registered microincisional cataract surgery (MICS) as a surgical concept. In MICS, the incision size is decreased to reduce the aggressiveness of the procedure and eliminate the astigmatic and aberrometric impact of the incision on the outcomes of cataract surgery. The concept of MICS is therefore related to the smallest incision size possible for the purpose of achieving this goal.[1,2]

Over the years, I have been working on the design of surgical instruments for MICS with two companies: Katena Inc. and MicroSurgical Technology. With Katena Inc., we have designed 19-gauge instruments, the key elements of which include the Alió Irrigating Stinger (Figure 1), the Alió MICS Capsulorrhexis Forceps, and the Alió MICS Scissors. The phaco tip used for the purpose is a 30º tip that fits through a 0.9-mm wound (Figure 2).

With MicroSurgical Technology, I have designed 20-gauge instruments (Figure 2), which fit into the concept of micro-MICS, or sub–1-mm surgery. For the purpose, I

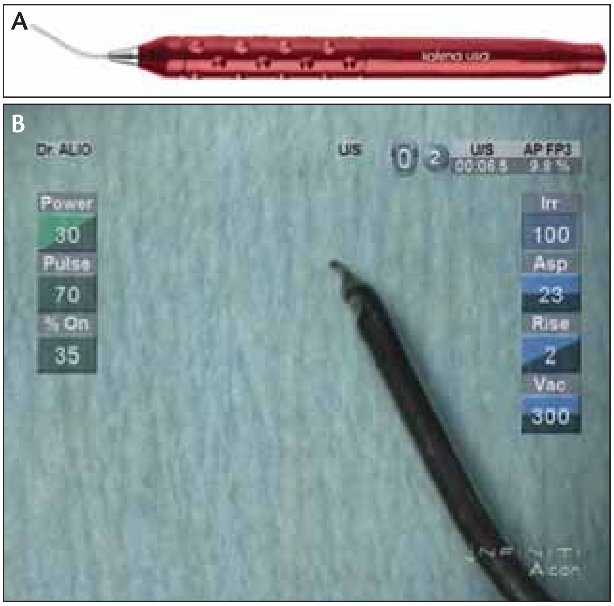

Figure 1. The 20-gauge Alió Irrigating Stinger.

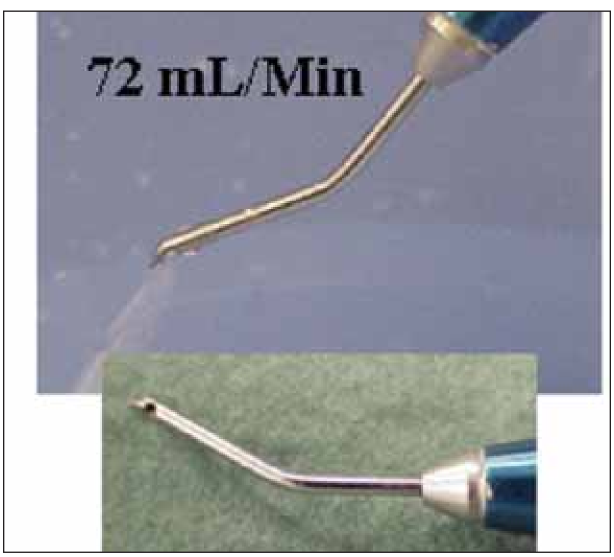

Figure 3. The stinger, a tiny finger projecting from the downside of the tip.

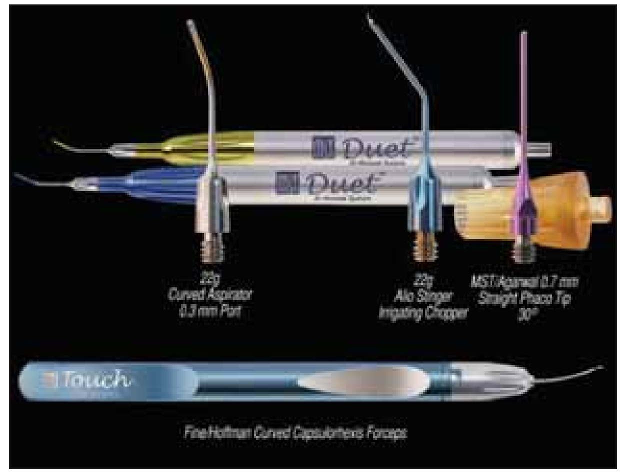

Figure 2. These 20-gauge instruments are designed with MicroSurgical Technology (MST).

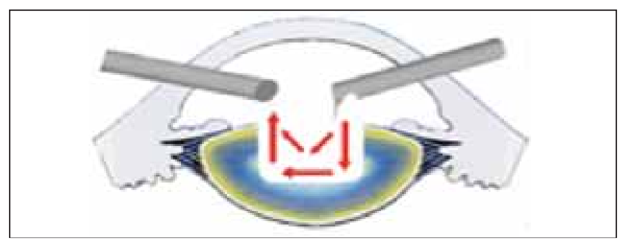

Figure 4. Downward irrigation with the Irrigating Stinger opens and widens the posterior capsule, levitating the nucleus fragments toward the phaco tip.

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use 1-mm incisions, made either with a femtosecond laser or with Mani blades (Mani, Inc.). The Irrigating Stinger fits perfectly through this incision. The phaco tip that I use has a 0.7 mm internal diameter and 0.9 mm total external diameter. In this way, total sealing of the incisions is guaranteed, and no leakage is present at any level.

In my opinion, the most important element of successful MICS is the irrigating cannula and the use of a pressurized infusion phaco pump. Concerning the cannula, in order to eliminate the need to change instruments during surgery and to have a less aggressive instrument inside the eye, I recommend using the Alió Irrigating Stinger. This is an instrument with an inferior opening hole and a stinger at the tip—a tiny finger projecting from the distal end of the instrument (Figures 2 and 3). The stinger is helpful in performing the surgery, as it not only assists in rotating the cataract, but also in segmenting fragments, in resolving occlusion of the

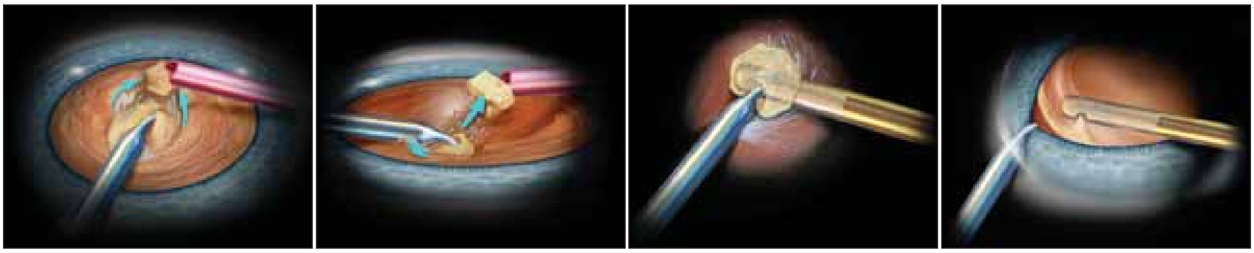

Figure 5. Downward irrigation with the Irrigating Stinger guarantees wide opening of the posterior capsule while the sting assists in the chopping, segmentation, iris retraction, and other maneuvers.

Sculpture	Bottle height	110 cm
	Pressurized infusion	100 mmHg
	Fixed vacuum	90 mmHg
	Fixed U/S	4%
	Duration	20 ms
	Duty cycle	60 %
Segment	Bottle height	110 cm
	Pressurized infusion	100 mmHg
	Fixed vacuum	350 mmHg
	Fixed U/S	2%
	Duration	20 ms
	Duty cycle	60%
I/A	Bottle height	110 cm
	Pressurized infusion	100 mmHg
	Maximum vacuum	350 mmHg
VISCO	Bottle height	30 cm
	Pressurized infusion	NO
	Maximum vacuum	85 mmHg

Figure 6. The author's personal settings with the Stellaris.

Chop	Irrigating	110 cm H_2O
	Power	35% 10 m s on /30 ms off
	Vaccum	150
	Aspiration rate	25
Quad	Irrigating	110 cm H_2O
	Power	20% 30 ms /on 45 m s off
	Vaccum	250
	Aspiration rate	30
Cortex	Irrigating	110 cm H_2O
	Vaccum	250
	Aspiration rate	30
Visco	Irrigating	50 cm H_2O
	Vaccum	60
	Aspiration rate	30

Figure 7. The author's personal settings with the Constellation.

aspiration tip, and in manipulating the iris safely and atraumatically. It is extremely gentle to use. Downward irrigation with the Irrigating Stinger (Figure 4) guarantees wide opening of the posterior capsule and levitation of the nuclear fragments from the capsular bag. As this occurs, the fragments are drawn to the phaco tip, and with this one instrument the whole nucleus is managed (Figure 5). I prefer to use venturi or hybrid vacuum pumps, my favorites being the Stellaris (Bausch + Lomb) and Constellation (Alcon Laboratories, Inc.) systems. Figures 6 and 7 show my personal settings with the Stellaris and Constellation pumps.

With these instruments, I can successfully remove any type of cataract, including brunescent and hypermature. The accompanying videos, which can be viewed at eyetube.net/?v=steev and eyetube.net/?v=belok, show several cases that demonstrate the efficacy of this surgery, not only in grade 3 cataracts but also in white, intumescent cataracts.

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An Integrated Platform for MICS

By Alexandre Denoyer, MD, PhD

I started performing bimanual MICS through a 1.8-mm CCI in 2004. At that time, less than 1% of French ophthalmologists had experience with this procedure, and only a few performed it routinely in hospitals. In the early days of MICS, surgeons were not likely to perform such a procedure for two main reasons: (1) there was no IOL injector fitted for a microincision; and (2) the bimanual techniques required the surgeon to modify his or her surgical practice and accept a learning curve for a new technique.

In France, Bausch + Lomb was the first company to offer an integrated platform for performing a true MICS procedure from beginning to end, including a phaco machine, instruments, and a foldable IOL suitable for a

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— *Alexandre Denoyer, MD, PhD*

microincision. Using this platform, we and others conducted clinical studies that showed that reducing the incision size decreased intraoperative corneal trauma, leading to fewer surgically induced optical aberrations and better visual outcomes.[1]

Today, the Stellaris enables us to perform coaxial MICS through a 1.7-mm CCI as well as biaxial surgery through two incisions of 0.9 mm (20 gauge) or less. For many years, Christophe Baudouin, MD, PhD, and his colleagues at the Quinze-Vingts National Ophthalmology Hospital in Paris have been involved in improving the machine settings (fluidics, ultrasound delivery) and developing new instruments (forceps, phaco tips, infusion cannula with chopper) in order to even better control the procedure and outcomes.[2]

In my opinion, MICS does not have to be reserved for standard cataract cases but can be used for complicated cases as well. The improved control of fluidics, which leads to excellent anterior chamber stability, combined with the thinness of the tip and canulas, makes MICS the first-choice technique for nonstandard patients. Indeed, fragile eyes, such as those presenting with lens subluxation or phakodonesis or those previously operated on (filtrating surgery or corneal grafts), may benefit from the deep reduction in anterior chamber stress provided by the Stellaris platform due to the tightness of the incisions combined with fluidic optimization. Other cases, such as those with narrow, undilated pupils, may benefit from the thinness of the devices, allowing precise surgery in a restricted space.

Recent developments in which a femtosecond laser is used for the first steps in cataract surgery can easily be associated with microincision aspiration and IOL implantation. Hence, coaxial MICS through 1.7-mm incisions should become the gold standard for routine cataract surgery, and the decrease in incision size to sub–1-mm scale will allow a level of precision and safety that has never before been reached in cataract surgery.

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MICS With High Fluidics

By Rupert Menapace, MD

Simply downsizing a standard phaco tip to fit a smaller incision will inevitably decrease its efficiency. Energy output will decrease as a function of the frontal projection plane, holdability will decrease as a function of the orifice area, and followability will decrease as a function of the flow rate created by the pump, which is limited by the influx dependent on the width of the infusion mantle between tip shaft and sleeve. The easyTip CO-MICS tip (previously termed CO-MICS 2, to distinguish it from the original CO-MICS tip design; Oertli Instrumente AG) compensates this loss of efficiency with its unique design. As the name implies, the CO-MICS tip is designed for use in coaxial MICS.

The design includes a slim shaft and strong bevel, features that inherently increase the frontal projection plane and widen the infusion mantle, thereby multiplying the energy output and allowing higher flow rates and, thus, higher followability due to the augmented infusion supply. The 53° bevel angle of the 23-gauge CO-MICS tip results in an area of orifice equal to that of a standard 19-gauge tip with a 30° bevel angle and provides the same strong holdability.

The slim shaft of the CO-MICS tip has a 0.4-mm bore. The resulting high flow resistance has two effects. First, it serves as a built-in surge brake, effectively suppressing surge upon occlusion breaks. Second, it makes the peristaltic pump behave similarly to a venturi pump when run at a higher speed. This occurs because the flow resistance of the small shaft bore produces a vacuum at the tip orifice even when it is not occluded. This vacuum without occlusion increases with the preset vacuum level on the machine. Other than with the venturi pump, however, the actual flow rate can still be controlled, as can the maximum flow rate. For optimal efficiency, tips should be run at high flow rates, as this increases followability as well as holdability by accelerating the vacuum rise

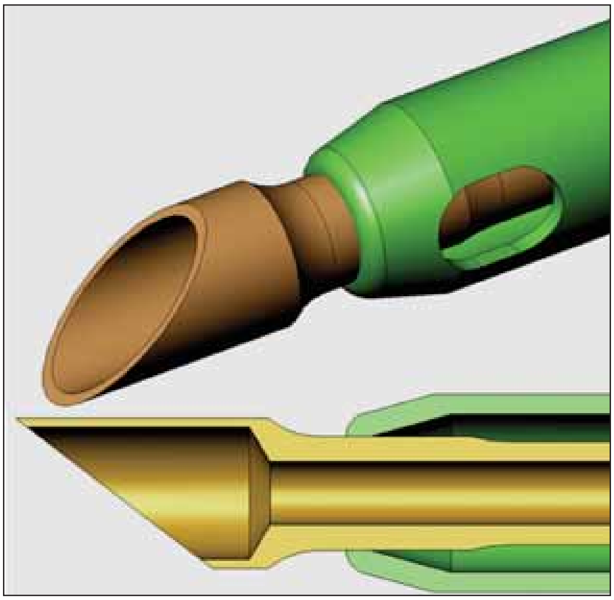

Figure 1. The Oertli easyTip CO-MICS tip designed for 1.6-mm coaxial microphaco (28 mL/min and 350 mm Hg max, with bottle set at 100 cm).

once occlusion occurs and by more readily reestablishing occlusion after occlusion breaks. It is of paramount importance to understand that, for these high flow rates to be attained, the vacuum must be set above a critical level to overcome the high flow resistance of the small shaft bore.[1]

Despite its slim shaft, infusion influx is still the crucial factor limiting the potential of the CO-MICS tip. Therefore, fluidics settings should not exceed a maximum of 28 mL/min and 350 mm Hg to prevent chamber flattening or collapse in the event of surge. To compensate for this, I have been using an additional irrigating spatula with standard tubing, which is fed by the same infusion bottle. I have termed this *infusion-assisted coaxial or hybrid microphaco* (Figures 1 through 3).

Infusion-assisted coaxial or hybrid microphaco allows the CO-MICS tip to be run with fluidics settings as high as 50 mL/min and 600 mm Hg, which tremendously enhances the instrument's efficacy and safety. This effect has been substantiated in a clinical study that showed a decrease in effective phaco time by 50% for nuclear emulsification, with only a 20% increase of fluid consumption; endothelial loss was 5% in both groups.

CONCLUSION

The Oertli CO-MICS 23-gauge microtip, designed to fit through a 1.6-mm incision, optimizes efficiency and fully maintains chamber stability. To exploit its full potential, the tip should be run with high fluidics; to allow this, the additional use of an irrigating spatula instead of a standard spatula is highly recommended. ■

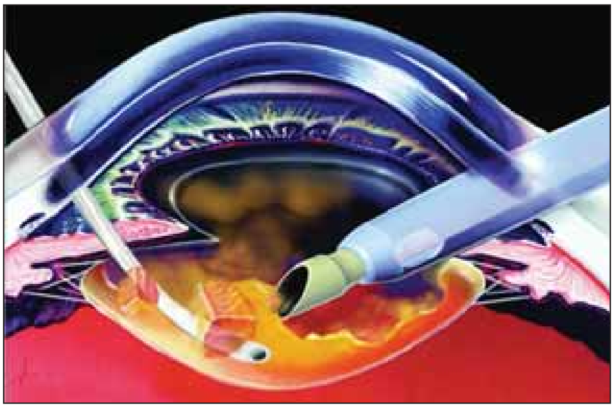

Figure 2. Infusion-assisted coaxial or hybrid microphaco using an irrigating spatula for high fluidics settings (50 mL/min, 600 mm Hg).

Figure 3. Set-up for hybrid microphaco.

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