

Creating a Foldable Lens

When lens technology helped surgeons realize the promise of phacoemulsification's small incision.

BY THOMAS R. MAZZOCCO, MD

Although by the 1970s the technique of Kelman Phaco Emulsification had been perfected to allow the removal of a cataract through a 3-mm incision, most surgeons still performed extracapsular cataract extraction, because IOL insertion required the enlargement of the phaco wound to between 6 and 8 mm. Even so, a small cadre of ophthalmologists, including myself, continued to perform phacoemulsification in the belief that the procedure was a superior method of cataract extraction and that smaller incisions were beneficial.

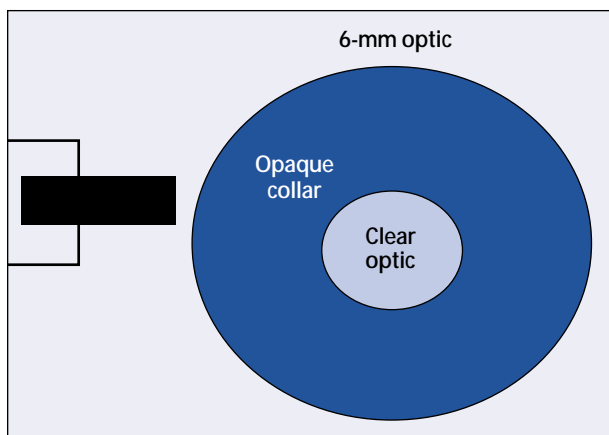


Figure 1. One of the author's design ideas was a 3-mm optic to which the surgeon could attach a dark plastic collar after inserting the pieces into the anterior chamber.

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Charles Kelman, MD, deserves credit for the idea of inserting an IOL through a 3-mm incision. During his frequently held phaco courses in the early 1970s, he showed a model of an anterior chamber lens with a 3-mm optic that he had designed and used. Unfortunately, because this IOL was angle-fixated, its centration over the pupil could not be ensured, and Dr. Kelman abandoned the design due to the excessive amount of glare it caused.

Every day, I observed the beautiful 3-mm incision I produced during phacoemulsification and longed for a method of IOL insertion that would not require me to enlarge the wound. I realized that patients needed an IOL with an optic of between 5.5 and 6.0 mm in order to achieve good visual acuity without glare.

BRAINSTORMING

My first idea was to cut a lens in half, possibly with a laser, and then glue it back together inside the anterior chamber after insertion. I decided that the adhesive posed an insurmountable problem: toxic chemicals might leach into the anterior chamber, and there was a

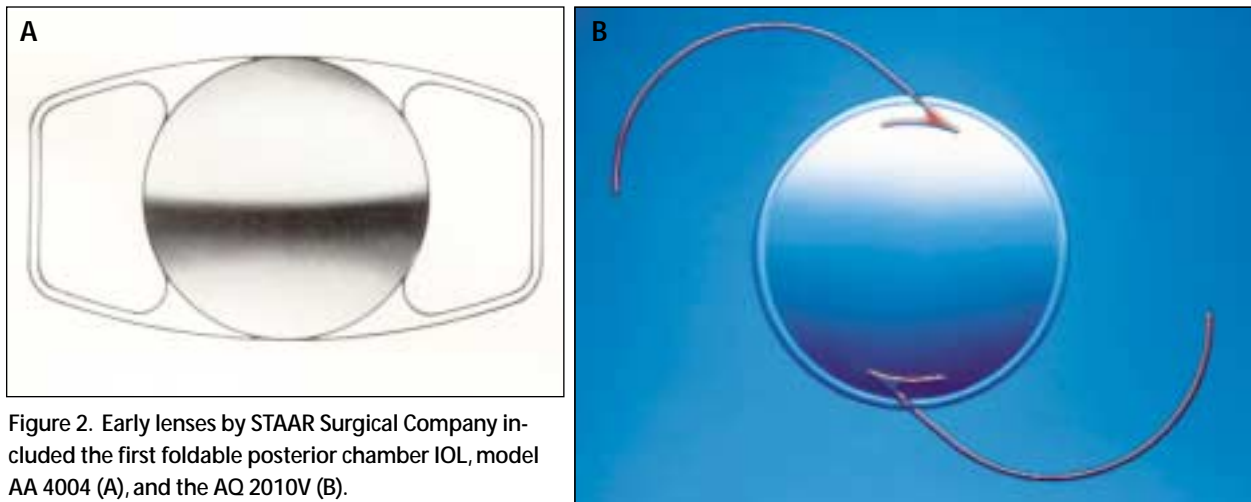


Figure 2. Early lenses by STAAR Surgical Company included the first foldable posterior chamber IOL, model AA 4004 (A), and the AQ 2010V (B).

likelihood of postoperative monocular diplopia.

I next considered the possibility of a 3-mm optic to which a surgeon could attach a collar of dark plastic by posts or a groove in order to produce a 6-mm zone of opacity with a 3-mm, clear, central optical zone (Figure 1). This assembly would occur within the anterior chamber after lens insertion. I felt that gaining FDA approval of the dye within the plastic would be problematic. Dr. Kelman later produced an elegant, small optic with opaque wings; regrettably, unexpectedly strong fibrosis of the capsular bag moved the wings back over the optic.

Finally, I began to consider using a soft material that could be folded and inserted through the 3-mm phaco incision. Other soft implants existed in 1980, but they were used primarily to lessen the degree of trauma to the delicate ocular structures. Edward Epstein, MD, of Johannesburg, South Africa, had considerable experience with soft implants. When we at STAAR Surgical Company (Monrovia, CA) settled on silicone as a suitable starting lens material, Dr. Epstein offered to assist us with the early insertions. He himself had unsuccessfully requested silicone material from Dow Corning Corporation (Midland, MI) during the late 1960s with the hope that he could construct IOLs from the material. His aim had been to create an atraumatic lens, but not for folding, because 3-mm incisions were not made in the 1960s.

LENS DESIGN

From the start, when the FDA approved the lenses for insertion in 1984, STAAR Surgical Company produced both one- and three-piece IOLs (Figure 2). I personally favored the three-piece design (polyimide haptics, silicone optic) because of its familiarity, but the simplicity and ease of manufacture led us to focus on the one-piece,

molded lens. The early one-piece lenses were very pliable in the haptic area, a design that worked for sulcus fixation. The popularization of in-the-bag fixation led many surgeons to implant the soft haptics within the capsular bag. This technique resulted in the deformation of the soft haptics, owing to fibrosis of the bag, and led to IOL decentration. The surgeon then had to reposition the lens haptics in the sulcus. A thicker, stronger haptic solved this problem; some surgeons still use this lens model with strong haptics today. The sobriquet *Mazzocco Taco*, coined by Tom Waggoner, Cofounder of STAAR Surgical Company, to describe our earliest lenses has stuck and refers to all of our folding lens designs.

The development of a foldable IOL for insertion through a small incision was slow at first. Now, 20 years after the first insertion of a foldable lens, more than 80% of IOLs are foldable or deformable. My dream of inserting a large optic through a small incision is now a reality that has resulted in “come and go” cataract surgery with early ambulation, physical healing, and visual recovery. Only patients and surgeons who have experienced the old, large-incision surgery can really appreciate how far the field has come. ■

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