The concept of phacoemulsification by Dr. Charles Kelman heralded the era of modern cataract extraction and paved the way for small-incision surgery. The evolution from the large-incision extracapsular cataract extraction, wherein the lens is removed en bloc, to the small incision required by phacoemulsification has led to quicker visual recovery with less induced astigmatism. Further reduction in size of the incision would allow for improved safety intraoperatively by providing a more stable anterior chamber and improved safety postoperatively with more rapid wound healing and less risk of endophthalmitis. Furthermore, smaller incisions may accelerate visual rehabilitation.

Currently, reduction in the size of the incision has been limited by the phacoemulsification probe and, in particular, the irrigation sleeve, which requires an incision of at least 2 to 3 mm. Recently, the concept of bimanual sleeveless microphacoemulsification, which has been promoted by Amar Agarwal, MD, has led to the development of sub-1-mm incision phacoemulsification. Intraocular lenses are being developed in order to realize the full benefits of small incision cataract surgery (SICS). At present, the small incisions must be enlarged in order to allow for insertion of the intraocular lens (IOL).

In bimanual microincisional cataract surgery (B-MICS), the large-diameter infusion sleeve is separated from the 0.9- to 1.5-mm titanium phacoemulsification tip, which can then be inserted through a 0.9- to 1.5-mm incision. One of the major concerns of bimanual phacoemulsification is corneal thermal burns from the sleeveless phaco tip. Thus, the fluidics must be optimized to (1) maintain fluid flow through the phaco tip in order to prevent corneal wound burn and (2) maintain a stable anterior chamber during surgery. Additionally, the phacoemulsification settings must be optimized to prevent continuous phacoemulsification from causing excessive heat transfer. This is typically done by cycling the ultrasound on and off with the computer software in the phacoemulsification machine.

In order to maintain a stable anterior chamber, the fluidics must be balanced such that the outflow is equilibrated by inflow. The inflow of fluid in current phacoemulsification units is provided by the infusion sleeve of the phacoemulsification handpiece, which also serves to protect the cornea from thermal injuries. With microphacoemulsification, the infusion sleeve is removed, and irrigation is provided by a second instrument via a paracentesis port. Various irrigating second instruments, such as irrigating choppers and nucleus...