

Management of Radial Tears During Capsulorhexis

Mehrdad Mohammadpour, MD
Ophthalmic Research Center
Shaheed Beheshti University of Medical Sciences
Tehran, Iran

■ ABSTRACT

Radial tears during continuous curvilinear capsulorrhexis (CCC) are one of the most unwanted events that a surgeon may experience during cataract surgery. There are many factors that may play a role in inducing radial tears during CCC, such as a shallow anterior chamber, weak zonules as seen in pseudoexfoliative syndrome (PEX), high positive vitreous pressure, intumescent and hypermature cataracts, pediatric cataracts and a surgeon with minimal experience performing CCC. I describe a technique in which by aspirating the anterior epinuclear lens materials prior to phacoemulsification (PE), we can produce some free space between the nucleus and lens capsule and then can rotate the nucleus without complete hydrodissection and safely proceed with PE after cortex aspiration by engaging the nucleus between the phaco tip and a second instrument with the help of high vacuum and by cracking the nucleus without sculpting or chopping in order to minimize the stress on the zonules and prevent extension of radial tears during CCC.

■ INTRODUCTION

Radial tears during CCC are one of the most unlucky and awkward events that a surgeon may experience during cataract surgery in its modern form, i.e. phacoemulsification and in-the-bag intraocular lens implantation (PE+PCIOL). Although it is more common when surgeons transition from the traditional extra-capsular cataract extraction (ECCE) to PE,[1–9] it can also happen to highly experienced phaco surgeons.

There are many factors that may play a role in inducing radial tears during CCC; including a shallow anterior chamber due to inadequate viscoelastic injection (low quantity or poor quality viscoelastic material), weak zonules such as those seen in pseudoexfoliative syndrome (PEX), high positive vitreous pressure due to excessive injection of anesthesia, inadequate anesthesia that may lead to patients discomfort and subsequent squeezing, large CCC that may disrupt the anterior zonules, intumescent and hypermature cataracts, pediatric cataracts with gummy anterior capsules and beginning surgeons for CCC.[1–9] Here in, I describe a technique (that was first reported by Krumeich[10] for routine PE even in hard cataracts) for the proper management of radial tears during CCC by exempting the surgeon from complete hydrodissection and continue safely with an uneventful cataract surgery.

■ SURGICAL TECHNIQUE

Two eyes of 2 patients, both with pseudoexfoliation syndrome, developed radial tears in the CCC after the capsulorrhexis had been performed approximately 180°. The applied OVD was hydroxypropylmethylcellulose, a viscodispersive OVD (Coatel, Chauvin, Opsia, France). The intended diameter of CCC was 5.5 mm, and it was started from the center of the anterior capsule and progressed in an anticlock wise direction (Fig. 1). However, during CCC the AC suddenly became shallow due to weak zonules and low quality viscodispersive material (methylcellulose) and a small radial tear, not extending to the lens equator, developed when I tried to guide the edge of the CCC to the inferior direction (Fig. 2). The edge of the anterior capsulorrhexis flap could not be redirected to the center of capsulorhexis by any effort. Then, I tried to complete it by continuing from the start-point in a clockwise direction. Although lifting the edge of the capsulorhexis from the start point in an opposite direction was difficult (Fig. 3), it was performed successfully (Fig. 4). The problem now, was the irregular and notched-out capsulorhexis that was highly amenable to posterior extension during hydrodissection.

I decided to perform a limited hydrodissection and hydrodeliniation by injecting 1–2 mL of BSS under the anterior lens capsule and within the nucleus 180 degrees away from the radial tear.

Address correspondence and reprint requests to Mehrdad Mohammadpour, MD, Ophthalmic Research Center, Shaheed Beheshti University of Medical Sciences, Tehran, Iran (e-mail: mahammadpour@yahoo.com).

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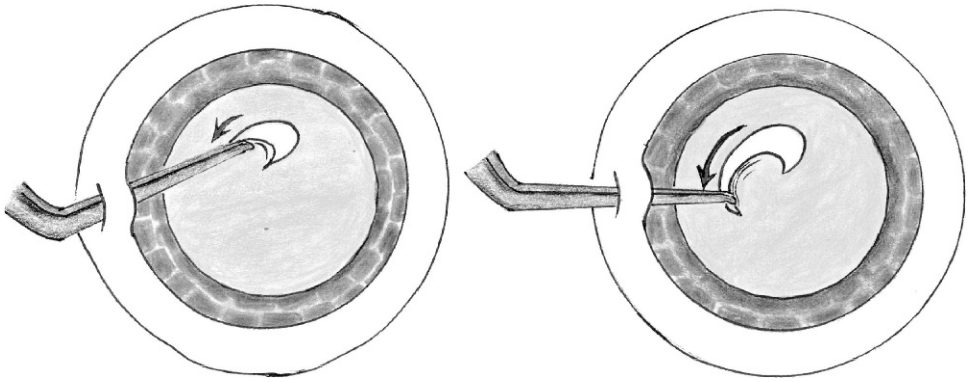

FIGURE 1. Starting the capsulorhexis in an anticlock wise direction.

Then I aspirated the anterior epinuclear lens materials by using the aspiration mode of a 30 degree PE probe through the main incision (before starting the PE) while applying an inflow to maintain the AC depth from an additional site of entry . During the aspiration procedure, space between the nucleus and lens capsule was created allowing me to rotate the nucleus without complete hydrodissection and safely proceed with PE after cortex aspiration. There was no need for sculpting or chopping. The next step was to separate the nucleus from the epinucleus with high vacuum (>200 mm-Hg). The epinucleus was shifted toward the posterior capsule and the nucleus was released for segmentation while it was engaged between the phaco tip and a blunt second instrument (Fig. 5).

I performed the above surgical plan and the overall procedure occurred uneventfully. I put a 3-piece Acrysof® PCIOL in the ciliary sulcus due to the irregular capsulorrhexis and weak zonules that might render the IOL to decentration or dislocation. The two patients had an uneventful postoperative follow-up period up to one year.

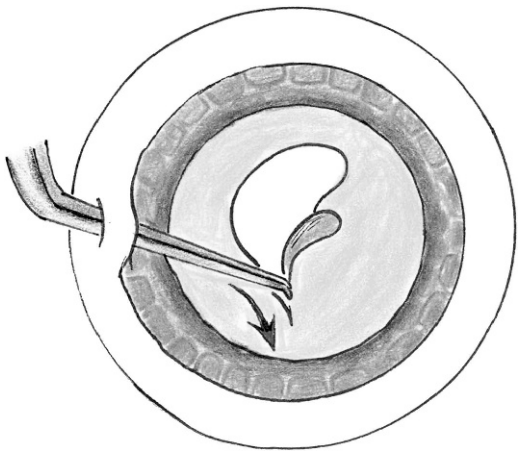

FIGURE 2. Radial tear formation on attempting to redirect the capsulorhexis edge.

■ DISCUSSION

Cataract surgery techniques have been rapidly evolving making it one of the most effective and safe procedures that is performed on patients. However, the risk of posterior capsular rupture, that is a dangerous and irreversible complication has still not been eliminated. One of the most important predisposing factors for posterior capsular tears are radial extensions during CCC.[1] Although, surgical experience is probably the best way to prevent this complication,[2–7] even highly experienced surgeons may encounter this troublesome complication.[1]

There are a lot of measures for managing a radial tear or extended capsulorhexis such as changing the procedure to a conventional can-opener capsulotomy and subsequent ECCE or restarting from the opposite direction, each with its own drawbacks and complications. Changing the procedure to an ECCE, especially when the temporal approach is applied, may cause significant postoperative against-the-rule astigmatism and exposure of the wound and sutures in the palpebral fissure. Restarting the capsulorhexis in an opposite direction is a difficult procedure and finally the rhexis may be decentered, irregular and notched out that may cause further extension of the rhexis to the posterior capsule during hydrodissection or PE. In order to prevent the above complications, I suggest performing a bimanual automated aspiration of available lens materials (instead of hydrodissection) prior to commencing PE as described above.

This technique has been previously described by Krumeich[10] as (decophaco:decortification of the anterior cortex prior to phacoemulsification) ideal for all patients with intact, well-done central capsulorhexis. He reported that this technique is a more safe and less energy-consuming method for PE in routine cases with regard to the applied energy and possible complications. The aspiration of anterior cortical lens material makes a 3 mm space between the nucleus and retained

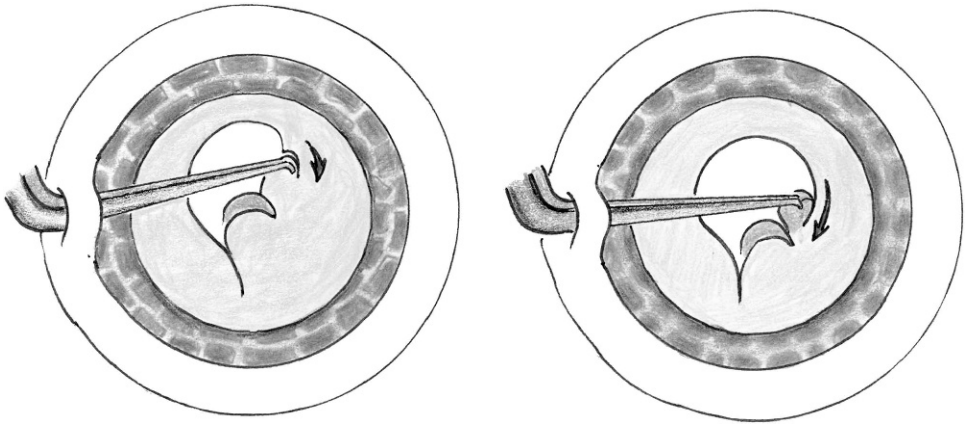

FIGURE 3. Starting the capsulorhexis from the opposite direction.

cortex and anterior capsule. He continues PE after hydrodissection, (without nucleus rotation, sculpting or chopping) with the help of high vacuum and nucleus cracking from the posterior surface. I do not use this procedure for all patients, but only suggest it for those with a "*rhexis at risk*" that is amenable to further complications such as patients with weak zonules (PXF, traumatic cataracts, previous viterectomy) and posterior capsular defects (posterior polar cataracts). I think if the surgeon believes that he may have an uneventful PE when the rhexis is at risk for posterior extension, his performance and self-confidence increase and when he starts the rhexis the probability of radial tear may decrease. On the other hand, if he thinks that any probable problem in the entire course of the capsulorhexis may lead to irreversible complications, the stress induced catecholamine release may essentially make his confidence ruined, especially if he is in the learning curve period.

Various measures have been suggested for preventing radial tear formation in special cases, such as vitrectorhexis for pediatric cataract surgery especially in the first 2 years of life,[10] use of indocyaine green dye staining for PE in white cataracts,[11] plasma blade and diathermy capsulotomy[12] for beginners with inadequate surgical experience, but there are few feasible and practical guidelines for the management of radial tears allowing the surgeon to continue with a safe PE+PCIOL.

Another important issue that needs to be addressed with decentered or irregular capsulorhexis associated with a radial tear is the preferred IOL type and site of implantation (capsular bag versus ciliary sulcus) and the long term results of various anterior capsulotomies and radial tears on IOL centration. Oner et al[13] compared the outcomes of different anterior capsulotomies for guaranteeing IOL centration and found the least rate of early decentration and tilt in patients with intact CCC and CCC with one radial tear and highest values of tilt and decentration in envelope capsulotomy. They concluded that additional symmetric relaxing incision at quadrant 6 revealed no effect on the prevention of decentration and tilt compared to one relaxing incision. Some authors suggest a 6.5 mm optic PMMA IOL in the case of radial tears in CCC to prevent later decentraton.[14] I suggest not to perform an additional opposing radial tear,

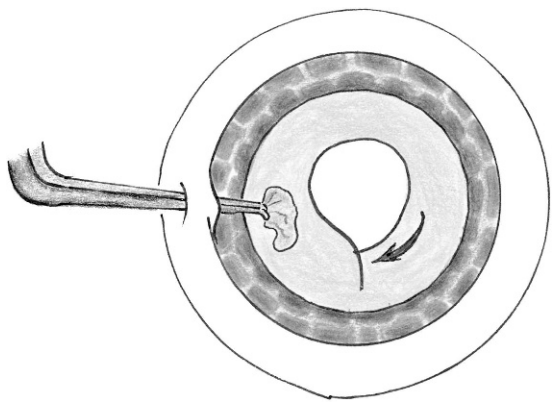

FIGURE 4. Completing the capsulorhexis with a superior radial tear.

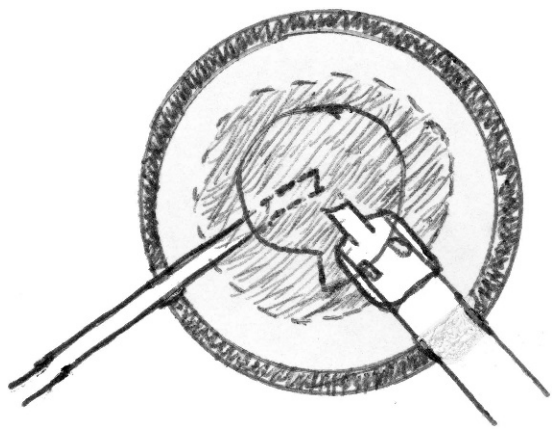

FIGURE 5. Engagement of nucleous between phacotip and the second instrument for cracking the nucleous.

continue with decophaco and finally implanting a 3-piece foldable IOL with a 6-mm optic and overall diameter of 13 mm [Acrysof® (MA60BM) IOLs (Alcon)]. This has the benefit of using a foldable hydrophobic acrylic IOL with an acceptable optic size and resistant haptics that minimizes the risk of IOL decentration and may be implanted safely in the ciliary sulcus even in children.[14] In conditions that the rhexis is completely decentered and/or the zonular integrity is poor such as PEX syndrome, I prefer to put the IOL in the ciliary sulcus to prevent further IOL decentration or dislocation due to asymmetric zonular support and capsular contraction after surgery.

In conclusion, cortical aspiration of anterior lens materials prior to PE exempts the surgeon from complete hydrodissection and even rotation of nucleus in the case of high risk irregular capsulorhexis with radial tear and/or weak zonules, and enables him to continue the entire PE uneventfully. It may also be suggested in special conditions where hydrodissection is high risk; such as cases with posterior polar cataracts, patients with history of vitreoretinal surgery and traumatic cataracts with zonular dehisance.

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CLINICIAN'S CORNER

What are Your Tricks to Avoid and Manage a Capsular Tear During Capsulorrhexis?

L. Felipe Vejarano
Alejandro Tello
Popayan, Columbia

An intact CCC is a crucial step in an uneventful phacoemulsification. If the capsulorrhexis extends toward the periphery the principal cause is the convexity of the anterior lens surface. This can be caused by vitreous pressure, a shallow anterior chamber and a big capsulorrhexis, which is seen with prominent anterior zonular fibers and of course, hydropic hypermature cataracts. The first action that you can do to avoid its extension is flattening the anterior lens surface and the best method is reinflating the anterior chamber with a very good cohesive OVD. Then with a stable anterior chamber you have several options to finish the capsulorrhexis. The best way for me is to inflate enough, but not over inflate, because it also can increase the tear, and always try to fold the capsular flap over itself, directing the force centripetally, grasping the anterior capsule not too close, but also not too far from the tear edge (1–2 mm), to have a complete control of the movements and change the direction of the tear. Almost always you can redirect it and finish with a mild decentered but continuous capsulorrhexis, and you can perform your standard Phaco in a regular manner. If it was impossible to redirect the tear, try in the opposite direction, but always with a stable AC and when you are near to the tear try to complete from outside to inside, avoiding the notch at the CCC and its risk to extend to the posterior capsule.

Also there are some kinds of capsules with a consistency that is not elastic, but is rigid, and is impossible to fold it over and may cause a direct tear to the periphery, even in hands of the more experienced surgeon. I have noted this in metabolic cataracts, and also happens when there is an underneath fibrosis.