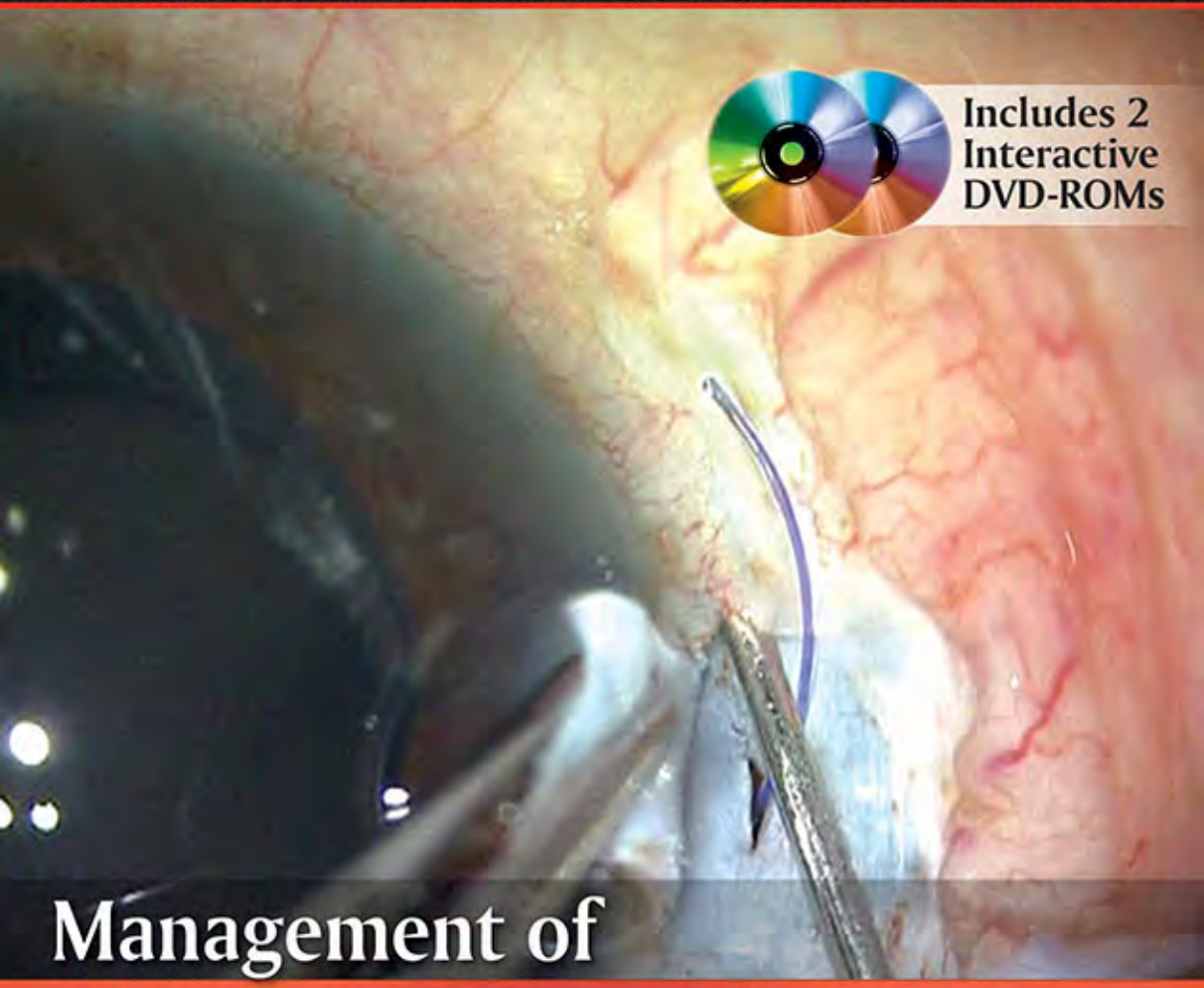
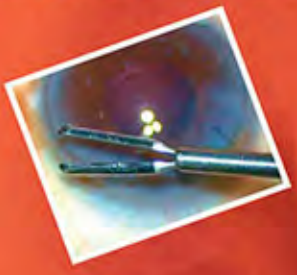
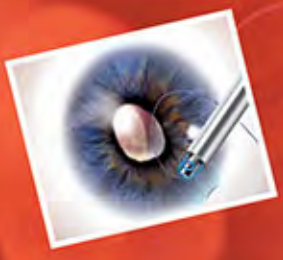
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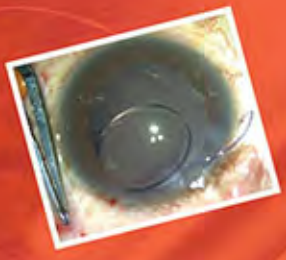


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CHAPTER 2

Posterior Capsular Rupture

Dhivya Ashok Kumar, Amar Agarwal

INTRODUCTION

Any breach in the continuity of the posterior capsule is defined as a posterior capsule tear. Intrasurgical posterior capsule tears are the most common and can occur during any stage of cataract surgery.[1,2,3] The incidence of posterior capsule complications is related to the type of cataract and conditions of the eye, increases with the grade of difficulty of the case, and furthermore is influenced by the level of experience of the surgeon. Timely recognition and a planned management, depending upon the stage of surgery during which the posterior capsule tear has occurred, is required to ensure an optimal visual outcome.

COMMON RISK FACTORS FOR POSTERIOR CAPSULAR RUPTURE

The common risk factors for posterior capsular rupture (PCR) are as follows:

- Intraoperative factors causing variation in anterior chamber depth
- Type of cataract
- Extended rhexis.

Intraoperative Factors Causing Variation in Anterior Chamber Depth

Intraoperative shallow anterior chamber could be due to various reasons. It may be a tight lid speculum, tight drapes, or pull from the recollecting bag. In all the above cases, remove the precipitating factor (Remove the speculum pressure, remove the tight drapes and collecting bags). Variation in the amount of space in the anterior and posterior chambers may result from changes in the intraocular pressure (IOP) due to an alteration in the equilibrium between inflow and outflow of fluid. Diminished inflow may be secondary to insufficient bottle height, tube occlusion or compression, bottle emptying, too tight incisions compressing the irrigation sleeve, or the surgeon moving the phaco tip out of the incision, making the irrigation holes come out of the incision. Excessive outflow may be caused by

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too high vacuum/flow parameters, or too large incisions with leakage. Another cause is the postocclusion surge. Use of air pump or gas forced infusion solves most of these problems of intraoperative shallow anterior chamber.[1]

Type of Cataract

A higher incidence of posterior capsule tear with vitreous loss is associated with cataract with pseudoexfoliation, diabetes mellitus, and trauma. Missing the diagnosis in a posterior polar cataract (Fig. 2.1) can be catastrophic to the surgeon and the patient. It is frequently associated with a weakened or deficient posterior capsule. Posterior lenticonus, cataracts with persistent primary hyperplastic vitreous, cataracts following vitreoretinal surgery and morgagnian cataracts are some of the other types. In any intraoperative diagnosis of posterior polar cataract, avoid hydrodissection with BSS. Hydrodissection may cause hydraulic perforation at the weakened area of the capsule, hence only a careful controlled hydrodelineation is preferred. One can also make multiple pockets of viscoelastic injection around the nucleus. If a capsular tear does occur, a closed system should be maintained by injecting viscoelastic before withdrawing the phaco tip. This helps to tamponade the vitreous backwards where a capsular dehiscence is present.

Extended Rhexis

Extension of anterior capsule can occur as a complication in MICS also. During capsulorhexis, anterior capsular tears can cause posterior capsule tear by

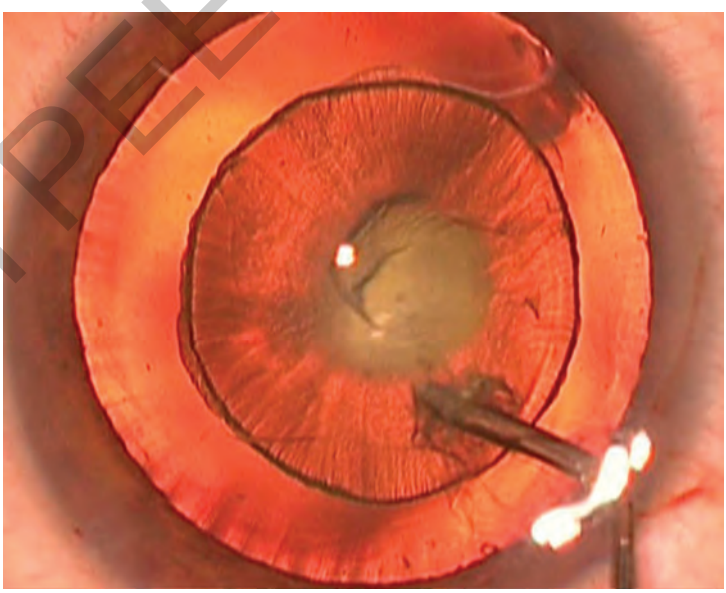


Fig. 2.1 Hydrodelineation is being performed in a posterior polar cataract

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extending to the periphery. In a new method of managing this situation, a nick is made from the opposite side of the rhexis using a cystitome or vannas and the capsulorhexis is completed. The viscoelastic in the anterior chamber (AC) is then expressed out to make the globe hypotonous, following which a gentle hydrodissection is done at 90 degrees from the tear while pressing the posterior lip of the incision to prevent any rise in intraocular pressure (IOP). No attempt is made to press on the center of the nucleus to complete the fluid wave. The fluid is usually sufficient to prolapse one pole of the nucleus out of the capsular bag; else it is removed by embedding the phacoemulsification probe, making sure not to exert any downward pressure and then gently pulling the nucleus anteriorly. The whole nucleus is brought out into the AC and no nuclear division techniques are tried in the bag. The entire nucleus is prolapsed into the anterior chamber and emulsified.

STEPS FOR MANAGEMENT OF POSTERIOR CAPSULAR RUPTURE

Surgeon should be aware of the signs (Table 2.1) of posterior capsular tear. Posterior capsule tears can occur during any stage of phacoemulsification surgery. They occurred most frequently during the stage of nuclear emulsification, as reported by Mulhern et al [4] (49%) and Osher et al [5], and during irrigation–aspiration, as reported by Gimbel et al[6].

Three possible situations can happen in a posterior capsule rent namely[7]:

1. Posterior capsule tear with hyaloid face intact and nuclear material present.
2. Posterior capsule tear with hyaloid face ruptured without luxation of nuclear material into vitreous.
3. Posterior capsule tear with hyaloid face ruptured and luxation of nuclear material into vitreous.

Immediate precautions are to be taken not to do further hydrate the vitreous and not to increase the size of the PCR. The conventional management consists of prevention of mixture of cortical matter with vitreous, dry aspiration, and anterior vitrectomy, if required. In addition, during phacoemulsification low flow rate, high vacuum, and low ultrasound are advocated if a posterior capsule tear occurs.

TABLE 2.1 Signs of posterior capsular rupture (PCR)

- Sudden deepening of the chamber, with momentary expansion of the pupil
- Sudden, transitory appearance of a clear red reflex peripherally
- Apparent inability to rotate a previously mobile nucleus
- Excessive lateral mobility or displacement of the nucleus
- Excessive tipping of one pole of the nucleus
- Partial descent of the nucleus into the anterior vitreous space
- 'Pupil snap sign'—sudden marked pupil constriction after hydrodissection

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Fig. 2.2 Posterior capsular rupture. Note the IOL sinking into the vitreous cavity. The white reflex indicates nuclear fragments also in the vitreous cavity. This patient was managed by vitrectomy, SPAL technique (for removal of the nuclear fragments) and the IOL repositioned in the sulcus

Reduce the parameters: Lowering aspiration flow rate and decreasing the vacuum will control surge and will allow the bottle to be lowered, diminishing turbulence inside the eye. If the nucleus is soft, only a small residual amount remains, and there is no vitreous prolapse, the procedure may be continued. If vitreous is already present, special care must be taken for preventing additional vitreous prolapse into the anterior chamber or to the wound. Small residual nucleus or cortex can be emulsified by bringing it out of the capsular bag and can be emulsified in the anterior chamber with viscoelastic underneath the corneal endothelium. In case of a small PCR and minimal residual nucleus (Fig. 2.2), a dispersive viscoelastic is injected to plug the posterior capsule tear. Subsequently the nuclear material is moved into the anterior chamber with a spatula and emulsified. The recommended parameters are low bottle height (20–40 cm above the patient's head), low flow rate (10–15 cc/min), high vacuum (120–200 mm Hg) and low ultrasound (20–40%).

Dry cortical aspiration: If there is only a small amount or no vitreous prolapse in the presence of a small capsular rent, a dry cortical aspiration with 23 G cannula can be performed.

Viscoexpression: It is a method of removal of the residual nucleus by injecting viscoelastic underneath the nucleus to support it and the nucleus is expressed along with the viscoelastic.

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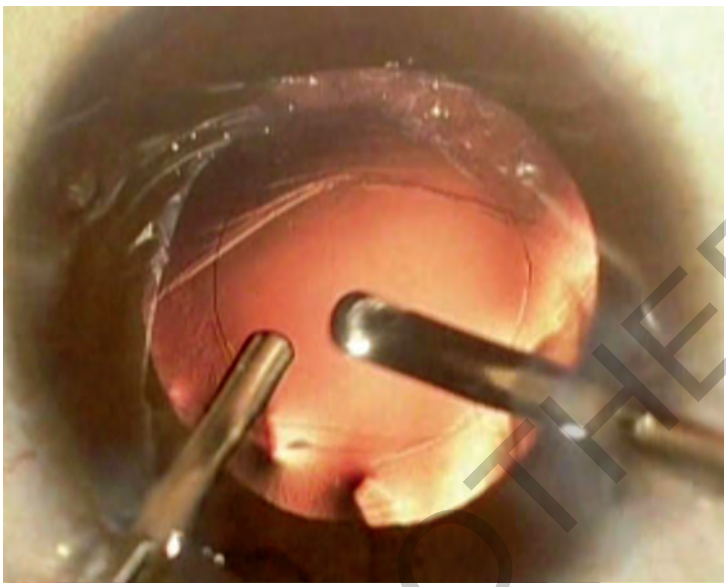


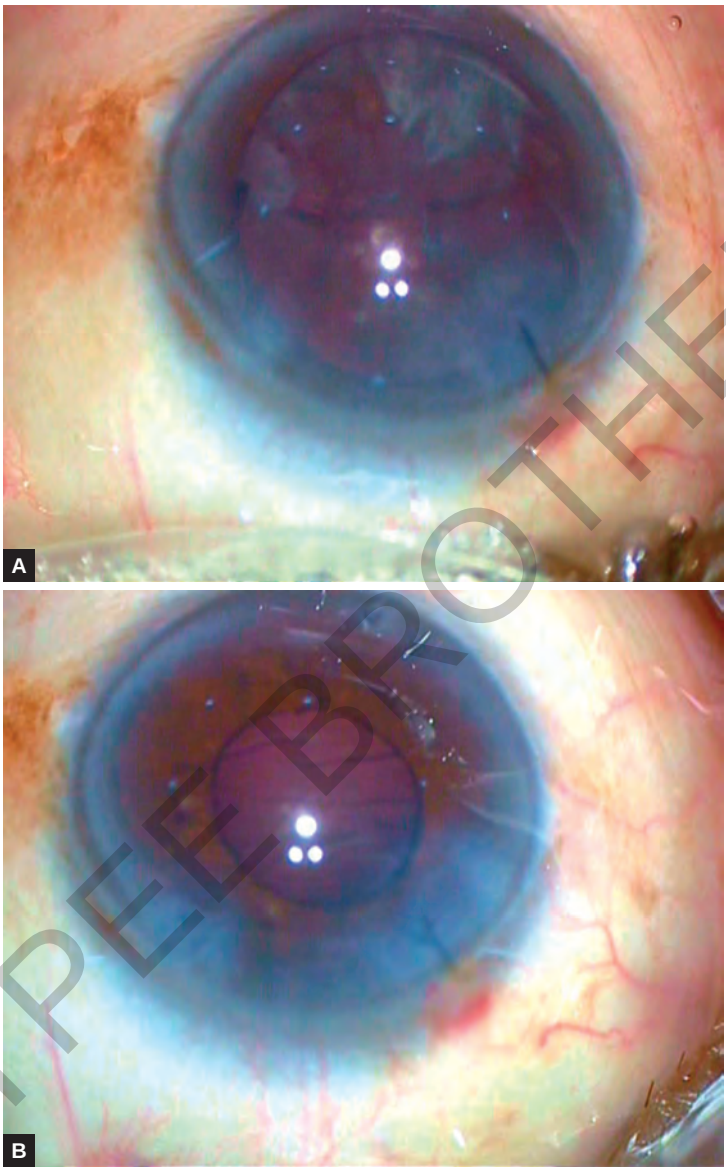
Fig. 2.3 Bimanual vitrectomy is being performed in a posterior capsular tear with vitreous prolapse

Conversion to ECCE: If there is sizeable amount of residual nucleus, it is advisable to convert to a large incision ECCE to minimize the possibility of a dropped nucleus.

Anterior bimanual vitrectomy: Bimanual vitrectomy (Fig. 2.3) is done in eyes with vitreous prolapse. Use 23 G irrigating cannula via side port after extending the side port incision. The irrigation bottle is positioned at the appropriate height to maintain the anterior chamber during vitrectomy. Vitrectomy should be performed with cutting rate (500–800 cuts per minute), an aspiration flow rate of 20 cc/min, and a vacuum of 150 to 200 mm Hg.

Anterior chamber cleared of vitreous: Vitrectomy is continued in the anterior chamber and the pupillary plane. A rod can be introduced into the anterior chamber to check the presence of any vitreous traction and the same should be released. Complete removal of the vitreous from the anterior chamber can be confirmed if you see a circular, mobile pupil (Figs 2.4A and B) and complete air bubble in the anterior chamber. The usage of the fiber of an endoilluminator, dimming the room lights and microscope lights, may be useful in cases of doubt, in order to identify vitreous strands. Another useful measure is the use of purified triamcinolone acetate suspension (Kenalog) to identify the vitreous described by Peyman [8]. Kenalog particles remain trapped on and within the vitreous gel, making it clearly visible.[9]

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Figs 2.4A and B Clinical photograph showing the change in the anterior chamber after complete removal of the vitreous from the anterior chamber. (A) Before vitrectomy; (B) After vitrectomy

Suture the wound: In cases with vitreous loss with PCR, it is recommended to suture the corneal wound as a prophylaxis to prevent infection. Remove any residual vitreous in the incision site in the main and side port with vitrector or manually with vannas scissors. If necessary insert a rod via the side port, and pass it over the surface of the iris, to release them.

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TABLE 2.2 Intraocular lens implantation in posterior capsular rupture

- Insertion and rotation of IOL should always be away from the area of capsule tear
- The long axis of the IOL should cross the meridian of the posterior capsule tear
- Eyes with (< 6 mm) PCR with no vitreous loss, IOL can be placed in the capsular bag
- In the presence of a posterior capsule tear (>6 mm) with adequate anterior capsule rim, an IOL can be placed in the sulcus
- In deficient capsules, glued IOL is a promising technique without complications of sutured scleral fixated or anterior chamber IOL.

Intraocular lens implantation: Depending upon the state of the capsular bag and rhexis, IOL is implanted (Table 2.2).

In the bag: In the presence of a posterior capsule tear with good capsular bag, the IOL can be placed in the bag. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed.

In the sulcus: If the rent is large, if the capsular rim is available, then the IOL can be placed in the sulcus. The rigid IOL can be placed in the sulcus in large PCR over the residual anterior capsular rim with Mc Person forceps holding the optic. The "chopstick technique" is another method of placing IOL in sulcus. In this new chopstick forceps namely, 'Agarwal- Katena forceps' (Figs 2.5A and B) is used for IOL implantation. This chopstick technique refers to the IOL being held between two flangs of the forceps. The advantage is the smooth placement of the IOL in the sulcus without excess manipulation. Moreover the IOL implantation is more controlled (Figs 2.6A to D) with the forceps as compared to other methods. Small PCR with no vitreous loss and good capsular bag, foldable IOL can be placed (Figs 2.7A and B). In eyes with intraoperative miosis with PCR, IOL can be implanted with the pupil expansion with "Agarwal's modified malyugin ring" method (Figs 2.8A and B). In this method,[10] a 6-0 polyglactic suture is placed in the leading scroll of the Malyugin ring and injected into the pupillary plane (Figs 2.9A and B). The end of the suture stays at the main port incision. Once in place, the ring produced a stable mydriasis of about 6.0 mm. Hereby IOL can implanted easily in the sulcus with visualization and this prevents the inadvertent dropping of the iris expander into the vitreous during intraoperative manipulation.

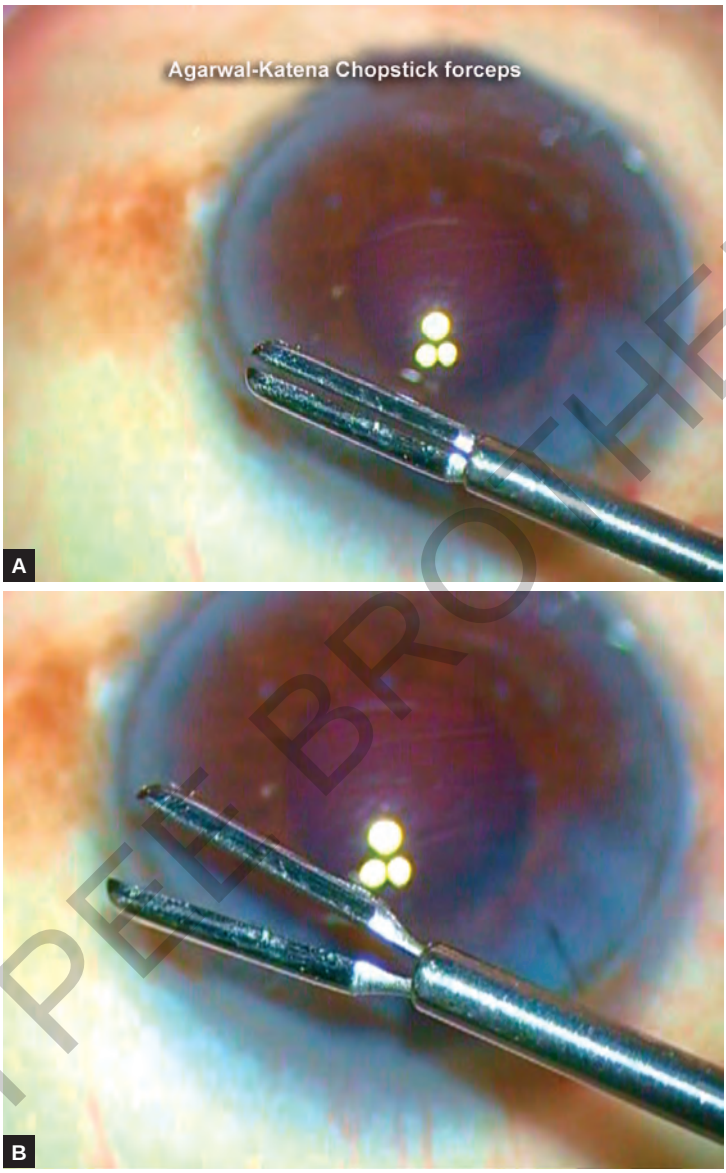
Deficient Posterior Capsule

Glued IOL[11,12,13] is easily performed in such cases with deficient posterior capsules. Scleral fixated posterior chamber lenses and anterior chamber IOLs[14,15] can also be implanted when the posterior capsule tear is large.

SEQUELAE AFTER POSTERIOR CAPSULAR RUPTURE

Vitreous traction: Incomplete vitrectomy can produce dynamic traction on the retina leading to retinal breaks.

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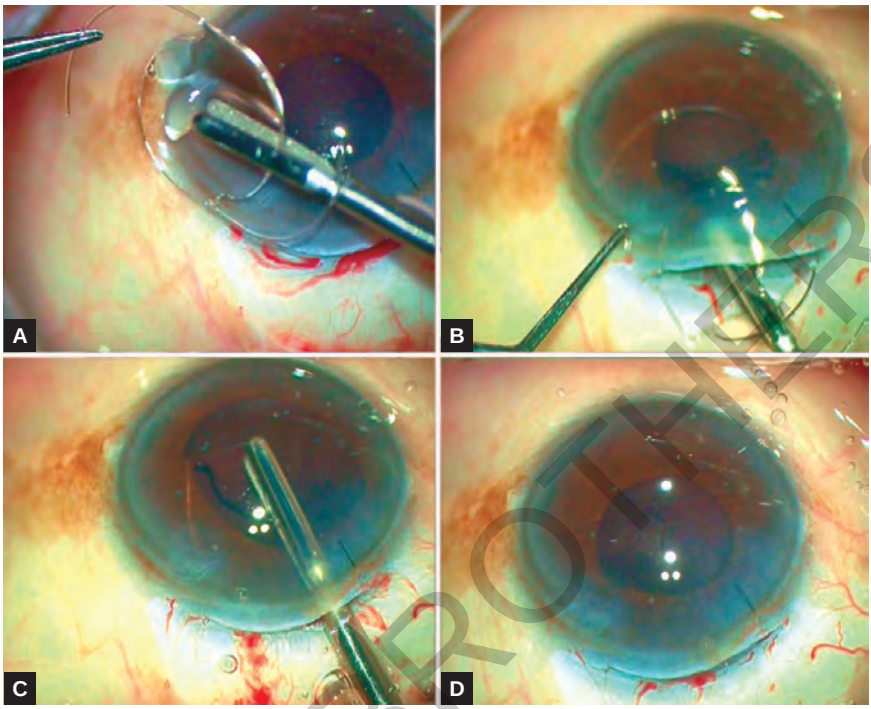


Figs 2.5A and B Photograph of an 'Agarwal- Katena' forceps. Reverse opening shown (left) (Katena, USA)

Retinal detachment: Undetected long standing vitreous traction progresses to retinal break and detachment.

Macular edema: Manipulation of vitreous will increase not only the traction transmitted to the retina but also the inflammation in the posterior segment, and the risk of macular edema.

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Figs 2.6A to D (A) The 6.5 mm PMMA rigid IOL being held between two flags of the forceps; (B) IOL is being introduced through the limbal incision; (C) IOL is positioned in the sulcus; (D) IOL is well centered

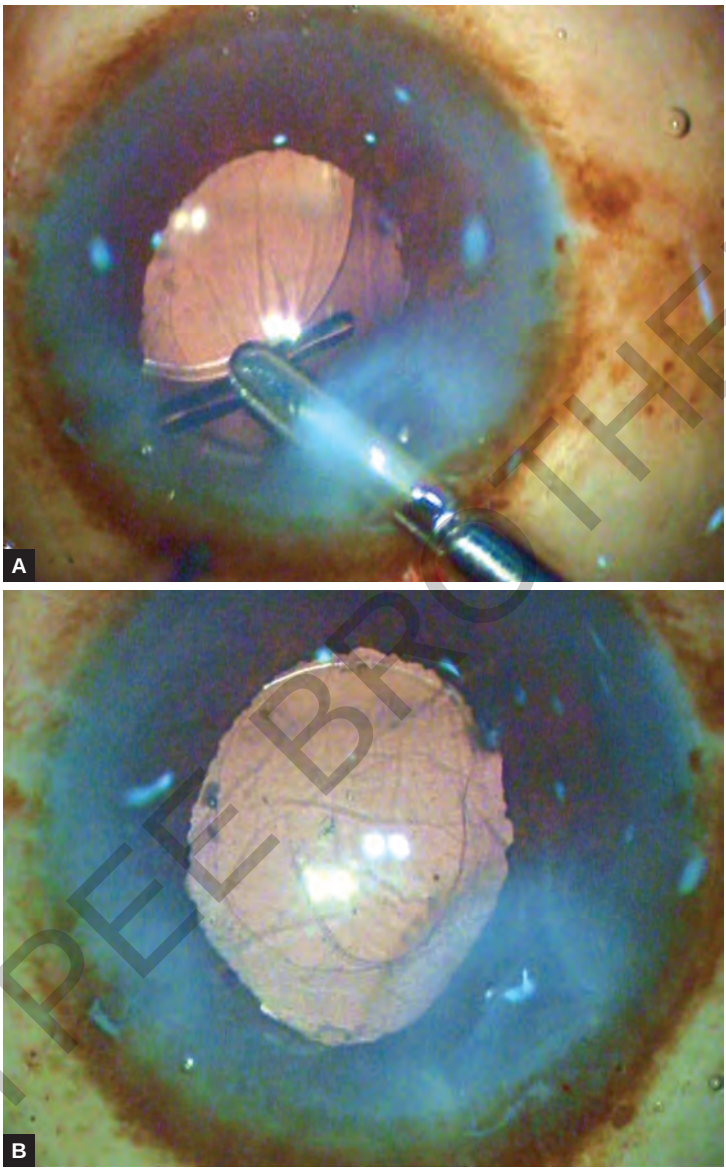
Vitritis: Over enthusiastic use of viscoelastic into the vitreous can lead to sterile inflammation. Dropped minimal residual cortex can also present with post-operative vitritis.

Intraocular lens related complications: Improperly placed IOL in the sulcus can lead to lens induced astigmatism and tilt.

CONCLUSION

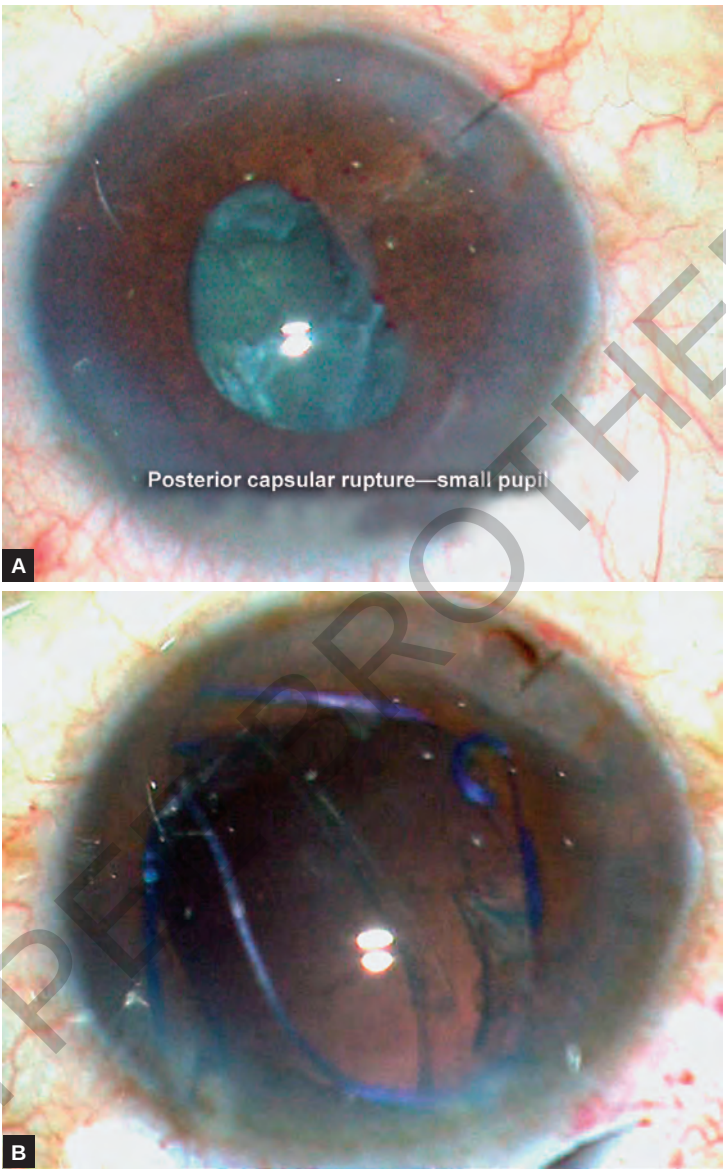
The occurrence of a posterior capsule tear during cataract surgery is one of the most serious complications. It is important for a surgeon to diagnose the occurrence of a posterior capsule tear at an early stage to avoid further enlargement of the tear and associated vitreous complications. The primary goal of all the maneuvers is to remove the remaining nucleus, epinucleus, and as much cortex as possible without causing vitreoretinal traction.

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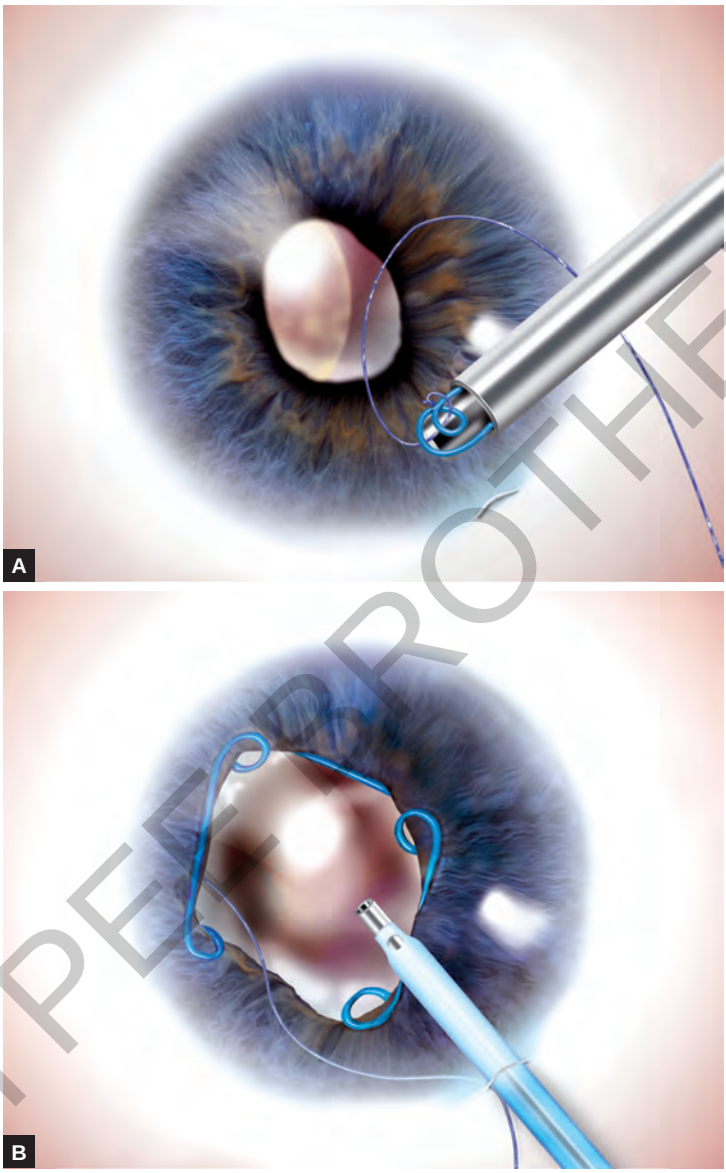
Figs 2.7A and B (A) Foldable IOL is placed with 'Agarwal–Katena' forceps into the sulcus; (B) IOL is well centered on the capsular rim

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Figs 2.8A and B (A) Intraoperative miosis with posterior capsular tear; (B) Agarwal's modification of the Malyugin ring iris expansion: A 6-0 polyglactic vicryl suture passed in the leading scroll of the ring and injected. The end of the suture stays at the main port incision

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Figs 2.9A and B Illustration depicting the Agarwal modification of the Malyugin ring for cases with small pupil with a posterior capsular rupture. (A) 6/0 suture tied to the ring; (B) Malyugin ring is place in the pupil. The suture can be pulled at if the ring begins to fall into the vitreous

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Amar Agarwal MS FRCS FRCOphth is the Chairman and Managing Director, Dr Agarwal's Group of Eye Hospitals and Eye Research Center, Chennai, Tamil Nadu, India. He was the Past-President, International Society of Refractive Surgery (ISRS) and Secretary General, Indian Intraocular Implant and Refractive Society (IIRSI). He is the pioneer of Phakonit Technology, which became popularized as Bimanual Phaco, Microincision Cataract Surgery (MICS) or Microphaco. He is the first to remove cataracts through a 0.7 mm tip with the technique called Microphakonit. He has discovered No Anesthesia Cataract Surgery and FAVIT, a new technique to remove dropped nuclei and also discovered a new refractive error called Aberropia. He is also the first Surgeon to implant a new mirror telescopic IOL (LMI) for the patients suffering from age-related macular degeneration. He has also been the first in the world to implant a glued IOL. Dr Agarwal's Eye Hospital has done for the first time an anterior segment transplantation in a 4-month-old child with anterior staphyloma and for the first time a glued endocapsular ring in cases of subluxated cataract.

Pre-Descemet's Endothelial Keratoplasty (PDEK) was started by him. In this, the Pre-Descemet's layer and the Descemet's membrane with endothelium are transplanted en bloc in patients with diseased endothelium. Dr Agarwal's Eye Hospital has also done for the first time CACXL or Contact lens-assisted collagen crosslinking, a new technique for crosslinking thin corneas.

He has received many awards for his work done in ophthalmology—most significant being the Casebeer Award, Barraquer Award and Kelman Award. He has performed more than 150 live surgeries at various conferences. He has also written more than 60 books which have been published in various languages—English, Spanish and Polish. He also trains doctors from all over the world in his center on Phaco, Bimanual Phaco, LASIK and retina.



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