A RETROSPECTIVE COMPARISON OF TECHNIQUES TO PREVENT SECONDARY CATARACT FORMATION FOLLOWING POSTERIOR CHAMBER INTRAOCULAR LENS IMPLANTATION IN INFANTS AND CHILDREN*

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ABSTRACT

Purpose: To determine the effect of various methods of managing the posterior capsule and anterior vitreous on the rate of posterior capsular opacification in children implanted with posterior chamber intraocular lenses (PC IOL).

Methods: We reviewed the charts of 20 eyes of 15 children (1.5 - 12 years) who underwent primary cataract surgery with PC IOL in the last 5 years. The posterior capsule and anterior vitreous were managed in a variety of ways: in 5 eyes the posterior capsule was left intact, and 15 eyes underwent posterior continuous curvilinear capsulorhexis (PCCC) - nine cases without and 6 with anterior vitrectomy. In 8 eyes posterior optic capture was performed, 3 with and 5 without vitrectomy. The follow-up ranged from 1 to 4.5 years (mean: 2 years).

Results: Visually significant secondary cataract developed in all 5 eyes with intact posterior capsules and in the 4 eyes that underwent PCCC without vitrectomy and without posterior optic capture (*i.e.*, the optic was left in the capsular bag). The optical axis remained clear in all 6 eyes that underwent PC IOL implantation with vitrectomy (with or without posterior optic capture). Initially, all optic capture cases without vitrectomy also remained clear, but after 6 months 4 out of 5 developed opacification.

Conclusions: In this series posterior capsulorhexis with anterior vitrectomy was the only effective method of preventing or delaying secondary cataract formation in infants and children.

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INTRODUCTION

The implantation of intraocular lenses (IOLs) has become a common method to treat aphakia in children and juveniles.[1-4] A major problem in pediatric IOL implantation is the high incidence of postoperative secondary cataract formation,[5] particularly if the posterior capsule is left intact. To prevent secondary cataract formation at the time of surgery, primary posterior capsulotomy or central capsulectomy,[4,6-9] anterior vitrectomy,[10-13] and optic capture through a posterior continuous curvilinear capsulorhexis (CCC)[14,15] have been investigated. The purpose of this study was to evaluate in pediatric eyes the rate of secondary membrane formation after the use of various techniques to treat the posterior capsule and anterior vitreous face.

PATIENTS AND METHODS

We studied a consecutive series of 20 eyes of 15 children who underwent primary cataract surgery with posterior chamber intraocular lens (PC IOL) implantation at the Cullen Eye Institute, Houston, Texas, between 1990 and 1995. Eighteen cataracts were congenital, 1 was traumatic, and 1 was postinflammatory. The mean age of the patients at the time of surgery was 6.1 years (range, 1.5 to 12 years); 8 were male and 7 were female. The follow-up period varied from 1 to 4.5 years (mean, 2 years).

All operations were performed by the same surgeon (D.D.K.). General anesthesia was used in all cases. Following superior conjunctival peritomy and cautery to obtain hemostasis, a scleral tunnel incision was made. A 5- to 5.5-mm groove was fashioned approximately 1 mm posterior to the limbus and was tunneled into clear cornea. Through a stab incision at the 2-o'clock position, the aqueous humor was exchanged with Healon GV (Kabi Pharmacia Ophthalmics, Inc, Monrovia, Calif), and the anterior chamber was entered through the superior wound using either a 2.5- or 3.0-mm keratome. An initial opening in the anterior capsule was made by using a cystotome, and anterior CCC and multilamellar hydrodissection were performed. Using the phacoemulsification handpiece, the nuclear material was removed primarily with the aspiration mode of the phacoemulsification machine. In 2 eyes of 1 patient, there was a mature cataract, and at the time of the initial capsular opening, the nucleus was noted to be completely liquefied. Therefore, a 26-gauge angled cannula was inserted, and the nuclear material was aspirated, after which the anterior capsulorhexis was completed using Utrata forceps. In all cases, the cortical material was aspirated with an automated irrigation/aspiration handpiece. If necessary, additional hydrodissection was performed to mobilize subincisional cortex.

In all 20 cases, a 5.5-mm optic, one-piece PMMA ((polymethyl methacrylate) IOL was implanted. The posterior capsule and IOL implantation were managed in a variety of ways:

INTACT POSTERIOR CAPSULE

The anterior chamber and the capsular bag were reinflated with Healon GV, the incision was enlarged to 5.5 mm, and the IOL was implanted into the capsular bag.

POSTERIOR CONTINUOUS CURVILINEAR CAPSULORHEXIS

The anterior chamber and the capsular bag were reinflated with Healon GV, and a bent needle was used to puncture the central posterior capsule. The viscoelastic agent was instilled between the posterior capsule and the anterior vitreous space. The posterior capsular flap was grasped with the Utrata forceps, and posterior CCC measuring 4 to 5.5 mm in diameter was performed. The IOL was then inserted into the capsular bag.

ANTERIOR VITRECTOMY

After completing a 4- to 5.5-mm posterior CCC, a moderate anterior vitrectomy was performed through the limbal incision. Irrigation was provided with an infusion cannula in the paracentesis incision. The anterior chamber was swept with an iris spatula to ensure that no vitreous was present anterior to the iris. The incision was enlarged to 5.5 mm, and the IOL was placed into the capsular bag.

OPTIC CAPTURE

Following posterior CCC and IOL implantation between the anterior and posterior capsular flaps, the IOL optic was pushed posteriorly with a Sinskey hook to allow optic placement or "capture" behind the posterior capsule (Fig 1). With this maneuver, the anterior and posterior capsular leaflets are brought together, except where the IOL haptics are sandwiched between them.

In all cases, the residual viscoelastic substance was removed by using the automated irrigation/aspiration handpiece, the wound was closed with interrupted 10-0 nylon sutures, 0.01% carbachol was instilled, and the anterior chamber was checked for additional vitreous strands, which were removed if necessary. The conjunctival peritomy was closed over the wound with light cautery. At the conclusion of the procedure, the eye was dressed with antibiotic/dexamethasone ointment and a light-pressure patch and shield. Further postoperative treatment included cyclopentolate drops twice daily and antibiotic drops 4 times a day for 1 week, and corticosteroid drops 4 times a day initially and then tapered over 8 weeks.

Routine postoperative examinations were performed at 1 day; 1 and 3

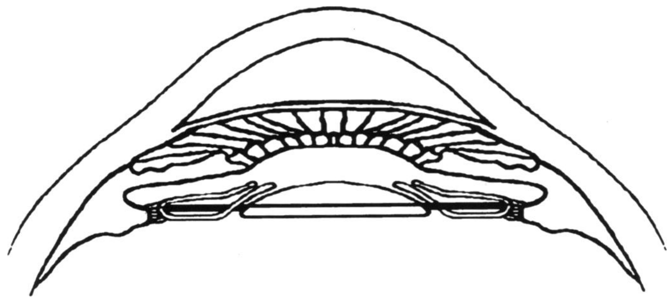


FIGURE 1
Schematic illustration of anterior segment following cataract extraction, posterior capsulorhexis, and implantation of a posterior chamber IOL with posterior optic capture. (Used with permission of the *German Journal of Ophthalmology*)

weeks; and 2, 6, 12, 18, and 24 months following surgery. Refraction, measurement of uncorrected and best-corrected visual acuity, slit-lamp biomicroscopy, and indirect ophthalmoscopy were performed at each visit. The decision to perform neodymium:YAG (Nd:YAG) laser surgery was based on postoperative reduction in best-corrected visual acuity accompanied by slit-lamp biomicroscopic evidence of visually significant secondary membrane formation.

RESULTS

Visually significant secondary cataract developed in all but 1 eye that did not undergo anterior vitrectomy (Figs 2 and 3). All 5 eyes with intact posterior capsules developed opacified posterior capsules. In 4 of these eyes (patient ages, 5, 5 [both eyes], and 6 years), the first Nd:YAG laser treatment had to be performed at a mean postoperative interval of 6 months (range, 3 to 9 months). In 3 of these 4 eyes, a second Nd:YAG laser treatment to clear the visual axis had to be performed within 9 months of the first procedure. The fourth patient in this group, a 11-year-old boy, underwent laser treatment 1.5 years following IOL implantation.

In all 4 eyes that underwent posterior CCC without vitrectomy and without posterior optic capture (ie, the optic was left in the capsular bag), Nd:YAG for visually significant opacification was performed within 1 year (in 1 patient at 3 months, in 2 patients at 6 months, and in 1 patient at 1 year).

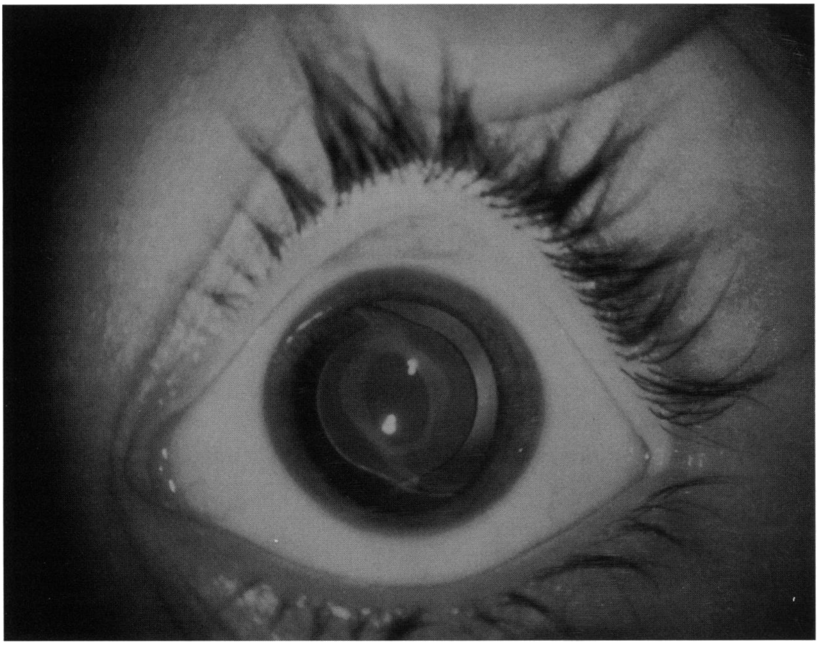


FIGURE 2

Retroillumination photograph of eye of 3-year-old child 4 months following implantation of one-piece PMMA 5.5-mm-optic intraocular lens with posterior optic capture. Note clear central visual axis and ring-shaped opacification at central edge of fused anterior and posterior capsules. (Used with permission of the *German Journal of Ophthalmology*)

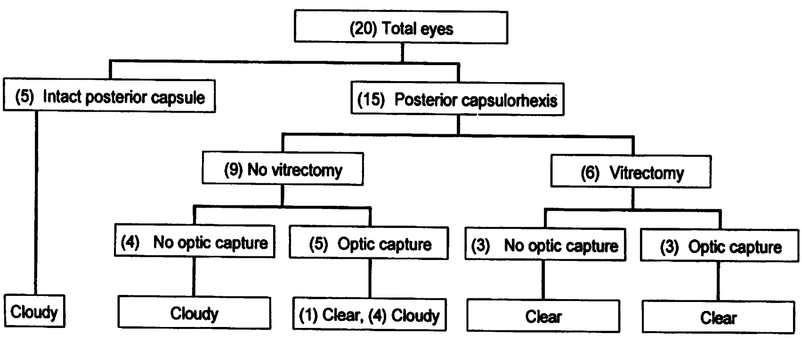


FIGURE 3

Flow diagram of secondary cataract formation following posterior chamber intraocular lens implantation in 20 eyes of 15 pediatric patients. (Number of the patients per treatment is given in brackets.)

Four of the 5 eyes that underwent optic capture without vitrectomy developed secondary cataracts. Three of the patients required Nd:YAG laser after 9 months, 2 years, and 2.5 years. In the fourth patient, opacification was noted by 6 months postoperatively; by 9 months opacification anterior to the PC IOL surface was also present (Fig 4). Using the Nd:YAG laser, both the anterior and posterior opacifications were opened without complications. The fifth patient required a lysis of posterior synechiae after 1.5 years, and at this time the optical axis was clear.

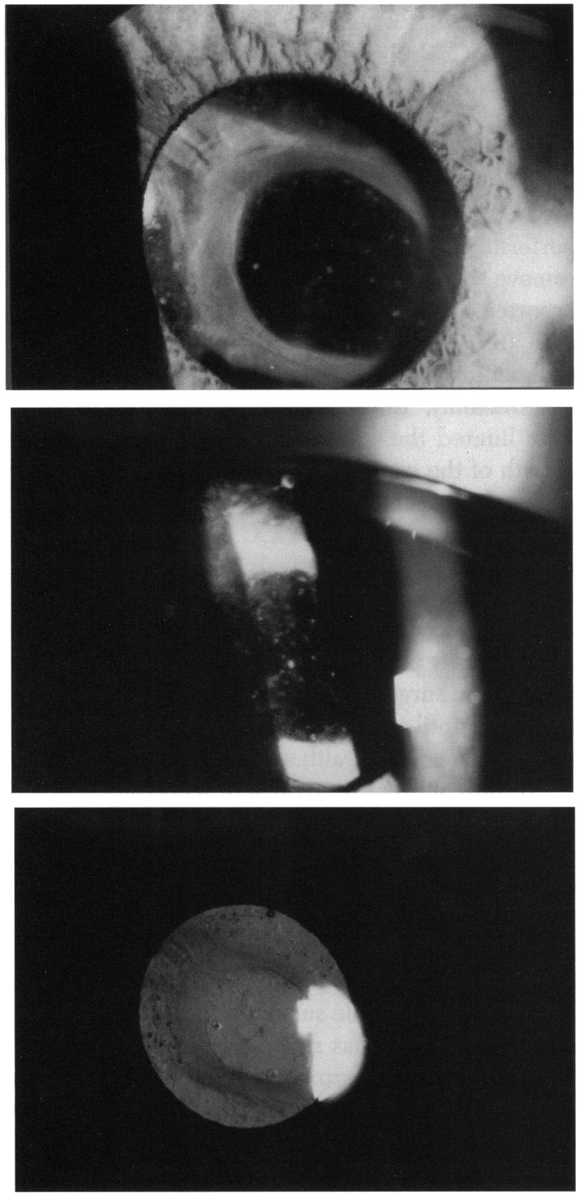
The optical axis remained clear in all 6 eyes that underwent PC IOL implantation with anterior vitrectomy (with or without posterior optic capture).

DISCUSSION

The implantation of IOLs in children was pioneered by Binkhorst[16] and Hiles.[6] Despite dramatic advances in surgical techniques and lens designs, secondary cataract formation remains a major complication of cataract extraction and IOL implantation in children.[5]

It is evident that leaving the posterior capsule intact following lens implantation in the capsular bag predisposes to an unacceptably high incidence of secondary cataract formation.[12] Hiles reported a 70% incidence of this complication following PC IOL in children under age 6.[17] Oliver and associates[18] found an opacification rate of 44% in infants and juveniles in the first 3 months following in-the-bag IOL implantation with an intact posterior capsule. Gimbel[7] estimated that the cumulative probability of requiring Nd:YAG capsulotomy in children with IOL implantation and intact posterior capsules was 17% after 1 year, 42% after 2 years, and 59% after 4 years. In our series, all 5 eyes with intact posterior capsules required Nd:YAG laser capsulotomies within 18 months of initial surgery, and 3 eyes required a second laser treatment within 9 months of the first one. Our limited experience therefore confirms that in children, intact posterior capsules rapidly opacify, and children under age 6 often require more than one Nd:YAG laser treatment.

Several approaches to prevent or delay secondary cataract formation have been studied. Some investigators have advocated opening the posterior capsule during initial cataract extraction. The posterior capsule can be opened in a variety of ways, including linear incision with a bent needle or posterior CCC.[4,7-9] The posterior capsule can also be opened with a vitrectomy cutting device, but this must be combined with an anterior vitrectomy.[10-13,19] Vasavada and Chauhan[8] reported that secondary cataracts developed within 1 year in all 8 eyes that underwent posterior CCC without vitrectomy. However, Zetterstrom and associates[9] reported clear visual axes in 20 of 21 eyes followed for 4 to 16 months after undergoing



A

B

C

FIGURE 4

Slit-lamp photographs of left eye of 12-year-old girl 9 months after PC IOL implantation with posterior optic capture: (A) overview, (B) oblique slit illumination, and (C) retroillumination. There is opacification of anterior and posterior IOL surfaces.

implantation of a heparin-surface-modified IOL in conjunction with posterior CCC. Unfortunately, in our series, the 4 eyes (patient ages, 3, 4, 12, and 12) managed with posterior CCC without vitrectomy or optic capture required laser treatment within the first year postoperatively. One patient (age 3 at time of initial surgery) required 2 subsequent laser procedures 6 and 12 months following the first laser treatment.

A second approach for preventing secondary cataract formation is to perform a posterior capsulotomy followed by an anterior vitrectomy to remove the vitreous scaffold for lens epithelial migration.[10-13] Of 213 eyes reported in 4 studies, secondary cataract formation occurred in only 13 eyes (6%). Spierer[20] also reported 2 eyes that developed secondary cataract formation after central 3-mm posterior capsulectomy and anterior vitrectomy. In these eyes, the small size of the capsular opening might have limited the extent of the anterior vitrectomy and facilitated overgrowth of the opening by the proliferation of lens epithelial cells. In our series, the visual axes have remained clear in the patients who underwent a 4- to 5.5-mm posterior CCC and moderately aggressive anterior vitrectomy. Thus far in our patients, there have been no complications attributable to the vitrectomy. Keech and associates[11] reported 1 retinal detachment that occurred after lensectomy and anterior vitrectomy followed 2 years later by pars plana vitrectomy for vitreous hemorrhage; it is unclear if the initial surgery predisposed to the detachment. Obviously, long-term follow-up until adulthood is required to fully understand the impact of vitrectomy on ocular health and development.

A third alternative to prevent secondary opacification is Gimbel's technique of optic capture of the IOL optic through the posterior capsular opening.[14,15,21] With this technique, the anterior and posterior capsular leaflets can fuse for almost 360°, except where they surround the haptic at the haptic-optic junction (Fig 1). Theoretically, this capsular fusion anterior to the IOL optic might diminish central lens epithelial cell migration or at least direct cell movement anteriorly over the lens optic, which is presumably an unsuitable substrate for lens cell survival.

While Gimbel has reported that this approach has nearly eliminated secondary cataract formation in his patients (Howard Gimbel, MD, personal communication), we noted secondary cataract formation in 4 of 5 eyes treated with this technique without concurrent anterior vitrectomy. Posterior optic capture leaves a gap between the anterior and posterior capsules where the haptic enters the capsular bag. In 1 of our patients, we noted that the initial growth of the lens epithelial cells emanated from this gap with linear spread of cells across the vitreous face along the axis of the haptics. The ability of this approach to prevent secondary cataract formation may depend upon the IOL design. Gimbel used a one-piece PMMA IOL with a 90° angulation between the haptic and optic, whereas the lens in our patients had an oblique haptic-optic junction. We suspect that the optimal IOL design for this technique should have the haptics exit from the anterior margin of the IOL edge; this would permit the posterior region of the optic edge to protrude below the portion of the posterior capsule that surrounds the haptic, enabling the optic edge to mechanically block posterior migration of lens epithelial cells.

Posterior optic capture is a somewhat technically challenging procedure, primarily owing to the difficulty of performing posterior CCC. However, we have found posterior CCC to be slightly easier than capsulorhexis of the anterior capsule in young eyes. The posterior capsule is less rubbery and resistant to tearing than the anterior capsule and in these respects is more similar to the adult anterior capsule than is the infant's anterior capsule. To ensure permanent optic capture, the diameter of the posterior capsulorhexis opening must be at least 1 mm smaller than the IOL optic.

One advantage of optic capture is that, with a well-centered posterior CCC, IOL centration can be enhanced. In one of our cases, the anterior capsulorhexis was markedly eccentric, and IOL centration was improved following optic capture through a well-centered posterior CCC. Conversely, a decentered posterior CCC could cause IOL decentration. Another potential disadvantage of optic capture is greater difficulty in performing IOL exchange, should this be required at a later date to manage anisometropia or a lens-related complication.

Posterior optic capture is best performed after creation of an intact posterior CCC. In one of our patients, a spontaneous small central opening of the posterior capsule was noted after nucleus aspiration. The central posterior capsulectomy was therefore made with the vitrector. Posterior optic capture was performed, but during aspiration of the viscoelastic agent, a large posterior capsular tear occurred, resulting in sudden IOL subluxation. Fortunately, the lens was safely repositioned in the capsular bag and has remained well centered with 2 years of follow-up. The posterior capsular rupture was presumably due to the discontinuous capsular edge produced by the vitrectomy cutter, although underlying posterior capsular fragility might also have predisposed to this problem.

In 3 of our patients, we performed combined anterior vitrectomy and posterior optic capture. The visual axis remained clear in these patients. We suspect that there is little long-term benefit of this approach compared with anterior vitrectomy alone, unless the optic capture is used to stabilize or enhance centration of the IOL.

In conclusion, we found that to prevent secondary cataract formation following PC IOL implantation in infants and children, central posterior capsulectomy and anterior vitrectomy are required. Certainly, further studies of this technique and others with careful long-term follow-up are required.

REFERENCES

1. Brady KM, Atkinson CS, Kilty LA, et al. Cataract surgery and intraocular lens implantation in children. *Am J Ophthalmol* 1995;120:1-9.
2. Lambert SR, Drack AV. Infantile cataracts. *Sur Ophthalmol* 1996;40:427-458.
3. Wilson ME. Intraocular lens implantation: Has it become the standard of care for children? *Ophthalmology* 1996;103:1719-1720.
4. Kohnen T, Eisenmann D, Jacobi KW. Funktionelle Ergebnisse nach Intraokularlinsenimplantation bei 92 Kindern und Jugendlichen (Functional results following intraocular lens implantation in 92 children and juveniles). In: Robert YC, Gloor B, Hartmann C, et al, eds. 7. Kongress der Deutschsprachigen Gesellschaft für Intraokularlinsen implantation. Berlin: springer, 1992:11-16
5. Apple DJ, Solomon KD, Tetz RM, et al. Posterior capsule opacification. *Surv Ophthalmol* 1992;37:73-116.
6. Hiles DA. Intraocular lens implantation in children with monocular cataracts: 1974-1983. *Ophthalmology* 1984;91:123-127.
7. Gimbel HV, Ferensowicz M, Raanan M, et al. Implantation in children. *J Pediatr Ophthalmol Strabismus* 1993;30:69-72.
8. Vasavada A, Chauhan H. Intraocular lens implantation in infants with congenital cataracts. *J Cataract Refract Surg* 1994;20:592-598.
9. Zetterström C, Kugelberg U, Oscarson C. Cataract surgery in children with capsulorhexis of anterior and posterior capsules and heparin-modified intraocular lenses. *J Cataract Refract Surg* 1994;20:599-601.
10. Mackool R, Chatiawala H. Pediatric cataract surgery and intraocular lens implantation: A new technique for preventing or excising postoperative secondary membranes. *J Cataract Refract Surg* 1991;17:62-66.
11. Keech RV, Tongue AC, Scott WE. Complications after surgery for congenital and infantile cataracts. *Am J Ophthalmol* 1989;108:136-141.
12. Buckley EG, Klombers LA, Seaber JH, et al. Management of posterior capsule during pediatric intraocular lens implantation. *Am J Ophthalmol* 1993;115:722-728.
13. Basti S, Ravishankar U, Gupta S. Results of a prospective evaluation of three methods of management of pediatric cataracts. *Ophthalmology* 1996;103:713-720.
14. Gimbel HV, DeBroff BM: Posterior capsulorhexis with optic capture: Maintaining a clear visual axis after pediatric cataract surgery. *J Cataract Refract Surg* 1994;20:658-664.
15. Gimbel HV. Posterior capsulorhexis with optic capture in pediatric cataract and intraocular lens surgery. *Ophthalmology* 1996;103:1871-1875.
16. Binkhorst C, Gobin M. Treatment of congenital and juvenile cataract with intraocular lens implants (pseudophakoi). *Br J Ophthalmol* 1970;54:759-765.
17. Hiles D, Hered R. Modern intraocular lens implants in children with new age limitations. *J Cataract Refract Surg* 1987;13:493-497.
18. Oliver M, Milstein A, Polack A. Posterior chamber implantation in infants and juveniles. *Eur J Implant Ref Surg* 1990;2:309-314.
19. BenEzra D. The surgical approach to pediatric cataract. *Eur J Implant Ref Surg* 1990;2:241-244.
20. Spierer A, Desatnik H, Blumenthal M. Secondary cataract in infants after extracapsular cataract extraction and anterior vitrectomy. *Ophthalmic Surg* 1992;23:625-627.
21. Kohnen T, Peract in infants afte. Secondary cataract formation following pediatric intraocular lens implantation: Six-months results. *Ger J Ophthalmol* 1996;5:171-175.

DISCUSSION

B. BATEMAN, MD. I thank the program committee for the opportunity to discuss this fine project. Drs Koch and Kohnen kindly sent me the manuscript well in advance of this meeting. They are addressing a serious problem associated with cataract surgery in children. Early in the evolution of pediatric cataract surgery, the technique was manual irrigation and aspiration, which produced tremendous inflammation; control of inflammation was the major issue facing the surgeon. In the late 1970s and early 1980s, mechanical cutting devices greatly decreased the inflammatory process, and management of the posterior capsule, the topic of this study, became the issue. Solutions remain controversial. Drs Koch and Kohnen studied different methods for managing the posterior capsule and assessed the development of visually-significant secondary cataracts.

The authors found that visually significant opacities developed in all of the 5 eyes with intact posterior capsules within 18 months; similarly, such opacities developed in all eyes that underwent posterior continuous curvilinear capsulorhexis without either vitrectomy or posterior optic capture within 1 year. If posterior optic capture was performed, the outcome was slightly better, with 2 of the 5 eyes maintaining an open visual axis for 2 years. Anterior vitrectomy resulted in clear optical axes in all for the duration of the study.

The advantages of this study include the following: All surgeries were performed by an experienced cataract surgeon, the follow-up period was reasonable, Dr Koch used "tried and true" adult methodology, and the cases were consecutive. As with all studies, there are disadvantages. The study is retrospective and the small number of cases precludes meaningful statistical analyses. The authors have included more than one eye of a single patient, and it appears that there was no randomization of technique for management of vitreous. The analyses are complicated by the fact that some of the patients are infants and may experience sufficient growth of the eye to alter the refractive error. Finally, the authors used a phacoemulsification machine, which is unusual among pediatric ophthalmologists, and comparisons of series may be akin to apples and oranges.

What can we conclude from this study? The authors take the position that opacification of the posterior capsule is undesirable. If we assume that one-stop cataract surgery is the goal, I suspect that the usefulness of the traditional method of anterior vitrectomy as presented in this study would withstand statistical analyses. However, this relatively short-term advantage may not stand the test of time, since the long-term risk benefit ratio of anterior vitrectomy in infants and children has not been established.

I conclude with several questions for Drs Kohnen and Koch. Were you consistently able to dissect the posterior capsule from the anterior vitreous with viscoelastic material? And in those patients with opacification following optic capture, where was the opacification? How many of the subjects were under 3 years of age? For the ethicists in the crowd, how does one approach an informed consent for intraocular lenses in children? Who reaps the greatest benefit of this procedure—the child or the parents?

I congratulate the authors on a fine study and appreciate the opportunity to participate in this discussion.

SUSAN DAY, MD. Thank you. Actually, I just want to get into the record book. I hope that maybe this is the first time there have been back-to-back women discussants.

I would like to congratulate Dr Koch on a fine paper and admit to you that this was really a set-up. Bronwyn mentioned that she was going to ask about the ethical issues related to this topic. And, so, I think that it does deserve to get addressed and there is no better place than AOS where you have multi-discipline sub-specialists all concerned about their patients, who can appreciate that ethical dilemmas are created as out technology expands.

What this does, the issue of intraocular lenses in infants and children, is change the doctor-patient relationship, trianguling into the patient, the parent, and the physician relationship. It asks the physician, in particular, to be a patient advocate for the infant. It asks that we be technically competent surgeons in a realm that may not be in the usual realm of a pediatric surgeon. It expects us to be able to communicate well with the patient's parents and to be very aware of vision development in the patient. So, we have to know a lot.

In addition to the triangulation of the basic relationships, we have 3 ethical issues we must think about: 1) surrogacy, where the basic tenets of autonomy and beneficence are now abrogated to the parent; 2) informed consent, where we have to be very truthful to say that we do not know what may happen 7 years or 70 years later; we do not know whether intraocular lenses have an advantage or disadvantage over extended duration with contact lenses and; 3) finally, we need, on a very basic level, to recall learning curve issues. What are we competent to do in our role in managing this type of patient? Who should be doing the surgery? How is amblyopia best prevented?

RICHARD LINDSTROM, MD. Congratulation doctor. I have a couple of questions. I use the exact same technique that you do; although, I do not do the optic capture in my patients and I also find opacification without posterior capsulectomy and anterior vitrectomy is nearly 100% in patients under the age of 5. The question I have is in how young a patient will you implant a lens, and are you still going to do optic capture or are you going to stop, and why? Another controversy is should the vitrectomy be via the anterior or posterior approach. Many think that we should be doing this through the pars plana. Are you comfortable with the anterior approach and why? I was just at a meeting in Italy and Robert Stegman, MD was there presenting results in the same category. There is a very large series in South Africa of traumatic unilateral cataracts in children. He frequently operates on very young patients. For a long time he did posterior capsulectomy and anterior vitrectomy, and he has been in practice now for a little over 20 years. He claimed that he had a relatively high incidence of retinal detachment in the patients that he did subtotal vitrectomy on 10 years or so postoperative. So the question is, if we do anterior vitrectomies in our adult patients, we may see macular edema or retinal detachment. Have you seen any macular edema or retinal detachments in the children you have operated? That is the thing that concerns me about doing this. I think that this is an excellent approach if those risks are not significant. Thank you.

KEN WRIGHT, MD. For years I have had trouble with posterior capsular opacification. For the past 3 years, I have been purposely removing cells from the anterior lens capsule. I feel that we have had less fibrosis since we have been removing these cells. I now do this routinely, and I find that the YAG capsulotomy, which is usually necessary, is much easier to perform, and we do not get secondary membranes. Thank you.

WILLIAM TASMAN, MD. I would like to congratulate Dr Kohnen for a fine paper. I just have a comment. Another group of patients that have a similar problem are the adult ROP patients. More and more of them now develop a cataract in their early 30's and sometimes their 40's. Almost invariably, their capsules opacify rapidly and require YAG laser capsulotomy which brings me to my question. I have been under pressure from our pediatric ophthalmology department to obtain the YAG that can be used in the OR so that some of these youngsters can undergo a YAG laser and we have done that. I wondered if you feel there is a role for YAG laser in pseudophakic children?

DOUGLAS D. KOCH, MD. I appreciate all of the excellent comments that have been made. I certainly concur with Dr Bateman's description of the limitations of our study. With regard to comparing techniques using phacoemulsifiers versus vitrectomy units, I do not think that this will produce different results. We use the phaco machine simply to aspirate the lens material and then use a vitrectomy cutter to perform the vitrectomy. I doubt that this difference will prevent different investigators from comparing data.

I think that it is interesting that the posterior capsule can be readily dissected from the vitreous face. I believe that this is because the size of the posterior capsulorhexis is under 5-5.5 mm, which keeps it within Wieger's ligament, where there is no vitreous attached to the posterior capsule. Dr Green informs me that this is Berger's space. Thank you Dr Green.

The opacification that occurred with posterior optic capture typically began along the axis of the haptics, ultimately spreading to produce opacification of the entire vitreous face.

Dr Bateman asked the number of patients below age 3, and I think it was 4, but I would have to check our numbers.

What I tended to do in my series was to leave the capsule intact in those older children in whom I knew I could perform an Nd:YAG laser posterior capsulotomy. We tended to treat the younger children more aggressively with regard to management of the vitreous. All of our patients are implanted under an IRB protocol using a special consent form, and we spend a great deal of time with the parents on informed consent. Having said that, I believe that intraocular lens implantation in children as young as 2, and maybe even younger, is becoming accepted standard practice. Also, I would point out that every time we implant an intraocular lens in someone who is under age 60, we are using an approved device - an IOL - for a non-approved indication. Because of the way IOL studies have been conducted in the U.S. under FDA auspices, all IOLs are approved for implantation only in individuals age 60 and older.

You asked me who receives the greatest benefit: the parents or the child? I believe that the child does. I think that if you implant an IOL safely in a child, you can restore and rehabilitate vision more rapidly, as long as you maintain a clear visual axis.

Dr Lindstrom asked the youngest patient in whom I would implant an intraocular lens. To date, my youngest patient is 1 year, 5 months. I think that I would implant a leng in a child as young as 1 year, but it would depend entirely on how the surgery went. If the surgery went smoothly with no complications, I would feel comfortable implanting a lens. It would also depend to a great extend upon my discussion with the parents and observations of the child to assess the likelihood of the child's ability to wear a contact lens postoperatively. Below age 18 months, you are getting into the time of rapid refractive change. This would lead one to leave the child more hyperopic, but eventually the child will become quite myopic, so this is a somewhat tougher choice from the standpoint of lens selection.

Currently, my preferred method for preventing posterior capsular opacification is to perform a vitrectomy. I am not doing optic capture at this time because of the problem that we have had with opacification. There are some excellent pediatric ophthalmologists who advocate performing a pars plana vitrectomy thorugh an incision 2-2.5 mm posterior to the limbus. Pars plana vitrectomy is the approach that I prefer in adults, but I have not yet undertaken this in children. However, it certainly makes sense, and it might relate to Dr Tasman's concern and your concern about the risk of retinal detachment and the need for long-term follow-up. If you operate through the pars plana, you can perform a more complete vitrectomy and reduce adhesions between the vitreous and posterior capsule. We produce inflammation in these young eyes. Does this inflammation cause more adhesion of the vitreous to the posterior capsular surface and thereby predispose to retinal detachment as the eye grows? If so, a pars plana vitrectomy might be more protective.

We do perform posterior capsulotomies with the Nd:YAG laser in young children. Whenever possible, this is performed with the child awake. If the child is uncooperative, we use general anesthesia with endotracheal intubation, supporting the child in an upright position in the anesthesiologist's arms or lap. Someone from the audience mentioned the availability of an Nd:YAG laser for performing capsulotomies with the patient in a supine position. That is correct, with the Lasag Microruptor 3, one can perform the laser posterior capsulotomy with the patient lying down. Unfortunately, I believe it is a $100,000 unit, so our approach has been to hold the child in an upright position or, preferably, avoid the need for laser capsulotomy by performing the anterior vitrectomy.

Again, I thank everyone for their excellent comments and questions.