Coaxial MICS: A New Frontier in Phacorefractive Surgery

CO-MICS with the Oertli system combines advantages of standard coaxial and bimanual ultrasmall incision techniques.

BY DETLEV R.H. BREYER, MD

Phacoemulsification surgeons first started to perform bimanual sleeveless microincision cataract surgery (MICS) approximately 5 years ago. We were excited by the possibility of using incision sizes of 1.2 to 2 mm because, according to many corneal astigmatism studies, they held the promise of astigmatism-neutral phaco surgery. This would allow us to achieve a higher level of refractive predictability in phacorefractive surgery.

Further potential advantages included greater stability of the globe immediately postoperatively, faster wound healing, and earlier refractive stability compared with classical coaxial phacoemulsification through a 2.6-mm incision.

DISADVANTAGES OF MICS

Despite these obvious advantages, bimanual MICS has never made a breakthrough into the practices of most high-volume cataract surgeons. What are the reasons for this?

The two instruments used in sleeveless bimanual MICS have to be held tightly within the incisions to avoid leakage problems, which can cause a spraying phenomenon, turbulent anterior chamber, and overall, a less effective closed system than we enjoyed with coaxial cataract surgery.

Additionally, the tight incarceration of the instruments in the incisions causes irreversible stretching of the corneal collagen fibers. This phenomenon, demonstrated in electron microscope photographs by Rupert Menapace, MD, of Vienna, Austria, results in less watertight incisions and more Descemet's membrane folds postoperatively than seen with coaxial phaco.

Another drawback is the separation of of the irrigation and aspiration functions in MICS, which most of the time negatively affects fluidics with the use of chop techniques and results in a short learning curve. Because of this, MICS is not suitable for less experienced or low-volume surgeons.

(Courtesy of Oertli Instrumente)

Figure 1. Evolution of the CO-MICS phaco tip.

CO-MICS PROPOSED

Rather than pursuing MICS, I became interested in coaxial microincision cataract surgery (CO-MICS), a technique that combines the advantages of coaxial phaco (using a sleeve without stretching the incision and one I/A port) with the advantages of MICS (incision size less than 2 mm).

The obvious solution is a sleeved phaco tip that fits through a 1.6-mm incision. But it takes time and effort to engineer tiny products and find technical solutions so that they can be mass produced. Oertli Instrumente (Berneck, Switzerland) has achieved this goal through evolution, first designing a sleeved tip that fit through a 2.2-mm incision and more recently releasing the CO-MICS tip, which is suitable for a 1.6-mm incision (Figure 1).

CO-MICS ANALYZED

I was excited to use this tip for the first time, because I thought it could be a great step forward in phacorefractive surgery. But, before applying a new method, one has to go through the intellectual process of analyzing its efficiency using physics. I wanted to answer the following

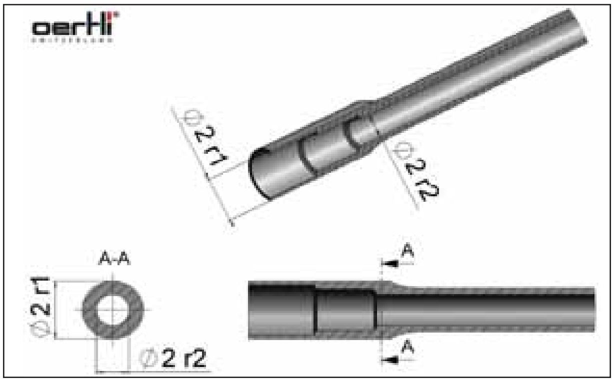

Figure 2. CO-MICS tip design.

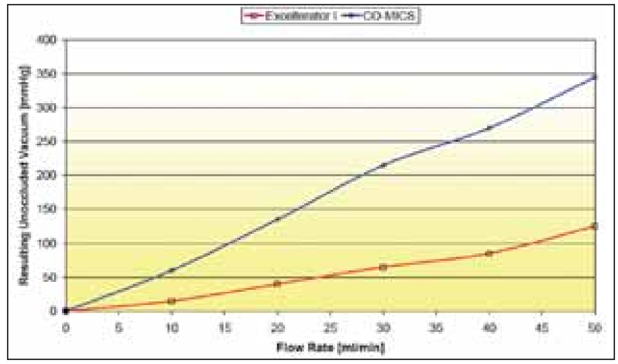

Figure 3. A higher flow rate is necessary in CO-MICS for sufficient vacuum.

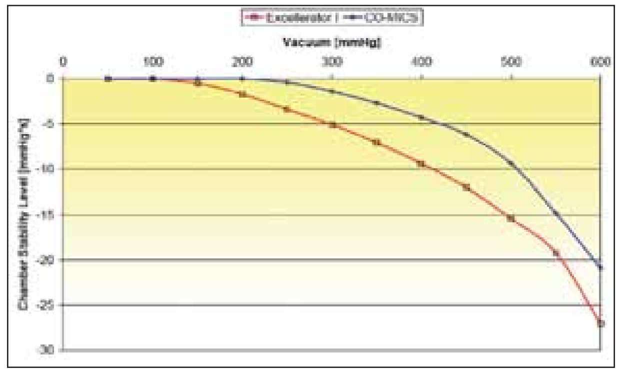

Figure 4. Greater stability of the anterior chamber is achieved in CO-MICS surgery.

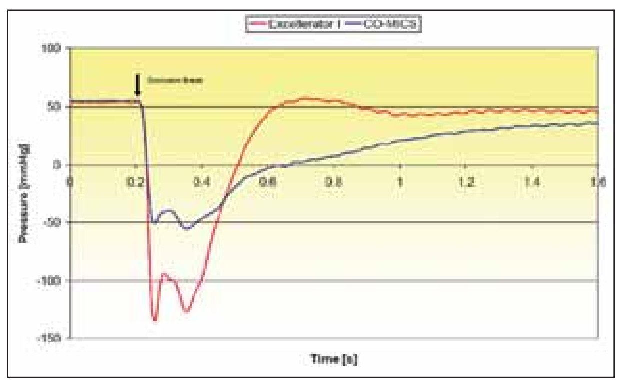

Figure 5. Less postocclusion surge is produced in CO-MICS than in classic phaco.

(Figures courtesy of Oertli Instrumente)

questions about CO-MICS: (1) how much energy is applied to the anterior chamberby the CO-MICS phaco tip, and (2) how stable is the anterior chamber during CO-MICS?

For Question No. 1, we analyzed the energy transfer of the phaco tip using this equation:

E = P X EPT, where E = energy (in joules) transferred to the anterior chamber during the whole surgery, P = acoustic power transfer of the phaco tip (in watts)—In the instrument and tip, how is electric energy converted to acoustic energy?—and EPT = effective phaco time, the product of elapsed time and phaco power, which is displayed on the phaco machine (in seconds)—In what form does the machine provide the energy?

The projected annular surface of the phaco tip defines the acoustic output (Figure 2). The output equals the annular surface area raised to the second power. The comparison of acoustic output with constant machine settings for ultrasound is shown in Table 1.

So, returning to the formula E = P X EPT, in comparison to a 19-gauge tip, the value for P with the CO-MICS tip is only 20%. Therefore, even if EPT (displayed on the machine) is two times higher than with a 19-gauge tip, only 40% of the energy will be produced in the anterior chamber with the CO-MICS tip.

The conclusion is that the CO-MICS tip is very efficient, because in comparison to a 19-gauge tip for removing a lens, only a maximum of 40% energy is needed.

To answer Question No. 2, we made the following physical observations: (1) a higher flow rate is necessary in CO-MICS for sufficient vacuum (Figure 3); (2) greater stability of the anterior chamber is achieved in CO-MICS surgery (Figure 4); and less postocclusion surge is produced in CO-MICS than in classic phaco (Figure 5).

These observations lead to the following conclusions for everyday use: (1) when setting the phaco machine parameters, raise the vacuum with peristaltic as well with venturi pumps; (2) for removal of fragments, choose to add approximately 150 mm Hg; and (3) ultrasound settings can be raised without harming the eye, because the energy impact is significantly lower than with a 19-gauge phaco tip.

PUTTING IT TO USE

After we contemplated the physical consequences of using the CO-MICS tip, we were ready to try it. In addition to the CO-MICS tip, we worked with a bimanual I/A system designed by Peter Brauweiler, MD, of Bonn,

TABLE 1. RELATIVE ACOUSTIC OUTPUT WITH CONSTANT ULTRASOUND SETTINGS

Tip size	Relative acoustic output *P* (%)
19-gauge	100
20-gauge	35
CO-MICS	20

Germany. We performed continuous curvilinear capsulorrhexis through a paracentesis with a bent needle, although special 23-gauge forceps might also be used.

We appreciated certain clinical advantages with CO-MICS. Using the smallest possible incision (1.6 mm), we could perform a bloodless clear corneal incision with high deformation stability and complete astigmatic neutrality. On the first day postop, the patient was impressed by the white eye, and we observed no stretching of collagen fibers and a quiet anterior chamber with no Descemet's folds.

Certain characteristics seemed to be the result of superb phacodynamics and fluidics, such as the soft postocclusion surge, stable anterior chamber, use of less energy in the anterior chamber, occurrence of minimal nucleus chatter, and the ability for the surgeon to use a familiar technique from day 1.

The only disadvantage I observed was a slightly prolonged surgical time in hard cataracts, which might cost the surgeon 1 minute longer in overall surgical time. We preferred the continuous phaco mode instead of the pulsed mode to guarantee fast surgery without prolonged tip occlusion. Nevertheless, we did not observe any thermal burns of the incision or wound leakage.

INDICATIONS FOR CO-MICS

The indications for CO-MICS surgery fall into two categories, medical and refractive. The medical indications include: (1) peripheral corneal degenerations: CO-MICS allows small, stable clear corneal incisions; (2) combined cataract and vitrectomy surgery: no leakage upon scleral indentation; (3) higher myopes or vitrectomized eyes: easier incision closure in soft eyes; (4) ocular surface disorders: small incision, less trauma, easier clear corneal incision; (5) glaucoma patients: incision will not interfere with filtering bleb in future surgery; (6) miosis: smaller tip does not interfere mechanically or with view; and (7) intraoperative floppy iris syndrome: smoother CO-MICS fluidics.

Refractive indications include: (1) clear corneal incision: cosmetic white eye on the first day postoperatively, no patching; (2) toric or multifocal IOL: absolute astigmatism neutrality guaranteed; (3) presbyopic lens exchange or clear lens extraction: safe, low-risk surgery (fluidics); and (4) prescription of glasses (if needed): 1 week postop possible.

Due to the aforementioned advantages and short learning curve, I am convinced that monomanual, sleeved CO-MICS will be more successful in the near future than bimanual sleeveless MICS has been in recent years.

I would like to end by describing my personal experience with CO-MICS for phacorefractive surgery. Two years ago, I started implanting the bitoric Acri.Tec Acri.Comfort IOL (Carl Zeiss Meditec AG, Jena, Germany). In a study with 1-year follow-up, 75% of patients had a successful reduction of astigmatism with less than 0.75 D of residual astigmatism. All IOLs were close to absolute rotational stability. Examining the 25% who had residual astigmatism of more than 0.75 D, I recognized that this was caused by surgically induced astigmatism with the 2.6-mm incision, especially when the steep meridian was in the 12-o'clock position. I looked for a better alternative and found it with CO-MICS.

Looking at pre- and postoperative Pentacam (Oculus Optikgeräte, Wetzlar, Germany) videokeratography of my first implantation of a bifocal toric IOL, the Acri.Tec Acri.LISA (Carl Zeiss Meditec AG), I could not identify any induction of astigmatism with CO-MICS. The patient's preoperative refraction in the right eye was −7.50 −2.50 X 05 and in the left eye −8.50 −3.25 X 180. The first day postop, the patient's refraction was plano in the right eye and −0.75 −0.50 X 170 in the left (I always aim for slight myopia in the nondominant eye) with UCVA of 20/20 near and far.

I wish you and your patients the same impressive results with CO-MICS and a bifocal toric MICS IOL. ■

TAKE-HOME MESSAGE

- Bimanual MICS has advantages; however, it has never made a breakthrough into the practices of most high-volume cataract surgeons.
- CO-MICS combines the advantages of coaxial phaco with those for MICS.
- Oertli Instrumente recently released the CO-MICS tip.
- In the near future, monomanual, sleeved CO-MICS may be more successful than bimanual sleeveless MICS.
- Videokeratography of Dr. Breyer's first bifocal toric IOL implant with CO-MICS did not identify any induced astigmatism.

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