Clinics of Surgery

Research Article

ISSN 2638-1451 | Volume 4

Comparison Between Limbal and Combined Limbal and Pars Plana Approaches Using Vitrectomy to Remove Congenital Cataracts with Primary Intraocular Lens Implantation in Yemen

Alshamahi EYA[1] and Al-Shamahy HA[2*]

[1]Ophthalmology Department, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen

[2]Medical Microbiology and Clinical Immunology Department, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen

***Corresponding author:**

Hassan A. Al-Shamahy,
Faculty of Medicine and Heath Sciences,
Sana'a University, P.O. Box 775 Sana'a, Yemen,
Tel: +967-1-239551, +967-770299847,
E-mail: shmahe@yemen.net.ye

Received: 25 Jan 2021
Accepted: 11 Feb 2021
Published: 17 Feb 2021

Keywords:

Congenital Cataracts; Intraocular Lens Implantation; Limbal and combined limbal and pars plana; Pars plana; Vitrectomy; Yemen

Citation:

Alshamahi EYA, Comparison Between Limbal and Combined Limbal and Pars Plana Approaches Using Vitrectomy to Remove Congenital Cataracts with Primary Intraocular Lens Implantation in Yemen. Clin Surg. 2021; 4(8): 1-7.

1. Abstract

1.1. Background: There are two approaches for cataract extraction, primary posterior capsulotomy and anterior vitrectomy with primary intraocular lens implantation using the vitrectomy system: Through the Limbal or Pars plana.

1.2. Aims: To compare the results in both approaches with some modifications in the pars plana approach, using combined limbal and pars plana approach in group B.

1.3. Methods: All children with congenital, traumatic pediatric cataracts who underwent cataract removal via limbal or combined limbal and pars plana approaches with primary IOL implantation were reviewed prospectively between August 2009 and August 2018 at the Al-Thawra Modern Hospital and at the Eye Consultation Center in Sana'a city. Main outcome measures included complications and the need of second surgery were reviewed.

1.4. Results: The study included 22 patients (25 eyes) whose mean age ± SD was 14.3 ± 12.8 months in the limb group; and 38 patients (46 eyes) whose mean ± SD age was 13.2 ± 13.3 months in the combined limbal and Pars plana group. Follow-up time was 46.9 ± 7.4 months for limb group and 42.8 ± 10 months for combined limbal and Pars plana group. Significantly, more eyes (32%) had at least one complication after the operation in the limbal group than 10.9% in the combined limbal and Pars Plana group ($P = 0.0293$) which were essentially; tilted IOL, vitreous prolapse, distorted pupil and opacefied post capsule in group A, opacefied post capsule and pupillary membrane in group B. More eyes in the limbal group had postoperative complications than in combined limbal and pars plana group and required additional surgery.

1.5. Conclusions: visual and optical results were encouraging in our modified combined limbal and pars plana approach. We recommend the combined limbal and pars plan approach for all pediatric cataract which reduces intraoperative manipulation and postoperative complications.

2. Introduction

One of the main causes of preventable child blindness is Pediatric cataracts, which affects nearly 200,000 children worldwide, and the prevalence rate is estimated to be between three to six per 10,000 live births [1]. Cataracts in children may be congenital if present during the first year of life, or developmental if present after feeding, or traumatic. Controversy persists over the optimal timing of congenital cataract surgery, which poses challenges for pediatric ophthalmologists [2]. Some studies have shown that early surgery is associated with a greater prevalence of secondary

membrane formation and the development of autonomic glaucoma [2-4]. The application of inappropriate surgical interventions in children may not only fail to restore visual function, but may also cause irreversible effects on the development of the eyeball [5, 6]. Delayed cataract surgery in infants increases the risk of developing resistance to strabismus treatment and reducing potential visual functions [7]. Consequently, pediatric surgeons have required to finalize lens removal surgery for the period of the very early times of life [8]. The use of vitreous aspirators for basic posterior capsulotomy and anterior vitrectomy in the mid-1970s revolutionized pediatric cataract surgery [9]. The introduction of microincision vitrectomy tools reduces microscopic injuries and infections resulting from the surgical procedure, thus accelerating recovery after surgery and enable immediate visual improvement and amblyopic treatment [10]. To perform lentectomy there are two methods of primary posterior capsulotomy and anterior vitrectomy using the vitrectomy system in managing congenital cataract: by the limbus [11, 12] or by the pars plana [13, 14] approaches. This prospective randomized study was conducted to compare the results of the Limbal against combined limbal and pars plana approaches using vitrectomy system with some modifications in the pars plana approach.

3. Materials and Methods

3.1. Patients: A prospective review of all patients with congenital cataracts who underwent cataract removal through the limbal or a combined limbal and pars plana approaches with the primary IOL implantation between August 2009 and August 2018 in Al-Thawra Modern Hospital (the main referral hospital in Yemen) and in the Eye Consultant Center in Sana'a, the clinical registration number was ES-OC-2009-2018. The parents' consent of all the participating children was obtained with the informed consent of the parents. Exclusion criteria were; sublaxated lens and traumatic cataract associated with infection at presentation time.

3.2. Surgical Procedures: Two hours prior to surgery, pupil was dilated with phenylephrine 2.5%, tropicamide 1% applied three times at ½ hour intervals. All surgeries were performed under general anesthesia by one surgeon (Alshamahi E) using the S4 Geuder machine (Germany) and Dorc vitrectomy machine (Italy). Anesthesia was especially deep during IOL implantation, otherwise the positive vitreous pressure would have led to capsular collapse, making IOL implantation difficult, and could led to IOL migration through the posterior capsule opening to the vitreous cavity in the group A limbal approach.

3.3. Group A Limbal Approach

3.3.1. Wound Configuration: Using super blade, two limbal self-sealed incisions were done at 10 and 2 o'clock positions. These incisions were made to adapt the vitrector and infusion cannula only, to prevent anterior camper fluctuation during surgery, which damages the corneal endothelium.

3.3.2. Anterior Capsulorrhexis and Ocular Viscoelastic Device: Trypan blue (0.6%) was injected into the anterior chamber to improve visualization of the anterior capsule. A cohesive viscoelastic (sodium hyluronate 1.4%) was used to facilitate anterior capsulorrhexis as it maintains anterior chamber stability, and help offset the low scleral rigidity and increased vitreous up thrust found in pediatric eyes. Since the lens capsule in children behaves completely differently from adults, mainly for flexibility and tensile strength, we recommend the use of capsulorrhexis forceps rather than cystotom for better control of the anterior capsulorrhexis. The central anterior capsulotomy were created with a diameter of 5.0-5.5 mm. Sodium hyluronate should be removed now.

3.3.3. Hydrodissection: Hydrodissection is known to be essential to ensure the maximum removal of the lens the cortex and epithelial cells of the lens from the equatorial region. It is performed by injecting ringer lactate or a balanced salt solution via a 3 ml syringe with a 27 G cannula under the margin of the capsulorrhexis into both limbal incisions.

3.3.4. Cataract Removal: Using the vitrector, the lens material was removed at a cut rate of 600 cuts per minute and a maximum suction pressure of 400 mmHg. The lens material was removed using the aspiration mode alone, without activating the cutting mode. However membranous or calcified cataract may need to activate the cutting mode. Every effort should be made to remove all lens matter, to reduce postoperative inflammation.

3.3.5. Posterior Capsulorrhexis, whether manually or using the vitrector was done, and limited anterior vitrectomy was carried out with the irrigation cannula in the 2 o'clock limbal position.

3.3.6. Intraocular Lens Implantation: For children in the limbal group, IOL (EYECRYL PLUS, Acrylic foldable IOL with delivery system, 360 advanced square edge, BIOTECH, India) implantation was performed after posterior capsulorrhexis and limited anterior vitrectomy. Implantation does not go smoothly, and IOL may migrate through the posterior capsulorrhexis to the vitreous cavity. Furthermore, the vitreous prolapse through posterior capsulorrhexis to the anterior chamber due to continuous globe irrigation with ringer lactate or balanced salt solution during anterior vitrectomy which hinders IOL implantation in the bag. Prolapsed vitreous causes IOL decentration, tilting, distorted pupil and persistent postoperative inflammation. Every effort should be made to implant in the bag to minimize postoperative complications. In some eyes especially after trauma, in which the posterior capsule was ruptured, making the foldable IOL implant unsafe, PMMA IOL (one single piece PMMA intraocular lens, BIO VISION, MODEL B55125C, 12.5 mm, 5.5 mm optic diameter, BIOTECH,

India) was implanted in the capsular bag. Viscoelastic material is finally removed from the capsular bag and the anterior chamber.

3.3.7. Wound Closure: The limbal incision at 10 o'clock position was closed with one 10-0 nylon suture, and stromal hydration of limbal incision at 2 o'clock position was done. In some cases, there was ocular hypotony, pars plana saline was injected using insulin tip attached to a 3 cc syringe, to reform the globe. Finally, gentamicin and dexamethasone was subconjunctivally injected.

3.4. Group B Combined Limbal and Pars Plana Approach:

Superior rectus suturing was taken with 4/0 silk suture. The conjunctiva was opened in the 9-12 o'clock position to expose pars plana, and to cauterize sclera 2-2.5 mm posterior to limbus.

Wound Configuration was done in a similar fashion mentioned in group A limbal approach. Anterior capsulorrhexis and ocular viscoelastic device was done in a similar fashion mentioned in group A limbal approach.

Hydrodissection was done in a similar way mentioned in group A limbal approach.

Cataract removal was done in a similar way mentioned in group A limbal approach.

3.4.1. Intraocular Lens Implantation: For children in the combined limbal and pars plana approach, the limbal incision at 10 o'clock position was enlarged to 2.8 mm. The capsular bag was then filled with methyl cellulose and the IOL (EYECRYL PLUS, Acrylic foldable IOL with delivery system,360 advanced square edge, BIOTECH, India) was implanted in the capsular bag. Implantation in the bag in this group goes smoothly, since the posterior capsule is still intact and there is no vitreous prolapse to the anterior chamber. The limbal incision at 10 o'clock position was then closed with one 10-0 nylon suture. In some eyes especially after trauma, in which the posterior capsule was ruptured, making foldable IOL implantation unsafe, PMMA IOL (one single piece PMMA intraocular lens, BIO VISION, MODEL B55125C, 12.5 mm, 5.5 mm optic diameter, BIOTECH, India) was implanted in the capsular bag. Viscoelastic material was finally removed from the capsular bag and anterior chamber.

3.4.2. Posterior Capsulorrhexis and Anterior Vitrectomy: Following the intraocular lens implantation, the limbic wound is closed with a 10/0 nylon suture. A pars plana incision was performed at the 10 o'clock position using MVR. Since pars plana is not well developed in young children, the options for scleral incision sites vary with each child's age. In our series, a sclerotomy site was chosen 2 mm posterior to the limbus in patients between 5 months to 2 years and 2.5 mm in those between 2 to 6 years. A 20 (or 23) gauge vitrectomy cutter was introduced. Central posterior capsulotomy and limited anterior vitrectomy with a cutter were performed in the same location described above. The infusion cannula was inserted through the limbal port incision at 2 o'clock position, to uphold the anterior chamber with BSS or ringer lactate. The height of infusion bottle was (55-60 cm), otherwise iris will prolapse through limbal wounds (Figure 1).

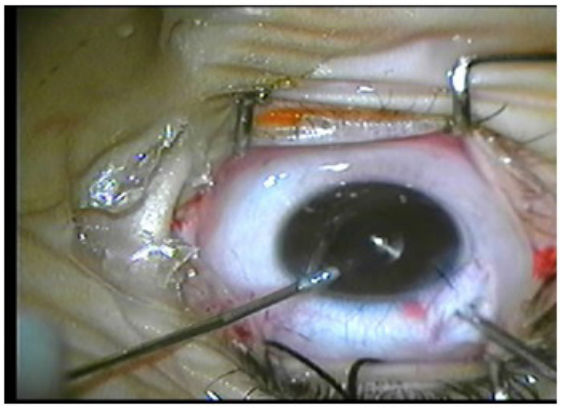

Figure 1: Photo capture of posterior capsulotomy and anterior vitrectomy, using vitrectom, after IOL implantation in the bag in group B combined limbal and pars plana approach.

3.4.3. Wound Closure: After performing posterior capsulorrhexis and anterior vitrectomy, the pars plana incision was closed with 8-0 vicryl suture. Closing the scleral incision should be lamellar not full thickness. The conjunctiva was closed by 8-0 vicryl sutures. Finally, stromal hydration of limbal incision at 2 o'clock position was done. In some eyes there were ocular hypotony, pars plana saline injection was done, using insulin tip attached to 3 cc syringe. Finally, gentamycin and dexamethasone were subconjunctivally injected. Postoperative systemic steroids and combined antibiotic, steroids drop and ointment were prescribed for each patient.

4. Result

Seventy-one eyes were included (60 patients). Twenty-five eyes in group A limbal approach, and forty-six eyes in group B combined limbal and pars plana approach. The mean age at the time of surgery in group A was 14.3 ± 12.8 months, the mean age at the time of surgery in group B was 13.2 ± 13.3 months (p = 0.75) (Table 1). The mean ±SD follow-up time in group A was 46.9 ± 7.4 months and the mean ±SD follow-up time in group B was 42.8±10 months (P = 0.09) (Table 2). When the traumatic eyes were excluded, postoperative complications in group A occurred in 32% of eyes, while postoperative complications in group B occurred in only 10.9% of eyes. This difference was statistically significant (P= 0.0293) (Table 2). When the traumatic eyes were included, the postoperative complications in group A occurred in 40% of eyes, while postoperative complications in group B occurred in 15.2% of eyes. The difference was also statistically significant (P = 0.0202) (Table 2). The most frequent complications in group A were tilted IOL, distorted pupil and astigmatism occurred in 4 eyes (16%) due to vitreous prolapse to AC, while such complication did

not occur in any child in group B and the P value was significant (0.0056). Posterior capsule opacification occurred in two children (8%) in group A and in three children (6.5%) of group B, the P value was (0.8146). Pupillary membrane formation occurred in three children (12%) of group A and in two children (4.3%) of group B, the P value was (0.2282) (Table 3). 2nd operation was done for two children (8%) of group A complicated by tilted IOL, distorted pupil, astigmatism, one of them the IOL was replaced with hard PMMA (optic diameter 5.5 mm), due to pigment deposition. IOL correction was done for the other child. Since such complication did not occur in any child in group B, the P value was significant (0.05) (Table 4). The second operation was performed on one child (4%) from group A complicated by opacity of the posterior capsule for posterior capsular enlargement and for two children (4.3%) from group B, the P-value was (0.9369). Subcutaneous trabeculectomy was performed with MMC of a single microscopic eye (4%) of group A complex with increased IOP. Such complication did not occur in any child in group B, the P value was (0.1750). One eye (2.2%) of group B who developed esotropia during the follow up period because she did not wear the prescribed glasses, squint correction was done for her. Such complication did not occur in any child in group A and the P value was (0.458). Intravitreal antibiotics injection was done for one child of group B who developed postoperative bleb related endophthalmitis (the 1ry surgery for her was combined lensectomy and subscleral trabeculectomy), Pupillary membrane formation in both groups was not dense and did not require surgery.

Table 1: The demographic data of children under cataract surgery by Limbal and combined limbal and Pars plana approaches, Sana'a, Yemen

Characteristics	Limbal and combined limbal approach GPA Patients n=22 Eyes n=25	Pars plans GPB Patients n=38 Eyes n=46	P value
Age at surgery (months)			
Mean ± SD	14.3 ± 12.8 months	13.2 ± 13.3 months	0.75
Range	5 – 48 months	5 – 60 months	0.75
Mode	6 months	8 months	0.75
Variance	163.8 moths	173.3 moths	0.75
Age groups			
1--6 months	9 (40.9%)	16 (42.1%)	0.95
7-12 months	6 (27.3%)	14 (36.8%)	0.45
≥ 13 months	7 (31.8%)	8 (21.1%)	0.03
Sex			
Male	12 (54.5%)	21 (55.3%)	0.95
Female	10 (45.5%)	17 (44.7%)	0.95

Table 2: Follow up time, eye side, and complication rate for children underwent cataract surgery by Limbal and combined limbal and Pars plana approaches, Sana'a, Yemen

	Limbal and combined limbal GPA Eyes n=25 GPA	Pars plans GPB Eyes n=46	P value
Follow up after surgery (months)			
Mean ± SD	46.9 ± 7.4 months	42.8 ± 10 months	0.09
Range	36 – 60 months	18 – 60 months	0.09
Mode	42 months	48 months	0.09
Variance	54.4 moths	100.7 moths	0.09
Eye side			
Unilateral	19 (86.4%)	30 (79%)	0.47
Bilateral	3 (13.6%)	8 (21%)	0.47
Left only	8 (36.4%)	15 (39.5%)	0.81
Right only	11(50%)	15 (39.5%)	0.43
Complications (Trauma cases were excluded)			
Positive	8 (32%)	5 (10.9%)	0.0293*
Negative	17 (68%)	41 (89.1%)	
Complications (Trauma cases were included)			
Positive	10 (40%)	7 (15.2 %)	0.0202*
Negative	15 (60%)	39 (84.8%)	

**significant*

Table 3: The complications occurrence in children under cataract surgery by Limbal and combined limbal (A) and Pars plana (B) approaches, Sana'a, Yemen

Complications	Group A N=25	Group B N=46	P value
Tilted IOL, distorted pupil, astigmatism	4 (16 %)	0 (0%)	0.0056
↑ IOP	1 (4%)	0 (0%)	0.175
Posterior capsule opacification	2 (8%)	3 (6.5%)	0.8146
Pupillary membrane formation	3 (12%)	2 (4.3%)	0.2282
Exotropia during the follow up period	0 (0%)	1 (2.2%)	0.4583
Bleb related endophthalmitis	0 (0%)	1 (2.2%)	0.4583

Table 4: Additional surgeries required postoperatively according to the adverse events that occurred in each group

Complications	Group A N=25	Group B N=46	P value
IOL tilted IOL, vitreous prolapse, distorted pupil	2 (8%)	0 (0%)	0.05 *
Posterior capsule opacification	1 (4%)	2 (4.4%)	0.9369
↑ IOP	1 (4%)	0 (0%)	0.175
Exotropia, not wearing glasses	0 (0%)	1 (2.2%)	0.4583
Total complications	4 (16%)	3 (6.5%)	0.2026

5. Discussion

In our study, children less than 6 months' account for 40.9% of group A and 42.1% of group B. we started surgery for significant congenital cataract in the beginning of the fifth month, and we found that in group A four out of the nine children (44.4%) had complications, two children had tilted IOL, pigment deposition, synaechia, and distorted pupil due to vitreous prolapse to anterior chamber. 2nd operation was done for the two children, one of them the IOL was replaced with hard PMMA (optic diameter 5.5 mm), due to pigment deposition. IOL correction was done for the other child. One microphthalmic eye developed increase IOP, 2nd subsceral trabeculectomy with MMC surgery was done for her. One child had posterior capsule opacification, 2nd surgery was done to enlarge the posterior capsule opening. In group B, two children out of sixteen (12.5%) developed complications, one child developed opacification of the posterior capsule, 2nd surgery was done to enlarge the posterior capsule. The other child developed bleb related endophthalmitis due to poor hygiene (the primary surgery was subsceral trabeculectomy with MMC and cataract surgery), intravitreal ceftazidim and vancomycin were injected. We concluded that cataract surgery and primary IOL implantation in children less than six months is safe and effective with minimal complications, especially in group B. It is now well established that the critical period for surgery for unilateral congenital cataracts is from birth to six weeks of age, whereas in the case of massive bilateral cataract, permanent sensory deprivation can occur if surgery is delayed by more than three to four months' age [15].

Regarding IOL implantation, Trivedi et al. report visual axis opacity using AcrySof IOL in 37.9% of children less than one-year-old even though a primary posterior capsulorrhexis with anterior vitrectomy had been performed [16]. Lambert SR et al, concluded in their preliminary data, that correcting aphakia after unilateral congenital cataract surgery with primary IOL implantation results in an improved visual outcome but with a higher rate of complications requiring reoperation [17]. Perucho-Martínez et al, found that the best visual acuity was achieved in eyes when treated with early primary IOL, but they had a higher rate of complications (Visual Axis Opacification), in a series of congenital cataracts treated with different surgical techniques (primary intraocular lens implantation vs aphakia) [18]. Our study supports the finding of Koch et al study, who concluded that primary IOL implantation and primary posterior capsulitis with anterior vitrectomy in the first two years of life is a secure and efficient way for aphakic correction [19].

5.1. Regarding the Surgical Approach: Buckley et al, performed endocapsular cataract extraction, a vitrectomy instrument was inserted through the Pars-Plana incision and used to create the posterior capsular incision and anterior vitrectomy. Primary posterior chamber intraocular lens implantation was done in all patients with unilateral traumatic, radiation-induced, and developmental cataracts. Optical axons were rapidly restored in all patients without additional intervention of posterior capsule opacity. Visual acuity returned to 20/40 or better in all patients. No complications occurred attributable to the intraoperative removal of the posterior capsule [20]. Ahmadieh et al, compared the results of a limbal versus a pars plana approaches with primary posterior capsulectomy and anterior vitrectomy in the management of childhood cataract. No visual acuity, IOL position, or postoperative complications were found to be statistically significant between the limbal versus pars plana [21]. Liu et al, comparing between limbal and pars plana approaches using microincision vitrectomy for removal of congenital cataracts with primary intraocular lens implantation, found that significantly, more eyes had at least one intraoperative complication in the limbal group than in the pars plana group ($P = 0.03$). More complications were associated with disturbance and irritation to the iris in the limbal group [22]. Our study supports their finding in that postoperative complications (Trauma cases were excluded) in limbal approach (32%) were higher than in the combined limbal and pars plana group (10.9%), and this difference was significant ($p = 0.0293$) (Table 2). when trauma cases were included, post-operative complications in limbal approach (40%) were higher than in the combined limbal and pars plana group (15.2 %), and this difference was significant ($p = 0.0202$) (Table 2). These results despite the difference between our surgical method in Group B the combined limbal and the Pars Plana group from their approach to Pars Plana. These finding despite the deference between our surgical technique in group B combined limbal and pars plana group from them in the pars plana approach. They introduce the vitrectom from pars plana/plicata to lens substance and by directing the opening of the vitrectom, they performed anterior capsulotomy, lensectomy, posterior capsulotomy and anterior vitrectomy then via new limbal incision at 12 o'clock position they implanted the IOL i.e. they implant the IOL after performing posterior capsulotomy and anterior vitrectomy. In contrast to our approach in group B, we performed anterior capsulorrhexis, lensectomy using vitrectom and IOL implantation firs through limbal incision, then through the pars plana, the vitrectom is introduced into the vitreous cavity posterior to the posterior capsule to perform posterior capsulotomy and anterior vitrectomy i.e. after IOL implantation (Figure 1).

5.2. Regarding The Types of Complications: Because the posterior capsule and the anterior vitreous face act as scaffolds for the visual axis opacification. Curvilinear capsulorrhexis and anterior vitrectomy in infants may interrupt the development of visual axis opacification and consequently reduce the rate of secondary cataracts [23-25]. Koch et al, in their series, noted re-opacification of the visual axis in 13.3% of the eyes despite primary posterior capsulorrhexis and anterior vitrectomy [19]. Our study demonstrates great reduction visual axis opacification, especially in group B

(6.5%) (Table 3). Koch et al. evaluated the long-term postoperative problems of pediatric cataract surgery, intraocular primary lens implantation (IOL) associated with posterior capsulotomy and anterior vitrectomy in patients treated with a corneal or pars plicata/pars plana approach. The researchers found that the most common postoperative complication was corectopia, followed by visual axis opacification (VAO); and VAO was defined as the regrowth of lens material extending to the pupillary space that obscures the optic axis [26]. Both complications occurred more frequently in group 1 ($P < 0.001$). our study strongly supports their finding in both the types of complications and the frequency of their occurrence in both groups, tilted IOL and distorted pupil (corectopia) due to vitreous prolapse occurred in (16 %)) of group A while in group B none of the children developed such complication (0 %) ($p = 0.0056$). Posterior capsule opacification occurred in 8% of group A and 6.5% of group B. Three children (12%) in group A developed pupillary membrane formation and two children (4.3%) of group B.

6. Conclusion

Based on the impressive visual and optical results obtained from the combined limbal and pars plana approach, all congenital cataract surgeries are now performed using this approach including microphthalmic and PHPV eyes. We abundant using the limbal approach. We recommend our modified technique for all pediatric cataract as it reduces intraoperative manipulations and postoperative complications. The limbal method should be kept for children older than 8 years, who are cooperative for YAG posterior capsulotomy.

References

1. Lim ME, Buckley EG, Prakalapakorn SG. Update on congenital cataract surgery management. Curr Opin Ophthalmol. 2017; 28: 87-92.
2. Birch EE, Cheng C, Stager DR, Weakley DR, Stager DR. The critical period for surgical treatment of dense congenital bilateral cataracts. J AAPOS. 2009; 13(1): 67-71.
3. Sheeladevi S, Lawrenson JG, Fielder AR, Suttle CM. Global prevalence of childhood cataract: a systematic review. Eye. 2016; 30: 1160-9.
4. Kuhli-Hattenbach C, Fronius M, Kohnen T. Impact of timing of surgery on outcome in children with bilateral congenital cataract. Der Ophthalmologe. 2017; 114(3): 252-8.
5. Medsinge A, Nischal KK. Pediatric cataract: challenges and future directions. Clin Ophthalmol. 2015; 9: 77-90.
6. Long E, Lin H, Liu Z, Wu X, Wang L, Jiang J, et al. An artificial intelligence platform for the multihospital collaborative management of congenital cataracts. Nature Biomedical Engineering. 2017; 1(2): 1-8.
7. Gasper C, Trivedi RH, Wilson ME. Complications of pediatric cataract surgery. Dev Ophthalmol. 2016; 57: 69-84.
8. Kugelberg U. Visual acuity following treatment of bilateral congenital cataracts. Doc Ophthalmol. 1992; 82(3): 211-5.
9. Lambert SR. Changes in ocular growth after pediatric cataract surgery. Pediatr Cataract. 2016; 57: 29-39.
10. Fujii GY, De Juan E, Humayun MS, et al. Initial experience using the transconjunctival sutureless vitrectomy system for vitreoretinal surgery. Ophthalmology. 2002; 109(10): 1814-20.
11. Li SY, Zhang ZP, Ji SJ, Liu HY, Si MY, Fan KS. Application of minimally invasive 23G vitrectomy via corneal approach for the treatment of pediatric cataract. European Review for Medical and Pharmacological Sciences. 2014; 18(17): 2413-8.
12. Biglan AW. Modification of the high-speed vitrectomy system TSV 25 for pediatric cataract surgery. Journal of Cataract and Refractive Surgery. 2005; 31(12): 2257-60.
13. Raina UK, Bhambhwani V, Gupta A, Bhushan G, Seth A, Ghosh B. Comparison of Transcorneal and Pars Plana Routes in Pediatric Cataract Surgery in Infants Using a 25-Gauge Vitrectomy System. J Pediatr Ophthalmol Strabismus. 2016; 53(2): 105-12.
14. Tartarella MB, Fortes Filho JB. Twenty-five-gauge sutureless lensectomy in infants with congenital cataract. J AAPOS. 2017; 21(5): 393-6.
15. Birch EE, Cheng C, Stager DR Jr, Felius J. Visual acuity development after the implantation of unilateral intraocular lenses in infants and young children. J AAPOS. 2005; 9: 527-32.
16. Trivedi RH, Wilson ME Jr, Bartholomew LR, Lal G, Peterseim MM. Opacification of the visual axis after cataract surgery and single acrylic intraocular lens implantation in the first year of life. J AAPOS. 2004; 8: 156-64.
17. Lambert SR, Lynn M, Drews-Botsch C, Loupe D, et al. A Comparison of Grating Visual Acuity, Strabismus, and Reoperation Outcomes Among Children with Aphakia and Pseudophakia After Unilateral Cataract Surgery During the First Six Months of Life. J AAPOS. 2001; 5(2): 70-5.
18. Perucho-Martínez S, Tejada-Palacios P, de-la-Cruz-Bertolo J. Congenital Cataracts: Complications and Functional Results According to Different Surgical Techniques. Arch Soc Esp Oftalmol. 2010; 85(1): 16-21.
19. Koch CR, Kara-Junior N, Serra A, Morales M. Long-term results of secondary intraocular lens implantation in children under 30 months of age. Eye. 2018; 32(12): 1858-63.
20. Buckley EG, Klombers LA, Seaber JH, Scalise-Gordy A, Minzter R. Management of the posterior capsule during posterior capsule during pediatric intraocular lens implantation. Am J Ophthalmol. 1993; 115: 722-8.
21. Ahmadieh H, Javadi MA, Ahmady M, et al. Primary capsulectomy, anterior vitrectomy, lensectomy, and posterior chamber lens implantation in children: limbal versus pars plana. Journal of Cataract and Refractive Surgery. 1999; 25 (6): 768-75.

22. Liu X, Zheng T, Zhou X, et al. Comparison between Limbal and Pars Plana Approaches Using Microincision Vitrectomy for Removal of Congenital Cataracts with Primary Intraocular Lens Implantation. Journal of Ophthalmology. 2016; 2016(17): 1-10.

23. Fenton S, O'Keefe M. Primary posterior capsulorhexis without anterior vitrectomy in pediatric cataract surgery: longer-term outcome. J Cataract Refract Surg. 1999; 25(6): 763-7.

24. Gawad SA, Awad EA, Saleh S, Ellayeh A. Twenty-three-gauge pars plana approach versus limbal approach for removal of congenital cataracts. J Egypt Ophthalmol Soc. 2019; 112: 90-8.

25. Koch DD, Kohnen T. Retrospective comparison of techniques to prevent secondary cataract formation after posterior chamber intraocular lens implantation in infants and children. J Cataract Refract Surg. 1997; 23(Suppl 1): 657-63.

26. Koch CR, Kara-Junior N, Santhiago MR, Morales M. Comparison of different surgical approaches for pediatric cataracts: complications and rates of additional surgery during long-term follow-up. CLINICS. 2019; 74: 966.