Long Term Emmetropization after Cataract Surgeries in Children

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ABSTRACT

Objectives: To evaluate the long-term refractive outcome of bilateral pediatric cataract surgeries with intraocular lens implantation in Children.

Methods: The medical records of children aged under 10 years, who underwent cataract surgeries with C were reviewed. All the children underwent primary posterior capsulotomy with anterior vitrectomy and primary IOL implantation. Only those with a follow-up of at least 5 years were evaluated.

Results: In total, 24 children (5 females and 19 males, 18 patients had developmental cataracts and 6 had congenital cataracts, 48 eyes) met the inclusion criteria for this study. Mean age at the time of surgery was 5.36±2.35 years (1 month–6 years). Mean follow-up time was 5.54±1.58 years. The average refraction followed a logarithmic decline with age. Typically, children who had a minor hyperopic refractive errors immediately following surgery developed substantial myopia as they grew older. Patients who were 0 to 4 years old at the time of surgery had a significantly larger myopic shift rate than patients who were 6 to 8 years and 9 to 11 years

Conclusion: This study demonstrate a trend toward declining postoperative hyperopia in pediatric patients undergoing intraocular lens implantation. Myopic shift varies significantly amongst patients. It is necessary to adjust the IOL calculation formula to specify more undercorrection, with the aim of achieving more optimal refractive outcomes in adulthood.

Keywords: Pediatric Cataract, IOL implantation, Myopic shift.

INTRODUCTION

Controlling long-term refractive results is currently one of the biggest hurdles in pediatric cataract surgery, despite tremendous advancements in surgical techniques, equipment, and IOL design. Axial Length (AL) increases rapidly in the first two years of life due to eye growth, then tapers off and stabilizes between the ages of seven and ten. Additionally, the other main causes of the refractive changes brought on by eye growth that make the eye more myopic include flattening of the cornea and a decrease in lens power. This process is called Emmetrization[1, 2]. Given the potential risk that an early Hypermetropia could be amblyogenic in and of itself,

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some pediatric ophthalmologists recommend a minor initial undercorrection, or emmetropia, with the possibility of refractive surgery or intraocular lens replacement later on if needed. The most widely used technique is still initial undercorrection, despite the lack of research comparing the visual or refractive results for these 2 methods. The foundation of this first undercorrection is a set of rules, the most well-known of which are those developed by Enyedi and colleagues and Dahan and colleagues. In the study conducted by Dahan *et al*.,[3] the IOL power was under corrected by 80% of the emmetropic IOL power for patients under 2 years old and 90% for patients older than 2 years of age. Another study offered an initial hypermetropia in children of different ages and evaluated the myopic shift during serial follow-up[2] . In another popular approach, Enyedi and associates[2] recommended a postoperative refractive goal of þ6 for a 1-year-old, þ5 for a 2-year-old, þ4 for a 3-year-old, þ3 for a 4- year-old, þ2 for a 5-year-old, þ1 for a 6-year-old, plano for a 7-year-old, and 1 to 2 for patients >_8 years of age (rule of seven).One of the main causes of the myopic shift in pediatric pseudophakic eyes is axial length elongation [4, 5]. Most children's eyes continue to elongate slightly throughout childhood, however after two years, this alteration becomes much less noticeable [6,7]. Because of this, some doctors choose to implant an IOL that first corrects emmetropia in young children because they are worried that the child won't wear an over refraction after surgery, which could lead to the development of or exacerbation of amblyopia [8,9]. Additionally, they have noticed that some of these eyes only undergo a tiny myopic shift, and they believe it is impossible to predict how much the refractive error in these eyes will change over time with any degree of accuracy. This study aimed to evaluate the long-term refractive outcome of bilateral pediatric cataract surgeries with intraocular lens implantation in Children. The purpose of this study is to close the gap in the literature by examining the long-term trends of emmetropization in children who have had cataract surgery. In the end, this information can assist young cataract patients have better visual outcomes throughout their growth by improving surgical methods, postoperative care plans, and IOL selection. The results may help advance our knowledge of how children's eyes develop and adapt after surgery, which could have consequences for treating refractive errors in other pediatric eye conditions.

PATIENTS AND METHODS

Patient recruitment

The medical records of children aged under 10 years, who underwent cataract surgeries and IOL implantation in the Chittagong eye infirmary and training complex between January 2010 and May 2018, were reviewed. Informed consent was taken from all patients. The study was approved by the institutional review board at Institute of Community Ophthalmology, Chittagong Eye Infirmary and Training Complex. The study comprised children who did not have any other ocular abnormalities. The study also included pediatric patients who had anterior vitrectomy, posterior capsulotomy, and lens aspiration with primary IOL implantation. In every patient, the IOL was inserted into a capsular bag. Immersion ultrasound A-scan was used to assess the preoperative axial length, and the SRK/T formula was utilized to determine the IOL power for each patient. Participants in the study were excluded if they had any other ocular abnormalities, such as retinal diseases that could impair the eyesight potential, retinal detachment, persistent fetal vasculature, glaucoma, optic nerve diseases, corneal abnormalities, active uveitis or signs of a previous episode of uveitis, history of laser treatment or cryotherapy for retinopathy of prematurity, surgical complications, IOL placement in sulcus, or failure to attend a follow-up. Anticipating the expected myopic shift allowed for the computation of the undercorrected IOL powers.

Data collection

Data on baseline characteristics, surgical techniques, visual results, postoperative refraction, and best corrected visual acuity (BCVA) were all obtained. Presenting visual acuity was assessed monocularly. Depending upon the age and cooperation of the patients, a variety of methods were used for assessing visual acuity such as following objects, CSM (central, steady & maintenance) methods, Preferential looking test (Cardiff acuity test) and Kay picture test . Mahindra near retinoscopy was done to find out the gross refractive status followed by cycloplegic refraction. The standards for quantifying refractive error were as follows: myopia was considered to be a mean spherical equivalent of $\geq$ -1.00D; hyperopia $\geq$ +1.00D; astigmatism as $\geq \pm$1.00D in any meridian and anisometropia as (mean sphere) $\geq$1.00D.

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Outcome measures

The postoperative refractive errors in pseudophakic eyes at the last follow-up visit in children older than 7 years old served as the major outcome measure. It is anticipated that the refractive status would stabilize beyond the age of seven. Children attain an emmetropic plateau between the ages of 5 and 7 years, beyond which there is no discernible change in refractive status, according to data from the study by Gwiazda et al. [6]. The study's follow-up data were collected postoperatively at 6 months, 1 year, 1 month (±2 weeks), and every year after that.

Statistical analysis

These survey results were all compiled into an Excel file created with Microsoft Office 2010. Then, IBM® SPSS® Statistic 16 was used to perform the analysis. For continuous variables Descriptive statistical measures such as mean ± Standard Deviation (SD) and for categorical variables percentages were computed. Paired sample t test and repeated measure anova were used to compare the outcome variables or association between two independent categorical variables. A value of P <0.05 at 5% level of significance was defined as statistically significant.

RESULTS

The characteristics of 48 eyes of 24 children are summarized in Table 1. Of these, 18 patients (81.3%) had developmental cataracts and rest (9.4%) had congenital cataracts. The average age at the time of cataract surgery was 5.36±2.35 years (1 month–6 years).All patients were bilateral cataract and all IOLs were placed primarily. There were 6 patients aged 0 to 2 years, 11 patients aged 3 to 5 years, 5 patients aged 6 to 8 years, 3 patients aged 9 to 11 years, and 7 patients aged 12 to 17 years. The average IOL power was 20.85±5.20 D(range: 6D to 28.00D). The average follow-up was 52.5 months (range: 24 to 108 months).Yag capsulotomy was done in 25% cases.

Table 01: Characteristics of Children with Pediatric Cataracts

Content	**No.(n=24patients)**	**Minimum**	**Maximum**
Age (Mean± SD)	10.37±4.90	2years	17years
Gender	Male -79.2%(19) Female-20.8%(5)	-	-
Types of Cataract	Developmental Cataract-75%(18) Congenital Cataract-25%(6)	-	-
Laterality	Bilateral-100%(24)		
Age at surgery(Mean± SD)	5.36±2.35years	6months	11 years
Interval(Mean± SD)	6.95±8.56 months	1month	30months
Duration of final follow up	5.54±1.58	4.0	8.00
IOL Power(Mean± SD)	20.85±5.20 D	6.00D	28.00D
Yag Capsulotomy	Yes –25%(6) No-75(18)	-	-

The maximum best-corrected visual acuity (BCVA) at the final visit was 70.7 %(34 eyes). However, Amblyopia was found in 33.3% of eyes. Amblyopic patients were given part time occlusion with active vision therapy. (Table 2)

Table 2: Best corrected VA in final follow up

Best corrected Visual acuity	**N(eyes)**	**Percentage**
6/6-6/18	34	70.7
<6/18-6/60	9	18.8
<3/60	3	6.3
CSM positive	2	4.2
Total	48	100

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Over the course of the follow-up period, the eyes underwent an average significant myopic shift of -6.0 ± 6.3D in spherical power and in cylindrical power 0.94±1.94D(p=0.00001, ANOVA). (Figure 1and 2)

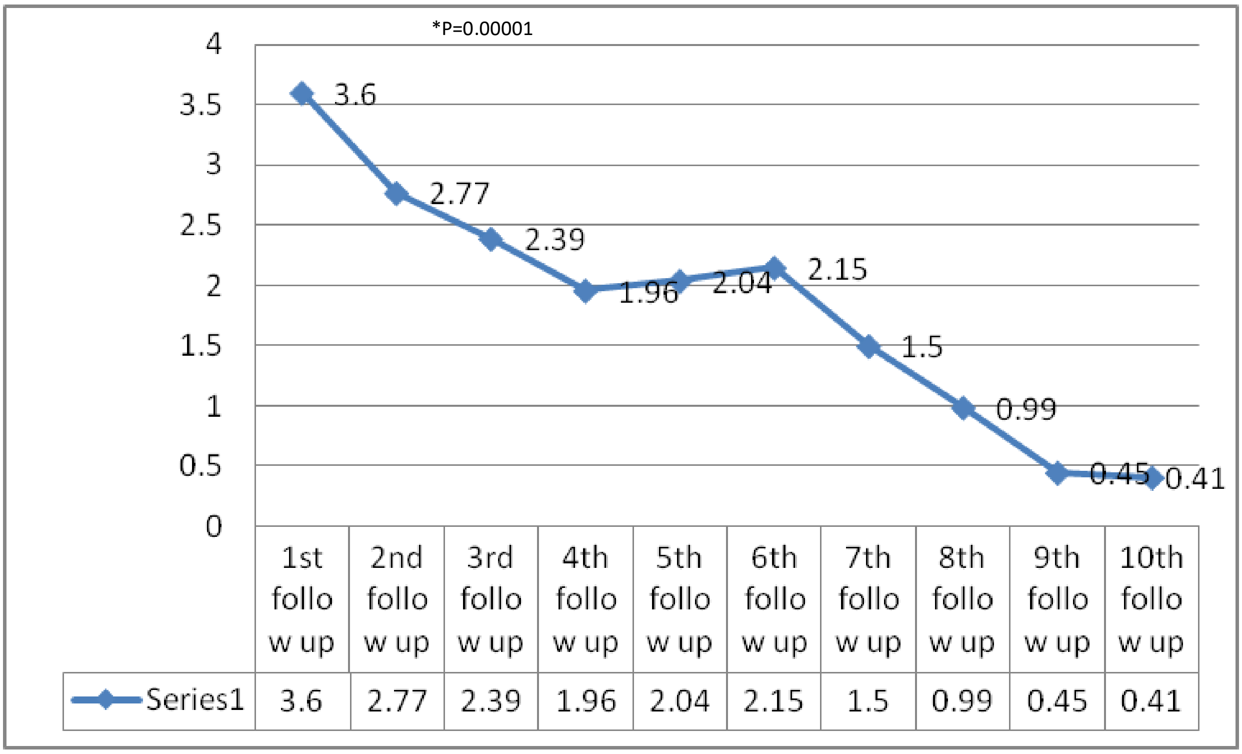

Figure 01: Changes in spherical power over time

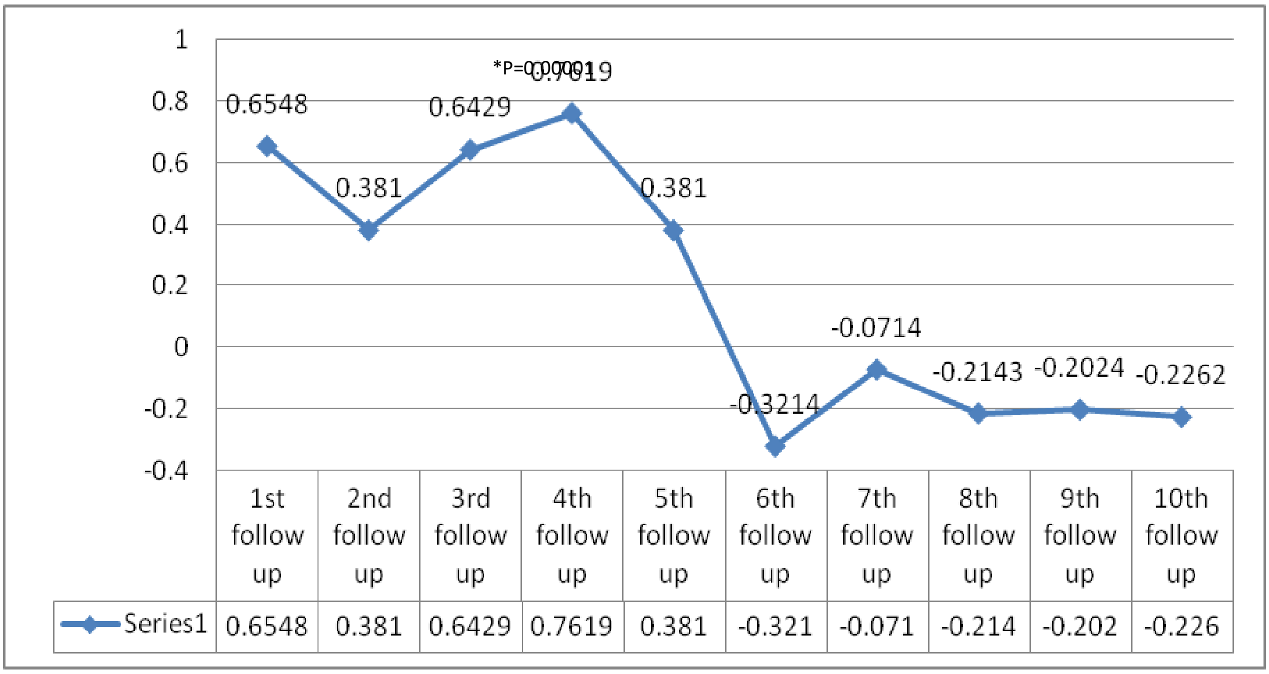

Figure 02: changes in cylindrical power over time

The mean refractive change(spherical and cylindrical power) versus different age group after IOL implantation has been summarized in Figure 3 and 4.The difference in total change in the refraction and in the rate of change of refraction were both statistically significant among different age groups (P < .00001, ANOVA). Pairwise comparisons among the age groups showed that patients who were 0 to 4 years old at the time of surgery had a significantly larger myopic shift rate than patients who were 6 to 8 years and 9 to 11 years .however no statistically significant difference in the rate of refractive change was shown in 5-8 years and 9-14 years groups.

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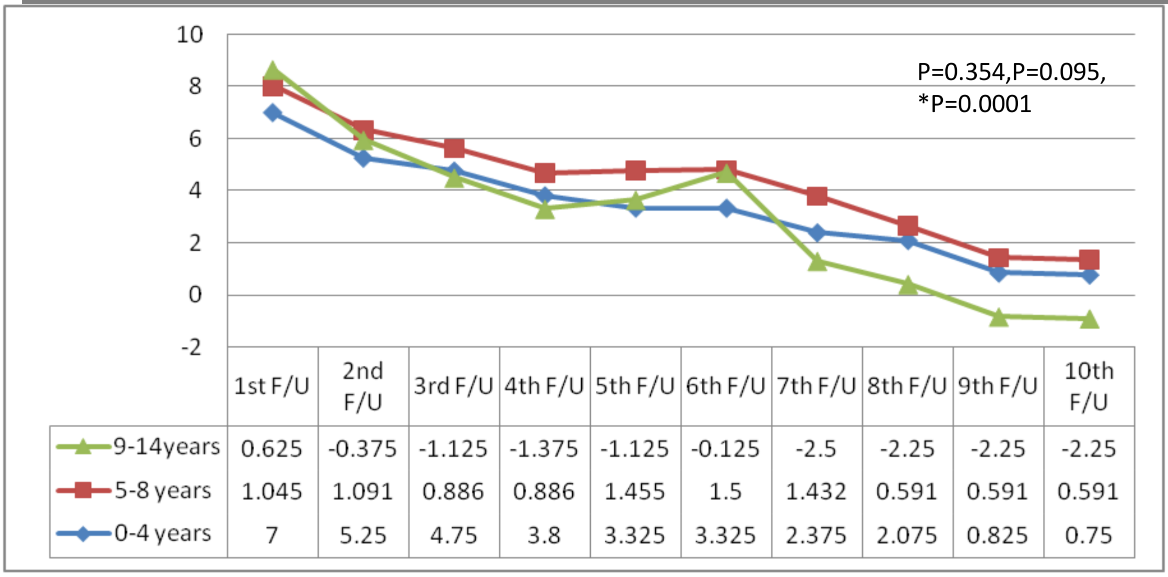

Figure 03: Changes in spherical power in different age groups over time.

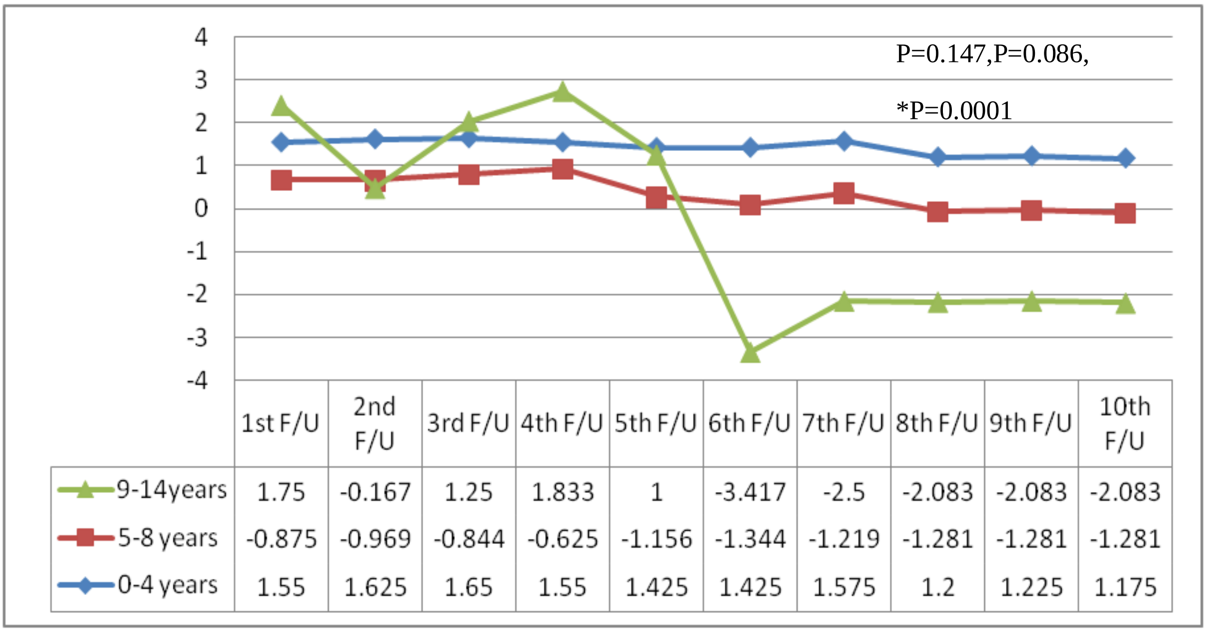

Figure 04: Changes in cylindrical power in different age groups over time.

DISCUSSION

The average age at the time of cataract surgery was 5.36±2.35 years (1 month–6 years).All patients were bilateral cataract and all IOLs were placed primarily. Postoperatively, over the course of the follow-up period, the eyes underwent an average significant myopic shift of -6.0 ± 6.3 diopters (D)in spherical power and in cylindrical power(p=0.00001). Fortunately, 70.7 %(34 eyes) children managed to achieve a postoperative BCVA better than 6/18 at the final visit.The primary factor contributing to a BCVA worse than 20/100 was deprivation amblyopia, highlighting the significance of managing amblyopia in the context of pediatric cataract treatment. The age of the patient at the time of surgery was also found to be a factor in determining the postoperative refractive status, with younger patients showing more postoperative myopia and older patients—those who had cataract surgery at least five years old—exhibiting lower refractive errors. Patients who were 0 to 4 years old at the time of surgery had a significantly larger myopic shift rate than patients who were 6 to 8 years and 9 to 11 years .however no statistically significant difference in the rate of refractive change was shown in 5-8 years and 9-14 years groups.These findings are consistent with other studies where overall postoperative myopic shift was greatest in the youngest patients aged up to 8 years.[8,9,10] One factor could be that measuring ocular parameters (axial length, keratometry) in young children presents challenges, which could result in additional errors when calculating IOL power.However, our findings are in contrast to those of Sachdeva et al,[11] who reported that children under the age of two had higher rates of hypermetropia and that this age group needed less undercorrection. Plager et al.[7] showed a mean myopic shift of 4.6 D in children operated at age 2 or 3 years over a period of 6 years with a mean rate of shift decreasing as the age increased. They also underlined how young children's myopic shift in the future is uncertain. Similar observations were made by Crouch et al.[12] who showed a myopic shift of 5.96 in children <2 years age with a mean follow-up of 5.4 years. This study acted as a guide for precise IOL power calculations based on children's refractive development. Dahan and Drusedau[3] reported a myopic shift of 6.9 D in infants over a period of 7 years after primary IOL implantation.

The limitations of this study include its small sample size and the uneven distribution of the age of the children.

CONCLUSION

It is considered still a challenge to choose an appropriate IOL power in children. Still today, there is no standardization in IOL power adjustment for intended undercorrection to account for myopic shift. In this series,there is a decreasing trend observed in final refraction over such a long follow-up. The IOL power calculation formula needs to be adjusted in this study for more undercorrection to achieve an optimal refractive outcome in adulthood. More studies are needed to compare these guidelines for undercorrection in other cohorts.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

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