

Approaches to a Posterior Polar Cataract

Inside-out delineation and strategies for emulsification.

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A posterior polar cataract is a dense white opacity that is situated on the central posterior capsule. It consists of characteristic concentric rings around the central opacity (bull's eye). A posterior polar cataract presents a special challenge to the phaco surgeon because of its predisposition to posterior capsular dehiscence during surgery.^{1,2} Osher et al¹ reported a 26% (8/31 eyes) incidence of posterior capsular rupture during surgery in eyes with a posterior polar cataract. We had a rate of 36% (9/25 eyes).² Hayashi et al³ reported 7.1% (2/28 eyes), whereas Lee and Lee⁴ reported 11% (4/36 eyes).

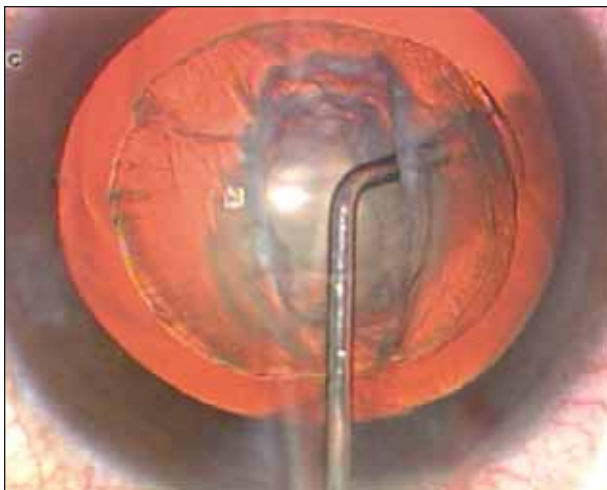


Figure 1. The authors perform inside-out delineation.

To prevent posterior capsular rupture, Osher et al¹ recommended using slow-motion phacoemulsification with a low aspiration flow rate, a low level of vacuum, and infusion pressure. Fine et al⁵ avoided overly pressurizing the anterior chamber with viscodissection to mobilize the epinucleus and cortex, Allen and Wood⁶ performed viscodissection, and Lee and Lee⁴ advocated a lambda technique with dry aspiration. We prefer inside-out delineation.⁷ Combined with modern instrumentation, refined surgical strategies, a better understanding of phacodynamics, and cumulative surgical experience, this technique has enabled us to reduce the incidence of posterior capsular rupture to 8% (2/25 eyes).⁷

In our opinion, surgery should be delayed as long as possible and undertaken only if the patient finds it difficult to perform routine activities. We believe that the subsequent paradigm should govern the procedure.

COUNSELING

During the preoperative examination, the physician should inform the patient of the possibility of the nucleus' dropping intraoperatively due to a posterior capsular rupture, a relatively long operative time, secondary posterior segment intervention, and a delayed visual recovery. In addition, the surgeon should discuss Nd:YAG capsulotomy for residual plaque¹⁻³ and emphasize the possibility of preexisting amblyopia, especially in cases of unilateral posterior polar cataract.³

ANESTHESIA

Peribulbar anesthesia with oculopressure to soften the globe diminishes intraoperative posterior pressure.¹ With increasing experience, one may use topical anesthesia in a selective manner.

SURGICAL TECHNIQUE

We prefer a closed chamber technique. The contours of the cornea and the globe should be maintained throughout the procedure. Hayashi et al³ performed phacoemulsification, pars plana lensectomy, or intracapsular cataract extraction, depending on the size of the opacity and the density of the nuclear sclerosis.

THE INCISION

We create a paracentesis with a 15° ophthalmic knife (Alcon Laboratories, Inc., Fort Worth, TX) and inject Provisc (Alcon Laboratories, Inc.). Next, we make a temporal, corneal, single-plane valvular incision of 2.6mm. A cohesive viscoelastic in the anterior chamber prevents its collapse as well as forward movement of iris-lens diaphragm during surgical entry into the eye. Fine et al⁵ cautioned against increasing the pressure in the anterior chamber.

THE CAPSULORHEXIS

Ideally, the capsulorhexis should be no larger than 5mm. Although a size of 4mm or less could be detrimental if the surgeon must prolapse the nucleus into the anterior chamber, a larger opening may not leave adequate support for a sulcus-fixated IOL if the posterior capsule is compromised.^{2,5}

HYDRO PROCEDURES

Cortical cleaving hydrodissection⁸ can lead to hydraulic rupture and should be avoided.^{1,2} It is logical instead to perform hydrodelineation to create a mechanical cushion of epinucleus.^{2-4,6,9,10} Fine et al⁵ performed hydrodissection in multiple quadrants and gently injected tiny amounts of fluid such that the fluid wave could not extend across the posterior capsule.

We employ inside-out delineation to precisely demarcate the central core of nucleus.⁷

INSIDE-OUT DELINEATION

We sculpt a central trench using the slow-motion technique with the Infiniti Vision System (Alcon Laboratories, Inc.). For nuclear sclerosis of grade 3 or less (on a grading system from 1 to 5),¹¹ our preset parameters are ultrasound energy of 30% to 60% (supraoptimal power), vacuum of 60mmHg, an aspiration flow rate of 18mL/min, and a bottle height of

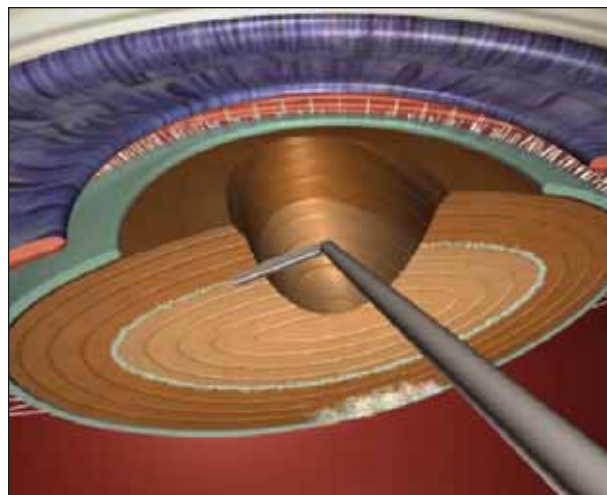


Figure 2. An animated view of inside-out delineation is depicted.

70cm. We are careful not to mechanically rock the lens. Injecting a dispersive viscoelastic (Viscoat; Alcon Laboratories, Inc.) through the sideport incision before retracting the probe prevents the forward movement of the iris-lens diaphragm.

We introduce a specially designed, right-angled cannula mounted on a 2-mL syringe filled with fluid through the main incision and place the tip adjacent to the right wall of the trench at an appropriate depth, depending on the density of the cataract. The tip then penetrates the central lenticular substance, and we inject fluid through the right wall of the trench (Figure 1). The fluid traversing inside out produces delineation (Figure 2). If the delineation is incomplete, the surgeon may inject fluid in the left wall of the trench with another right-angled cannula. The trench allows the surgeon to reach the central core of the nucleus. When fluid reaches a desired depth, it will create an epinuclear bowl that will act as a mechanical cushion to protect the posterior capsule during subsequent maneuvers.

With conventional hydrodelineation, the cannula penetrates the lenticular substance and thus causes the fluid to traverse from the outside inward. It is sometimes difficult to introduce the cannula within a firm nucleus, and the effort can rock and stress the capsular bag and zonules. The surgeon may also inadvertently inject fluid into the subcapsular plane and thereby conduct unwarranted hydrodissection. Inside-out delineation is easy to perform, provides excellent surgical control, reduces stress to the zonules, and precisely demarcates the central core of nucleus.

NUCLEAR REMOVAL

We avoid rotating the nucleus, because this maneuver can rupture the posterior capsule. All of our techniques are geared toward facilitating the removal of the nucleus while it is cushioned by the epinucleus. Bimanual cracking and division of the nucleus involve outward movements and can distort the capsular bag. For nuclear sclerosis greater than +2, we use the technique of step-by-step chop in situ and lateral separation¹² with 40% to 50% ultrasound, vacuum of 150 to 250mmHg, an aspiration flow rate of 18mL/min, and a bottle height of 70 to 90cm. The resultant fragments are removed with a stop, chop, chop-and-stuff technique.¹³

“All of our techniques are geared toward facilitating the removal of the nucleus while it is cushioned by the epinucleus.”

For less dense nuclei, we aspirate the entire nucleus within the epinuclear shell. We use an aspiration flow rate of 16mL/min and a vacuum level of 100 to 120mmHg. Traction of posterior lenticular fibers and posterior polar opacity during surgery are sufficient to break the weak posterior capsule. Thus, the slow-motion technique reduces turbulence in the anterior chamber.¹⁴ Injecting viscoelastic prior to removing the instrument prevents the anterior chamber from collapsing and the posterior chamber from bulging forward.^{2,15}

Lee and Lee⁴ described their use of the lambda technique to sculpt the nucleus, after which they cracked along both arms and removed the central piece.

EPINUCLEAR REMOVAL

First, we strip off the peripheral lower half of epinucleus using 30% ultrasound, 80 to 100mmHg of vacuum, an aspiration flow rate of 16mL/min, and a bottle height of 80 to 90cm. The central area of epinucleus remains attached.^{2,5,11} Next, we mobilize the peripheral upper epinucleus (subincisional epinucleus) with gentle, focal, multiquadrant hydrodissection using a right-angled cannula that faces right and left (Figure 3). The fluid wave travels along the cleavage formed between the capsule and lower epinucleus without threatening the integrity of the posterior capsule. Hydrodissection is safe at this stage, because the capsular bag is not fully occupied. In other words, the built-up hydraulic pressure is not sufficient to rupture the posterior capsule. Finally, we aspirate the entire epinucleus, including the central area.

Others have suggested performing viscodissection of the epinucleus by injecting viscoelastic (Healon5 [Pharmacia AB, Stockholm, Sweden]⁶ or Healon GV [Pharmacia AB] and Viscoat⁵) under the capsular edge to mobilize the rim of epinucleus. The surgeon then removes this rim with a coaxial I/A handpiece. Alternatively, one may perform manual dry aspiration with a Simcoe cannula.⁴

PSEUDOHOLE

At times, the classic appearance suggestive of a defect may be observed in the posterior cortex when the posterior capsule actually remains intact. This phenomenon is known as a *pseudohole*.

Bausch & Lomb
Zylet.
 loteprednol etabonate 0.5%
 and tobramycin 0.3%
 ophthalmic suspension

BRIEF SUMMARY
INDICATIONS AND USAGE: Zylet is indicated for steroid-responsive inflammatory ocular conditions for which a corticosteroid is indicated and where superficial bacterial ocular infection or a risk of bacterial ocular infection exists. Ocular steroids are indicated in inflammatory conditions of the palpebral and bulbar conjunctiva, cornea and anterior segment of the globe such as allergic conjunctivitis, acne rosacea, superficial punctate keratitis, herpes zoster keratitis, iritis, cyclitis, and where the inherent risk of steroid use in certain infective conjunctivitis is accepted to obtain a diminution in edema and inflammation. They are also indicated in chronic anterior uveitis and corneal injury from chemical, radiation or thermal burns, or penetration of foreign bodies. The use of a combination drug with an anti-infective component is indicated where the risk of superficial ocular infection is high or where there is an expectation that potentially dangerous numbers of bacteria will be present in the eye. The particular anti-infective drug in this product (tobramycin) is active against the following common bacterial eye pathogens: Staphylococci, including *S. aureus* and *S. epidermidis* (coagulase-positive and coagulase-negative), including penicillin-resistant strains. Streptococci, including some of the Group A beta-hemolytic species, some nonhemolytic species, and some *Streptococcus pneumoniae*. *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Proteus mirabilis*, *Morganella morganii*, most *Proteus vulgaris* strains, *Haemophilus influenzae*, and *H. aegyptius*, *Moraxella lacunata*, *Acinetobacter calcoaceticus* and some *Neisseria* species.

CONTRAINDICATIONS: Zylet, as with other steroid anti-infective ophthalmic combination drugs, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures. Zylet is also contraindicated in individuals with known or suspected hypersensitivity to any of the ingredients of this preparation and to other corticosteroids.

WARNINGS: NOT FOR INJECTION INTO THE EYE. Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision, and in posterior subcapsular cataract formation. Steroids should be used with caution in the presence of glaucoma. Sensitivity to topically applied aminoglycosides may occur in some patients. If sensitivity reaction does occur, discontinue use. Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In those diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. In acute purulent conditions of the eye, steroids may mask infection or enhance existing infection. Use of ocular steroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex). Employment of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation.

PRECAUTIONS: General: For ophthalmic use only. The initial prescription and renewal of the medication order beyond 14 days should be made by a physician only after examination of the patient with the aid of magnification, such as slit lamp biomicroscopy and, where appropriate, fluorescein staining. If signs and symptoms fail to improve after 2 days, the patient should be re-evaluated. If this product is used for 10 days or longer, intraocular pressure should be monitored even though it may be difficult in children and uncooperative patients (See WARNINGS). Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local steroid application. Fungal invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal cultures should be taken when appropriate. As with other antibiotic preparations, prolonged use may result in overgrowth of nonsusceptible organisms, including fungi. If superinfection occurs, appropriate therapy should be initiated. Cross-sensitivity to other aminoglycoside antibiotics may occur; if hypersensitivity develops with this product, discontinue use and institute appropriate therapy.

Information for Patients: This product is sterile when packaged. Patients should be advised not to allow the dropper tip to touch any surface, as this may contaminate the suspension. If pain develops, redness, itching or inflammation becomes aggravated, the patient should be advised to consult a physician. As with all ophthalmic preparations containing benzalkonium chloride, patients should be advised not to wear soft contact lenses when using Zylet.

ADVERSE REACTIONS: Adverse reactions have occurred with steroid/anti-infective combination drugs which can be attributed to the steroid component, the anti-infective component, or the combination. Zylet: In a 42 day safety study comparing Zylet to placebo, the incidence of ocular adverse events reported in greater than 10% of subjects included injection (approximately 20%) and superficial punctate keratitis (approximately 15%). Increased intraocular pressure was reported in 10% (Zylet) and 4% (placebo) of subjects. Nine percent (9%) of Zylet subjects reported burning and stinging upon instillation. Ocular reactions reported with an incidence less than 4% include vision disorders, discharge, itching, lacrimation disorder, photophobia, corneal deposits, ocular discomfort, eyelid disorder, and other unspecified eye disorders. The incidence of non-ocular adverse events reported in approximately 14% of subjects was headache; all other non-ocular events had an incidence of less than 5%.

Loteprednol etabonate ophthalmic suspension 0.2% - 0.5%: Reactions associated with ophthalmic steroids include elevated intraocular pressure, which may be associated with infrequent optic nerve damage, visual acuity and field defects, posterior subcapsular cataract formation, delayed wound healing and secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera. In a summation of controlled, randomized studies of individuals treated for 28 days or longer with Loteprednol etabonate, the incidence of significant elevation of intraocular pressure (≥ 10 mm Hg) was 2% (15/901) among patients receiving Loteprednol etabonate, 7% (11/164) among patients receiving 1% prednisolone acetate and 0.5% (3/583) among patients receiving placebo.

Tobramycin ophthalmic solution 0.3%: The most frequent adverse reactions to topical tobramycin are hypersensitivity and localized ocular toxicity, including lid itching and swelling and conjunctival erythema. These reactions occur in less than 4% of patients. Similar reactions may occur with the topical use of other aminoglycoside antibiotics. Other adverse reactions have not been reported; however, if topical ocular tobramycin is administered concomitantly with systemic aminoglycoside antibiotics, care should be taken to monitor the total serum concentration.

Secondary Infection: The development of secondary infection has occurred after use of combinations containing steroids and antimicrobials. Fungal infections of the cornea are particularly prone to develop coincidentally with long-term applications of steroids. The possibility of fungal invasion must be considered in any persistent corneal ulceration where steroid treatment has been used. Secondary bacterial ocular infection following suppression of host responses also occurs.

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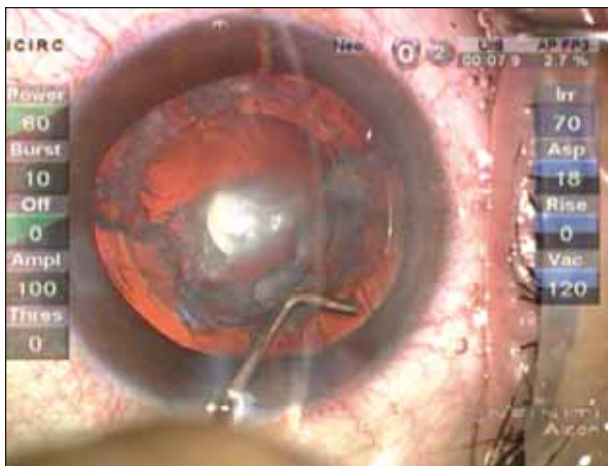


Figure 3. The authors remove the upper half of the epinucleus by means of focal and multi-quadrant hydrodissection.

CORTICAL REMOVAL

Bimanual, automated I/A using an aspiration flow rate of 20mL/min and vacuum of 400mmHg optimizes surgical control, preserves the anterior chamber, and aids in the complete removal of the cortex. Fine et al⁵ reported using coaxial phacoemulsification to protect the posterior capsule with viscoelastic during cortical removal.

POLISHING THE POSTERIOR CAPSULE

We avoid polishing the posterior capsule due to its fragility.^{1-3,5,11} The traction produced by polishing an excessively adherent plaque could eventually rupture an otherwise normal posterior capsule. We prefer to perform an Nd:YAG posterior capsulotomy postoperatively when needed.

POSTERIOR CAPSULAR DEHISCENCE

If a defect is present in the posterior capsule, we inject Viscoat over the area before withdrawing the phaco or I/A probe from the eye.¹⁵ Then, we perform a two-port, limbal anterior vitrectomy using a cutting rate of 800 cuts/min, vacuum of 300mmHg, and an aspiration flow rate of 25mL/min. Once the anterior chamber is free of vitreous, we aspirate the cortex with bimanual I/A. A posterior capsulorhexis may be performed if the rupture is confined to a small central area.

IOL IMPLANTATION

In eyes with a posterior capsular defect, we implant the IOL in the bag only if we can create a posterior capsulorhexis. If the posterior capsular defect is large, we will place the lens over the anterior capsule in the

ciliary sulcus. Although others have suggested capturing the optic through the anterior capsulorhexis,^{5,16} we believe optic capture increases inflammation.¹⁷

After implanting the IOL, we remove viscoelastic by two-port vitrectomy rather than I/A. Vitrectomy aspirates material in a piecemeal and gradual manner, and it reduces the chance of rapidly aspirating vitreous.

We do not suture the main valvular incision but do suture the paracentesis in eyes with a posterior capsular defect. We will periodically evaluate these eyes for retinal break, cystoid macular edema, and raised IOP. ■

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