Secondary intraocular lens implantation following infantile cataract surgery: intraoperative indications, postoperative outcomes

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Abstract

Purpose The purpose of this study was to determine the long-term complications and outcomes of secondary intraocular lens (IOL) implantation in patients with congenital cataracts.

Patients and Methods The medical records of children operated for secondary IOL implantation surgery between 2000 and 2014 were retrospectively reviewed. Those who had undergone their initial congenital cataract surgery before 7 months of age were included and were analyzed for intra- and postoperative factors and postoperative refractive outcomes. We focused on three complications: visual axis opacification (VAO), glaucoma, and IOL exchange after at least 1 year of follow-up.

Results A total of 49 eyes of 49 patients were analyzed for intraoperative indications. Of those, 37 eyes of 37 patients had at least 1 year of follow-up and were analyzed for postoperative outcomes. The mean age at secondary implantation was 55.2 ± 21.6 months. At secondary implantation, 69.4% of eyes were implanted in the capsular bag, 28.6% in the sulcus, and 2.0% that were angle-supported. There was no significant correlation between the site of secondary IOL implantation and age at implantation ($P = 0.216$). The mean follow-up after implantation was 57.6 ± 33.6 months. The rate of VAO was 5.4%, the rate of glaucoma occurring after secondary implantation was 16.2%, and the rate of IOL exchange was 2.7%. The median visual acuity at final follow-up was 20/40. For patients with unilateral cataracts it was 20/60 and for bilateral patients it was 20/30.

Conclusions The secondary IOL implantation in children is a relatively safe procedure associated with low rates of postoperative complications. Visual outcomes are acceptable and are better for bilateral patients than for unilateral patients. *Eye* (2016) 30, 1182–1186; doi:10.1038/eye.2016.131; published online 1 July 2016

Introduction

The infant aphakia treatment study, a randomized clinical trial comparing contact lens to intraocular lens (IOL) correction of monocular aphakia during infancy, concluded that there was no significant difference between the median visual acuity of operated eyes in children who underwent primary IOL implantation and those left aphakic.^{1,2} However, there were significantly more adverse events and additional intraoperative procedures in the IOL group. When operating on an infant with a unilateral cataract, the authors recommended leaving the eye aphakic.¹ When the child is left aphakic, contact lenses or aphakic spectacles are used and a secondary IOL implantation is planned for later in childhood. It is therefore imperative to analyze the outcomes and complications of secondary IOL implantation. Several studies have previously examined the visual outcomes and complications of secondary IOL implantation, however, they have often been limited by small sample size, short duration of follow-up, or multiple surgeons. We aim to report the rates of complications of secondary IOL implantation in patients who underwent congenital cataract surgery as infants

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and who have at least 1 year of follow-up after secondary IOL implantation. Specifically, we aim to report the long-term visual outcome, rate of visual axis opacification, IOL exchange, and glaucoma in a large number of eyes that were operated by the same surgeon.

Methods

We conducted a retrospective review of the medical records of children who underwent secondary IOL implantation surgery between 2000 and 2014. The study was approved by the Institutional Review Board of the Medical University of South Carolina for Human Research. To assure that all eligible children were identified, a chronological surgery list was cross-referenced with a database search of all children treated for cataract by one of the authors (MEW) at the Medical University of South Carolina. Eyes of children who were <7 months of age at the time of their original cataract surgery, performed by a single surgeon (MEW), were included in the study. Infants were excluded if they had congenital glaucoma, or had retinopathy of prematurity. In bilateral cases, one eye was randomly chosen for inclusion using the random assignment of each eye to either group A or B using 'Research Randomizer' (<https://www.randomizer.org>). We also excluded cases with incomplete details pertaining to cataract extraction or post-implantation follow-up. For examination of post-secondary implantation complications, only eyes with >1 year of follow-up after secondary implantation were included. The main outcomes measured were intraoperative and postoperative complications and visual outcomes at the final follow-up.

Data collection included age at cataract surgery, gender, ethnicity, laterality, type of cataract, corneal diameter, axial length by immersion A-scan (Ellex, Eden Prairie, MN, USA), keratometry (hand-held KM 500 MARCO keratometer, Macro Ophthalmic, Inc., Jacksonville, FL, USA), age at IOL implantation, reason for IOL implantation, IOL power implanted, IOL type implanted, and site of fixation of IOL. We also recorded age at final follow-up, duration of follow-up between secondary implantation and final follow-up, visual acuity at final follow-up, and refraction at final follow-up. Three complications were specifically examined and recorded: VAO, glaucoma, and IOL exchange. VAO was considered present if a note described visually significant after-cataract or proliferation that obscured the visual axis.³ A patient was considered to have secondary glaucoma if an eye had pressures >22 mm Hg at two or more consecutive visits and exhibited associated ocular changes. These include increased optic nerve cupping (increase by 0.2 or more than previous visit or an asymmetric cupping of more than 0.2 in unilateral cases), greater than expected myopic refractive shift, or increased corneal diameter compared with the

most recent visit.⁴ If the patient had increased IOP but no associated ocular changes, we considered this glaucoma suspect. Statistical analysis was performed using *t*-test for continuous variable and *P*<0.05 was considered statistically significant.

Results

Seventy-six eyes of 49 patients were identified that were operated for secondary IOL implantation and underwent cataract surgery at less than 7 months of age. We evaluated 49 eyes of 49 patients (26 girls, 23 boys) for intraoperative data. Of these 49, 37 eyes of 37 patients had at least 1 year of follow-up after their secondary implantation. These 37 eyes were evaluated for post-secondary implantation complications. These patients had their secondary implantations between 2000 and 2014. The mean patient age at cataract extraction was 1.68 ± 1.18 months (range, 0.16–5.39), and the mean patient age at secondary implantation was 4.56 ± 1.80 years (range, 1.00–10.30). The most common age for secondary implantation was between 4 and 6 years of age (Figure 1). We found that 57.1% of 49 eyes had experienced contact lens incompatibility and 42.9% had sufficient normal growth to allow for the parents and the surgeon to mutually agree that it was time for elective implantation.

Details of preoperative parameters are described in Table 1. Thirty (61.2%) were in the capsular bag, 14 (28.6%) were in the sulcus, 4 (8.2%) were piggyback, and 1 (2%) was angle-supported. However, there was no significant correlation between site of secondary IOL implantation and age at implantation (*P*=0.216). We also gathered data concerning the reason for secondary implantation. Twenty-eight (57.1%) of 49 eyes had developed contact lens incompatibility and 21 eyes (42.9%) had elective implantation at an age agreed upon by the parents and the surgeon.

Examination of the postoperative records (Table 2) revealed the complication rates after secondary implantation in 37 eyes. The average age at last follow-up

Figure 1 Mean age at implantation of secondary IOL shown in years. The most common age at implantation was 4–5 years. The least common was 7–8 years.

Table 1 Preoperative parameters

Number of eyes	49
Number of eyes with >1 year follow-up	37
Age at cataract surgery	Mean 1.68 (SD 1.18) months (median 1.38) (range, 0.16–5.39)
Age at implantation	Mean 4.56 (SD 1.80) years (median 4.69) (range, 1.00–10.30)
Gender	26 female 23 male
Ethnicity	41 Caucasian 5 African-American 3 Other
Bilaterality	Yes: 24 patients ^a No: 25 patients
Laterality	OD: 25 OS: 24

Abbreviations: OD, right eye; OS: left eye. ^aTwenty-seven patients were identified with bilateral cataracts. One patient had one visually insignificant cataract, so the eye with the visually significant cataract was chosen. For the other bilateral patients, one eye was randomly selected for inclusion.

was 9.1 ± 2.4 years (range, 4.2–13.5 years). The average duration of follow-up after secondary implantation was 4.8 ± 2.8 years (range, 1.2–10.8 years). Posterior capsule opacification occurred in two (5.4%) eyes. IOL exchange occurred in only one eye (2.7%). A planned sulcus IOL removal occurred in three eyes that had piggyback lenses (8.1%). Because it was planned, this was not considered a complication. Glaucoma occurred in 11 (29.7%) of 37 eyes. Two of these required surgical intervention and nine were managed medically. Three eyes developed glaucoma suspect (8.1%). When analyzed for glaucoma that occurred only after secondary implantation, six eyes (16.2%) had developed glaucoma (four treated medically and two treated surgically) and one eye (2.7%) had developed glaucoma suspect.

The median visual acuity at final follow-up was 20/40. For patients with unilateral cataracts it was 20/60 and for bilateral patients it was 20/30.

Discussion

The average age at secondary IOL implantation was 55.2 ± 21.6 months. This is likely because this is the age that most children enter preschool. Due to the burdensome nature of aphakic spectacles and contact lenses, and because it may give their child a psychological boost not to wear contact lenses or thick aphakic spectacles, many parents choose this time for implantation.

In this study, we examined 37 eyes for postoperative complications. This included the operated eye for unilaterally affected patients and a randomly selected eye from bilaterally affected patients. The results of our study and similar other studies are reported and summarized as weighted means^{4–9} in Table 2. While the precise methods vary between our study and the other reported studies, this table allows for easy comparison of the studies' data concerning secondary IOL implantation. In this study,

VAO occurred in 5.4% ($n = 2$) eyes. In the studies reported in Table 2, the average occurrence of VAO, or secondary membrane formation, was 7.0%. True IOL exchange, due to refractive error, took place in 2.7% ($n = 1$) of eyes in our study. The overall average rate of IOL exchange in all reported studies was 1.8%. IOL explantation took place in three (8.1%) additional eyes in this study. However, these were planned removals of sulcus-fixated piggyback lenses and were not considered complications.

Postoperative glaucoma developed in 16.2% ($n = 6$) of eyes in this study, and postoperative glaucoma suspect developed in 2.7% ($n = 1$) of eyes. Of the eyes that developed glaucoma, 10.8% ($n = 4$) were treated medically and 5.4% ($n = 2$) required surgical intervention. The average rate of postoperative glaucoma was 7.4%. Since these eyes were all originally operated in early infancy, they retained a life-long risk for developing glaucoma.

The average follow-up after secondary implantation varied greatly among the studies. This study had an average follow-up of 57.6 ± 33.6 months. The average follow-up time after secondary implantation for all reported studies was 32.9 months.

In this study, the median visual acuity at final follow-up was 20/40. In unilateral eyes, the median visual acuity at final follow-up was 20/60, and in bilateral eyes was 20/30. These results are comparable to similar studies, including the study by Nihalani and Vanderveen,⁹ which found 50% of eyes to have a BCVA of 20/40 or better, and Shenoy *et al*,⁴ who found 35% of eyes to have a BCVA of 20/40 or better.

A previous study by Wilson *et al*⁸ found that secondary IOLs implanted in the capsular bag are associated with slightly fewer complications than are IOLs implanted in the ciliary sulcus. One of the strengths of this study is that there is a very high rate (69.4%) of implantations in the capsular bag. This may be one reason for the low complication rates observed, and demonstrates the importance of preserving the capsular bag for secondary implantation. However, it

Table 2 Postoperative complications

	Sample size, eyes	Mean age at secondary implantation (months)	Rate of in-the-bag implantation	Rate of sulcus implantation	Rate of IOL exchange	Rate of VAO	Rate of glaucoma, onset after secondary implantation	Mean follow-up after implantation (months)
Cinic and Associates ⁶	55	88.8	0%	100%	Not available	9.00%	11.00%	28
Nihalani and Vanderveen ⁹	50	109.2	52.00%	48.00%	0.00%	0.00%	4.00%	12.3 ± 8.3
Wilson and Associates ⁸	54	61.2 ± 36	61.10%	38.90%	3.20%	6.50%	6.50%	58.8 ± 30
Trivedi and Associates ³	77	93.6 ± 60	18.20%	55.80%	1.30%	5.20%	Not available	32.4 ± 22.8
Shenoy and Associates ⁴	174	73.2 ± 45.6	1.10%	98.90%	Not available	9.80%	5.00%	25.7 ± 25.0
Present study	49	55.2 ± 21.6	69.40%	28.60%	2.70%	5.40%	16.20%	57.6 ± 33.6
Average of all studies	77	73.2	31.10%	71.70%	1.80%	7.00%	7.40%	32.9

Note: the study by Moore *et al.*⁷ was excluded from this comparison because of the lack of post-secondary implantation follow-up data.

does limit the generalizability of the study to other centers where a larger proportion of in-the-bag implantations to sulcus-fixated implantations are performed. Another strength of this study was that the same surgeon operated all eyes. This study was limited by its retrospective nature and at times by incomplete records: eyes that did not have complete data sets for the three outcomes of interest were excluded. In the future, as more patients undergo this operation, this study should be repeated and expanded to include more patients and other postoperative complications. In addition, the age of patients prevented consistent BCVA Snellen measurements. In the future studies, a more standardized method of measuring visual acuity would be beneficial.

Summary

What was known before

- Leaving a child aphakic rather than performing primary IOL implantation is associated with fewer complications.
- Studies have reported postoperative outcomes and preoperative indications of secondary IOL implantation previously, but have had short-term follow-up, or small sample sizes.

What this study adds

- This study adds long-term follow-up data.
- The other aspects that make this study unique include that all eyes were operated by a single surgeon, and there is a high rate of implantations in the capsular bag.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

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