

ASCRS white paper

Hydrophobic acrylic intraocular lenses in children

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After Sir Harold Ridley's invention of the intraocular lens (IOL) in 1949, Dr. Edward Epstein implanted an IOL in a 12-year-old aphakic child in 1952.¹ However, implantation in pediatric eyes was slow to catch on as many early attempts at IOL implantation in children resulted in complications. These results have been attributed to a lack of awareness of the need for primary posterior capsulectomy and vitrectomy, poor IOL design for children, and the inherent propensity for an increased inflammatory response in a child's eye after intraocular surgery. Advances in surgical techniques and technologies resulted in a reduction in the postsurgical inflammatory response, even in the highly reactive eyes of children. Improvements in IOL design are important contributing factors in this regard.

Implantation of IOLs in children began to increase steadily in the 1980s and early 1990s. This increase was the result of the introduction of poly(methyl methacrylate) (PMMA) IOLs, which were highly polished, downsized to 12.0 mm overall length, and equipped with more flexible haptics. In addition, the use of mechanized vitrectomy instrumentation to selectively perform a primary posterior capsulectomy and vitrectomy combined with IOL implantation resulted in fewer reoperations in younger children.

Soon after its introduction in the mid 1990s, the hydrophobic acrylic IOL assumed a prominent role in adult cataract surgery. Because posterior capsule opacification (PCO) is one of the most frequent and severe complications in pediatric cataract surgery, reports that acrylic IOLs decreased the incidence of PCO after adult cataract surgery prompted pediatric cataract surgeons to use this material in pediatric eyes.^{2,3} The

trend away from PMMA and in favor of hydrophobic acrylic in childhood IOL implantation occurred more slowly than in adults but ultimately was driven by a desire for a highly biocompatible material that could be inserted through a smaller incision and fit the smallest capsular bag without excessive stretching.⁴ Laboratory investigations by Pandey et al.⁵ evaluated 6 types of IOLs manufactured from rigid and foldable biomaterials to determine which design was best suited for implantation in pediatric eyes. The 1-piece hydrophobic acrylic AcrySof IOL (Alcon Laboratories) was associated with significantly less capsulorhexis ovaling and capsular bag stretch than the others tested.

In a 2001 survey of members of the American Society of Cataract and Refractive Surgeons (ASCRS) and the American Association for Pediatric Ophthalmology and Strabismus (AAPOS),⁶ 66.8% of ASCRS respondents and 71.7% of AAPOS respondents said they preferred hydrophobic acrylic IOLs for implantation in children. A survey of AAPOS members conducted in 2006⁷ showed that for in-the-bag fixation, 93.3% of the respondents (95.9% and 85.2% of USA and non-USA respondents, respectively) preferred hydrophobic acrylic IOLs. AcrySof hydrophobic acrylic IOLs were preferred by 90.2% of overall respondents (94.2% and 77.8% of USA and non-USA respondents, respectively). Among AcrySof users, more physicians preferred 1-piece AcrySof IOLs (SA and SN series) for in-the-bag fixation. For sulcus fixation, 69.9% of the respondents (76.6% and 48.1% of USA and non-USA respondents, respectively) preferred hydrophobic acrylic IOLs and 65.3% of overall respondents (71.8% and 44.3%, respectively) preferred the AcrySof hydrophobic acrylic IOL. Among those implanting AcrySof IOLs, most (122/143) preferred the 3-piece model for sulcus fixation. The 1-piece hydrophobic acrylic AcrySof IOL was selected for use in the National Eye Institute-funded Infant Aphakia Treatment Study under an investigational device exemption from the U.S. Food and Drug Administration.

During the past decade, many reports have documented the outcomes of hydrophobic acrylic IOL implantation in children.^{3,4,6,8-29} More than 1000 pediatric hydrophobic acrylic IOL implantations have now been reported in the literature (Table 1).

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Table 1. Literature review of visual axis opacification after primary hydrophobic acrylic IOL implantation in children.

Ref #	Year	Age (Y)	N	Follow-up (Y)	IOL Model	Posterior Capsule Management	Secondary Intervention (%)	Time to Secondary Intervention (Y)
3	2001	5.0 ± 4.4 (0.03-19)	110	1.2 ± 1.3	MA60BM, MA30BA	Intact (n = 22)	45.4	1.6 ± 1.2
8	2001	3.4 ± 1.9 (2-8)	8	2.4 ± 0.4	MA60BM, MA30BA	PC+V (n = 88) PC (IOL optic capture)	ND 0	ND NA
9	2002	Median 5.7* (0.2-15.2)	50	Median 1.6*	MA30BA	PC (n = 31) PC+V (n = 19)	25.8 (≤7 y: 50; >7 y: 14.3) 0	ND NA
11	2002	<0.5	15	ND	MA30BA	PC+V	80	0.4 (0.1-0.8)
12	2002	8.3 ± 3.7	26	2.7	MA30BA	Intact	50 (<4 y: 100; >4 y: 38)	ND
13	2003	8.6 ± 4.6 (3-16)	10	1.0 ± 0.7	MA60BM	PC (n = 1), PC+V (n = 3) Intact (n = 6)	0 16.7	NA 1.8
14	2003	(2-16)	50	1.7	MA30BA	2-6 y: PC+V (n = 12); PC+V+OC (n = 8) 6-12 y: intact (n = 15); PC (n = 8); PC+OC (n = 7)	8 (PC+V) 13.3 (intact posterior capsule)	ND ND
15	2003	(0.3-12)	64	Minimum 2	MA30BA	PC+V (n = 16) Intact (n = 16)	ND; vis sig PCO: 12.5 ND; vis sig PCO: 75	NA NA
4	2003	2.8 (0.04 - 9.1)	42	1.0	SA30AL, SA60AT	PC+V	≤1.5 y: 29.4 1.5 y: 0	0.9 NA
21	2004	1.8 ± 2.8	24	1.5	MA30BA	PC+V	0	NA
19	2004	0.1-15	35	1.5 (0.04-3.9)	MA30BA, MA60BM	PC (n = 8), intact (n = 26) }	45.7	1.7
20	2004	0.4 ± 0.3	29	2.8 ± 1.3	MA30BA, MA60BM, SA30AL, SA60AT	PC+V	37.9	0.4 y
22	2004	5.2 ± 5.0	103	2.3 ± 0.9	MA30BA	≤2 y: PC+V > 2 y: intact PC PC+V	8.1 27.7 7 0	1.3 2.0 2.7 NA
18	2004	6.5 (3-12)	42	1.1 (0.5-1.5)	MA30BA, MA60MB	PC (n = 25) PC (n = 13) (6 OC); PC+V (n = 4)	16 0	(0.5-1.0) NA
23	2005	Median 7.6 (3.3-15.3)	66	—	SA30AL	PC (n = 28)	68	ND
27	2006	6.0 ± 3 (2-15)	134	2.6 ± 0.6	SA30AL	PC+V (n = 38) 2-6 y: PC 6-15 y: intact	20.6 9.1 14.7	ND 2.6 2.4
25	2006	7.4 ± 2.4	23	0.1-2.5	MA30BA	Intact	17.4	2
26	2006	Median 0.92	22	1-1.5	SA30AL	PC+V	50	ND
29	2007	0.9-13	29	—	SA60AT	PC+V (n = 4), intact (n = 34)	26	ND
		0.9-15	38		SN60AT	PC+V (n = 2), intact (n = 27)	31	ND

IOL = intraocular lens; N = study size; NA = not applicable; ND = no data; PC = posterior capsulectomy; Ref = reference; V = vitrectomy; vis sig PCO = visually significant posterior capsule opacification

*Age was given as a group; n = 85, including 35 heparin-surface-modified poly(methyl methacrylate)

We reviewed the literature on hydrophobic acrylic IOL implantation in eyes operated on for pediatric cataract. Variations in age at surgery, surgical technique, and associated ocular pathology made it difficult to directly compare studies. However, we sought to document the current trends and practice recommendations for the use of hydrophobic acrylic IOLs in children.

INTRAOPERATIVE PERFORMANCE

Historically, one of the most commonly cited reasons surgeons were less enthusiastic about the use of IOLs in children was the surgical trauma related to the difficulty of implanting an IOL into a small eye. With the availability of foldable IOLs, pediatric surgeons finally had biocompatible IOLs that could be inserted in small eyes less traumatically and through a smaller incision. Rowe et al.¹⁹ report that primary implantation of 3-piece AcrySof IOLs in pediatric eyes was associated with fewer perioperative complications than primary implantation of rigid PMMA IOLs ($P < .05$). One-piece AcrySof IOLs can be easily inserted into small capsular bags and are even more suitable for children based on the implantation characteristics of the IOL.⁴ Extremely flexible haptics, combined with excellent memory, make the IOL unfold very slowly and adapt to any size capsular bag while retaining enough memory after placement to resist deformation and equatorial lens capsule fibrosis. Bowman et al.³⁰ recently reported that hydrophobic acrylic IOLs were more likely than PMMA IOLs to be fixated in the bag.

POSTOPERATIVE OUTCOMES

Visual Axis Opacification

Posterior capsule opacification is inevitable in the very young child after cataract surgery if the posterior capsule is left intact. Even after primary posterior capsulectomy and vitrectomy, eyes operated on during the first year of life are predisposed to develop reopacification of the visual axis. The incidence of PCO (posterior capsule intact) or visual axis opacification (VAO) (after primary posterior capsulectomy) is a common postoperative outcome measure of pediatric cataract surgery. Table 1 shows a review of the literature on the incidence and characteristics of PCO or VAO.

Wilson et al.³ reported the outcomes in 110 pediatric eyes that received hydrophobic acrylic IOLs and 120 pediatric eyes that received PMMA IOLs. The neodymium:YAG (Nd:YAG) laser capsulotomy rate was 45.4% in the acrylic IOL group and 50% in the PMMA IOL group in eyes with an intact posterior capsule. The mean time from surgery to Nd:YAG posterior capsulotomy was 1.6 years in the acrylic IOL

group and 1.5 years in the PMMA IOL group. No patient with an acrylic IOL needed more than 1 Nd:YAG capsulotomy. Five patients with a PMMA IOL needed multiple Nd:YAG laser treatments for recurrent opacification. The mean age at surgery was higher in eyes with PMMA IOLs than in eyes with acrylic IOLs (6 years versus 5 years) ($P = .051$). Eyes in early infancy and those with ocular anomalies may have been more likely to receive an acrylic IOL than a PMMA IOL. Eyes with ocular anomalies are at a higher risk for VAO. Being a historical control, eyes with PMMA IOLs had a longer mean follow-up (2.6 years) than eyes with acrylic IOLs (1.2 years) ($P < .001$).

Kugelberg and Zetterström⁹ found that some eyes with a heparin-surface-modified PMMA IOL (809C, Pharmacia & Upjohn) developed VAO even though surgery was performed with an anterior vitrectomy. In contrast, all eyes in the acrylic IOL group received a vitrectomy and remained clear.

Ram et al.¹⁵ report that 2 eyes with an acrylic IOL and 3 with a PMMA IOL developed VAO in a vitrectomy group ($P > .05$). Of 16 eyes with an intact posterior capsule, 12 (75%) with a hydrophobic acrylic IOL and 13 (81%) with a PMMA IOL developed PCO ($P > .05$). The authors evaluated only PCO and did not mention how many eyes required secondary intervention (surgical or Nd:YAG laser). There was a significant delay in the development of PCO in the acrylic group compared with the PMMA group ($P < .05$). Ten of 13 eyes with PCO and a PMMA IOL developed fibrotic opacification. However, 12 of 12 eyes in the hydrophobic acrylic IOL group developed proliferative Elschnig pearl opacification. Proliferative VAO progresses more slowly, is less visually significant, and requires secondary intervention less often.²²

In a retrospective study, Kuchle et al.¹³ compared the outcomes of PMMA IOL and hydrophobic acrylic IOL implantation in children. The age at surgery was not significantly different between the 2 groups ($P = .84$), although the follow-up was significantly longer in the PMMA group ($P = .03$). Primary anterior vitrectomy was performed in 7 (35%) of 20 eyes in the PMMA group and 3 (30%) of 10 eyes in the acrylic group. There were significantly fewer complications in the acrylic group (2 versus 20) ($P = .007$). For early complications (postoperative fibrin, synechias), the difference was also significant (1 in acrylic group, 11 in PMMA group) ($P = .02$). In eyes with an intact posterior capsule, the rate of PCO requiring an Nd:YAG capsulotomy was 1 of 6 in the acrylic group and 7 of 12 in the PMMA group ($P > .05$). The mean time from surgery to Nd:YAG capsulotomy was 1.8 years in the acrylic group and 1.6 years in the PMMA group.

In a series by Rowe et al.,¹⁹ Nd:YAG laser rates were similar between PMMA IOLs and hydrophobic acrylic

IOLs ($P > .05$). However, the posterior capsule was intact in more eyes with an acrylic IOL than eyes with a PMMA IOL (76% versus 32%). The mean time to surgical intervention was 2.5 years (95% confidence interval [CI], 1.8 to 3.2) in the PMMA group and 1.7 years (95% CI, 1 to 2.3 years) in the acrylic group (log rank test 1.53, $P = .22$).

Aasuri et al.²⁵ compared the inpatient incidence of PCO in children with bilateral cataract after implantation of a 3-piece AcrySof IOL in 1 eye and a PMMA IOL in the fellow eye. Forty-six eyes of 23 patients aged 5 to 15 years (mean 7.4 years) were followed. The incidence of clinically significant PCO was 21% in the acrylic IOL group and 75% in the PMMA IOL group ($P = .002$), with a median onset of 2.9 months and 0.7 months postoperatively, respectively. Neodymium:YAG laser capsulotomy was performed in 4 (17.4%) of 23 eyes with an AcrySof IOL and 7 (30.4%) of 23 eyes with a PMMA IOL. The mean "survival" time to Nd:YAG laser capsulotomy was 2 years in the acrylic IOL group and 1 year in the PMMA IOL group ($P = .005$, log rank test).

The published literature suggests that when the posterior capsule is left intact, pediatric eyes with a hydrophobic acrylic IOL have a similar or less frequent PCO rate than eyes with a PMMA IOL. However, VAO after acrylic IOL implantation with an intact posterior capsule is more "proliferative" than the "fibrous" reaction commonly seen in conjunction with the PMMA IOLs. Posterior capsule opacification is generally delayed in eyes with a hydrophobic acrylic IOL compared with eyes with a PMMA IOL. After a primary posterior capsulectomy and an anterior vitrectomy, VAO is rare in older children with an acrylic IOL. When it does occur, it is usually in a patient operated on in the first year of life.

When infants have implantation of an acrylic or PMMA IOL, VAO is common even when posterior capsulectomy and vitrectomy are performed. The literature reports an average VAO rate of 44.0%; however, it ranges from 8.1% when all children younger than 2 years are included to 80% when all children younger than 6 months are included.^{11,20,22,26} Secondary VAO in eyes that have IOL implantation in infancy tends to occur within the first 6 months after cataract surgery²⁰; the mean interval to the procedure was 4.8 months (Kaplan-Meier survival analysis). Thus, including patients with longer follow-ups will not likely change the incidence of VAO in the eyes of infants. Trivedi et al.²⁰ found that the relative risk for subsequent VAO surgery was 2.7 times greater after primary surgery performed at or before the first 6 months of life than after surgery performed when the child was 6 months or older. Opacification was significantly related to associated ocular anomalies (eg, anterior

segment dysgenesis, iris hypoplasia, or persistent fetal vasculature), with a relative risk of 8.6.

In children older than 2 years at the time of cataract surgery, the secondary VAO rate after primary posterior capsulectomy and vitrectomy varies from 0% to 20.6%, with a mean of 5.1% (Table 1). In older children, some authors prefer to perform posterior capsulorhexis without vitrectomy. The mean rate of secondary intervention in these eyes was 13.8% (range 0% to 68%) (Table 1). Kugelberg and Zetterström⁹ found that in children younger than 7 years with a hydrophobic acrylic IOL, the rate of VAO was significantly lower in those who had an anterior vitrectomy at the time of cataract surgery than in those who had not ($P < .05$). In children older than 7 years in the acrylic IOL group, there was no difference in the VAO frequency between the vitrectomy group and no-vitrectomy group ($P > .05$). Trivedi and Wilson⁴ report that none of the 25 eyes that had surgery at or after 18 months of age required a second surgery after posterior capsulectomy and vitrectomy and implantation of a 1-piece AcrySof IOL. Nihalani and Vasavada²⁷ report that in 2- to 6-year-old children, 6 (9.1%) of 20 eyes required a secondary procedure after implantation of 1-piece AcrySof IOLs (with primary posterior capsulectomy, but no vitrectomy). This figure is slightly higher than the 7% Vasavada et al.²² reported after 3-piece AcrySof IOL implantation. However, a difference in age may explain this marginal difference in the secondary VAO rate.

Studies report PCO rates in eyes with an intact posterior capsule ranging from 14.7% to 100% (mean 25.1%, excluding eyes with 100% PCO in children younger than 4 years). Some studies did not specify the duration of follow-up. With longer follow-up, even in older children, the mean Nd:YAG laser capsulotomy rate may be higher than the 25.1% noted here. Again, these publications are not all comparable in terms of selection criteria and duration of follow-up. Vasavada et al.²² found that in eyes with an intact posterior capsule, PCO occurred in 10 of the 15 whose age at surgery was greater than 8 years and in 21 of 22 eyes whose age at surgery was 2 to 8 years ($P = .01$). Nihalani and Vasavada²⁷ report that in children older than 6 years with an intact posterior capsule, 14.7% required a secondary procedure for PCO. This figure is lower than the 27.7% Nd:YAG capsulotomy rate with 3-piece AcrySof IOL reported by Vasavada et al.²² However, a difference in age selection may explain this difference.

In a prospective randomized clinical trial, Vasavada et al.²² found that of 31 eyes with a hydrophobic acrylic IOL that developed opacification, 21 (67.7%) had proliferative PCO, 9 (29.0%) had mixed PCO, and 1 (3.2%) had fibrous PCO. The mean age of those

developing proliferative PCO was significantly higher than that of those developing mixed PCO (proliferative and fibrous) (8.2 ± 3.6 years and 5.2 ± 3.0 years, respectively) ($P = .03$). The proliferative type of PCO is probably less amblyogenic than the fibrous type. As previously noted, PMMA IOLs in children have been associated with predominantly fibrous PCO.²²

Wilson et al.³ report that no eye with a hydrophobic acrylic IOL required more than 1 Nd:YAG capsulotomy. Vasavada et al.²² report that the opacification recurred in 2 eyes; 1 had a repeat Nd:YAG capsulotomy, and 1 had intraocular surgery to clear the visual axis. In a study by Stager et al.,¹² PCO recurred after Nd:YAG capsulotomy in 4 (15%) of 26 eyes with an acrylic IOL.

Stager et al.²⁸ evaluated the effectiveness of Nd:YAG laser capsulotomy for the treatment of PCO in 73 eyes with an acrylic IOL. Fifty-one eyes (70%) maintained a clear visual axis after a single Nd:YAG procedure, 10 eyes (84% cumulative) after 2 Nd:YAG procedures, and 3 eyes (88% cumulative) after 3 Nd:YAG procedures. Six eyes (8%) required pars plana membrane removal to clear the visual axis. The probability of maintaining a clear central visual axis after 24 months with a single Nd:YAG capsulotomy was 35% in children younger than 24 months and 74% in older children.

Uveal Biocompatibility

Fibrinous uveitis has been reported in the early postoperative period in eyes having pediatric cataract surgery. In a study by Kuchle et al.,¹³ postoperative fibrin formation was less frequent in eyes with an acrylic IOL (1 of 10) than in eyes with a PMMA IOL (9 of 20). Aasuri et al.²⁵ report increased uveal inflammation in 6 (26.1%) of 23 eyes with a PMMA IOL and in no eye with an acrylic IOL. Presumed noninfectious endophthalmitis occurred in 8.7% eyes in the PMMA IOL group and no eye in the AcrySof IOL group.

Deposits on the surface of an IOL optic are often seen in the postoperative period in children. Assessment of the type and amount of deposits helps us understand uveal biocompatibility. Wilson et al.³ found IOL deposits on 6.4% (7 of 110) of hydrophobic acrylic IOLs and 21.7% (26 of 120) of PMMA IOLs. Other studies of hydrophobic acrylic IOLs report the incidence of deposits as 25%,¹⁴ 35.9%,²² and 24.1%.²⁰ The incidence of deposits was significantly higher in younger age groups (age at surgery younger than 2 years) than in older age groups ($P < .04$).²²

Younger age at the time of cataract surgery increases the risk for synechia formation. Wilson et al.³ found posterior synechias in 5 (4.5%) of 110 eyes with a hydrophobic acrylic IOL and 23 (19.2%) of 120 eyes with a PMMA IOL. In an evaluation of 1-piece AcrySof

IOLs in children, Trivedi and Wilson⁴ found synechias in 5 eyes (11.9%). None produced enough corectopia to cause a noticeable cosmetic deformity. Kuchle et al.¹³ report posterior synechia formation in no eye in the hydrophobic acrylic IOL group and in 6 of 20 eyes in the PMMA group. Vasavada et al.²² found posterior synechias in 14 eyes (13.6%); all except 1 were operated on during the first 2 years of life. The incidence of synechia formation was significantly higher in children who had surgery before 2 years of age than in older children ($P < .001$). Of eyes with a 1-piece AcrySof IOL, synechias developed in 31% that had surgery in the first year of life and 3% that had surgery between 2 years and 6 years of age; no child older than 6 years developed synechias.^{20,27}

Glistenings

Müllner-Eidenböck et al.¹⁴ report visually insignificant glistenings in 2 eyes of 1 pediatric patient with an AcrySof IOL. The glistenings were noted 1 week after implantation. They increased during the first 2 postoperative years and then remained stable until the last follow-up at 40 months. No other cases of AcrySof IOL glistenings in pediatric patients have been reported.

Intraocular Lens Centration

Excessive capsule fibrosis and asymmetric IOL fixation are the most common causes of IOL decentration. In a series of 42 1-piece AcrySof IOL implantations in children, Trivedi and Wilson⁴ found that all eyes maintained a clinically centered IOL. Vasavada et al.²² report that 103 eyes in their series had well-centered hydrophobic acrylic IOLs. Trivedi et al.²⁰ found mild clinically insignificant decentration of a hydrophobic acrylic IOL in 2 (6.9%) of 29 eyes operated on for cataract during the first year of life. Nihalani and Vasavada²⁷ report mild IOL decentration in 1 eye with a hydrophobic acrylic sulcus-fixated IOL.

Cystoid Macular Edema

Using modern techniques and technologies, pediatric cataract surgery does not predispose the child to an increased risk for cystoid macular edema (CME). Two articles report that fundus examination did not reveal CME in any eye after pediatric cataract surgery and hydrophobic acrylic IOL implantation.^{9,21}

Ocular Hypertension and Glaucoma

Complex microphthalmia predisposes an infant to glaucoma after cataract surgery. The onset of aphakic glaucoma is documented from very early after surgery to many years later. In a multicenter retrospective review, Asrani et al.³¹ found a lower incidence (0.3%;

1/377) of open-angle glaucoma in eyes having primary IOL implantation than in eyes that remained aphakic (11.3%; 14/124) after cataract surgery. Recently, Trivedi et al.³² reported postoperative glaucoma in 3.8% (10/266) of eyes with IOL implantation and 17.0% (8/47) of aphakic eyes. However, in patients who had surgery during the first 4.5 months of life, the glaucoma incidence was 24.4% (10/41) in eyes with IOL implantation and 19.0% (8/42) in aphakic eyes ($P = .55$). The results in the study suggest that an IOL does not protect against the development of glaucoma.³² Eyes with congenital cataract that require surgery early in life are at higher risk for the development of glaucoma with or without an IOL. Eyes with childhood cataracts that develop after infancy are usually not microphthalmic, almost always have IOL implantation, and are at very low risk for glaucoma. Because the eyes at highest risk for glaucoma are also those most likely to be left aphakic, IOL implantation may falsely appear to protect against glaucoma.

Astigmatism

Bowman et al.³⁰ found that eyes with hydrophobic acrylic IOLs were less likely than eyes with PMMA IOLs to have more than 3.0 diopters of astigmatism (odds ratio, 2.5; 95% CI, 1.04-6.06).

Visual Acuity

In a series of 67 eyes, Wilson et al.³ found that 48 had 20/40 or better best corrected visual acuity (BCVA) at the last follow-up and 63 (94%) had 20/100 or better BCVA. Müllner-Eidenböck et al.¹⁴ report a BCVA of 20/25 in 78% of eyes with bilateral cataracts operated on at 2 to 6 years of age, 45% with unilateral cataract operated on at 2 to 6 years of age, and 61% with bilateral cataract operated on between 6 years and 16 years of age. Visual deficits in both series were most often related to residual amblyopia.

SPECIAL SITUATIONS

Secondary Intraocular Lens Implantation

Secondary implantation of an IOL is generally recommended when traditional spectacle or contact lens correction of aphakia is unsuccessful. Crnic et al.¹⁷ recently reported the use of foldable acrylic IOLs for secondary implantation in children. Complications included IOL decentration in 3 eyes (5%), wound leak in 3 (5%), secondary membrane formation in 5 (9%), and pupillary block glaucoma in 1 (2%). In a study of the outcomes of secondary IOL implantation in children, 30 with an acrylic IOL, Trivedi et al.²⁴ found clinically significant decentration requiring surgical intervention only in eyes with sulcus-fixed foldable IOLs (28.6%; 4/14). Eyes with an axial

length of more than 23.0 mm were 4 times more likely than eyes with an axial length of less than 23.0 mm to develop decentration if they had a sulcus-fixed foldable IOL ($P = .03$). In larger eyes, PMMA IOLs stayed centered when placed in the sulcus. Secondary in-the-bag fixation of foldable IOLs is associated with a low rate of complications and is recommended. This can be accomplished in eyes with a Soemmering's ring by dissecting open the capsule and cleaning the lens material from the Soemmering's ring, as reported by Trivedi et al.²⁴ and Wilson et al.³³

Developing World Setting

Implantation of an IOL during cataract surgery in the developing world seems to be a practical option, while contact lenses are less suitable in most of these settings. In many developing countries, the use of high-quality, inexpensive PMMA IOLs has been associated with good outcomes in children.³⁴ The major disadvantage of implantation of hydrophobic acrylic foldable IOLs in children in the developing world is cost. In addition, the limited availability of modern ophthalmic viscosurgical devices (OVDs) in many locations makes implantation of acrylic IOLs in the capsular bag in small eyes more difficult. However, in the developing world setting, in which hydrophobic acrylic IOLs are available and are implanted using modern OVDs, outcomes improve, as they have in the industrialized world.

SUMMARY

1. Hydrophobic acrylic IOLs have improved the intraoperative performance of pediatric cataract surgery. These hydrophobic acrylic IOLs not only allow easier and safer implantation in small (even microphthalmic) pediatric eyes, they also help the surgeon consistently achieve the desired in-the-bag fixation in these eyes.
2. We recommend hydrophobic acrylic IOL implantation in children. Implantation is usually combined with a posterior capsulectomy and an anterior vitrectomy from infancy until the age of 5 years.^{16,22} In children older than an infant, combined posterior capsulectomy, vitrectomy, and hydrophobic acrylic IOL implantation avoids the need for a secondary intervention in most eyes.
3. In the eyes of infants, VAO is much more common when an IOL of any type is implanted than in cases of primary aphakia, even when a posterior capsulectomy and an anterior vitrectomy are performed. Surgical removal of VAO is usually uncomplicated and rarely has to be repeated.
4. In pediatric eyes with an intact posterior capsule, PCO develops in most eyes, even those with

hydrophobic acrylic IOLs. However, some studies document a delay in PCO development in eyes with hydrophobic acrylic IOLs compared with eyes with PMMA IOLs. This delay may allow the child to reach an age at which he or she can cooperate during an Nd:YAG laser capsulotomy in the office. Also, during the amblyopic ages, any delay in the onset or progression of PCO may be beneficial. In children, proliferative PCO is more common with hydrophobic acrylic IOLs than with PMMA IOLs, with which fibrous PCO is more common.

5. Patients having cataract surgery during early infancy are at high risk for the development of glaucoma with or without IOL implantation. Children who have surgery and IOL implantation later in childhood are at a much lower risk for glaucoma.
6. Finally, an IOL implanted in a child's eye must remain there for several decades, perhaps 70 years or more, without biodegrading. To date, hydrophobic acrylic IOLs have been found to be efficacious in providing good short-term to intermediate-term results after implantation in pediatric cataract surgery. Longer-term outcomes will continue to be evaluated.

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