The History of the Capsulorhexis Technique

The technique evolved primarily to make lens removal safer, but it also provided many benefits for the IOL's placement and stability.

BY HOWARD V. GIMBEL, MD

With the development of the in-the-bag single-plane posterior chamber IOLs in the early 1980s, it became obvious to me, and others, that a capsular opening without any extending tears would facilitate placement of both loops into the capsular bag. These tears always originated at a "V" of can-opener capsulotomies.

CONTINUOUS CURVILINEAR CAPSULORHEXIS

My first thoughts on how to avoid these V-shaped notches in the capsulotomy occurred in 1983 while watching James Gills, MD, of Tarpon Springs, Florida, tear a short arc using the scissors as a forceps after a cut in the capsule. I reasoned that tears with a cystatome could be directed in a curvilinear fashion. Because I was not using viscoelastics routinely at that time, at first, I tore the capsule in arc-like sections leaving small bridges to stabilize the flap in the turbulence of the irrigation fluid until the circle was mostly complete. After performing more than 1,000 of these procedures in my Canadian practice, I made my first public presentation of the concept with a video titled, "The Continuous Tear Capsulotomy" at the American Intraocular Implant Society film festival in Boston in April 1985.[1] My development and some of its advantages were also reported on in an ophthalmic trade publication.[2] In the fall of 1985, this video was shown at the IOLAB intraocular lens company booth at the AAO meeting in San Francisco. An illustrated information sheet on the new technique was distributed by IOLAB. The video was shown again in 1986 at the AAO film festival. When viscoelastics became routine, the technique changed to a full circle tear, which capsular forceps designed by Peter Utrata of Columbus, Ohio, facilitated. The new technique was appreciated and adopted with enthusiasm by those surgeons implanting the STAAR Surgical silicone plate-haptic IOL (STAAR Surgical, Monrovia, CA).

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Thomas Neuhann, MD, from Munich, Germany, developed a technique that started a smooth, circular capsular opening with a subincisional needle puncture and then completed it with arcs taken both ways from this puncture. He coined the term *capsulorhexis*, which appropriately uses the Greek suffix rhexis meaning "to tear." He presented his capsulorhexis technique at the German Society of Ophthalmology meeting in the fall of 1985 and published a description of the technique in a German medical journal in 1987.[3]

Calvin Fercho, MD, of Fargo, North Dakota, presented a circular capsular opening technique at the Welsh Cataract Congress, in Houston in September 1986 titled "Continuous Circular Tear Anterior Capsulotomy."

Kimiya Shimizu, MD, in Kanagawa, Japan, reported on a method of opening the capsule in a smooth, round fashion at the Japanese ophthalmic surgeons' meeting in January 1987.

The name *continuous curvilinear capsulorhexis* (CCC) was selected as the most appropriate for the technique, because the opening it created did not have to be exactly circular to have all of the desired qualities.[4,5]

A number of modalities other than tearing have been evaluated to open the capsule. The Fugo plasma blade (Medisurg Research & Management Corporation, Norristown, PA) has proven very efficacious, especially when tearing is prevented by fibrosis in the capsule such as in late traumatic cataract cases.[6,7]

The intact CCC has made the nucleus' removal more efficient and safe.[8] In addition, cortex removal can be more complete, lens epithelial cell removal can be made possible, and the IOL's implantation can be easier, safer, and more secure. If in-the-bag fixation is not possible because of a posterior capsular tear, the intact CCC may be used for optic capture fixation described as Anterior Rhexis Fixation by Tobias Neuhann, MD, of Munich, Germany at the 1991 ASCRS Film Festival.[9]

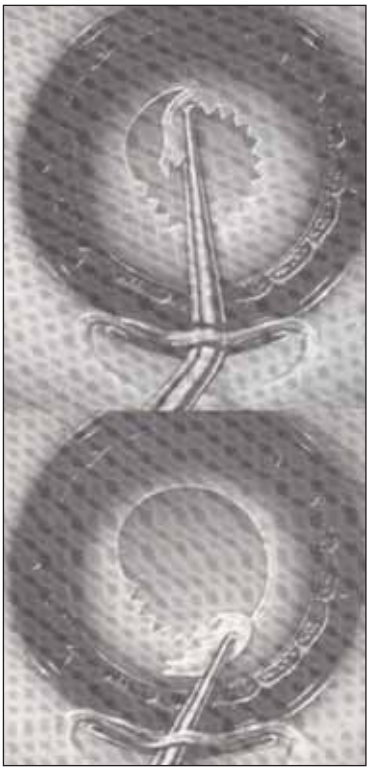

Figure 1. Following a tangential snip at the can-opener margin, an additional ribbon of capsule is removed in the process of converting to a smooth-edged CCC.

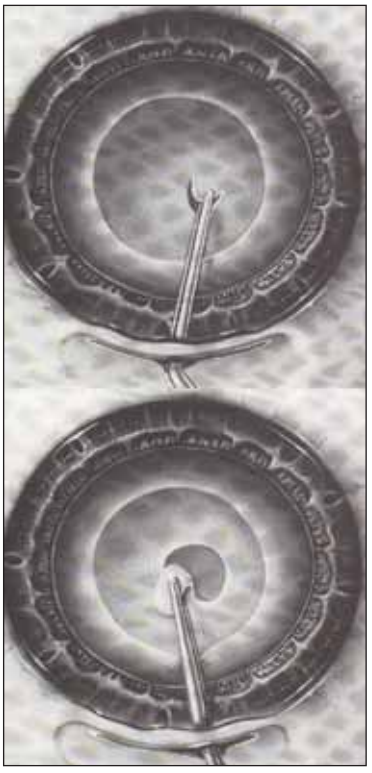

Figure 2. Using principles of CCC, PCCC is used to convert a posterior capsular tear into a continuous tear opening resistant to extension.

TWO-STAGE CAPSULORHEXIS

I developed two-stage capsulorhexis in June 1988, and it has extended the possibilities for achieving a CCC in challenging and complicated cases.[10] This technique was first employed before capsular stains were used when the original capsulectomy was purposefully made small or can opener-like for safety reasons in white cataracts. The initial anterior capsular opening was converted to a CCC of the desired diameter by making a tangential snip on one side of the opening with a Vannas scissors (Katena Products, Inc., Denville, NJ). The second tear was then extended with forceps to remove a strip or ribbon of additional capsule (Figure 1). Short radial tears were turned back using a forceps, and for large radial tears, a snip and tear in the opposite direction was used to complete the opening.

POSTERIOR CCC

It was soon recognized that the intra- and postoperative advantages of the CCC could also be applied to make a smooth continuous curvilinear tear in the posterior capsule, a technique I first utilized on November 26, 1987, for removing a dense plaque on the posterior capsule. Naming it *posterior continuous curvilinear capsulorhexis* (PCCC), I presented this technique on April 30, 1989, at the Storm Eye Institute Ophthalmology Update Meeting in Charleston, South Carolina.

The PCCC technique was used in the making of a primary opening or used to advantage in cases where small, linear or triangular tears in the posterior capsule occurred during cataract surgery without extending too far toward the capsule's equator.[11] I first used a PCCC on September 27, 1988, after a tear inadvertently developed in the posterior capsule as I was polishing it with a stainless steel irrigation/aspiration tip. The posterior capsular tear was completed into a continuous smooth circular opening (Figure 2). The IOL was placed in the bag with no extension of the posterior capsular opening. No vitreous presented.

I then started to intentionally make 4.0- to 4.5-mm PCCCs in pediatric cataract surgery, and, without vitrectomy, capture the optic with the PCCC.[12] As expected, the secondary cataract "pearls" have all spilled into the anterior chamber without obstructing the visual axis.

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CONCLUSION

Although the impetus to develop a CCC opening was the propensity of multiple adjoining tears in the can-opener technique to extend to the equator and even to the posterior capsule during lens removal and IOL placement, the strength of the CCC opening not only made phacoemulsification safer but also has lead to many other techniques. These techniques include in-the-bag lens disassembly, optic capture, lens epithelial cell removal, and safe strategies for managing small posterior capsular tears, posterior capsular plaques and with posterior CCC, optic capture for IOL fixation, and for maintaining a clear visual axis without vitrectomy. ■

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