

The Evolution of Phakonit

The technique's developer reflects on its beginning and popularization.

BY AMAR AGARWAL, MS, FRCS, FRCOPHTH

When I devised phakonit in 1998, I did not realize it would become so popular so fast. As basically a vitreoretinal surgeon, I used to perform all lensectomies by removing the infusion sleeve and passing the phaco needle into the lens through the pars plana. Infusion was delivered through a separate infusion cannula. I realized I could easily remove cataracts simultaneously in patients in whom I had to perform a vitrectomy. The problem in adapting this technique to anterior segment surgery was the need to deliver adequate irrigation without the phaco sleeve. I thought of bending a needle like a chopper and using it for irrigation and chopping (Figure 1). To avoid causing a corneal burn, I opted to try irrigating the corneal wound with fluid during emulsification.

My first case involved a dense cataract. I removed the infusion sleeve from the phaco handpiece and connected a 20-gauge needle to the irrigation bottle. I made the incision with a microvitreoretinal blade. Because the incision was small, not much fluid escaped from the eye. I carefully avoided injecting excessive fluid during hydrodissection.



Figure 1. The author performs his first phakonit procedure with a needle bent like a chopper.

Whenever I began to remove the nucleus, the chamber would partially collapse. It was obvious that the inflow was inadequate. Changing to an 18-gauge needle solved this problem and provided a stable chamber. I was able to chop the hard cataract with the irrigating needle, although not as well as I could have with a standard chopping instrument (Figure 2). Once the procedure was complete, I realized that it might be the next frontier in cataract surgery, because the incision was drastically smaller in size than in standard cataract surgery. I named the procedure *phakonit* (now known internationally as *bimanual phacoemulsification*), because it was “phako” with “needle incision technology.”

I described the phakonit technique in a chapter of my first textbook.¹ As it turned out, Steven Shearing, MD, of Las Vegas had previously published an article in 1985 on separating the infusion from the phaco handpiece,² and Tsutomu Hara, MD, of Utsunomiya, Japan, had published a similar article in 1987.³ I had been unaware of their work when I developed phakonit. As the procedure's popularity grew, their pioneering work gained appreciation.

DEVELOPMENTS IN INSTRUMENTATION

I collaborated with many companies to create the irrigating chopper and other instruments for phakonit, including the phakonit knife (Huco Vision SA, St. Blaise, Switzerland). Various companies now offer bimanual phaco instruments.

Fluidics represent one of the main problems in phakonit. I tried to solve the problems of chamber collapse and surge by using a separate anterior chamber maintainer and performing three-port phakonit.⁴ My sister, Sunita Agarwal, MD, proposed the idea of pressurized infusion, which we accomplished by injecting air into the infusion bottle.⁵ In 1999, she had the idea of connecting an aquarium air pump to the infusion bottle via an IV set (Figure 3). This setup provided a constant supply of air to the infusion bottle, and the pressurized infusion source allowed us to use 20- or 21-gauge irrigating choppers. This change represented the first use of pres-



Figure 2. Well-designed irrigating choppers replaced the original bent needle. The Agarwal Irrigation Nucleus Chopper at left has an opening at its end for fluid, whereas that at right has two openings on its sides (both products from Geuder AG, Heidelberg, Germany).

surized fluid for anterior segment surgery. We use the device for all our phaco cases, not only phakonit procedures, and we no longer need an anterior chamber maintainer.

Another problem in phakonit was that fluid would spray over the cornea. Placing the hub of the infusion sleeve so that it is present only at the needle's base solved this problem.⁶

THE CONTRIBUTIONS OF OTHERS

In 1999, a live performance of phakonit and no-anesthesia cataract surgery was telecast via satellite from our OR in India to the ASCRS meeting in Seattle. That same year, Phillippe Crozafon, MD, of Nice, France, reported successfully using a sleeveless, 21-gauge, Teflon-coated tip for minimally invasive bimanual phacoemulsification. Dr. Crozafon felt that coating the phaco tip with Teflon could prevent thermal burn because the material has poor thermal conductivity and reduced frictional heat.

Also in 1999, Hiroshi Tsuneoka, MD, of Tokyo studied the use of ultrasonic phacoemulsification and aspiration for lens extraction through a microincision.^{7,8} He proposed that an incision sized slightly larger than the phaco needle would allow sufficient fluid leakage to cool the tip. He also felt that too tight an incision would result in incisional deformation from movement of the phaco tip.

Jorgé Alió, MD, PhD, of Alicante, Spain coined the term *microincision cataract surgery* in 2000 to refer to cataract surgery performed through an incision sized 1.5 mm or smaller.⁹ The term could be applied to laser cataract surgery (pioneered by Jack Dodick, MD, of New York) and to ultrasound (phakonit).

Randall Olson, MD, of Salt Lake City deserves credit for

raising interest in microincisional cataract surgery. His studies in peer-reviewed journals addressed the concerns of early critics,¹⁰⁻¹³ and he helped to develop new equipment that did not restrict inflow. In 2001, Dr. Olson reported the feasibility of sleeveless phacoemulsification through a 1-mm incision using the Sovereign with Whitestar Technology (Advanced Medical Optics, Inc., Santa Ana, CA). He found that hyperpulse mode limited heating of the phaco tip by generating ultrasound for extremely short intervals. He coined the term *microphaco* and was also the first surgeon to combine the use of a 21-gauge irrigating chopper and a 0.8-mm phaco needle.

MICROINCISIONAL IOLs

Christine Kreiner, PhD, from Germany designed an ultra-small-incision IOL (Acri.Smart IOL; Acri.Tec GmbH, Berlin, Germany) made of a special copolymer lens material.¹⁴ This single-piece acrylic lens can be dehydrated and pre-rolled. The first Acri.Smart IOL was implanted by A. John Kanellopoulos, MD, of Athens, Greece, in 2000.¹⁵

Headed by Wayne Callahan, Thinoptx (Abingdon, VA) designed an ultrathin lens using Fresnel principles.^{16,17} He and his son, Scott, then developed a special manufacturing process for an extremely thin lens. The first such lens was implanted in 2001 by Jairo Hoyos, MD, of Barcelona, Spain. I subsequently implanted the first 5-mm optic Thinoptx rollable IOL in 2001. The lens could be rolled rather than folded, and it received CE Marking in 2002.

CONCLUSION

Phakonit¹⁸⁻²² has taken the field of ophthalmology by storm through the efforts of numerous surgeons worldwide.

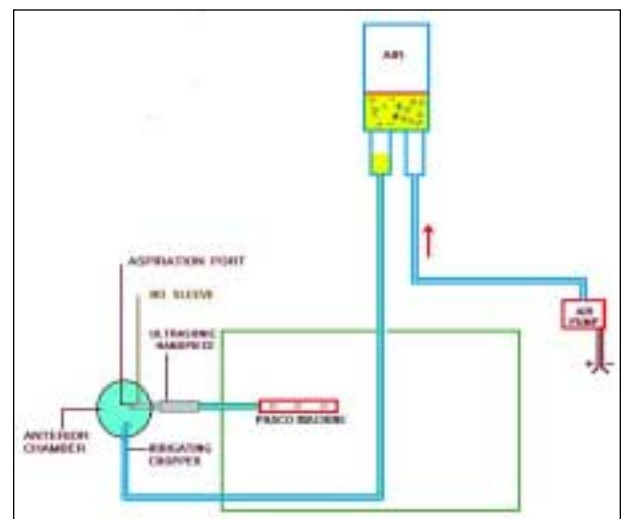


Figure 3. Sunita Agarwal, MD's development of an air pump allowed the use of pressurized fluid for anterior segment surgery.

The main obstacle at present is the need for IOLs that will pass through a sub-1-mm incision without reducing quality of vision. The additional availability of easy-to-use injectors for these IOLs would be an asset. ■

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