

STEPWISE MANAGEMENT OF ZONULAR INSTABILITY

A practical intraoperative sequence for restoring capsular stability while minimizing additional zonular stress.



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Zonular instability during cataract surgery exists on a spectrum that ranges from diffuse weakness to focal or extensive dialysis. Regardless of the etiology, once instability is present, even routine maneuvers such as nuclear rotation and cortical removal can place additional stress on the remaining zonules.

When we encounter zonular instability, we slow down and stabilize the capsular bag before proceeding. Rather than rely on a single maneuver or device, we manage these cases in a deliberate sequence that progressively restores capsular stability while minimizing additional zonular stress.

RECOGNIZING INSTABILITY

Zonular instability may be recognized preoperatively or discovered intraoperatively.

Preoperative Recognition

In select eyes with preexisting dialysis or zonular instability, we consider performing the capsulotomy

with a femtosecond laser because it can create a centered, reproducible opening without relying on zonular countertraction, which can be helpful when the capsule is unstable.

Intraoperative Recognition and Capsulorhexis Strategy

Sometimes, zonular instability becomes apparent intraoperatively—often during the capsulorhexis. In these eyes, the capsule frequently moves with the tearing force because the zonules cannot provide adequate countertraction. The capsulorhexis may be smaller than intended because the capsule follows the vector of the tear. We try to maintain chamber stability with an OVD, frequently regrasp the capsule with forceps, and deliberately direct the tear outward to compensate for this tendency.

When focal zonular dialysis is present, we typically initiate the capsulorhexis away from the area of weakness. As the tear approaches the dialysis, directing the tearing vector

to maximize countertraction from the remaining intact zonules can help prevent uncontrolled extension. If zonular loss provides insufficient countertraction to complete the capsulorhexis, we place capsule retractors or iris hooks to engage the capsulorhexis' edge and provide additional stabilization before tearing across the weakened area.

In this situation, we strongly favor microforceps over a cystotome because the former instrument allows frequent regrasping and shorter tearing vectors. We tailor the size of the capsulorhexis to the degree of zonular instability and the anticipated need for capsular support devices and aim to preserve adequate optic overlap at the end of the case.

STABILIZING THE BAG

OVD management becomes particularly important once zonular instability has been identified, and mechanical stabilization of the capsular bag becomes a priority.

OVD Control

A dispersive OVD is injected to protect intraocular structures, maintain chamber stability, and help limit vitreous prolapse in eyes with significant zonular dialysis. When the bag appears to be unstable, it can be tempting to fill the eye aggressively with an OVD in an attempt to create stability. In our experience, however, excessive chamber deepening can actually worsen stress on compromised zonules. We have found that frequent small additions of an OVD provide better control than large injections that abruptly deepen the chamber.

Mechanical Support

Capsule retractors that engage the capsulorhexis' edge redistribute forces away from areas of zonular loss and help restore centration of the capsular bag. If capsule retractors are not available, iris hooks can provide temporary support, but they are not ideal.

Another option is to place a capsular tension segment (CTS) and grasp the eyelet with an iris hook. This provides immediate stabilization while preserving the option to permanently fixate the capsular bag later in the case. The step can be especially helpful when there is nasal zonular loss. For surgeons operating temporally, nasal instability can make nuclear rotation and chopping maneuvers more difficult. Mechanical support frequently restores enough stability to safely proceed.

NUCLEAR DISASSEMBLY

Controlled Rotation and Fragmentation

Once the capsular bag has been stabilized, nuclear disassembly can proceed. We generally prefer a horizontal chop technique in these cases. In our hands, the centripetal movement tends to place less stress on the zonules than sculpting and may be gentler than vertical chop techniques because downward forces are avoided. When rotating the nucleus, we try to simultaneously use two instruments and keep forces tangential to the circular contour of the capsular bag.

Tangential forces allow the nucleus to rotate while minimizing stress on the zonules.

If the nucleus does not rotate easily, we avoid forcing it. Instead, after a horizontal chop, a heminucleus can be brought into the anterior chamber and emulsified in a more controlled position.

Dense Nuclei

It can be helpful to segment dense cataracts with the miLoop (Carl Zeiss Meditec) if the capsule is sufficiently stable, but care must be taken when deploying the loop within the capsular bag. For extremely brunescient lenses, we may bring larger nuclear segments into the anterior chamber for further fragmentation with the miLoop.

CAPSULAR SUPPORT

The timing of capsular tension ring (CTR) placement depends on the clinical situation. In eyes with significant zonular loss, we often place a CTS to provide focal stabilization of the capsular bag.

CTR Timing

Early CTR placement can improve capsular stability but may make cortical removal more difficult. Delayed CTR placement can facilitate cortical cleanup but allows greater capsular movement earlier in the case. We time CTR placement according to the degree and pattern of zonular compromise; the device is placed as early as necessary to restore stability while preserving access for cortical removal.

Cortical Cleanup

Cortical cleanup can be particularly challenging in eyes with zonular instability because radial traction during cortical stripping may further stress weakened zonules.

Bimanual irrigation and aspiration can provide better control of traction vectors during cortical removal. Whenever possible, we begin cortical cleanup away from the area of focal

zonular weakness and perform gentle tangential stripping instead of applying direct radial traction.

CTS Fixation

The CTS is positioned at the area of greatest zonular weakness and temporarily supported with an iris hook until definitive fixation is performed.

For scleral fixation, we prefer the double-flanged belt loop technique described by Canabrava using a 6-0 polypropylene suture.¹ After positioning the CTS, we use a thin-walled 30-gauge needle to enter the sulcus approximately 2.5 mm posterior to the limbus. The polypropylene suture is passed through the eyelet of the CTS to create a belt loop configuration and then docked into the needle and externalized. Once externalized, the suture ends are cauterized to create flanges. We then apply gentle tension to center the capsular bag and bury the flanges in the sclera to provide stable knotless fixation. In our experience, this technique allows precise centration of the capsular bag with minimal intraocular manipulation. A conjunctival peritomy is not required.

In eyes with more extensive zonular weakness, a CTS can be combined with a CTR to provide additional circumferential support of the capsular complex. ■

1. Canabrava S, Bernardino L, Batistelli T, Lopes G, Diniz-Filho A. Double-flanged-haptic and capsular tension ring or segment for sutureless fixation in zonular instability. *Int Ophthalmol*. 2018;38(6):2653-2662.

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- Financial disclosure: None acknowledged