Evolution of Pediatric Cataract Surgery

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Pediatric cataract is one of the leading causes of treatable childhood blindness accounting for 7-20% of childhood blindness in the world1. Early detection and timely management of the same can lead to dramatic reduction in prevalence of childhood blindness and amblyopia.

Cataract surgery in pediatric age group has undergone remarkable changes over the years in terms of a better surgical technique of cataract extraction, reduced incidence of intraoperative and postoperative complications and an early visual rehabilitation of the child. The improvement in management of pediatric cataract has largely been due to a better pre-operative evaluation as well as advances in technology and microsurgical techniques.

The Early Years

Cataract surgery techniques in children have undergone major changes in the last 40 years. In the past, several techniques have been used such as discission and needling, linear extraction, or a combination of discission and displacement of lens fragments into the anterior chamber by irrigation without IOL implantation. These earlier techniques have paved way for the modern phacoemulsification with IOL implantation in children including infants.

Discission and needling

One of the earliest techniques which had been described for the removal of lens in children is the needling technique in which with wide dilation of the pupil, a Ziegler or Knapp knife-needle is entered under conjunctiva at the limbus into the anterior chamber and the anterior capsule is opened by two or more cuts. The cortical material is then stirred up taking care that the posterior capsule is not touched2. Absorption is allowed for a minimum of eight weeks after which time additional needlings may be done at intervals no closer than twelve weeks apart if unabsorbed cortex is still present. When the cortex is gone, then if a secondary membrane remains, it may be opened with a sharp Wheeler discission.

Linear Extraction

Another technique of surgical removal of lens which came into existence was linear extraction in which a keratome incision is made 1.5 to 2.0 mm inside the limbus about 5mm in size followed by a large capsulotomy with the Fuchs capsule forceps. The lens substance is then expressed and the anterior chamber wash is given. Air is then injected and anterior chamber formed3.

Some surgeons preferred a combination of a discission and linear extraction. In this procedure, after an extensive discission of the anterior capsule, the eye is kept under observation for several days, until the lens material is sufficiently disintegrated to permit easy removal by linear extraction.

Owens and Hughes found that linear extraction, or discission followed by linear extraction, produced better results than simple discission in that the number of secondary operations necessary to clear the visual axis was higher after simple discission than after linear extraction or after discission with subsequent extraction4. It was observed that late retinal detachment and spontaneous intraocular hemorrhage occurred much more frequently after needling, especially repeated needling, than after linear extraction.

Aspiration

In the early 1960s, the aspiration procedure, popularized by Scheie5 became the accepted technique for extracting
A paracentesis incision is created in the clear cornea 30° on either side of the main incision. The small tunnel paracentesis incisions of 0.9–1.2 mm width are adequate to allow insertion of irrigation–aspiration cannulas and vitrectomy probe. A 2.6–3mm wide limbal valvular incision with 1–1.5mm internal entry is preferred. The sclera in a young child is elastic, encouraging the use of the smallest possible incision, which also helps to prevent iris prolapse.

**Anterior Capsulotomy**

Manual CCC may be achieved using a bent needle, cystitome, forceps, or a combination of these. A forceps is often necessary for control of the elastic capsule encountered in children using several repeated grasps at the leading edge of the tear. The capsulorrhexis should be kept relatively small because the elasticity of the child’s lens capsule can create a capsular opening that is larger than expected or desired. A central capsulorrhexis of about 4.5–5 mm is usually adequate so that it covers the IOL optic in all directions.

Alternative techniques currently available include vitrectorhexis, radio-frequency diathermy and Fugo plasma blade. Vitrectorhexis has proved to be a good alternative to manual CCC for young children, especially in the first 2 years of life when the capsule is very elastic and difficult to control. High frequency endodiathermy has also been used to create a continuous curvilinear capsulorrhexis but it produces a coagulated capsular debris along the edge. The Fugo blade helps to create a perfectly controlled anterior capsulotomy of any size, without the risk of a radial tear. A thorough hydrodissection is done and cortical matter is separated from the capsule.

**Irrigation-Aspiration**

Separate irrigation–aspiration minimizes the anterior chamber fluctuations and aids in thorough removal of cortex. Hard nuclei can be removed using short bursts of phacoemulsification.

**Posterior Capsulotomy and Anterior Vitrectomy**

Primary posterior capsulotomy is the preferred choice in children up to 6–8 years of age. A 26-gauge cystitome is used to make the initial cut in the posterior capsule. The flap is lifted and then held with capsulorrhexis forceps and a PCCC is accomplished aiming at a size of 3.5–4mm by using the ACCC principles and strategies. Inflammatory response in small children is severe and fibrous membranes may form on an intact vitreous face which can act as a scaffold for lens epithelial cell (LEC) migration and proliferation. Hence anterior vitrectomy along with posterior capsulotomy is advocated in infants and young children up to 2 years of age. A central anterior vitrectomy up to the depth of 2mm is adequate. Posterior chamber Intraocular lens is then placed in the bag or sulcus. Viscocoeastic is removed from the anterior chamber and the main incision is closed with sutures.
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<td>1958</td>
<td>Choyce</td>
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<td>Cohen Koch</td>
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<tr>
<td>Anterior capsulotomy</td>
<td>1994</td>
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Visual rehabilitation in the pediatric age group

Aphakic Glasses

Aphakic glasses are the safest and their power can be readily changed to compensate for ocular growth but they have poor cosmesis and inferior optics causing spherical aberration, prismatic effect and marked retinal image size disparity.

Contact Lenses

Contact lenses have proved to be a good option in correction of pediatric aphakia. They can be changed with the changing refraction of the child unlike intraocular lenses. However, contact lenses are successful in a relatively small number of pediatric cases over a long period, are emotionally stressful both for the child and the family, and are economically beyond the reach of many patients, particularly those in developing countries.

Epikeratophakia

Epikeratophakia was introduced in the early 1980s as an alternative method of correcting aphakic eyes. A lamellar corneal disc was sutured in front of the recipient’s eye after removal of the epithelium thus correcting the refractive error by changing the anterior surface of the cornea. Disadvantages included intensive postoperative management, decreased corneal lenticular clarity with time, irregular astigmatism, spherical error, and a prolonged period until visual rehabilitation is achieved.

Such difficulties with aphakic spectacles, contact lenses and epikeratophakia, combined with more experience with intraocular lenses, viscoelastics and improved surgical techniques, have increased the popularity and diminished the controversy over IOL implantation. IOL implantation offers the method of optical correction that requires the least compliance and induces minimal aniseikonia and astigmatism.

Intraocular lenses

The first intraocular lenses to be used in children were anterior chamber and iris supported lenses. The first published implantation of an IOL in a child was by Choyce in 1955, using an anterior chamber lens. Disadvantages included an intense inflammatory reaction, secondary glaucoma and uveal tissue bleed due to contact with vascular tissues. Binkhorst and Gobin implanted an iridocapsular fixed IOL in 1959. They were also associated with complications, including iris sphincter erosion, hyphema, anterior synechiae, iris bombé, iritis, and pupillary fibrotic membranes. Also, lens dislocation, pseudophakodonesis, and corneal endothelial trauma were possible when capsule fixation was not achieved.

With the advent of technique of continuous curvilinear capsulorrhexis developed in the 1980s, in the bag placement of IOL’s have been made possible. PMMA lenses have given way to foldable acrylic lenses in pediatric age group owing to lower incidence of posterior capsular opacification, need for a smaller incision for insertion of the IOL and minimal inflammatory response.

The youngest age at which implants can be safely and effectively used has not yet been clearly established. IOL is routinely implanted in the bag in children more than 2 years of age. Experts in the field of pediatric cataract extraction have recently been implanting posterior chamber IOLs in infants as early as 2 months old since IOL implantation has been considered to be the best option for the prevention of amblyopia with immediate visual rehabilitation. Recent studies have demonstrated excellent results with bilateral primary IOL implantation in children between the ages of 4–6 months of age.

Conclusion

Pediatric cataract surgery has seen a dramatic change over the years from the days of needling and aphakia to present day phacoemulsification with primary in the bag IOL implantation in infancy leading to early visual rehabilitation of the child. With continued improvements in surgical and laser techniques, IOL designs, anti-inflammatory agents, and amblyopia therapy, the refractive and visual outcomes in pediatric cataract surgery should continue to improve, whereas the need for secondary procedures should diminish.

References


