

Surgical techniques for Pediatric cataract surgery

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Historically, several primitive surgical techniques such as surgical iridectomy, 1-5 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. Lensectomy and anterior vitrectomy 6-13 is today the only viable and practical alternative to extracapsular cataract extraction or phacoaspiration with IOL implantation in selected cases. 14-35

1. Surgical iridectomy:

This technique was commonly used in the developing countries. Surgical iridectomy was indicated and performed particularly in zonular cataracts where a zone of crystalline lens still remained clear.¹ This procedure was a stop gap arrangement before formation of total cataract and surgical removal of cataract. Another stop gap arrangement is pupillary dilatation with atropine eye ointment or hom-atropine eye drop in partial cataract or where there is clear area around central cataract till surgery is performed.

2. Needling:

There was trend until a few decades back to perform needling to create an opening in the anterior capsule and lens matter was left behind totally for spontaneous absorption.²⁻⁵ The common complications of this procedure were residual cortical material in the anterior /posterior chamber, thick posterior capsule opacification, glaucoma, and induced amblyopia. This procedure is not recommended today as a form of management of pediatric cataract.

3. Needling and aspiration:

This technique is even still practiced by many

ophthalmologists in the developing world. The capsulotomy is usually can opener. Irrigation and aspiration is done using a two way Simcoe Canula. Posterior chamber IOL implantation is done in selected cases. The main postoperative complication is posterior capsule opacification. Other complications associated with sulcus fixation of intraocular lenses, which may be placed at the time of primary surgery or secondarily, are pupillary capture of IOL, pigment and cellular deposits on the IOL and glaucoma which are frequently observed in these cases.

4. The lensectomy and anterior vitrectomy (LAV) Technique.

Until recently, the basic surgical technique for pediatric cataract surgery has been lensectomy and anterior vitrectomy (LAV).⁶⁻¹³ This technique provides a clear visual axis but needs rehabilitation of aphakia by use of the spectacle or contact lens. The approaches for LAV are either a limbal or pars plana approach. Most of the surgeons prefer limbal approach to minimize the risk of damaging the peripheral retina and to prevent vitreous from becoming incarcerated in the wound. This approach is particularly used for the management of rubella cataract and infantile cataract associated with uveitis, cataract with juvenile rheumatoid arthritis. With the general acceptance of intraocular lenses as a mode of aphakic correction especially in children older than 2 years of age, LAV is losing ground to extracapsular techniques of cataract removal because it does not allow the option of placement of a posterior chamber IOL. Even in children younger than 2 years of age, where primary intraocular lens may be of concern, extracapsular techniques have an edge over LAV as they facilitate the placement of secondary

PcIOLs. The current status of LAV is more or less limited to handling complicated cataracts in children. Some authors have described a technique of pars plana lensectomy where a peripheral rim of anterior capsule is left intact for a sulcus fixation of the IOL also known as epilenticular placement of the intraocular lens.

5. Phacoaspiration with primary posterior capsulotomy with or without anterior vitrectomy and capsular bag implantation/optic capture of intraocular lens 7-35

This technique is today the most accepted technique in handling pediatric cataract surgery. A survey of pediatric cataract surgery and intraocular lens (IOL) implantation practice patterns of adult and pediatric cataract surgeons was performed among members of American Society of Cataract and Refractive Surgery and the American Association for Pediatric Ophthalmology and Strabismus.³⁶ Results show that pediatric cataract surgery with IOL implantation is being performed at a younger age than 8 years ago. Also, pediatric cataract surgery practice patterns are evolving in step with advances in adult surgery but with notable differences.

The main aim of the surgical technique is to provide a long term clear visual axis and visual rehabilitation. This is achieved by clearing the visual axis by surgical removal of cataract and capsule management. The rehabilitation of aphakia should be performed with modalities having full term compliance such as posterior chamber intraocular lens implantation.

A surgical team is very important to achieve optimal anatomical and functional outcome. This team consists of experienced ophthalmologist trained in the field, anaesthetist and a pediatrician. The cataract surgical procedure should be performed in established well equipped tertiary care centre.

Surgical steps:

Surgery is performed under general anesthesia.

Incision construction: Two clear corneal side port incisions are fashioned to facilitate bimanual aspiration of lens material. Bimanual aspiration is preferable to coaxial aspiration systems as they facilitate easier and more complete removal of lens matter as well as polishing of the capsule which may be required in selected cases. The main incision is fashioned superiorly with a 1-1.5mm entry into the cornea to create a valve. Most surgeons prefer scleral tunnel incision over clear corneal incision for the main wound as corneal incisions have a higher risk of fish mouthing of the incision with poor closure as well as greater scarring leading to more induced astigmatism, especially when the incision is large in order to accommodate rigid IOLs. With the availability of soft foldable lenses which require incisions of 3.0 mm or less, some surgeons are shifting to clear corneal incision with good results. Wound closure is performed using 10-0 monofilament nylon suture particularly in younger children to prevent wound leak.

Anterior capsulotomy: A continuous curvilinear capsulorhexis (CCC) is gold standard for pediatric cataract surgery. There are several variations of CCC available for pediatric cataract surgery.³⁷⁻⁴² Anterior chamber is filled with viscoelastic agent. A high molecular weight viscoelastic agent (Healon® or Healon GV or Viscoat) is preferred. An attempt should be made to fashion a continuous curvilinear capsulorhexis in all cases as it provides a smooth and strong opening. A small initial opening is made in the centre of anterior capsule with the help of needle cystitome. The capsulorhexis is performed with the help of Utratta's forceps which greatly facilitates the control of capsulorhexis. Repeated grasping and re-grasping maneuvers are essential to achieve successful CCC. The CCC gets bigger than one anticipates. Capsulorhexis is difficult to perform in younger children where anterior capsule is thin and highly elastic. Another alternative is to use the recently available 20G capsulorhexis forceps which can be used from the side port entry and facilitates a good capsulorhexis even when using lower viscosity viscoelastic agents such as

methylcellulose. This may be important in developing countries where cost of better viscoelastic agents may be of concern. Another alternative to manual CCC is to perform a vitrector mediated anterior capsulotomy. Other alternatives for fashioning CCC are use of RF diathermy and plasma blade may also be used to achieve CCC. Anterior capsulorhexis formation is greatly facilitated by staining the anterior capsule with trypan blue or indocyanine green dye in selected cases.⁴³ This is particularly helpful in white cataracts and younger children where capsule is very elastic. Staining of anterior capsule guides CCC boundary and helps to visualize the margin of rhexis. The desirable size of CCC is 5.0 to 5.5 mm in diameter.

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 ³⁴. It is performed by injecting ringer lactate or balanced salt solution in 2ml disposable syringe with 27-30 G cannula under the capsulorhexis margin. It should be avoided in cataract with posterior lenticonus or posterior polar cataract.

Lens substance removal: The cortical material is aspirated using two port irrigation-aspiration (IA). Two port IA helps to remove the cortex completely and it also maintains the anterior chamber during the procedure.

Posterior continuous curvilinear capsulorhexis (PCCC): Posterior capsule opacification (PCO) is the most common complication after a successful cataract surgery in children. In younger children PCO is almost inevitable if posterior capsule management is not performed at the time of primary surgery. 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.^{8, 14, 15, 18, 22, 25, 26, 27, 29, 31, 32, 35} We perform PCCC in children undergoing cataract surgery at age less than 8 years. When using acrylic IOLs with square edge with capsular

bag implantation, some surgeons opt for a primary posterior capsulotomy only in children younger than 4 years of age and do not perform it in children who are older. Technically a posterior capsulotomy can be achieved in several ways. Primary posterior capsulorhexis (PCCC) makes a capsulotomy safe because the smooth margin created at the opening resists peripheral extension of tears. Manual PCCC with the help of cystitome and forceps is preferable over other methods. Vitrector assisted posterior capsulotomy is also done in selected situation. Use of high viscosity viscoelastic helps to achieve PCCC. The desirable size of posterior rhexis is 3-3.5mm. Staining of posterior capsule with Trypan blue or indocyanine green dye may help in performing posterior CCC.⁴³

Anterior vitrectomy: Most surgeons prefer to perform anterior vitrectomy along with primary PCCC to decrease the incidence of PCO.^{14,23,25,35} Anterior vitreous acts as a scaffold and helps in LEC migration and proliferation. The vitrectomy may be performed using limbal or pars plana route. We perform anterior vitrectomy using limbal route. In children the aim is to remove only central anterior vitreous in the posterior capsulotomy opening. Two port vitrectomy is ideal. It is performed from the side port incisions.

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 ^{18,25,28} with the haptics either in the ciliary sulcus or in the bag. Two techniques may be employed - one with the haptics in the sulcus and the optic captured either into both the anterior as well as posterior rhexis and secondly placing the haptics within the capsular bag and

capturing the optic into the posterior rhexis. These maneuvers are difficult and should be performed only by experienced surgeons. A point of importance when considering optic capture of IOL is an adequate sizing of rhexis vis-a-vis the optic size. Too large a rhexis may lead to a lightly captured optic which may get de-captured later. Too small a rhexis may make the maneuver of optic capture very difficult as well as dangerous. We use PMMA, Heparin surface modified PMMA or Hydrophobic acrylic foldable IOL (Alcon Acrysof MA 60BM or Single piece SA60 AT) in pediatric cataract surgery.

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.^{44,45} Some surgeons advocate suturing of even the side port incisions. Wound closure may be performed using 10-0 nylon suture or a 10-0 polyglactin suture.

Summary:

1. Lensectomy with anterior vitrectomy with or without IOL implantation is today the only alternative surgical technique to phacoaspiration with posterior capsulotomy and anterior vitrectomy with or without IOL implantation
2. Ideally an anterior capsulorrhexis must be performed which may be achieved manually or with a vitrector
3. Primary posterior capsulotomy with anterior vitrectomy should be performed in all children younger than 4 years. Some surgeons may choose to do this even in children upto the age of 10 years
4. Anterior and posterior rhexis construction may be aided by use of high viscosity viscoelastic agents and capsule staining dyes
5. IOL implantation should be preferably be in-the-bag. In some situations, optic capture may be performed.
6. One must suture the main incision in children to prevent chamber collapse due to fish mouthing of the incision ?

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