

Surgical Technique and Postoperative Complications in Pediatric Cataract Surgery: Retrospective Analysis of 21 Cases

Ivanka Petric, Valentina Lacmanović Lončar

Eye Clinic, Sisters of Mercy University Hospital, Zagreb, Croatia

Aim. To evaluate postoperative complications of different surgical techniques for cataract treatment in children.

Methods. We reviewed clinical records of 21 children (33 eyes) who underwent cataract surgery between January 1998 and December 2002. The median age of children at the time of cataract surgery was 39 months (range, 4-115 months). The median follow up was 26 months (range, 6-58 months). A posterior continuous curvilinear capsulorhexis with anterior vitrectomy was performed in 24 eyes, and posterior continuous curvilinear capsulorhexis without anterior vitrectomy in 9 eyes (children older than 7 years). Nine eyes were left aphakic and intraocular lens was implanted in 24 eyes.

Results. Opacification of the visual axis was the most frequent complication. One of nine eyes in the group of children undergoing posterior continuous curvilinear capsulorhexis developed posterior capsule opacification. This also occurred in 6 out of 24 eyes with posterior continuous curvilinear capsulorhexis and anterior vitrectomy. In 5 eyes with secondary opacification Nd:YAG laser capsulotomy was performed as a secondary procedure. In uncooperative children (2 eyes) more extensive anterior vitrectomy was repeated. Other postoperative complications included aphakic glaucoma (n=1), synechia formation (n=4), intraocular lens deposits (n=2), and pupil capture (n=1).

Conclusions. The main complication in the pediatric cataract surgery was posterior capsule opacification, and the management of posterior capsule seems to be a very important factor. In younger children, cataract surgery with posterior capsulorhexis and anterior vitrectomy was advantageous, whereas in older children a clear visual axis was achieved without vitrectomy.

Key words: capsulorhexis; cataract; cataract extraction; child;; complications; infant; vitrectomy

Pediatric cataract presents the major preventable cause of visual impairment and blindness in childhood (1). The estimated incidence of cataract in infancy has been as high as 6 per 10,000 infants (2). In a young child, a cataract blurs the image received by the retina, and disrupts the development of the visual pathways in the central nervous system (2). Since normal sight cannot develop without visual stimulation, cataract, if left untreated, can lead to blindness. Calculated in blind years, cataract is the fourth leading cause of blindness in the world (3). Therefore, it presents an important pediatric, ophthalmologic, economic, psychological, and social problem.

A cataract can have varying degrees of density. The cataract that interferes with normal visual development (dense cataract or cataract in the central visual axis) requires early surgery, whereas patients who have punctate opacities with intervening clear zones often develop good visual acuity without surgery (4).

The management of pediatric cataract requires an early detection, an adequate surgical procedure, a

method of aphakic correction that is easy to comply with, and aggressive amblyopia therapy. Pediatric aphakia can be corrected by the use of spectacles (5), contact lenses (5), epikeratophakia (6), and an intraocular lens (7). Less than a decade ago, the use of intraocular lenses in children was considered dangerous and radical. Primary intraocular lens implantation is the treatment of choice for children older than 2 years (1,2). Implantation of intraocular lens in infancy is still being questioned. A higher reoperation rate and an uncertain visual benefit from the primary intraocular lens implantation have made contact lenses commonly used in the first year of life (2,8,9).

Optimal surgical treatment of the pediatric cataract requires a procedure that will provide a clear optical axis. In young children, clouding of the visual axis occurs at a critical period in their visual development and the major concern is amblyopia. The visual axis may be obstructed by posterior capsule opacification, inflammatory membranes, thickening and opacification of the hyaloid face, and proliferation of the lens epithelial cells (10). Leaving the posterior

capsule intact in children predisposes to an unacceptably high rate of capsule opacification (11-13). Many surgical maneuvers and tools have been used to minimize or eliminate visual axis opacification. Removal of the posterior capsule, ie, posterior continuous curvilinear capsulorhexis with anterior vitrectomy, has been the gold standard in the treatment of children. Long-term complications such as retinal detachment and cystoid macular edema after anterior vitrectomy have not been studied extensively. Many surgeons do not perform anterior vitrectomy in older children (12-15).

We evaluated postoperative complications in children who had cataract surgery with and without anterior vitrectomy. In children younger than 7 years, we performed cataract surgery using posterior continuous curvilinear capsulorhexis with anterior vitrectomy, whereas in children older than 7 years we performed posterior continuous curvilinear capsulorhexis without vitrectomy.

Patients and Methods

Patients

Between 1998 and 2002, 11 boys and 10 girls (33 eyes) were surgically treated for congenital cataract at Department of Ophthalmology, Sisters of Mercy University Hospital. Eyes with a traumatic cataract or ocular abnormality (e.g., microphthalmos, coloboma, glaucoma, and uveal inflammation) were excluded from the study. Median age of the children was 30 months (range, 4-115 months). Complete ocular examination and slit lamp biomicroscopy were performed in all cases. In young or uncooperative children, the ocular examination was performed under general anesthesia. Nine eyes were left aphakic because of the patient age (1-2 years) and in 24 eyes intraocular lens was implanted. In 16 eyes an AcrySof® MA30BA foldable acrylic intraocular lens (Alcon, Forth Worth, TX, USA) was implanted, and in 8 eyes, a heparin-surface-modified poly(methyl methacrylate) (HSM PMMA) intraocular lens 809C (Pharmacia & Upjohn, Upsala, Sweden). The median age at the time of cataract surgery of 11 boys and 10 girls was 39 months (range, 4-115 months). The median follow up was 26 months (range, 6-58 months).

Surgical Technique

All operations were performed by a single surgeon (ZM). General anesthesia was used in all patients. The initial approach was a 3.2-mm scleral tunnel 2 mm posterior to the limbus. Sodium hyaluronate 1.4% (Healon GV[®], Pharmacia & Upjohn) was injected into the anterior chamber, and anterior capsulorhexis was performed by using the diathermy unit (ERBE Dicaputom, Tübingen, Germany). The size of anterior capsulorhexis was between 4.5 and 5.0 mm. Cortical hydrodissection was performed by injecting fluid between the capsule and cortex. Lens material was aspirated with irrigation/aspiration mode of phacoemulsifier. The capsular bag was then filled with a viscoelastic material Healon GV[®] and a posterior continuous curvilinear capsulorhexis was performed with or without anterior vitrectomy. Posterior continuous curvilinear capsulorhexis was created with a diathermy needle in all eyes, and the size of posterior capsulorhexis was between 3.5 and 4.0 mm. Anterior vitrectomy was not performed in children older than 7 years. Nine eyes were left aphakic (without intraocular lens implantation). In 24 eyes, intraocular lens was implanted (AcrySof or HSM PMMA intraocular lens) in the capsular bag and the incision was widened to 5.0 mm for HSM PMMA intraocular lens. The scleral incision was closed by 10.0 nylon sutures.

All patients received 2 mg subconjunctival dexamethasone at the end of surgery.

Postoperative Evaluation

Postoperatively, all patients received topical dexamethasone 8 times a day tapered over 2 months, and cyclopentolate 1% once a day for 2 weeks. Postoperative examinations were

performed at the Sisters of Mercy University Hospital. Patients were followed daily for 2 days postoperatively, once a week for the next 4 weeks, every 2 months for 6 months, and later every 6 months.

Ocular examination and slit lamp biomicroscopy were done in all cases. Fundus examination by direct and indirect ophthalmoscopy was used in young children to ensure clarity of the visual axis. In younger children and in the suspected presence of any postoperative complication, an examination with an operating microscope under general anesthesia was performed. All postoperative complications were noted (posterior capsule opacification, glaucoma, synechia formation, and intraocular lens deposits).

In cooperative children with posterior capsule opacification, neodymium:YAG (Nd:YAG) laser capsulotomy was performed. In young or uncooperative children, surgical procedure (repeated anterior vitrectomy and membranectomy) was done under general anesthesia.

Statistical Analysis

Data were presented as median with range. Differences between age groups were tested by the Mann-Whitney U-test. Statistical significance level was set at $p < 0.001$. The difference in the most frequent postoperative complication (posterior capsule opacification) was tested with the Fisher's exact test.

Results

Demographic Characteristics

The cataracts were bilateral in 12 children and unilateral in 9 children. A posterior continuous curvilinear capsulorhexis with anterior vitrectomy was performed in 24 eyes (Fig. 1), and posterior continuous curvilinear capsulorhexis without anterior vitrectomy in 9 eyes. In children aged 4-16 months (median, 12 months), ie, 11 eyes, an intraocular lens was not implanted (aphakia). In 22 eyes, an intraocular lens was implanted (pseudophakia) in the capsular bag (Acry Sof or HSM PMMA intraocular lens); median age of these children at cataract surgery was 47 months (range, 15-115).

The median age at cataract surgery (Table 1) in the group of children undergoing only capsulorhexis was 82 months (range, 34-115), and in group undergoing anterior vitrectomy it was 18 months (range, 4-55). There was statistically significant difference in age between these two groups ($p < 0.001$).



Figure 1. Clear visual axis (arrow) in an 8-year-old child with posterior curvilinear capsulorhexis and without anterior vitrectomy.

Table 1. Demographic and clinical characteristic of 21 children (33 eyes) surgically treated for congenital cataract at the Sisters of Mercy University Hospital, Zagreb, 1998-2002

Characteristic	No. of patients with posterior continuous curvilinear capsulorhexis	
	without anterior vitrectomy (n=9)	with anterior vitrectomy (n=24)
Male/female	3/6	14/10
Unilateral/bilateral	1/8	8/16
Age at surgery (months; median, range)	82 (34-115)	18 (4-55)
Implantation of intraocular lens	9	13
Follow up (months; median, range)	26 (8-58)	25 (6-52)

Table 2. Postoperative complications in children after cataract surgery

Complications	No. of patients with posterior continuous curvilinear capsulorhexis	
	without anterior vitrectomy (n=9)	with anterior vitrectomy (n=24)
Posterior capsule opacification	1	6
Glaucoma	0	1
Synechiae formation	1	3
Deposits on intraocular lens	0	2
Pupil capture	0	1

Postoperative Complications

Posterior capsule opacification was the most frequent complication (Table 2). One out of 9 eyes in children that had posterior capsulorhexis without vitrectomy developed posterior capsule opacification, compared with 6 out of 24 eyes in children with anterior vitrectomy. There was no statistically significant difference in the incidence of posterior capsule opacification between these two groups ($p=0.642$). In cooperative children (5 eyes) with posterior capsule opacification Nd:YAG capsulotomy was performed as a secondary procedure, and in one case the procedure was repeated. In 2 out of 24 eyes a more extensive anterior vitrectomy was repeated and capsulorhexis with vitrectomy performed. Aphakic glaucoma developed in one eye 8 months postoperatively. Synechia formation was detected in one out of 9 eyes with posterior capsulorhexis and without



Figure 2. Pupil capture (arrow) in a pseudophakic eye of a 4-year-old child, who underwent posterior capsulorhexis and anterior vitrectomy 2 years after surgery.

vitrectomy, and in 3 out of 24 eyes with posterior capsulorhexis and anterior vitrectomy. In one pseudophakic eye that had posterior capsulorhexis and anterior vitrectomy, a pupil capture occurred (Fig. 2). Giant inflammatory cell deposits were detected in 2 eyes, one with an implanted HSM PMMA (Fig. 3) and one with AcrySof intraocular lens. We found no post-operative complications attributed to the anterior vitrectomy, such as retinal detachment and cystoid macular edema.

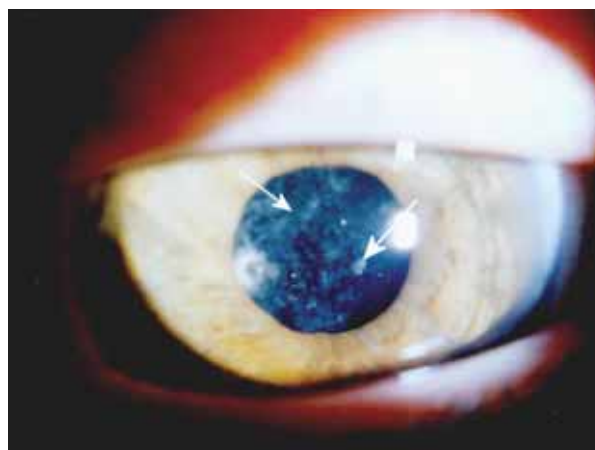


Figure 3. Giant inflammatory cell deposits (arrows) in a 3.5-year-old child with an implanted intraocular lens, posterior capsulorhexis, and anterior vitrectomy.

Discussion

Our results showed that posterior capsule opacification was the major complication of the pediatric cataract surgery. It developed in one out of 9 eyes where posterior capsulorhexis with no vitrectomy was done, and children were older than 7 years. In 6 out of 24 eyes, posterior capsule opacification developed although the surgery was performed with anterior vitrectomy. Despite improvements in surgical techniques, children that undergo cataract surgery still have a high incidence of posterior capsule opacification. Due to the shallow anterior vitrectomy, lens epithelial cells grew over the anterior vitreous face. Additionally, more aggressive anterior vitrectomy was performed. The extent of the vitrectomy, as well as the size of capsulorhexis may be associated with the proliferation of lens epithelial cells. Higher incidence of posterior capsule opacification in this group may be explained with significantly younger age of patients, where lens epithelial cells show more aggressive behavior. As this was a retrospective study, the amount of anterior vitrectomy could not be analyzed.

Posterior synechias occurred in 4 eyes in our series, and deposits on anterior intraocular lens surface (giant cells) in 2 eyes. Higher incidence of uveal inflammatory reaction was noted in the group with posterior capsule opacification and vitrectomy, which can be attributed to the age of our patients. This group was significantly younger, and immature trabecular meshwork with decreased fibrinolytic activity as well

as breakdown of the blood aqueous barrier might be associated with a higher inflammatory reaction.

There are different opinions on the management of the posterior capsule during pediatric cataract surgery. The reported incidence of posterior capsular opacification when the posterior capsule is left intact is 43.5-100% (11-17). Primary posterior capsulorhexis alone does not guarantee a permanently clear visual axis because anterior surface of the vitreous serves as a scaffold for the lens epithelial cells to migrate into the pupillary axis. Also, children capsule is highly elastic, allowing us to use diathermy as the technique for performing controlled anterior and posterior continuous curvilinear capsulorhexes. All capsules in our series were with no radial tears or vitreous herniation.

In younger children, anterior vitrectomy with posterior continuous curvilinear capsulorhexis reduces the opacification of the visual axis. However, it is impossible to say exactly at what age anterior vitrectomy should be performed, and many studies report different results. Basti et al (13) performed primary posterior capsulotomy with anterior vitrectomy in children younger than 8 years. Vasavada and Desai (18) suggested that anterior vitrectomy with posterior continuous curvilinear capsulorhexis was desirable in children with congenital cataracts younger than 5 years. In 5 out of 8 eyes in which posterior continuous curvilinear capsulorhexis with no vitrectomy was performed, visual axis was obscured and secondary procedure was needed. Koch and Kohnen (12) reported 20 eyes that underwent various methods of managing the posterior capsule and anterior vitreous. No eye having a posterior continuous curvilinear capsulorhexis with anterior vitrectomy developed visually significant secondary cataract. The study included only children older than 1.5 years (1.5-12 years) and 6 eyes that underwent posterior continuous curvilinear capsulorhexis with anterior vitrectomy. Kugelberg and Zetterström (19) reported secondary cataract formation in 85 eyes undergoing cataract surgery with or without anterior vitrectomy according to age (patients aged 0-15 years). They suggested that cataract surgery with anterior vitrectomy should be performed in younger children. Dahan and Salmenson (20) recommended posterior capsulorhexis and anterior vitrectomy in children younger than 8 years. Fenton and O'Keefe (21) reported an opacification rate of 15.6% after performing posterior capsulorhexis with no anterior vitrectomy over a mean follow up of 19 months.

The reported incidence of open angle glaucoma following pediatric cataract surgery ranges from 3-41% (22-24). The pathogenesis of aphakic glaucoma after pediatric cataract surgery is unknown. Some theories include increased inflammation, residual lens material, and a chemical vitreous component. Aphakic glaucoma presents a long-term complication that requires a longer follow up. Asrani (25) reported a decreased incidence of open angle glaucoma in primary pseudophakic eye, with only a single case of glaucoma among 377 pseudophakic eyes, and 14 eyes with glaucoma among 124 aphakic eyes.

Other postoperative complications, such as inflammatory response, may contribute to visual axis obstruction. Pediatric cataract surgery is associated with a higher incidence of uveal inflammatory reaction. Intense topical steroid and cycloplegics are beneficial in increased reactivity postoperatively, but fibrinoid uveitis may result in the formation of posterior synechias and depositions on the intraocular lens. Vasavada et al (26) reported posterior synechia formation in 34.6% of eyes where posterior capsulorhexis with anterior vitrectomy was done. Zetterström et al (27) reported posterior synechia formation in one eye with implanted HSM PMMA intraocular lens in a series of 21 eyes. Sharma (28) reported the sequelae of uveitis (posterior synechia and intraocular lens deposits) in one-third of the eyes in a study that included traumatic pediatric cataract and implanted PMMA intraocular lens. Satisfactory biocompatibility of AcrySof intraocular lens was reported by Wilson (29), who found intraocular lens deposits and posterior synechias in a very small percentage of patients.

Secondary opacification of a visual axis still remains a major complication of pediatric cataract surgery. A clear visual axis must be maintained to allow vision to develop and to avoid amblyopia. To maintain a clear visual axis, posterior capsulotomy with anterior vitrectomy is needed in younger children, while vitrectomy is not necessary in older children.

Pediatric cataract is an important cause of visual loss. The disease is rare, and large series of patients are hard to obtain. Despite the small number of patients and retrospective design of our study, the results gave us valuable information. The advantage of our study was relatively long follow-up period. However, even longer follow up and a prospective randomized study would be needed to answer many surgical dilemmas, especially the question of the timing of anterior vitrectomy. Thus, the treatment of patients with pediatric cataract still remains a challenge.

References

- 1 Taylor D. The Doyne lecture. Congenital cataract: the history, the nature, and the practice. *Eye*. 1998;12:9-36.
- 2 Lambert SR, Drack AV. Infantile cataracts. *Surv Ophthalmol*. 1996;40:427-58.
- 3 Foster A, Gilbert C, Rahi J. Epidemiology of cataract in childhood: a global perspective. *J Cataract Refract Surg*. 1997;23 Suppl 1:601-4.
- 4 Taylor D, Wright KW, Amaya L, Cassidy L, Nischal K, Russell-Eggitt I, et al. Should we aggressively treat unilateral congenital cataracts? *Br J Ophthalmol*. 2001; 85:1120-6.
- 5 Baker JD. Visual rehabilitation of aphakic children. II. Contact lenses. *Surv Ophthalmol*. 1990;34:366-71.
- 6 Kelley CG, Keates RH, Lembach RG. Epikeratophakia for pediatric aphakia. *Arch Ophthalmol*. 1986;104: 680-2.
- 7 Zwaan J, Mullaney PB, Awad A, al-Mesfer S, Wheeler DT. Pediatric intraocular lens implantation. Surgical results and complications in more than 300 patients. *Ophthalmology*. 1998;105:112-8.
- 8 Lambert SR, Buckley EG, Plager DA, Medow NB, Wilson ME. Unilateral intraocular lens implantation during the first six months of life. *J AAPOS*. 1999;3:344-9.

- 9 Hutchinson AK, Wilson ME, Saunders RA. Outcomes and ocular growth rates after intraocular lens implantation in the first 2 years of life. *J Cataract Refract Surg.* 1998;24:846-52.
- 10 Nishi O. Fibrinous membrane formation on the posterior chamber lens during the early postoperative period. *J Cataract Refract Surg.* 1988;14:73-7.
- 11 BenEzra D, Cohen E. Posterior capsulectomy in pediatric cataract surgery; the necessity of a choice. *Ophthalmology.* 1997;104:2168-74.
- 12 Koch DD, Kohnen T. Retrospective comparison of techniques to prevent secondary cataract formation after posterior chamber intraocular lens implantation in infants and children. *J Cataract Refract Surg.* 1997;23:657-63.
- 13 Basti S, Ravishankar U, Gupta S. Results of a prospective evaluation of three methods of management of pediatric cataracts. *Ophthalmology.* 1996;103:713-20.
- 14 Ram J, Brar GS, Kaushik S, Gupta A, Gupta A. Role of posterior capsulotomy with vitrectomy and intraocular lens design and material in reducing posterior capsule opacification after pediatric cataract surgery. *J Cataract Refract Surg.* 2003;29:1579-84.
- 15 Simons BD, Siatkowski RM, Schiffman JC, Flynn JT, Capo H, Munoz M. Surgical technique, visual outcome, and complications of pediatric intraocular lens implantation. *J Pediatr Ophthalmol Strabismus.* 1999;36:118-24.
- 16 Hosal BM, Biglan AW. Risk factors for secondary membrane formation after removal of pediatric cataract. *J Cataract Refract Surg.* 2002;28:302-9.
- 17 Oliver M, Milstein A, Pollack A. Posterior chamber lens implantation in infants and juveniles. *Eur J Implant Refract Surg.* 1990;2:309-14.
- 18 Vasavada A, Desai J. Primary posterior capsulorhexis with and without anterior vitrectomy in congenital cataracts. *J Cataract Refract Surg.* 1997;23:645-51.
- 19 Kugelberg M, Zetterstrom C. Pediatric cataract surgery with or without anterior vitrectomy. *J Cataract Refract Surg.* 2002;28:1770-3.
- 20 Dahan E, Salmenson BD. Pseudophakia in children: precautions, techniques, and feasibility. *J Cataract Refract Surg.* 1990;16:75-82.
- 21 Fenton S, O'Keefe M. Primary posterior capsulorhexis without anterior vitrectomy in pediatric cataract surgery: longer term outcome. *J Cataract Refract Surg.* 1999;25:763-7.
- 22 Mills MD, Robb RM. Glaucoma following childhood cataract surgery. *J Pediatr Ophthalmol Strabismus.* 1994;31:355-60.
- 23 Parks MM, Johnson DA, Reed GW. Log-term visual results and complications in children with aphakia. A function of cataract type. *Ophthalmology.* 1993;100:826-41.
- 24 Simon JW, Mehta N, Simmons ST, Catalano RA, Lininger LL. Glaucoma after pediatric lensectomy/vitrectomy. *Ophthalmology.* 1991;98:670-4.
- 25 Asrani S, Freedman S, Hasselblad V, Buckley EG, Egbert J, Dahan E, et al. Does primary intraocular lens implantation prevent "aphakic" glaucoma in children? *J AAPOS.* 2000;4:33-9.
- 26 Vasavada AR, Trivedi RH. Role of optic capture in congenital cataract and intraocular lens surgery in children. *J Cataract Refract Surg.* 2000;26:824-31.
- 27 Zetterstrom C, Olivestedt G, Lundvall A. Exfoliation syndrome and heparin surface modified intraocular lenses. *Acta Ophthalmol.* 1992;70:91-5.
- 28 Sharma N, Pushker N, Dada T, Vajpayee RB, Dada VK. Complications of pediatric cataract surgery and intraocular lens implantation. *J Cataract Refract Surg.* 1999;25:1585-8.
- 29 Wilson ME, Elliott L, Johnson B, Peterseim MM, Rah S, Werner L, et al. AcrySof acrylic intraocular lens implantation in children: clinical indications of biocompatibility. *J AAPOS.* 2001;5:377-80.

Received: January 2, 2004.

Accepted: April 15, 2004.

Correspondence to:

Ivanka Petric
Eye Clinic
Sisters of Mercy University Hospital
Vinogradska cesta 29
10000 Zagreb, Croatia
ivankapetric@hotmail.com