Original Article

Outcome of in-the-bag implanted square-edge polymethyl methacrylate intraocular lenses with and without primary posterior capsulotomy in pediatric traumatic cataract

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Purpose: To study the outcome of in-the-bag implanted square-edge polymethyl methacrylate (PMMA) intraocular lenses (IOL) with and without primary posterior capsulotomy in pediatric traumatic cataract. **Materials and Methods:** The study was undertaken in a tertiary care center. Thirty eyes of 30 children ranging in age from 4 to 16 years with traumatic cataract which underwent cataract extraction with capsular bag implantation of IOL were prospectively evaluated. Group A included 15 eyes of 15 children where primary posterior capsulotomy (PPC) and anterior vitrectomy with capsular bag implantation of square-edge PMMA IOL (Aurolab SQ3602, Madurai, Tamil Nadu, India) was performed. Group B comprised 15 eyes of 15 children in which the posterior capsule was left intact. Postoperative visual acuity, visual axis opacification (VAO) and possible complications were analyzed. **Results:** Best corrected visual acuity (BCVA) of 20/40 or better was achieved in 12 of 15 eyes in both groups. Amblyopia was the cause of no improvement in visual acuity in the remaining eyes. Visual axis opacification was significantly high in Group B as compared to Group A (P=0.001). Postoperative fibrinous uveitis occurred in most of the eyes in both groups. Pupillary capture was observed in one eye in each group. **Conclusion:** Primary posterior capsulotomy and anterior vitrectomy with capsular bag implantation of square-edge PMMA significantly helps to maintain a clear visual axis in children with traumatic cataract.

Access this article online
Website:
www.ijo.in
DOI:
10.4103/0301-4738.83609
Quick Response Code:

Key words: Pediatric traumatic cataract, primary posterior capsulotomy, posterior capsule opacification, square-edge intraocular lens, visual axis opacification

Children account for between 20 and 50% of all ocular injuries.[1] In developing countries like India, 7.4–15.3% of childhood blindness is due to cataract.[2] Incidence of traumatic cataract in children is reported as high as 29% of all childhood cataracts.[3] In most cases, traumatic cataract interferes with the visual performance and needs removal.[4]

Traumatic cataracts pose several additional problems in contrast to congenital cataracts.[5-7] Firstly, traumatic cataracts are unilateral and in young children, management of the associated amblyopia can be at times, frustrating.[5-7] Secondly, injury to other ocular structures complicates the issue. The postoperative inflammation encountered after cataract surgery is also greater than seen after surgery for developmental cataracts, because of a number of reasons such as lens-induced inflammation, sulcus fixation of intraocular lens (IOL) and the cataract surgery being a second intraocular intervention following the primary repair in cases with penetrating eye injury.[8]

Presently, cataract surgery with posterior chamber intraocular lens (PCIOL) implantation offers the best option for visual rehabilitation in children with traumatic cataracts. Fixation of PCIOL in the capsular bag offers the best place for implantation as it minimizes trauma, iris contact and reduces the chances of decentration of the IOL.[9-11]

The main postoperative complications noted after cataract surgery with PCIOL implantation are fibrinous uveitis, IOL precipitates, pupillary capture, decentration of IOL and visual axis opacification (VAO).[12] These complications are much higher in traumatic cataract as the integrity of ocular structures is disturbed. VAO remains the most frequent long-term complication after cataract surgery with implantation of an IOL.[12,13] Clinically significant VAO rates, as high as 92% have been reported in children implanted with IOL where no primary posterior capsulotomy (PPC) was performed.[13]

Till now no study has compared the role of PPC versus intact posterior capsule and in-the-bag fixation of PCIOL in children with traumatic cataract. We aimed to study the outcome of in-the-bag implanted square-edge polymethyl methacrylate (PMMA) IOL with and without PPC in pediatric traumatic cataract.

Materials and Methods

We prospectively enrolled 30 children from 4 to 16 years of age with unilateral traumatic cataracts undergoing cataract extraction with in-the-bag PCIOL implantation [Fig. 1]. Thirty children were randomized into two groups using random table. Group A comprised children with unilateral traumatic cataract who underwent cataract extraction with in-the-bag implantation of square-edge PMMA IOL (Aurolab SQ3602, Aravind IOL Division, Madurai, India) with PPC and anterior vitrectomy (AV) [Fig. 2]. Group B comprised children with unilateral traumatic cataract who underwent cataract extraction

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Manuscript received: 27.10.09; Revision accepted: 18.11.10

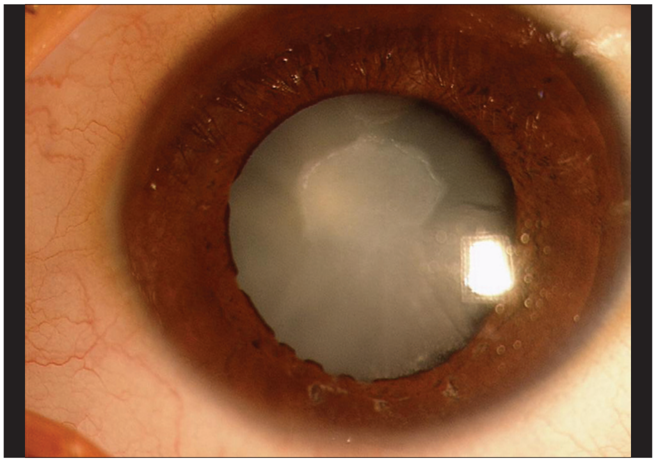

Figure 1: Five-year-old child with traumatic cataract following injury with fist. Note the anterior capsular fibrosis with plaque

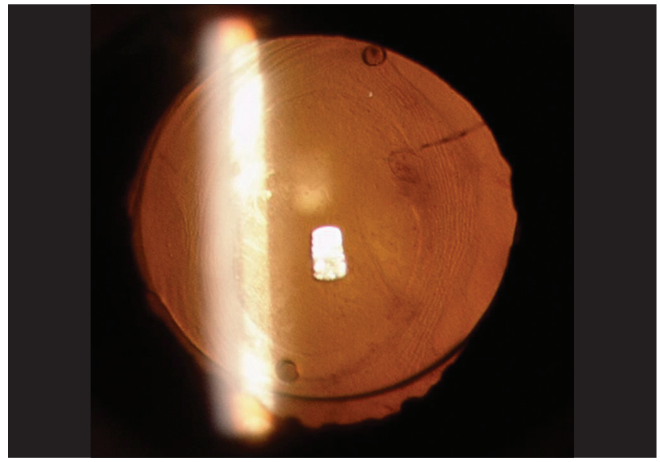

Figure 2: Same eye of the child as in Figure 1 where no PPC was done. There is dense opacification of posterior capsule obscuring the visual axis seen at seven months post surgery

with in-the-bag implantation of square-edge PMMA IOL without PPC [Fig. 3]. Patients were followed up for a minimum period of 12 months. The study protocol was reviewed and approved by the Institutional Review Board. Informed consent was obtained from the parents of each child included in the study.

Exclusion criteria were traumatic cataracts associated with large corneal laceration (10 mm or more) or laceration involving the visual axis, other obvious extensive ocular trauma that was likely to affect visual outcome like hyphema, angle recession or posterior segment involvement, e.g. vitreous hemorrhage, retinal detachment as detected on B-scan ultrasound, cases with inadequate posterior capsule support to permit in-the-bag IOL implantation, children with systemic disorders, e.g. congenital rubella syndrome, galactosemia or any other ocular anomalies, e.g. micro-ophthalmia, and microcornea.

Detailed ocular history pertaining to the nature of trauma was ascertained. Ocular examination included recording of best corrected preoperative visual acuity (using Snellen's letter chart, Landolt's C test or 'E' chart, depending upon the age and cooperation of the child). Visual axis, fixation preference and pupillary reactions were also noted. Intraocular pressure (IOP) was recorded with Goldman applanation tonometer in cooperative children. In uncooperative children measurement of IOP was done by non-contact tonometer. Slit-lamp biomicroscopic examination of the anterior segment was done after achieving pupillary dilatation with topical 5% phenylephrine and 1% cyclopentolate eye drops. Type of cataract was documented according to the location of the predominant type of opacity. Posterior segment evaluation was carried out with an indirect ophthalmoscope in eyes with relatively clear media. Ultrasound B-scan was performed in all cases to exclude any posterior segment pathology. IOL power calculations were made using the Sander's-Retzlaff-Kraff (SRK II) formula on the basis of axial length (A-scan) and keratometric readings. Whenever corneal trauma precluded accurate keratometry, the measurements from the fellow eye were used.

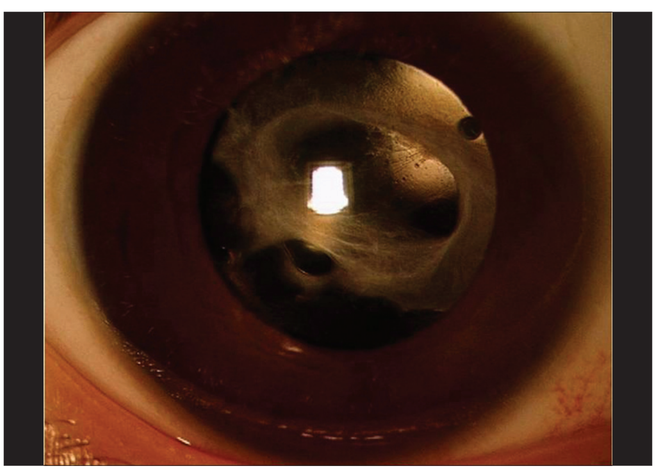

Figure 3: PMMA IOL (SQ 3602, Aurolab) implanted in capsular bag in an eye where PPC was done eight months back. A membrane is also seen which is partially covering the visual axis. Note thick fibrosis of the capsulorhexis margin

All children underwent surgery under general anesthesia and all surgeries were performed by the same surgeon (JR). A superior conjunctival peritomy was done followed by a partial-thickness scleral incision 1.5 mm from the limbus. Two clear corneal side port incisions were made with 15^0 disposable keratome 180^0 apart. Scleral incision was then deepened and fashioned into a tunnel with 3.0-mm keratome. The anterior chamber was then filled with viscoelastic (Healon GV®, AMO Santa Ana, California) and synechiolysis was done if required using the same viscoelastic. Continuous curvilinear capsulorrhexis (CCC) was performed with capsulorrhexis forceps wherever possible. The size of the anterior capsulorrhexis was kept between 5 mm and 5.5 mm. Cortical cleaving hydrodissection was performed by injecting fluid between the capsule and cortex. Phacoaspiration was done using phacoemulsifier. Residual cortical matter was aspirated using automated two-port irrigation-aspiration (IA) canulae. The capsular bag was then filled with viscoelastic material and 360^0 square-edge PMMA IOL with 6 mm optic and 12.5 mm overall diameter (Aurolab SQ3602, Madurai, Tamil Nadu, India) was implanted in the capsular bag.

In Group A, PPC with AV was performed. The size of the posterior capsule opening was between 3.0 mm and 3.5 mm and IOL was implanted in the capsular bag. In Group B, the posterior capsule was left intact and IOL was implanted in the capsular bag. The viscoelastic material was irrigated out from the capsular bag and anterior chamber. Incision was closed by applying horizontal cross-suture using 10-0 monofilament. Subconjunctival injection of gentamycin 20 mg and dexamethasone 2 mg was given at the end of surgery in each case.

Postoperatively, all patients received intensive topical steroid (Betamethasone 0.1%) eye drops hourly for the first two days, then six to eight times a day for the next five days, and tapered over the next five weeks, along with topical antibiotic (Moxifloxacin 0.5%) and nonsteroidal anti-inflammatory agent (Ketorolac 0.5%). All patients received twice daily homatropine 2% for four weeks, postoperatively. A short course of oral prednisolone (1 mg/kg body weight) was given to the patients having severe fibrinous uveitis. In those children at risk for amblyopia, part-time occlusion therapy of the dominant eye was instituted within two weeks of surgery along with refractive correction. Patients were followed at Day 1, Week 1, Week 3 and then at three and six months and one year. Visual acuity, IOP and detailed slit-lamp examination were performed where possible, on follow-up visits. Visually significant VAO was defined as opacification of the posterior capsule leading to a decrease in visual acuity of at least two Snellen's lines. Children developing visually significant VAO underwent Nd:YAG laser capsulotomy or a pars plana membranectomy.

Results

The mean age of the children in Group A was 7.80 years and in Group B it was 9.87 years. The difference in the mean age between the two groups was not statistically significant (P=0.11). Group A included a total of 14 males and one female while Group B included 12 males and three females (P=0.28). Distribution of types of traumatic cataracts is depicted in Table 1.

The preoperative vision varied from light perception with inaccurate projection to 20/80 in both the groups. The interval between injury and cataract surgery ranged from 0.7 to 7 months in Group A (average 3.3 ± 2.2 months) and from 0.2 to 25 months in Group B (average 4.0 ± 6.5 months) (P=0.28). The mean preoperative IOP was 15.13 ± 2.03 mmHg in Group A and 14.33 ± 3.03 mmHg in Group B (P=0.26).

Table 1: Patient demographic profile of children with traumatic cataract

Parameter	Group A n (15)	Group B n (15)
Mean age (in years)	7.80	9.87
Gender		
Male	14	12
Female	1	3
Eye		
Right	12	8
Left	3	7
Morphology of traumatic cataract		
Total	12	8
Focal cortical	-	1
Rosette	-	1
Posterior subcapsular	1	-
Partially absorbed lens	1	-
Lens matter in AC	1	5

In Group A, early postoperative complications included transient corneal edema in one of 15 eyes, shallow anterior chamber (AC) in another one of 15 eyes. Mild fibrinous uveitis was found in 13 of 15 eyes, moderate fibrinous uveitis in five of 15 eyes, and severe fibrinous uveitis was found in two of 15 eyes. Pigment deposits over the intraocular lens surface were seen in eight out of 15 eyes, while posterior synechiae were formed in two out of 15 eyes. Fibrinous membrane on the IOL surface was seen in two of 15 eyes. This complication was related to the severe fibrinous uveitis found in two eyes.

In Group B, early postoperative complications included high IOP in one of 15 eyes, mild fibrinous uveitis was found in seven of 15 eyes, moderate fibrinous uveitis in two of 15 eyes. Pigment deposits over the IOL surface were observed in three out of 15 eyes. The difference between the two groups was not statistically significant (P=1.0 (corneal edema), P=1.0 (shallow AC), P=.05 (mild fibrinous uveitis), P= 0.39 (moderate fibrinous uveitis), P=0.48 (severe fibrinous uveitis), P= 0.12 (pigment deposits over the IOL surface), P=0.48 (posterior synechiae), P=0.48 (fibrinous membrane on the IOL surface). On follow-up, one eye in each group developed pupillary capture. The anterior rhexis was incomplete in cases with optic capture.

In Group A, only two out of 15 eyes had to undergo intervention for visually significant VAO compared to 13 out of 15 eyes in Group B in which the posterior capsule was left intact. The difference between the two groups was statistically significant (P = 0.001). Final visual acuity was 20/40 or more in 12 of 15 eyes in each group. Poor visual outcome in three patients in Group A was attributed to amblyopia and in Group B, to amblyopia in two eyes and amblyopia plus corneal scarring in one eye.

Discussion

The major management challenges for successful pediatric cataract surgery are aggressive postoperative inflammatory response, secondary membrane formation in the visual axis and the potential for developing severe vision-deprivation amblyopia.[14]

When a child of penetrating eye injury with traumatic cataract presents to an ophthalmologist, the preferred approach is to repair the corneal or scleral laceration first and then do the cataract extraction four to six weeks later.[15] Cataract extraction with intraocular lens implantation has dramatically changed in recent times due to refinement in microsurgical techniques. Previous concerns regarding implantation of IOL in these cases because of possible long-term adverse effects of synthetic materials, the changing refractive status of the developing eye, and the greater inflammation that occurs after pediatric cataract surgery have been significantly reduced. The major postoperative concerns following pediatric cataract surgery are fibrinous uveitis, VAO, pupillary capture, deposits on the IOL surface and decentration of the IOL.[16] Traumatic cataract on the other hand, represents a more complex situation where there is more tissue damage and breakdown of the blood-aqueous barrier resulting in difficult operative and postoperative management.

Fibrinous uveitis is a common postoperative complication due to increased tissue reactivity in children that may lead to posterior central synechiae, pupillary block glaucoma and lenticular membrane formation.[10,17-20] Brar *et al.*,[15] noticed fibrinous uveitis in 40.9% of eyes in the blunt trauma group compared to 61% eyes in the penetrating group. Eckstein *et al*.,[13] reported 19% incidence of severe anterior uveitis in their series. We found moderate to severe fibrinous uveitis in seven out of 15 eyes in Group A. In Group B, moderate fibrinous uveitis was found in two out of 15 eyes. Severe inflammatory reaction was not seen in any cases in this group. The difference between the two groups was not statistically significant (P= 0.05 (mild fibrinous uveitis), P= 0.39 (moderate fibrinous uveitis), P= 0.48 (severe fibrinous uveitis). This complication may have been caused by the increased permeability of the vasculature and breakdown of the blood-aqueous barrier as a result of trauma. To avoid complications of fibrinous uveitis, our patients were started on intensive topical steroids, together with oral corticosteroids in the immediate postoperative period, which were gradually tapered over three months.

Increased uveal contact in eyes with sulcus fixation of IOL leads to a persistent low-grade uveitis that predisposes to synechiae formation and subsequent pupillary capture.[21-23] In-the-bag fixation of IOL and less associated postoperative uveitis are important factors in decreasing this complication. Pupillary capture can occur despite angulated (10^0) haptics.[16] The incidence of pupillary capture in children is reported to range from 9-45%.[13,15,18,21-23] In a study by Pandey *et al*.,[23] a higher incidence of pupillary capture was noted in sulcus-fixated IOLs (40%) compared to capsular bag-fixated lenses in pediatric traumatic cataracts. Out of total 30 children enrolled in our study, one eye in each group developed pupillary capture. The pupillary capture in Group A was left untreated as it was not associated with other complications such as IOL malposition or elevated IOP. In Group B, IOL recentration was performed four months after cataract surgery for IOL malposition (one haptic in AC). In the first patient the capsulorrhexis was of larger size and oval in shape and in the second case shrinkage of the capsular bag could have resulted in pupillary capture.

We noticed pigment deposits in eight out of 15 eyes and three out of 15 eyes in Group A and Group B respectively (P=0.12). To prevent pigment deposits on IOL surface, heparin surface-modified lens[13] and use of heparin in balanced salt solution has been recommended earlier.[20] Benezra observed that in children of a younger group, a large capsulectomy and sulcus–to-sulcus insertion of IOL was followed by less intraocular inflammation, than when a small capsulotomy and in-the-bag insertion of IOL was performed.[22]

The most serious and vision-impairing complication of traumatic cataract surgery is VAO. Incidence of VAO in children with traumatic cataract has been reported between 21–100%.[13,17,19,21,22] Brar *et al.*, have reported a rate of visually significant VAO as high as 83.33% in patients of penetrating eye injury with traumatic cataract, where a PPC was not performed.[15] In another study, VAO occurred in 100% eyes where PPC and AV were not done in patients with traumatic cataract and penetrating eye injury.[22] In our study, the incidence of VAO was significantly lower in Group A, occurring in only two out of 15 eyes in which PPC was performed in comparison to Group B, in which VAO was noticed in 13 out of 15 eyes in which the posterior capsule was left intact at the time of cataract surgery. The difference between the two groups was statistically significant (P=0.001). In our study, VAO developed in two out of 15 eyes in Group A. This was probably due to the greater postoperative inflammatory reaction seen in these cases, which led to closure of the opening of the posterior continuous curvilinear capsulorhexis (PCCC) and formation of a membrane over the IOL surface. Kugelberg *et al.*, showed that patients who did not receive an AV had surgery for after-cataract more often (P<.01).[24] Age at surgery and whether an AV was performed did not significantly affect the posterior capsular opacification score.[24]

This study shows that a significant number of children with intact posterior capsule may develop visually significant VAO even after placement of square-edge IOL in the capsular bag. We found that performing PPC in pediatric traumatic cataract significantly reduced the opacification of the posterior capsule and helped in maintaining clear visual axis. This has special relevance to a developing country like India, where patients are likely to be lost to follow-up because of socioeconomic factors and the lack of adequate ophthalmic infrastructure.

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Cite this article as: Verma N, Ram J, Sukhija J, Pandav SS, Gupta A. Outcome of in-the-bag implanted square-edge polymethyl methacrylate intraocular lenses with and without primary posterior capsulotomy in pediatric traumatic cataract. Indian J Ophthalmol 2011;59:347-51.

Source of Support: Nil. **Conflict of Interest:** None declared.