Intra-Operative Strategies to prevent post op surprises. Tips & Pearls:

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Modern day Cataract surgery is a refractive surgery. Apart from accurate biometry, and choosing the appropriate lens the actual surgical technique does play a critical role in ensuring predictable outcomes every single time. The architecture of the Incision, the size and centration of the CCC and complete removal of the OVDs are some of the most important technical issues which eventually decide the refractive outcome in cataract surgery.

The Incision:
Self-sealing suture less Clear corneal incisions are arguably the most commonly performed incisions in modern day cataract surgery. The incision induces flattening effect on the cornea (Surgically induced Astigmatism [SIA]). This effect positively co-relates with the incision size (large incision =larger astigmatism). There is evidence suggesting the benefits of a square shaped incision, both in terms of strength and surgically induced astigmatism1.

I prefer a posterior limbal incision as described by Paul Ernst2. It is easier to make a square shaped 2.2 mm incision when compared to a 2.8 mm incision, which often becomes rectangular. I prefer to make a groove initially on the posterior limbus (indicated by mild tricking of blood) sparing the conjunctiva and then use a bi-bevel 2.2mm keratome to make a square shaped incision. I always use a temporal incision.
Apart from proper wound construction, maintaining its integrity throughout the procedure is important. Undue stretching of the wound (both the main incision & the side port) during IOL implantation and other surgical maneuvers can induce more astigmatism and has to be avoided. We need to be aware of our surgical induced astigmatism. We can look up at the pre & Post-op Keratometer readings of our last 50 or 100 cases and get our SIA^3.

**The CCC:**
The size & centration of the CCC is probably the most important factor in ensuring the proper positioning of the IOL and consequently providing predictable refractive outcomes.

**What's the right size of the CCC?**
An Ideal CCC is one, which should overlap 360 degree of the optic of the IOL by 0.5 mm to 1 mm. For a 6 mm Optic an ideal CCC would be 5 to 5.5mm. Studies have repeatedly shown that full overlap of the capsulorhexis' edge is the most important determinant of the development of PCO. By creating a "shrink wrap" and a capsular bending effect in the posterior capsule, a 360° overlapping edge on the optic is believed to deter lens epithelial cells from proliferating, the so-called barrier effect. The capsulorhexis therefore should not be much larger than 5.5 mm for PCO prevention.
BENEFITS OF COMPLETE ANTERIOR CAPSULE/IOL OVERLAP

Anterior capsular overlap locks in the final effective lens position, which affords two critical and beneficial effects.

1. The first is the long-term stabilization of refractive outcomes. If there is no 360 degree overlap then over a period of time owing to capsular fibrosis and stiffening of the posterior capsule there is anterior shifting of the IOL leading to myopic refractive error and PCO.

2. The second critical effect of 360° capsular overlap is standardization of the effective lens position and thus the A-constants of IOLs, which has huge implications for the accuracy of IOL power calculations. Before the significance of capsular overlap was appreciated, different surgeons with variously sized capsulorhexes would get different refractive results with the same IOL, hence the evolution of the personalized A-constant.

THE PROBLEM OF PARTIAL CAPSULAR OVERLAP

Complete 360° coverage is necessary for the prevention of PCO and the IOL's stability. If the overlap is only partial, or the capsulorhexis is decentered, the rate of PCO increases as the barrier effect is lost. Furthermore, the forces of asymmetric capsular contraction can cause a late decenteration of the IOL. Although surgeons have gotten away with some decentration and/or tilt with
traditional monofocal lenses, current IOLs with negative spherical aberration (aspheric) are very sensitive to decenteration, and higher-order aberrations may increase when these lenses are displaced by even 0.3 mm. Sensitivity to decenteration applies even more so to (aspheric) multifocal or toric lenses, as patients' postoperative expectations with refractive premium IOLs are high.

WHEN IS THE CAPSULORHESIS TOO SMALL?
The evidence for constructing a capsulorhexis smaller than the 6-mm optic is compelling, but surgeons should not make it too small. A small capsular opening makes surgery more difficult and places greater stress on the anterior capsule during nuclear division or quadrant removal. Beyond the operative disadvantages, significant negative consequences can occur during the postoperative period with capsular contraction syndrome. Anterior capsular fibrosis with opacity and shrinkage probably occurs to some degree after every case of cataract extraction. Although extreme capsular phimosis can obscure vision, even a more modest contraction can have adverse effects. Furthermore, a smaller capsular opening can obscure peripheral retinal visibility and treatment.

With multifocal lenses such as the AcrySof Restor (Alcon Laboratories, Inc., Fort Worth, TX) and the ReZoom (Abbott Medical Optics Inc., Santa Ana, CA), a smaller capsular opening can have obviously negative consequences by diminishing the light through the peripheral refractive zones.
How to achieve the perfect CCC?

Femto laser is a great tool but an expensive one to achieve a perfectly sized and centered CCC. For the majority of us who cannot afford it there are ways and means of achieving the same manually.

I use a 5mm corneal marker (figure a), which acts as a guide to achieve the right sized CCC and also helps in centering the rhesis on to the visual axis. The patient is instructed to look at the light and the marker is placed centered on the corneal light reflex to create a corneal impression. This corneal impression acts as a guide to size the CCC accurately (Figure b). The 5 mm corneal impression is especially helpful in eyes with widely dilated pupils. But the corneal impression technique is not very accurate due to varying anterior chamber depth, keratometry, and parallax.

Another tool is to use the flexible 5mm rings and place them directly over the anterior capsule and use it like a stencil to perform CCC within it. Intra Ocular calipers are also being used to measure the CCC size.

A promising technological solution involves overlaying a reference ring on the surgeon's view through the microscope. Carl Zeiss Meditec, Inc., and Verion by Alcon developed an interface module that adjusts the size of the ring appropriately with microscope magnification while keeping it centered within the limbus using real-time eye tracking.
3. Removing the OVD:
The standard practice has been to use OVD to inflate the capsular bag before we implant the lens. It is critical to remove 100% of this OVD behind the IOL to ensure that the IOL rests against the Posterior Capsule. Any left over OVD may shift the lens anteriorly causing myopic shift. It may also rotate the IOL marginally, which will be deleterious if the lens is a Toric IOL. Hence to ensure axial stability, rotational stability and to minimize the PCO it is imperative that we remove OVD completely behind the IOL. I prefer to use a cohesive OVD like Sodium Hyaluronate, which can be aspirated completed, and easily as a single bolus. Once the OVD is removed, the lens is gently tapped back to ensure that it snugly rests against the posterior capsule. The side port and the main port incisions are hydrated and checked for any potential leak.

![Image of the Aspiration cannula is under the IOL to remove the OVD behind the lens.](image)

Conclusion:
To ensure predictable refractive outcomes in our cataract patients a good surgical technique is critical. Proper wound architecture ensures minimal surgically induced astigmatism and a perfectly sized and centered CCC guarantees axial and rotational stability to the IOL which in turn ensures predictable refractive outcomes.
References:


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