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Evaluation of Factors Affecting the Results of Pediatric Cataract Surgery: A Retrospective Case Series

Pediatrik Katarakt Cerrahisi Sonuçlarını Etkileyen Faktörlerin Değerlendirilmesi: Retrospektif Olgu Serisi

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ABSTRACT Objective: To evaluate the effect of various factors, including age, laterality, surgical technique used, intraocular lens (IOL) implantation site, and target refraction, on the long-term outcomes of pediatric cataract surgery. **Material and Methods:** This single-center, retrospective case series included 74 eyes of 50 patients who underwent surgery for pediatric cataract. Patients were divided into subgroups: Group I [posterior continuous curvilinear capsulorhexis (PCCC) combined with anterior vitrectomy (AV) and aphakic follow-up], Group II (PCCC combined with AV and IOL implantation), Group III (IOL implantation only without PCCC and AV). Patients were also divided into 4 subgroups according to the age at primary surgery as Group A (0-3 months), Group B (3-12 months), Group C (12-24 months), and Group D (24 months and over). **Results:** The mean age of all patients was 55.90±48.0 months. Thirteen (81.25%) eyes in Group I had visual acuity of 0.1 or less, 28 (65.1%) eyes in Group II had visual acuity between 0.1-0.5-9 (60.0%) eyes in Group III had visual acuity of 0.5 or more (p<0.001). Secondary glaucoma was detected in 15 (20.3%) eyes and it was significantly higher in the ciliary sulcus group (n=8, 29.6%) than in the capsular bag group (n=2, 6.5%) (p=0.042). PCO was observed in 8 (10.8%) eyes, including 1 (2%) eye in Group II and 7 (46.6%) eyes in Group III (p<0.001). **Conclusion:** The surgical technique used, the location of IOL implantation, the timing of secondary IOL implantation and determination of target refraction are extremely critical in pediatric cataracts.

Keywords: Congenital cataract; pediatric cataract; posterior capsule opacification; secondary glaucoma; visual outcomes

ÖZET Amaç: Yaş, taraf, kullanılan cerrahi teknik, göz içi lens (GİL) implantasyon bölgesi ve hedef refraksiyon gibi çeşitli faktörlerin pediatrik katarakt cerrahisinin uzun dönem sonuçları üzerindeki etkisini değerlendirmek. **Gereç ve Yöntemler:** Bu tek merkezli, retrospektif olgu serisine pediatrik katarakt cerrahisi geçiren 50 hastanın 74 gözü dâhil edildi. Hastalar alt gruplara ayrıldı: Grup I [ön vitrektomi (ÖV) ve afakik takip ile birlikte arka sürekli eğrisel kapsüloreksis (posterior continuous curvilinear capsulorhexis-PCCC)], Grup II (ÖV ve GİL implantasyonu ile birlikte PCCC), Grup III (PCCC ve ÖV olmadan sadece GİL implantasyonu). Hastalar ayrıca primer cerrahi yaşına göre Grup A (0-3 ay), Grup B (3-12 ay), Grup C (12-24 ay) ve Grup D (24 ay ve üzeri) olmak üzere 4 alt gruba ayrıldı. **Bulgular:** Ortalama hasta yaşı 55,90±48,0 aydı. Grup I'deki 13 (%81,25) gözde görme keskinliği 0,1 veya daha az, Grup II'deki 28 (%65,1) gözde görme keskinliği 0,1-0,5 arasında ve Grup III'teki 9 (%60,0) gözde görme keskinliği 0,5 veya daha fazla idi (p<0,001). Sekonder glokom 15 (%20,3) gözde saptandı ve siliyer sulkus grubunda (n=8, %29,6) kapsüler kese grubuna (n=2, %6,5) göre anlamlı derecede yüksekti (p=0,042). Grup II'de 1 (%2) gözde ve Grup III'te 7 (%46,6) gözde olmak üzere toplam 8 (%10,8) gözde arka kapsül opasifikasyonu gözlenmiştir (p<0,001). **Sonuç:** Pediatrik kataraktlarda kullanılan cerrahi teknik, GİL implantasyonunun yeri, sekonder GİL implantasyonunun zamanlaması ve hedef refraksiyonun belirlenmesi son derece kritiktir.

Anahtar Kelimeler: Konjenital katarakt; pediatrik katarakt; arka kapsül opasifikasyonu; sekonder glokom; görsel sonuçlar

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Congenital or infantile cataracts, a major preventable cause of blindness in childhood, are a critical target of international health programms.[1,2] Unlike adult cataracts, pediatric cataracts, which can lead to varying degrees of amblyopia risk and even blindness, have their own serious challenges.[3] These challenges include the difficulty in determining the optimal surgical timing, selecting the correct surgical technique and the timing of intraocular lens (IOL) implantation.[2,4,5] However, although the factors influencing the long-term outcome of pediatric cataracts have been widely investigated in the literature, most studies have focused on age at surgery, laterality of the cataract, and IOL implantation.[6,7] However, despite this extensive research, it remains challenging to draw definitive conclusions and achieve complete consensus on the factors affecting final visual acuity and surgical success.[8-13]

In order to determine prognostic indicators for these patients, it is necessary to examine a large number of parameters, particularly given the variety and diversity of anatomical and physiological factors related to the patient, the surgical techniques used, and the processes related to postoperative management. However, there is a paucity of studies that have examined the long-term clinical course of pseudophakic and aphakic eyes after pediatric cataract surgery and the factors affecting surgical success in a multifaceted manner.[14] The purpose of the presented study was to assess the effect of various parameters, such as age, laterality, surgical technique, IOL implantation site, and target refraction, on the long-term results of cataract surgery in children.

MATERIAL AND METHODS

STUDY DESIGN AND PATIENTS

This single-center, retrospective case series included 74 eyes of 50 patients who underwent surgery for congenital or infantile cataracts between 2011-2019 at the Department of Ophthalmology, Erciyes University Faculty of Medicine. The Erciyes University Faculty of Medicine Ethics Committee approved the study protocol, and the study followed the principles of the Declaration of Helsinki. Every patient's parents or legal guardians provided informed consent. The medical records of patients diagnosed with congenital or infantile cataracts were retrospectively reviewed, and eligible patients were included in the study. Patients with traumatic cataract, uveitis cataract, nanophthalmic eyes, and follow-up time shorter than 6 months were excluded from the study.

Preoperative Evaluation

The data files of patients were evaluated and ophthalmic examination findings including best-corrected visual acuity (BCVA) measurement using Snellen or Tumbling "E" cards if possible, IOP measurement using Schiotz tonometry or Goldmann applanation tonometry, refractive measurement, slit-lamp biomicroscopy, and retinoscopy were recorded. Refractive measurements performed with an automatic refractometer (Tonoref II, Nidek, Japan) in compliant patients and with manual refractometer (Nidek HandyRef-K, Japan) under general anesthesia in non-compliant patients were also recorded. IOL power was determined using optical biometry or ultrasound biometry (Amplitude scan) according to the the SRK-T or SRK II formulas. Target IOL power was determined according to age by decreasing the measured emmetropic IOL power by 10% in patients aged 2-8 years and by 20% in patients younger than 2 years.

Surgery

All procedures were carried out under general anesthesia by the same surgeon (H.A). One hour before surgery, 0.5% cyclopentolate and 0.5% tropicamide eye drops were instilled 3 times at 5-minute intervals to dilate the pupil. After side-port incisions were made with a 23-gauge microvitreoretinal blade, a 2.2 mm main incision was made in patients scheduled for IOL implantation. A 5-6 mm anterior continuous curvilinear capsulorhexis (CCC) was created with micro capsulorhexis forceps under ophthalmic viscosurgical device (OVD), followed by lens aspiration with a bimanual irrigation/aspiration probe. To separate the anterior hyaloid from the posterior capsule and to prevent vitreous prolapse during posterior continuous curvilinear capsulorhexis (PCCC), dispersive OVD injection into the capsular bag and Berger's space was repeated after the posterior capsular flap was created with a cystotome. Subsequently, a PCCC

was performed with forceps, with a diameter of approximately 4-4.5 mm, which was slightly smaller than the anterior CCC. This was followed by a routine AV. Triamcinolone acetonide (TA) was then injected into the anterior chamber and vitreous control was performed. After the main incision and the side port incisions were closed with 10.0 monofilament sutures, diluted TA and 1mg/0.1 ml cefuroxime were injected into the anterior chamber. Some patients were left aphakic, while others underwent IOL implantation into the capsular bag.

Postoperative Evaluation and Follow-up

Postoperatively, all patients were started on topical moxifloxacin 0.5% drops every three hours, topical dexamethasone 0.1% drops every hour, and diluted cyclopentolate 1% drops 3 times a day. The doses of drops were tapered and discontinued after 3-4 weeks according to anterior segment findings at follow-up. Patients at risk of amblyopia received occlusion therapy.

Aphakia rehabilitation was achieved with contact lenses in all unilateral cases and in the majority of bilateral cases, while aphakic spectacles were used in only a few patients. Secondary IOL implantation was performed in the capsular bag if the integrity of the bag was good and in the ciliary sulcus if the integrity of the capsular sac was not good, usually after 24 months. Postoperative evaluations were carried out on the 1st and 2nd days, the 1st and 2nd weeks, the 1st month, and every 3 or 6 months thereafter. At the control visits, all patients underwent refractive measurements, slit-lamp examinations, fundus examinations, BCVA measurements, and IOP measurements. The absolute spherical equivalent (SE) was calculated as spherical diopter+cylindrical diopter/2.

To investigate the impacts of IOL implantation location, time, and surgical technique on complication rates and final visual acuity, patients were divided into subgroups: Group I (PCCC combined with AV and aphakic follow-up), Group II (PCCC combined with AV and IOL implantation), Group III (IOL implantation only without PCCC and AV). Patients were further separated into 4 categories based on their age at primary surgery: Group A (0-3 months), Group B (3-12 months), Group C (12-24 months), and Group D (24 months or above).

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software (version 16.0, SPSS Inc., Chicago, IL, USA). The Shapiro-Wilks test, Q-Q plots, and histograms were employed to determine whether the data distribution was normal. Levene's test was used to determine whether the variances were homogeneous. Descriptive data are reported as mean±standard deviation, median [inter quantile range (IQR), 1st-3rd quartile)], and n (%). Mean differences between groups were evaluated using analysis of variance, Kruskal-Wallis test for continuous variables, and Pearson's chi-square test for categorical data. SNK and LSD "post hoc" tests were used to identify similar and different subgroups. The p value was chosen at 0.05 to indicate statistical significance.

RESULTS

The study included 21 (42%) male and 29 (58%) female patients, with an average age of 55.9±48.0 months (range, 8-156 months). The average follow-up period was 36.0 months (IQR, 27.00-66.00 months). Table 1 presents the patients' demographic and clinical data.

VISUAL OUTCOMES

When analyzing the postoperative BCVA, 8 (10.8%) eyes could not be evaluated, 2 (2.7%) eyes had no object tracking, 16 (21.6%) eyes had visual acuity of

TABLE 1: Demographic and clinical characteristics of the patients

Parameter	n (%)
Total number of eyes	74 (100)
Right/left eye ratio	11 (22)/15 (30)
Bilateral cataract	24 (48)
Family history positivity	7 (14)
Presence of consanguineous marriage	11 (22)
Premature birth history	9 (18)
Microphthalmia	4 (5.4)
Systemic diseases	
Down syndrome	4 (8)
Developmental delay	3 (6)
Epilepsy	2 (4)
Mental retardation	2 (4)
Neurofibromatosis type 1 and hyperactivity disorder	1 (2)

Values are shown as n (%).

0.1 and below or object tracking, 33 (44.5%) eyes had visual acuity between 0.1-0.5 and 15 (20.2%) eyes had visual acuity of 0.5 and above. When the cases were evaluated according to the timing of surgery and surgical technique, 13 (81.25%) eyes in Group I (median age at primary surgery 3 months) had visual acuity of 0.1 or less or object tracking, 28 (65.1%) eyes in Group II (median age at primary surgery 5 months) had visual acuity between 0.1-0.5, and 9 (60.0%) eyes in Group III (median age at primary surgery 40 months) had visual acuity of 0.5 or more. Visual acuity in Group III was statistically significantly higher than in Group II and Group I (p<0.001) (Table 2). When all 3 groups were compared for amblyopia, 5 (31.3%) eyes in Group I and 28 (65.1%) eyes in Group II had amblyopia, whereas only 7 (46.7%) eyes in Group III had amblyopia and there was a significant difference between the groups (p<0.001). On the other hand, 23 (88.4%) of the patients with unilateral cataract had amblyopia, whereas only 10 (41.6%) of the patients with bilateral cataract had amblyopia (p<0.001).

POSTOPERATIVE COMPLICATIONS

Secondary glaucoma was detected in 15 (20.3%) of 74 eyes in the postoperative period (Table 3, Table 4). Of these patients with secondary glaucoma, 5 (31.3%) were in Group I, 9 (20.9%) in Group II and 1 (6.7%) in Group III (p=0.25). When the patients were analyzed according to the age at primary surgery, secondary glaucoma developed in 8 eyes (27.6%) in Group A, 6 eyes (22.2%) in Group B, and 1 eye (25.0%) in Group C (p<0.001) (Table 3). No patient developed secondary glaucoma in Group D. Secondary glaucoma rates (according to IOL position) were significantly higher in the ciliary sulcus group (n=8, 29.6%) than in the capsular bag group (n=2, 6.5%) (p=0.042) (Table 4). In Group II, 8 out of

TABLE 2: Comparison of groups according to surgical technique used

Parameter	Group I (n=16)	Group II (n=43)	Group III (n=15)	p value
Total number of patients (%)	10 (20.0)	31 (62.0)	9 (18.0)	-
Age at diagnosis (months), median (IQR)	2.0 (1.0-3.0)[a]	3.0 (2,0-5.0)[a]	40.0 (24.0-64.0)[b]	**<0.001**
Age at primary surgery (months), median (IQR)	3.0 (2.0-4.0)[a]	5.0 (3.0-7.0)[a]	40.0 (36.5-65.5)[b]	**<0.001**
Age at secondary IOL implantation (months)				
18 months and below		3 (7.0)	1 (6.7)	
18-24 months	NA	34 (79.1)	1 (6.7)	**<0.001**
24-48 months		6 (14.0)	3 (20.0)	
48 months and above		0 (0.0)	10 (66.7)	
Secondary IOL implantation location, eyes (%)				
Capsular bag	NA	17 (39.5)	14 (93.3)	**<0.001**
Ciliary sulcus		26 (60.5)	1 (6.7)	
BCVA, eyes (%)				
Not assessed	1 (6.25)	6 (13.9)	1 (6.6)	
No object tracking	2 (12.5)	0 (0.0)	0 (0.0)	
0.1 and below/object tracking	13 (81.25)	3 (6.9)	0 (0.0)	**<0.001**
0.1-0.5	0 (0.0)	28 (65.1)	5 (33.3)	
0.5 and above	0 (0.0)	6 (13.9)	9 (60.0)	
Complications, eyes (%)				
Amblyopia	5 (31.3)	28 (65.1)	7 (46.7)	**<0.001**
Secondary glaucoma	5 (31.3)	9 (20.9)	1 (6.7)	0.251
Posterior capsular fibrosis	7 (17.0)	30 (73.1)	4 (26.7)	**0.009**
Posterior capsular opacity	0 (0.0)	1 (%2)	7 (46.6)	**<0.001**

Values are shown as n (%) and median (1st quartile-3rd quartile). Different letters indicate different groups (a,b "post hoc" test). Significant p values are indicated in bold. Group 1: PCCC combined with anterior vitrectomy and aphakic follow-up; Group 2: PCCC combined with anterior vitrectomy and IOL implantation; Group 3: OL implantation only without PCCC and anterior vitrectomy. IQR: Inter quantile range; IOL: Intraocular lens

TABLE 3: Comparison of groups according to age at primary surgery (Group A-D)

Parameter	Group A	Group B	Group C	Group D	p value
Number of eyes (%)	29 (39)	27 (36)	4 (5)	14 (19)	-
Age at diagnosis (months) median (IQR)	2.00 (1.00-2.00)	4.00 (3.00-5.00)	15.00 (12.00-22.50)	44.00 (36.00-72.00)	**<0.001**
Age at primary surgery (months) median (IQR)	3.00 (2.00-3.00)	5.00 (4.00-7.00)	17.5 (14.50-22.75)	44.5 (37.00-73.75)	**<0.001**
Complications, eyes (%)					
Secondary glaucoma	8 (27.6)	6 (22.2)	1 (25.0)	0 (0,0)	**<0.001**
Nystagmus	9 (31.0)	9 (33.3)	0 (0.0)	1 (7.1)	0.160
Excessive fibrin reaction	14 (48.3)	7 (25.9)	1 (25.0)	0 (0.0)	0.012
Pupillary retraction/irregularity	8 (27.6)	7 (25.9)	1 (25.0)	0 (0.0)	0.188
Anterior synechiae	3 (10.3)	4 (14.8)	0 (0.0)	0 (0.0)	0.422
Posterior synechiae	10 (34.5)	3 (11.1)	2 (50.0)	0 (0.0)	0.013
Cortex remnants	2 (6.9)	1 (3.7)	0 (0.0)	0 (0.0)	0.712
Posterior capsular fibrosis	18 (62.1)	17 (63.0)	2 (50.0)	4 (28.6)	0.153
Posterior capsule opacification	1 (3.4)	0 (0.0)	0 (0.0)	7 (50.0)	**<0.001**

Values are shown as n (%). Significant p values are indicated in bold. Age at primary surgery; Group A: 0-3 months; Group B: 3-12 months; Group C: 12-24 months; Group D: After 24 months. IQR: Inter quantile range

TABLE 4: Evaluation of complications according to secondary IOL implantation locations

	Secondary IOL implantation site		
Parameter	Capsular bag	Ciliary sulcus	p value
Glaucoma	2 (6.5)	8 (29.6)	**0.04**
Posterior capsular fibrosis	17 (54.8)	17 (63.0)	0.471
Posterior capsule opacification	8 (25.8)	0 (0.0)	**0.002**
Excessive fibrin reaction	5 (16.1)	5 (18.5)	0.541
Anterior synechiae	3 (9.7)	3 (11.1)	0.869
Posterior synechiae	6 (19.4)	4 (14.8)	0.426
IOL decentration	3 (9.7)	3 (11.1)	0.398

Values are shown as n (%). Significant p values are in bold. IOL: Intraocular lens

9 patients with secondary glaucoma had an IOL implanted in the ciliary sulcus.

The most common postoperative complication was posterior capsular fibrosis, which was detected in 41 (55.4%) cases. Although 18 of these cases were in Group A and 17 in Group B, there was no significant difference between the 4 groups (p=0.15). When the groups were compared according to surgical technique, 7 (17%) patients with posterior capsular fibrosis were in Group I, 30 (73.1%) in Group II, and 4 (26.7%) in Group III (p=0.009). However, there was no statistically significant difference between the ciliary sulcus and capsular bag implantation groups (p=0.47).

PCO was observed in 8 eyes, representing 10.8% of the total number of eyes included in the study. Of these, 1 (2%) was in Group II and 7 (46.6%) in Group III (p<0.001). In 1 case in Group II, the optic axis was cleaned by re-operation, whereas in all cases in Group III, Nd:YAG laser capsulotomy was performed. When comparing PCO rates according to IOL position, no PCO was observed in the ciliary sulcus group, whereas it was observed in 8 eyes (25.8%) in the capsular bag group (p=0.002). In addition, PCO was significantly higher in Group D compared to the other groups (p<0.001).

Nineteen eyes (25.7%) had nystagmus and 9 of these patients were in Group A, 9 in Group B, and 1 in Group D (p=0.16). Postoperative excessive fibrin reaction developed in 22 eyes (29.7%) and these patients were treated with high-dose steroids and cycloplegic agents. Only 2 eyes (2.7%) that did not respond to medical treatment required reoperation. Among the eyes with excessive fibrin reaction, 14 eyes in Group A and 7 eyes in Group B, whereas none of the patients in Group D had excessive fibrin reaction (p=0.01). When the groups were compared in terms of IOL position, there was no significant difference in fibrin reaction between the ciliary sulcus group (n=5, 18.5%) and the capsular bag group (n=5, 16.1%) (p=0.54).

Pupillary retraction or irregularity was observed in 16 eyes (21.6%). Other complications were IOL precipitates in 10 eyes (13.5%), anterior synechiae in

TABLE 5: Postoperative spherical value and SE value						
	Capsular bag group		Ciliary sulcus group		Total	
Age group	**n (%)**	**Spherical value**	**n (%)**	**Spherical value**	**n (%)**	**Spherical value**
2-3 years old	2 (9)	2.63±0.18	7 (35)	1.00±3.59	9 (22.0)	1.36±3.19
3-5 years old	5 (24)	2.25±2.66	5 (25)	-0.20±1.10	10 (24.4)	1.03±2.31
5-7 years old	9 (43)	0.08±3.08	5 (25)	1.00±2.24	14 (34.1)	0.41±2.75
7 years and over	5 (24)	-1.75±1.95	3 (15)	-0.33±1.51	8 (19.5)	-1.22±1.83
Age group	**n (%)**	**SE**	**n (%)**	**SE**	**n (%)**	**SE**
2-3 years old	2 (9)	3.38±0.88	7 (35)	0.00±4.70	9 (22.0)	0.75±4.34
3-5 years old	5 (24)	1.95±3.35	5 (25)	-0.10±1.97	10 (24.4)	0.93±2.80
5-7 years old	9 (43)	-0.28±3.60	5 (25)	0.60±3.06	14 (34.1)	0.04±3.32
7 years and over	5 (24)	-2.55±1.84	3 (15)	-2.33±1.61	8 (19.5)	-2.47±1.63

Values are shown as n (%). Data are presented as dipotries (D). SE: Spherical equivalent

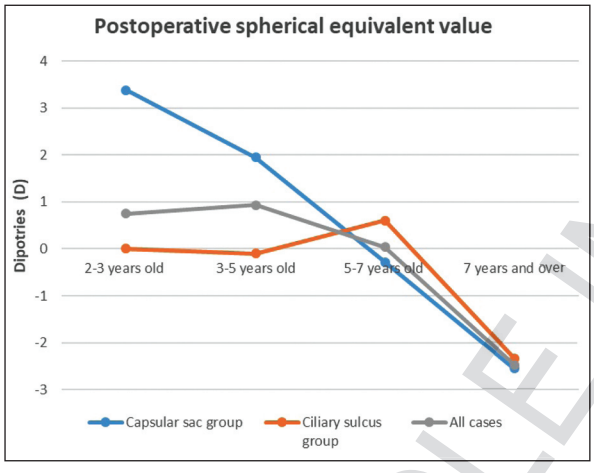

FIGURE 1: The mean postoperative SE

7 eyes (9.5%), posterior synechiae in 15 eyes (20.3%), and cortical remnants in 3 eyes (4.1%). In addition, IOL decentration was observed in 6 eyes (8.1%). There was no significant difference between the groups in terms of anterior synechiae, posterior synechiae and IOL decentration according to the secondary IOL implantation site (p=0.86, 0.42-0.39, respectively). However, posterior synechiae were significantly more common in Group A compared to the other groups (p=0.01). None of the patients developed endophthalmitis or retinal detachment during the follow-up period.

REFRACTIVE OUTCOMES

Postoperative spherical value and absolute SE were analyzed in 41 eyes (75.9%) that underwent secondary IOL implantation at least 6 months after IOL implantation (Table 5). The IOL was implanted in the capsular bag in 21 eyes and in the ciliary sulcus in 20 eyes. When the refraction results were monitored over the years, it was observed that there was mild hypermetropia around 24 months, whereas myopic shift developed with increasing age (Figure 1).

DISCUSSION

Congenital cataract surgery differs significantly from adult cataract surgery, with higher complication rates.[3] Our study found that, in group III patients with a higher mean age at primary surgery, visual acuity was significantly higher, and postoperative complications were less common than in other groups. This highlights the importance of a good surgical procedure, correct timing of surgery, and effective management of complications in congenital cataracts.

Postoperative secondary membrane and PCO occlude the visual axis and decrease the success of the surgery.[8,9] According to Demirkılınç Biler et al. PCO occurred in 34.3% of eyes that received PCCC combined with AV, compared to 76.4% in eyes that did not get PCCC.[15] A recent meta-analysis of eleven randomized controlled studies found that AV reduces the incidence of PCO in pediatric cataracts.[16] According to our results, only 2% of eyes with AV and PCCC (Group II) developed PCO, whereas 46.6% of eyes with PCCC and IOL implantation without AV (Group III) developed PCO. Leaving the posterior capsule intact or performing a PCCC without AV

leaves behind a surface for lens epithelial cells to proliferate.[10] Our results confirm the effectiveness of PCCC combined with AV in reducing the development of PCO in congenital cataract surgery. On the other hand, recent studies suggest that the use of 3-piece IOL models after PCCC without AV may reduce the risk of pseudophakic PCO in children under the age of 2 years, but further studies are needed to confirm this.[17]

Posterior capsular fibrosis is another complication seen in congenital cataracts other than PCO. In the literature, Şimşek et al. found fibrosis at the posterior capsulotomy margin in 53 patients (76.8%), 39 (88.6%) of whom were between 1-4 years of age and 14 (56.0%) of whom were 4 years and older.[18] This problem was noted as 49.2% in a research by Nurözler et al. although the age categories were not mentioned.[19] In our study, posterior capsular fibrosis was found in 55.4%, which is consistent with the literature, and the majority of patients (Groups A and B) were less than 12 months old at the time of main surgery. We think that this is due to an increased excessive inflammatory response and fibrotic changes in the capsule, especially in patients with younger primary surgical age. Indeed, many investigations have found that young age is related with a higher likelihood of surgical complications.[2]

On the other hand, according to our results, excessive fibrin reaction forming secondary membrane was seen in 22 cases (29.7%), 14 (%) of these cases were in Group A and 7 (%) in Group B. However, it did not develop in patients with primary surgical age greater than 24 months (Group D). Similarly, Hosal and Biglan found that age during surgery was substantially linked with secondary membrane development following pediatric cataract surgery, with a 4.74-fold increase in fibrin membrane formation in children under 1 year.[20] These results support the notion that the younger the age at surgery, the more inflammatory response develops. Moreover, it has been shown that pupillary synechiae, pupillary irregularities and IOL precipitates develop more frequently as a result of an increased inflammatory response with decreasing age.[21] Similarly, in our study, most of the patients who developed pupillary irregularities, anterior and posterior synechiae were younger than 12 months of age at the time of primary surgery.

The presence of nystagmus affects visual outcomes in congenital cataract cases, and there is also an increased likelihood of latent nystagmus in patients with late surgery and total cataract.[22] According to the study by Abadi et al. major form deprivation can be a cause of nystagmus even when surgery is performed early period.[23] In their study, latent nystagmus was found in 75% of cases. Lambert et al. reported that the best visual outcomes in patients with bilateral dense congenital cataract were obtained after surgery performed in the first 5-8 weeks of life, and the success rate decreased when surgery was performed after the 10th week and in the presence of nystagmus.[24] In conclusion, surgery within the first 6 weeks of life for unilateral cataracts and within 10 weeks for bilateral cataracts can be considered ideal in congenital cataract patients. However, the risk of secondary glaucoma development has been reported to be high especially for surgery performed before the first month of life.[2,12] In our study, the mean age at primary surgery was 5.00 (3.00-12.50) months. The earliest age at surgery was 5 weeks and the latest age at surgery was 96 months. Patients in Group D and Group III who underwent surgery at an older age had lower complication rates and better visual acuity.

Secondary glaucoma is an important complication causing visual loss after congenital cataract surgery and the main risk factor is early age at surgery.[2,12] Various studies have shown that the incidence of aphakic glaucoma ranges from 5-41% and the primary risk factor is cataract surgery conducted within the 1st year of life.[25,26] Vishwanath et al. found that half of kids who underwent bilateral lensectomy in the first month of life developed glaucoma over a 5 year period.[27] Multiple logistic regression analysis showed that the incidence of secondary glaucoma was significantly associated with younger age at surgery, aphakia, and the presence of systemic comorbidities.[14] In our study, secondary glaucoma was detected in 15 (20.3%) of 74 eyes, glaucoma surgery was performed in 3 (20%) of these cases, and 12 (80%) cases were followed up with medication. Of the patients with secondary glaucoma, 5 (31.3%) were in Group I, 9 (20.9%) in Group II, and only 1

(6.7%) in Group III. When secondary glaucoma rates were analyzed according to age at primary surgery, there were 8 cases (27.6%) in Group A, 6 cases (22.2%) in Group B, and 1 case (25%) in Group C. Most patients with glaucoma were younger than 12 months at the time of primary surgery.

IOL implantation has been reported to reduce the risk of secondary glaucoma development due to mechanical support of the trabeculum.[28] However, there are very limited studies in the literature investigating the effect of IOL implantation site on secondary glaucoma development in congenital cataract. In a study comprising 60 eyes of 44 patients, Zhu et al. observed no significant difference in the incidence of glaucoma between the 2 groups of patients who had undergone IOL implantation in either the ciliary sulcus or the capsular bag.[29] However, according to our results, secondary glaucoma development was significantly higher in patients with IOL implantation in the sulcus than in patients with IOL implantation in the capsular bag. The target refraction after secondary IOL implantation for congenital cataract is controversial and there is no consensus. The general approach is to achieve emmetropisation in adulthood rather than at the end of surgery. According to our results, the mean spherical value of 9 patients aged 2-3 years was 1.36±3.19 D, and 8 patients older than 7 years was 1.22±1.83 D.

According to our results, visual acuity was significantly higher in patients with later timing of surgery and older age at primary surgery. Indeed, Lin et al. analyzed 114 eyes with a mean follow-up of 48.7 months after congenital cataract surgery.[5] Similarly, the authors reported that overall BCVA was significantly better in the 6-month group (0.81±0.28 logMAR) than in the 3-month group (0.96±0.30 logMAR) (p=0.02). On the other hand, in our study, 88.4% of patients with unilateral cataracts had amblyopia, whereas only 41.6% of patients with bilateral cataracts had amblyopia. These results confirm previous studies showing that bilateral cataracts have a better visual prognosis than unilateral cataracts.[23,24]

The main limitations of the study were the relatively small patient population and its retrospective design. Additionally, in this presented study, the results were not evaluated in terms of cataract density. However, the primary strength of our study was its comprehensive evaluation of numerous factors that had not been extensively examined in previous studies. Furthermore, it assessed the impact of these factors on surgical outcomes collectively, which is a notable contribution to the field.

CONCLUSION

The results of our study showed that the timing of surgery, the surgical technique used, the location of IOL implantation, the timing of secondary IOL implantation, determination of target refraction, and the management of postoperative complications are extremely critical for successful surgical outcomes and satisfactory final visual acuity in pediatric cataracts. An effective AV with PCCC during surgery seems to be an effective option to prevent PCO. On the other hand, the development of secondary glaucoma was significantly higher in cases with IOL implantation in the sulcus than in cases with IOL implantation in the capsular bag. Nevertheless, further multicenter clinical trials involving more patients are needed to confirm these results and to elucidate this issue.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Mustafa Eroğlu, Hatice Arda;* ***Design:*** *Mustafa Eroğlu, Hatice Arda;* ***Control/Supervision:*** *Mustafa Eroğlu, Hatice Arda;* ***Data Collection and/or Processing:*** *Mustafa Eroğlu;* ***Analysis and/or Interpretation:*** *Mustafa Eroğlu, Hatice Arda;* ***Literature Review:*** *Mustafa Eroğlu;* ***Writing the Article:*** *Mustafa Eroğlu;* ***Critical Review:*** *Mustafa Eroğlu, Hatice Arda;* ***References and Fundings:*** *Mustafa Eroğlu, Hatice Arda;* ***Materials:*** *Mustafa Eroğlu, Hatice Arda.*

REFERENCES

1. World Health Organization [Internet]. Global Initiative for the Elimination of Avoidable Blindness: action plan 2006-2011. © 2024 WHO [Cited: September 1, 2024]. Available from: https://apps.who.int/iris/handle/10665/43754
2. Kuhli-Hattenbach C, Fronius M, Kohnen T. Operationszeitpunkt der kongenitalen katarakt: zwischen amblyopie und aphakieglaukom [Timing of congenital cataract surgery: amblyopia versus aphakic glaucoma]. Ophthalmologe. 2020;117(3):190-8. German. PMID: 32076840.
3. Lenhart PD, Lambert SR. Current management of infantile cataracts. Surv Ophthalmol. 2022;67(5):1476-505. PMID: 35307324; PMCID: PMC10199332.
4. Ugalahi M, Adediran O, Olusanya B, Baiyeroju A. Management of childhood cataract: practice patterns among ophthalmologists in Nigeria. Eye (Lond). 2024;38(11):2058-64. doi:10.1038/s41433-023-02755-x
5. Lin HT, Long EP, Chen JJ, Liu ZZ, Lin ZL, Cao QZ, et al. Timing and approaches in congenital cataract surgery: a four-year, two-layer randomized controlled trial. Int J Ophthalmol. 2017;10(12):1835-43. PMID: 29259901; PMCID: PMC5733510.
6. Chak M, Wade A, Rahi JS; British Congenital Cataract Interest Group. Long-term visual acuity and its predictors after surgery for congenital cataract: findings of the British congenital cataract study. Invest Ophthalmol Vis Sci. 2006;47(10):4262-9. PMID: 17003414.
7. Lambert SR, Cotsonis G, DuBois L, Nizam Ms A, Kruger SJ, Hartmann EE, et al; Infant Aphakia Treatment Study Group. Long-term effect of intraocular lens vs contact lens correction on visual acuity after cataract surgery during infancy: a randomized clinical trial. JAMA Ophthalmol. 2020;138(4):365-72. PMID: 32077909; PMCID: PMC7042945.
8. Müllner-Eidenböck A, Amon M, Moser E, Kruger A, Abela C, et al. Morphological and functional results of AcrySof intraocular lens implantation in children: prospective randomized study of age-related surgical management. J Cataract Refract Surg. 2003;29(2):285-93. PMID: 12648639.
9. Writing Committee for the Pediatric Eye Disease Investigator Group (PEDIG); Repka MX, Dean TW, Kraker RT, Bothun ED, Morrison DG, Lambert SR, et al. Visual acuity and ophthalmic outcomes in the year after cataract surgery among children younger than 13 years. JAMA Ophthalmol. 2019;137(7):817-24. PMID: 31095258; PMCID: PMC6537788.
10. Kohnen T, Davidova P, Lambert M, Wenner Y, Zubcov AA. Posterior continuous curvilinear capsulorhexis with anterior vitrectomy vs optic capture buttonholing without anterior vitrectomy in pediatric cataract surgery. J Cataract Refract Surg. 2022;48(7):831-7. PMID: 34670945.
11. Luo Y, Lu Y, Lu G, Wang M. Primary posterior capsulorhexis with anterior vitrectomy in preventing posterior capsule opacification in pediatric cataract microsurgery. Microsurgery. 2008;28(2):113-6. PMID: 18220313.
12. Abdelmassih Y, Beaujeux P, Dureau P, Edelson C, Caputo G. Incidence and risk factors of glaucoma following pediatric cataract surgery with primary implantation. Am J Ophthalmol. 2021;224:1-6. PMID: 32950509.
13. Pfeifer W. Managing pediatric cataract patients: amblyopia treatment and binocularity outcomes. J Binocul Vis Ocul Motil. 2023;73(4):109-14. PMID: 37931117.
14. Oshika T, Endo T, Kurosaka D, Matsuki N, Miyagi M, Mori T, et al. Long-term surgical outcomes of pediatric cataract-multivariate analysis of prognostic factors. Sci Rep. 2023;13(1):21645. PMID: 38062153; PMCID: PMC10703864.
15. Demirkılınç Biler E, Yıldırım Ş, Üretmen Ö, Köse S. Long-term results in pediatric developmental cataract surgery with primary intraocular lens implantation. Turk J Ophthalmol. 2018;48(1):1-5. PMID: 29576890; PMCID: PMC5854852.
16. Cao K, Wang J, Zhang J, Yusufu M, Jin S, Hou S, et al. Efficacy and safety of vitrectomy for congenital cataract surgery: a systematic review and meta-analysis based on randomized and controlled trials. Acta Ophthalmol. 2019;97(3):233-9. PMID: 30565873; PMCID: PMC6587933.
17. Solebo AL, Rahi JS; British Congenital Cataract Interest Group. Visual axis opacity after intraocular lens implantation in children in the first 2 years of life: findings from the IoLunder2 cohort study. Ophthalmology. 2020;127(9):1220-6. PMID: 32312636.
18. Şimşek Ş, Yazıcıoğlu A. İntraoküler lens uygulanan konjenital katarakt olgularında komplikasyonların yaş gruplarına göre değerlendirilmesi [Evaluation of complications in intraocular lens implanted congenital cataract cases according to age groups]. Türkiye Klinikleri J Ophthalmol. 2004;13:211-5. https://search.trdizin.gov.tr/en/yayin/detay/45678/intraokuler-lens-uygulanan-konjenital-katarakt-olgularinda-komplikasyonlarin-yas-gruplarina-gore-degerlendirilmesi
19. Nurözler A, Ünlü N, Aslan BS, Duman S, Canlı A. Konjenital kataraktlarda vizüel prognoza etki eden faktörler. T Klin Oftalmoloji. 1998;7:169-74.
20. Hosal BM, Biglan AW. Risk factors for secondary membrane formation after removal of pediatric cataract. J Cataract Refract Surg. 2002;28(2):302-9. PMID: 11821214.
21. 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(12):1585-8. PMID: 10609200.
22. Kim SJ, Slinger K, Lambert SR, Koo E, Shue A, Roberts TL. Strabismus and nystagmus in patients with pediatric cataracts: study using insurance claims data. Am J Ophthalmol. 2023;248:87-95. PMID: 36410473; PMCID: PMC11088441.
23. Abadi RV, Forster JE, Lloyd IC. Ocular motor outcomes after bilateral and unilateral infantile cataracts. Vision Res. 2006;46(6-7):940-52. PMID: 16289271.
24. Lambert SR, Lynn MJ, Reeves R, Plager DA, Buckley EG, Wilson ME. Is there a latent period for the surgical treatment of children with dense bilateral congenital cataracts? J AAPOS. 2006;10(1):30-6. PMID: 16527677.
25. Chen TC, Bhatia LS, Walton DS. Complications of pediatric lensectomy in 193 eyes. Ophthalmic Surg Lasers Imaging. 2005;36(1):6-13. PMID: 15688966.
26. Chen TC, Walton DS, Bhatia LS. Aphakic glaucoma after congenital cataract surgery. Arch Ophthalmol. 2004;122(12):1819-25. PMID: 15596586.
27. Vishwanath M, Cheong-Leen R, Taylor D, Russell-Eggitt I, Rahi J. Is early surgery for congenital cataract a risk factor for glaucoma? Br J Ophthalmol. 2004;88(7):905-10. PMID: 15205235; PMCID: PMC1772229.
28. Kugelberg M, Kugelberg U, Bobrova N, Tronina S, Zetterström C. Implantation of single-piece foldable acrylic IOLs in small children in the Ukraine. Acta Ophthalmol Scand. 2006;84(3):380-3. PMID: 16704702.
29. Zhu XN, Yu F, Xing XY, Zhao YE, Gong XH, Li J. [Comparison of effects of secondary in-the-bag and sulcus intraocular lens implantation in pediatric aphakia after congenital cataract operation]. Zhonghua Yan Ke Za Zhi. 2013;49(8):700-5. Chinese. PMID: 24246808.