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Posterior Polar Cataract – Assessment of Risk Factors and Surgical Outcome.

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Abstract

Background: Posterior polar cataract is a relatively uncommon form of cataract associated with an increased risk of PCR (Posterior Capsular Rupture) during surgery due to the inherent weakness and thinning of the posterior capsule. This study evaluates the surgical and visual outcomes and assesses the risk factors associated with posterior capsular rupture in patients with posterior polar cataract. ***Methods: A*** prospective study involving 50 eyes of patients diagnosed with posterior polar cataract was conducted at Regional Eye Hospital, Kurnool, from April 2024 to May 2026. Patients underwent either phacoemulsification or SICS (Small Incision Cataract Surgery). Preoperative clinical findings, surgical techniques, intraoperative complications and postoperative visual outcomes were documented. Visual acuity was assessed on postoperative day 1, at 1 week and at 6 weeks. ***Results:*** The mean age of presentation was 45 years, with 50% of patients belonging to the 40–60-year age group. Pure posterior polar cataract was observed in 50% of eyes, while 36% had associated nuclear sclerosis and 14% had posterior subcapsular cataract. Phacoemulsification was performed in 60% of cases and SICS in 40%. Posterior capsular rupture was the most common intraoperative complication, occurring in 5 (10%) eyes, including 2 cases in the phacoemulsification group and 3 in the SICS group. Postoperative visual acuity improved significantly ($p<0.001$), with 96.7% of eyes in the phacoemulsification group and 100% in the SICS group achieving visual acuity of ≥6/36 at six weeks. ***Conclusion:*** Posterior polar cataract remains a surgical challenge due to the increased risk of posterior capsular rupture. Careful preoperative evaluation, appropriate surgical technique, maintenance of anterior chamber stability and gentle handling of the posterior capsule can minimize complications and achieve favourable visual outcomes.

Keywords: Posterior Polar Cataract, Posterior Capsular Rupture, Phacoemulsification, Small Incision Cataract Surgery, Visual Outcome.

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INTRODUCTION

Posterior polar cataract is a distinct form of cataract characterized by a well-defined, circular, disc-shaped opacity located at the posterior pole of the crystalline lens. It is usually congenital and may occur sporadically or follow an autosomal dominant inheritance pattern.[1] Its clinical significance lies in the increased risk of intraoperative complications, particularly PCR (Posterior Capsule Rupture), due to abnormal adhesion between the opacity and the posterior capsule or pre-existing capsular weakness.[2] Cataract surgery in eyes with PPC is challenging because posterior capsule rupture may result in vitreous loss, displacement of lens material into the vitreous cavity, and difficulties with IOL (Intraocular Lens) implantation.[3] The reported incidence of PCR varies considerably across studies, depending on patient characteristics, surgical techniques, and the surgeon's experience.[1] Younger age and larger posterior polar opacities have been associated with an increased risk of capsular rupture in some studies.[4]

Preoperative assessment is essential for identifying potential risk factors and planning appropriate surgical management. Slit-lamp examination helps characterize the opacity, while AS-OCT (Anterior Segment Optical Coherence Tomography) can assist in evaluating posterior capsular integrity and identifying areas of capsular thinning or dehiscence.[5] Careful surgical planning, avoidance of conventional hydrodissection, maintenance of anterior chamber stability, and gentle manipulation of lens material are important strategies for minimizing complications.[2] Despite the technical challenges, satisfactory postoperative visual outcomes can be achieved with appropriate surgical techniques. However, complications

such as PCR, vitreous loss, and nucleus drop may necessitate additional surgical interventions and influence visual recovery.[4] Therefore, identifying preoperative risk factors and evaluating intraoperative complications and postoperative visual outcomes are essential for improving the safety and effectiveness of cataract surgery in these patients.

Aims and Objectives

The study aimed to assess the risk factors associated with posterior capsular rupture in posterior polar cataracts and to evaluate the surgical and postoperative visual outcomes. The study also aims to describe the surgical techniques employed, identify intraoperative complications and the stage at which they occur, document postoperative visual outcomes, and assess the need for any additional postoperative interventions.

MATERIALS AND METHODS

Study Design

The present study was conducted as a prospective observational study involving 50 eyes of patients diagnosed with posterior polar cataracts who presented to the Regional Eye Hospital, Kurnool, during the study period from April 2024 to May 2026.

Inclusion and Exclusion Criteria

The study included eyes with typical posterior polar cataract, either alone or associated with nuclear sclerosis or posterior subcapsular cataract. Eyes undergoing combined surgical procedures, those with corneal pathology, glaucomatous damage, or coexisting retinal pathology were excluded. Eyes with any other ocular pathology that could impair vision, apart from cataract, subluxated lens, and zonular dehiscence, were also excluded.

Data Collection Procedure

Medical records of patients diagnosed with posterior polar cataract who underwent cataract surgery at the Regional Eye Hospital, Kurnool, between April 2024 and May 2026 were reviewed. A total of 50 eyes fulfilling the inclusion criteria were selected for the study. Preoperative data, including age, sex, presenting visual symptoms, eye selected for surgery, UCVA (Uncorrected Visual Acuity), BCVA (Best-Corrected Visual Acuity), anterior segment findings, type of posterior polar cataract, associated nuclear sclerosis or posterior subcapsular cataract, presence of pre-existing capsular defects, intraocular pressure, dilated fundus findings, A-scan biometry and keratometry, were recorded. Intraoperative details, including the type of surgical procedure performed, surgical technique, occurrence and stage of intraoperative complications, interventions undertaken, type and placement of intraocular lens, and presence of residual posterior plaque or primary capsular opacity, were documented. Postoperative visual acuity, both UCVA and BCVA, was assessed using Snellen's chart on postoperative day 1, at 1 week and at 6 weeks. Any postoperative complications and additional interventions, if required, were also recorded. All patients underwent surgery by experienced surgeons under retrobulbar anaesthesia, using either manual small-incision cataract surgery or phacoemulsification. Postoperatively, patients received topical antibiotic-steroid combination eye drops for six weeks, followed by topical steroids in tapering doses.

Statistical Analysis

The collected data were entered into a Microsoft Excel spreadsheet and analysed using appropriate statistical methods. Descriptive statistics were used to summarise the demographic and clinical characteristics of the study population. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean with standard deviation or median with interquartile range, as appropriate. Preoperative and postoperative visual acuity outcomes were compared to assess visual improvement following surgery. The incidence of intraoperative complications, particularly posterior capsular rupture, was calculated and expressed as percentages. Associations between potential risk factors and the occurrence of posterior capsular rupture were evaluated using appropriate statistical tests. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1. Demographic Profile and Laterality of the Study Population

Variable	Category	Number	Percentage (%)
Age	30–40 years	9	18.0
	40–60 years	25	50.0
	Above 60 years	16	32.0
Gender	Male	25	50.0
	Female	25	50.0
Study eye	Left eye (LE)	26	52.0
	Right eye (RE)	24	48.0
Total		50	100

Table 1 illustrates the demographic characteristics and laterality of the 50 study subjects. Half of the participants were aged 40–60 years (25; 50.0%). Males and females were equally represented (25; 50.0% each). Left eye involvement was observed in 26 cases (52.0%), while the right eye was involved in 24 cases (48.0%). The youngest patient was 30 years and the oldest was 78 years.

Table 2. Axial Length and Type of Posterior Polar Cataract

Variable	Category	Number of eyes	Percentage (%)
Axial length	≤24 mm	38	76.0
	>24 mm	12	24.0
Type of PPC	Pure posterior polar cataract	25	50.0
	Nuclear sclerosis with PPC	18	36.0
	Posterior subcapsular cataract with PPC	7	14.0
Total		50	100

Table 2 illustrates the axial length distribution and the clinical type of posterior polar cataract among the 50 study eyes. An axial length of ≤24 mm was recorded in 38 eyes (76.0%), while 12 eyes (24.0%) had an axial length greater than 24 mm. Pure PPC was present in 25 eyes (50.0%), PPC with nuclear sclerosis in 18 eyes (36.0%), and PPC with posterior subcapsular cataract in 7 eyes (14.0%).

Table 3. Type of Cataract Surgery Performed

Type of surgery	Number of eyes	Percentage (%)
Phacoemulsification	30	60.0
Small incision cataract surgery (SICS)	20	40.0
Total	50	100

Table 3 illustrates the distribution of surgical procedures performed in the study population. Phacoemulsification was performed in 30 eyes (60.0%), while 20 eyes (40.0%) underwent small incision cataract surgery.

Table 4. Intraoperative Complications According to Surgical Technique

Intraoperative Outcome	Phaco (n=30)	SICS (n=20)	Total (n=50)
No complications	28 (93.3%)	17 (85.0%)	45
Posterior capsular rupture (PCR)	2 (6.7%)	3 (15.0%)	5
Total	30	20	50

Table 4 illustrates the occurrence of intraoperative complications in the phacoemulsification and SICS groups. No intraoperative complication was recorded in 45 eyes. Posterior capsular rupture occurred in 5 eyes (10.0% overall), including 2 eyes (6.7%) in the phacoemulsification group and 3 eyes (15.0%) in the SICS group. The difference between the groups was not statistically significant (chi-square test, p=0.33).

Table 5. Postoperative Visual Acuity at Baseline and Follow-Up

Group	Time Point	Median Snellen equivalent	LogMAR (Mean ± SD)	Min–Max	Within-group p-value*
Phaco	Baseline	6/60	0.91 ± 0.31	0.30–1.78	—
	Day 1	6/12	0.36 ± 0.19	0.00–0.78	<0.001
	1 week	6/9	0.19 ± 0.13	0.00–0.48	<0.001
	6 weeks	6/6	0.11 ± 0.11	0.00–0.30	<0.001
SICS	Baseline	6/36	0.83 ± 0.27	0.30–1.18	—
	Day 1	6/18	0.43 ± 0.20	0.18–0.78	<0.001
	1 week	6/12	0.21 ± 0.13	0.00–0.48	<0.001
	6 weeks	6/9	0.14 ± 0.10	0.00–0.30	<0.001
Overall	Baseline	6/60	0.88 ± 0.29	0.30–1.78	—
	Day 1	6/12	0.39 ± 0.20	0.00–0.78	<0.001
	1 week	6/9	0.20 ± 0.13	0.00–0.48	<0.001
	6 weeks	6/6	0.12 ± 0.11	0.00–0.30	<0.001

Table 5 illustrates the visual acuity changes from baseline to six weeks after surgery. In both surgical groups, mean LogMAR visual acuity improved at each postoperative assessment. In the phacoemulsification group, mean LogMAR improved from 0.91 ± 0.31 at baseline to 0.11 ± 0.11 at six weeks. In the SICS group, it improved from 0.83 ± 0.27 to 0.14 ± 0.10. The overall mean LogMAR improved from 0.88 ± 0.29 at baseline to 0.12 ± 0.11 at six weeks. Within-group comparisons showed p<0.001 at each postoperative follow-up.

Table 6. Baseline and Final Visual Status in the Two Surgical Groups

Assessment	Visual acuity	Phaco n (%)	SICS n (%)
Baseline	≥6/36	9 (30.0%)	10 (50.0%)
	<6/36	21 (70.0%)	10 (50.0%)
Final (6 weeks)	≥6/36	29 (96.7%)	20 (100%)
	<6/36	1 (3.3%)	0 (0%)

Table 6 illustrates the proportion of eyes achieving visual acuity of ≥6/36 before and after surgery. At baseline, 9 eyes (30.0%) in the phacoemulsification group and 10 eyes (50.0%) in the SICS group had visual acuity of ≥6/36. At six weeks, this increased to 29 eyes (96.7%) and 20 eyes (100%), respectively.

DISCUSSION

Posterior polar cataract is a demanding lens opacity because the opacity adheres firmly to an abnormally thin posterior capsule, predisposing the eye to PCR[6,7] In this prospective study of 50 eyes managed with modified closed-chamber techniques, PCR occurred in 5 eyes (10%), and 96.7% of eyes in the phacoemulsification group and 100% in the manual SICS group achieved a visual acuity of 6/36 or better at 6 weeks.

Demographic Profile

Our patients were aged 30 to 78 years, and half (50%) were between 40 and 60 years, supporting the view that PPC presents in a relatively young population. Pathak et al.[8] reported comparable mean ages of 47.6 ± 10.4 years (phacoemulsification) and 49.5 ± 12.0 years (SICS), Aswin et al.[9] reported 53.8 ± 12.4 years in 388 eyes, and Siatiri and Moghimi[10] a younger cohort (mean 33.5 years). The sex distribution in the present study was equal (25 males, 25 females), in agreement with Pathak et al.[8] (52.2% and 53.8% males in the two groups) and Aswin et al.[9] (46.6% males), confirming that PPC has no sex predilection.

Cataract Type and Surgical Technique

Pure PPC accounted for 50% of our eyes, 36% had associated nuclear sclerosis and 14% had associated posterior subcapsular cataracts. Phacoemulsification was performed in 60% and SICS in 40%. Pathak et al.[8] similarly compared both techniques (107 phacoemulsification and 57 SICS eyes) and concluded that both can be used safely. Siatiri and Moghimi[10] followed the same principle and recorded no PCR in 38 eyes.

Posterior Capsule Rupture

PCR was the most common intraoperative complication in our study (5 of 50 eyes, 10%). This is considerably lower than the 26% reported by Osher et al.[6] 36% by Vasavada and Singh[7] and 31% by Das et al.[3] and close to the 11.6% (19 of 164 eyes) of Pathak et al.[8] and the 9.0% (35 of 388 eyes) of Aswin et al.[9] Hayashi et al.[11] reported a somewhat lower rate (7.1%, 2 of 28 eyes), Siatiri and Moghimi[10] none, and Stanić et al.[12] 28.5% (4 of 14 eyes) in a very small series. The wide range probably reflects differences in era, technique, case mix and surgeon experience. Osher et al.[6] and Das et al.[3] included extracapsular extraction. Das et al[3] also found PCR to be more frequent with extracapsular extraction than phacoemulsification and in patients under 40 years, supporting our preference for closed-chamber surgery.

Phacoemulsification versus SICS

PCR occurred in 2 of 30 phacoemulsification eyes (6.7%) and 3 of 20 SICS eyes (15.0%), a non-significant difference ($p = 0.33$). Pathak et al.[8] found a similar pattern (10.3% versus 14.0%, $p = 0.506$), suggesting that with careful technique SICS is not clearly inferior to phacoemulsification in PPC, although neither study was powered to detect a small difference.

Stage of PCR

Both phacoemulsification ruptures occurred during nucleus emulsification, whereas two of three SICS ruptures occurred during epinucleus removal and one during cortical aspiration. Aswin et al.[9] likewise found that most PCRs (51.4%) occurred during nucleus emulsification, and Osher et al[6] noted that ruptures occurred during removal of the opacity or cleaning of the posterior capsule. Epinucleus removal is therefore a critical step in manual surgery; Nagappa et al[13] described a modified epinucleus removal technique that considerably reduced PCR. In all five of our eyes, viscoelastic was used to tamponade the rent, the cortex was aspirated dry, bimanual anterior vitrectomy was performed, and a three-piece IOL was placed in the bag or sulcus according to support. Vasavada and Singh[7] placed the haptics in the sulcus in 8 of their 9 eyes with PCR.

Visual Outcome

Visual acuity improved significantly in both groups (logMAR 0.91 ± 0.31 to 0.11 ± 0.11 with phacoemulsification and 0.83 ± 0.27 to 0.14 ± 0.10 with SICS; $p < 0.001$ for both), and the proportion of eyes with 6/36 or better rose from 30.0% to 96.7% and from 50.0% to 100%, respectively. Aswin et al.[9] reported improvement in mean BCVA from 0.50 to 0.02 logMAR at 1 month with 93.0% of eyes achieving 6/9 or better, and Siatiri and Moghimi[10] reported 20/40 or better in

89.4% of eyes, in keeping with our results. Pathak et al.[8] found better 1-month BCVA after phacoemulsification than SICS (6/6 in 87% versus 67%), but acknowledged better preoperative vision in their phacoemulsification group. In our series baseline acuity (p = 0.421) and 6-week acuity (p = 0.512) did not differ between groups, so we found no evidence that technique affected the final visual result.

One eye did not improve because of dense amblyopia, the commonest cause of a poor final result in PPC: Hayashi et al.[11] found it in 4 of 28 eyes, Siatiri and Moghimi[10] in 8 of 38 and Stanić et al.[12] in most eyes with unsatisfactory improvement. Aswin et al.[9] also observed that eyes with PCR had poorer acuity on day 1 but not at 1 month, indicating that an appropriately managed rupture need not compromise final vision.

Factors Contributing to the Low PCR Rate

We attribute our 10% rate to careful preoperative slit-lamp assessment for pre-existing capsular dehiscence, preoperative counselling, controlled hydrodelineation without hydrodissection or rotation, low-flow fluidics with stable chamber maintenance, leaving the central posterior plaque until the last step of cortical aspiration, and the availability of bimanual vitrectomy. This is consistent with Kapoor et al.[14] who concluded that controlled surgery with well-defined methods yields satisfactory outcomes with a low incidence of PCR.

CONCLUSION

The present study concludes that posterior polar cataracts commonly present at a younger age, with a mean age of 45 years, and glare and difficulty with night driving being the predominant symptoms. Posterior capsular rupture was the most common intraoperative complication, occurring in approximately 10% of cases. Despite the surgical challenges, significant improvement in postoperative visual acuity was observed. Careful preoperative assessment, appropriate modifications in surgical technique, minimal manipulation of the posterior capsule, adequate patient counselling and close postoperative follow-up are essential for achieving favourable surgical outcomes.

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