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Post-Operative Refractive Status and Visual Outcomes of Bilateral Congenital Cataract in Children Aged 5 Years and Below

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ABSTRACT

Purpose: To evaluate the post-operative refractive status and visual outcomes of bilateral congenital cataract in children aged 5 years and below.

Design: A prospective hospital based study.

Method: It was a prospective study where total 200 eyes of 100 children were selected who underwent bilateral congenital cataract surgery (Lens aspiration + PPC + AVT + PCIOL) with clear corneal or scleral incision for a two year period irrespective of gender. Medical records were reviewed for demographic, pre-operative, intra-operative, and post-operative information recorded on the forms designed for the study.

Results: All (100%) patients had a minimum follow-up of 6 months. The mean age of presentation to the hospital was 44.18 months (range: 6-60 months). The mean age of surgery was 45.85 months (range: 8-60 months). Pre-operatively, 88 patients (88%) had visual acuity <6/60, in the better eye, compared to 24 patients (24%) post-operatively ($P < 0.01$). Forty eight patients (48%) had post-operative visual acuity >6/18. The most common intra-operative complication was anterior capsular extension in 12 eyes (6%). Pre-operative mean IOP was 10.87 mm of Hg (SD = 0.99) in the right eye and 10.84 mm of Hg (SD = 1.01) in the left eye. The mean post-operative IOP was 12.75 mm of Hg (SD = 2.93) in the right eye and 12.90 mm of Hg in the left eye (SD = 3.22). According to Spearman correlation, there was moderate positive correlation between the IOL under correction and post-operative refraction ($r^2 = 0.474$; $p<0.01$).The most common early post-operative complication was fibrinous uveitis in 16 eyes (8%) and the most common delayed post-operative complication was posterior capsular opacification in 17 eyes (8.5%). The most important prognostic factor for poor outcome was congenital cataract with nystagmus (50%).

Conclusion: Most cases of poor outcome occurred in the congenital cataract with nystagmus group and are attributed to early visual deprivation and resulting amblyopia. Carefully and meticulously performed primary IOL implantation appears to be a safe and effective method of aphakic correction in younger children. Primary Posterior Capsulorrhexis (PPC) and Anterior Vitrectomy (AVT) reduces the rate of secondary opacification of the visual axis in a pseudophakic eye. Early detection and surgery, optical rehabilitation, and close follow-up are essential for good outcome.

Introduction

Congenital cataracts are responsible for nearly 10% of all vision loss in children worldwide.

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According to National Blindness and Low Vision Survey, cataract (31%) is number one reason for childhood blindness. In Bangladesh 12,000 of 40,000 blind children are blind due to congenital cataract[1].

The management of childhood cataract remains a challenge in developing countries[2,3]. In Bangladesh childhood cataract also remains the prime cause of low vision and blindness along with refractive error.

In a study of Zhang et al. 2012, have shown that the unilateral cataract surgery had poor visual outcome than bilateral cataract surgery, in children with bilateral congenital cataract, surgery was fruitful when it was before 6-8 weeks of age[4]. The possibility of developing amblyopia is high after the operation if post-operative management is poor. Another study of Congdon et al. 2007, also showed that about 40% of the children became amblyopic due to lack of regular follow-up, delayed cataract surgery is also a fact for worse visual acuity, 61.9% of the children had their visual acuity worse than 6/18 even when operated before 6 months of age and 71.2% of children had visual acuity worse than 6/18 whose cataract was operated after 6 months of age[5]. In a study of You et al. 2011 showed that due to delayed surgery 41.4% of eyes had visual impairment or blindness and 30.4% of children had visual acuity better than 6/12, another 28.2% of the children had visual acuity in between 6/12 and 6/18.[6] The above reviews revealed that most of the cataract surgery of children was effective when it was in an early age particularly before 6 months of age. Post-operative compliance was also an important fact to reduce the probability and rate of visual impairment and blindness due to childhood cataract[2,3,4,5,7,8].

Therefore, the diagnosis and surgical management as early as possible is the only way for saving vision of children with congenital cataract. Postoperative target refractive error according to age plays an important role in the evaluation of final outcome of surgery. The main objective of the current study is to investigate the post-operative refractive status and visual outcomes of bilateral congenital cataract in children aged 5 years and below.

Rationale

Childhood blindness is relatively complex and demanding area of work. Childhood cataract is one of the major avoidable cause of blindness in both developed and developing countries and it is a priority for VISION 2020. The number of patients over the years may decrease but the scenario of unpredictable result of childhood cataract in terms of visual impairment or blindness is extremely disappointing due to poor post-operative management. Post-operative management is important in children after cataract surgery to achieve maximum visual outcome as well as to prevent amblyopia. Therefore, the aim of this study is to evaluate post-operative refractive status and visual outcomes with proper and periodic follow-up in children with bilateral congenital cataract aged 5 years and below.

Methods

It was a prospective study conducted at Chittagong Eye Infirmary and Training Complex (CEITC), Chittagong for two years.

Children with bilateral congenital cataract aged 5 years and below were included in the study. Children with traumatic cataract, secondary cataract, anterior segment digenesis-microcornea, aniridia, persistent hyperplastic primary vitreous, posterior segment disease like vitreous opacity, macular diseases, optic nerve diseases, glaucoma or any other retinopathy causing functional impairment of vision were excluded from the study.

In this specialized facility, patients were followed up by the qualified pediatric ophthalmologists of the pediatric clinic of CEITC. Approval of the Ethics Committee of the Institute was obtained for the data collection. Medical records were reviewed for demographic, pre-operative, intra-operative, and post-operative information were recorded on the forms designed for the study. Demographic information and history included age at diagnosis, presence or absence of consanguinity, and family history of cataract. wered recorded. The method of recording visual acuity varied, depending on the age and cooperation of the child. If optotype methods such as kay pictures, Teller acuity, or Snellen's chart was unsuccessful, fixation pattern were determined. Other features like intraocular pressure (IOP), presence or absence of nystagmus, squint, morphology of cataract were recorded. Presence or absence of others pathologies responsible for loss of vision were also be recorded, either by fundus examination or by B-scan. Intra-operative information included the type of surgery, presence or absence of primary posterior capsulotomy (PPC),

anterior vitrectomy (AV), intraocular lens (IOL) type and size, method of IOL placement, surgeon profile, and complications. IOL power calculations were done on the basis of keratometry and axial length using the SRK II formula. Under correcting biometry reading by 20% in children below 2 years and 10% for children 2 to 5 years. Postoperative refractive goal of +6D for a 1-year-old, +5D for a 2-year-old, +4D for a 3-year-old, +3D for a 4-year-old, +2.0D for a 5-year-old.

All patients were followed up on 1st postoperative day, 7th postoperative day, after one, three and six months follow up or last follow up. In each follow up visual acuity, anterior segment (wound, corneal edema, AC reaction, position of (IOL) as well as fundus examination were performed. All sutures were removed after 1 month of surgery. Post-operative refractive status were recorded by dry and wet retinoscopy after removal of suture and at the last follow up. Post-operative complications, method of optical correction, and presence of amblyopia were documented. Complications were defined as early, if they occurred within 3 months of surgery and delayed if they occurred later. Glaucoma was confirmed if IOP was more than 21 mm of Hg recorded on three different occasions.

Results

Total 100 children with bilateral congenital cataracts were enrolled in this study. Out of 100, 58 (58%) children were boys. The mean age of presentation was 44.18 months (median, 48 months; range, 6-60 months) and 63 (63%) children were within 4 to 5 years of age. Results are shown in table 01 .

Table-01: Age and gender distribution of the study group

Age group	Age group (years)	Male		Female		Total	
		n	%	n	%	n	%
Pre-verbal	0-<3 year	13	13%	11	11%	24	24%
Pre-school	3+ year - <4 year	11	11%	2	2%	13	13%
School Going	4+ year - <5 year	34	34%	29	29%	63	63%
Total	-	58	58%	42	42%	100	100%

There were 81 (81%) children who had normal birth history & 19 (19%) children were preterm with low birth weight. There were 14 (14%) children who had a positive family history of congenital cataract. History of consanguinity among parents was present in 11 (11%) children. There were 67 (67%) children from the low income group, 23 (23%) from the medium and only 10 (10%) from the high income group.

Lens morphology was symmetrical in 90 (90%) patients. Out of 200 eyes, the most common was lamellar cataract 72 (36%) followed by diffuse/total cataract 54 (27%), nuclear cataract 53 (26.5%), posterior sub-capsular cataract (PSC) 13 (6.5%), posterior polar cataract 4 (2%), and membranous cataract 4 (2%). Results are shown in Table 02.

Table-02: Lens morphology of the study group

Types of cataract	Frequency	Percent
Lamellar	72	36.0
Diffuse/Total	54	27.0
Nuclear	53	26.5
PSC	13	6.5
Posterior polar	4	2.0
Membranous	4	2.0
Total	200	100.0

Surgical procedures

The mean age of surgery was 45.85 months (median, 50 months; range, 8-60 months). The most common surgical procedure was phacoaspiration with Primary Posterior Capsulorrhexis (PPC) with anterior vitrectomy (AVT) with posterior chamber IOL implantation in 166 eyes(83%), followed by extra-capsular cataract extraction (ECCE) with PPC with AVT in 34 eyes (17%).

Comparison between pre and post-operative visual acuity

Twenty four (24%) children had post-operative visual acuity of less than 6/60 in the better eye (defined as poor fixation or visual acuity less than 6/60), compared to 88 (88%) children pre-operatively (p <0.01) (Figure 1). The final post-operative visual acuity of children having nystagmus was more likely to be less than 6/60 than those without nystagmus (50% vs. 12.85%, P<0.01 (Figure 01).

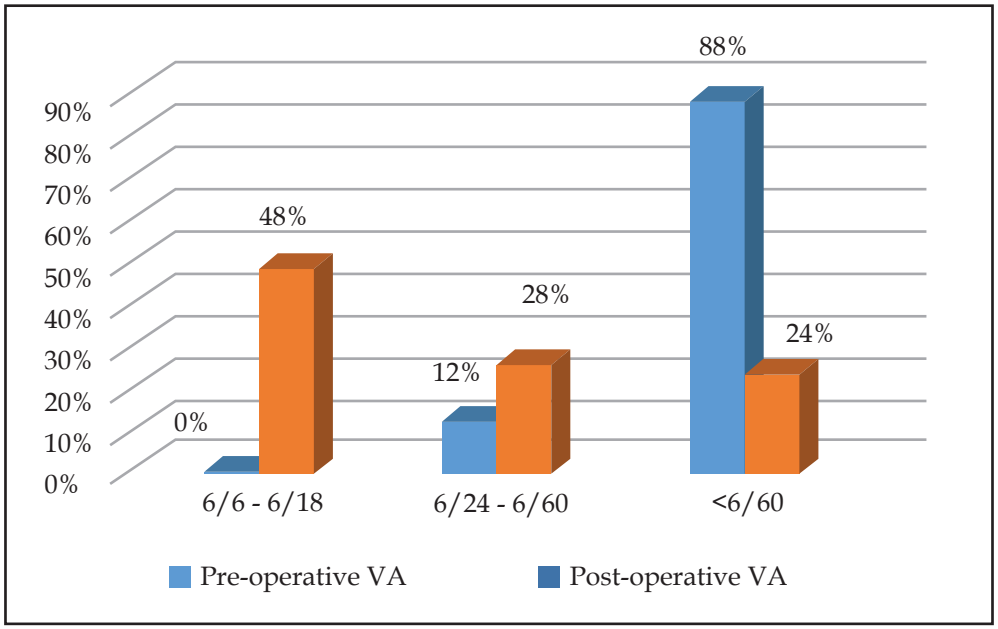

Figure-01: Comparison between pre- and postoperative visual acuity

Pre-and postoperative mean IOP

Pre-operative mean IOP was 10.87 mm of Hg (SD = 0.99) in the right eye and 10.84 mm of Hg (SD = 1.01) in the left eye. The mean post-operative IOP was 12.75 mm of Hg (SD = 2.93) in the right eye and 12.90 mm of Hg in the left eye (SD = 3.22). Results are shown in Table 03.

Table-03: Pre-and postoperative mean IOP

	Pre-operative IOP (mm Hg)		Post-operative IOP (mm Hg)	
	RE	LE	RE	LE
Mean	10.87	10.84	12.75	12.90
Median	11.00	11.00	12.00	12.00
Mode	10	10	12	12
Std. Deviation	0.991	1.012	2.931	3.224

Comparison between pre-and post-operative IOP

One hundred eighty seven (93.5%) eyes had post-operative IOP within 0 - 20 mm of Hg, compared to 200 (100%) eyes pre-operatively (p<0.01). None of the patients had pre-operative IOP more than 21 mm of Hg but 13 (6.5%) eyes had post-operative IOP more than 21 mm of Hg. Results are shown in Table 04.

Table-04: Comparison between pre-and post-operative IOP

IOP (mmHg)	Pre-operative IOP		Pre-operative IOP		
			n	%	
Low (0-10)	88	44.0	23	11.5	P<0.01
Normal (11-20)	112	56.0	164	82.0	
High (>21)	0	0.0	13	6.5	
Total	200	100.0	200	100.0	

Correlation between the pre-operative IOL under correction and post-operative refractive status of the eyes

According to Spearman correlation, there was moderate positive correlation between the IOL under correction and post-operative refraction. (r^2 =0.474; p<0.01) (Figure 02).

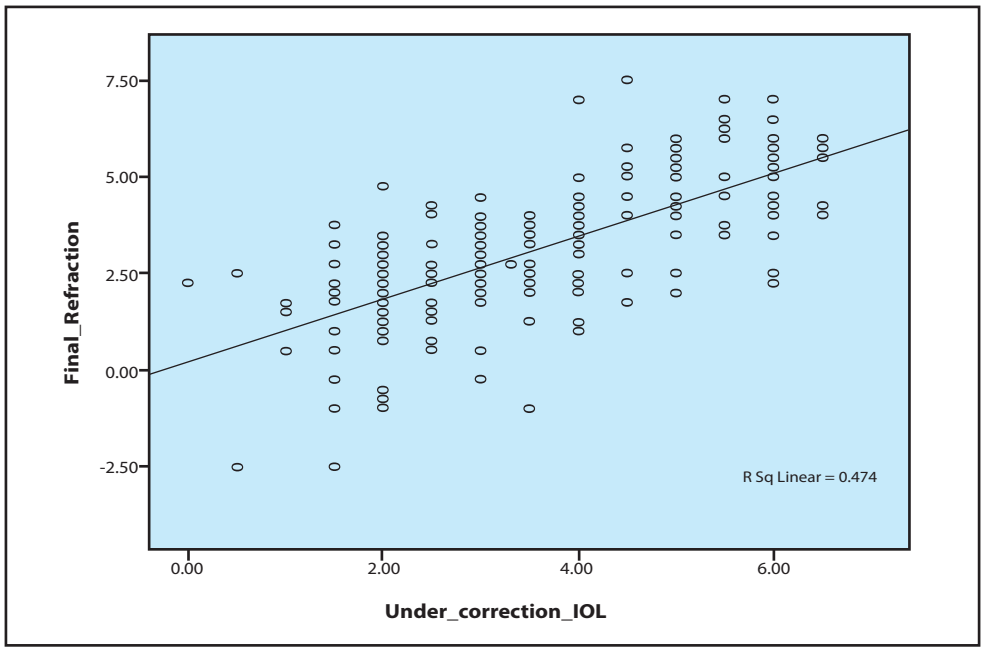

Figure-02: Correlation between the pre-operative IOL under correction and post-operative refractive status of the eyes

Intra and Post-operative complications

The most common intra-operative complication was anterior capsular extension seen in 12(6%) eyes. The most common early post-operative complication was anterior fibrinous uveitis in 8(4%) eyes and the most common delayed post-operative complication seen was Posterior Capsule Opacification (PCO). All the eyes that were underwent PPC, PCO occurred in seventeen (8.5%) eyes and eight eyes were treated with YAG laser capsulotomy along with nine eyes underwent membranectomy (Figure 03).

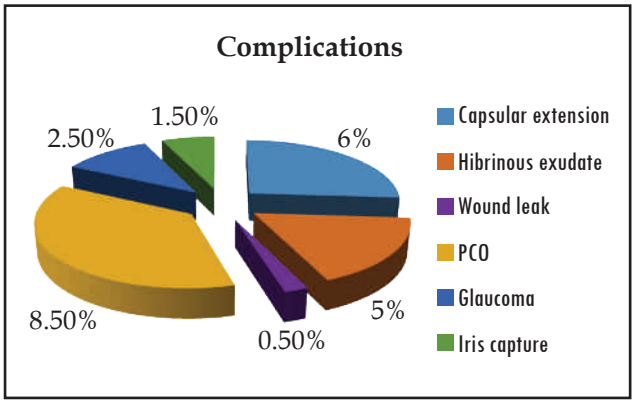

Figure-03: Intra and Post-operative complications in 200 eye underwent surgery

Amblyopia

Amblyopia was present in 92 (178 eyes) children and was the most common cause for visual impairment or blindness. Eighty six children had bilateral amblyopia and six had unilateral amblyopia (Table 13). In the bilateral group, 62 were equally amblyopic in the 2 eyes.

Discussion

Management of childhood cataract remains a challenge and is complicated by the fact that it requires special surgical skills, tends to have more inflammation, and over a period of time has a risk of amblyopia along with change in refractive state of the eye.

Long at al. 2017 have shown that the top three types of unilateral cataracts were polar 55, (42.3%), total 42, (32.3%), and nuclear 23, (17.7%); and the top three types of bilateral cataracts were nuclear 110, (35.8%), total 102, (33.2%), and lamellar 34, (11.1%) among 438 children[25]. According to another study by Tătaru at al. 2020, the most frequent morphological variation was the total (29) cataract, followed by lamellar (17), nuclear (12) and cerulean (11) among 82 children[26]. Result of our study, out of 200 eyes showed the most common was lamellar cataract 72 (36%) followed by diffuse/total cataract 54 (27%), nuclear cataract 53 (26.5%), posterior sub-capsular cataract (PSC) 13 (6.5%), posterior polar cataract 4 (2%), and membranous cataract 4 (2%).

The visual outcome of cataract surgery in children have generally been poorer than in adults[27], as blindness in children with cataract is not only attributed to cataract, but also to visual deprivation from early onset and delayed presentation, and thus delayed surgery, complications of surgery, and associated ocular abnormalities[28,29]. But these days visual prognosis of children with congenital cataracts has improved dramatically because of early detection, prompt treatment and amblyopia management, advances in microsurgical techniques and instrumentation, and IOL developments[30, 7].

In our series, 48% of children regained good acuity (6/18 or better). The proportion with good acuity after surgery is similar to the figures of 44% reported by Yorston et al.[31] in Kenya, 48% by Yang et al.[32] in Taiwan, 47% by Sharma et al.[33] in India, 44% by Basti et al.[34] in India and 50% by Magnusson et al.[35]

Visual outcome in our series is comparably better to a study from south India that reported 39.5% having post-operative vision ≥6/18.[36] whereas a study from Pune had 35.5%[37] and Nepal that had 36.6% eyes having post-operative vision ≥6/18.[38]

Series reporting significantly better results in the developing world; these include Eck stein et al.[39] in India (57.1% R6/18), Alexandrakis et al.[40] (60%, R 20/40), Crouch et al.[41] (85%, R20/40), and Young et al.[42] (52.8%, R20/40) in the United States, Inatomi et al.[43] (79%, R20/40) in Japan and Cassidy et al.[44] (73.5% R6/12 or better). Children in the Inatomi et al.43 study were significantly older (mean age 10.3 years) than our cohort, which has generally been a predictor of better visual outcomes.

Complete success was defined as visual acuity > 6/18. Qualified success was visual acuity 6/24 to 6/60 and failed visual acuity < 6/60. Post-operatively, there was significant improvement in visual acuity in this study Overall, 24% children had visual acuity less than 6/60.

This study also shows that, the final post-operative visual acuity of children having nystagmus was more likely to be less than 6/60 than those without nystagmus (50% vs. 12.85%, P < 0.01). So, the risk of poor outcome in congenital

cataract with nystagmus was nearly 4 times more than those without nystagmus. Presence of nystagmus has poor visual outcome similar to other studies[45] wilson et al[46] but Young et al[47] and Bradford et al[48] has suggested that its presence is not a poor prognostic factor.

Early surgery is important in congenital cataract. Various authors have addressed the issue of timing in case of surgery for bilateral congenital cataract, but controversy persists as early surgery increases the risk of developing subsequent glaucoma and late surgery is associated with deprivation of visual development. In contrast to other authors like Gilbert at al. showed the best results occurred in patients who underwent surgery before they were 8 weeks old.[49] Magnusson at al. also reported that the visual acuity improved to a considerable extent after school age, especially in children who underwent surgery between the ages of 7 weeks and 1 year.[35] we were unable to document any difference in outcome for patients operated within 6 months and those operated between 6 month to 60 months. It could be due to the shorter follow-up of patients.

Primary IOL implantation achieved better[50,51] and or similar visual outcomes[52] after cataract extraction in patients younger than 2 years. Intraocular lenses were also associated with an increased risk of visual axis opacities and did not reduce the odds of postoperative glaucoma.[51,52] Another surgical factor predictive of good vision in the current study was the use of IOLs, which other studies suggest not only improves visual outcomes in children[53] but also reduces the magnitude of myopic shift[54]. Most reports have recommended under-correction of the IOL power for pediatric cataract, anticipating the myopic shift following IOL implantation. In our study, there was moderate positive correlation between the IOL under correction and post-operative refraction. (r^2 =0.474; p<0.01)

The most common early post-operative complication encountered was presence of fibrinous uveitis, 16 eyes (8%) in this study. Findings are reported by other authors (28.2% by Cassidy et al. 4430.5% by Yorston et al.[31] and 20.8% by Khanna et al.[36]. It may due to the use of systemic steroid and biocompatible IOLs and in-the-bag implantation in all cases.

Postoperative Capsular Opacification (PCO) was seen in 43.7%[34] and 48.4%[36] of eyes in the ECCE + IOL group and in 3.65%[34] and 7%[36] of eyes in the ECCE + PPC + AVT + IOL (p < 0.001). In our series, of 200 (100%) eyes that underwent PPC, PCO occurred in 17 eyes (8.5%) hence, we agree with other authors that PPC with AV should be mandatorily done in all children till 6-7 years of age.

Wong et al. have shown that 9.8% of eyes (6.6% within 1 year) in the planned aphakic group, all four eyes with failed implantation and 13.5% of the pseudophakic eyes (10.8% within 1 year) developed glaucoma at a mean follow up of 2.5 years.[55] Kirwan et al. also have shown the incidence of glaucoma was significantly greater (p = 0.02) in the aphakic (15 eyes, 33% among 113 +/-69 months follow up) compared to the pseudophakic (seven eyes, 13% among 56+/-44 months follow up) group.[56] Another study by Urban et al. have shown that the postoperative glaucoma developed in 9.7% of eyes of children with cataract (Mean post cataract surgery follow-up was 6.2 years). Postoperative open-angle glaucoma developed in 6 pseudophakic eyes and in 2 aphakic eyes; postoperative closed-angle glaucoma developed in 3 aphakic eyes.[57] Though glaucoma is one of the frequent serious complication, that were only 12 (6%) eyes that had post-operative IOP more than 21 mm of Hg in our series, however, follow-up was short. A long-term follow-up of these cases will help to establish the incidence of glaucoma.

The leading cause of poor visual outcome was amblyopia reported by Yorston et al.[31]. Beside this, Kuhli-Hattenbach et al. suggest that long-term prevalence of mild, moderate, and severe amblyopia is similar between the two cohorts of bilateral congenital cataract eyes based on the age ≤ or >10 weeks at the time of surgery.[58] Amblyopia was the most common cause of visual deprivation, and it was symmetrical in most of the cases (86%) reveals in this study.

Conclusion

Late age of presentation, presence of nystagmus and amblyopia were found to be significantly associated with poor post-operative visual outcome of cataract surgery in children. Primary

posterior capsulotomy with anterior vitrectomy significantly reduces the chance of visual axis opacification. Limitations include smaller sample size and difficulty in actual quantification of visual acuity in preverbal children. Long term visual outcome was also not evaluated due to short follow-up duration of 6 months. Further studies are needed to investigate these outcomes in the long term.

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