

VISUAL OUTCOME AND CHANGE IN REFRACTION AFTER PAEDIATRIC CATARACT SURGERY

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ABSTRACT: INTRODUCTION: Cataract remains one of the most important avoidable causes of blindness in children. IOL implantation has the advantage of immediate visual rehabilitation, less hospital visits and less vigorous supervision by the ophthalmologists. We assessed the effects of intra ocular lens implantation on post-operative complications, method of optical correction, and presence of amblyopia as immediate visual outcomes. Additionally, changes in refraction in one year follow up period. **METHODS:** We studied congenital and developmental cataract who underwent extra capsular cataract extraction (ECCE) with posterior capsulotomy and anterior vitrectomy between 2007 and 2010. Patient demographics, cataract type, presenting symptom, complications of surgery, post-operative visual acuity and refractive changes were recorded. **RESULTS:** 34 children were included and a total 50 eyes of were evaluated. Unilateral cataracts were present in 18(51.43%) patients, and are predominantly in age group of 9-14 years. Post operatively 13 patients had visual acuity <6/60, compared to 47 patients at admission. The most common early post-operative complication observed was fibrinous uveitis which occurred in 6 patients. At the end of 1 year follow up 28 eyes showed increase in axial length of that 13 patients are in age group of 1-4 years. **CONCLUSION:** Primary IOL implantation and primary posterior capsulorrhexis with anterior vitrectomy is a safe and effective method for pediatric cataract, We observed less post-operative complications, improved visual acuity, and less refractive changes. Intraocular lens implantation acts as an aid for early visual rehabilitation for pediatric cataracts if the children undergo surgery before abnormal foveolar function develops. **KEYWORDS:** BCVA - best corrected visual acuity; PC-posterior capsule; RD- retinal detachment; ECCE+IOL- extracapsular cataract surgery + intraocular lens; ECCE+PPC+AV-extracapsular cataract surgery + primary posterior capsulotomy + anterior vitrectomy, amblyopia.

INTRODUCTION: Cataract remains one of the most important avoidable causes of blindness in children. In developing countries the prevalence of blindness from cataract is thought to be about 1–4/10 000 children. This is about 10 times higher than the figure for industrialized countries.¹ Management of congenital and childhood cataracts remain a challenge. Increased intraoperative difficulties, propensity for increased postoperative inflammation, changing refractive state of the eye, more common postoperative complications and a tendency to develop amblyopia, all add to the difficulty in achieving a good visual outcome in the pediatric patients. IOL implantation has the advantage of immediate visual rehabilitation, less hospital visits and less vigorous supervision by the ophthalmologists because of the availability of best of the surgical hands, refined surgical procedures, improved instruments and suture materials. We studied the etiology of the cataract,

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IOL power calculation and implantation surgical complications, compliance for amblyopia therapy, myopic shift, axial length and immediate visual outcome of intraocular lens implantation after pediatric Cataract Surgery. Additionally, we also assessed the change in refraction after primary IOL implantations in one year follow up period.

METHODS: This interventional study was conducted at our hospital during November 2007 to November 2009. Children below the age of 15 years, who were undergoing primary posterior chamber IOL implantation either congenital or developmental unilateral or bilateral cataract were enrolled into the study. Children with secondary IOL, anterior chamber, scleral fixated and iris claw IOL Implantation or complicated and traumatic Cataract or eyes with severe ocular anomalies were excluded from the study. Cataract was classified as congenital, if the age of diagnosis was within 1 year of birth and developmental if the age of diagnosis was later.

Demographic information such as age at diagnosis, presence or absence of consanguinity and family history of cataract was recorded. Visual acuity was determined depending on the age and co-operation of child by either by Allen pictures, or Teller acuity or Snellens chart or fixation pattern. IOL power is calculated using SRK II (Sanders-Retzlaff-Kraff II) formula. with biomedix machine. The decision of IOL power to implant was made taking into account the age of the patient, and the refraction/IOL power of the fellow eye. All surgeries were done by a single surgeon under general anesthesia. Extracapsular cataract extraction (ECCE) with primary posterior capsulotomy and anterior vitrectomy and IOL implantation was the type of surgery performed on all patients.

STATISTICAL ANALYSIS: Data was entered in excel spread sheet and statistical analysis was carried using Graphpad Prism software version-4 USA. Continuous data was presented as mean \pm standard deviation and categorical data as numbers and percentages. Absolute change from baseline was used as a change in refraction. Predictive error was calculated automatically by using regression method.

RESULTS: A total of 50 eyes were evaluated, among them 19 patients were boys and 31 were girls. The mean age of presentation was 13.4 ± 3.8 years. History of consanguinity was present in 12(36%) patients, prematurity in 4(12%) patients, idiopathic in 8(24%), infectious in 1(3%) patients. Zonular cataract was found to be the most common type (36 eyes), total dense cataract were in 5 eyes, blue dot cataract (3 eyes) and posterior polar cataracts were (6 eyes). 16 (48.57%) patients had cataract in both the eyes, 10 had cataract in the right eye and 8 patients had cataract in the left eye. Associated ocular abnormalities were observed in patients includes nystagmus-6, exodeviation-5, esodeviation-2, and heterochromia iridis in 1 patient. We found that one patient was positive for IgG antibodies to toxoplasma. This patient had nystagmus, exotropia, and epilepsy since childhood. The patient also had mental retardation and fundus examination showed macular scar due to toxoplasmic retinochoroiditis in both eyes. The axial length between 20-23mm was found in 40 eyes; between 23-25mm in 7 eyes and between 25-28mm in 3 eyes Pre-operative visual acuity (VA) was recorded by snellens opto type equivalent appropriate for that age. 47 patients had VA less than 6/60. All cases had IOL implantation after

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primary posterior capsulorhexis and anterior vitrectomy. Due to peripheral extension 4 eyes had large PPC (>5.5-6mm) and IOL was implanted in the sulcus. Other eyes had IOL implanted in the bag. Majority of the patients had post-operative best corrected visual acuity of 6/36-6/24. (21 eyes) at the end of 1 yr (graph-1). Amblyopia was present in 15 patients and most common cause of visual impairment. At the end of 1 yr follow up, (Tables-1) 28 eyes in our study showed axial length increase. Among the 0-4yrs age group, axial length increase of 0.5mm was noted in 3 eyes, 0.4mm increase in 10 eyes. Among 5-8yrs age group 0.35mm axial length increase was noted in 3 eyes, 0.25mm in 8 eyes, 0.15mm in 2 eyes. Among 9-14 yrs age group axial length increase of 0.5mm was noted in 2 eyes. Children under 4 years experienced the most myopic shift. At the end of one year, Mean change in refraction (Tables2) 0-4y is -1D, 5-8y is -0.4D and 9-14y is -0.09D. Our data set shows that the mean target refractions aimed for more hyperopia in the 0-4y age group at time of surgery. The range of implanted power varies within each group based on additional attempts to balance within 3 D of the fellow eye refraction as well, which is particularly important in the unilateral cataract patients. The prediction error (Tables-3) was higher in 0- 4 yrs age group and smaller in the 9-14 yr age Groups, demonstrating the difficulties in predicting implant power in younger children, especially under age 4 years. It was also observed that under age 4 years there is much more myopic shift than over age 4 years.

DISCUSSION: In this study, we investigated visual outcome of intraocular lens implantation after pediatric Cataract Surgery and to find out the cause of poor visual outcome. Adaptation of techniques for cataract surgery specific to children is necessary owing to low scleral rigidity, increased elasticity of the anterior capsule, and high vitreous pressure. Appropriate surgical timing and adequate visual rehabilitation are paramount, to avoid irreversible visual damage secondary to amblyopia.² Wright et al³ emphasized the advantage of very early surgery so visual acquisition can be achieved before abnormal binocular interaction develops. Sinskey et al⁴ have demonstrated that IOLs can be implanted without major surgical complications as early as 17 days after birth. Yorston and coworkers⁵ also recommended IOL implantation as the treatment of choice for most children with cataract in the developing world. Based on the published studies⁶⁻⁹ and our experience so far, we agree that extracapsular cataract surgery, primary posterior capsulectomy and anterior vitrectomy (ECCE, PPC, and AV) provide the best chance of a long term clear visual axis.

Vijayalakshmi et. al.¹⁰ found that out of 366 children with non-traumatic cataract 25% were hereditary, 15% were due to congenital rubella syndrome and remaining was undetermined. Out of 50 cases in our study we found that consanguinity was present in 12(36%) patients, prematurity in 4(12%) patients, idiopathic in 8(24%), infectious in 1(3%) patients.

Koch DD¹¹ reported that PPC with anterior vitrectomy was the only effective method of preventing or delaying secondary cataract formation in infants and children. Vasavada. A¹² et al results suggested that anterior vitrectomy is desirable along with PPC in children younger than 5 years with congenital cataract.

In our study, majority of the patients had post-operative best corrected visual acuity of 6/36-6/24. The probable causes of reduced visual acuity (<6/60-13 eyes) were due to the presence of squint, amblyopia, nystagmus and macular scar. Other factors such as delay in

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bringing the child for treatment, compliance with occlusion therapy may hamper the child's possibility of developing good visual acuity even after a good surgical correction of cataract. Visual prognosis also depends on the degree of lens opacity, the patient's age and whether the condition was unilateral or bilateral.

We used single piece biconvex PMMA posterior chamber lenses. We found it to be safer material as suggested in a previous study by Wilson.¹³ We chose single piece lens because we found them to be more stable with less amount of decentration. In the study by Robert A Sinskey et al,¹⁴ they used three piece PMMA optic with poly propylene loops as they found it to be more flexible than one piece lenses. Some authors reported that lenses with poly propylene loop might not be biologically inert.

Foldable lenses allow a much smaller incision than PMMA IOLs, for children. Smaller incisions are more secure and practical in children than adults since the lenses are soft and no hard nucleus is present. Small incisions incite less inflammation and require less suture closure. The major disadvantage of foldable IOLs for children is cost. As children show more likelihood of axial length differences between each eye, IOL calculations for both eyes become crucial to ultimate long-term success in balancing and maintaining appropriate long-term postoperative refractions. Neely et al. demonstrated that, SRK-II was the least variable in the paediatric population with cataracts, particularly in younger children with axial lengths less than 19 mm. As a result of these literature findings, we made a decision to use the SRK-II formula for our cataract surgeries in these children. Several authors have recommended how much to under power an IOL in children undergoing cataract surgery depending on age, in order to compensate for the myopic shift as children's eyes grow.¹⁵ Selecting the best IOL power to implant in a growing child presents unique challenge. If emmetropia or mild myopia is selected as the target refraction in operating young children, high myopia will probably occur later.¹⁵ In order to minimise the need to exchange IOLs later in life when a large myopic shift occurs, it has been advised to undercorrect children with IOLs so that they can grow into emmetropia or mild myopia in adult life. Dahan and coworker¹⁶ have advised utilising an IOL with a power that is 20% less than that predicted by these formulas when the child is less than age 2 years, and a 10% undercorrection from age 2–8 years. Residual hyperopic should be managed with spectacles if possible.

At the Storm Eye Institution¹⁷ we have noted much better distance and near functional vision in children than would be predicted with poor spectacle compliance for residual hyperopia in the 1–3 dioptre range. Pseudoaccommodation in children with monofocal IOLs can be impressive even though the reasons for its existence have not been fully elucidated.

In bilateral cases we aimed for balanced hyperopic correction immediately post operatively anticipating emmetropization with aging. and in unilateral cases to match the refractive error in the fellow eye.

In unilateral cases these options would induce hyperopic anisometropia immediately post operatively, risking development of anisometropic amblyopia and possibly resulting in poorer visual outcomes.

Plager et al¹⁸ recommended post op ref goal of +5d at the age of 3yrs. they disregarded the previous suggested guide lines, which followed a linear trend, and attempted to incorporate

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more physiologic logarithmic component, similar to that described by Mc Clatchey and Parks.¹⁹ In addition they recommended that the post op ref goal be tempered by the refraction in the fellow eye to minimize the occurrence of induced anisometropia and prevent anisometropic amblyopia.

In an attempt to counteract the anticipated myopic shift identified in the literature, Mc clatchey¹⁹ suggested under powering the pseudophakic refraction of the operated eye to deliberately induce hyperopia. They suggested under powering by +3.00 D at age 1 year, +2.00 D at age 3 years, and +1.00 D at age 7 years.

Another pertinent issue to consider in children with cataracts is the refractive power of the fellow phakic eye in unilateral cataract cases. An attempt should be made to balance the refraction of both eyes regardless of whether the cataracts are bilateral or unilateral, and avoid as much anisometropia as possible.. Anisometropia greater than 2.50–3.00 D can induce dense amblyopia.

All attempts should be made to aim for minimizing anisometropia over the long term. Not only is the overall under powering of the proposed IOL for the cataractous eye important, depending on age, but the refractive power of the fellow eye is also key to final decision-making on implant power for the cataractous eye. Whether the cataracts are unilateral or bilateral is also important to long-term refractive success of the operation. Gordon and Donzis²⁰ have reported that in normal children axial length increases rapidly until age 2 to 3 years, then slowly changes until stabilization at age 8 to 10 years. Several studies have shown myopic shift with age after cataract surgery. making IOL calculations even more challenging to predict if cataract/IOL surgery is contemplated in this age group. Plager et al¹⁸. Demonstrated that children definitely experience a myopic shift with age, with a mean myopic shift 4.60 D in children aged 2–3 years in their study. Children 1–2 years of age at the time of surgery had a myopic shift averaging –5.96 D, decreasing to –2.03 D in the 7–8 years group at time of surgery. McClatchey and Parks,¹⁹ and Crouch et al.¹⁶ have documented that aphakic eyes of children follow a logarithmic change in myopic shift over time, as children grow. We have documented the same type of logarithmic shift with age in our group of pediatric IOL patients, with less myopic shift occurring in children implanted at an older age, as compared to those much younger. Dahan et al.²³ have shown a myopic shift of 6.39 D in children undergoing IOL surgery from 1 to 18 months of age, yet decreasing to 0.76 D in children 3–8 years of age. Our data are compatible with these studies, again showing the much larger myopic shift that occurs under age 3–4 years and more so under age 2 years.

Although some have postulated that the myopic shift documented in children is caused by excessive axial elongation from visual deprivation and amblyopia, a much more plausible explanation for the myopic shift is that it is directly related to normal eye growth in eyes of fixed IOL power Dahan et al.²³ measured axial lengths in children and showed that the most growth in pediatric pseudophakic eyes occurs under 2 years of age. The myopic shift continues in older children but more slowly, as would be expected in phakic eyes. In a unilateral cataract situation, the fellow non-cataractous eye will demonstrate less myopic shift than a pseudophakic eye because the normal phakic lens and cornea power changes to compensate for the axial elongation.¹³ As with these studies, our series demonstrates the same findings, with younger children experiencing more myopic shift than older children because their eyes elongate more

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with growth, and with comparable numbers for the amount of myopic shift seen in these papers outlined.

To further demonstrate the efficacy of paediatric pseudophakia over an aphakic condition, McClatchey et al.¹⁹ and Superstein et al.²¹ have both independently shown that pseudophakic eyes in children showed less myopic shift than aphakic eyes. In addition, Weakley et al.²² examined the correlation between the rate of refractive growth in aphakia and visual acuity outcome in these patients. Their research showed that aphakic eyes had a greater myopic shift which correlated with these eyes having poorer long-term visual acuity outcomes. Although Superstein et al.²¹ did not comment on children less than 2 years of age, the work of McClatchey et al.¹⁹ and Weakley et al.²² does imply that the refractive growth of the eye is potentially affected in a positive way by the presence of an IOL. This is important information as it shows that children will have more favourable and predictable visual and refractive outcomes with implantation of an IOL than without one.

CONCLUSION: Primary IOL implantation and primary posterior capsulorrhexis with anterior vitrectomy is a safe and effective method for pediatric cataract, we observed less post-operative complications, improved visual acuity and less refractive changes. Intraocular lens implantation acts as an aid for early visual rehabilitation for pediatric cataracts if the children undergo surgery before abnormal foveolar function develops. Factors affecting axial growth after cataract surgery such as gender and race may affect growth of the normal eye and may influence eye growth after cataract surgery.

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Age group	Axial length increase	No of eyes
0-4 yrs	0.5 mm	3
	0.4mm	10
5-8 yrs	0.35 mm	3
	0.25 mm	8
	0.15 mm	2
9-14 yrs	0.5 mm	2

TABLE 1: POST OPERATIVE INCREASE IN AXIAL LENGTH AT THE END OF 1 YEAR FOLLOW UP

Age & Laterality	No. of eyes in the study	Mean change in refraction (Diopter)	No. of eyes showing change in refraction	No. of eyes with no change in refraction
0-4yrs	13	-1.12D	13	0
5-8yrs	15	-0.43D	13	2
9-14yrs	22	-0.09D	2	20
Total	50	0.46 D	28	22
Unilateral	18	-0.53D	10	
Bilateral	32	-0.4D	18	

TABLE 2: CHANGE IN REFRACTION IN DIFFERENT AGE GROUPS

Age	No. of eyes	Mean target refraction	Mean implant power(D)	Predictive error at 1 months(D)
0-4y	13	+3.25D	+21.96	1.29
5-8y	15	+1.7 D	+21.57	0.58
9-14y	22	Emmetropia (0 D)	+20.93	0.16

TABLE 3: PREDICTIVE ERROR OF MEAN TARGET REFRACTION AT 1 MONTHS (D)

BCVA	Pre OP (Eyes)	Post OP (Eyes)
< 1/ 60	16	0
1/60 - 3/60	9	4
4/60 - 6/60	22	9

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6/36 - 6/24	3	21
6/18 - 6/12	-	10
6/9 - 6/6	-	6
Total	50	50

TABLE 4: PRE & POST OPERATIVE BEST CORRECTED VISUAL ACQUITY

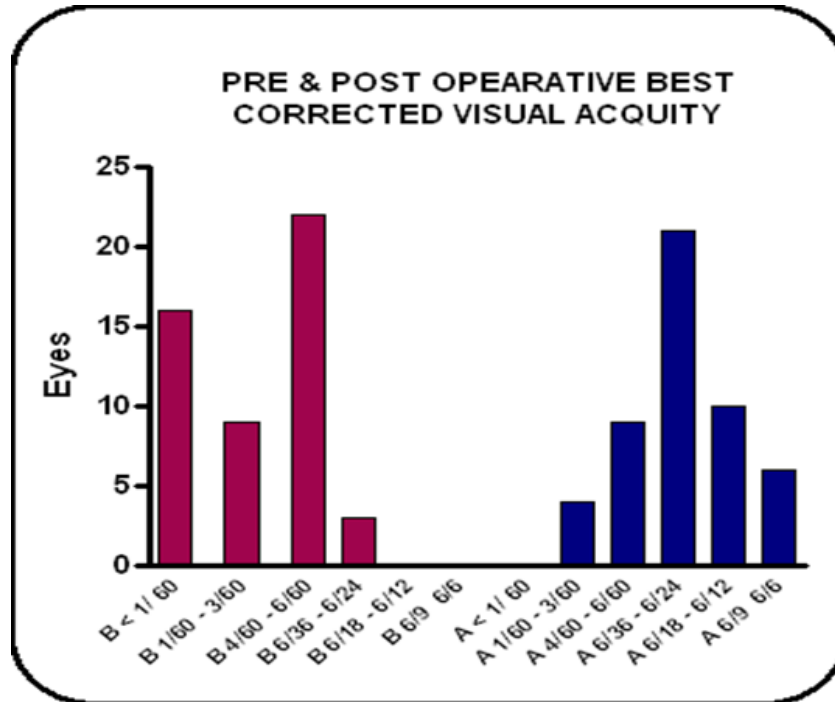


FIG. 1: PRE & POST OPERATIVE BEST CORRECTED VISUAL ACQUITY (B- before, A- after)

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