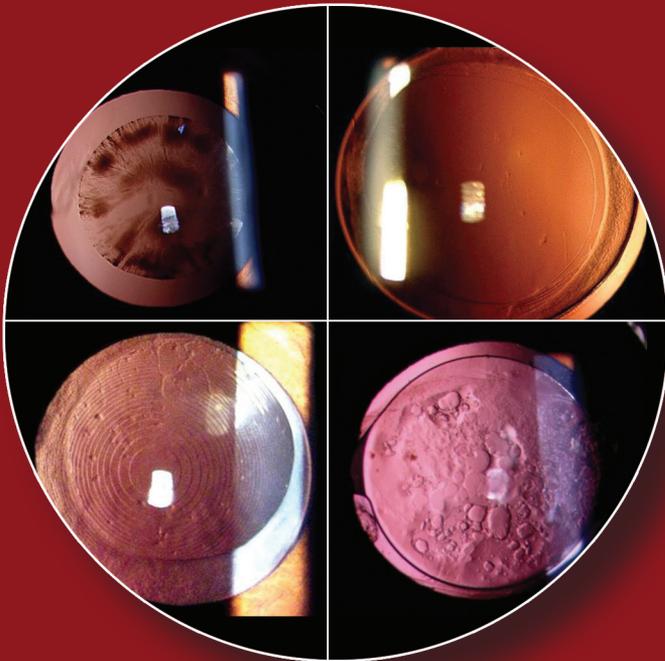




Pediatric Cataract Management



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Pediatric Cataract Management



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Foreword

Paediatric cataracts are relatively common and constitute one of the most treatable causes of childhood blindness. However the management of cataract in infancy and childhood is more challenging and demanding than adult cataract management. Intra operative surgical complexities, a marked propensity for post operative inflammation, the changing refractive status, increased incidence of capsular opacification and secondary membrane formation, occurrence of post operative glaucoma and the potential to develop abmlyopia all add to the difficulty of achieving successful outcome in paediatric cataract surgery. The surgical technique need to be tailored and customized to address the low scleral rigidity, increased elasticity of the anterior capsule and high vitreous pressure seen in this group of patients. Advances in surgical techniques, availability of better visco elastic materials, accessibility of appropriately sized and deigned IOLs all have significantly improved paediatric cataract surgery outcome.

It is in this perspective that ARC AIOS is bringing out this CME series on management of Paediatric cataract. This booklet does a very comprehensive review and recommendation on the state of the art management of cataract in children. We are sure that this CME Series will provide useful information on the subject to all ophthalmic surgeons at all levels, from novice to most experienced paediatric and adult cataract surgeons. The ARC AIOS and the expert panel of authors have indeed done a great job. Congratulations!



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Preface

According to WHO cataract is the leading cause of preventable blindness. The statistics show the cataract is the leading cause of blindness even during childhood. Diagnosis of pediatric cataract is not difficult; however management is more complex than cataract in the adult. The surgical expertise needed is at a higher level. Experience is needed in terms of decision making regarding timing of the surgery, spacing of cataract surgery between two eyes, whether to go for an intra ocular lens implantation or not. One needs to be well versed with the primary posterior capsulotomy to avoid posterior capsular opacification and consequent amblyopia. Post-operative care need to be more aggressive in terms of treatment of inflammation and visual rehabilitation. One needs to keep setting of amblyopia in mind, in these children. If needed amblyopia treatment need to be instituted very early in the post-operative period to have optimal visual recoveries. However, I would like to re-emphasize that screening of children for white reflex should be taken up along the lines of a public campaign. The impact of a child going blind is enormous as it corresponds to the loss of number of man years of productivity.

The Academic and Research committee has brought out this CME on pediatric cataract with an intention to increase awareness among Ophthalmologists. This CME gives an excellent overview of clinical features, diagnosis and management of pediatric cataract. It can serve as good guide to approach a child with pediatric cataract. In this CME, the authors have demonstrated good surgical approach in a child with pediatric cataract and IOL power calculations in this age group. They also discussed appropriately the risks of amblyopia and its management especially in unilateral and bilateral cataracts and their care in the post-operative period. The reviewers have done good job in pointing out the relevant lacunae, so that the CME series can be as useful as possible to all Ophthalmologists.

I expect all members of All India Ophthalmological Society go through this CME series, imbibe and understand the implications of amblyopia in children with cataract as well as help in preventing blindness in children due to pediatric cataract.



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Pediatric Cataract Management

Incidence

There are 1.5 million blind children (corrected visual acuity <20/400 in the better eye) in the world and one million of them live in Asia.^{1,3} The prevalence of childhood cataract has been reported as 1 to 15 cases in 10,000 children in the developing countries. It is estimated that globally, there are 200,000 children blind from bilateral cataract.³

Etiology of Childhood Cataract

The main causes of infantile cataract are genetic, metabolic disorders, prematurity and intrauterine infections.^{4,6} However Indian data shows unknown cause is the most common.⁶ Other causes of childhood cataract in older children include trauma, drug-induced, radiation and laser therapy for ROP. Trauma is one of the commonest causes of unilateral cataract in the developing countries.^{5,6} Bilateral cataracts occur commonly due to the long-term use of topical or systemic steroid. In industrialized countries, approximately 50% of bilateral cases and virtually all of the unilateral cases, the underlying cause usually cannot be determined.^{1,3} But, an area of great interest is in the molecular genetics of cataracts. Inherited cataracts contribute significantly in the aetiology of childhood cataracts. Approximately, half of the families have mutations in crystallins and a quarter have mutations in connexins.⁷ Zonular cataract is the commonest type of congenital cataract (Figure 1).

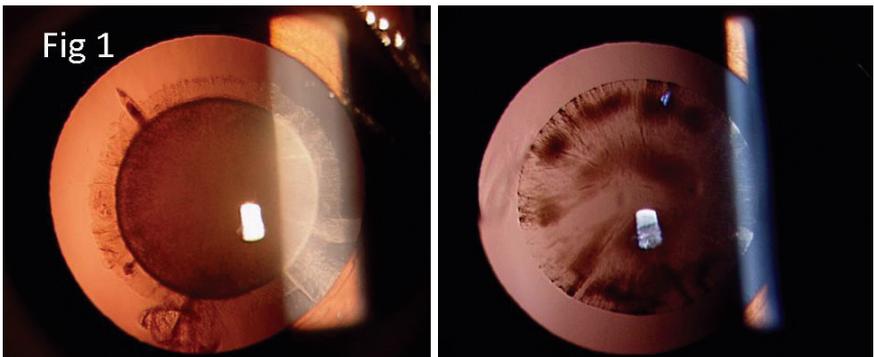


Fig 1
Zonular cataract in children.

Ocular Examination

Often the first symptom is a white or partially white reflex noted by the parents. Strabismus may be the initial manifestation, especially in unilateral cases, and nystagmus or poor visual fixation may herald the presence of bilateral lens opacities in infancy. A history from the parents is useful to understand whether the cataract is congenital, developmental or traumatic in origin. It is a must to screen parents and siblings to rule out familial causes. One must ascertain if there is any history of maternal drug use, infection or exposure during pregnancy. It is important to quantify the visual acuity of the child with cataract as precisely as possible. The grade of visual fixation is also important. A thorough ocular and systemic examination is a must in every child. Ocular examination should include visual acuity assessment, pupillary response and ocular motility. The slit lamp biomicroscopic examination should be carried out in each case to evaluate the size, density, and location of cataract to plan the surgical procedure. Fundus examination should be carried out after pupillary dilatation. A-scan helps to measure the axial length for calculating IOL power and monitoring the globe elongation postoperatively. B scan is an important tool in ruling out any posterior segment pathology as many of the pediatric cataracts are dense and preclude view of the fundus. Each child should be examined by a pediatrician for thorough systemic work up to rule out systemic associations, anomalies or congenital rubella. Leukocoria is often noticed by family members as a finding in the eye of the child. However every white reflex is not a cataract. Retinoblastoma is the most serious and a common cause of white reflex in the child. Other pathologies which may present with white reflex in the eye include persistent hyperplastic primary vitreous (PHPV), Coats' disease, ocular toxocariasis, retinopathy of prematurity, retinal hamartomas, congenital falciform fold or organized vitreous hemorrhage. The B scan is therefore of utmost importance in this condition as performing cataract surgery in such conditions can be disastrous and land one into medicolegal problems.

Laboratory Work-up

Most children do not require systemic work up. Unilateral, familial and traumatic cataracts do not require any systemic investigations.

However if a child has peculiar facies or evident systemic malformation then a work up is required. In children with bilateral cataract, membranous morphology, lenticonus, inflammatory pathology or any history of maternal illness during pregnancy a tailor made approach is followed. The work-up includes fasting blood sugar, urine for reducing substance for galactosemia after milk feeding and urine amino acids for Lowe's syndrome. Plasma phosphorus, red blood cells transferase, galactokinase levels and calcium evaluation for hypothyroidism should be done. The titres for toxoplasma, rubella, cytomegalovirus and herpes simplex (TORCH titres) should be carried out to rule out these disorders.

Cataract surgery in children

Management of childhood cataracts remains complex. The physiology and anatomy of the growing eyes of children are so different from those of adults that unique applications of modern technology are needed to maximize outcomes. Low scleral rigidity, increased elasticity of the anterior capsule, and high vitreous pressure are among the major obstacles that interfere with the highly demanding surgery. Even the best of surgeons can be humbled by the challenges of the small, soft, poorly developed eyes that require cataract surgery. Intraoperative problems coupled with a risk for increased postoperative inflammation, a changing refractive state, higher re-surgery rate and an inherent risk of amblyopia make cataract surgery in children more complex which thus have an effect on final visual outcome. Historically, several primitive

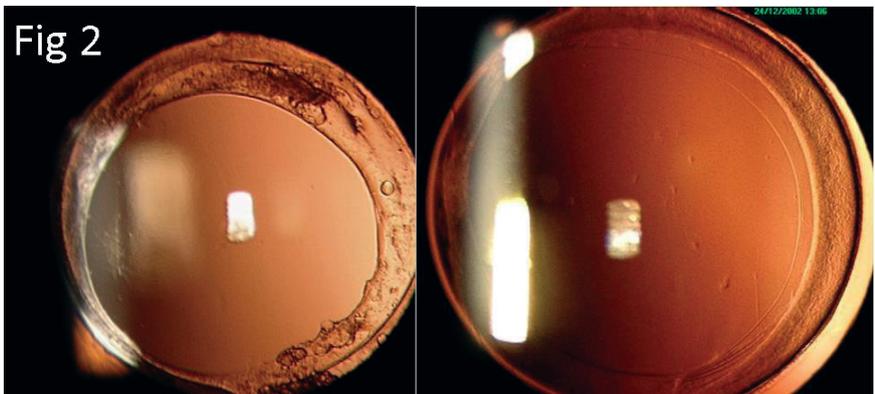
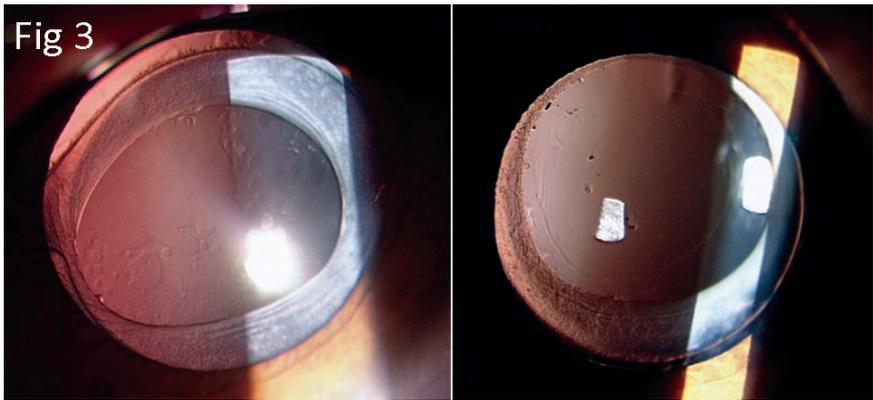


Fig 2
Clear visual axis in these eyes where primary posterior capsulorhexis has been performed.



Left image- Alcon SA 60 AT single piece endocapsular implantation of IOL with a good anterior curvilinear capsulorhexis. Right image shows Sensor optiedge (three piece hydrophobic acrylic) IOL in the capsular bag with clear visual axis.

surgical techniques such as surgical iridectomy,⁸⁻¹² needling, and needling and aspiration were used for cataract surgery in children and a few of them are even today in practice in many parts of the developing world. Phacoaspiration with primary posterior capsulotomy with or without anterior vitrectomy and capsular bag implantation/optic capture of intraocular lens¹³⁻⁴² is today the most accepted technique followed while performing pediatric cataract surgery (Figure 2 & 3).

Timing of surgery and amblyopia

The timing of surgery for pediatric cataract can be a matter of considerable importance. The development of the visual system in the immature mammal is profoundly affected by visual deprivation. In prolonged unilateral or bilateral deprivation, these changes become irreversible.

Once visually significant cataract is detected, it should be operated as early as possible. In symmetrical bilateral cases, the second eye should be operated on within one to two week of the first. When there is significant asymmetry, the denser cataract is generally removed first; surgery on the second eye may then be deferred until after the first eye receives optical correction.

The first 6 months of life, however, remains a controversial time frame for IOL implantation. Preliminary results of a study on unilateral congenital cataracts indicate that IOL implantation in the first 6 months of life may produce better visual acuity, but at the expense of a higher complication rates.^{43,44} Unilateral cataracts should be operated within first 6 weeks of life to prevent development of deprivation amblyopia.⁴⁵

Cataract morphology has considerable relevance to surgical indications and visual prognosis. Severe amblyopia usually results only from cataracts that completely block light transmission through the central 3 mm of the lens.⁴⁶ Most polar opacities (particularly those involving only the anterior capsule), smaller nuclear cataracts, and lamellar cortical opacities that transmit light centrally usually can be left alone at least until the child reaches a developmental stage that permits reliable assessment of visual potential. The near vision should be monitored very closely in these cases. Posterior cortical cataracts (especially those resulting from posterior lenticonus) usually do not become visually significant until months or years after birth, in which case the likelihood of a good visual outcome is considerably better than for a comparable congenital opacity.⁴⁷

How does Pediatric Cataract Surgery differ from adult?

The specific characteristics of the pediatric eye especially in children less than two years of age are - 1) intra-operative: scleral collapse, vitreous pressure, highly elastic anterior and posterior capsule for continuous curvilinear capsulorhexis (CCC), miosis, fibrin release, etc. 2) post-operative: uveitis, visual axis opacification (VAO), secondary membrane formation, amblyopia, 3) long-term: growth of the eye and myopic shift.

A factor of important concern after the birth is the changing axial length of the globe. The eye of an adult is 40 to 50% larger than that of a child.⁴⁸ The mean axial length of a newborn's eye is 17.0 mm compared to 23 to 24 mm in adult. The mean diameter of the crystalline lens is 6.0 mm at birth and 9.3 mm at 16 years.⁴⁹ There is also change in the size of the capsular bag from 7 mm at birth to 9.0 mm at two years.⁴⁸ The resultant major problem is IOL power calculation particularly for infantile cataract. Most of the authors

suggest under correction to prevent myopic shift.⁵⁰⁻⁵³ The incidence of post-operative complications such as uveitis, secondary glaucoma and posterior capsular opacification is also much higher in the pediatric age groups.⁵⁴⁻⁵⁶

IOL Power Calculation-axial length, acuity and refractive aims

The optics of a child's pseudophakic eye is based on the same principles, but in practice these adult formulas have proven less precise, especially for the youngest children. Numerous studies have found that IOL formulas for adult cataract surgery are less accurate in children. In adults, modern theoretical formulas are accurate within approximately 0.5 diopters (D); in children various studies have found mean absolute errors of between 1.08 and 1.4 D.⁵⁷⁻⁵⁹ Most reports have recommended under-correction of the IOL power for pediatric cataract, anticipating the myopic shift following IOL implantation.^{51,52} As the axial length of the eye grows in proportion with the lens and cornea, the refraction of a normal infant's eye stays close to emmetropia. Gordon and Donzis's cross-sectional biometric study of 148 normal eyes found on average that the axial length increased from 16.8 to 23.6 mm from birth to adulthood, whereas the refraction changed minimally, from +0.4 to - 0.5 D.⁶⁰ This is primarily because the power of the crystalline lens declined from +34.4 to +18.8 D. In contrast, aphakic eyes have a decline in hyperopia of 10D over the same period.⁶¹ As there is no proportionally changing lens to compensate for the ocular growth; aphakic eyes have a large myopic shift.

Implantation of an IOL can address this issue although the initial hypermetropic overcorrection needed in infants (to allow for subsequent ocular growth) may necessitate contact lens/spectacles use. The glasses required for correction of any eventual residual refractive error are usually of much lower dioptric power, more cosmetically acceptable and less cumbersome than aphakic spectacles. In addition, the reduced anisometropia lessens any amblyogenic stimulus.

The axial length and keratometry readings should be measured for IOL power calculation in children. Dahan, et al⁵¹ have suggested

undercorrecting biometry reading by 10% in children between 2 to 8 years. For children younger than 2 years, perform biometry and under-correct by 20% or use the axial length only. IOL power suggested for 21 mm is (22.00D), 20 mm (24.00D), 19 mm (26.00D), 18 mm (27.00D) and for 17 mm axial length 28.00D. The paediatric cataract surgeon must choose an IOL power that will give a certain initial predicted postoperative refractive error. Some surgeons choose emmetropia or myopia to help in the early management of amblyopia; others choose hyperopia that varies with age at surgery, to reduce the child's ultimate myopia. On the basis of these goals, authors prefer to aim for an initial postoperative undercorrection (hyperopia) that varies with age at surgery. Enyedi et al recommended a 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, +1D for a 6-year-old, plano for a 7-year-old and -1 to -2D for an 8-year-old and older.⁶²

Who should perform pediatric cataract surgery?

Only the ophthalmologist trained in the surgical techniques of pediatric cataract, possessing adequate knowledge of IOL power calculation and have infrastructure such as Ophthalmic surgical microscope, manual or automated irrigation-aspiration equipment, vitrectomy facilities may perform surgery. Often experienced cataract surgeon can manage cataract in children as well. At the primary care level where microsurgical facilities are limited, it is best to diagnose the child suffering from cataract early and refer to secondary or tertiary care centre. Child with cataract may be best operated by an experienced surgeon at any tertiary care facility which may be either at the district level or even medium town or big city. Operating surgeon should have adequate knowledge in management of amblyopia and postoperative complications.

Current Surgical Techniques

Advances in microsurgical techniques, newer lens technology and an improved knowledge of the refractive growth of the eye has paved the way for IOL implantation, even in infants. The aim of the surgical technique is to provide a long term clear axis by preventing development of PCO or secondary membrane.

Incisions

Wound configurations that are self-sealing in adults often leak when used in children because of elastic sclera. Even the corneal tissue is less likely to self-seal in children. We recommend suture closure of tunnel wounds and paracentesis openings.

Anterior capsulorhexis and ocular viscoelastic devices

A cohesive viscoelastic like sodium hyaluronate 1.4% is recommended for pediatric cataract surgery to facilitate anterior capsulorhexis as they maintain anterior chamber stability, and help offset the low scleral rigidity and increased vitreous upthrust found in pediatric eyes. The lens capsule in children behaves quite differently than in adults, mainly secondary to its elasticity and tensile strength. The anterior capsulotomy shape, size, and integrity are important to long-term centration of the IOL.

Run away capsulorhexis are more common in children as the capsule is very elastic but if completed uneventfully it resists tearing.⁶³ In such situations comes the use of cohesive viscoelastics. Coupled to it is the centripetal force required while performing this maneuver. Capsule staining dye, 0.6% trypan blue, can provide better visualization of the anterior capsule in children with total, white cataracts.⁶⁴ The completion rate of successful anterior and posterior CCC has been shown to be higher when stained with trypan blue dye.⁶⁵ There are two primary techniques in paediatric cataract surgery, manual continuous curvilinear capsulorhexis or vitrectorhexis, Wilson analyzed five methods of anterior capsulotomy using a porcine model to measure the strength and edge characteristics of each method.⁶⁶ The manual CCC produced the most successful porcine capsulotomy (85%) with smooth edge. The Kloti radio frequency endodiathermy uses high-frequency (500 kHz) current to heat the probe tip to about 160 degrees and cuts the capsule using thermal energy.⁶⁷⁻⁷⁰ The Fugo plasma blade is a new tool for performing an anterior capsulectomy in children.^{71,72}

Hydrodissection: Hydrodissection is essential to ensure maximum removal of lens cortex and lens epithelial cells from the equatorial region. It may be a single site or multiple site hydrodissection.⁷³ It is performed by injecting ringer lactate or balanced salt solution in 2 ml

disposable syringe with 27-30 G cannula under the capsulorhexis margin. It should be avoided in cataract with posterior lenticonus or posterior polar cataract.

Cataract removal: The lens material may be removed using phacoaspiration, or automated irrigation and aspiration. However membranous or calcified cataract may need phacoemulsification.

Posterior continuous curvilinear capsulorhexis (PCCC): Visual axis opacification (VAO) is the most common complication after a successful cataract surgery in children. The PCO is amblyogenic and the purpose of surgery is defeated if long-term clear visual axis is not achieved. The general consensus is to perform a posterior capsulotomy especially in younger children.⁷³⁻⁷⁶ We perform PCCC in children undergoing cataract surgery at age less than 6-8 years and any children with nystagmus where future YAG-capsulotomy may be difficult (Figure 3). Manual PCCC with the help of cystitome and forceps is preferable over other methods. Vitrector assisted posterior capsulotomy is also done in selected situation. We think safety is a primary issue. If someone is not comfortable with the manual PCCC, they can do the same with the vitrector (Especially after implanting the IOL). Use of high viscosity viscoelastic helps to achieve PCCC. The desirable size of posterior rhexis is 3-3.5 mm.

Anterior vitrectomy: Most surgeons prefer to perform anterior vitrectomy along with primary PCCC to decrease the incidence of PCO.⁷⁷⁻⁸⁰ Anterior vitreous acts as a scaffold and helps in lens epithelial cell migration and proliferation. The vitrectomy may be performed using limbal or pars plana route. We mostly perform anterior vitrectomy using limbal route.

The vitrector may be used to make the posterior capsular opening from an anterior approach or a pars plana approach. The posterior capsulotomy and anterior vitrectomy may be performed before or after in-the-bag placement of the IOL. If performed before placement of the IOL, care must be taken when placing the lens in the capsular bag and not to extend the posterior capsulotomy. Performing posterior capsulotomy after implantation of IOL ensures in-the-bag IOL fixation. However, it is technically difficult to perform posterior capsulorhexis behind the IOL. An automated

vitrector may be used for both posterior capsulotomy and anterior vitrectomy in the second approach.

Intraocular lens implantation: Capsular bag implantation of IOL is the best choice to reduce the contact of IOL with uveal tissue and to achieve IOL centration. The capsular bag is filled with viscoelastic agent and IOL is implanted into the capsular bag. Viscoelastic material is finally removed from the capsular bag and anterior chamber. Other options of IOL fixation which are equally effective in reducing PCO formation and achieving IOL centration are optic capture of IOL with the haptics either in the ciliary sulcus or in the bag.⁸¹⁻⁸³ We recommend use of IOL in children aged 1 year or above by pediatric ophthalmologist trained in the surgical technique if there is no contraindication such as microphthalmos, micro-cornea or associated anterior chamber angle anomaly. Implantation of IOL in children below one-year age is to be undertaken only by experienced pediatric ophthalmologists as there is high incidence of vision threatening sequelae such as glaucoma, refractive surprises and retinal complications.

IOL selection and design: Primary IOL implantation in young children is becoming more acceptable as surgical techniques and biocompatible IOL materials and designs improve. Until recently, implanting PMMA IOLs were the only choice. We have shown that square-edge hydrophobic acrylic IOLs were found to be compatible

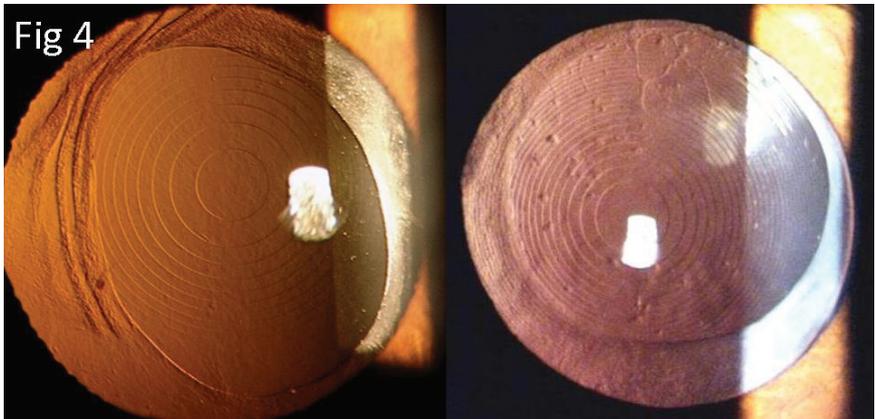


Fig 4
New generation multifocals – Alcon Restore with +3D add in left picture and Tecnis Acrylic in right picture is implanted in children above 6 years age.

and safe for use in pediatric cataract surgery with similar visual axis clarity and postoperative outcome.⁸⁴ The single-piece hydrophobic acrylic IOLs are ideal for implantation into the small capsular bag of children (Figure 3). Multifocal IOL implantation is gaining ground for pediatric pseudophakia⁸⁵ (Figure 4). The main theoretical advantage of the multifocal IOL in children is to give them a greater potential range of focal points for good near and distant vision. However there are certain limitations like IOL power calculation predictability, refractive instability, visual development of the pediatric eye with a nonoptimum optic (multifocality), and higher incidence of amblyopia in unilateral cases. Wilson et al has shown that axial length keeps on changing till 20 years of life.⁸⁶ Till we get an optimum answer to these problems one should proceed cautiously as the decision of which IOL to implant will affect not only visual acuity but also general visual development.

Incision closure: Because of lower scleral rigidity in children with a consequently greater risk of fish mouthing of the incision with resultant anterior chamber collapse, all incisions should be closed with a suture especially the main incision.⁸⁷

Management of Pediatric Aphakia

Though low complication rates have been reported with Kelman open loop anterior chamber IOL implantation in adults,⁸⁸ long term effect of ACIOLs for pediatric cataract is not known. We do not recommend this technique for pediatric cataract. Other techniques for secondary IOL implantation are placement of IOL in the sulcus-sulcus and bag-bag. There are several reports on the use of secondary IOL implantation for pediatric aphakia.^{89,90} A secondary posterior chamber IOL may be implanted in the sulcus or in the capsular bag if an intact bag can be salvaged and reopened at the time of secondary implants.

The rehabilitation of pediatric aphakia is must to prevent further amblyopia and changes in the visual pathways. The options in management of pediatric aphakia include aphakic glasses, contact lenses and intraocular lens implantation. We have shown that meticulously performed primary IOL implantation and primary posterior capsulorrhexis with anterior vitrectomy in the first two years of life is a safe and effective method of aphakic correction.⁹¹

Operative problems in pediatric cataract surgery

There are several operative complications similar to cataract surgery in adults but a few specific complications for pediatric cataract surgery are 1) difficulty in capsulorhexis formation, 2) positive intravitreal pressure, 3) intraoperative miosis, and 4) wound leak. These complications have significantly reduced using close chamber surgical technique.

Constriction of pupil during surgery is a common problem in younger children. Pupillary dilatation is achieved using pre-operatively topical phenyl epinephrine hydrochloride 2.5% eye drops, cyclopentolate (0.5%), tropicamide (0.5%) and flurbiprofen (0.03%). Use of 0.3 ml of adrenaline (1:1000) in 500 ml of irrigating fluid also helps to maintain pupillary dilatation. Most surgeons prefer scleral incision to a clear corneal incision in children. Wound closure may be performed using 10-0 nylon.

Postoperative Management

Postoperatively, a child's eye tends to show more tissue reaction. The inflammatory response can be managed with the use of intensive topical steroid (as frequently as six to eight times a day). The steroids are tapered over a period of 6 to 8 weeks. Topical antibiotics are instilled three times a day for 10 to 14 days. Homatropine eye drops (2%) twice a day or atropine eye ointment once a day should be used for about four weeks to prevent posterior synechiae formation. Refraction should be done as soon as inflammation subsides and appropriate correction should be provided based on the age of the child. Children in the preschool



Occlusion therapy is a must for optimizing visual gain over a long term period after pediatric cataract surgery. This child has been given bifocal glasses with patching in the sound eye.

age may be provided near add incorporated in the retinoscopy where as older children should be given bifocal glasses.

Postoperative amblyopia therapy should be instituted meticulously. Occlusion therapy for unilateral cataract after surgery should be instituted early as these children are at higher risk of developing amblyopia.

Postoperative Complications in Pediatric Cataract Surgery

Post-operative complications after pediatric intraocular surgery are high due to greater inflammatory response.^{92,93} Close follow up, early detection and management of complications is must.

Uveitis

Postoperative uveitis (fibrinous or exudative) is a common complication due to increased tissue reactivity in children. The incidence of uveitis has decreased because of intensive topical steroids and cycloplegics in the postoperative period.

Posterior Capsular Opacification

Posterior capsular opacification is the most common complication after cataract surgery with or without IOL surgery in children and

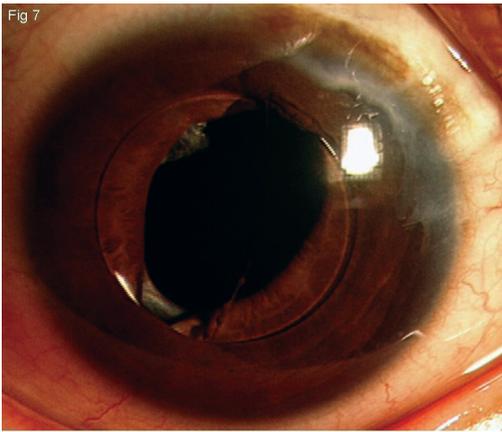


Posterior capsule opacification is the commonest complication after IOL implantation in children. Left image shows PCO (clump of lens epithelial cells) starting from the upper and lower periphery. The bunch of grapes pattern has spread its wings but is still sparing the centre where the visual axis is clear. Right image shows a central PCO which needs surgical or Nd: Yag Laser capsulotomy.

in adults.⁹⁴⁻⁹⁷ In a thick PCO, surgical posterior capsulotomy is required to prevent amblyopia. Nd: YAG laser is a non invasive option in older children for PCO. Primary posterior CCC and anterior vitrectomy reduces PCO rate.⁹⁸⁻¹⁰¹

Pupillary Capture

Pupillary capture occurs when a portion of the optic passes anterior to the iris. The incidence of pupillary capture is 8.5% to 33%.^{102,103} Fixation of posterior chamber IOL in the capsular bag decreases the incidence of this complication.¹⁰⁴



Photograph showing optic capture of the IOL. This complication is seen more frequently in children where the IOL is implanted in the sulcus coupled with excessive inflammation.

Decentration of IOL

Capsular bag placement of IOL is mandatory to reduce this complication.¹⁰⁴ Asymmetrical fixation bag-sulcus should be avoided in order to minimize IOL decentration.¹⁰⁴

Glaucoma

The incidence of glaucoma following pediatric cataract surgery varies from 3% to 32%.⁵⁴⁻⁵⁶ Glaucoma occurring soon after surgery is usually due to pupillary block or peripheral anterior synechie formation while open-angle glaucoma may occur late, which emphasizes the need for the life-long follow-up of these children. A peripheral iridectomy may prevent pupillary block in pseudophakic glaucoma. Intraocular pressure should be periodically recorded to detect and treat this vision threatening complication.

Secondary Membrane Formation

Secondary membranes are common after infantile cataract surgery and traumatic cataract.¹⁰² Nd: YAG laser capsulotomy is sufficient to open them in the early stage.⁹⁷ However primary posterior capsulotomy and anterior vitrectomy with capsular bag implantation of square-edge IOL significantly helps to maintain a clear visual axis in children with traumatic cataract.¹⁰⁵ Dense secondary membrane may need membranectomy and anterior vitrectomy.

Retinal complications

The incidence of retinal detachment following cataract surgery has been reported between 1 to 1.5%.¹⁰⁶ Retinal detachments are usually a late complication of pediatric cataract surgery.¹⁰³ The significant risk factors for an occurrence of retinal detachment are high myopia and repeated surgeries.¹⁰⁶

Amblyopia

Amblyopia,^{107,108} is one of the most important vision-threatening complications. The aphakic or pseudophakic child must be provided with suitable optical correction after surgery. Postoperative patching of the normal eye in cases of unilateral congenital or developmental or traumatic cataract is done to achieve binocular vision and stereopsis.¹⁰⁷⁻¹⁰⁹

Visual Outcome

Several studies¹⁰⁹⁻¹¹² have reported good visual outcome following intraocular lens implantation in children. Ram et al²³ showed that 62.2% of children with bilateral cataract achieved logMAR visual acuity of 0.3 or better whereas in unilateral cataract only 30.9% achieved this visual acuity. Birch compared the visual outcome of unilateral cataract operated during the first 6 weeks of life with those operated 2 to 8 years age.⁴⁵ The visual acuity of children operated during the first 6 weeks of life was 20/40 compared to 20/100 for children operated at the age between 2 to 8 years. Bradford, et al¹¹³ found visual acuity of 20/80 or more in 61% of children with an average postoperative follow up of 6.3 years in dense bilateral congenital cataract after surgery. They found that preoperative nystagmus; age at the time of surgery and postoperative nystagmus

was not prognostically significant in visual outcome. The visual outcome and academic performance is also influenced by the presence of systemic abnormalities and mental status.¹¹⁴

Pediatric cataract surgery in difficult situations

Microphthalmos with cataract: The short eyes pose a complex situation wherein the working space is limited and standard IOL formulas don't give accurate results. Most surgeons would not implant an IOL in such a scenario as the risk of glaucoma increases manifold. Dimensions of IOL may be too big for a small sized eye; however few authors reported encouraging results in such cases.¹¹⁵⁻¹¹⁷ However no conclusions can be drawn unless long term results are available.

Lenticonus: Intraocular lens implantation is usually the strongly preferred means of optical correction for eyes with posterior lenticonus and cataract, because patients are young and have unilateral involvement mostly. However one needs extra precision in handling the thin and ectatic posterior capsule which has a tendency to rupture and complicates IOL placement.

Subluxated cataract / lens coloboma: Management of subluxated crystalline lens in children is a challenge.¹¹⁸⁻¹²⁴ Surgical procedures such as intracapsular cataract extraction, limbal or pars plana lensectomy and anterior vitrectomy and suturing of the capsule to the sclera or the haptics to the sulcus have been reported with several complications.¹¹⁸⁻¹²¹ Use of CTR helps in maintaining IOL centration, stabilization of capsular bag and good postoperative visual recovery. Thus phacoaspiration with the help of CTR is a safe and predictable procedure in subluxated lens in children. However, elimination of PCO still remains a great challenge in children even after successful phacoaspiration with CTR implantation.¹²³ CTR is also a reliable option in children with lenticular coloboma where it provides support in the area of deficiency.¹²⁴

Buphthalmos with cataract: There is very little information on cataract surgery in children with buphthalmos. The extralarge capsular bag size, stretched sclera and IOL power calculation are several issues of concern. Implantation of IOL in such cases is technically difficult as the maximum diameter IOL usually 13 mm

will float in the huge capsular bag; however optic capture may help in few cases.

Persistent fetal vessels (PFV) or persistent hyperplastic primary vitreous (PHPV) with cataract: Persistent hyperplastic primary vitreous (PHPV), also known as persistent fetal vasculature, is a rare congenital developmental malformation of the eye, caused by the failure of regression of the primary vitreous. It is divided into anterior and posterior types and is characterized by the presence of a vascular membrane located behind the lens. In cases in which cataract is associated with PHPV, intraoperative bleeding is a potential complication during cataract surgery. Endocautery of bleeding vessels is required in such cases. This can be done via anterior route or pars plana. Anterior PHPV is cut with vitrector after performing PPC. A new technique wherein Fugo plasma blade has been used for PHPV has been described recently.¹²⁵

Summary

Several reports have shown a trend towards posterior chamber intraocular lens implantation for management of pediatric cataract. Surgery in very young children is best performed in a referral center by trained ophthalmologists with reasonable experience in this field. The anterior chamber is often unstable; capsule management requires special technique and the tendency for postoperative complications is more. Advances in technology have made surgery in children patients faster and safer. Modern vitrector units, viscosurgical devices with high viscosity, flexible single-piece acrylic IOLs, synthetic absorbable sutures, and newer radiofrequency diathermy and plasma blades have allowed delicate surgical maneuvers to be performed with greatest precision. Innovative surgical maneuvers such as optic capture and pars plana capsulectomy techniques have also added to the approaches that can be used in these complex cases. Visually significant cataracts may be successfully operated in newborns in order to prevent amblyopia. Careful planning of surgical procedure, selection of IOL and use of appropriate IOL power is must for pediatric cataract surgery. Primary posterior CCC with anterior vitrectomy helps to decrease the incidence of PCO and is particularly useful for pediatric cataract in children younger than 8 years.

Most importantly, the words of Ellis¹¹³ are worth remembering, “Young children with an IOL in place are a unique clinical responsibility of an ophthalmologist. Long-term follow-up is especially important.”

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