A posterior polar cataract is a rare form of congenital cataract with incidence ranging from 3 to 5 in 1000\(^1\)\(^{-2}\). It is bilateral in 65–80% of the cases with no gender predilection\(^3\). Posterior polar cataract presents a special challenge to the surgeon because of its predisposition to posterior capsular dehiscence and possible nucleus drop during surgery.

The high incidence of PC rupture during surgery may be due to tight adherence of the plaque to an otherwise normal capsule, thin PC underlying the plaque that ruptures to minimal trauma and congenitally absent PC.

**Classification**

Duke-Elder classified it as stationary and progressive forms\(^4\). The *stationary form*, which is more common (about 65%), is a well-circumscribed circular opacity, localized on the central posterior capsule. The concentric thickened rings around the central plaque opacity give an appearance of a *Bull’s-eye*. Sometimes, the opacity is camouflaged by nuclear sclerosis. Sometimes there is a smaller satellite rosette lesion adjacent to the central opacity. Progression may begin in any decade. In the *progressive type*, whitish opacification take place in the posterior cortex in the form of radiating rider opacity. It has feathery and scalloped edges but they do not involve the nucleus. Both stationary and progressive posterior polar cataract may become symptomatic.

*Singh classified posterior polar cataract into*\(^5\):

**Type 1:** The posterior polar opacity is associated with posterior subcapsular cataract.

**Type 2:** Sharply defined round or oval opacity with ringed appearance like an onion with or without grayish spots at the edge.

**Type 3:** Sharply defined round or oval white opacity with dense white spots at the edge often associated with thin or absent PC. These dense white spots are a diagnostic sign (Daljit Singh sign) of posterior capsule leakage and extreme fragility.

**Type 4:** Combination of the above 3 types with nuclear sclerosis.

Schroeder\(^5\) on the other hand graded posterior polar cataract in his pediatric patients according to its effect on pupillary obstruction in the red reflex testing as follows:

**Grade 1:** A small opacity without any effect on the optical quality of the clear part of the lens.

**Grade 2:** A two-thirds obstruction without other effect.

**Grade 3:** The disc-like opacity in the posterior capsule is surrounded by an area of further optical distortion. Only the dilated pupil shows a clear red reflex surrounding this zone.

**Grade 4:** The opacity is totally occlusive; no sufficient red reflex is obtained by dilation of the pupil.

**Clinical presentation**
Posterior polar cataract presents as a distinctive discoid lens opacity situated posteriorly, adjacent to the posterior capsule. The typical symptoms are increasing glare while driving at night and difficulty in reading fine prints. The reasons for delayed presentation may be increasing density of the opacity, age-related pupillary miosis, or increased functional needs. If it is visually significant since childhood, it might present with strabismus indicating amblyopia in that eye.

Slit-lamp examination and pupillary retroillumination allow good evaluation of the visual significance of the opacity. When posterior polar cataract is fully formed, it presents as a dense, circular plaque in the central posterior part of the lens giving rise to “bull’s-eye” appearance (concentric rings around the central opacity). It can be surrounded by vacuoles and smaller areas of degenerated lens material. Examination of the anterior vitreous may reveal oil-like droplets or particles. The presence of such finding should raise the possibility of pre-existing capsular opening.

**Timing of Surgery**

Timing of surgery is crucial. While it should be delayed as long as the patient is able to perform his routine activities, it must be balanced against the potential of a posterior capsule (PC) defect developing in an intact capsule, as well as the relative technical difficulty in performing phacoemulsification in advanced cataracts. Furthermore, when it is visually significant in childhood, it is considered amblyogenic. All these reasons emphasize the importance of early intervention in these cases.

**Counseling**

During the preoperative examination, the physician should inform the patient of the possibility of a PC rupture, a relatively long operative time, secondary posterior segment intervention, and a delayed visual recovery. In addition, the possibility of leaving the patient aphakic should be explained. Also, the need for Nd:YAG capsulotomy for residual plaque should be discussed and the possibility of preexisting amblyopia, especially in cases of unilateral posterior polar cataract should be emphasized. Genetic counseling for parents in addition to screening of family members is important.

**Anesthesia**

Local and topical anesthesia can be utilized. Peribulbar anesthesia may be preferred, especially for novice surgeons, as it provides prolonged action and reduces positive vitreous pressure. This is in contrast to topical anesthesia, in which squeezing the lids with a speculum can distort the globe. Increased eye movement and lack of hypotony would increase the forward movement of the posterior capsule.

**Phacoemulsification**

The incision

A temporal clear corneal incision, as routinely performed for all patients, is preferable for topical anaesthesia surgery. It is important to ensure that the accessories used during the procedure (i.e. phaco tip, sleeve etc) correspond to the incision size, else this would result in an incision that is too tight or one that is leaky, resulting in an unstable anterior chamber during the procedure.

The capsulorhexis

The capsulorhexis should be between 4.5 to 5.5mm in size (Figure 1). A larger opening may not leave adequate support for a sulcus-fixated IOL if the posterior capsule is compromised. However, it should not be too small (<4 mm) for several reasons. A smaller capsulorhexis may increase the hydrostatic pressure during hydrodelineation and subsequent nuclear emulsification and may jeopardize the nuclear, epinuclear or cortical matter removal. Additionally, if vitreous loss occurs during phacoemulsification, it is easier to manually prolapse the nucleus into the anterior chamber in the presence of a large capsulorhexis without having to further enlarge it.

**Hydrodissection and hydrodelineation**
Cortical cleaving hydrodissection is considered a contraindication in eyes with Type 3 and 4 posterior polar cataracts. However, gentle hydrodissection may be done for type 1 and 2 cases, wherein pre-operative examination has ruled out a PC defect. Nuclear rotation is avoided in all cases. Meanwhile, hydrodelineation, which is the separation between the nucleus and the epinucleus, is mandatory to create a mechanical cushion of epinucleus (Figure 1). Following a continuous curvilinear capsulorhexis, multiple fluid injections are undertaken in a controlled manner to hydrodelineate the nucleus from the epinucleus. Vigorous decompression of the capsular bag after the delineation should be avoided.

**Inside-out delineation**

Vasavada and Raj described a technique for posterior polar cataracts with advanced nuclear sclerosis called inside-out delineation\(^7\). In this technique, a trench is first sculpted and a right-angled cannula is used to subsequently direct fluid perpendicularly to the lens fibers in the desired plane through one wall of the trench. This would avoid the possibility of inadvertent subcapsular injection and overcome the difficulty of introducing cannula to a significant depth in a dense cataract.

**Parameters of the phacoemulsification machine**

We prefer a slow motion phacoemulsification with low vacuum, low aspiration and low inflow parameters to ensure a more stable anterior chamber. Ultrasound energy 40-70%, vacuum 250-270 mmHg, aspiration flow rate (AFR) 18-20 cc/ min and bottle height of 70-80 cm is recommended. The parameters are adjusted appropriately according to the density of cataract. The low vacuum and aspiration rates maintain a very stable chamber and the reduced infusion drives less fluid around the lens.

**Nucleotomy techniques**

The technique of nuclear emulsification varies with the grade of nuclear sclerosis. During the procedure, it is important to avoid collapse of the anterior chamber as this might cause the anterior tenting of the posterior capsule and can lead to spontaneous rupture. This can be done by judicious injection of a dispersive viscoelastic through the side port incision before withdrawal of the phacoemulsification tip. In addition, nuclear rotation and aggressive nuclear cracking techniques with wide separation of fragments should be avoided.

For grade 1 nuclear sclerosis, we prefer sculpting (Figure 2) followed by sequential layer-by-layer aspiration using partial segmentation technique\(^8\). The wedge shaped cortical material is gradually aspirated till the central area of the posterior polar cataract (which may or may not have a preexisting defect) is reached. The cortical material is mechanically separated from the central plaque from approximately 3-4 mm outside the central area with the aid of a second instrument such as a chopper or a Sinskey hook. This maneuver avoids traction at the posterior pole, which may otherwise be generated from attempting to directly aspirate the cortical matter. The penultimate layer is carefully aspirated leaving the posterior plaque along with a thin layer of the cortex. This reduces undue stress on the posterior capsule. The posterior plaque is then viscodissected and aspirated with the automated irrigation aspiration probe. The advantage of layer-by-layer phacoemulsification\(^10\) is the availability of an adequate cushion throughout the procedure, which is available during debulking of the nucleus. Further, the visibility of the plaque is enhanced as the subsequent layers are gradually peeled off by aspiration.

For grade 2 and 3 nuclear sclerosis, a small central trench is made followed by quadrantic division of the nucleus. Each nuclear piece is then pulled towards the centre and emulsified without rotation. Removal of each segment creates adequate space for fragmenting the subsequent segments. This facilitates nuclear emulsification without undue stress on the posterior capsule.

For advanced nuclear sclerosis, a crater and chop technique is used. In this, a central large crater is made leaving the epinuclear plate intact, followed by chopping without nuclear rotation.

If case of a PC plaque, if it is strongly adherent to the capsule that could not be peeled off even by viscodissection, the safest option is to leave the plaque untouched for later Nd-YAG laser capsulotomy.

**Pseudohole**
At times, the classic appearance suggestive of a defect may be observed in the posterior cortex when the posterior capsule actually remains intact. This phenomenon is known as a pseudohole (Figure 2).

**Posterior capsular dehiscence**

If a defect is present in the posterior capsule, a dispersive viscoelastic, Viscoat, is injected over the area of defect before withdrawing the phaco or I/A probe from the eye. If the vitreous face is intact, the cortex is aspirated with bimanual I/A. A posterior capsulorhexis may be performed if the rupture is confined to a small central area, although most cases of posterior polar cataract have a linear PC defect extending up to the equator, distinct from that observed in other cases of PC rupture. This linear defect is not amenable for conversion to a PCCC in most cases. In the case of a vitreous disturbance, a two port limbal anterior vitrectomy using a high cut rate, low vacuum and flow rates, vitrectomy can be safely performed even close to the torn capsule. Typical parameters are cut rate 800 cuts/ min; vacuum 200 mm Hg and AFR 20 cc/min. The vitrector is never placed behind the peripheral posterior capsule. The infusion cannula is directed into the peripheral anterior chamber, and the fluid jet is directed toward the angle of the chamber, away from the defect. This reduces turbulence near the tip of the cutter and avoids enlarging the capsular tear. It also reduces hydration of the vitreous and forward movement of vitreous into the anterior chamber. Once the anterior chamber is free of vitreous, which is confirmed by injecting preservative free triamcinolone acetonide into the anterior chamber, the remaining cortex is aspirated.

**Intraocular lens (IOL) implantation**

It depends on whether or not there is a capsular tear. If there is none or the size of the PC rupture is small or it could be converted to a round one, single piece IOL can be implanted in the bag.

In eyes where the posterior capsule is compromised, the remaining capsular support is evaluated to choose the site for intraocular lens fixation. It is safer to compress the trailing haptic rather thansubjecting the capsular bag to rotational forces that may extend the tear. If the tear is large, a multipiece IOL has to be placed in the ciliary sulcus with or without rhexis capture. The advantage of capturing the optic by the rhexis is to stabilize the IOL and to reduce the contact of optic with iris. In cases in which there is a big rupture with questionable zonular integrity, it would be safer to implant an anterior chamber IOL, suturing an IOL to the sclera, or planning an intra-scleral haptic fixation of IOL with glue. The main valvular incision should be sutured in eyes with a PC defect. These eyes should be periodically evaluated for retinal break, cystoid macular edema, and raised IOP.

**Posterior Polar Cataract in children**

Posterior Polar Cataract has been identified in 7% of eyes of children undergoing congenital cataract surgery. Unlike adult eyes, PPC occurs as unilateral cataract in a majority of pediatric eyes (93%). The preoperative diagnostic signs of a pre-existing posterior capsule defect in children include a well-demarcated defect with thick margins, chalky white spots in a cluster or a rough circle on the posterior capsule, and white dots in the anterior vitreous that move with the degenerated vitreous like a fish tail sign.

The surgical paradigms for cataract surgery in eyes of children with PPC remain essentially similar to those used in adult eyes. The anterior chamber is first entered using a paracentesis incision. It is then filled with a high-viscosity 1.4% sodium hyaluronate. A clear corneal incision is made. An anterior capsulorhexis is initiated by making a nick with a 26-gauge cystotome, and thereafter completed using micro-forceps by repeatedly grasping the flap. No hydroprocedures are performed. If a thin posterior capsule with well-demarcated margins or a capsular flutter is noticed, posterior capsulectomy and vitrectomy are performed with a vitrector. While carrying out vitrectomy, the goal is to remove only the central anterior vitreous without attempting to remove the peripheral or posterior vitreous. This is followed by in-the-bag implantation of IOL. All the incisions are sutured.

**Fellow eye examination**

It is imperative to examine the fellow eye in all cases, particularly those with complicated surgery in one eye. In these cases presenting with an ACIOL or sulcus IOL in one eye, one should keep in mind the possibility of a pre-existing risk factor for PC rupture/ PC defect such as a posterior polar cataract. The subsequent eye should be thoroughly
examined to rule out this entity, though it may be difficult in cases of advanced nuclear sclerosis or mature cataracts, and surgery should be done with all necessary precautions.

**Bimanual microphacoemulsification in posterior polar cataracts**

Bimanual microphacoemulsification technique with separate infusion and aspiration instruments placed through watertight incisions 1.4 mm in width has been advocated by some authors in cases of posterior polar cataract. Besides having a controlled operating environment for slow motion phacoemulsification, the advantages of this technique lie primarily in the following: (1) allowing withdrawal of the phaco-needle first while maintaining the anterior chamber with infusion from the separate irrigating chopper, and (2) easy injection of viscoelastic into the anterior chamber before final withdrawal of the irrigating chopper.

**Summary**

- All cases of posterior polar cataract need thorough examination and pre-operative counseling
- Pre-operatively, vitrectomy equipment should be ready
- A dispersive viscoelastic (eg Viscoat) should be available
- Adequate-sized and complete CCC should be achieved
- Hydrodissection is avoided, delineation is a must
- Nucleus rotation should be avoided
- Sudden anterior chamber collapse should be avoided at all times during the surgery
- Slow motion phaco with low flow parameters are used
- Most importantly, surgeon should continue with his routine technique which he is well versed in and comfortable with, rather than trying a new technique for these cases

**References**