ORIGINAL ARTICLE

An Analytical Study of Surgical and Visual Outcome of Posterior Polar Cataract in Phacoemulsification Surgery

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Abstract:
Background and Objectives: Posterior Polar cataract(PPC) presents as a dense, circular plaque with concentric rings involving mainly the posterior subcapsular and capsular region. It has classically been described to have a "Bull's eye" or onion peel appearance. Ultra structurally, PPC is associated with either a thin and fragile posterior capsule with the discoid opacity being adherent to it, or posterior capsule may be congenitally deficient. Thus the risk of posterior capsule rupture is exceptionally high in posterior polar cataracts than other type of cataracts. The present study aims to evaluate the surgical and visual outcome of phacoemulsification surgery in eyes with posterior polar cataract (PPC). It also aims to observe intraoperative and post-operative complications of phacoemulsification surgery in patients with posterior polar cataract. *Material and Methods:* A Hospital based cross sectional analytical study was carried out on patients with posterior polar cataract at the Department of Ophthalmology, at a tertiary care centre. The study duration was between October 2019 to October 2021. Fifty-four individual eyes were identified with age more than 18 years and willing to be a part of study. Patients with complicated cataract, glaucoma, corneal opacity/corneal degeneration, ocular trauma, previous ocular surgery, retinal pathology and any other ocular pathologies were excluded from study. All patients underwent complete ophthalmological examination including visual acuity, thorough anterior segment examination with slit lamp biomicroscopy and posterior segment examination.Patients were posted for phacoemulsification surgery with posterior chamber intraocular lens implantation (PCIOL).

Keywords: Posterior Polar cataract, Posterior capsule rent, Phacoemulsification, Surgical techniques, Pre-existing capsular dehiscence.

Introduction:

Lens opacities can present with wide variations ranging from a white dot in anterior lens capsule toa total opacity that is dense and involves all lens structures. It can be zonular, sub capsular, polar, nuclear,sutural, total and membranous. Posterior polar cataract is an important morphological presentation of lens opacity. [(1)]It is a common and visually significant form of congenital cataract. [(2)]In 65-80% of the cases it is bilateral and with no gender predilection. [(3)]Pathogenesisof posterior polar cataract is not known. [(4)] Persistence of hyaloid artery or invasion of the lens by the mesoblastic tissues have been suggested as the etiology of posterior polar cataract. [(4,5)] Duke-Elder classified it as stationary and progressive posterior polar cataract.The stationary type is more common (about 65%)and compatible with good visual acuity. The progressive type manifests with more symptoms. [(3,5)]The condition does not become a problem for patients till young adulthood and then presents as glare or other disturbing visual images, especially while driving at night. [(6)]Surgical treatment is indicatedin visually significant cataracts that impair patient's quality of life. [(6,7)] The cataract surgery in patients withposterior polar cataracthas a high risk of posterior capsular rupture, as the opacity is adhered to the capsule and is often extremely thin and fragile.[(8,9,10)] The incidence of posterior capsular rupture has been reported to vary from 26-36%.[(11, 12)]Polar opacities that are 4 mm or more in diameter have more risk of posterior capsule rupture than those that are less than 4 mm in diameter (30.43% vs 5.71%).[(7)]The surgeon needs to adhere to special surgical strategies to minimize the risk of a posterior capsular rupture[(9)]like adhering to the principles of closed chamber technique, avoiding hydro dissection – instead performing 'inside out' hydro delineation and using modest to low phaco parameters and reducing these in a stepwise manner.[(9)] The present study aims to evaluate the surgical and visual outcomes of phacoemulsification surgery. It also aims to observe intraoperative and post-operative complications of phacoemulsification surgery in patients with posterior polar cataract.

Material and Methods:

A Hospital based cross sectional analytical study was

carried out on patients with posterior polar cataract at the Department of Ophthalmology, at a tertiary care centre. Patients were diagnosed on the basis of history, symptoms, signs and investigations. Study duration was between October 2019 to October 2021. Demographic data of the patients was recorded in the proforma. Fifty-four individual eyes were selected by purposive sampling techniquewith age more than 18 years and willing to be a part of study. Patients with complicated cataract, glaucoma, corneal opacity/corneal degeneration, ocular trauma, previous ocular surgery, retinal pathology and any other ocular pathologies were excluded from the study. The sample size was relatively smaller in our study because during first and second waves of COVID-19 pandemic, we had restrictions in performing routine cataract surgeries. Detailed history of the patients was recorded which included age, sex, duration and progress of visual symptoms like decreased visual acuity,glare at night, intolerance to light and any other symptoms in the affected eye. The visual acuity of both the eyes was assessed. We recorded best corrected visual acuity (BCVA) of all the patients. Thorough anterior segment examination was done with the help of torch light followed by examination on the slit lamp. After pupillary dilatation size of posterior polar opacity was measured using Haag Streit slit lamp by adjusting the height of slit beam and recorded in millimeter. It was measured in its greatest linear dimension.[7]In every case examination withpupillary retroillumination was done to look for any pre-existing capsular dehiscence. Patients were posted for phacoemulsification surgery with posterior chamber intraocular lens implantation (PCIOL) under local (peribulbar) anaesthesia. Informed consent was obtained after counselling patients about the possibility of intraoperative posterior capsular tear, relatively longer surgical time,nucleus drop, secondary posterior segment intervention, and possibly delayed visual outcome in a language that they would understand. In phacoemulsification surgery two side port incisions were made at 10'o clock and 2'o clock using a 15° side port entry blade. This was followed by the injecting viscoelastic material. Continuous curvilinear capsulorhexis of size around 5 mm was done using cystitome.[13]Clear corneal tunnel of 2.8 mm was made in all cases with angled crescent blade.[14]Cortical cleaving hydrodissection was avoided due to risk of hydraulic rupture and nucleus drop. Hydrodelineation was preferred instead, which is the separation between nucleus and the epinucleus. Epinucleus acts as a cushion protecting the posterior capsule.[9] Phacoemulsification with low parameters was preferred. Power was kept at around 60%, bottle height at 70-80 cm, aspiration rate of 14-16 cc/min and vacuum of 150-200 mmHg were used.[1,13] For soft cataract with less than grade 2 nuclear sclerosis minimal power was used and demarcated nucleus was emulsified by creating adjacent trenches to create a bowl. For nuclear sclerosis more than grade 2 step-by-step phaco chop and lateral separation technique was used.[13]The epinucleus in the 180° opposite the main incision, was stripped off the capsule with the phaco tip.[13]If posterior capsular opacity was found to be firmly adherent to capsule then it was left behind and Nd:YAG laser capsulotomywas performed for it post operatively. Cortex aspiration was done.If there was no posterior capsular rupture or the size of rupture was small, hydrophobic foldable IOL was implanted in the bag. However in the presence of large posterior capsular tear, vitrectomy was performed followed by IOL implantation in the sulcus.[15] All patients were advised follow up on day 7, day 15, 1 month and 3 months.

Results:

The present study included 54 patients. The mean age group in our study was 52.75±9.07 years. Preponderance of posterior polar cataract was seen in males 54% (n=29) than in females 46% (n=25). Right eye (52%) and left eye (48%) were almost equally presented. In present study out of 54 patients posterior polar cataract was seen in association with posterior subcapsular cataract in 7% of the cases, and with nuclear sclerosis in 22% of the cases. Pre-existing posterior capsular dehiscence was seen in 2% of the cases. Size of posterior polar opacity was less than 4 mm in 87% (n=47) of the cases. Whereas in 13% (n=7) of the cases posterior capsular opacity was of size 4mm or more. In the present study no complications occurred in 78% (n=42) patients intra-operatively. The most common intra-operative complication was posterior capsular rupture, seen in 9% (n=5) of the patients. One out of these five (2%) cases had pre-existing capsular dehiscence. Vitreous loss was seen in 4% (n=2) patients. There was decrement's membrane detachment in 4% (n=2) of the patients and 5% (n=3) patients had corneal burn intra-operatively. None of the patients in our study had nucleus drop. Cystoid macular edema was a delayed postoperative complication in 7% (n=4) of patients. Residual plaque/posterior capsular pacification was seen in 6%(n=3) of the patients with a p value of <0.0001, which was statistically significant. In our study 40.74%(n=22) patients presented with visual acuity between 6/60 to 6/18 pre-operatively. Whereas 59.25% (n=32) patients had pre-operative visual acuity less than 6/60 (p value <0.0001). Post-operatively after

three months 85.18% (n=46) patients had visual acuity in the range of 6/12- 6/6 and 14.81% (n=8) patients had visual acuity between6/60 to 6/18 (p value <0.0001). All these observations suggest that there is statistically significant increase in postoperative visual acuity compared to preoperative visual acuity (p value patients. The mean age group in our study was 52.75±9.07 years. Because of amblyopia one patient did not show any improvement in visual acuity. The present study included54 <0.0001). Out of 54 patients in our study 98%(n=53) patients showed improved visual acuity post-operatively. Our study found preponderance of posterior polar cataract in males 54% (n=29) than in females 46% (n=25).

Table 1.Distribution of study patients according to Age

Age category (years)	Number of Patients	Percentage (%)
21-30	1	2
31-40	5	9
41-50	11	20
51-60	32	59
61-70	4	8
>70	1	2
Total	54	100

Figure 1- Distribution of study patients according to age

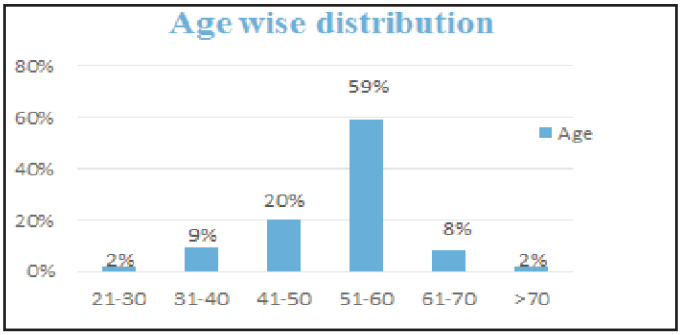
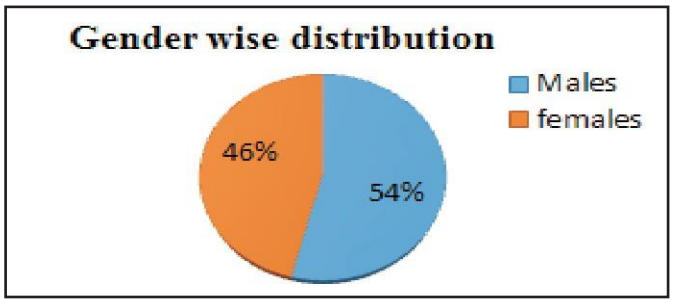


Table 2.Distribution of study patients according to Gender

Sex	Number of Patients	Percentage (%)
Male	29	54
Female	25	46
Total	54	100

Figure 2- Distribution of study patients according to gender

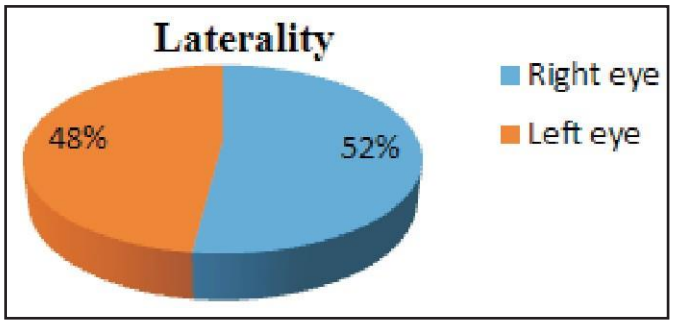


Right eye (52%) and left eye (48%) were almost equally presented

Table 3. Distribution of study patients according to laterality

Eye	Number of Patients	Percentage (%)
Right	28	52
Left	26	48
Total	54	100

Figure 3. Distribution of study patients according to laterality



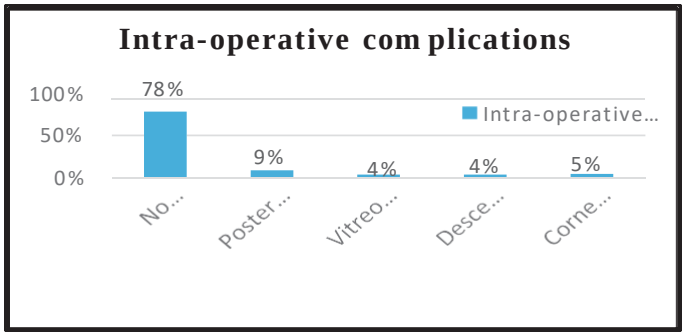
In present study out of 54 patients posterior polar cataract was seen in association with posterior subcapsular cataract in 7% of the cases, and with nuclear sclerosis in 22% of the cases. Pre-existing posterior capsular dehiscence was seen in 2% of the cases. Size of posterior polar opacity was less than 4 mm in 87% (n=47) of the cases. Whereas in 13% (n=7) of the cases posterior capsular opacity was of size 4mm or more. In the present study no complications occurred in 78% (n=42) patients intra-operatively. The most common intra-operative complication was posterior capsular rupture, seen in 9% (n=5) of the patients. One out of these five (2%) cases had pre-existing capsular dehiscence. Vitreous loss was seen in 4% (n=2) patients. There was descemet membrane detachment in 4% (n=2) of the patients and 5% (n=3) patients had corneal burn intra

-operatively. None of the patients in our study had nucleus drop. Cystoid macular edema was a delayed postoperative complication in 7% (n=4) of patients.

Table 4. Intra-operative complications

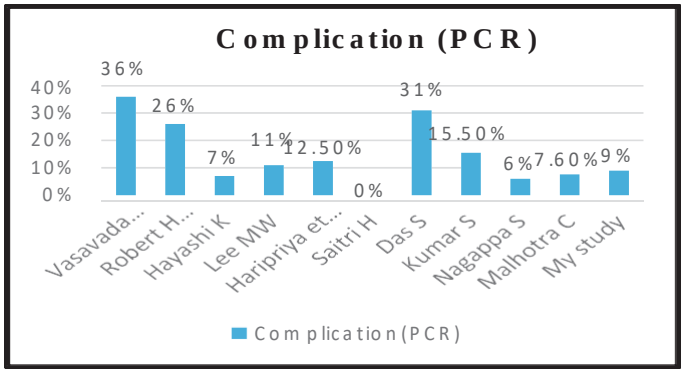
Complication	No. of Patients (n)	Percentage (%)
No complications	42	78
Posterior capsular rupture	5	9
Vitreous loss	2	4
Descemet membrane detachment	2	4
Corneal burn	3	5
Nucleus drop	0	0

Fig.4- Distribution of patients according to intra-operative complications



Authors	Complication(PCR)
Vasavada et al(16)	36%
Robert H. osher et al(15)	26%
Hayashi K(41)	7%
Lee MW(9)	11%
Haripriya et al(52)	12.5%
Saitri H.(2)	0%
Das S(14)	31%
Kumar S(11)	15.5%
Nagappa S(63)	6%
Malhotra C(47)	7.6%
My study	9%

Fig.5- Complication rate (PCR)



Residual plaque/posterior capsular opacification was seen in 6%(n=3) of the patients with a p value of <0.0001, which was statistically significant. These patients were advisedNd-YAG laser capsulotomy after 6 months postoperatively. In our study 40.74%(n=22) patients presented with visual acuity between 6/60 to 6/18 pre-operatively. Whereas 59.25% (n=32) patients had pre-operative visual acuity less than 6/60 (p value <0.0001).After three months post-operatively 85.18 % (n=46) patients had visual acuity in the range of 6/12- 6/6 and 14.81 % (n=8) patients had visual acuity between 6/60 to 6/18 (p value <0.0001).All these observations suggest that there is statistically significant increase in postoperative visual acuity compared to preoperative visual acuity (p value <0.0001).Out of 54 patients in our study 98%(n=53) patients showed improved visual acuity post-operatively. Because of amblyopia one patient did not show any improvement in visual acuity.

Table 5. Post-operative visual acuity

n= number of patients

Visual acuity	6/12-6/6	6/60-6/18	<6/60	P-value
Pre-operative	n=0	n=22	n=32	< 0.0001
Day 1	n=11	n=43	n=0	< 0.0001
Day 7	n=17	n=37	n=0	< 0.0001
Day 15	n=23	n=31	n=0	< 0.0001
Month 1	n=39	n=15	n=0	< 0.0001
Month 3	n=46	n=8	n=0	< 0.0001

Discussion:

The present study included 54 patients. The mean age of the group in our study was 52.75 ± 9.07 years. A study by Kumar et al.(7) on phacoemulsification in posterior polar

shaped opacity giving Bull's eye appearance
Typical posterior polar cataract- Central disc

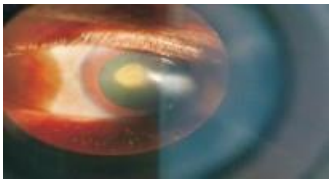


Figure-1 PPC

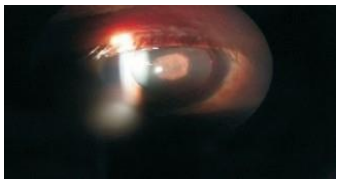


Figure- 2 PPC
Posterior polar cataract on retro illumination

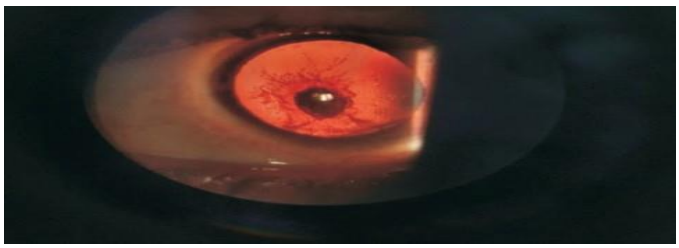


Figure-3. Posterior polar cataract on retro illumination Post operative Residual plaque

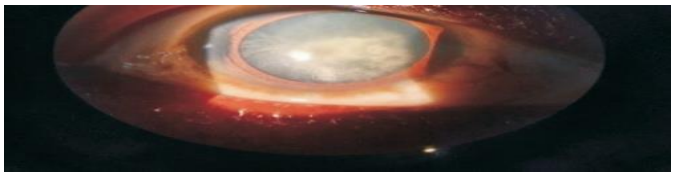
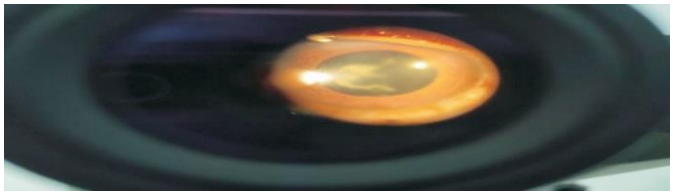


Figure-4 a. Preoperative



b. Postoperative (Residual plaque seen)

cataracts showed the mean age to be 56.6 ± 2.4 years. Malhotra et al.(14) reported the mean age of the study cohort as 52.21 ± 14.49 years, both of which were similar to our study. Our study found a preponderance of posterior polar cataracts in 54% of males (n=29) and 46% of females (n=25). There was no gender predilection. A study by Siatri H et al(2) showed 52.17% (n=12) male and 47.82% (n=11) female patients. Similarly, a study by Malhotra et al(14) showed 51.6 %(n=33) males and 48.4 %(n=31) females. In our study, posterior polar cataracts were more common in males, which matches other study. Cataracts in the right eye (52%) and left eye (48%) were almost equally presented. Our study matches with a study done by Malhotra et al.(14), where out of 80 operated eyes, 47.5%(n=38) were right eyes and 52.5%(n=42) were left eyes. In the present study, posterior polar cataract was seen in association with posterior subcapsular cataracts in 7% of the cases, and with nuclear sclerosis in 22% of the cases. Pre-existing posterior capsular dehiscence was seen in 2% (n=1) of the cases. in the rest of the cases(69%; n=37) cases, there was no association with posterior polar cataracts. Malhotra et al.(14) found the incidence of pre-existing capsular dehiscence in 6% of patients, which was more compared to our study. In our study, the size of posterior polar opacity was less than 4 mm in 87%(n=47) of the patients, whereas, in 13%(n=7) of the patients, the size was more than 4 mm. In a study by Kumar et al.,(7)the size was less than 4 mm in 60.35%(n=35) patients, and in 39.65%(n=23) patients, the size was more than 4 mm, the incidence of which was variable as compared to our study. Our study matches with a study done by Centikeya S et al.(8), wherein in group 1, the polar opacity size was < 4 mm in 78.2%(n=18) eyes and larger than 4 mm in 21.8%(n=5) eyes. In group 2, the size was smaller than 4 mm in 76.2%(n=16) eyes and larger than 4 mm in 23.8%(n=5) eyes. The most common intraoperative complication was posterior capsule rupture which was seen in 9% (n=5) of the patients. Out of these 5 cases, a posterior capsular rupture occurred during the removal of the cortex in two eyes, and the rupture occurred while emulsifying the nucleus in two cases. One case had pre-existing posterior capsular dehiscence. Posterior capsular rupture in posterior polar cataracts has been reported as the most common complication in almost all studies conducted. The incidence has been as high as 36% reported by Vasavada et al,(12) 26% by Osher et al,(11) 31% by Das et al,(10) 18.49% in a study by Bhardwaj M et al,(3) and 7.6 % in a study by Malhotra C et al.(14)In our study posterior capsular rupture occurred in 57.14%(n=4) patients with polar opacity size 4mm or more. Whereas in eyes with polar opacities smaller than 4mm, only 2.12%(n=1) of patients had a posterior capsular rupture. In a study by Kumar S et al.(7), seven patients (30.43%) had posterior capsule rupture with polar opacities 4mm or more. Only two (5.71%) patients had posterior capsule ruptures with polar opacities less than 4mm. Other intra-operative complications included vitreous loss in 4% (n=2), Descemet's membrane detachment in 4% (n=2) and corneal burn in 5% (n=3) of the patients. None of the patients had a nucleus drop among our study participants. In a study by Hayashi K et al.,(16) lens nucleus drop in the vitreous cavity was noted in one patient. Cystoid macular edema was a delayed postoperative complication in 7% (n=4) of patients. In a study by Kumar S et al.(7), cystoid macular oedema was seen in one (1.72%) patient, which was less than that in our study. In research by Vajpayee RB

et al.(18), one (12.5%) patient developed cystoid macular edema that was detected clinically four weeks after surgery, the incidence of which was higher than in our study. Residual plaque/posterior capsular opacification was seen in 6% (n=3) of the patients with a p-value of <0.0001, which is significant in our study. These patients were advised Nd: YAG laser capsulotomy at a later stage. Our study matches Malhotra et al.(14), where 5% of the cases had residual posterior capsular plaques, managed later with Nd: YAG laser capsulotomy. Our study had a lesser incidence (6%) of residual posterior capsular plaque than a study done by Siatri H et al.(2), in which the incidence of the same was 18.4%. The best-corrected visual acuity was 6/12 or better in 85.18% (n=46) patients in our study with a p-value <0.0001, which is statistically significant compared to baseline visual acuity. In one case, the status remained the same due to amblyopia which was explained to the patient. Our study matches with the study done by Kapoor GC et al.(20), in which 89.13%(n=41) of eyes achieved a visual acuity of 6/12 or better. Similar findings were noted by Malhotra C et al.(14), in which 87.5%(n=70) of eyes achieved the best corrected visual acuity of 6/12 or better. In a study by Kumar S et al.(7) best corrected visual acuity of 6/9 or better was achieved in 94.8%(n=55) eyes which were more than our study.

The data was analyzed by using SPSS (trial version 24.0) software. Descriptive analysis of quantitative parameters was done and expressed as means and standard deviation. For ordinal data absolute number and percentage were used to express. Test of significance such as t test for quantitative variables and chi square test for qualitative variables was done. For all statistical measures, probability of value <0.05 was considered statistically significant.

Conclusion:

Though posterior polar cataract is a true challenge for cataract surgeons due to high risk of surgical complications, with modern technique and a better understanding of surgical techniques, outcomes of surgery can be improved. Most patients were below 60 years of age. The most common intraoperative complication was posterior capsular rupture which occurred in 9% of the cases. Eyes with a more extensive polar opacity (>4mm) tend to have a high risk of posterior capsular rupture during surgery. In PPC patients, one should measure the opacity size after pupillary dilatation to quantify the risk involved in managing such cases; accordingly, the patients can be counselled. The postoperative vision had significantly improved when compared to baseline vision. Though posterior polar cataract is a true challenge for cataract surgeons due to the high risk of surgical complications, ophthalmologists can improve surgery outcomes with modern techniques and a better understanding of surgical techniques. The principles to be adhered to during PPC surgery include good capsulorhexis, avoidance of cortical cleaving hydrodissection, gentle hydrodelineation, a traumatic nucleus handling and tackling the central epinuclear plate in the last part of the cortical clean-up, ensuring a safe surgery and favorable postoperative outcomes. Preoperative patient counselling with a proper explanation of the expected complications is mandatory. In the event of any complications, adequate follow-up of the patients is necessary.

Conflict of Interest - Nil

Sources of Support- Nil

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How to cite this article: *Swati S. Bhombe, Archana A. Vare and Varsha S. Nandedkar.* An Analytical Study of Surgical and Visual Outcome of PosteriorPolar Cataract in Phacoemulsification Surgery. Walawalkar International Medical Journal 2022; 9(2):19-25, http://www.wimjournal.com.

Received date: 05/02/2022 Revised date: 14/12/2022 Accepted date: 19/12/2022