Management of Difficult Cataracts and Challenging Cataracts

Instruction Course

ASCRS 2016, New Orleans

Chief Instructor : Dr. Abhay R. Vasavada, MS, FRCS (England)

Faculty : Dr. Alan Crandall, Dr. Robert Osher, DR. Robert Cionni, Dr. Kevin Miller, Dr. Nick Mamalis

Femtodelineation : Posterior Polar Cataracts Simplified (Figures 1 to 4)

Posterior polar cataracts always present a challenge to the cataract surgeon due to their propensity for posterior capsule weakness and rupture (PCR). As techniques, technology and surgeons’ understanding of this problem have evolved, the PCR rates have dropped from as high as 26 and 36% in the 1990s to 7-8%. With the advent of femtosecond laser technology for cataract surgery, its use is being reported more and more in various challenging situations. We find this technology invaluable in dealing with posterior polar cataracts. Currently, the femtosecond laser is being used to create corneal incisions, capsulotomies and nuclear division. We described the application of cylindrical lens division pattern in posterior polar cataracts – Femtodelination. This technique enhances safety and reduces rupture rates in posterior polar cataracts.

The basic principles of posterior polar emulsification hold true even for this technique, that is:

- Preventing forward bulge of capsule-zonule diaphragm
- Mechanically cushioning and protecting the weak posterior capsule
- Avoid sudden, rapid buildup of hydraulic pressure inside the capsular bag

Femtodelination - Surgical Technique

Once the femtosecond laser is docked on to the patient’s eye with the interface, cylindrical pattern of lens division is selected. The laser is programmed to create 3 cylinders within the nucleus, with diameter of the outermost cylinder set at 5.5 to 6mm (Figure 1). The number, depth
advantages of Femtodelineation in Posterior Polar Cataracts
We performed a prospective, observational study in 45 consecutive eyes of 45 patients undergoing cataract surgery for posterior polar cataracts. Using the femtodelination technique, our PCR rate was only 4.4%, i.e. only 2 of the 45 eyes had a PCR. Of these, 1 had an accidental aspiration of the posterior capsule in the aspiration probe during I/A and 1 had a PCR noted at the end of nucleus removal. In a previous study, we described the Inside-Out-Delineation technique for posterior polar cataract removal and we had found a PCR rate of around 9%. Thus, this technique offers lowest possible PCR rates and enhances safety during surgery.

In effect, what femtodelineation does is that the multiple nuclear layers or zones created act as shock absorbers during surgery. They prevent the transmission of mechanical forces as well as fluidic turbulence to the weakest part of the posterior capsule until the very end of surgery. Further, since there is no hydroprocedure involved, the risk for buildup of hydraulic pressure within the bag is eliminated. One of the biggest advantages of using the laser to create delineation is that it creates extremely well demarcated and predictable walls of delineation. These sharp vertical walls separating the layers from each other make removal easy with minimal mechanical maneuvering with the second instrument. Finally, when the last layer of epinucleus is being removed, gently stripping it off the fornices in 180 degrees creates a plane of separation between the lens material and the posterior capsule. Since there is a cleavage created between the epinucleus and the posterior capsule, passage of fluid in this space will not lead to buildup of hydraulic pressure. Therefore, even if there is a pre-existing or intraoperative PCR, there is no or minimal enlargement of this rupture. As a result, the final goal of being able to implant an IOL in the capsular bag can be achieved by converting this small rupture into a continuous PCCC. Further, unlike any of the manual techniques, with femtodelination, the size, number and the depth of the cylinders can be customized by the surgeon depending on the size of the pupil as well as rhexis, or based on surgeon comfort. The femtosecond laser platform is integrated with a live anterior segment OCT which not only shows the integrity of the posterior capsule, but also allows the surgeon to keep a “safety margin” from the posterior capsule. This ensures that there is no inadvertent damage to the posterior capsule due to collateral effects of the photodisruption created by the femtosecond laser. We have found that femtodelineation is also useful in posterior polar cataracts with an associated dense nucleus. As the nucleus is already predivided, it is easily debulked without the
need for any mechanical division techniques, which could otherwise cause stress on the capsule-zonular complex.

An added benefit with laser assisted cataract surgery is the ability to achieve a centric rhesis of a desired size, that not only may ensure better effective lens position, but can also be very useful in case a ciliary sulcus IOL implantation needs to be performed.

Potential Concerns with Femtodelineation

There is a concern of rise in intralenticular pressure due to the bubbles generated with femtosecond laser application. However, we believe that with the use of lower energy settings as well as greater layer and spot separation, the bubbles generated are of a smaller size (Figure 5) and compliant. These bubbles may not have the capability to produce a dramatic rise in intralenticular pressure. Capsular block syndrome with rupture of the posterior capsule has been reported in the past with femtosecond laser during cataract surgery. However, as the understanding of the technology has improved, surgeons are now more cautious with performing hydrodissection and recently there are no reports of capsular block syndrome.

To summarize, as the femtosecond laser technology is especially useful in posterior polar cataracts as it helps to avoid hydroprocedures and yet provide customizable, sharp, predictable layers of cushioning that protect the posterior capsule until the very end of lens removal.

SURGICAL CORRECTION OF ECTOPIA LENTIS (Figures 6 to 9)

Ectopia Lentis is one of the most challenging situations for any surgeon, and its management requires adhering to certain special paradigms and principles. The two major challenges in removing subluxated lenses are:

1. Removal of the lens itself
2. Fixation of the Intraocular Lens
Strategies include:

- **Preoperative counseling**: The patient and the family need to be aware of the special situation and should be thoroughly explained about
  - Complexity of the situation
  - Possibility of suboptimal visual recovery
  - Difficulties in preserving capsular bag
  - Different options for IOL fixation including sutured / intrascleral fixation of IOL
  - Need for secondary interventions
  - Lifelong need to followup for monitoring glaucoma and retinal complications

- **Preoperative evaluation includes but is not limited to**:  
  - Clinical examination under maximum mydriasis for – extent of zonular weakness, grade of nuclear sclerosis, presence of vitreous in the anterior chamber, pre-existing glaucoma and peripheral retinal lesions

The surgical approach is decided by the extent and degree of zonular loss / weakness. In grossly subluxated lenses, with zonular weakness of more than 9 clock hours, pars plana lensectomy with sutured / intrascleral fixation of an IOL, or a retro-iris fixated IOL is a good option. However, we prefer to preserve the capsular bag wherever possible for the following reasons:

- It maintains the natural compartments within the eye by preserving the capsular bag barrier
- Avoids disruption of anterior vitreous phase and vitrectomy
- Allows in the bag IOL implantation, which is the preferred site for IOL fixation

**Surgical Steps**:

My preferred surgical technique involves:

a) **Creation of a Scleral flap** – A partial thickness scleral flap can be dissected, or a Hoffman’s pocket may be created. However, recently I have given up creating any kind of scleral flaps if I plan Cionni ring fixation of the bag. I only perform 2 limited conjunctival peritomies, 180 degrees apart, in the area of the maximum zonular weakness / loss.

b) **Corneal Incisions**- An initial 1mm paracentesis is created. Thereafter, using the “soft shell” technique of Dr. Arshinoff, dispersive OVD (Viscoat) and cohesive OVD are injected to create space, as well as to tamponade the anterior vitreous phase. I create as many small (sub 1mm) paracentesis incisions as required for inserting capsular hooks to fixate the capsular bag. Apart from that I make two 1.2mm sideport incisions (limbal) for bimanual irrigation / aspiration. The main temporal incision is enlarged only prior to IOL implantation.

c) **Capsulorhexis** – this is the sheet anchor for preserving the capsular bag. Due to the lack of counter-pressure and elastic nature of the capsule, often initiating a rhexis is difficult. A sharp 26
A gauge cystotome needle or an MVR knife may be used to puncture the capsule. Thereafter, microcapsulorhexis forceps are used to grasp and regrasp the capsule and create a rhexis. It should be kept in mind that since the lens is decentered, the rhexis should not be centered on the visible portion of the lens, but often has to be extended behind the pupillary area. Capsular or iris hooks can be used to stabilize the capsular bag even during capsulorhexis. An initial small rhexis can be created which can be enlarged later, if required.

d) Cortical cleaving hydrodissection – Multiple quadrant, gentle, hydrodissection should be performed which makes lens removal easier and reduces stress on the zonular complex.

e) Lens Removal – In young individuals, bimanual irrigation / aspiration (I/A) is performed. Bimanual I/A allows maintenance of closed chamber during surgery. Low bottle height, aspiration flow rate, and vacuum parameters should be used to minimize turbulence in the anterior chamber. At every stage, Viscoat should be injected in the anterior chamber prior to withdrawal of instruments.

f) Capsular bag fixation – The capsular bag is inflated using high viscosity OVD. I prefer to use the Cionni modified CTR to fix the capsular bag to the scleral wall. A single or a double islet ring can be used depending on the extent of zonular loss. Previously, my suture material of choice was 9-0 polypropylene (Prolene). However, for the last 3 years I almost exclusively use the GoreTex (PTFE) suture to fix the Cionni ring to the scleral wall. The advantage of using GoreTex, which is an off label use of the suture, is that it is biologically very inert and does not biodegrade. Although 9-0 prolene degrades slower than 10-0 it is still not immune to biodegradation. Often, these patients are children or young adults who have a long life ahead of them, and therefore, using GoreTex makes sense.

Technique of ring fixation: A corneal paracentesis is created opposite the area of maximum subluxation. A double armed Goretex suture is threaded through the Cionni element of the ring outside the eye. The ring is then introduced into the eye through a 2.8mm incision and dialed into position using a Leister hook subjacent to the scleral flap / site of fixation. A bent 26 gauge needle is passed transsclerally, 1.5 mm behind the limbus to fetch one needle. Similarly, another needle is used to externalis the other end of the suture. Thereafter, both ends are tightened and tied. The overlying conjunctiva is then sutured. Being an inert material, goretex even if it is subconjunctival does not incite any inflammation.

Once the capsular bag is stabilized, my choice of IOL is the single piece hydrophobic acrylic IOL (Alcon). Bimanual I/A is used to remove the OVD from the eye, and incisions are sutured and hydrated before closing the eye.

The Ahmed Capsule Tension segment is a modification of the Cionni ring, which can be used either alone or in combination with CTR/ Cionni ring to fixate the capsular bag in cases of limited zonular loss. There are other devices such as the Assia’s anchor, glued Capsular hook and others which can also be used to stabilize the capsular bag.
Alternatives to Bag Fixation of IOL:

In cases with extensive zonular loss or where the capsular bag cannot be preserved, the options are:

- Sutured scleral fixation of a PMMA IOL: the drawback here is that a large incision is needed, and GoreTex suture can be used here as well to fixate the IOL haptics to the sclera.
- Intrascleral (glued) IOL fixation: using bimanual instrumentation, a foldable 3 piece IOL can be fixated. However, it must be kept in mind that an adequate anterior vitrectomy is must in these cases.
- Iris fixation of IOL: in front or behind the iris can be performed.
- Anterior chamber IOL

TRAUMATIC CATARACT – OPTIMIZING IOL FIXATION

In traumatic cataracts, there are often multiple problems that need to be tackled. Many of these have visualization difficulties due to corneal scars or corneal lacerations. Also, often, these cataracts may have penetrating injury, resulting in rupture of the anterior and/or posterior capsule with vitreous prolapse into the anterior chamber.

This presentation highlights how the anterior and posterior capsules can be managed optimally to ensure good anatomical outcome and a stable IOL fixation.

In this eye with traumatic cataract, there is a pre-existing rupture in the anterior capsule. Slitlamp examination does not reveal any vitreous in the anterior chamber. However, as a first step, preservative-free triamcinolone acetonide should be injected through a paracentesis injection into the eye to stain any vitreous strands. If found to be present, an anterior vitrectomy should be performed.

Since the patient is a young child of 14 years, lens matter is removed using bimanual I/A. At this point, no attempt is made to create an anterior capsulorhexis. The fibrosed margins of the rupture allow enough exposure for lens removal. The use of bimanual I/A allows maintenance of a closed chamber and thus prevents turbulence as well as zonular stress. Having done that, now an ACCC has to be fashioned. Special microincision scissors are used to create a nick in the fibrous margin of the anterior capsule rupture. Then, using microcapsulorhexis forceps, an ACCC is fashioned in the intact capsule. Similarly, an opening is created on the other side.

It should be kept in mind that low aspiration parameters are used and closed chamber should be maintained as far as possible. Therefore, I enlarge the temporal incision only prior to IOL implantation.

Having done this, now, there are two options for IOL fixation:
1) In the bag IOL implantation of a 3 piece or a single piece foldable IOL. This is easy to perform. However, there are issues with this method- namely, since the ACCC is not continuous there are chances of IOL tilt. Further, there are very high chances of posterior capsule opacification with young patients and traumatic cataracts.

2) Thus, I chose to perform a primary posterior continuous curvilinear capsulorhexis and then implant a 3 piece hydrophobic acrylic IOL and capture it through the PCCC. This allows stable IOL fixation, and avoids any changes in effective lens position or IOL tilt. Also, most importantly, since the IOL optic is slid behind the PCCC margins, there is fusion of anterior and posterior capsules all around the optic margin, and therefore, proliferating LECs do not gain access to the central visual axis. Thereby significant visual axis obscuration is avoided. Often, in these eyes, with corneal scars and irregular wounds, performing an Nd:YAG capsulotomy is difficult postoperatively. Further, since these eyes are prone to glaucoma owing to inflammation and mechanical damage to the trabecular meshwork, the further the IOL is from the backsurface of the iris, the lesser the chances of iris chaffing and related pigment dispersion as well as glaucoma.

Thus, in traumatic cataracts with an intact or a ruptured anterior capsule, if the posterior capsule is either intact or has a small rupture, it can be converted to a continuous PCCC which allows stable IOL fixation of a 3 piece IOL and also prevents or delays visual axis obscuration.