Original Article

Outcome of superior manual small-incision cataract surgery in pediatric age group - A five year retrospective study at a tertiary eye hospital in Karnataka

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Purpose: To analyze intraoperative difficulties and visual and surgical outcomes following pediatric cataract surgery. **Methods:** This five-year retrospective study (2014–2019) included 138 eyes (85 children) with cataract aged between 12 months and 18 years (either sex). All children had undergone best-corrected visual acuity (BCVA), anterior and posterior segment evaluation, intraocular lens (IOL) power calculation, superior manual-small-incision cataract surgery (MSICS) with or without posterior capsulotomy/anterior vitrectomy and IOL implantation under general or local anesthesia, visual rehabilitation, and had been followed up for a minimum period of 12 months. **Results:** The mean age was 111.27 ± 4.84 months. Preoperative BCVA distance: 113 (81.88%)eyes had BCVA < 6/60; near BCVA: 114 (82.6%) eyes had ≤N36. At last postoperative follow-up (mean: 20.98 ± 13.08 months): distant BCVA- ≥6/60 had been recorded in 120 (86.96%) eyes; near BCVA- >N36 in 123 (89.13%) eyes. Improvement in BCVA was statistically significant. Intraoperative scleral tunnel difficulties were seen in three eyes (thin flap in two, and buttonhole in one eye); in the majority of the eyes 113 (81.88%), IOL was placed in the bag. Twenty eyes had early postoperative inflammation. At last follow-up: posterior capsular opacity was recorded in six eyes, IOL decenteration in two eyes, secondary glaucoma in six eyes, and severe amblyopia in 36 (26.09%) eyes. The mean myopic shift was − 1.11 ± 0.89 D and was statistically significant. **Conclusion:** Superior MSICS as a treatment for pediatric cataract has minimal intraoperative complications and satisfactory visual and surgical outcomes.

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Pediatric cataract is a treatable leading cause of childhood blindness. It accounts for 7.4%–15.3% of pediatric blindness and a significant avertable disability-adjusted life years.[1,2] The prevalence of childhood cataract is higher in low-income economies (0.63–13.6/10,000) compared to high-income economies (0.42–2.05/10,000).[3] Cataract blindness in children presents an enormous problem to developing countries in terms of human morbidity, economic loss, and social burden.[4] Surgical management includes cataract removal with or without primary posterior capsulotomy, with or without anterior vitrectomy, and with or without Intraocular lens (IOL) implantation. This depends on the age of the child and other associated factors such as microcornea and microphthalmos. Phacoaspiration with foldable IOL (hydrophobic-acrylic) in most situations would be the ideal choice in terms of faster wound healing, lesser postoperative inflammation, and lesser posterior capsular opacification (PCO) and hence lesser development of amblyopia.[5] However, in underdeveloped and developing countries, where pediatric cataract is relatively more common and because of lower socioeconomic status,[5] choosing foldable IOL may not be feasible. Yet another affordable and satisfactory choice in these children is performing manual small-incision cataract surgery (MSICS) with rigid polymethyl methacrylate (PMMA) IOL implantation. Hence, our aim was to analyze both visual and surgical outcomes as well as intraoperative difficulties following MSICS in the pediatric age group.

Methods

A five-year retrospective analysis of case files of children who underwent cataract surgery between January 2015 and December 2019 was carried out in the pediatric ophthalmology department at a tertiary eye hospital after obtaining the approval of the institutional review board and adhered to the principles mentioned in the Declaration of Helsinki 2000. Inclusion criteria: children aged between 1 and 18 years of either sex with unilateral or bilateral; congenital or developmental cataract, who underwent cataract removal- superior manual small-incision cataract surgery (MSICS) done by a single surgeon, with or without anterior vitrectomy; with implantation of rigid PMMA IOL; and with a minimum follow-up period of 1 year postoperatively were included in the study. Exclusion criteria: children with traumatic cataract; subluxated and dislocated cataract; steroid-induced cataract; cataracts associated with microcornea, microphthalmos, aniridia, anterior segment dysgenesis, corneal opacity, uveitis,

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glaucoma, persistent fetal vasculature, retinal detachment, ocular tumors and syndromes, in isolation or combination were excluded from the study.

The various parameters recorded from the case sheets were age; gender; duration of presence of cataract; history of consanguineous marriage; antenatal history; detailed birth history; family history of cataract; presence of any coexisting systemic problems; ocular treatment history (medical and/or surgical); uncorrected and best corrected visual acuity (UCVA, BCVA) for distance and near; intraocular pressure (IOP) readings; anterior segment findings (corneal diameter, cataract morphology); posterior segment findings; diagnosis of both eyes; management plan; investigations, including B-Scan, automated keretometry, A-Scan, calculated intraocular lens (IOL) power (Sanders–Retzlaff–Kraff T formula); blood investigations, including hemoglobin, bleeding and clotting time, TORCH titers IgG and IgM; surgery details, including type of anesthesia: general or local; details of the operated eye: superior MSICS with or without vitrectomy; details of IOL implanted: IOL power {Dahan *et al*.[6] guidelines were adopted with slight modification by authors: children less than 2 years - power was undercorrected by 20% (similar to Dahan *et al*.); between 2 and 5 years - undercorrected by 15%; 5–8 years - undercorrected by 10% (whereas Dahan *et al*. undercorrected by 10% in children aged between 2 and 8 years)}, size and material of IOL, in the bag or in the sulcus implantation, any intraoperative difficulty or difficulties noted in the case file; immediate (day 1–day 3) postoperative findings such as corneal edema, anterior uveitis, and IOL status were noted from the case files. The various parameters that were noted from the case files during the first follow-up (4–6 weeks was considered as the first follow-up) and last follow up (noted in months) were BCVA for distance and near (measured by Snellen's chart and converted to LogMAR value), IOP readings, detailed anterior and posterior segment findings (postoperative uveitis, secondary glaucoma (Infant Aphakia Treatment Study (IATS) criteria for glaucoma diagnosis),[7] pupil status, IOL decenteration, presence of visual axis opacification and treatment modalities done for the same such as YAG capsulotomy or surgical membranectomy (during any of the follow-up visits); retinal problems: cystoid macular edema, retinal detachment and presence of any other problem and medical and/or surgical treatment given for the same (during any of the follow up visits); glass prescription at first and last visit follow-up; presence of amblyopia, occlusion therapy and vision improvement; Amblyopia (BCVA ≤6/9) was categorized into mild (6/9–6/12), moderate (<6/12–6/36), and severe (<6/36).[8] Glass prescription was converted into spherical equivalent, and the amount of myopic shift was assessed between the first and last follow-up visits.

Statistical analysis

Descriptive analysis was carried out by mean, range and standard deviation for quantitative variables and frequency and proportion for categorical variables. Non-normally distributed quantitative variables were summarized by the median and interquartile range (IQR). All quantitative variables were checked for normal distribution within each category of the explanatory variable. Shapiro–Wilk test was also conducted to assess normal distribution. Shapiro–Wilk test $P > 0.05$ was considered normal distribution. For non-normally distributed quantitative parameters, medians and IQR were compared between study groups by using Mann–Whitney U test (two groups). The change in the quantitative parameters before and after the intervention was assessed by paired t test (in case of two time periods). $P < 0.05$ was considered statistically significant. Data were analyzed using SPSS software V.22.

Results

In total, 138 eyes of 85 children were included in our study. The mean age was 111.27 ± 4.84 months, the minimum age was 14 months, and the maximum was 216 months. Fifty-two (61.18%) and 33 (38.82%) were male and female children, respectively. A history of consanguinity was present in 35 (41.18%) of the parents. Table 1 shows the preoperative and postoperative BCVA for distance and near and spherical equivalent. The mean preoperative IOP was 15.79 ± 2.84 mmHg. Fifty-three (62.35%) children had bilateral cataracts, whereas 26 (30.59%) had unilateral involvement, and six (7.06%) children presented with pseudophakia in one eye and cataract in the other. The most common type of cataract was mature cataract in 41 (29.71%) eyes, followed by nuclear and zonular cataract in [Fig. 1a] 35 (25.36%) eyes each, absorbed cataract in 12 (8.70%) eyes, posterior subcapsular cataract (PSC) in seven (5.07%) eyes, posterior polar cataract in three (2.17%) eyes, blue dot cataract in two (1.45%) eyes, nuclear cataract with PSC in two (1.45%) eyes, and blue dot cataract with PSC in one (0.72%) eye. The most common ocular association observed in our study was squint in 22 children (25.88%): exotropia in 19 (22.35%) children and esotropia in three (3.53%) children followed by nystagmus in six (7.06%) children. Fundus could not be visualized in 41 eyes, but B-scan was normal, and in the remaining children, fundus was normal. Thirty children (25.5%) were found positive for rubella antibodies (IgG), out of which three children (10%) were IgM-positive as well; ten children (11.76%) were negative, and in the remaining 45, it was not tested. The mean K1 value was 43.99 ± 1.95 D (range: 40.00–51.00 D) and K2 was 45.58 ± 2.26 (range: 39.00–53.75 D). The mean axial length was 22.54 ± 1.86 mm. (range: 18.41–29.51 mm). The mean calculated IOL power was + 22.39 ± 6.04 D (range: +1.50 to +35.00 D). Fifty-seven (41.30%) eyes underwent cataract removal with IOL implantation; cataract removal with primary posterior continuous curvilinear capsulorhexis (PPCCC) with anterior vitrectomy (AV) with IOL implantation was done in 48 (34.78%) eyes, and cataract removal with posterior capsulectomy (using vitrectomy cutter) with AV with IOL implantation was performed in 33 (23.91%) eyes. The mean IOL power implanted was +20.67 ± 5.6 (range: +1.50 D to +30.00 D; median: +21.50 D), in the capsular bag IOL implantation [Fig. 1b] was feasible in 113 (81.88%) eyes; wereas, in 25 (18.12%) eyes, IOL was implanted in the sulcus. Twenty-two (15.94%) eyes received lower powers ≤ +16 D. Regarding the sizing of single-piece rigid PMMA IOLs, the majoriy, that is, 82 (59.42%) eyes received IOL of 6.5 mm (optic diameter) × 13 mm (overall length), 55 (39.85%) eyes received 6 mm × 12.50 mm sized IOLs, and one (0.72%) eye received 5.25 mm × 12.00 mm. Intraoperative, difficulty in making scleral tunnel was noted in three (2.17%) eyes (in high myopia): thin flap in two (1.45%) eyes and buttonhole formation in one (0.72%) eye; difficulty in obtaining anterior capsulorhexis: rhexis runaway in three (2.17%) eyes (in mature cataract), small rhexis (<5 mm) in two (1.45%) eyes; preexisting posterior capsular (PC) dehiscence (in mature cataract) in three (2.17%) eyes; PC plaque and PC fibrosis in five (3.62%)

Table 1: Preoperative and postoperative BCVA for distance and near

	Preoperative BCVA	Postoperative first Follow-up	Postoperative last follow-up
BCVA Distance			
6/6-6/12	1 (0.72%)	35 (25.36%)	69 (50%)
6/18-6/36	18 (13.04%)	37 (26.81%)	33 (23.90%)
6/60-1/60	60 (43.48%)	58 (42.03%)	34 (24.64%)
CFCF	11 (7.97%)	3 (2.17%)	1 (0.72%)
HM+	7 (5.07%)	0	0
PL+	41 (29.71%)	5 (3.62%)	1 (0.72%)
P value		<0.01	<0.01
BCVA near			
N6-N12	6 (4.35%)	74 (53.62%)	101 (73.19%)
N18-N36	73 (52.90%)	56 (40.55%)	35 (25.36%)
N36 CF	11 (7.97%)	3 (2.17%)	1 (0.72%)
HM+	7 (5.07%)	0	0
PL+	41 (29.71%)	5 (3.62%)	1 (0.72%)
Spherical equivalent (mean±SD)		1.02±1.4D	-0.08±1.1D
		P<0.01	

BCVA=best-corrected visual acuity, CFCF=counting finger close to face, HM=hand movement, PL=perception of light, CF=close to face

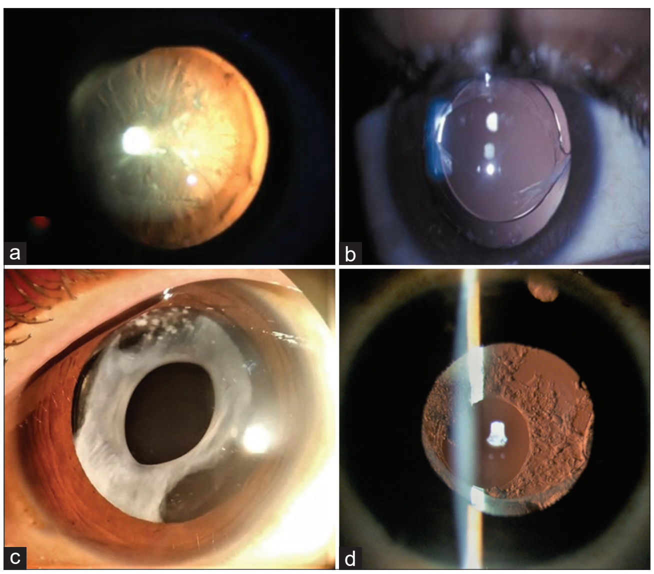

Figure 1: (a) Zonular cataract (b) Well-centered intraocular lens; (c) Anterior capsular opacification; (d) Posterior capsular opacification

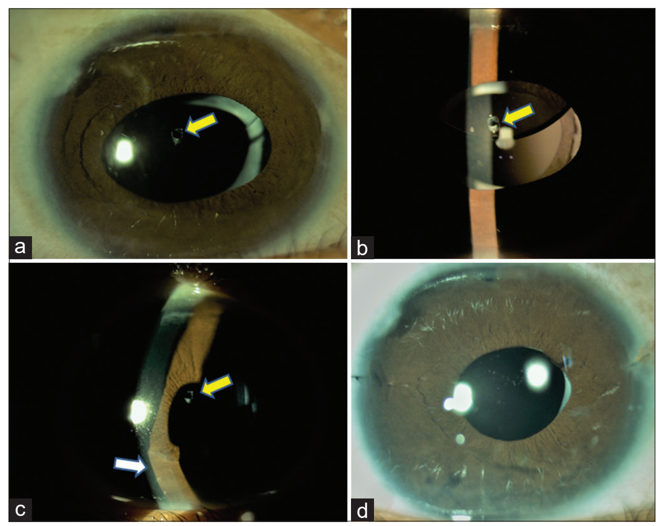

Figure 2: Late postoperative period- intraocular lens decenteration. Footnote: (a and b) upward decenteration of intraocular lens decenteration; (c) inferior peripheral anterior synechiae; (d) post intraocular lens exchange

eyes - underwent posterior capsulectomy and anterior vitrectomy; difficulty in performing anterior vitrectomy due to small pupil - six (4.35%) eyes. Postoperatively, on day 2, 18 (13.04%) eyes and two (1.45%) eyes had mild and severe anterior uveitis, respectively. Thirteen (9.42%) eyes had mild corneal edema. IOL was well centered in all the eyes. The mean postoperative last follow-up was 20.98 ± 13.08 months (range: 12–77 months). Table 2 shows the various parameters during the postoperative period: at the first and last follow-up visits. Clear central visual axis with peripheral anterior capsular opacification is depicted in Fig. 1c.

Discussion

Pediatric cataract is an important cause of childhood blindness, especially in lower socioeconomic countries[3] (underdeveloped and developing countries). The lower economic status acts like a two-edged sword: the prevalence of pediatric cataract is higher in these countries and hurdles are encountered in delivering the most recent facilities in the management of pediatric cataract. These facilities paradoxically are relatively easily available in developed or higher socioeconomic countries. Phacoaspiration with foldable IOL (hydrophobic acrylic) in most situations would be the ideal choice in terms of faster wound healing, lesser postoperative inflammation, and lesser PCO [Fig. 1d] and hence lesser development of amblyopia.[5] However, this procedure needs expensive and elaborate equipment, incurs higher maintenance costs,[9] and involves difficulty and delay in procuring phacoemulsification machine parts, especially in remote areas. This is in addition to the longer learning curve[9] that a surgeon has in terms

Table 2: Various parameters during the postoperative period: at first and last follow-up visits

Postoperative Observations	Postoperative first follow-up status	Postoperative last follow-up status
Mean intraocular pressure (mmHg)	14.63±3.01	14.53±3.89
Glaucoma (eyes)		
Steroid responder	4 (2.90%)	0
Secondary glaucoma	0	6 (4.35%)
Uveitis (eyes)	3 (2.17%)	0
Pupil status (eyes)		
Irregular	4 (2.90%)	5 (3.62%)
Pupillary capture	1 (0.72%)	3 (2.17%)
IOL status (eyes)		
Decentered	0	2 (1.45%)
IOL deposits (pigments)	5 (3.62%)	4 (2.90%)
Posterior capsular opacification	0	6 (4.35%)
Nd: YAG capsulotomy	0	2 (1.45%)
Membranectomy	0	4 (2.90%)
Fundus (eyes)		
Disc pallor	22 (15.94%)	22 (15.94%)
Salt pepper retinopathy	4 (2.90%)	4 (2.90%)
Amblyopia (eyes)		
No (6/6)	4 (2.90%)	31 (22.46%)
Mild (6/9-6/12)	31 (22.46%)	38 (27.54%)
Moderate (<6/12-6/36)	37 (26.81%)	33 (23.91%)
Severe (<6/36)	66 (47.83%)	36 (26.09%)

IOL=intraocular lens, Nd: YAG=Neodymium-doped Yttrium Aluminum Garnet

of understanding the phacoemulsification machine and mastering the procedure as compared to MSICS. With phacoemulsification, the most preferred IOL in children is acrylic hydrophobic foldable IOL because 1) it can be easily implanted in the capsular bag, and 2) it helps in the prevention of PCO, which has a long-term benefit in children. However, foldable IOLs are expensive. In lower socioeconomic countries, purchasing and procuring phacoemulsification machines and foldable IOLs are herculean tasks. Therefore, a good alternative for pediatric cataract surgery is superior MSICS with rigid PMMA IOL implantation.[5,9] A superior section is preferred in children because it is safer and the steeper axis is a vertical meridian, which takes care of astigmatism, although it takes a longer duration for healing and requires suturing. Rigid PMMA IOLs are easily available, much cheaper than foldable IOL, and the short-term safety profile is comparable with acrylic IOLs.[5,10] At present, foldable hydrophobic IOLs are manufactured by Indian pharmaceutical companies and are available, though not as cheap as PMMA IOLs. The mean age at presentation in our study was 111.27 ± 4.84 months and comparable with the study by Gogate *et al*.[5] Male children were significantly higher than female (61.18% male and 38.82% female). A history of consanguineous marriage was present in 41.18% of the parents, probably because many came from rural areas. Muhit *et al*.[11] found parental consanguinity among 33.3% of the cases with hereditary childhood blindness. In our study, the most common type of cataract was mature cataract, seen in 41 (29.71%) eyes, followed by nuclear and zonular cataract in 35 (25.36%) eyes each, in contrast to the study by Long *et al*.,[12] where they observed nuclear cataract to be the most common type. Intraoperatively, we had difficulty in making scleral tunnel in three (2.17%) eyes:- thin flap in two (1.45%) eyes and buttonhole formation in one (0.72%) eye. All the three eyes were high myopic and this could be the reason for the difficulty. This was comparable with the study by Maske *et al*.[13] wherein they observed a single incidence of scleral tunnel buttonholing among 168 cases in the MSICS series from Pune. Other difficulties such as runaway rhexis, small rhexis, preexisting posterior capsular (PC) dehiscence, and PC plaque and PC fibrosis are not specific to MSICS; these may be encountered even in phacoemulsification. While performing anterior vitrectomy in MSICS, care has been taken to secure the section adequately with sutures so that there is no collapse of the anterior chamber. However, this step can be conveniently performed in phacoemulsification because the section size is much smaller. Intracameral triamcinolone acetonide can be used to stain the anterior vitreous to ensure complete anterior vitrectomy, decrease postoperative inflammation, and PCO.[14,15] However, in our study, we have not used intracameral triamcinolone acetonide. In our study, at the end of the surgery, all children required suturing of the superior scleral section with two or three interrupted sutures with 10-0 nylon; side port was sutured if 20-G vitrectomy cutter was used for anterior vitrectomy to ensure that the anterior chamber was well-formed. There was statistically significant difference between preoperative and postoperative first visit and last visit BCVA ($P < 0.01$). Myopic shift between postoperative first visit and last visit was approximately − 1.11 ± 0.89 D and was statistically significant. Postoperatively, six eyes had PCO: two eyes underwent Nd: YAG capsulotomy- these two children were 10 and 12 years old, and the procedure was done at 37 and 39 months, respectively; membranectomy was done in four eyes, all children were less than 4 years old. Early postoperative uveitis was observed in 20 eyes: 18 were mild and two were severe; all resolved with oral steroids. Late postoperative complications such as IOL decenteration [Fig. 2a-c; post IOL exchange- Fig. 2d], pupillary capture, and secondary glaucoma were minimal [Table 2]. Severe amblyopia (>6/36) in the first follow-up visit was 47.83% and improved to 26.09% in the last follow-up visit, a significant improvement in vision.

Conclusion

Superior MSICS with rigid PMMA IOL implantation as a treatment for pediatric cataract has minimal intraoperative complications and satisfactory visual and surgical outcomes.

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Conflicts of interest

There are no conflicts of interest.

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