Recreating the Posterior Chamber Lens

Rethinking lens design and material yielded a usable technology.

BY STEVEN P. SHEARING, MD

The history of IOLs began in 1949 with Sir Harold Ridley's insertion of an artificial lens into the posterior chamber. Although placing an IOL within the space from which the cataract had been removed seemed (and seems still) a natural, almost obvious choice, ophthalmologists abandoned posterior chamber lens implantation within a few years. I reawakened surgeons' interest in posterior chamber IOLs by integrating the concept of compressibility into posterior chamber lens design. An open-looped, compressible, posterior chamber IOL became the first commercially successful, FDA-approved, posterior chamber lens (the Shearing 101 lens; IOLAB Corporation). To this day, the open-looped configuration is a mainstay of posterior chamber lens design. This article describes the genesis of my idea.

THE ORIGIN OF AN IDEA

I consider the creation of my lens design in terms of an experiment in thought. I underwent my training in the late 1960s when IOLs were so out of favor that they were never even discussed. Ophthalmologists' attitudes changed dramatically in the 1970s.

In late 1973, I attended a phacoemulsification course taught by Richard Kratz, M.D., and Robert Sinskey, M.D. The following year, I traveled to the Netherlands to observe the work of Cornelius Binkhorst, M.D., and Jan Worst, M.D. During the next 18 months, I implanted IOLs at my practice in Las Vegas. In a way, I was an ideal person to reevaluate IOL design, because I had enough experience to question the pronouncements of those who promoted themselves as authorities. Yet, I was uncommitted to any particular lens or technology.

In contrast to phacoemulsification (invented by Charles Kelman, M.D.) and the YAG laser (developed by Danièle Aron Rosa, M.D.), IOLs were relatively low-tech. Unfortunately, the assistance of skilled engineers and physicists was unavailable to me, and a research grant was out of the question. They proved unnecessary, however. My real task was to rethink what others had already done.

EARLIER LENSES

To me, IOLs were clearly the future of cataract surgery. When Ridley replaced a cataractous lens with an artificial IOL, he had taken the most important step in cataract surgery since Dr. Jacques Daviel invented the operation. He was vilified for his innovation and then ignored, but...
progress could not be stalled forever. First, Dr. Binkhorst and then Peter Choyce were being widely hailed in the ophthalmic community for their contributions to IOL design. Yet, the number of IOL-related complications with these lenses was disturbingly high. Too many eyes sustained serious damage. I found that the incidence of IOL dislocation increased as the quality of my extracapsular surgery improved. I theorized that there was less inflammatory glue to lock the lens in place, and I did not want to be dependent on inflammation for fixation.

Dr. Binkhorst's solution to the problems associated with IOLs in the 1950s was to invent an iris-supported lens, but the iris was proving to be too flimsy a structure on which to hang a lens. Too often, the IOL failed to fixate, even with extracapsular surgery. Rising interest in Choyce's anterior chamber lens showed that I was not the only surgeon having difficulty with iris-supported lenses. Although anterior chamber lenses seemed to solve the problem of fixation (except for "propellering"), their implantation could damage delicate tissue as they were jammed into a limited space. This very problem had been the initial inspiration for Dr. Binkhorst's invention of the iris-supported lens.

NEW THINKING

If Choyce's anterior chamber lens (the Mark VIII lens), which had been denigrated for more than a decade, was worth the reconsideration suggested by multiple well-known surgeons, did not the same hold true of Ridley's posterior chamber lens? Considering the problems with existing lenses, I concluded it did. Removing a patient's natural lens certainly created adequate space in the posterior chamber for an IOL, but Ridley's lens—despite its large and heavy optic—was too small to fill the space. The lens inevitably shifted, damaged tissue, and often failed to fixate. Why had Ridley not simply filled the available space as the anterior chamber lens surgeons later did?

A careful review of the early literature suggested that Ridley's operation had been technically difficult. He had been caught on the horns of a dilemma. The shorter or smaller his posterior chamber lens, the easier it was to insert atraumatically through the pupil and into the posterior chamber. The longer the lens, the closer it came to achieving centration and then fixation (but at the price of increased trauma). By compromising, Ridley failed to achieve either goal; the surgery was difficult, and the lens did not fixate.

A SOLUTION

The posterior chamber lens needed to be short for the purposes of insertion but long for centration and fixation. These seemingly incompatible goals led to the concept of compressibility. I theorized that, if a lens could be compressed for insertion but had the memory to expand to its original shape once safely inside the posterior chamber, it would fill the space left by the extracted natural lens. Because the lens would be stable, capsular fixation would also be likely. In the mid-1970s, all lens optics were made of rigid PMMA. Softer, more flexible haptic materials were newly available, however, and I believed that compressible or flexible lens haptics could facilitate atraumatic IOL insertion and fixation.

At the annual AAO meeting in 1976, I approached executives from IOLAB Corporation about creating a compressible posterior chamber lens, because that manufacturer was the first to use haptics of polypropylene (PROLENE; Ethicon Inc., Somerville, NJ). Because polypropylene was both flexible and nonbiodegradable, it was the most suitable haptic material for a compressible IOL at the time. I believed it would be possible to make a three-piece lens with open-looped, polypropylene haptics and an overall diameter slightly greater than that of the posterior chamber.

To avoid manufacturing problems, I decided to mimic manufacturing techniques already shown to work with older, known IOLs. I requested that the company manufacture an IOL resembling the long-abandoned anterior chamber lens of Dr. Joaquin Barraquer, but with polypropylene haptics incorporating my recommended dimensions (Figure 1). The company's executives were reluctant to proceed. I indicated my willingness to pay, not only for the lenses I used, but also for any additional startup costs. The company, therefore, was guaranteed a profit from the outset. Moreover, I agreed to work with them exclusively to develop a commercial lens. They accepted this proposal.

Within a few weeks, I was testing IOL prototypes in cadaver eyes. In M arch 1977, with great trepidation and hesitation, I implanted the first compressible posterior chamber IOL in the eye of a living patient. Insertion proved relatively easy, and the lens immediately achieved fixation. Postoperatively, the eye was quiet, and the patient saw well. During a routine slit-lamp examination, it was easy not to notice the presence of the IOL. My idea had become reality.

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