Review of primary posterior capsulorhexis in cataract surgery

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Abstract:

This article reviews the history and technique of primary posterior capsulorhexis with emphasis on anterior hyaloid membrane preservation and combined posterior optic capture of intraocular lenses into Berger's space for the purpose of lens stability and secondary cataract elimination among other potential advantages. Applications, variations, efficacy, and safety of the procedure are reviewed.

Keywords:

Anterior hyaloid membrane, Berger's space, continuous curvilinear capsulorhexis, posterior optic buttonhole, posterior optic capture, Wieger's ligament

Introduction

Primary posterior capsulorhexis, a maneuver known since the late 1980s, remains uncommonly practiced. Particularly, when combined with posterior optic capture (POC) into Berger's space, it deserves to be embraced. This article reviews the benefits, risks, and techniques of this paradigm-changing technique.

The most common complication of modern cataract surgery is secondary cataract, visual axis opacification. Despite attempts to limit it with square-edged optics, meticulous cortical cleanup, capsule polishing, capsule expander rings, and rhexis optic overlap this still occurs in 20% to 77% of adults and up to 100% of pediatric eyes with intact posterior capsules (PCs). Extreme attempts to inhibit or destroy lens epithelial cells (LECs) have proved unsuccessful. We now presume that LEC activity, when metaplasia and fibrosis are not induced by intraocular lens touch and loss of contact inhibition, is crucial to the maintenance of viability, transparency, and flexibility of the remaining capsule.[1] With standard surgery, hundreds of thousands of Nd: YAG capsulotomy procedures are performed for PC opacity every year in the United States alone.[2] Consequently, the current pediatric protocol includes primary anterior vitrectomy with posterior vitrector capsulotomy, considered a complication in adults. This exposes immature trabeculum to vitreal elements which likely contributes to a 15% to 21% incidence of subsequent open-angle glaucoma in patients without evidence of anterior segment anomaly.[3] Adults worldwide, tolerate the second period of glare and decreased acuity as the visual axis re-opacifies. When sufficiently severe to again interfere with daily activities surgeons perform the seemingly simple Nd: YAG laser posterior capsulotomy despite the challenges of cost and limited developing world access. We concomitantly accept the disruption of the anterior hyaloid membrane (AHM), the barrier defining the two-chambered eyes. Ophthalmologists consider as successful the small clear opening in a sea of fibrosis with occasional floaters and 20/20 Snellen acuity even though the youthful healthy eye enjoys a clear lens equator to equator. Though incidence is low, ophthalmologists must accept the increased risk of cystoid macular edema, intraocular pressure spikes, progression of diabetic retinopathy, and retinal detachment following laser capsulotomy.

Hyaloid sparing posterior continuous curvilinear capsulorhexis (PCCC) deserves consideration to prevent or correct complications, avoid delayed recovery of vision in unpolishable plaques, and to stabilize toric or subluxated intraocular lenses (IOL). We under-appreciate the anterior hyaloid's role in maintaining

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ocular homeostasis. Disrupting the hyaloid, either through complication or intention, influences morbidity in both the anterior and posterior segments. Whenever possible, the first goal in surgery of subluxated or secondary IOL's is to avoid an unnecessary breach of the hyaloid membrane and subsequent vitrectomy.

Posterior capsulorhexis requires a steep short learning curve merely adding nuance to the common cataract surgeon skill of anterior continuous curvilinear capsulorhexis (ACCC). It requires no additional special equipment or technology. When used as a primary procedure combined with POC, also called posterior optic buttonhole (POBH), LECs cannot migrate to the retrolenticular space using the capsule, vitreous face, or posterior optic of the lens as a scaffold as with PCCC alone which can still allow Elschnig pearl proliferation across the visual axis. In addition, the peripheral PC, now sandwiched between the anterior capsule and the lens optic avoids contact between the two; the primary cause of capsule fibrosis. Drastic reduction if not elimination of fibrotic LEC transformation and metaplasia avoids the white shrinkage and fibrosis of the peripheral capsule routinely seen in standard surgical outcomes sometimes leading to phimosis and late bag-lens complex subluxation.[4]

POC can be selectively introduced for the neediest patients: Pediatric cataracts, those who cannot sit for the laser, or those without access. This author hopes that soon, hyaloid sparing primary PCCC with POC will become routine. It would reduce stray light compared to intact "clear" PCs, eliminating the need for dysphotopsia-creating square-edged implants and virtually end secondary cataracts while conveying numerous other proven and theoretic advantages.[5] Our present standard of lens-in-the-bag cataract surgery with intact PC need not define the state of the art.

History

Over 50 years ago Kelman revolutionized cataract removal with small incision cataract surgery employing ultrasound to break up the nucleus. Along with improved IOL to restore light focus, the next great advance was the creation of the ACCC which replaced slits and can-opener methods and allowed reliable use of the lens capsular bag for secure IOL implantation.[6] In 1987 Gimbel used his technique on the PC and converted inadvertent tears to a continuous rhexis avoiding what would otherwise have been a complication. He soon applied the technique to remove unpolishable posterior capsular plaques and recognized that it was possible to prevent vitreous prolapse or loss with this technique.

Later, in 1991, Tobias Neuhann presented the fixation of a lens implant by an ACCC (ASCRS Film Festival). Concurrently the conundrum of posterior visual axis opacification in the pediatric cataract attracted Gimbel's attention. Given his experience in adults, he showed that primary PCCC with optic capture in the pediatric age range prevents opacification.[7] Ultimately Gimbel and Debroff showed 6 methods of optic capture for IOL stabilization.[8] Early primary PCCC advocate Galand believed that removing the PC alone would be sufficient to maintain visual axis clarity, however, it became obvious that LECs could still grow over the anterior vitreous surface or along the posterior surface of the IOL.[9,10] In the 1990s few saw the value and safety of mastering these techniques when it was generally believed that the PC was the most important barrier between the front and back of the eye. It remained for Jan Worst and subsequently Tassignon and Menapace to prove that the AHM actually provided this barrier function.[5] All current and, likely future techniques of PCCC rely on the preservation of this precious structure. We are indebted to Vasavada studying pediatric techniques and Rupert Menapace who has given us some of the most convincing prospective clinical trial evidence of safety and efficacy in adults for confirmation.[11,12] Much of our anatomical understanding and high-volume long-term retrospective data are due to the work of Tassignon.[13] Oetting, Stegman, Jones, Snyder Crandall, Arbisser, and others selectively apply these techniques and some see primary PCCC with POC as the next great leap forward in routine modern cataract surgery. Great credit goes to Dick who has led the way for femtolaser assisted posterior capsulotomy techniques.[14] Wilson, a leader in the field of pediatric cataract, along with Vasavada use the technique selectively in patients over 6 months of age.

Anatomy

Until recently imaging systems viewed the posterior segment and anterior segment with gates that excluded the retrolenticular area. Newer technologies like intraoperative and swept-source optical coherence tomography (OCT) confirm 16th- and 17th-century anatomists' observations.[15] Both old and new insights help unravel important mysteries like the mechanisms of accommodation[16] and the etiology of misdirected aqueous syndromes.[17] The worst first objectively showed the conformation of Berger's space; whether real or potential delimited by the PC anteriorly, the AHM posteriorly, and circumferentially by Wieger's ligament. This is where the optic is captured in POC [Figure 1]. Tassignon has pursued this work further translating old international literature and using the most current OCT technology.[18]

The anterior capsule is 12–14 microns thick. The more elastic PC measures 4–6 microns. During embryology, the basement membrane covering the ciliary processes and the pars plana is a continuation of the basement membrane of the visual portion of the retina. It has the same origin and the same structural makeup as the hyaloid membrane. The AHM appears to line the entire ciliary body and the ciliary processes and participates in the development of the zonule of Zinn. Before reaching the tips of the heads of the ciliary process, the AHM veers toward the lens, forming the anterior wall of the zonular fibers.

The designation "AHM" identifies the cellophane-like covering over the anterior aspect of the "crust of the vitreous." This structure adheres at Wieger's ligament and extends like

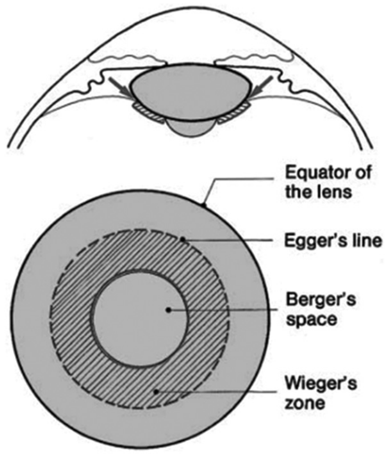

Figure 1: Schematic of Berger's space. Courtesy of M.-J. Tassignon

a transparent parachute toward the ora serrata where it joins the ciliary processes to the preequatorial portion of the lens and forms the posterior boundary of the posterior chamber.

The AHM lacks anatomic or histologic relationship to the so-called "posterior hyaloid membrane." It should be considered an independent and distinct entity and not misconstrued as an anterior vitreous condensation. This membrane resembles a transparent parachute composed of two scalloped, concentric circles. The free open end inserts circumferentially into the spike of the ora serrata and extends anteriorly toward the PC where it inserts to become the hyaloideocaspular ligament of Wieger. The central postlenticular hyaloid membrane is its thinnest part seen occasionally herniated through the pupil into the anterior chamber following intracapsular cataract extraction.

The area delimited by the PC anteriorly, the AHM posteriorly, and Wieger's ligament circumferentially, is known as Berger's space. Although the literature indicates this real or potential space is at least 6–8 mm in diameter, it varies from one individual to the next. Berger's space is often only potential with the AHM in contact with the PC of the lens, biomicroscopically blending as a single layer. It retains the capability of separating or detaching under many conditions. The anterior hyaloid extending anteriorly to ciliary processes is the true barrier between the anterior and posterior segments the PC is redundant.[19]

Recently described dysgenesis of Berger's space in unilateral congenital posterior cataract patients may lack this space due to fusion of the two membranes. Vitreous presentation may be unavoidable in these patients, a surgical planning consideration.[20]

Technique of Primary Posterior Continuous Curvilinear Capsulorhexis

After thorough removal of all lens material from the capsule bag contents confirm an intact ACCC. Many reliable methods of sizing the anterior capsulotomy are in use. Once the ACCC is assured to be slightly smaller than the intended IOL optic to be implanted, it can be used as a "cookie-cutter" template for sizing a slightly smaller PCCC in the primary setting. The nonfibrotic virgin PC is extremely elastic and therefore forgiving of smaller sizing while permitting secure capture. Reoperated fibrotic capsule requires more caution and precision. For a 6 mm optic, a 4.5 mm to 5 mm PCCC opening is the aim to assure a tight capture. The use of capsule forceps with etched millimeter markings helps assess size (ASICO). Centration on the visual axis is desirable but not critical because the IOL will be centered by the haptics located either in the bag or sulcus with only the optic below the PC in Berger's space. When using the Bag-in-the-lens method (Morcher; not Food and Drug Administration [FDA] approved) ideal centration and sizing of both anterior and posterior rhexes are essential as there are no haptics but rather a collar button groove into which the capsules are fitted. Using a ring caliper guide (Morcher) helps achieve these goals.

Employ high magnification with optimized red reflex and well-moistened cornea for visibility. Irrigation may cause topically anesthetized patients to flinch. A smooth layer of dispersive ophthalmic viscosurgical device (OVD) or hydroxypropylmethylcellulose on the corneal surface avoids the need for irrigation during this delicate maneuver.

If the bag is extremely flaccid, placement of a capsular tension ring before initiation facilitates the PCCC.

To begin the PCCC place cohesive OVD in the sulcus to collapse the anterior capsule rim and the PC together into a single plane, facilitating shearing forces with vector control. There should be no posterior pressure at this point. A 30 g bevel-up needle on a syringe containing a small amount of BSS (to exclude air) is employed as a handle. Avoid a sharp needle attached to the OVD syringe which seems efficient but is inadvisable because the sharp tip may rupture the hyaloid while instilling the OVD as the next step. Do not use a cystotome, as the downward direction of the sharp tip might open the hyaloid membrane along with the capsule if there is no space between them. Similarly, a forceps pinch to initiate the rhexis is inadvisable. Introduce the needle through the corneal incision or paracentesis at a flat angle to the PC. Start in the center of the pupil. Engage the diaphanous PC with the needle tip, lifting it upward slightly, away from the hyaloid below, causing a wrinkle to form [Figure 2]. Open the PC with a simultaneous slight sideways and forward movement. The opening will likely assume an ovoid appearance [Figure 3].

A small but important detail is to instruct scrub assistants to always prepare OVD by placing BSS into the hub of the cannula before attaching the cannula to the syringe. Liquid in a syringe displaces air more reliably than OVD can. This prevents an unanticipated and untimely bubble from extruding into Berger's space obstructing the view and disturbing the fine balance of viscous fluid movement.

Classically, cohesive OVD is now employed with the standard OVD cannula at, or just below the PC opening to push the anterior hyaloid face posteriorly away from the PC thereby inflating Berger's space. One can watch the OVD fill into itself and begin to assume a round bubble-like shape as it reaches the limits of Wieger's ligament [Figure 4]. In some cases where Wieger's ligament is detached, there will be no clear round OVD bubble and endpoint. The posterior movement of the AHM can be visualized with intraoperative OCT as well.

Instill adequate OVD at this stage to fill, but not forcefully overfill Berger's space. Judgment as to how much OVD to instill is gained with experience. Alternately inject OVD on top of the PC as well as under it as needed to keep the PC flat. PCCC's do not radialize like ACCC's do because the posterior zonules are under less tension than anterior zonules and, with the lens body removed there is no downhill lenticular slope. Avoid anterior chamber loss from this point forward to prevent vitreous herniation through the opening. An overly exuberant fill could potentially lead to anterior chamber collapse as vitreous burps out the incision so care is indicated.

Menapace recommends a modification. Rather than instilling OVD upon opening the PC, Menapace first grasps the edge of the opening to initiate one quadrant of the tear and then initiates OVD instillation to push back the hyaloid. He believes, in the rare event of simultaneous puncture of the hyaloid along with the PC, this avoids inadvertently removing the AHM along with the PC flap and then erroneously instilling OVD into the vitreous body rather than into Berger's space.[21] Tassignon, and most practitioners, prefer the classic method described previously [Video 1].

Due to the thin elastic nature of the PC, the proper vector direction of the shearing forces applied during the completion of the rhexis must be directed more centripetally than ACCC typically demands [Figure 5]. More frequent re-grasping to correct the vector is also indicated. To finish the circular tear, the "Little maneuver"-pulling the flap in a backward direction to the vector of the tear in the plane of the capsule helps to complete the rhexis without spiraling it outward and becoming bigger than intended. This is similar to the behavior of a pediatric anterior capsulorhexis.[22]

Posterior Optic Capture Technique

Once the PCCC is complete, add cohesive OVD just below the edge of the posterior rhexis in any direction where Berger's space is not already filled to prepare for optic capture. Then, direct OVD to the capsule fornix inflating the "spare tire" of the bag with the anterior capsule above, and the posterior opening below, creating an excellent landing zone for the leading IOL haptic which is now placed above the PCCC rim

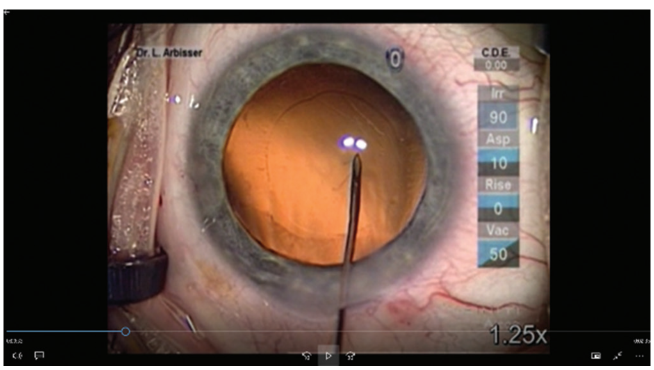

Figure 2: 30 g needle lifting and opening the posterior capsule to avoid the anterior hyaloid membrane

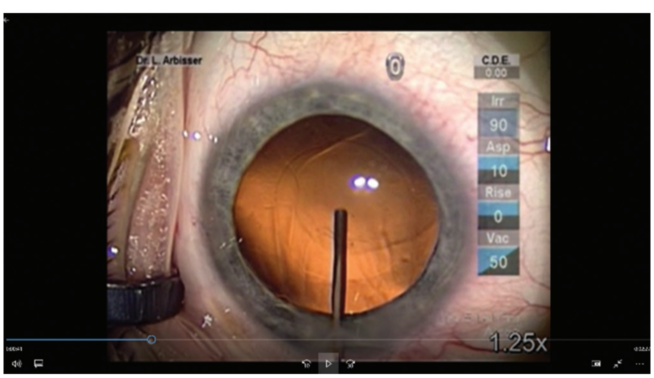

Figure 4: OVD filling into itself as it expands Berger's space

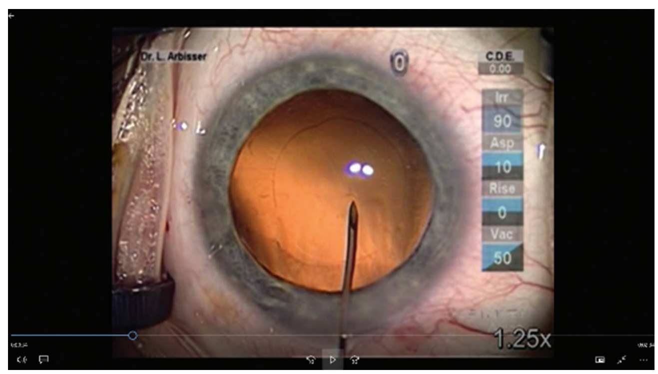

Figure 3: Oval opening in the PC as needle is withdrawn

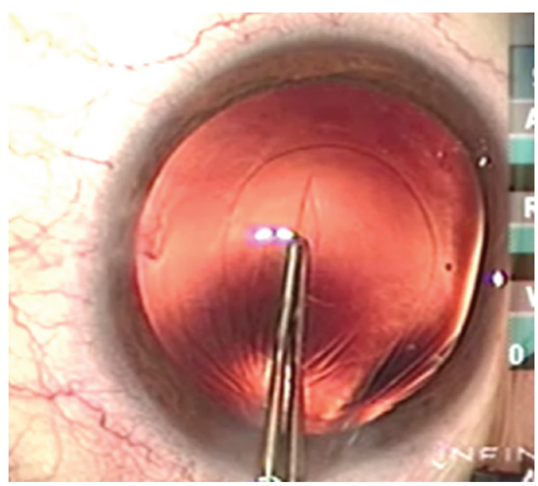

Figure 5: Creating the rhexis with forceps applying centrifical forces to keep elastic tissue from increasing sized opening (similar to pediatric ACCC)

and below the ACCC rim. Visually confirm the leading haptic enters the bag fornix and not below the PC into the vitreous cavity before rotating the trailing haptic into the bag. Do not use the incision tunnel (wound assist) requiring speed to avoid premature IOL unfolding. Rather place the inserter just inside the Descemet membrane's internal lip of the incision and choose an automated or screw-type inserter to avoid uncontrolled delivery by a plunger.

Although a one-piece IOL can be employed for capture its broad optic haptic junction makes it less ideal however there is no presbyopia or toric implant available on a three-piece IOL in the US. Jason Jones has employed this lens in many cases.[5,23] The ideal lens is a three-piece IOL with an optic-haptic junction as close to 90 degrees as possible for the tightest capture fit excluding LECs that may undergo metaplasia postoperatively. Plate haptic or accommodative lenses cannot be used safely for capture techniques though they can be placed in the bag with the PC opening below. New IOL designs may be driven by this technique in the future.

Avoid one-piece haptics in the sulcus to prevent iris chafing and subsequent pigment dispersion and UGH syndrome.[24] This scenario is not seen when sulcus implantation is combined with ACCC optic capture of three-piece lenses. In the case of a toric IOL, once captured in the correct meridian it will never rotate. The intraocular lens power changes minimally from that of the in-the-bag calculation, on average + 0.50 diopters for lower power lenses and + 0.75 for higher power lenses.[25] One significant advantage of POC is that the IOL will not move after implantation in the antero-posterior direction as do standard in the bag lenses and the effective lens position remains stable and potentially more predictable.[26]

Now, with the lens in the bag, pressure is applied to the distal lens optic edge 90 degrees away from the optic-haptic junction, which tilts the optic posteriorly under the PC rim and into the previously placed bed of OVD in Berger's space. Unlike anterior capture, often the edge of the optic must be depressed sequentially towards the optic-haptic junction on both sides of the initial 90-degree position to "walk" the capsule edge over the optic edge all the way from optic-haptic junction to optic-haptic junction. Because the PC is thin and elastic, the optic rim may not pop under the edge completely without this gentle nudge. One can then push the optic gently distally, allowing the proximal optic edge to be similarly captured. Observe the "cat-eye" or "football" ovoid appearance of the PC edge covering the round optic and meeting at the optic-haptic junctions. The ACCC remains round [Figure 6].

Once capture is accomplished, the posterior segment is hermetically sealed, the vitreous body stabilized in an almost physiological posterior position and cytokines can't flow from anterior to posterior. OVD remaining behind the optic in Berger's space will naturally dissipate with time. Compartmentalization from the trabeculum prevents pressure rise.[27] OVD in the anterior chamber can be carefully removed with bimanual or coaxial irrigation and aspiration after burping

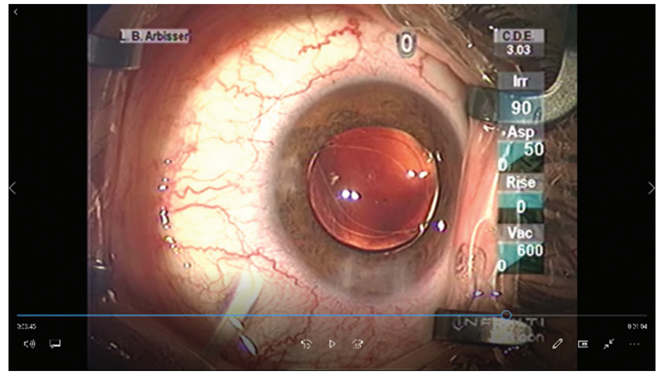

Figure 6: "Cat eye" or "football" appearance of captured posterior CCC with round anterior CCC

excessive OVD to avoid over-inflation. Irrigate incisions before OVD removal so they will seal without loss of chamber on instrument removal which could threaten to un-capture the optic. During the learning period (not as standard procedure) consider instilling triamcinolone acetonide diluted 10-1 with BSS into the anterior chamber before completing any case with the possible vitreous presentation to identify any wisp of vitreous or prolapse around an implant. In addition to assisting in visualizing vitreous, it also has a desirable anti-inflammatory effect.

Complication Management and Avoidance

Limit primary PCCC to eyes with an intact ACCC with a diameter adequate to capture the intended IOL optic. If one fails to produce the hyaloid sparing PCCC a wonderful result can still be had by using other methods of optic capture.[8] These options will sequester any vitreous presentation, post anterior vitrectomy if needed, and leave the patient with a securely stable IOL and rapid recovery. Assure Adequate visualization and the absence of posterior pressure before the initiation of the PC opening.

In cases complicated by PC rupture convert the tear to a PCCC by first stabilizing the anterior chamber, ascertaining if there is prolapsed vitreous and performing a one port pars plana vitrectomy.[28] This approach to anterior vitrectomy (irrigation through paracentesis and vitrector through pars plana, placed port up under the PC rent) unlike using both irrigation and vitrector through anterior incisions (even if the vitrector is placed down through the PC rent) is the only way to prevent enlarging the PC rent. One port pars plana vitrectomy affords the best chance for conversion to a continuous posterior rhexis capable of stable bag implantation or optic capture, the ideal for both spontaneous complication and long term, minimally invasive, subluxated IOL management as well.

Once prolapsed vitreous is cleared and the posterior segment compartmentalized with dispersive OVD to prevent representation of vitreous, fill the sulcus with OVD to flatten the anterior capsular rim and PCs together as with a primary PCCC. Then, grasp an edge of the rent in the PC (or create a starting place with an intraocular scissor) and complete the PCCC with forceps as described above. Even round-appearing tears lack the strength of a continuous opening and deserve conversion. The bag can now be safely used for implantation or capture though care is needed when OVD is removed from the anterior chamber given the open vitreous face unless the IOL is captured.

Evidence for Efficacy and Safety

Vasavada initially failed to reproduce Gimbel's results of stable lens position with clear visual axis in all eyes with 10-149-month follow-up using one-piece PMMA lenses. The broad stiff haptic optic junction of these lenses causing un-capture and access to the retro-IOL space was later recognized as the likely cause. His subsequent studies with hydrophobic acrylic IOL's relegate that experience to history.[11] These events and other data can be found in an excellent meta-analysis and a review paper on pediatric cataracts in which the conclusion is that POC leads to good centralization of the IOL no increase in complications, and no visual axis opacification. The review concluded that POC does not increase the incidence of other postoperative complications, and appears to be a promising alternative to the standard surgical technique for the treatment of pediatric cataracts allowing clinicians to avoid the additional step of anterior vitrectomy.[29]

Despite the long history of PCCC, there were no prospective randomized trials of efficacy and outcomes until the work of Menapace in which he compared POBH to standard in the bag cataract surgery, PCCC alone and POBH over time in a large series of patients randomized to one eye each comparing procedures.[12] He estimated a learning curve of about 150 cases to feel fully confident. Menapace found the patient preference for the eye without a PC compared to the intact "clear" capsule eye was objectively explained by increase stray light measured with the C-Quant stray light meter (Oculus Optikgerate GmbH) in the intact capsule eye.[30] No visual axis obscuration was observed over several years follow-up in POBH eyes underscoring the value of this technique. His work, Tassignon's findings using her design of the BIL (not FDA approved), and other surgeons have confirmed no increase in macular thickness, fluorophotometry cell and flair, early or late pressure spikes or ocular hypertension, and no increase in retinal detachment (in fact a slight decrease) using these techniques.[12,27,31-39]

Other Applications

In addition to patients who cannot sit at the laser, other ideal POC eyes include those with posterior polar cataracts whose fragile PCs benefit from removal by PCCC avoiding uncontrolled rupture while polishing to avoid residual opacity or early laser capsulotomy. Patients with high myopia, uveitis, and those with pseudoexfoliation may especially benefit from the reduction in capsular fibrosis, phimosis and an intact AHM for life afforded by some form of optic capture including hyaloid sparing double capture where a three-piece IOL's haptics are in the sulcus with the optic captured through both anterior and posterior continuous capsulotomies into Berger's space.[40-42]

Femtolaser Assisted Posterior Capsulotomy

Burkhard Dick pioneered the off-label use of the femtosecond laser with sterile redocking to create a posterior capsulotomy following standard in the bag femtolaser-assisted cataract surgery (FLACS). Following completion of the case with incision closure, without opening the PC or instilling OVD into Berger's space, the eye is redocked. The Catalys femtolaser (J&J Vision) can detect the PC and the AHM with a safe distance apart of 400u or greater in 72% of all adult eyes and in 100% of all eyes >25 mm axial length. Femto-assisted PCCC is performed with sterile redocking immediately following cataract surgery for both pediatric and adult patients.[43] For adults the posterior capsulotomy size is predictable based on the input settings, however, young patients display variable PC elasticity. An age-based nomogram has been developed to adjust the setting for the desired outcome.[44] The OCT image guidance system scans the eye, processes the full volume data, and attempts to identify the anatomical surfaces of the eye. In the pseudophakic state, the system alerts that abnormal anatomy has been detected. Until there is an on-label program for posterior capsulotomy, the surgeon must manually adjust the surface fits for the anterior and posterior lens. The high-resolution axial and sagittal OCT images will show the <5 µm thick PC in a convex shape and, the anterior hyaloid in a concave shape, with Berger's space between them.[45] By manually manipulating the gates, the PC is "identified" as the anterior capsule, and the AHM is interpreted as the PC with Berger's space "identified" from the software's point of view as the lens. Because the capsulotomy treatment is calculated based on user confirmed surfaces, the planned capsulotomy can be delivered to the PC giving the desired result. POC requires sterile reentry into the eye.

Several femtolaser platforms including Vasavada's use of the LenSX for pediatric cataracts demonstrate similar capabilities. The requirement of two patient interfaces for planned FLACS and posterior capsulotomy in the same eye creates an economic barrier, and its off-label status raises medicolegal questions. Time will tell whether the femtosecond laser technique will be useful for planned POC.

The mobile Ziemer femtolaser platform is employed in the operating room for convenient sterile redocking and is therefore ideally suited for primary PCCC, however Menapace's research presents a new wrinkle. He found that not all patient's retrolenticular structures can be visualized and identified. Worse, often they are not adequately spaced apart to permit safe hyaloid sparing posterior capsulotomy. He currently performs transzonular capsulo-hyaloidal hydroseparation with BSS to define Berger's space. Triamcinolone acetate even more reliably marks Berger's space. This need for added invasive

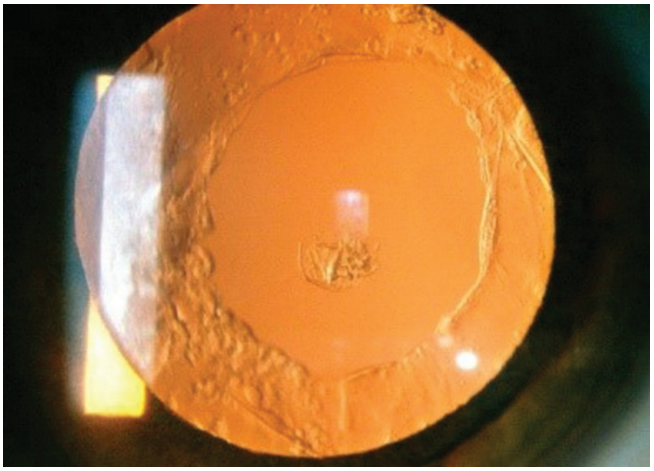

Figure 7: Standard modern cataract surgery patient post Nd: YAG laser posterior capsulotomy with 20/20 vision (Courtesy of Rupert Menapace)

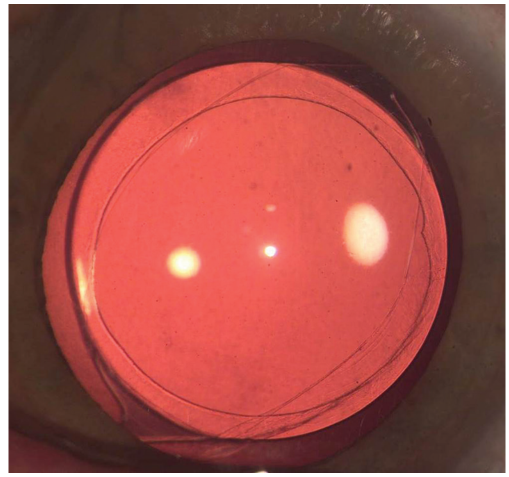

Figure 8: Primary posterior continuous curvilinear capsulorhexis with posterior optic capture patient with 20/20 vision and no present or future need for laser treatment (Courtesy of Rupert Menapace)

technique in some patients has significant implications for the practical use of femtolaser PCCC.[46]

Although there are other automated means in the use of creating a primary anterior rhexis, Zepto precision pulse capsulotomy device (Centricity Vision) and CAPSULaser (Excel-Lens), they are not yet been developed or approved for the posterior capsulotomy.

Summary

This review paper focused on current and future techniques for the creation of a hyaloid-sparing posterior capsulorhexis with emphasis on combined POC. The technique is reliable with a short steep learning curve. Facility with handling the thin and elastic PC should be part of the armamentarium of the comprehensive anterior segment surgeon though not classically emphasized in many training programs. When combined with posterior optic capture, another anesthetic risk can be avoided for patients who cannot sit at the laser for visual axis obscuration. The procedure also provides immediate rehabilitation for unpolishable plaques and posterior polar cataract patients. Repositioning subluxated IOL is safest and most stable when capsule fixation can be employed. When the anterior capsulotomy isn't continuous, is larger than the optic, or cannot be centralized to allow anterior capture from the sulcus, we should consider the PC for fixation. This may necessitate creating a posterior capsulotomy primarily or converting a noncontinuous PC tear into a continuous rhexis as utilized during a complication. Only then can we depend on the strength and integrity of the capsule opening to resist the splitting and tearing forces required for lens insertion and stabilization. This safe configuration reduces and resists postoperative forces of progressive fibrosis and the minor traumas of everyday life.

Whenever possible, hyaloid-sparing techniques minimize the potential for sequelae of retinal pathology and trabecular meshwork compromise. Cataract surgeons have unfortunately traditionally been taught to avoid the PC at all costs when the AHM actually maintains the benefits of the two-chambered eyes. This is evident from embryology, anatomy, and a copious body of peer-reviewed research. PC opacity, causing the patient to undergo a second period of visual degradation is the main complication of modern phacoemulsification. The common cure, Nd: YAG laser, virtually always destroys the anterior hyaloid [Figure 7]. AHM preservation has myriad potential and proven advantages.

A large body of mostly Canadian and European authored peer-reviewed literature proves the safety of these hyaloid-sparing procedures as well as their efficacy in eliminating visual axis opacity and additional benefits. Despite the barriers of a learning curve and possible financial disincentives for eliminating subsequent laser capsulotomy, as surgeons become more familiar and adept at PC management a future where cataract surgery is a permanent visual rehabilitation allowing clear optics for a lifetime is feasible [Figure 8].

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Conflicts of interest

There are no conflicts of interest.

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