

SURGICAL TECHNIQUE

An alternative endocapsular approach for the management of Argentinean flag capsular tear during cataract surgery

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Key words:

Argentinean flag, capsulorhexis tear, mature cataract

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Received: 16-08-2019;
Accepted: 12-10-2019
doi: 10.15713/ins.clever.37

**Abstract**

Many techniques are employed to prevent the formation of a radial anterior capsular tear which resembles an Argentinean flag during surgery for the extraction of white mature cataract. We aim to describe an original endocapsular approach to manage this intraoperative complication once it has already occurred, which was employed in four eyes of four patients, all with mature white cataracts prior surgery. Using this technique, without hydrodissection, the surgeon proceeds with phacoemulsification through the slit of the open anterior capsule. The anterior capsule is only manipulated following intraocular lens (IOL) insertion to the capsular bag by creating two symmetric semicircles. In all cases, no posterior capsular tear occurred during surgery, and there were no further intra- or post-operative complications. The final best-corrected visual acuity was 20/25 in each case on the 3-month follow-up appointment, and the IOLs were well centered in the capsular bag.

Introduction

Achieving a continuous curvilinear capsulorhexis (CCC) during surgery for a mature white cataract extraction remains a technical challenge. Given the typical brittle nature of the capsule in these cases,^[1] and the limited visualization of the capsular edges in the lack of a proper red reflex,^[2] the risk of an anterior capsular tear is high.^[3,4] The hydrated lens fibers in a mature swollen cataract increase both anterior and posterior intralenticular pressure.^[1,4,5] Once the anterior capsule is perforated, this pressure gradient accompanied by extracapsular forces from a posterior or equatorial origin may displace the lens toward the anterior chamber (AC), contributing to an anterior capsular tear with rapid and immediate expansion to the periphery. The Argentinean flag sign is the observation of a white cataract stripe in contrast to the typically trypan blue-stained anterior capsule on both of its sides.

Achieving a CCC for a mature, white cataract is difficult and many techniques have been suggested. These include decompressing the pressure within the capsular bag through aspiration of cortical material on perforating the anterior capsule,^[6] using phacocapsulotomy technique,^[7] using the two-stage

capsulorhexis,^[1] creating peripheral iridotomies,^[8] and capsule milking, as lately described by Chee and Chan.^[9] Some surgeons routinely inject intravenous mannitol preoperatively in those cases and/or use viscoelastic agents such as Healon5[®] intraoperatively (Johnson & Johnson Vision, Santa Ana, CA, USA).^[10] Emerging technologies for automated capsulotomy such as the nanopulse capsulotomy (Zepto, Mynosys Cellular Devices, Inc.), and CAPSULaser (Excel-Lens, Inc.) may have a value in preventing this complication, though efficacy is yet to be proven.

Nevertheless, and despite the best of efforts, an Argentinean flag sign may still be observed in these complex cases. Once this complication has occurred, it is imperative for the surgeon to meticulously plan the next steps. The main concern is to avoid tear propagation to the posterior capsule, which may lead to capsular or zonular tears, vitreous loss and dropped nucleus, or intraocular lens (IOL).^[11] There are, however, no guidelines or explicit recommendations for the management of such complications.

We, therefore, report our technique to perform phacoemulsification without hydrodissection through the slit inadvertently created in the anterior capsule. The anterior capsule is only manipulated following IOL insertion to the

capsular bag by creating two symmetric semicircles. Our technique was applied successfully in four cases.

Surgical Technique

All patients were given intravenous sedation and were monitored by anesthesia care. All patients had a paracentesis incision with injection of preservative-free lidocaine 2%. Filtered air bubble and 0.06% trypan blue were injected. Dye was washed by balanced salt solution, and the AC was then filled with dispersive viscoelastic. A temporal biplanar clear corneal incision using a 2.4 mm keratome was created, and a nick at the anterior capsule was achieved using a bent cystitome.

In all cases, immediately on penetrating the anterior capsule and before aspirating any cortical fluid, a radial tear was noted, and the tear propagated rapidly to the periphery. Without performing hydrodissection, the surgeon proceeded directly to phacoemulsification using the centurion vision system (Alcon Laboratories Inc.). The active fluidics strategy was selected to improve the surgical environment's stability, a key element in this high-risk procedure. The infusion pressure was kept stable at 55 mmHg to maintain chamber stability. In all cases, the liquefied cortex was aspirated, and the core nucleus was phacoemulsified through the slit of the open anterior capsule using the following parameters: Vacuum set at 400 mmHg and aspiration flow set at 35 cc/min. No attempts to complete the capsulorhexis were done at this stage. Efforts were made to avoid any strain on the capsule and minimize rotational force on the nuclei during the procedure. Following the removal of all cortical material by the irrigation and aspiration (I&A) port, ophthalmic viscosurgical device (OVD) was injected to the AC. The exchange to OVD

was done simultaneously to the I&A removal as to avoid flattening of the AC. A one-piece acrylic hydrophobic lens was loaded and injected into the capsular bag with haptics oriented perpendicular to the tear. As long as the posterior capsule remained intact, an anterior capsular flap was initiated with a bent cystitome both superior and inferior to the slit [Figure 1].

At the end of surgery, OVD was removed from the eye using the I&A port, and the IOL was noted to be well located and stable in the capsular bag. No OVD removal was attempted behind the IOL. Corneal wounds were then hydrated, tested, and found to be watertight. A 10-0 nylon suture was used to secure sealing of the main incision in one of the four eyes. Subconjunctival antibiotics and steroids were injected at the end of each procedure.

Results

This procedure was done in all the cases; an Argentinean flag sign was noted by a single surgeon between 2012 and 2017, at an academic center setting. Overall, four eyes of four patients, all with mature white cataracts prior surgery underwent the procedure. In all cases, no posterior capsular tear occurred during surgery, and there were no further intra- or post-operative complications. The final best-corrected visual acuity was 20/25 in each case on the 3-month follow-up appointment, and the IOLs were well centered in the capsular bag.

Discussion

Given the limited capsular visualization and diminished red reflex in the presence of a white mature cataract, achieving

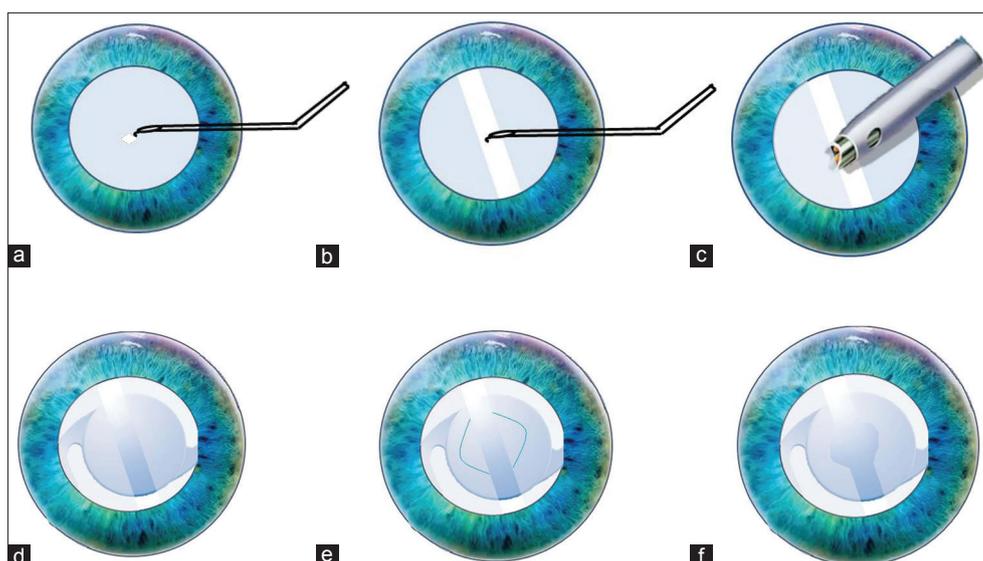


Figure 1: Our technique to perform endocapsular phacoemulsification in the presence of an “Argentinean flag” capsulorhexis tear is illustrated above. During an attempt to achieve continuous curvilinear capsulorhexis (a), a capsulorhexis runaway occurs (b). Phacoemulsification without hydrodissection is performed through the anterior capsule slit (c). The intraocular lens is inserted into the capsular bag (d), and two symmetric semicircles are created in the anterior capsule at the end of surgery (e+f).

*Original iris photography by Thomas Tolkien adopted from Wikimedia Commons and modified.

a CCC becomes more challenging, and the risk for related complications increases.^[2]

Many techniques have been investigated for the prevention of a capsular tear in hypermature cataract surgery;^[9,12] however, data regarding the management of such a complication are sparse. Although it is important to take every precaution to avoid the potentially catastrophic Argentinean flag sign, some measures are either unavailable in every operating room or technically demanding.

Once an Argentinean flag sign is noted, the main challenge is the successful removal of the lens and completion of the surgery without propagating the tear posteriorly with subsequent dropping of the nucleus. Some surgeons tend to try and complete the capsulorhexis at this stage, either by a transition to the can-opener technique, by attempting to pull back the capsulorhexis edge, or by initiating a new flap in the anterior capsule. This is done with the belief that performing hydrodissection and phacoemulsification as an endocapsular surgery may increase the risk to the posterior capsule integrity.^[13] These anterior capsule manipulations may, however, exert further strain on the capsule, extend the tear, and may lead to posterior capsular rupture or otherwise prevent an in-the-bag IOL insertion at a later stage. Other surgeons would convert to extracapsular cataract extraction at this point, usually by extending the incision to a limbal or scleral tunnel as in manual small incision cataract;^[14] however, the nucleus would still need to be extracted by hydrodissection or viscodissection.^[15] These manipulations may pose risks to the posterior capsule integrity.

An alternative approach would be to attempt an endocapsular phacoemulsification without hydrodissection, as was previously described by Little for cases of primary capsulorhexis tear-out.^[15] The authors suggested that following debulking of the central nucleus by sculpting it, auto-hydrodissection of connections between the cortex and the capsule occurs mechanically with the gradual direction of fluids toward a subcapsular plane. Thus, rotation of the nucleus, cortex, and epinucleus and their removal are concurrently facilitated while the risk for tear extension in the setting of an existing anterior capsular tear is reduced. The use of OVD in such cases may assist in phacoemulsification and aspiration of the remaining nucleus. A hydrodissection-free phacoemulsification surgery was also suggested as a preventive method in high-risk eyes by Masuda and Tsuneoka.^[16] The mechanical characteristics of the capsulorhexis and lens in cases complicated with the Argentinean flag sign, however, are unique. The capsular tear in these cases differs from the simple primary anterior capsule tear which may occur in every cataract case. Our technique, therefore, implements the endocapsular approach in cases of a present Argentinean flag sign, showing that the slit in the anterior capsule does enable a safe completion of phacoemulsification, while the capsulorhexis can proceed thereafter.

The IOL implantation may also possess risks for capsular bag integrity,^[13] and judicious choice should be made regarding the implanted IOL. A choice of one-piece acrylic hydrophobic lenses may be preferable since they tend to unfold more gradually in the

bag. On the implantation of the IOL in the capsular bag in the presence of an Argentinean flag tear, the anterior capsule may be left as is later to be treated with Yag capsulotomy to clear the optical axis. However, establishing a controlled semi-circular rhexis of the anterior capsule inferior and superior to the tear can be safely achievable at this point [Figure 1, e+f]. This would allow for the establishment of an open optical axis while still appropriately supporting the IOL in the bag.

Conclusion

In conclusion, this surgical technique is suggested in the unlikely event of an Argentinean flag sign. By avoiding hydrodissection and directly performing phacoemulsification through the slit of the open anterior capsule, the risks for tear extension may be reduced. Manipulating the anterior capsule to clear the optical axis following an implantation of a one-piece acrylic hydrophobic IOL can then follow.

Disclosure

Neither author has a financial or proprietary interest in any material or method mentioned.

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How to cite this article: Sella R, Afshari NA. An alternative endocapsular approach for the management of Argentinean flag capsular tear during cataract surgery. *Clin Exp Vis Eye Res* J 2019;2(2):34-37.

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