Oval capsulorhexis for phacoemulsification in posterior polar cataract with preexisting posterior capsule rupture

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We describe use of an oval capsulorhexis rather than the conventional circular capsulorhexis for phacoemulsification in posterior polar cataract with preexisting posterior capsule rupture. An oval capsulorhexis minimizes the turbulence in the capsular bag by increasing the area available for efflux of fluid. It also enables end-to-end nuclear sculpting, removal of the nuclear fragment from the bag, intraocular lens (IOL) implantation, and vitrectomy without stretching the capsular bag. The smaller axis of the oval capsulorhexis facilitates optic capture of a sulcus-fixated IOL. The oval capsulorhexis can be used safely for phacoemulsification of all grades of nuclear sclerosis in posterior polar cataract with preexisting posterior capsule rupture.

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POSTERIOR POLAR CATARACT WITH PREEXISTING POSTERIOR CAPSULE RUPTURE

Posterior polar cataract with preexisting posterior capsule rupture is a clinically distinct entity characterized by a central, dense, disk-shaped opacity located on the posterior capsule with a surrounding opening in the posterior capsule.1,2 Phacoemulsification in this situation is challenging as there is a significant chance of nucleus drop during the surgery. Little data about such cases are available. We have been performing phacoemulsification of posterior polar cataracts using an oval capsulorhexis with good results (unpublished data). We describe our technique and report the results in 10 eyes.

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SURGICAL TECHNIQUE

Eyes with a classic bull’s-eye appearance (concentric rings around the central opacity) with a surrounding posterior capsule rupture with or without flecks in the anterior vitreous are identified by slitlamp examination (Figures 1, A, 2, A, 3, A, and 4, A). The extent and meridian of the posterior capsule rupture are documented.

Surgery is performed under peribulbar anesthesia. Peribulbar anesthesia is preferred in case of an unexpected nucleus drop, which would be managed by a retinal surgeon in the same sitting. All patients are informed about this possible complication.

A 2.8 mm clear corneal tunnel is created between 10 o’clock and 12 o’clock. The incision site is not determined by the meridian of the preexisting posterior capsule rupture or the preoperative keratometry. The anterior chamber is formed with hydroxypropyl methylcellulose, and an oval capsulorhexis of approximately 8.0 mm by 4.5 mm is created with a bent 26-gauge needle. The axis of the capsulorhexis is the same as the meridian of the corneal incision, irrespective of the meridian of the preexisting posterior capsule rupture (Figure 1, B).

Gentle and complete hydrodelineation is performed using a 24-gauge bent cannula; hydrodissection is not done. Completion of hydrodelineation is indicated by the formation of a single golden ring
(Figure 1, C). This maneuver may be incomplete in cases of a very hard nucleus and can be abandoned after 1 attempt.

Slow motion phacoemulsification is performed with low irrigation (bottle height 60 cm), low flow rate (15 to 20 cc/min), and low vacuum (60 to 80 mm Hg) using the stop-and-chop technique in grade 2 to grade 4 nuclear sclerosis and phacoaspiration in grade 1 nuclear sclerosis. The nucleus is not rotated during the stop-and-chop technique. After a trough is created to the periphery of the nucleus (Figure 1, D), the nucleus is divided into 2 halves. Each half is manually hooked out of the capsular bag into the pupillary plane using a Sinskey hook and emulsified in the pupillary plane (Video 1, available at http://jcrsjournal.org). Before the nucleus halves are manually brought out of the bag, the anterior chamber is filled with an ophthalmic viscosurgical device (OVD) to push the vitreous face back. The manipulations are very gentle, with no backward force. The Sinskey hook is used to keep the outer

Figure 1. Case 2. A: Preoperative picture showing posterior polar cataract with preexisting posterior capsule rupture with grade 2 nuclear sclerosis. B: Intraoperative picture showing oval capsulorhexis performed with bent 26-gauge needle. C: Intraoperative picture showing hydrodelineation using a 24-gauge cannula. D: Intraoperative picture showing trench formation in the axis of the oval capsulorhexis. E: Intraoperative picture showing completion of surgery after IOL implantation in the capsular bag.
nuclear shell in place while the nuclear fragment is peeled away.

After the inner firm nucleus is removed, the epinucleus is removed by viscoexpression after the incision is enlarged or by the irrigation/aspiration (I/A) cannula. The anterior chamber is filled with OVD before the phacoemulsification handpiece or I/A probe is removed from the eye. This maneuver prevents sudden decompression and hence vitreous prolapse. The cortex is removed by manual dry aspiration with a 24-gauge or 26-gauge cannula attached to a 1.0 cc syringe after hydroxypropyl methylcellulose is injected into the anterior chamber.

A single-piece foldable acrylic intraocular lens (IOL) is placed in the bag where the posterior capsule opening is not at full length and the peripheral rim of the posterior capsule is present (Figure 1, E). The IOL is implanted without an injector if the incision is enlarged and with an injector if the incision is not enlarged (Video 1, available at http://jcrsjournal.org). If the posterior capsule rupture is full length, a single-piece or multipiece poly(methyl methacrylate) IOL is placed in the sulcus with capsulorhexis capture (Video 2, available at http://jcrsjournal.org) (Figure 4, B). This is achieved after the corneal incision is enlarged. The incision is sutured with 10-0 nylon sutures at the end of surgery. The residual OVD is gently aspirated using an I/A cannula and the corneal tunnel hydrated with balanced salt solution.

Postoperatively, topical betamethasone sodium phosphate 0.1% is prescribed 4 times a day tapered over 4 weeks and ciprofloxacin 0.3%, 4 times a day for 1 week.

**Results**

Phacoemulsification using an oval capsulorhexis has been performed by the same surgeon (K.S.) in 10 eyes of 8 patients who had posterior polar cataract with a preexisting posterior capsule defect. The mean age of the 7 men and 1 woman was 53 years (40 to 78 years). The mean preoperative corrected distance visual acuity was 0.221 (decimal equivalent), which improved to 0.75 (decimal equivalent) after surgery. The clinical data are summarized in Table 1.

A nuclear chopper was not used in any case, and a Sinskey hook was used as a second instrument in all cases. Minimal or no extension of preexisting tears in the posterior capsules occurred during the surgery. Nucleus drop did not occur in any patient, and the IOL was stable in all patients postoperatively. The minimum follow-up was 6 months. No patient had cystoid macular edema. The edge of the oval capsulorhexis was not seen through the undilated pupil in any patient postoperatively, and no patient reported glare...
or halos (Figure 2, A and B, Figure 3, A and B, Figure 4, A and B).

Two patients had full-length preexisting posterior capsule ruptures, and both had cortical matter flecks in the anterior vitreous. To clean the flecks, anterior vitrectomy was performed after IOL implantation in the ciliary sulcus, with optic capture by the anterior capsule edge. The approach to the ruptured posterior capsule and anterior vitreous was easy even after IOL implantation because of the oval capsulorhexis (Figure 4, C). No patient had vitreous prolapse at any stage of surgery.

**DISCUSSION**

Phacoemulsification in posterior polar cataract is a challenge to the anterior segment surgeon. The incidence of posterior capsule rupture during removal of the polar opacity is reported as 26% by Osher et al. and 36% by Vasavada and Singh. The surgery becomes more difficult when there is an associated pre-existing posterior capsule rupture. Many surgical innovations and modifications have been tried to prevent complications during phacoemulsification in posterior polar cataract. The aim of the surgical technique in such cases is to minimize the turbulence and pressure in the anterior chamber and capsular bag, preventing posterior capsule rupture or extension of a preexisting posterior capsule rupture. To achieve this, slow motion phacoemulsification (low vacuum, low aspiration flow rate, low bottle height, and high phacoemulsification power) and gentle hydrodelineation without hydrodissection is recommended.

A few studies have highlighted the importance of the capsulorhexis size during phacoemulsification in cases of posterior polar cataract with preexisting posterior capsule rupture. Most previous studies of phacoemulsification in posterior polar cataract aimed at a 5.0 to 5.5 mm circular curvilinear capsulorhexis (CCC). Vasavada and Singh favored a smaller capsulorhexis (4.5 mm) in phacoemulsification in posterior polar cataract to capture the optic of the sulcus-fixated posterior capsule IOL (PC IOLs) in cases of large posterior capsule rupture to avoid optic–iris touch and to have good IOL stability; however, Pong and Lai suggest a larger CCC (5.5 to 6.0 mm) in phacoemulsification of hard cataracts with posterior polar cataract. The larger capsulorhexis was advocated to facilitate insertion of the instruments for chopping the hard nucleus.

We have performed phacoemulsification in posterior polar cataracts using the oval capsulorhexis for the past 3 years and found it very compatible with any phacoemulsification technique in posterior polar cataract with any grade of nuclear sclerosis. A smaller
capsulorhexis, although helpful for optic capture, stretches the capsular bag during phacoemulsification, especially during insertion of the instruments to chop a hard nucleus and during IOL implantation. A large capsulorhexis has the advantage of causing minimum turbulence in the capsular bag during phacoemulsification and IOL implantation, but it lacks the above-mentioned advantage of a smaller capsulorhexis. It also fails to retain nuclear fragments in the capsular bag, and these may touch the endothelium.

The oval capsulorhexis has the advantages of both small and large capsulorhexes during phacoemulsification of posterior polar cataracts. The main advantage of the oval capsulorhexis is the large opening in the anterior capsule, hence a larger area for continuous eflux of fluid during hydro procedures and handling the nucleus or IOL during phacoemulsification. This minimizes the turbulence within the capsular bag, which restricts extension of the preexisting rupture. A large vertical opening in the anterior capsule makes it safe to perform end-to-end nuclear sculpting, which enables easy division of the nucleus. The larger available area of the oval capsulorhexis facilitates insertion of the instruments in the bag for chopping a hard nucleus or manually removing the nuclear fragments out of the bag without stretching the anterior capsule. In our series, 2 cases of hard cataract were successfully phacoemulsified using the stop-and-chop technique. Accessibility to the epinucleus and cortex (including subincisional cortical matter) is greater with an oval capsulorhexis than with a conventional small curvilinear capsulorhexis. The oval capsulorhexis also smooths IOL entry into the capsular bag without stretching the anterior or posterior capsule. In cases in which vitrectomy is required, the vitrectomy probe can be inserted from the larger meridian of the oval capsulorhexis without tilting the IOL or causing pressure on the capsular bag. We performed phacoaspiration or layer-by-layer phacoemulsification in soft cataracts and modified stop-and-chop in harder cataracts. We found the ease and safety of performing phacoemulsification was greater with any technique using the oval capsulorhexis than with the small circular capsulorhexis.

One significant advantage of the smaller meridian of the oval capsulorhexis is the ease of optic capture of the IOL haptic in cases of sulcus-placed posterior chamber IOLs. The smaller meridian of the oval capsulorhexis also retains the remaining nuclear fragments within the bag while 1 fragment is being emulsified; the remaining fragments might otherwise come out of the bag, especially in a large capsulorhexis, and damage the endothelium. The shorter meridian of the oval capsulorhexis tamponades the forward bulging vitreous mushroom. The smaller axis of the oval capsulorhexis can enter the pupillary plane if it is smaller than 4.0 mm. In such cases, the capsulorhexis can be enlarged on both sides with the help of a Vannas scissors after surgery is completed.

We performed oval capsulorhexis in the 12 o’clock to 6 o’clock meridian because in most of our cases, we operated through a superior corneal incision. However, we think the ideal meridian of oval capsulorhexis should be perpendicular to the preexisting rupture to minimize stress on the edges of the rupture. This may be particularly important when the posterior capsule rupture is full length.

In all our cases, the IOL haptics were placed perpendicular to the axis of the preexisting posterior capsule rupture to minimize the stress on its edges. This might not hold true when optic capture is done after the IOL is placed in the ciliary sulcus. In this case, the IOL has

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<th>Case</th>
<th>Age (Y)</th>
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<th>LOCS Grading</th>
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<th>Vit</th>
<th>IOL Material</th>
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NS = nuclear sclerosis; PA = phacoaspiration; Phaco Tech = phacoemulsification technique; S-C = stop and chop; Vit = vitrectomy

Table 1. Preoperative, intraoperative, and postoperative clinical data of patients with posterior polar cataract with preexisting posterior capsule rupture.
to be placed in the axis of the oval capsulorhexis to capture the optics with the capsulorhexis edge. None of our cases had IOL tilt.

None of our cases had vitreous prolapse during the surgery, and we performed vitrectomy to clean the flecks in the anterior vitreous, which might otherwise have caused visual disturbances. We think there were 2 reasons for having no vitreous prolapse. First, we ensured there was no sudden decompression of the anterior chamber. This was achieved by forming the anterior chamber with the OVD before removing the phacoemulsification handpiece or the I/A probe from the eye. Second, we used the oval capsulorhexis. A small CCC gets stretched during IOL insertion, allowing the OVD to escape out of the capsular bag. Hence, the IOL haptic may touch the posterior chamber, and the pressure used to maneuver the IOL into the bag may lead to an increase in the rupture. With the oval capsulorhexis, since a larger surface area is available, the IOL goes into the capsular bag without much pressure and does not extend the posterior capsule tear.

In conclusion, we think the oval capsulorhexis makes it safer and easier to perform phacoemulsification in cases of posterior polar cataract with preexisting rupture.

REFERENCES

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