

Visual outcomes following cataract surgery with intraocular lens implantation in vitrectomized eyes among children

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Purpose: To assess the visual outcomes and associated factors in pediatric patients undergoing cataract surgery following pars plana vitrectomy (PPV). **Methods:** A total of 52 eyes of 52 children who underwent cataract surgery and intraocular lens (IOL) implantation in previously vitrectomized eyes between January 2008 and December 2017 were included in this retrospective study. Descriptive and inferential statistical measurements (Chi-square test, Fisher's exact test, odds ratio, multiple logistic regression) were done. **Results:** The mean age at PPV was 11.3 ± 2.9 years. The most common indication for PPV was retinal detachment in 43 eyes (82.69%) and vitreous hemorrhage in 6 eyes (11.53%). The mean preoperative and postoperative best-corrected visual acuity (BCVA) was 1.31 ± 0.48 logMAR (logarithm of the minimum angle of resolution) units (20/400) and 0.69 ± 0.45 logMAR units (20/100), respectively; $P < 0.001$. The final visual outcome was good in 37 eyes (71.15%) and poor in 15 eyes (28.85%). In mean follow-up of 4 years, 42.3% developed posterior capsular opacification, 13.5% developed glaucoma, and 3.8% had retinal redetachment after cataract surgery. In the presence of macular pathology, the visual outcome was poor (aOR [adjusted odds ratio] = 4.26, $P = 0.002$). **Conclusion:** Cataract surgery with IOL implantation in vitrectomized eyes among children is a safe procedure and can improve visual acuity and quality of life. However, the extent of improvement is limited by macular pathology.

Key words: Cataract surgery, IOL implantation, pediatric vitrectomized eyes, pars plana vitrectomy, visual outcomes

The advent of advanced surgical techniques and instrumentation has allowed surgeons to manage a wide range of retinal pathologies in children with vitreoretinal surgery. Cataract formation is a well-known complication following pars plana vitrectomy (PPV). It is reported that up to 80% of adult patients develop a cataract within 2 years of vitrectomy.^[1-5] There is no literature available in children, but we assume that a similar proportion of children would require cataract surgery following PPV.

Cataract surgery following PPV is more challenging due to the anatomical changes brought about by PPV.^[6-10] Surgery is further complicated by additional procedures done along with PPV such as intraocular tamponade or belt buckle. Implantation of intraocular lens (IOL) with cataract removal is a standard practice to correct aphakia in adults as well as in children.^[11-14] Cataract surgery after PPV has been reported to be relatively safe with good visual outcomes in adults.^[15-18]

However, the outcomes of cataract surgery in vitrectomized eyes in children have not been studied. Previous studies have described some difficulties during cataract surgery in these eyes including a decrease in vitreous support of the lens, zonular weakness, an excessively mobile posterior capsule, positive

posterior pressure, poor visibility due to silicone oil in the anterior chamber, and posterior capsule plaque.^[15-18] These factors along with amblyogenic potential in children may have an impact on the visual outcome.

The aim of this study is to report the visual outcomes and the factors associated with these outcomes in pediatric patients undergoing cataract surgery following pars plana vitrectomy.

Methods

This hospital-based study included all children <16 years old who underwent cataract surgery and IOL implantation in previously vitrectomized eyes between January 2008 and December 2017 in a tertiary eye care center. The study was approved by the institutional review board and adhered to the tenets of the Declaration of Helsinki. All children <16 years of age who underwent cataract extraction surgery in eyes that had previously undergone vitrectomy surgery were included. Those with penetrating or perforating ocular trauma were excluded. The patients for whom preoperative and postoperative data were not available or follow-up was less than 6 weeks were also excluded.

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Data were collected from the hospital electronic medical records of the patients, which included age at PPV surgery, indication for vitrectomy, status of macula before and after PPV surgery, gap between PPV and cataract surgery, intraoperative complications, details of the intraocular lens implantation at the time of cataract surgery, duration of silicone oil in the eye, whether cataract surgery was combined with silicone oil extraction or not, best-corrected visual acuity (BCVA) prior to cataract surgery, improvement in BCVA post cataract surgery, and BCVA at last follow-up. We also noted postoperative complications such as glaucoma, retinal redetachment, posterior capsule opacification, and the need for neodymium-doped yttrium aluminum garnet (Nd: YAG) laser posterior capsulotomy for posterior capsular opacification. BCVA post laser capsulotomy and during follow-ups when available were also noted.

IOL power calculation was done using the SRK (Sanders–Retzlaff–Kraff)-II formula. The IOL power to be implanted was decided based on the age of the child at surgery, fellow eye status, and hereditary factors.

Visual acuity of 0.05 (1.3 logMAR [logarithm of the minimum angle of resolution]) or higher was measured using the Snellen visual acuity chart. For visual acuity levels lesser than 0.05, the following scale was used: 0.04 (1.4 logMAR) for counting fingers from 1 to 5 m, 0.03 (1.5 logMAR) for counting fingers at 50 cm, and 0.02 (1.7 logMAR) for hand movement or light perception.^[15]

Changes in BCVA after cataract surgery instead of absolute visual acuity levels are presented in the results.^[15] Due to underlying vitreoretinal pathology, we found very low visual acuity levels (<1.3 logMAR) after PPV in most of the cases. The visual outcome after cataract surgery was graded as good if there was ≥ 2 lines improvement and poor if improvement was ≤ 1 line in the Snellen visual acuity chart.

The data were entered in MS Excel and analyzed using IBM SPSS Version 23.0. Appropriate descriptive and inferential statistical measurements (Chi-square test, Fisher's exact test, odds ratio, and multiple logistic regression) were done with $P < 0.05$ taken as statistical significance.

Results

Of the 68 eyes of 66 patients who underwent cataract surgery during the study period, 16 eyes were excluded from the analysis because of incomplete data (6 eyes), lack of adequate follow-up (5 eyes), and corneal opacity obscuring the fundus examination (5 eyes).

Thus, a total of 52 eyes of 52 children who underwent cataract surgery and IOL implantation in previously vitrectomized eyes were included in the analysis. Table 1 shows the baseline characteristics of the study cohort. Surgery was done in the right eye in 27 eyes (51.92%) and 25 in the left eye (48.07%). Of the 52 children, 45 were male (86.53%). The mean follow-up was 4.05 ± 3.78 years. The most common indication for PPV was retinal detachment (RD) in 43 eyes (82.69%) and vitreous hemorrhage in 6 cases (11.53%). There was a history of trauma in 30 eyes (57.7%).

The mean age at PPV was 11.3 ± 2.9 years. The mean interval between the two procedures was 12.2 ± 10.1 months. The most frequent morphological type of cataract in this series was posterior subcapsular cataract. Out of the 52 eyes, IOL details were available for 46 eyes. Thirty-five eyes had

Table 1: Patient characteristics of the study cohort

Variables	n (%)
Gender	
Boys	45 (86.6%)
Girls	7 (14.4%)
Eyes	
Right eye	27 (51.9%)
Left eye	25 (48.1%)
Mean age at PPV* (years, mean+SD)	11.29±2.93
Mean interval between PPV* and cataract surgery (months, mean+SD)	12.25±10.15
Indication for PPV*	
RD	42 (80.8%)
Vitreous hemorrhage	7 (13.5%)
Others	3 (5.8%)
Duration of silicone oil in eye	
<6 months	22 (42.3%)
>6 months	21 (40.4%)
Duration of RD [†] before PPV*	
<1 month	24 (57.1%)
>1 month	18 (42.8%)

*PPV: Pars plana vitrectomy; [†]RD: retinal detachment

single-piece acrylic foldable IOL (SA60AT in 30 eyes and SN60WF in 4 eyes, Alcon Laboratories, Bengaluru, Karnataka; ZCB00 in 1 eye, Abbott Medical Optics); 9 eyes had three-piece acrylic foldable IOL (AR40E, Abbott Medical Optics) and 2 eyes had nonfoldable PMMA lens (Medicontur, Geneva, Switzerland). Details of IOL were not available for 6 eyes. Preexisting posterior capsular dehiscence was noted in three eyes. IOL was implanted in the sulcus in these 3 patients. Seventeen eyes underwent lens aspiration with primary posterior capsulotomy. None of the patients in our series had intraoperative posterior capsular rent.

The pre- and postoperative BCVA of all eyes are shown in Fig. 1. The mean preoperative BCVA was 1.31 ± 0.48 logMAR units (20/400) and the mean postoperative BCVA was 0.69 ± 0.45 logMAR units (20/100) $P < 0.001$. The final visual outcome was good in 37 eyes (71.15%) and poor in 15 eyes (28.85%) [Fig. 2]. Of the 15 eyes with poor outcomes, 5 had glaucoma, 8 had macular pathology, 1 had redetachment, and 1 eye became phthisical.

Eyes with normal macula post PPV surgery had significantly better visual outcomes. Thirty-four eyes had no macular pathology after PPV. Of these, 29 eyes had good visual outcomes after cataract surgery. However, 5 eyes with no macular pathology had poor visual outcomes. Of these, 3 eyes had glaucoma and 1 developed redetachment. Of the 18 eyes that had macular pathology post PPV, 8 eyes had good visual outcomes.

Table 2 shows the analysis of factors associated with good and poor outcomes. There was no significant difference in visual outcome between those aged ≤ 10 years of age and those > 10 years of age. The indication for vitreoretinal surgery had no significance on the visual outcomes. However, those with traumatic etiology had a significantly better visual outcome than others (aOR [adjusted odds ratio] = 0.043). In the eyes with retinal detachment, the duration of detachment prior to PPV – less than or more than 1 month – did not have any

Table 2: Analysis of risk factors for visual outcome

Variables	Category	Visual Outcome		OR [†]	95% CI [‡]	P	sOR (95% CI [§])
		Good	Poor				
Age	>10 years	27 (77.1%)	8 (22.9%)	2.36	[0.679, 8.223]	0.171	3.31 [0.43, 25.30]
	≤ 10 years	10 (58.8%)	7 (41.2%)	1			
Gender	Male	33 (73.3%)	12 (26.7%)	2.06	[0.402, 10.593]	0.32	2.151 [0.51, 9.11]
	Female	4 (57.1%)	3 (42.9%)	1			
Vitrectomy indication	others	7 (77.8%)	3 (22.2%)	1.52	[0.277, 8.310]	0.485	4.07 [0.42, 39.21]
	RD*	30 (69.8%)	12 (30.2%)	1			
History of trauma	Present	24 (80.0%)	6 (20.0%)	3.60	[1.012, 12.811]	0.043	0.84 [0.21, -3.38]
	Absent	10 (52.6%)	9 (47.4%)	1			
Macula status (Pre)	Normal	7 (100.0%)	0 (0%)	1.5	[1.000, 1.844]	0.077	5.04 [0.50, 51.29]
	Abnormal	30 (66.7%)	15 (33.3%)	1			
Duration of silicone oil	≤ 6 months	22 (71.0%)	9 (29.0%)	1.02	[0.301, 3.478]	0.971	1.35 [0.37, 4.92]
	>6 months	15 (71.4%)	6 (28.6%)	1			
Macula status (Post)	Normal	29 (85.3%)	5 (14.7%)	7.25	[1.920, 27.373]	0.002	4.26 [1.09, 18.18]
	Abnormal	8 (44.4%)	10 (55.6%)	1			
Glaucoma	Absent	35 (77.8%)	10 (22.2%)	8.75	[1.470, 52.098]	0.016	1.38 [0.17, 1.092]
	Present	2 (28.6%)	5 (71.4%)	1			
Duration of RD*	>1 month	14 (77.8%)	4 (22.2%)	2.10	[0.526, 8.388]	0.236	1.17 [0.27, 5.14]
	≤ 1 month	15 (62.5%)	9 (37.5%)	1			

*RD: Retinal detachment, †OR: Odds ratio, ‡CI: Confidence interval, §aOR: Adjusted odds ratio (multiple logistic regression)

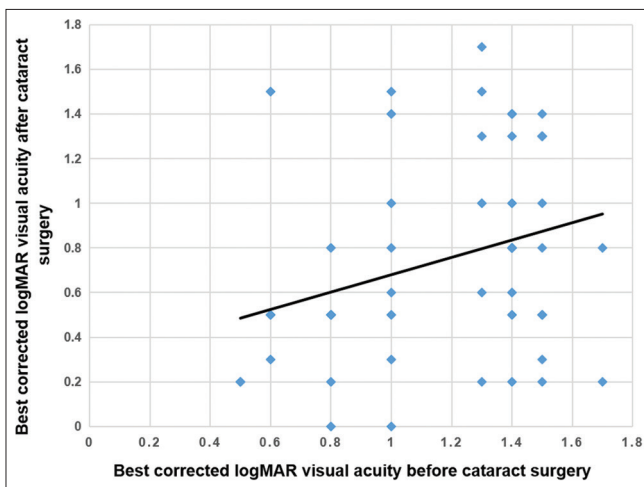


Figure 1: Best-corrected logMAR visual acuity before and after cataract surgery

significant effect on the visual outcome after cataract surgery. Likewise, in the presence of macular pathology, the visual outcome was poor (aOR = 4.26).

Silicone oil was injected in 43 (82.69%) eyes at the time of PPV. The mean duration of silicone oil in the eye was 5.92 ± 4.03 months. Silicone oil removal was done along with cataract surgery in 30 (69.76%) patients, whereas in 13 (30.23%) patients it was done before cataract surgery. The duration of silicone oil in the eye did not have any significant effect on the visual outcome of the cataract surgery.

On follow-up, 22 eyes (42.3%) developed posterior capsular opacification (PCO), of which 12 with significant PCO underwent Nd: YAG laser capsulotomy. Five patients had improvement in

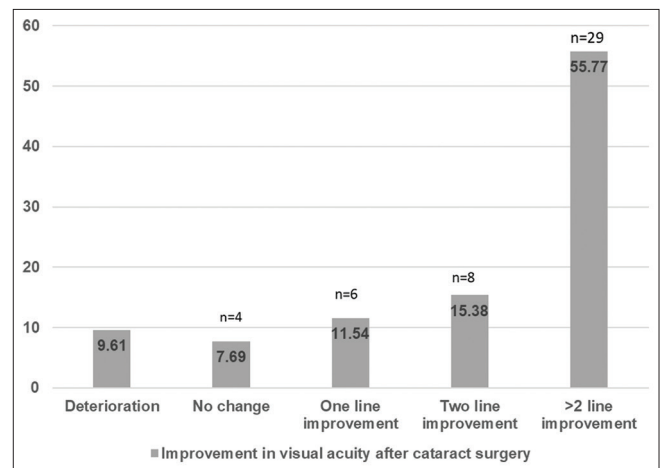


Figure 2: Improvement in visual acuity after cataract surgery

visual acuity following laser capsulotomy. The mean duration between cataract surgery and laser capsulotomy was 9.27 months.

On follow-up, of the 52 eyes, 7 eyes developed glaucoma (13.5%). The mean years of onset was 2.99 ± 2.94 years with a range of 0 to 7 years after cataract surgery. The final visual outcome was poor in the eyes that developed glaucoma compared with eyes that did not develop glaucoma; however, it did not reach a statistical significance. Only 28.6% of eyes with glaucoma had a good visual outcome. Two eyes developed redetachment (3.8%) after cataract surgery requiring further vitreoretinal surgery.

Discussion

We studied the visual outcome of cataract surgery with IOL implantation in children who had a prior vitrectomy and

found that more than two thirds of patients had improvement of two lines or more after cataract surgery. The factor strongly associated with poorer outcomes was the presence of macular pathology. Similarly visual outcomes were better if indication of pars plana vitrectomy was trauma. Over a mean follow-up of 4 years, 42.3% developed PCO, 13.5% developed glaucoma, and 3.8% had retinal redetachment after cataract surgery.

The most common indication for PPV in children was retinal detachment followed by vitreous hemorrhage compared with adults where diabetic retinopathy is the leading indication for PPV.^[17] Similar to studies in adults, the mean duration between PPV and cataract surgery was 1 year in our series.

In our study, 71.1% of the patients had improvement of two lines or more after cataract surgery. The mean postoperative BCVA was less (0.69 ± 0.45 logMAR). This is lesser than what is reported in adults. This could be due to differences in the indication of vitrectomy in our series (retinal detachment) and in adults (macular hole or vitreous hemorrhage).

We found that patients who underwent vitrectomy with a history of trauma had a better visual outcome after cataract surgery (aOR = 4.26). This is probably due to the more structural retinal damage seen with other indications of vitrectomy such as familial exudative vitreoretinopathy, high myopia, sequelae of posterior uveitis, retinochoroidal coloboma, and Eales disease. We also found that the presence of macular pathology was associated with poor outcome (aOR = 4.26). The macular pathologies associated with poor visual outcome included macular scar (5 eyes), retinochoroidal coloboma involving the fovea (2 eyes), full-thickness macular hole (2 eyes), and subretinal gliosis (1 eye). Other factors like duration of retinal detachment or presence of silicone oil did not affect the final outcome of cataract surgery. Macular pathology does impact the ultimate visual outcome. This has been extensively reported in the literature in adults.^[8] We found similar results in children.

The incidence of posterior capsular opacification in adult eyes undergoing cataract surgery after vitrectomy has been reported to be 31.8% to 51% after a follow-up of 19 to 20 months. In children, we found that 42.3% developed PCO. This underscores the need for continuous monitoring of the visual axis in children as visual axis opacification can lead to both visual impairment and amblyopia.

In our series, 13.5% of patients developed glaucoma with a mean of 3 years after cataract surgery and were associated with poor visual outcome. This emphasizes the role of regular follow-up examination, including IOP checks in children undergoing cataract surgery.

The limitations of this study are inherent to the retrospective nature of the study. It is also possible that there may be some inaccuracies in the assessment of visual acuities, as multiple optometrists measured acuity. We tried to account for this variability by categorizing the visual acuity variable in our analysis. Several surgeons, pediatric ophthalmologists, and vitreoretinal surgeons were involved in the patient care; thus, there was a lack of standardized protocol. We did not take into account the surgeon factor that might have influenced the visual outcome. But in the past 10 years, there has not been a very dramatic change in operating techniques as well as IOL designs. This may not affect the validity of conclusion of the study. However, future prospective studies can address this limitation more effectively.

Conclusion

In conclusion, cataract surgery with IOL implantation in vitrectomized eyes in children is a safe procedure and can improve visual acuity and quality of life. However, the extent of improvement is limited by macular pathology.

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Conflicts of interest

There are no conflicts of interest.

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