

Outcomes of paediatric cataract surgery at Lighthouse for Christ Eye Centre - Mombasa, Kenya: A retrospective case series

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ABSTRACT

Background: Paediatric cataract is one of the main and treatable causes of childhood blindness and visual impairment in developing countries, with varied outcome because of lack of properly equipped facilities, late presentation and poor follow-up.

Objective. This study aimed to assess the outcome of non-traumatic cases of paediatric cataract surgically managed at Lighthouse for Christ Eye Centre, Mombasa, Kenya.

Methods: This was a retrospective case series carried out from 1st January 2013 to 31st December 2014. Eyes of children <16 years of age operated for non-traumatic cataract, were included. The clarity of the visual axis and the Visual Acuity (VA) were the primary outcome measures. The types of surgery, the method of aphakic correction and complication rates were also recorded.

Results: Most patients were males (male: female ratio of 2.5:1). Majority of patients were in the 1-5 year age category (48.7%). Most patients were bilaterally affected (70.5%), with developmental cataract being the most common in 67.7% of eyes. Majority of the surgeries done were lensectomy + anterior vitrectomy (AV) + intraocular lens (IOL) implantation. Foldable IOLs were the most commonly implanted, in 82 eyes (75.2%). Twenty-four eyes were left aphakic (18%). The most common type of post-operative refractive correction was spectacles (55.6%). Majority of eyes with post-operative VA recorded, fell in the good outcome category as per World Health Organization (WHO) and Kilimanjaro Centre for Community Ophthalmology (KCCO) guidelines, for each follow-up visit. More than 90% of eyes had a clear visual axis for each follow-up period. At 12 weeks follow-up period, post-operative findings and complications were noted in approximately 40% of eyes, the most common finding was amblyopia (8.8 %).

Conclusion: Lens washout, primary posterior capsulotomy, anterior vitrectomy and primary intra-ocular lens implantation offers an effective method for correction of aphakia related to paediatric cataract surgery. It also maintained a clear visual axis for up to 1 year post-operatively with a significant number (>90%) remaining clear at each follow up visit. A majority of eyes (50%) had good visual outcome.

Recommendations: Strict follow up schedule is advised for consistent visual rehabilitation to further improve the outcome.

Key words: Childhood blindness, Paediatric cataract, Outcome

INTRODUCTION

Paediatric cataract has been found to be the main and treatable causes of childhood blindness and visual impairment worldwide¹. Globally, the incidence of blindness in children is unknown. However, surveys carried out with the use of key informants and other approaches have enabled identification of blind children and provision of information on the likely magnitude of blindness within the communities². In childhood, the overall incidence of cataracts that are clinically significant is unknown, but has been estimated to be

as high as 0.4%³. In developing countries, comprising mostly African and Asia, the prevalence was estimated at between 5 to 15/10,000 children⁴. Therefore, childhood cataract is an important cause of avoidable childhood blindness, more so in the middle and low income countries⁵.

Surgery is considered the first step in the pathway to visual rehabilitation for childhood cataract and this pathway is often affected by the post-operative outcome, resultant complications and the follow up⁶. Although early surgical intervention is advised to prevent amblyopia, complications have been noted

to increase with early surgery⁷. These postoperative complications are associated with a poorer visual outcome. Therefore, there is need to balance between the timing of surgery to prevent amblyopia and the ability to minimize postoperative complications.

Studies done in Africa⁸ and in Asia⁹ showed some deficiency in terms of post-operative care and follow up. These studies demonstrated that 20–40% of children who had cataract surgery were not brought back for their routine follow-up visits. The follow up appointments are important in ensuring that these children receive spectacle correction and low vision rehabilitation, amblyopia therapy, monitoring and managing both short term and long term complications therefore better visual and anatomical outcomes.

MATERIALS AND METHODS

A retrospective case series carried out at Lighthouse for Christ Eye Centre, Mombasa. Ethical approval was obtained from the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee and permission to conduct the study was also sought from the administrative head of Lighthouse for Christ Eye Centre. All children less than 16 years of age diagnosed and surgically managed for non-traumatic cataract from 1st January 2013 to 31st December 2014 were included in the study. A pre-designed questionnaire was used to record the information from the medical records.

All information relevant to the study was collected and entered into the pre-designed questionnaire. Post-operative outcome was determined in two ways; a clear visual axis post operatively for all the children and the visual acuity for those whose visual acuity was recorded. This was because of the difficulties

experienced in taking visual acuity in children especially the pre-verbal age group. The post-operative findings or complications and the post-operative duration of follow up was also documented. Follow up period was divided into day 1, week 1-3, week 4-11, week 12+, month 6, month 12 and last follow up.

Data was analyzed using STATA/IC v14. The variables were analyzed for normality. Variables that were normally distributed were summarized using mean and standard deviation (SD), whilst median and interquartile range (IRQ) were used for data that was not normally distributed. Odds ratios were constructed with a 95% confidence interval. Statistical significance was set at p-value of < 0.05. The frequencies and proportions of the variables have been presented in tables and graphs where appropriate.

RESULTS

Out of the 78 patients who met the inclusion criteria, there were significantly more males 56 (71.8%) than females with a male: female ratio of 2.5:1. Most patients 38 (48.7%) were in the 1-5 years age category. Mean age of patients was 54.6 months (SD 41.5 months), median age was 48.5 months (IQR 17-84 months). A significant proportion of patients 55 (70.5%) were bilaterally affected. Only 6 (7.7%) patients had documented systemic co-morbidities.

Congenital and developmental cataracts were the commonest and more likely to be bilateral. Twenty patients (25.6%) were classified to have congenital cataract, out of which 23.1% were bilateral and 2.6% unilateral, while 53 (67.9%) were developmental cataract with 47.4% of these being bilateral. Four patients (5.1%) were classified as having steroid induced cataract while one patient (1.3%) was not in any of the categories above.

Table 1: Type of surgical procedure by age (years)

Surgical procedure (N=133)	<1 N (%)	1-5 N (%)	6-10 N (%)	>10 N (%)	Total N (%)
LWO+PPC+AV+IOL	8 (28.6%)	60 (92.3%)	34 (100%)	6 (100%)	108 (81.2%)
LWO+PPC+AV	20 (71.4%)	4 (6.2%)	0	0	24 (18%)
LWO+IOL	0	1 (1.5%)	0	0	1 (0.8%)
	28	65	34	6	133

The surgical procedure was the same for 108 (81.2%) eyes. Majority of eyes of younger patients < 1 year of age were left aphakic, whilst most eyes of patients >1 year of age had and IOL inserted. One (0.8%) eye did not have the standard surgical procedure that involves a primary posterior capsulotomy and anterior vitrectomy. One hundred and fourteen (85.7%) eyes had vitrectorhexis for the anterior and posterior capsulotomy while the rest (14.3%) had continuous curvilinear capsulorhexis (CCC). The most common type of IOL implanted was foldable in 82 (61.7%) eyes, 27 (20.3%) eyes had polymethyl methacrylate (PMMA) the rest (18%) were left aphakic. Majority of eyes had no complications intra-operatively (88.7%). The most common complication was a decentered IOL in 4 eyes. Others included iris prolapse (2), split IOL (2), twisted haptic (1), VH (1), premature PC tear (1) and wound buttonhole (1).

There was poor follow-up noted with a significant drop-out rate of eyes between week 4-11 and week 12+. Sixty-eight (84%) eyes were examined at week 12+ post-operative period, but only 31 (23%) eyes were seen at 1-year follow-up visit.

Table 2 gives the visual acuity of eyes from the pre-operative to the post-operative period.

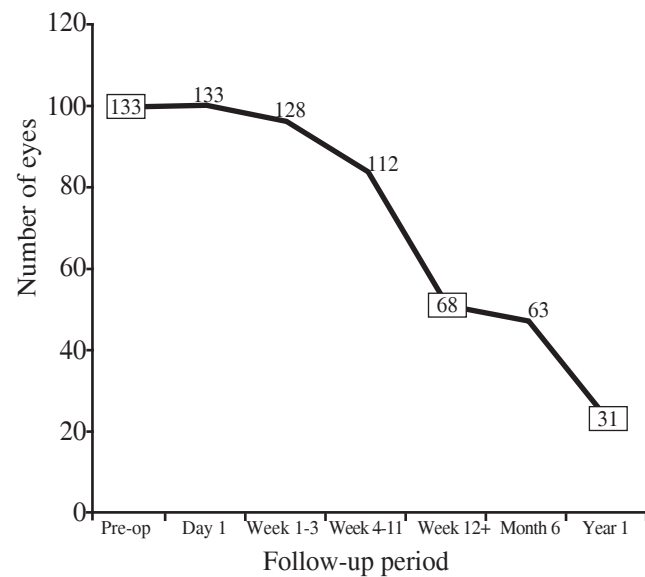


Figure 1: Post-operative follow up drop-out rate

Table 2: Pre- and post-operative visual assessment

Visual acuity (N=133)	Pre-op UCVA	Post-operative period					
		Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
≥6/18	0	8(6%)	16(12.5%)	20(17.9%)	8(11.8%)	16(25.4%)	12(38.7%)
<6/18-6/60	18(13.5%)	9(6.8%)	14(10.9%)	17(15.2%)	1(1.5%)	7(11.1%)	6(19.4%)
<6/60-3/60	4(3%)	2(1.5%)	1(0.8%)	1(0.9%)	6(8.8%)	0	1(3.2%)
<3/60	5(3.8%)	4 (3%)	6(4.7%)	10(8.9%)	2(2.9%)	8(12.7%)	5(16.1%)
Picks objects	1(0.8%)	2(1.5%)	5(3.9%)	2(1.8%)	1(1.5%)	0	2 (6.5%)
FFO	0	5(3.8%)	19(14.8%)	23(20.5%)	16(23.5%)	16(25.4%)	4(12.9%)
FFL	1(0.8%)	6(4.5%)	25(19.5%)	18(16.1%)	7(10.3%)	5(7.9%)	0
Good fixation	57(42.9%)	0	0	0	0	0	0
Poor fixation	5(3.8%)	0	0	0	0	0	0
Not indicated	42(31.6%)	97(72.9%)	42(32.8%)	21(18.8%)	27(39.7%)	11(17.5%)	1(3.2%)

For the majority of eyes, non-conventional methods of recording visual acuity were used both in the pre-operative and post-operative period. VA was not indicated for forty two (31.6%) eyes pre-operatively. Good outcome was defined as visual acuity of $\geq 6/18$ with a good proportion of eyes with quantitative vision noted to have improved from pre-operative period to

final follow up visit at year 1 (38.7%), although the number of eyes being seen reduced during this time. Poor outcome was defined as visual acuity of $< 6/60$.

Table 3 shows the post-operative visual outcomes classification as per WHO and KCCO expected visual outcomes for eyes with quantitative vision (Snellen's or equivalent) at weeks 1-3, 4-11 and 12+.

Table 3: Post-operative visual outcome per WHO and KCCO classification

VA outcome	Guidelines		Post-operative VA		
	WHO	KCCO	1-3 Weeks N=33	4-11 Weeks N=44	12+ Weeks N=16
Good	$\geq 6/18$	$>80\%$	$>70\%$	16 (48.5%)	18 (40.9%) 8 (50%)
Borderline	$<6/18-6/60$	$<15\%$		14 (42.4%)	17 (38.6%) 1 (6.3%)
Poor	$<6/60$	$<5\%$	$<5\%$	3 (9.1%)	9 (20.5%) 7 (43.7%)

Majority of eyes were in the good category of visual outcome across all follow-up periods, although this was still less than WHO recommended values.

Table 4 indicates visual axis clarity status of the eyes available for each post-operative period. More than 90% of eyes had a clear visual axis at every follow-up period.

Table 4: Visual axis clarity

Follow-up duration	Clear visual axis	Not clear visual axis
Day 1 (N=133)	130 (97.7%)	3 (2.3%)
Week 1 (N=128)	124 (96.9%)	4 (3.1%)
Weeks 4-11 (N=112)	105 (93.8%)	7 (6.2%)
Weeks 12+ (N=68)	65 (95.6%)	3 (4.4%)
Month 6 (N=63)	60 (95.2%)	3 (4.8%)
Month 12 (N=31)	29 (93.5%)	2 (6.5%)

Table 5 describes the type of post-operative correction used in the eyes

Table 5: Post-operative refractive correction

Post-op correction	<1 year	1-5 years	6-10 years	>10 years	Total
Spectacles	14 (50%)	42 (64.6%)	14 (40%)	4 (80%)	74 (55.6%)
Contact lens	4 (14.3%)	0	0	0	4 (3%)
None	10 (35.7%)	23 (35.4%)	21 (60%)	1 (20%)	55 (41.4%)
Total	28	65	35	5	133

Majority of eyes had spectacles correction post-operatively (55.6%). Only 4 eyes had contact lenses, which were all aphakic eyes of

patients younger than 1 year of age. Table 6 describes the type of post-operative correction used in aphakic eyes.

Table 6: Type of post-operative correction in aphakic eyes

Aphakic eyes (N=24)	Type of correction		
	Spectacles	Contact lens	None
Number of eyes (%)	12 (50%)	4 (16.7%)	8 (33.3%)

Most eyes with aphakia had spectacle correction post-operatively. Ninety-one eyes had refraction done post-operatively. Table 7 describes the post-operative residual spherical refractive error according to the age of the patients whose eyes are being studied.

Table 7: Post-operative residual spherical refractive error according to age

Post-op spherical error	Age (years)			
	<1	1-5	6-10	>10
-0.50	0	1 (2%)	0	0
0 to +0.99	4 (20%)	4 (8.2%)	5 (27.8%)	1 (25%)
+1 to +1.99	0	6 (12.2%)	2 (11.1%)	1 (25%)
+2 to +2.99	0	12 (24.5%)	5 (27.8%)	0
+3 to +3.99	0	12 (24.5%)	1 (5.6%)	2 (50%)
≥ +4.00	16 (80%)	14 (28.6%)	5 (27.8%)	0
Total	20 (100%)	49 (100%)	18 (100%)	4 (100%)

80% of patients <1 year of age had residual spherical refractive error of ≥ +4.00D.

Table 8 describes the post-operative residual cylindrical refractive error according to the age of the patients for eyes that had refraction done.

Table 8: Post-operative residual cylindrical refractive error according to age

Post-op cylindrical error	Age (years)			
	<1	1-5	6-10	>10
-3 to -3.99	1 (5.6%)	3 (7%)	0	0
-2 to -2.99	1 (5.6%)	4 (93%)	1 (3.8%)	0
-1 to -1.99	2 (11.1%)	9 (20.9%)	5 (19.2%)	1 (25%)
0 to -0.99	14 (77.8%)	27 (62.8%)	20 (69%)	3 (75%)
Total	18 (100%)	43 (100%)	26 (100%)	4 (100%)

Majority of eyes in each age group had residual cylindrical error in the range of 0 to -0.99D

Table 9 describes the post-operative complications seen in the eyes. Some eyes had more than one complication.

Table 9: Post-operative complications

Post-op complications (N=133)	Follow-up period					
	Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
Corneal oedema	9 (6.8%)	2 (1.6%)	3 (2.7%)	2 (2.9%)	2 (3.2%)	2 (6.5%)
Pupil abnormality/ capture	5 (3.8%)	9 (7%)	9 (8%)	5 (7.4%)	3 (4.8%)	1 (3.2%)
Shallow AC	2 (1.5%)	5 (3.9%)	4 (3.6%)	2 (2.9%)	2 (3.2%)	0
Decentered IOL	2 (1.5%)	2 (1.6%)	2 (1.8%)	1 (1.5%)	0	1 (3.2%)
Hyphaema	1 (0.8%)	0	0	0	0	0
Fibrinous uveitis/ membrane	1 (0.8%)	7 (5.5%)	6 (5.4%)	0	1 (1.6%)	0
VAO	0	1 (0.8%)	4 (3.6%)	2 (2.9%)	1 (1.6%)	0
Glaucoma	0	0	2 (1.8%)	2 (2.9%)	2 (3.2%)	2 (6.5%)
Others	1 (0.8%)	2 (1.6%)	1 (0.8%)	5 (7.4%)	3 (4.8%)	2 (6.5%)
None	116 (87.2%)	105 (81.4%)	85 (75.9%)	42 (61.8%)	46 (73%)	23 (74.2%)

Others include VH and posterior synechiae

The most common complication on day 1 was corneal oedema. Four eyes developed VAO at week 4-11 period, for which 3 eyes had membranectomy and

AV, and 1 eye had membranectomy, AV, pupilloplasty and synechiolysis. Table 10 describes other post-operative findings in study eyes.

Table 10: Other post-operative findings (N=133)

Post-op Complications (N=133)	Follow-up period					
	Day 1 (N=133)	Week 1-3 (N=128)	Week 4-11 (N=112)	Week 12+ (N=68)	Month 6 (N=63)	Year 1 (N=31)
Amblyopia	NA	1 (0.8%)	5 (4.5%)	6 (8.8%)	4 (6.3%)	4 (12.9%)
Squint	0	0	2 (1.8%)	4 (5.9%)	4 (6.3%)	4 (12.9%)
Chorioretinal atrophy	0	0	2 (1.8%)	2 (2.9%)	2 (3.2%)	2 (6.5%)

Amblyopia was not assessed on day 1 but was most common finding at weeks 12+

Table 11 shows the causes of poor visual outcome at the 4-11 weeks and 12+ weeks post-operative period. Eyes with poor vision (<6/18) were 26 and 8 for post-operative weeks 4-11 and 12+ respectively.

Table 11: Causes of poor visual outcome week 4-11 and week 12+

Attributable cause of poor vision	Number of eyes with VA < 6/18 or equivalent	
	4-11 weeks (N=26)	12+ weeks (N=8)
Uncorrected refractive error	14	3
Patient selection (Nystagmus)	4	1
Amblyopia	4	2
Intraoperative complications	1	0
VAO	1	1
Unknown	2*	1

*Both eyes of the same patient who had other systemic co-morbidities (deafness and dumbness)

DISCUSSION

Management of paediatric cataract still remains a challenge in our set up. This is because apart from the risk of amblyopia that comes with visual deprivation, there is also a rapid change in the refractive status of the eye. This type of surgery also tends to require special surgical skills, which may not always be available in our setting.

In our study, approximately 70% of eyes did not have Visual Acuity (VA) assessed or documented on the first post-operative day. However, this number reduced to 30% during follow up in the 1-3 week period.

The proportion of eyes with good vision (>6/18) improved from pre-operative period to final follow-up visit at one year, although the number of eyes seen during this time reduced.

The post-operative visual outcome of 50% having visual acuity of $\geq 6/18$ at 12+ weeks is better compared to other studies in India and Nepal that reported 16.4% and 36.6% respectively of eyes with post-operative vision of $\geq 6/18$ ^{10,11}.

Even though majority of eyes were in the good visual outcome category across all follow-up periods, this number was still low compared to WHO recommendations. Of the eyes that had a minimum follow up of three months, 56.3% had a best corrected VA of 6/60 or better. This number was lower compared to the study by Yorston *et al*⁸. in Kikuyu Eye Unit, which reported a BCVA of 6/60 or better in 91.2% of eyes. This may be attributed to the short and erratic follow-up of most patients in our study. It has been shown that visual development progresses up to around 10-12 years in those with paediatric cataract which are operated within 1 year¹². Therefore, the visual acuity may improve with strict and longer follow up especially

for those with congenital cataracts. This supposedly low level of visual improvement may be sufficient because it provides ambulatory vision and therefore reduces over dependence of these children when it comes to their daily basic activities and furthermore increasing their chances of survival¹³.

Accurate visual acuity assessment in children is challenging and difficult compared to adults. Different methods of visual acuity assessment which are age-appropriate have been developed but they may not be readily available in some eye health facilities. Therefore, visual acuity testing may not always be possible for all patients who present to these child eye health facilities. In Kenya, Yorston *et al*⁸ suggested that even though accurate visual assessment was difficult, the decision to operate can be based on observing the child's behavior. The unpredictable co-operation of children, the preverbal nature of some of the patients in this age group, level of education or associated disability may also make it difficult to quantify the visual response. Because of such factors, Trivedi *et al*¹³ opted to broadly classify VA into ambulatory and non-ambulatory. Although, use of such a classification may be of use in some setups, it is not applicable in our study because this broad categorization may make it difficult to determine whether expectations or targets have been achieved.

For the majority of eyes in this study, non-conventional methods of recording visual acuity were used. Even though these patients were noted to have good fixation, this was not further clarified as to whether it was Central, Steady and Maintained (CSM). This method of VA recording is useful but not accurately quantitative because it has been found to be compatible with a wide range of VA from 6/9 to 6/36, making it difficult for the clinician to track changes in vision that

could occur over time⁹. VA was not assessed for 42 (31.6%) eyes which may also reflect the difficulty in VA assessment in children. For the 27 eyes which had a pre-operative Snellen VA (or equivalent) recorded, 4 eyes had severe visual impairment. In Tanzania, Bowman *et al*¹⁴ concluded that pre-operative blindness was a strong predictor of post-operative outcome.

Aphakic optical correction can be achieved by spectacles, contact lenses, IOL implantation and epikeratophakia which at present is not commonly used. Although IOL implantation is the most preferred method of aphakic correction, it is intentionally under-corrected depending on the age of the child and the axial length. It therefore results in residual hyperopia which should be managed with spectacles while allowing the child to grow into emmetropia or undergo a myopic shift with increasing age¹⁵. Twenty four eyes were left aphakic and of these, twelve (50%) received spectacle correction for the aphakia while four (16.7%) eyes had contact lenses prescribed and fitted. Majority of eyes (55.6%) had spectacles correction post-operatively to try and correct the residual refractive error, this included the twelve eyes that had been left aphakic. Contrary to what other studies have suggested, the use of contact lenses was not found to be impractical or unsuitable in our set up^{8,15}. Clarity of the visual axis is an important aspect that is necessary for an eye to achieve good vision. Several studies have showed that primary posterior capsulotomy markedly reduce visual axis opacification¹⁵. In contrast, other studies have reported VAO after paediatric cataract surgery ranging from 40-80%¹⁶. In our study, only four (3.6%) eyes developed VAO and required secondary intervention whilst more than 90% of eyes had a clear visual axis at every follow-up period. These findings therefore support the fact that posterior capsulotomy coupled with anterior vitrectomy should be performed primarily during paediatric cataract surgery to prevent VAO and any associated stimulus deprivation amblyopia.

Refraction was done for ninety one eyes post-operatively and majority of eyes (70.3%) had a residual cylindrical error of < -1.0D. In their study in Tanzania, Bowman *et al*¹⁴ reported that biometric data was not associated with smaller post-operative refractive errors. However, in our study, eyes which had biometry done had a lower median and mean post-operative spherical errors than eyes for which biometry was missing and the differences were statistically significant ($p=0.00$). This confirms the importance of biometric data in reducing the post-operative refractive errors during pediatric cataract surgery.

Post-operatively, the most common complication on day one was corneal oedema. Two eyes of the same patient were noted to have persistent corneal oedema up to one year post-operatively on follow-up. This same patient was noted to have congenital glaucoma. The corneal oedema persisted despite being on medications.

This was attributed to be the uncontrolled intra-ocular pressures due to poor follow-up pattern and poor compliance to medications by this patient. Referral to a glaucoma specialist for Combined Trabeculotomy/Trabeculectomy (CTT) was unfruitful due to financial constraints.

Amblyopia was not assessed on day one but was the most common finding at week twelve (12+), seen in thirteen eyes (9.8%). This is similar to findings by Yorston *et al*⁸ who concluded that amblyopia was the leading cause of poor visual outcome, with two major risk factors for amblyopia being surgery before age of two years and the timing of when surgery on the second eye is scheduled. They reported a higher percentage of eyes with amblyopia in their study at 31.4%. This low number of amblyopia in our study may be due to the difficulty of visual assessment in children although a clear preferential fixation can also be used to help in the diagnosis of amblyopia. The poor follow-up pattern of these patients may also signify that children with amblyopia were not actually diagnosed. This may possibly also suggest that probably the guardians were not satisfied with the post-operative outcome and therefore chose to abandon the scheduled follow-up visits. Patching (occlusion) was the treatment of choice in both our study and that of Yorston *et al*⁸. However, in our study the compliance to amblyotherapy was not objectively and adequately assessed probably also due to poor follow-up.

CONCLUSIONS

In conclusion, lens washout, primary posterior capsulotomy, anterior vitrectomy and primary intra-ocular lens implantation offers an effective method for correction of aphakia related to paediatric cataract surgery. It also maintained a clear visual axis for up to 1 year post-operatively with a significant number (>90%) remaining clear at each follow up visit. A majority of eyes (50%) had good visual outcome.

RECOMMENDATIONS

There is need to ensure that paediatric patients have proper and age specific visual acuity assessment at every visit as well as timely refraction. Educate and counsel care givers about good compliance to follow-up visits for consistent visual rehabilitation to further improve the outcome.

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