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Original Research

Visual Axis Opacification after Congenital Cataract Surgery and Primary Intraocular Lens Implantation: Comparison of Three Different Lenses

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ABSTRACT

Objective: To evaluate the incidence of visual axis opacification (VAO) in children who underwent pediatric cataract surgery combined with intraocular lens (IOL) implantation.

Methods: We retrospectively evaluated 65 eyes of 49 patients (range 24–96 month) who underwent pediatric cataract surgery between 2006 and 2012. We divided the patients into groups according to the implanted IOL. In group A, an MA60BM hydrophobic; in group B, a Sensar® 40e hydrophobic; and in group C, an Eyecryl® 600 hydrophilic IOL were implanted. Patients in all groups who completed 12 months of follow-up were included in this study. The demographic data, VAO, and postoperative complications were evaluated.

Results: A total of 33 patients had unilateral and 16 had bilateral cataract surgery. The rate of VAO was 10 (45.5%) in Group A; 7 (41.2%) in Group B; and 16 (61.5%) in Group C. We determined no significant difference between the groups in terms of VAO development (p=0.353).

Conclusion: Our results demonstrated that different IOLs cause comparable VAO rates in children undergoing surgery at an older age. Based on these findings, it can be concluded that performing a posterior curvilinear capsulorhexis and anterior vitrectomy are more important than IOL design in preventing after-cataract formation in older children.

Keywords: Congenital cataract surgery, visual axis opacification, intraocular foldable lens

INTRODUCTION

Congenital and developmental cataracts are the most common treatable causes of childhood blindness (1, 2). With improvements in surgical techniques and intraocular lens (IOL) designs, primary implantation of IOLs for rehabilitation has become popular in recent years. However, implanting an IOL to pediatric eyes is still controversial because the eye globe continues to grow, and axial length and refractive values constantly change. Additionally, postoperative complications requiring secondary surgery frequently occur in younger children because of ocular inflammation during the postoperative period (3).

Visual axis opacification (VAO) is a major complication in pediatric cataract surgery. Several surgical techniques, such as posterior continuous curvilinear capsulorhexis (PCCC), anterior vitrectomy (AV), optic capture, and the bag-in-the-lens technique, can prevent this complication. However, these techniques have some limitations that still present a threat to clear visual axis because of excessive immune response and migration of lens epithelial cells (LEC) (4). Most surgeons prefer hydrophobic acrylic IOL for pediatric cataract surgery. Nevertheless, VAO has been performed with all types of IOL material (5). There are very few reports concerning the relationship between different IOLs and VAO in congenital cataract surgery with posterior capsulotomy and AV. We aim to report the VAO incidence in children who underwent cataract surgery with posterior capsulotomy, AV, and primary IOL implantation with three different IOLs.

METHODS

The parents of the children provided written informed consent approval of the ethics committee was received, and the study followed the principles of the Declaration of Helsinki. Our study is a retrospective study of 65 eyes of 49 children aged 24–96 months who underwent congenital and developmental cataract surgery at an older age in our hospital between 2006 and 2012. Preoperatively, all children had complete ophthalmic examination. In younger or uncooperative children, ocular examination was performed under general anesthesia. Eyes that had the poor red reflex were operated. The exclusion criteria were persistent hyperplastic primer vitreous, uveal inflammation or congenital glaucoma, microphthalmos, and coloboma. Children who did not complete 12 months follow-up were excluded from the study.

All surgeries were performed under general anesthesia by a surgeon. A clear 2.8 mm corneal incision was performed at 12 o'clock meridian. Anterior chamber was filled by sodium hyaluronate

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Table 1. Intraocular lenses used in this study

	ALCON AcrySof® MA60BM	**AMO Sensar® 40e**	**BIOTECH Eyecryl® 600**
Material	Hydrophobic Acrylate/ Methacrylate Polymer optic, PMMA haptics (three piece)	Hydrophobic acrylic copolymer optic, PMMA haptics (three piece)	Hydrophilic Acrylic 26% CQ optic and haptic (single piece)
Optic length (mm)	6	6	6
IOL length (mm)	13.0	13.0	12.5
Optic–haptic angle	10°	5°	5°
Refractive index	1.55	1.47	1.46
Optic edge design	Square edge	Square edge	Square edge
Haptic shape	Modified C	Modified C	Optimized C
“A” constant	118.9	118.4	118.0

IOL: intraocular lens

Table 2. Demographic and clinical characteristics of groups

Characteristic	Group A	Group B	Group C	p
IOL	Alcon AcrySof® MA60BM	AMO Sensar® 40e	Biotech Eyecryl® 600	–
Number of eyes/patients	22/17	17/13	26/19	–
Age[a], months Mean+SD Range	40.9±19.9 (24–90)	44.6±21.9 (24–92)	44.7±22.5 (24–96)	0.843[b]
Sex Male/female	9/8	7/6	10/9	0.998[c]
Laterality Unilateral/Bilateral	12/5	9/4	12/7	0.881[c]

[a]: at the time of surgery; [b]: One–way ANOVA test; [c]: Chi–square test; IOL: intraocular lens; SD: standard deviation

(3.0%), and a 4.0–5.0 mm anterior continuous curvilinear capsulorhexis was performed by using a capsulorhexis forceps. After cortical hydrodissection, lens material was aspirated. Then, viscoelastic material (1.4%) was injected into the capsular bag, and a PCCC approximately 3.5 mm was performed followed by AV and foldable IOL implantation into the bag. All incisions were closed by 10.0 nylon suture after intracameral antibiotic injection.

Postoperatively, children received topical steroid and antibiotic drops eight times a day, which were tapered during the first month, and 1% cyclopentolate once a day for the first 4 weeks. Subjects were followed once a week for the next 4 weeks, every 2 months for 6 months, and 12 months after surgery. Direct and indirect ophthalmoscopic ocular examination was performed in all children to determine VAO. In younger or uncooperative children and in the suspected presence of any postoperative complication, an examination using an operating microscope was performed under general anesthesia. Postoperative complications and implanted IOL design were noted.

Based on the three different IOLs implanted, we divided children into three groups. In group A, an Acrysof® MA60BM hydrophobic three-piece IOL; in group B, Sensar® 40e hydrophobic three-piece IOL; and in group C, an Eyecryl® 600 hydrophilic single-piece IOL was implanted in the bag (Table 1).

Statistical Analysis

All data obtained from the study were analyzed using Statistical Package for the Social Sciences version 16 software (SPSS Inc.; Chicago, IL, USA). The one-way ANOVA test and Chi-square test were used to compare data among groups. Statistical significance was taken as p value <0.05.

RESULTS

A total of 65 eyes of 49 patients were included in the study. Among them, 26 (53%) were male and 23 (47%) were female. Patients were aged between 24 and 96 months, and the mean age was 43.40±21.14 months.

A total of 33 children underwent unilateral and 16 children underwent bilateral surgery. Based on the three different IOLs implanted, children were divided into three groups (Table 2).

Group A had 22 eyes, and VAO developed in 10 (45.5%) of them. Out of 17 eyes in group B, VAO developed in 7 (41.2%) of them. Group C had 26 eyes, and 16 (61.5%) of them developed VAO. The VAO rate was higher in group C than in the other groups (Table 3), but statistically significant difference was not found among the groups (p=0.353).

We observed fibrin reaction in two eyes in group A, two eyes in group B, and four eyes in group C. Two eyes in group C devel-

Table 3. Rate of complications in groups

	No(%)			
Complications	**Group A**	**Group B**	**Group C**	**p**[a]
After–cataract formation	10 (45.5)	7 (41.2)	16 (61.5)	0.353
Fibrin reaction	2 (9.1)	2 (11.7)	4 (15.4)	0.801
IOL decentration	1 (4.5)	0 (0)	2 (7.7)	0.501
Secondary glaucoma	1 (4.5)	1 (5.8)	2 (7.7)	0.902

[a]: Chi–square test; IOL: intraocular lens

oped IOL decentration. One eye in group A, one eye in group B, and two eyes in group C developed secondary glaucoma during follow-up period (Table 3). One eye in group A, two eyes in group B, and five eyes in group C underwent reoperation due to VAO development.

We did not observe other complications such as hyphema, iris prolapse, IOL drop, retinal detachment, and endophthalmitis.

DISCUSSION

Primary posterior capsulorhexis does not always guarantee a permanently clear visual axis because anterior surface of the vitreous serves chance for the LEC migration into the visual axis (6). In younger children, AV with PCCC reduces the VAO. However, it is not clear at what age AV should be performed. Basti et al. (7) performed primary posterior capsulotomy with AV in children aged less than 8 years. Vasavada and Desai (8) suggested AV with PCCC in children aged less than 5 years. In five out of eight eyes in which PCCC without AV was performed, VAO was observed, and a secondary procedure was required. Koch and Kohnen reported 20 eyes that underwent different methods of managing the posterior capsule and anterior vitreous. They found that none of the eyes that had PCCC with AV developed visually significant VAO (9). Kugelberg and Zetterström (10) reported VAO in 85 eyes that underwent cataract surgery with or without AV according to age (patients aged 0–15 years). They suggested that cataract surgery combined with AV should be performed in younger children. Dahan and Salmenson (11) recommended PCCC and AV in children aged less than 8 years. Fenton and O'Keefe (12) reported a VAO rate of 15.6% performing posterior capsulorhexis without AV. In our study group, children age range from 2 to 8 years. We performed PCCC, AV, and in-the-bag IOL implantation for all children. Most pediatric ophthalmologists agree that IOL implantation is the most suitable treatment for Aphakia rehabilitation, and primary IOL implantation has become the popular and acceptable approach in patients above 2 years of age (13).

Intraocular lens designs and materials are designed to prevent VAO (14). Wilson and Trivedi surveyed ophthalmologists about their choice of IOL for pediatric surgery (15). The AcrySof MA (Alcon Laboratories, Inc., Fort Worth, Texas, USA) series is the most preferred worldwide for sulcus fixation. For in-the-bag fixation, most surgeons prefer the MA series, whereas the SA series is more popular in the United States (16). Our results showed that VAO was the major complication in all groups. We found similar rates of VAO in groups A and B. VAO rate of group C was higher than in other groups, but we did not find a statistically significant difference in VAO among groups.

Trivedi et al. (17) showed that there was no statistically significant difference between implantation of single and three-piece IOLs in infants regarding the development of VAO. The lens design is also another critical factor in LEC migration. The square edge design of the IOLs may prevent LEC migration that is important for avoiding VAO (18–20). The three-piece IOLs provide better adhesion between the anterior and posterior capsules. The single-piece lens has bulky haptics than three-piece IOLs that may lead to LEC migration (14). The hydrophobic acrylic IOLs have less after-cataract formation rate than hydrophilic acrylic IOLs. It has been shown by previous studies that hydrophobic acrylic material contacts firmly with posterior capsule and prevents LEC migration and decreases VAO (21). High permeability of hydrophilic acrylic IOLs allows penetration of nutrients to LECs and increases VAO rate (22, 23). We thought that IOL material and design had low additional effect in reducing VAO. This may occur because of the fact that PCCC and AV eliminate the vitreous and hyaloid face as a scaffold for the LECs' migration to the visual axis.

The purpose of congenital cataract surgery is to provide a clear visual axis. However, anterior segment complications after congenital and developmental cataract surgery are more common in adults. This immune response is generally activated by the presence of an IOL, and response is more aggressive in children than in adults. With decreasing age, immune response increases (3). We observed similar rates of fibrin reaction in groups. This may be explained by no significant difference in age among groups. The similar rates of IOL dislocation between groups may also explained by in-the-bag implantation. In-the-bag placement of the IOL is preferred because it mostly eliminates the risk of lens dislocation, iris capture, and uveal inflammation. Apple et al. (24) showed the advantages of capsular bag fixation over ciliary sulcus implantation. Capsular-fixated IOLs provide less pupillary capture and pigment dispersion, elimination of ciliary body erosion. Moreover, capsular fixation provides better centration and stabilization of IOL when compared with sulcus fixation.

Kugelberg et al. (25) showed that IOL implantation protects against secondary glaucoma. The first theory is that IOL may protect the trabecular meshwork from harmful effects of vitreous chemical components. Secondly, IOLs may also provide a mechanical support for trabecular meshwork (26, 27). We observed similar rates of open angle secondary glaucoma in all groups. Longer follow-up period can increase the incidence of secondary glaucoma.

In our study, the overall rate of VAO appears high compared with existing literature. This may be because VAO was described as a fibrosis of anterior or posterior capsular opening and opacification of anterior vitreous surface that closed or threated the optic visual axis in this study. In other studies, fibrosis of anterior surface of vitreous or posterior surface of IOL that closed the visual axis, accepted as VAO or after-cataract formation (4, 5, 28, 29).

CONCLUSION

Our outcomes showed that different IOLs cause comparable VAO rate in children having undergone congenital cataract surgery at an older age. We conclude that performing a posterior curvilinear capsulorhexis and AV is more important than IOL choice in preventing VAO in late-consulted older children. Long-term studies are needed to understand the importance of IOL selection and to determine the best treatment in this age group.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Gaziantep University.

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