14 Surgical Management of Pediatric Cataract

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The aim of surgery is not just to clear visual axis but also to maintain clear visual axis for a long time. Success of pediatric cataract surgery depends on meticulous surgery, close follow-up, and compliance to visual rehabilitation aids. Surgery is not required in all cases of cataract. It is recommended in visually significant cataract >3 mm [1], dense nuclear or posterior cataracts, cataracts not permitting fundus evaluation, and those associated with nystagmus or strabismus.

14.1 Timing of Surgery

The ideal time to perform cataract surgery is when optimal visual outcome can be achieved with minimum risk of complications. Delay in surgery increases risk of stimulus deprivation amblyopia while early surgery is associated with higher risks of complications. There is evidence that risk of glaucoma reduces if cataract surgery is performed at older age [2, 3]. Visual outcome has been observed to be better in surgery at earlier age especially in cases of unilateral cataract [4, 5]. Birch et al. [4] identified a 6 week latent period for unilateral cataract where there was no difference in visual outcome in this period. We have identified the ideal time for surgery in unilateral and bilateral cataract to be by 6 weeks and 8 weeks, respectively [6]. In case of bilateral cataract, we prefer to perform sequential surgery within a week's time [6]. Simultaneous surgery is not recommended for most cases. After IOL placement in one eye, fine tuning of IOL power can be done at the time of second eye surgery based on retinoscopy of first eye.

14.2 Anesthesia

General anesthesia team plays an essential role in management of pediatric cataract. Considerations in facilitating surgery include control of intraocular pressure, eye movements including Bell's phenomena, understanding risk of apnea in infants, and control of postoperative pain, nausea, and vomiting [7].

14.3 Surgical Steps for Cataract Surgery

14.3.1 Head Positioning and Proper Exposure

Pediatric cases require proper head positioning to ensure good exposure and ease of surgery as the child is under general anesthesia. Head ring of correct size can be used according to the age along with shoulder support. Size of the speculum in relation to palpebral aperture has to be taken into consideration (Fig. 14.1a–c).

14.3.2 Incision

Two paracentesis incision almost 180° apart give access to whole of the anterior chamber and lens with ease. They can be used for bimanual surgery along with injecting viscoelastic devices. Main incision can be clear corneal or scleral tunnel. Both incision techniques are acceptable and are shown to similar surgically induced astigmatism (SIA) [8]. Superior incision is preferable in small children as it protects from inadvertent trauma. Incision can be placed in steepest axis in older children for reducing SIA [9].

14.3.3 Anterior Capsulorhexis

Staining of anterior capsule is required in cases of total cataract or in cases where good glow is absent. High molecular weight ocular viscoelastic devices (OVDs) should be used to flatten the anterior capsule [10]. Manual capsulorhexis is considered gold standard although it is more difficult in children due to elastic nature of capsule [11]. Steps of manual

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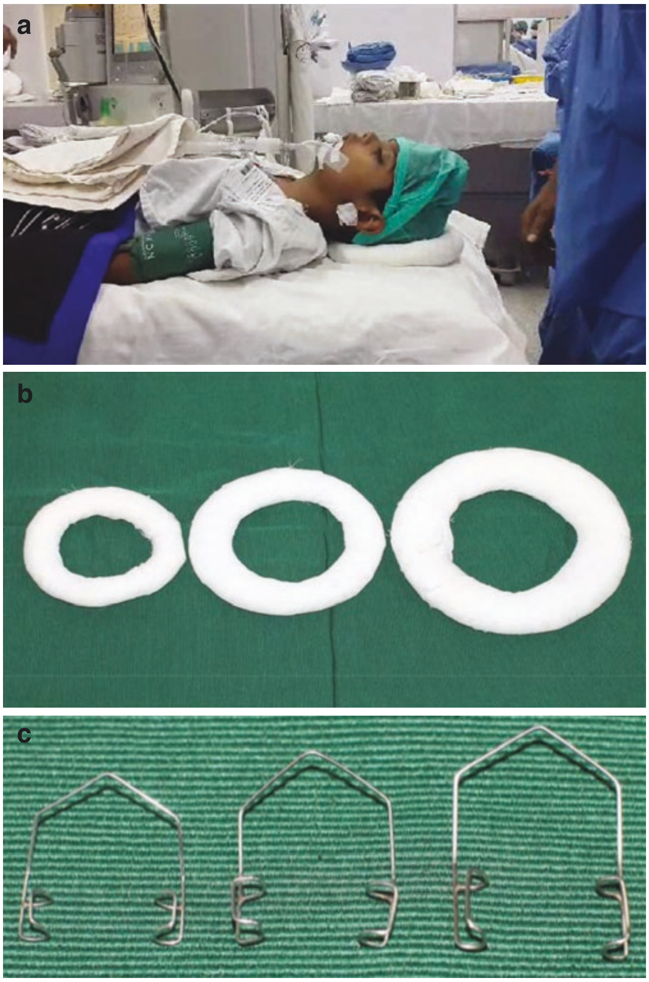

Fig. 14.1 (**a**) Ideal head position after intubation with head ring and shoulder roll for appropriate exposure. (**b**) Various size of head rings. (**c**) Various size of eyelid speculum

capsulorhexis are shown in (Fig. 14.2a–d). During manual capsulorhexis, aim should be to pull the capsulorhexis to center with frequent regrasps near the tearing edge to avoid extension. The anterior capsulotomy shape, size, and edge integrity are very important for the long-term centration of intraocular lens (IOL). In cases where manual capsulorhexis is not possible, vitrectomy cutter can be used to create capsulorhexis [12, 13] referred to as vitrectorhexis. Various other methods including use of diathermy, Fugo blade, femtosecond laser, etc. for creation of capsulorhexis are also available and can be selected for specific cases [14–19]. Tools for measurement of rhexis size accurately can be used. These include internal rings or external devices. Capsulorhexis size assesment and intruments which can be used to perform rhexis are shown in (Fig. 14.3a–f).

14.3.4 Hydrodissection and Lens Aspiration

Gentle hydrodissection in all quadrants can help in reducing surgical duration and improve cortical clean up [20]. Coaxial and bimanual techniques are available for lens matter removal. Bimanual technique of lens matter removal helps in complete removal of lens matter including subincisional cortex. It also allows for better chamber stability and more controlled lens aspiration. We prefer using wider gauze (20 gauze) bimanual instrument for irrigation and aspiration (Fig. 14.4a, b). Vitrectomy cutter can be used for lens aspiration in special cases such as preexisting posterior capsular defect, which have been discussed before.

14.3.5 Posterior Capsulorhexis and Anterior Vitrectomy

As mentioned earlier, aim of pediatric surgery includes maintaining clear visual axis for a long time. Visual axis opacification (VAO) remains the commonest complication post pediatric cataract surgery. Posterior capsulorhexis with or without anterior vitrectomy has been used to reduce VAO formation since 1980s [21]. This has been advocated over and again and is now considered standard of care for pediatric cataract surgery [22–25]. We recommend posterior capsulorhexis in children up to 8 years of age and anterior vitrectomy in children up to 6 years of age [6, 26].

Posterior capsulorhexis can be performed manually or with vitrectomy cutter. Technique of manual posterior capsulorhexis (PCC) differs from anterior capsulorhexis (Fig. 14.5). In PCC, underfill of the bag is required to prevent extension of PCC. OVD is injected in the anterior chamber but not the capsular bag to prevent convexity of capsule. Afterwards, PCC is performed after giving nick and grasping with forceps (Fig. 14.6a–d). Size should be 4–4.5 mm about 1 mm smaller than anterior capsulorhexis (Fig. 14.7a, b).

Anterior vitrectomy should be performed in smaller children to remove scaffold for proliferation of epithelial cells. High cut rate and low aspiration should be used to avoid traction on retina. Current vitrectomy systems have better control and high cut rate. Vitrectomy can be performed using same machine as that for lens aspiration like centurion or separate machine like constellation (Fig. 14.8a, b).

Vitrectomy can be done before or after IOL placement depending on surgeon's preference. Triamcinolone can be used at the end of vitrectomy for better visualization [27].

14.3.6 IOL insertion

IOL can be implanted in eyes with AL >17 mm and white to white distance >10 mm [6]. Insertion of IOL in smaller eyes is associated with more complications.

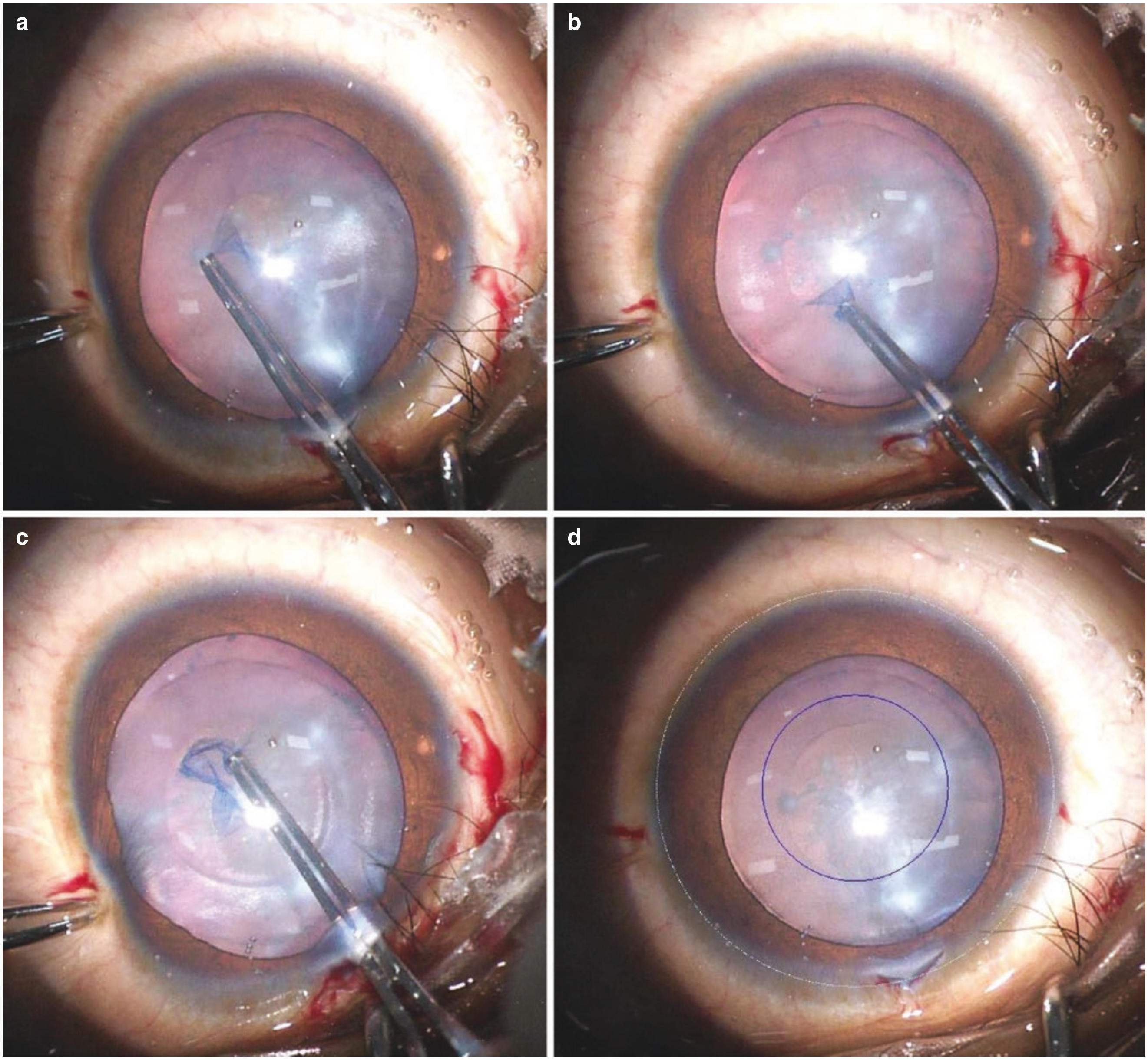

Fig. 14.2 Steps of anterior capsulorhexis. (**a**, **b**) After nick of capsule, sheering edge of the capsulorhexis is held with capsulorhexis forceps with frequent regrasp. (**c**) Capsulorhexis is completed in circular fashion. (**d**) Relative size and centration in relation to limbus using capsulorhexis assist of Zeiss Lumera 700 microscope

Placement of IOL in the bag is considered standard for all cataract surgery. Insertion of IOL is challenging in cases of open posterior capsule. We have described a safe technique of IOL insertion in pediatric cases [28]. Incision of 2.75 mm size is made (slightly larger than the IOL insertion system). Leading haptic of the IOL is gently inserted in the bag against the back surface of the anterior capsule. Once optic of IOL goes in the bag, trailing haptic is tucked into the bag without the need of dialing it (Fig. 14.9a–d).

Alternately, technique of optic capture [29] can be used in pediatric cataract. This has been used for reducing VAO formation as well [30, 31].

14.3.7 Viscoelastic Removal and Suturing

Viscoelastic should be removed at the end. Since high molecular weight OVD is used in most cases, removal is generally easy and quick. Main incision can be sutured with nonabsorbable or absorbable suture. Leaving the main wound sutureless may be associated with anterior chamber collapse or increased risk of infection especially in younger children who may rub their eyes. Hydration of paracentesis is generally adequate for stability of anterior chamber but they should be sutured if leak is suspected.

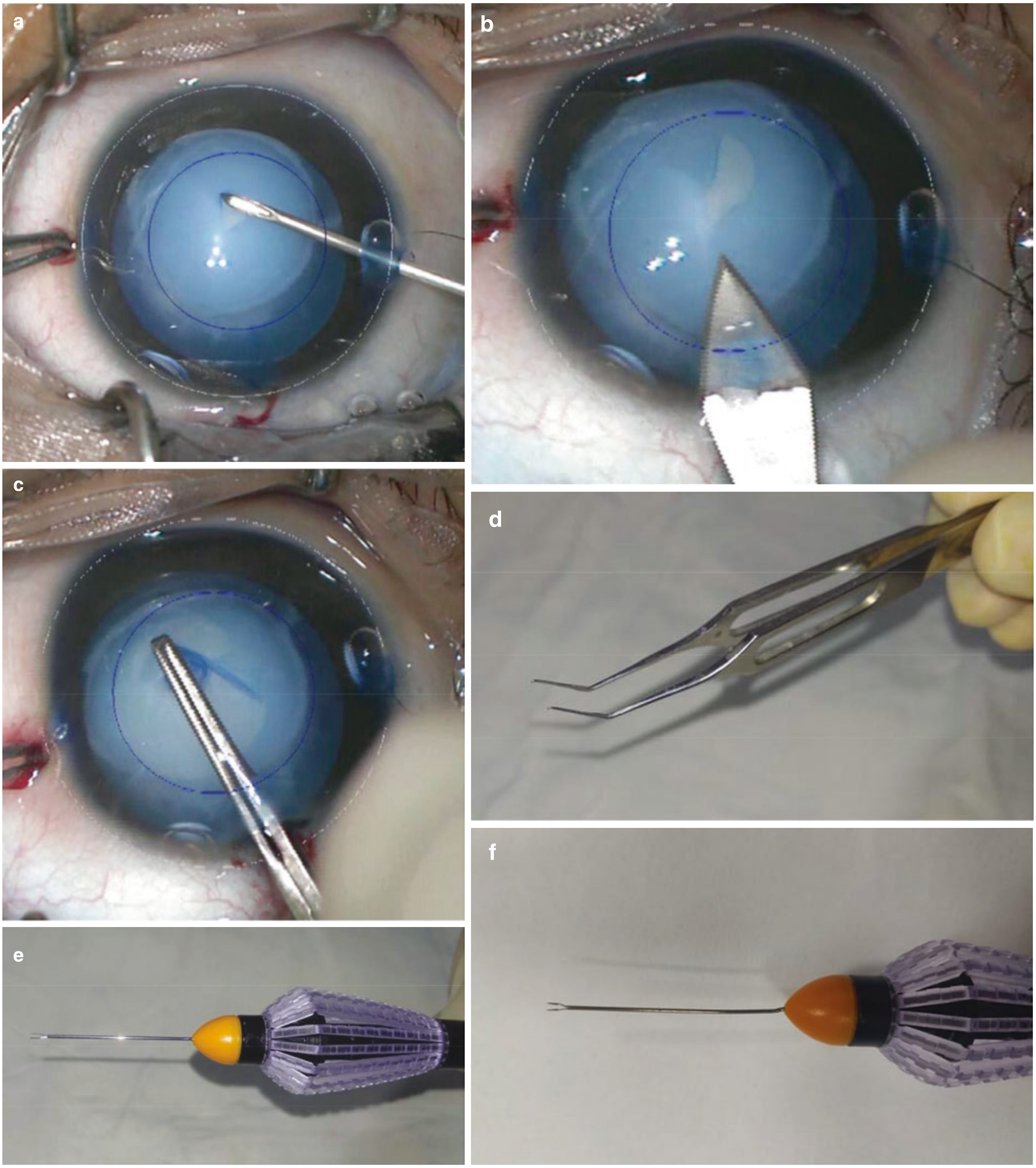

Fig. 14.3 Anterior capsulorhexis using capsulorhexis assist of Zeiss Lumera 700 microscope. (**a**) Nick is given to anterior capsule. (**b**) Nick is extended to 1 mm short of intended rhexis size and wound is extended. (**c**) Capsulorhexis is completed using Utrata capsulorhexis forceps. (**d**) Utrata capsulorhexis forceps. (**e**) Intravitreal forceps which can be used in place of microincision capsulorhexis forceps. (**f**) Serrated forceps (also known as Alligator forceps) generally used in scleral fixation of IOLs

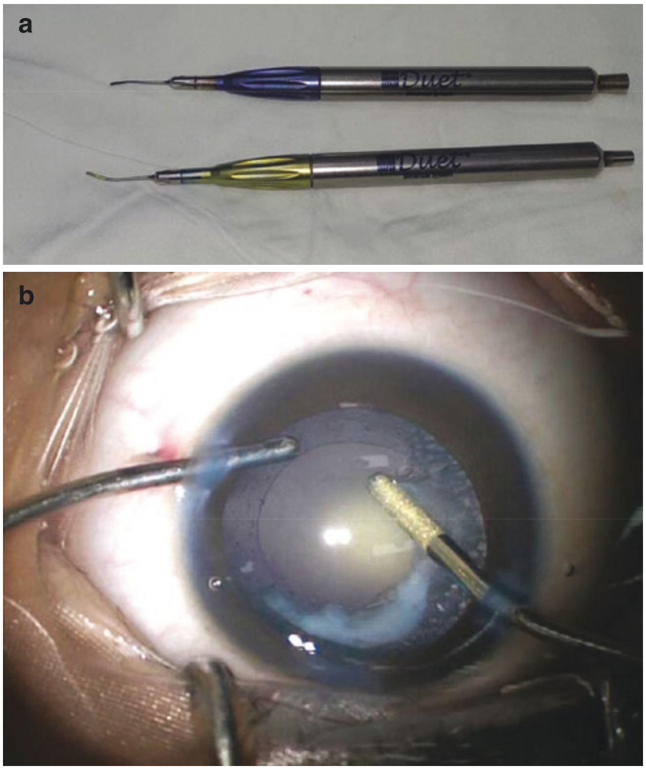

Fig. 14.4 (**a**) Bimanual Irrigation and aspiration instrument. (**b**) Intraoperative picture of bimanual Irrigation and aspiration in total cataract

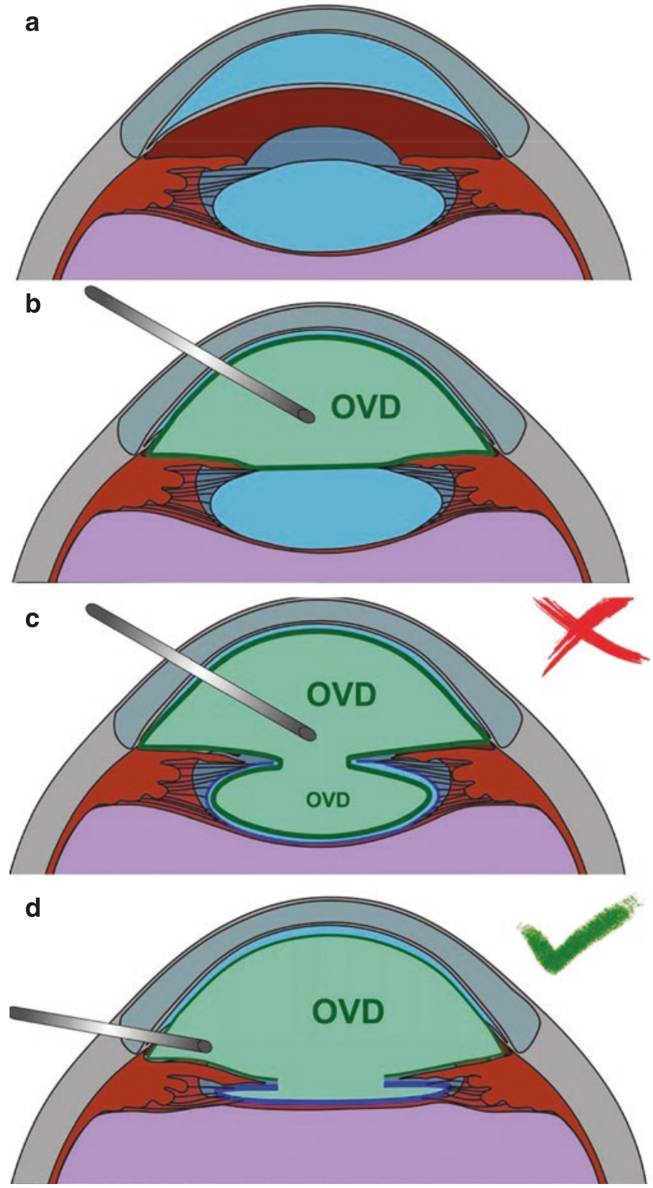

Fig. 14.5 Tricks for anterior and posterior capsulorhexis. (**a**) Sketch diagram showing lens and its capsule before capsulorhexis. (**b**) anterior chamber showing flattening of anterior lens capsule after insertion of OVD (ophthalmic viscosurgical device) for anterior capsulorhexis. (**c**) For posterior capsulorhexis, OVD, if filled inside the capsular bag would lead to bulging of posterior capsule (PC), which may lead to run out of posterior capsulorhexis. (**d**) For posterior capsulorhexis, OVD should be filled in anterior chamber only, to avoid posterior bulging of posterior capsule (PC). A flat PC maintained by just adequate vitreous pressure is desirable for good posterior capsulorhexis

14.4 Secondary IOL Implantation

In children, where primary implantation of IOL is not feasible due to age, smaller size of eye, or associated problems, secondary IOL implantation can be performed after considering a number of factors.

- Age of the patient—IOL can be implanted after 2 years of age as maximum growth of eye happens in the first 2 years of life [32].
- Best corrected visual acuity helps in guiding about patient's prognosis.
- Specular count should be performed whenever possible for objective assessment of corneal endothelium.
- Associated ocular pathology such as uveitis should be taken into consideration.
- Rim of sulcus should be assessed clinically. Ultrasound biomicroscopy can be used to assess details of rim, not otherwise clinically visible as discussed in previous chapter.

Technique of IOL placement depends on adequacy of rim. If adequate rim is present IOL can be placed in the bag or sulcus depending on the nature and size of rim [33–35] (Fig. 14.10). Formation and separation of rim of sulcus may be challenging in cases with extensive fibrosis. Each case requires unique approach (Fig. 14.11). Optic capture can help in better centration and VAO reduction (Fig. 14.12). If rim is inadequate, IOL can be placed in anterior chamber or iris fixated or scleral fixated IOL may be placed [36–38] (Fig. 14.13). Scleral fixated IOL is preferably avoided in small children with thin sclera as there is risk of haptic extrusion (Fig. 14.14).

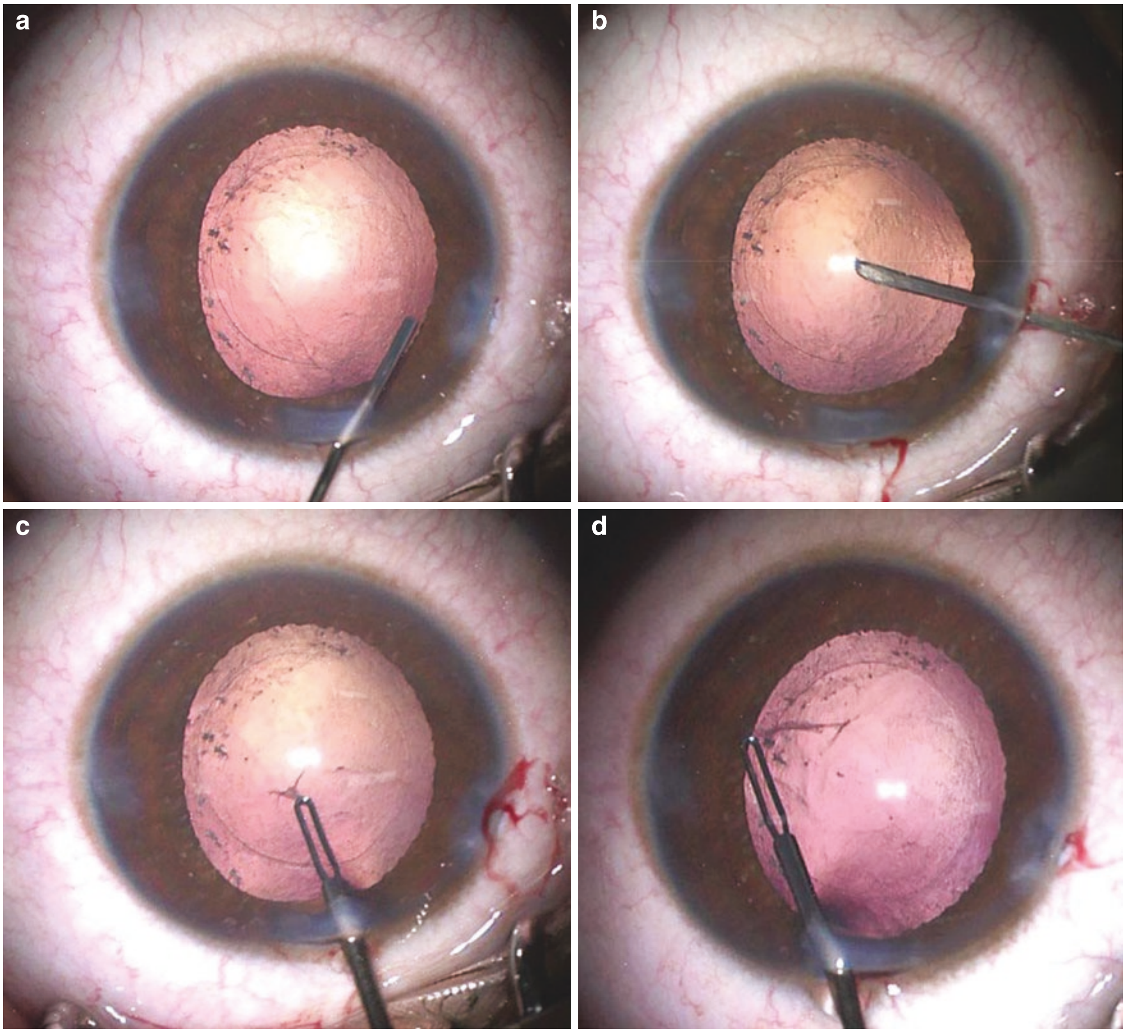

Fig. 14.6 Posterior capsulorhexis. (**a**) Anterior chamber is formed with viscoelastic devices. (**b**) Nick is given to posterior capsule. (**c**) Capsulorhexis started using microincision forceps. (**d**) Capsulorhexis is completed

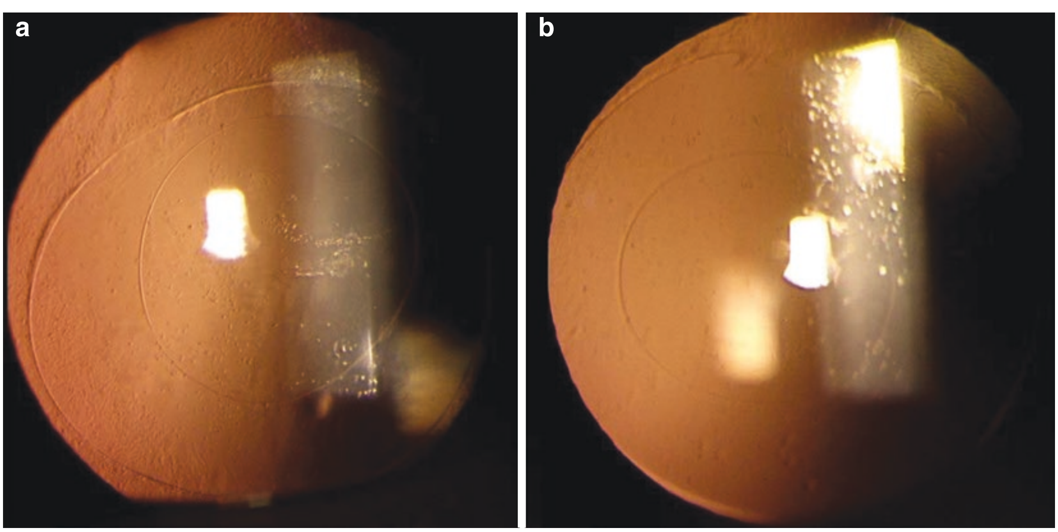

Fig. 14.7 (**a**, **b**) 5 months Postoperative picture of a 3-year-old boy with anterior and posterior capsulorhexis with IOL in bag in right and left eye, respectively. Note the sizing and centration of capsulorhexis. Slightly nasal posterior capsulorhexis is preferred

Fig. 14.8 Setting for vitrectomy machine (Centurion system @Alcon). (**a**) For anterior vitrectomy, use high cut rate and low vacuum. (**b**) For lens matter or viscoelastic removal keep low cut rate and more vacuum

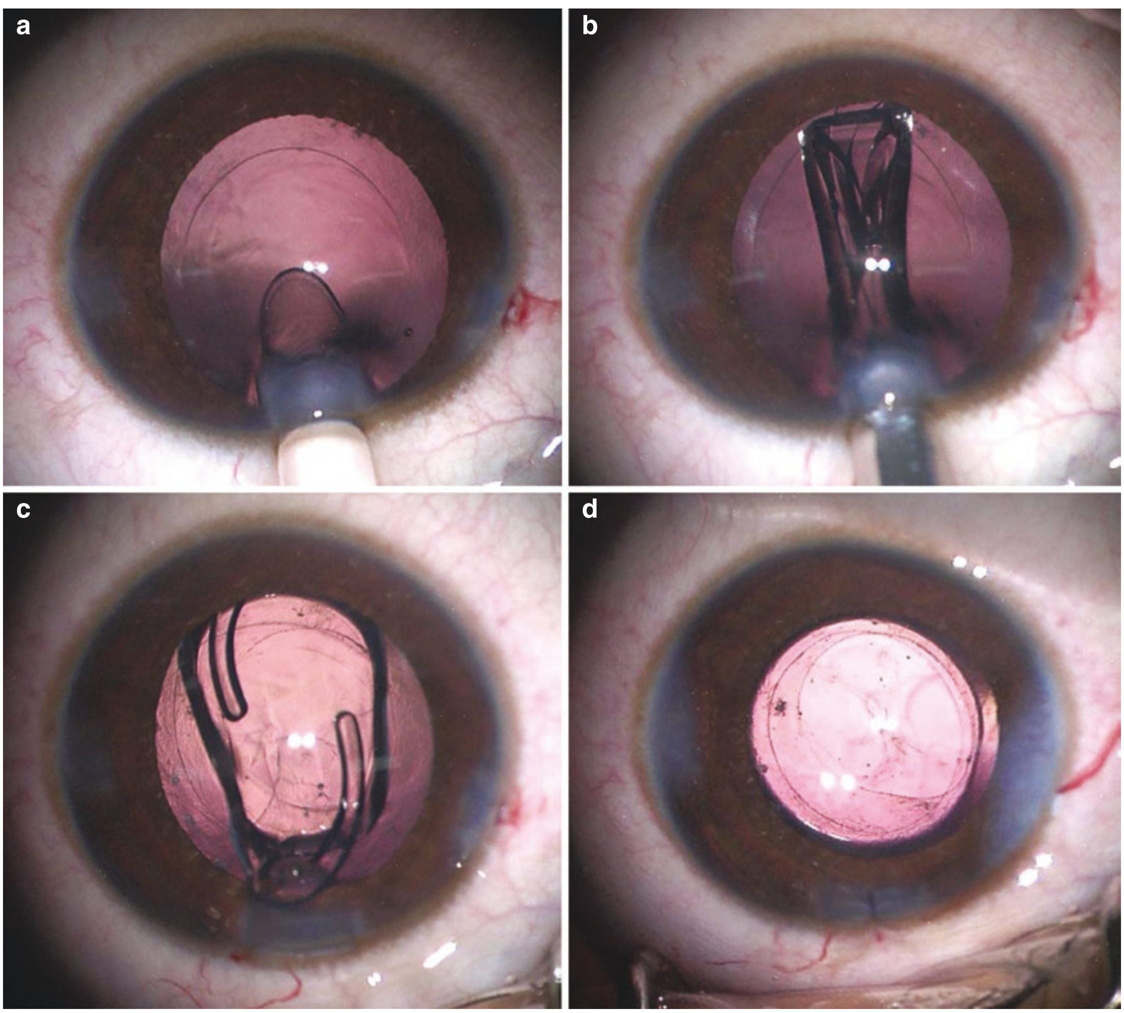

Fig. 14.9 Safe technique of IOL insertion in bag with posterior capsule opening. (**a**) Tip of IOL cartridge is inserted in anterior chamber via slightly larger incision. (**b**) Leading haptic of the IOL is gently inserted in the bag against the bag surface of the anterior capsule. (**c**) Allow IOL to open. (**d**) Final position of IOL after tucking trailing haptic

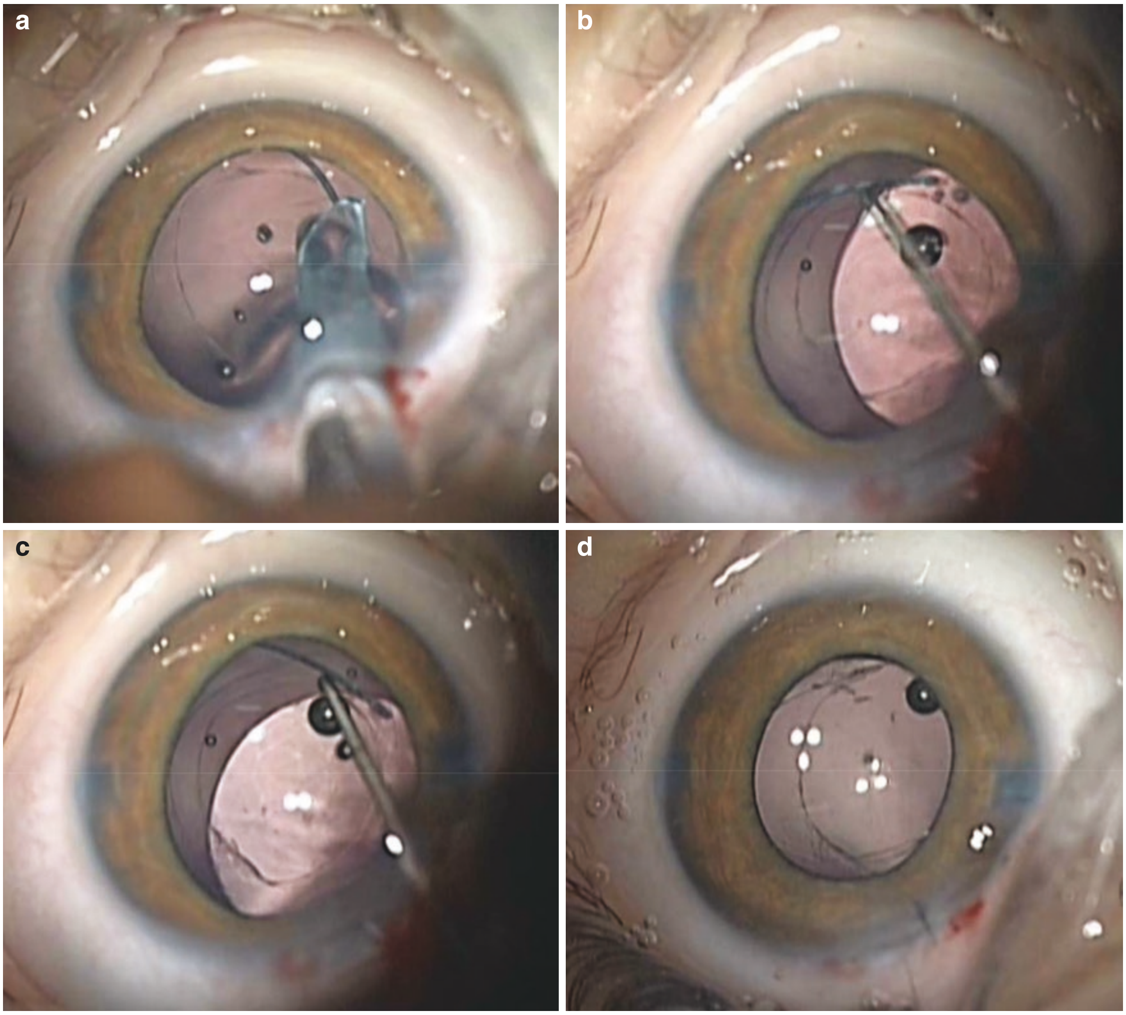

Fig. 14.10 Secondary IOL insertion. (**a**) Leading haptic of multipiece IOL is opened in the sulcus while rotating the IOL insertion system. (**b**) IOL is inserted in the sulcus and dialed. (**c**) IOL captured with anterior capsulorhexis. (**d**) Final position and centration of IOL

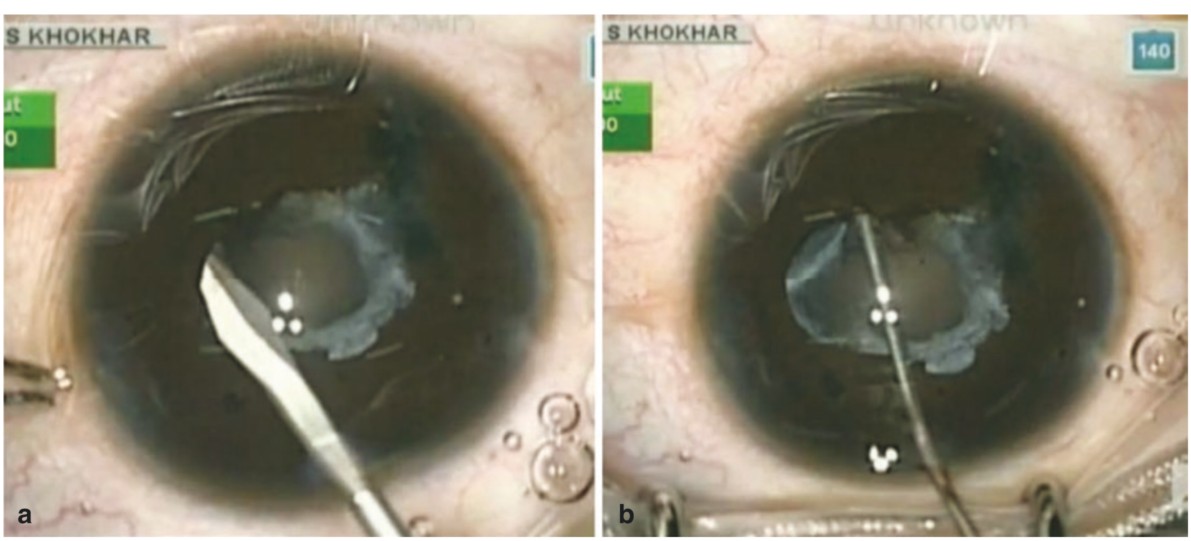

Fig. 14.11 Sulcus formation for difficult secondary IOL insertion. (**a**) Sharp dissection with 1 mm blade is used to make a first point of separation between capsule and iris. (**b**) Viscoelastic assisted separation is done once a plane is formed by sharp dissection, rest of the technique is similar

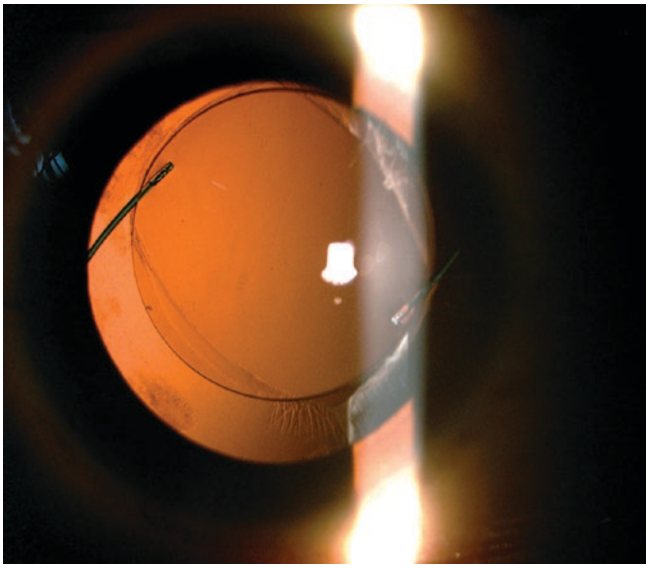

Fig. 14.12 1 year postoperative picture of a 5-year-old boy operated for secondary IOL with optic capture. IOL is well centered and visual axis is clear

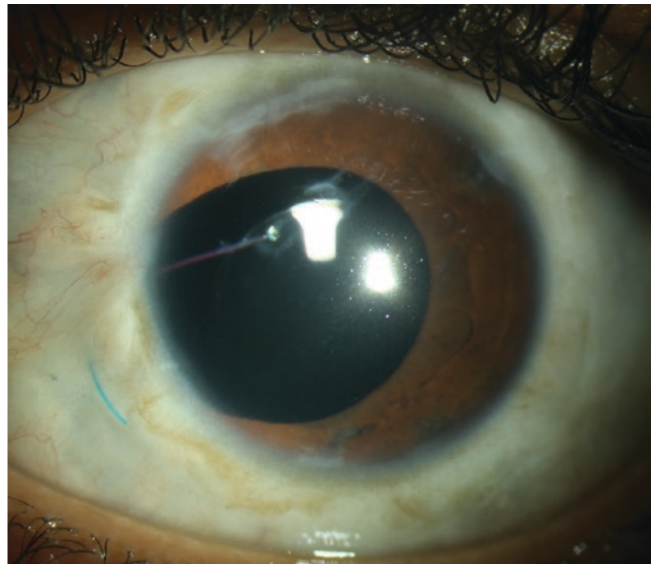

Fig. 14.14 5 months postoperative picture of 12-year-old girl with haptic extrusion of scleral fixated IOL with IOL decentration and tilt

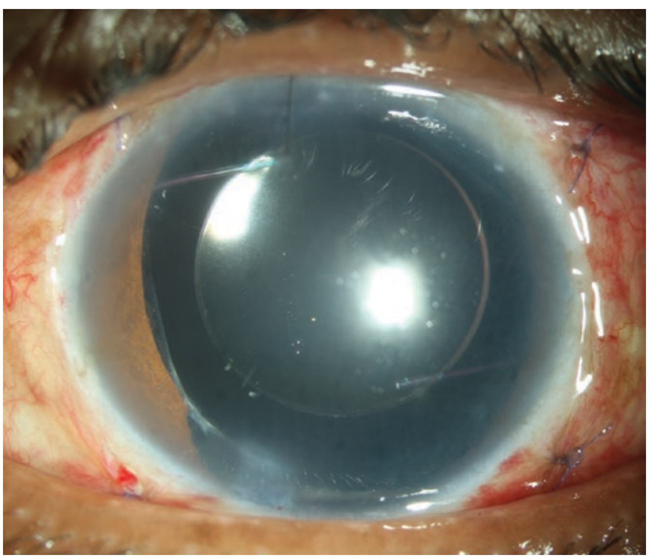

Fig. 14.13 Postoperative picture of scleral fixated IOL in a 10-year-old patient. Notice well-centered IOL, large iris defect (post trauma), and peripheral inadequate rim of sulcus in inferonasal quadrant

To summarize, cataract surgery in children poses greater surgical challenge as compared to adults due to difference in anatomy and higher risk of complications. Special considerations and meticulous surgical technique for primary surgery as well as secondary IOL implantation helps in achieving optimal outcome.

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