Simplifying Posterior Polar Cataracts

Femtodelineation: Posterior Polar Simplified

Posterior Polar Cataracts are a nightmare for every surgeon, owing to the potential of intraoperative posterior capsule rupture/dehiscence. One of the most important strategies to protect the posterior capsule remains avoiding buildup of hydraulic pressure within the capsular bag, and protecting the area of potential weakness until the end by creating a cushion of epinucleus.

We explore a unique application of the Femtosecond Laser in enhancing safety and predictability during posterior polar surgery. The Femtosecond Laser is equipped with different options for lens fragmentation. We find the cylindrical pattern of lens division particularly useful for posterior polar cataracts.

The Laser is programmed to create 3 cylinders within the lens. As the laser fires, it creates distinct layers of demarcation, from centre to periphery, shielded by a peripheral epinucleus zone. Thus, it creates a laser-delineation within the lens substance. *(Figure 1)*

What’s even more important, the surgeon gets to choose the number, the diameter and depth of each cylinder, guided by the live Anterior-Segment OCT view.

*So how does femtodelineation actually help the surgeon?*

After removing the capsulorhexis flap, we directly proceed to de-bulking the nucleus. Starting from the innermost central zone, each zone of the nucleus is removed from inside out in a piece-meal manner. Each section of the nucleus is then emulsified step-wise within the cushion of the other. An adequate layer of cushion is left behind even at the very end. The multiple nuclear stacks act as shock absorbers. They effectively prevent transmission of mechanical maneuvers as well as fluid turbulence to the weakest part of the capsule. Therefore, the potential area of weakness in the nuclear capsule is safeguarded until the very end.
At last the outermost layer of epinucleus can gently be stripped of. At this stage, if required a gentle, focal hydrodissection can also be done. Because the capsular bag is nearly empty, there is no risk of buildup of hydraulic pressure anymore. And the end result is guaranteed to calm the nerves of every cataract surgeon!

This technique works well even when there is an associated dense nucleus. As the nucleus is already pre-divided, it is easily debulked without using any manual division techniques. The best part here is that the protection offered by this approach can limit further enlargement of an already existing dehiscence. If the surgeon can restrict the size of the dehiscence, the small dehiscence can be converted into a continuous posterior capsulorhexis that allows IOL implantation in the bag.

We would like to acknowledge the contribution of Dr. Osher and other stalwarts who established paradigms for posterior polar emulsification. These include:

- Avoiding buildup of hydraulic pressure within the capsular bag
- Adhering to the principles of Closed Chamber Technique
- Generating a Cushion by delineating the Nucleus

However, with conventional hydrodelineation we run the risk of inadvertent hydrodissection and the plane of delineation is not always controlled.

“Inside-Out Delineation” Technique:

A trench is sculpted as the first step. The sculpted trench has walls on the left and right sides. A specially designed right-angled cannula is mounted on a 1 cc syringe filled with fluid. The cannula penetrates the central lens substance through right wall of the trench. The fluid is then injected rapidly. A delineation is produced by the fluid which traverses from inside to the out. The plane of injection is decided depending upon the density of the cataract. A golden ring, within the lens is evidence of successful delineation. Fluid injection may be repeated in the left wall of the trench with another right-angled cannula. As this is done under direct vision, a desired thickness of nucleus-epinucleus cushion can be achieved. The plane of injection can be precisely demarcated thereby preventing inadvertent hydrodissection. The central nucleus can be consumed within the nucleus-epinucleus bowl using an appropriate technique. Therefore, this technique, allows better titration of the depth of delineation, but again produces only a single layer of cushioning.

Femtodelineation is unique because it offers

- Multiple layers to cushion the posterior capsule
- Precise and predictable layers within the lens
• Guaranteed protection till the very end of surgery

Moreover, this is done without injecting any fluid and risking buildup of hydraulic pressure.

To summarize, Femtodelineation ensures enhanced protection and better outcomes for posterior polar cataracts in a predictable manner.

**Further reading:**


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**Tackling the Malpositioned IOL**

Dealing with a ‘malpositioned’ IOL is a challenge for the surgeon. The issues are manifold: the cause of subluxation / dislocation of the IOL, the extent of dislocation, the type of IOL, the presence or absence of vitreous in the anterior chamber and co-existing ocular morbidities. All these factors will influence the surgical strategy and more importantly, the outcome for the patient.

Here, we will present different cases that will show varying presentations of IOL malpositioning, and their remedial options.

**Case 1: Asymmetric placement of Single-Piece Acrylic IOL**

A 66 year-old lady, with a history of previous laser PI done, was planned for cataract surgery with multifocal IOL implantation. Following an uneventful surgery, a single-piece hydrophobic acrylic, multifocal IOL implantation was planned. However, during IOL implantation, the pupil started
constricting, and once the IOL was placed, it was difficult to determine whether it had gone in the bag completely or not. The surgeon did not attempt to manipulate any further and closed the eye. She presented to us 1 month after the original surgery, with an IOP of 26 mm Hg and best-corrected vision of 6/12. Dilated exam revealed that the one haptic of the IOL was in the bag and the other was in the sulcus. In 180 degrees, the anterior and posterior capsule had fused (Figure 2).

**What is the next step for this patient?**

The important point to note here is that the single piece design has thick haptics. These tend to rub in the ciliary body region, and produce recurrent low-grade uveitis, pigment dispersion and worsening of glaucoma. We have shown this very effectively by UBM analysis of eyes with single piece acrylic IOL in the sulcus(Vasavada AR, Raj SM, Karve S. Retrospective ultrasound biomicroscopic analysis of single-piece sulcus fixated intraocular lenses. J Cataract Refract Surg 2010; May: 771-7). Therefore, it should not be left in the ciliary sulcus.

After proper counselling patient was taken up for IOL repositioning. The plan was to try and reopen the capsular bag, and reposition the IOL in the bag. In case, at any stage, the capsular bag would be compromised, the plan was to explant the single piece IOL and place a 3-piece IOL in the ciliary sulcus. Using high viscosity cohesive ophthalmic viscosurgical device (OVD) and a spatula, the capsular bag was gently viscodissected and opened up. Subsequently the IOL was dialed in the bag. Postoperatively, the vision improved to 6/6(p) and IOP came down to 15 mm Hg. (Figure 3)

**Take Home Message:** SINGLE PIECE ACRYLIC IOL SHOULD NOT BE PLACED IN THE CILIARY SULCUS. If detected in the early postoperative period, the capsular bag can be opened up to reposition the IOL in the bag. If this is not possible, still explant the IOL and place a 3-piece IOL in the ciliary sulcus.

**Case 2: IOL dislocated posteriorly with good anterior capsule support**

A 62 year-old man was operated for a posterior polar cataract 10 years ago. Intraoperatively there was a posterior capsule rupture. However, using the rest of the posterior capsule as a support, a single-piece hydrophobic acrylic IOL was implanted in the bag. 10 years later, he presented with a dimunition of vision for 6 months.

Slit-lamp examination revealed aphakia in the pupillary area. The IOL could not be seen in primary gaze on the slitlamp, but was seen in the anterior vitreous in a supine position. The margin of the original posterior capsule rupture could be clearly visualized, and anterior chamber was free of any vitreous (Figure 4).

We counseled the patient regarding explantation of the dislocated IOL with possible re-fixation of another IOL. The surgical strategy was to perform a pars planavitrectomy, explant the single-piece IOL and re-fixate another IOL depending on the available anterior capsular support.
As a first step, a 23-gauge, pars planavitrectomy was performed on the Infiniti Vision System® (Alcon, USA) The parameters used for vitrectomy were: cut rate of 2500/minute, vacuum 300 mm Hg, aspiration flow rate 25 cc/minute and irrigation bottle height 50 cm H2O. Thorough vitrectomy was performed to ensure that the IOL was free of all surrounding vitreous. Using a bimanual technique and microincision grasping forceps, the IOL was gently brought out into the anterior chamber. A dispersive ophthalmic viscosurgical device (OVD), Viscoat, was injected in the anterior chamber to coat the corneal endothelium. A temporal clear corneal incision of 2.4 mm was fashioned. The IOL was explanted using a special wire-loop passed through the Alcon ‘A’ cartridge. This special device has been innovated by Dr. Arup Bhowmick from Kolkata, India. This device enables ‘reverse folding’ of the IOL, i.e. it allows the entire IOL to fold back into the cartridge and be removed a very small incision.

Once the IOL was explanted, the anterior capsule support was assessed, and was judged to be adequate for a sulcus IOL fixation. A 3-piece Acrysof® IOL was implanted in the sulcus, and the optic was captured through the anterior capsulorhexis margin. At the end, intracameraltriamcinoloneacetonide (preservative-free) was injected in the anterior chamber to detect presence of any residual vitreous. Postoperatively, at 1 month, the patient achieved a best-corrected visual acuity of 20/30 with a very stable and centred IOL. He maintained the same IOL centration and stability even at 1.5 years postoperatively (Figure 5).

Take home message: Perform an adequate vitrectomy to ensure that the IOL is free of all coating vitreous. Use an appropriate IOL explantation strategy that is least traumatic to the eye. Finally, very critically assess the available capsular support and then decide the site of IOL fixation.

Case 3 : IOL Dislocated posteriorly with no capsular support

A 68 year-old gentleman had an injury to the eye, and presented with dimunition of vision. Examination revealed IOL dislocated into the anterior vitreous. However, there was no visible anterior or posterior capsule support. (Figure 6)

Just as in the previous case, an adequate vitrectomy was performed through the pars plana approach. The IOL was then elevated and brought into the anterior chamber, it was a single piece hydrophilic acrylic IOL. It was explanted through a small incision using the same wired loop snare device as mentioned in the case above.

In absence of capsular support, we prefer to fixate the IOL to the sclera. In this case, we performed an intrascleral fixation of a foldable 3-piece IOL, using the technique described by Dr. Gabor Scharioth and then modified by Dr. Amar Agarwal. (Figure 7)

Other alternatives include performing a conventional sutured scleral fixation, sutured posterior iris fixation of the IOL or an anterior chamber IOL implantation.

Take Home Message: In absence of adequate capsular bag support, fixate the IOL to the sclera, iris or implant it in the anterior chamber.
Thus, each case of a ‘malpositioned’ IOL is different. Depending on the extent of malpositioning, the type of IOL and the surgeon’s comfort, the management changes. It will be beneficial for the surgeon to be familiar with various IOL exchange/explantation techniques.

Surgical Correction of Ectopia Lentis

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Ectopia lentis due to any cause presents a challenge to the ophthalmologist, and management requires adhering to certain paradigms and principles.

Surgical management of ectopia lentis poses two major challenges:

1. Removal of lens itself
2. Fixation of IOL

Strategies include:

Counseling: The patient and the family are made aware of:-
   -Possibility of uncertain surgical outcome,
   -Challenges and consequences of scleral fixation of IOL,
   -Postoperative suboptimal visual recovery
   -Need for secondary intervention
   -Regular monitoring for glaucoma and retinal complications

Preoperative evaluation: is carried out under maximum mydriasis for detecting:-
   -Extent of zonular weakness,
   -Grade of cataract, if any
-Presence of vitreous strands in anterior chamber, and
-Peripheral retinal lesions.

As per extent of area of zonular dehiscence surgical strategy is decided. Pars plana lensectomy with vitrectomy is an option for gross subluxation of lens, following which scleral fixation of lens or intrascleral fixation-glued IOL or iris fixated lens can be done for IOL implantation.

We prefer to preserve the bag as far as possible because of the advantages:

1) It preserves and maintains natural compartments
2) It preserves the intact anterior vitreous phase
3) In the bag IOL implantation is the ideal site for IOL fixation

But this is technically demanding and long-term stability is still a question. There are many options for bag fixation and in-the-bag IOL implantation. The Cionni ring and Ahmed segments are designed to fixate the capsular bag to the sclera without violating the integrity of the capsular bag. However, several innovative devices are available for fixating the capsular bag to the sclera.

**Surgical Steps:**

**My preferred surgical strategy consists of the following steps:**

-**Creation of a Scleral Pocket:**

Initially, a scleral pocket is created in the area of maximum zonular dehiscence. I prefer the technique described by Dr Hoffman, which involves creation of a partial thickness limbal groove, which is then dissected backwards into the sclera, without disinserting the conjunctiva. ([Figure 8](#))

-**Corneal Incision**

I fashion two clear corneal paracentesis incisions of about 1.00 mm. I also make a temporal clear corneal paracentesis of 1.00 mm to start off. Using the “soft shell technique” of Dr. Arshinoff, first dispersive OVD, Viscoat is injected into the anterior chamber, specifically over the area of zonular dehiscence. This creates a tamponade on the exposed anterior vitreous face. This is followed by injection of cohesive OVD such as Provisc. This ensures adequate space maintenance in the anterior chamber.

-**Capsulorhexis**

An initial small rhexis is initiated with 26-gauge needle. In conditions where initiating the rhexis with 26 gauge needle is difficult, a paracentesis knife is used to make a slit opening on the anterior capsule, subsequently the rhexis is completed using microincision rhexis forceps through the same 1.00 mm
paracentesis incision. This allows maintenance of a closed chamber. An initial small rhesis is attempted and then definite large rhesis is performed if necessary.

-Capsular Bag Stabilisation
Capsular bag stabilization is either required to complete the capsulorhexis, or after completing the capsulorhexis. Iris retractors help to temporarily support the cataract and prevent additional loss of zonules. Other devices such as Mackhool capsular hooks may also be used to stabilize the capsular bag. (Figure 9)

-Cortical Cleaving Hydrodissection
Gentle but thorough multiquadrant hydrodissection is performed to reduce the stress on zonules during cortex removal.

-Lens Removal
In cases of children or young individuals, bimanual I/A is performed for lens removal. This allows maintenance of a closed chamber. By using a low aspiration flow rate and low bottle height minimal turbulence is maintained within the anterior chamber. At every stage, Viscoat is injected into the eye before retracting an instrument out of the eye to prevent collapse of the anterior chamber and forward bulge of the vitreous face.

-Capsular Bag Fixation
The capsular bag is inflated using high viscosity cohesive viscoelastic. I prefer to use a Cionni modified capsule tension ring for stabilization and centration of the bag. A corneal paracentesis incision is made opposite to the area of maximum zonular dialysis. The Cionni element of the ring is threaded with 9/0 prolene monofilament nonabsorbable suture, double armed with 2 straight needles (Ethicon) outside the eye. The ring is then is passed through a 2.8 mm corneal incision into the capsular bag. It is dialed until the Cionni’s element is subjacent to scleral flap. Bent 26 G needle is passed transconjunctivally through scleral pocket to fetch the curved needle which is introduced through the opposite corneal stab incision. Similarly the second needle is passed in the same track. Both the needles are cut, and the ends of the sutures are pulled out through the scleral pocket, and tied. This allows the knot to be buried inside the dissected scleral pocket. (Figure 10) Once the capsular bag is stabilized the IOL is implanted in the bag. My IOL of choice is a hydrophobic acrylic IOL (AcrySof, Alcon Laboratories, USA). Thereafter, a thorough removal of the OVD is performed, again taking care to avoid very high aspiration. Finally, before retracting the I/A cannula from the eye, stromal hydration of incisions is performed. The paracentesis incisions and the main incision are sutured. (Figure 11)
The Ahmed capsule tension segment is a modification of the Cionni ring, that provides segmental support, and can be used for small areas of zonular dehiscence or as an additional support in presence of a cionni ring.

Several other devices, like the Assia Anchor device and others have also been designed to provide stable capsular bag fixation.

**-Alternatives to Capsular Bag Fixation**

In cases where the capsular bag cannot be preserved, I fixate the IOL to the sclera using conventional scleral fixation technique. However, the intrascleral IOL fixation (the glued IOL) is also a very elegant method of stable IOL fixation. Other options are iris sutured IOL fixation of anterior chamber IOL implantation.

**To recapitulate, the pearls for surgical management of ectopia lentis are:**

(i) Adhere to the principles of the closed chamber technique
(ii) Use modest irrigation and aspiration parameters to prevent turbulence
(iii) Choose the IOL fixation site according the available capsular bag support
(iv) Capsular bag fixation with IOL implantation in-the-bag preferred

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**Legends for the figures:**

Fig-8: Hoffman’s Scleral Pocket.
Fig-2: Capsular bag stabilization with Iris retractors.
Fig-3: Capsular Bag Fixation with cionni ring
Fig-4: Cionni ring and in the bag IOL implantation.

**Suggested reading :**


Femtodelineation
IOL Placement Asymmetric - Partly in-the-bag, Partly in sulcus

ACCC behind Optic

ACCC fused with PCCC with fibrosis in 180 degrees

ACCC in front of Optic