ORIGINAL ARTICLE

Foldable posterior chamber intraocular lens implantation into the anterior chamber in aphakia treatment: Retrospective observational case series

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ABSTRACT

Purpose: The purpose of the study was to report the long term results of implantation of a foldable posterior chamber intraocular lens (PCIOL) into the anterior chamber (AC) in aphakia treatment.

Materials and Methods: Patients with aphakia who underwent foldable PCIOL implantation into the AC were included in the study. Haptics of PCIOL were passed to PC through two iridectomies. Preoperative and postoperative best corrected visual acuity (BCVA), postoperative lenticular astigmatism, perioperative and postoperative complications were recorded. Anterior chamber depth (ACD) was measured by ultrasonic biomicroscopy at 1 year.

Results: Fifty-one eyes of 51 patients were included in the study. Of these eyes, 21 were examined for 10 years postoperatively. The mean preoperative BCVA was 1.06 ± 0.68 LogMAR and the mean postoperative BCVA was 0.49 ± 0.44, 0.49 ± 0.44, and 0.45 ± 0.39 LogMAR at postoperative 1, 2, and 10 years, respectively. The mean lenticular astigmatism was 0.96 ± 0.78 D at 1 year. Glaucoma in 11 eyes, retinal detachment (RD) in 3 eyes, cystoid macular edema (CME) in 6 eyes, corneal decompensation in 11 eyes, and haptic dislocation in 7 eyes were observed postoperatively. The mean ACD was measured as 3.03 ± 0.29 mm at 1 year postoperatively.

Conclusions: We obtained comparable visual outcomes to other IOL implantation techniques in aphakia treatment. The advantage of using the foldable PCIOL to treat aphakia was the lack of the need for special design IOLs. The technique can be useful in aphakia treatment especially in developing countries.

Keywords: Absence of capsular support, absence of zonular support, aphakia, foldable intraocular lens, iris sutured intraocular lens.

INTRODUCTION

The intraocular lens (IOL) cannot be implanted intracapsular or sulcus in eyes with capsular insufficiency. Various IOL implantation techniques have been described to treat aphakia in previous studies.[1-5] Anterior chamber IOL (ACIOL) can be implanted in such cases; however, surgeons are undecided to use ACIOL in young patients or patients with glaucoma, uveitis, shallow anterior chambers, or endothelial dysfunction.[1,6] Due to these limitations of ACIOL, the scleral fixation (SF) technique has been developed to treat aphakia. However, late-term IOL dislocation and suture erosion were reported in previous studies, and a longer operative time was achieved with the SF technique.[6,7] A technique in which the haptics of the IOL were flanged with cauterization to fixate in the sclera was reported in recent studies.[5,8] However, only three piece PCIOL with strong and flexible haptics is recommended for this technique. Kükner et al.[9] described a foldable PCIOL implantation into the AC with the haptics passing through two iridectomies to the PC for the first time in 2014. Thirty three eyes of 33 patients were operated with this technique and the postoperative results were found to be reliable.

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The purpose of the study was to report the long term results of a foldable PCIOL implantation into the AC with the haptics passing through two iridectomies to the PC in aphakia treatment.

MATERIALS AND METHODS

This retrospective analysis comprised 51 eyes of 51 patients who underwent foldable PCIOL implantation into the AC at Sakarya University Training and Research Hospital between October 2009 and June 2012.

Approval for the study was obtained from the Ethics Committee of the Sakarya University Faculty of Medicine (2022/292). The study was in accordance with the principles of the Declaration of Helsinki. An informed consent form was obtained from all participants.

Patients with at least one year of follow-up were included in the study. Age, sex, cause of failed intracapsular implantation, preoperative and postoperative best corrected visual acuity (BCVA), intraocular pressure (IOP), postoperative gonioscopy, corneal and lenticular astigmatism, and complications were recorded for each patient. Pigment dispersion was classified as no, mild, and moderate on gonioscopic examination according to surgeon experience. The lenticular astigmatism was calculated using vector analysis. ACD was measured by ultrasonic biomicroscopy in all eyes at 1 year postoperatively (Figure 1).

Surgical Technique

All operations were performed by the same senior surgeon (GA) under topical anesthesia. All patients were aphakic and IOL implantation was performed consecutive operation. An anterior vitrectomy was performed if the vitreous was remained in the AC and miosis was provided with carbachol (Miostat®%0.01, Alcon, USA) administration in the AC. The vacuum level of the vitrectomy was adjusted at 50 to 100 mmHg and the frequency at 50 cuts/min. Two iridectomies were performed on the midperipheral iris with a vitrectomy cutter at the 6 and 12 o'clock positions. Safety iridectomy was performed at the 10 o'clock position to prevent pupillary block glaucoma. A single piece foldable PC IOL was implanted in AC with the haptics passing through two iridectomies to PC (Figure 2).

Statistical Analyses

The SPSS (ver. 24, IBM Corp., Armonk, NY, USA) programme was used for statistical analyses. The dependent variables were compared with the Wilcoxon test. If the data showed a normal distribution, the categorical variables were compared with the Anova test. If the data did not show a normal distribution, the categorical variables were compared with the Kruskal–Wallis test. A p-value < 0.01 was statistically significant.

RESULTS

Fifty-one eyes of 51 patients were included in the study. Of these eyes, 21 were examined for 10 years postoperatively. The mean follow-up period was 74.45 ± 38.7 months.

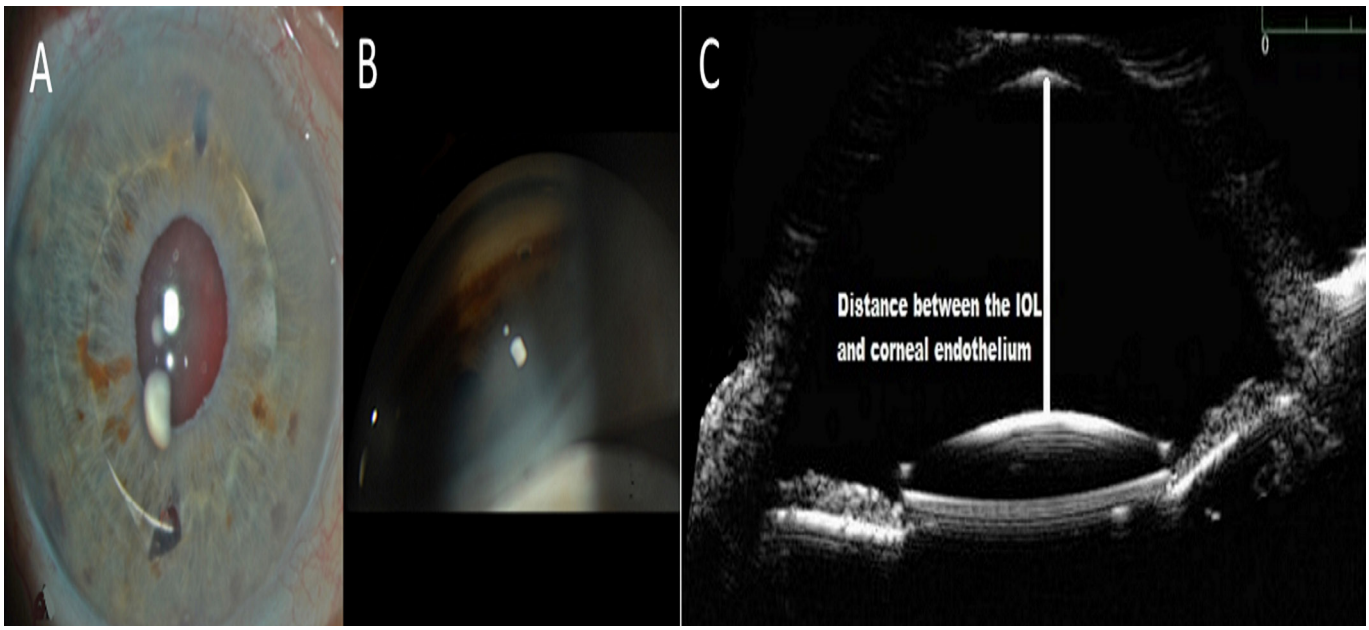

Figure 1: (A) *Anterior segment photo of the patient who underwent implantation of foldable posterior chamber intraocular lens in the anterior chamber with the haptics passing through two iridectomies to the posterior chamber and* **(B)** *Gonioscopic examination of the same patient for pigment dispersion.* **(C)** *Ultrasonic biomicroscopy image of the anterior chamber.*

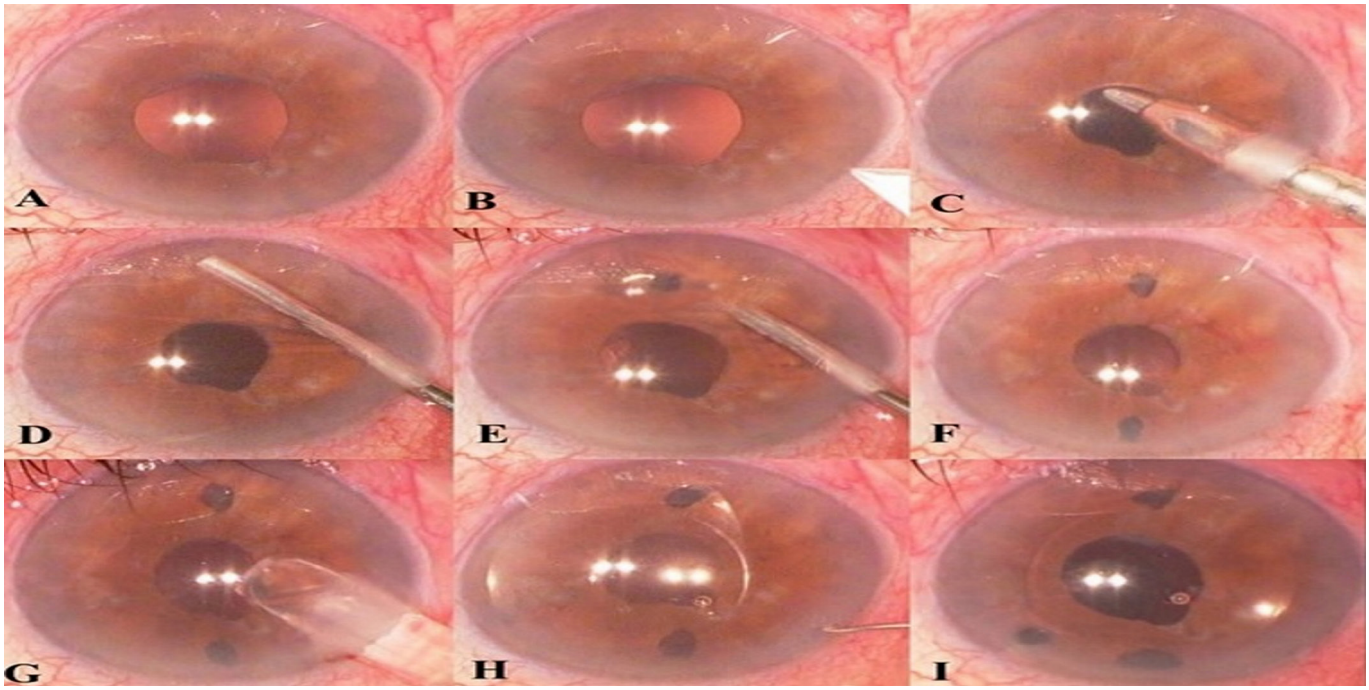

Figure 2: *Surgery technique* **(A)** *Inadequate capsular support was observed after complicated cataract surgery.* **(B)** *The 2.8 mm main incision was made at 11 o'clock.* **(C)** *An anterior chamber was filled with viscoelastic material.* **(D)** *Anterior vitrectomy was performed using a 20-gauge probe.* **(E-F)** *Two iridectomies were created at the 6 and 12 o'clock positions using the same probe at 50-100 mmHg vacuum* **(G)** *Foldable posterior chamber intraocular lens was implanted in the anterior chamber* **(H-I)** *IOL was centralised and safety iridectomy was observed at the 10 o'clock position.*

The patients who were lost to follow-up in the study were evaluated to the best extent possible.

The mean age of the 28 men and 23 women was 70.98 ± 9.16 years (Table 1). The first reason for the failure of intracapsular implantation was complicated cataract surgery (35 eyes, %68.6), the second was cataract surgery after trauma (11 eyes, 21.6%), and the third was spontaneous IOL dislocation (5 eyes, 9.8%).

Table 1: *Demographic data of the patients.*

Parameter	Value
Eyes (N)	51
Right, n (%)	25 (49)
Left, n (%)	26 (51)
Sex	
Female, n (%)	28 (54,9)
Male, n (%)	23 (45,1)
Age (years)	
Mean ± SD	70,98±9,16
Range	36
Reason for surgery, n (%)	
Complicated cataract surgery	35 (68,6)
Trauma	11 (21,6)
Spontan IOL dislocation	5 (9,8)
IOL: Intraocular lens	

The mean preoperative BCVA was 1.06 ± 0.68 logMAR, the mean postoperative BCVA was 0.49 ± 0.44, 0.49 ± 0.44, 0.50 ± 0.42 and 0.45 ± 0.39 ($p<0.01$, at 1, 2, 3 and 10 years respectively compared to baseline). While the mean BCVA was compared to the baseline, statistically significant differences were observed in all visits. However, no statistically significant differences were found between mean BCVA levels postoperatively (Table 2).

The mean corneal astigmatism was found to be – 2.42 ± 1.37 D (range – 6,00 D to 0.50 D) and the lenticular astigmatism was calculated to be 0.96 ± 0.78 D (range 0.25 D to 3.25 D) at 1 year with vector analysis. Fourteen eyes (27.40%) had a postoperative lenticular astigmatism greater than 1.00D, and 8 eyes (15.60%) had more than 2.00D. A statistically significant difference was observed

Table 2: *Follow-up times and post-op visual acuity.*

Follow-up time (Number)	Mean ± SD (min-max)	p* value
Baseline (51)	1,06 ± 0.44	
1 year (51)	0.49 ± 0.44	<0.001
2 years (51)	0.49 ± 0.44	<0.001
3 years (41)	0.50 ± 0.42	<0.001
10 years (21)	0.45 ± 0.39	<0.001
* Wilcoxon test		

in terms of lenticular astigmatism between the etiological groups (p<0.001), in greater with traumatic aphakia group (Table 3).

Pigment dispersion was observed as mild in 15 (29.4%) eyes, as moderate in 8 (15.7%) eyes and no dispersion in 28 (54.9%) eyes on gonioscopic examination at 1 year postoperatively. Postoperative complications were observed such as uveitis in 6 (11.8%) eyes, postoperative glaucoma which was controlled with anti-glaucomatous drops in 11 (21.6%) eyes, and mild iris atrophy in 14 (27.5%) eyes. No pupillary block glaucoma was observed. There was no significant correlation between angle pigmentation and glaucoma progression or iris atrophy (p>0.01).

The mean ACD was measured as 3.03 ± 0.29 (2.21-3.61) mm on average at 1 year postoperatively. There was no significant difference between the etiological groups (p=0.72). Corneal decompensation was observed in 11 eyes (21.6%) during long term follow-up. A statistically significant correlation was observed between postoperative ACD and corneal decompensation (p<0.01); of these 11 eyes, 6 eyes (11.7%) had ACD <3.00 mm. Haptic dislocation in the AC of the iridotomies was observed in 7 (13.7%) eyes at 1 year postoperatively. The IOL was not sutured to the iris in 6 eyes (11.7%). In one eye, the haptic was sutured to the iris with a 10/0 nylon suture with the Siepser knot technique. Mild pupil distortion occurred in 6 (11.7%) eyes. There were no significant differences between the haptic dislocation and corneal decompensation (p=0.15) (Table 3).

In terms of other complications, transient haemorrhage, which was resorbed spontaneously, occurred in 11 (21.5%) eyes during perioperative iridectomies. Retinal detachment (RD) was observed in 3 (5.9%) eyes at 3 years of follow-up and pars plana vitrectomy was performed in these eyes. Cystoid macular edema (CME) was observed in 6 (11.8%) eyes, only one eye was treated with intravitreal dexamethasone and, consequently, others were treated with topical drugs (Table 4).

Table 3: *Correlation between aetiology of aphakia and lenticular astigmatism*

	Mean ± SD	p* value
Complicated cataract surgery	0,63 ± 0,45	<0,01
Trauma	1,96 ± 0,76	
Spontan IOL dislocation	0,62 ± 0,24	
* Anova test (post hoc)		
Correlation between the results and complications		p* value
Angle pigmentation- glaucoma progression		0,20
Post-op ACD (3,03 ± 0.29 mm)- corneal decompensation		0,72
Haptic dislocation and corneal decompensation		0,15
* Kruskal-Wallis Test		

Table 4: *Perioperative and Postoperative complications.*

Complication	Number (%)
Haptic dislocation	7 (13.7%)
Uveitis	6 (11.8%)
Glaucoma	11 (21.6%)
Corneal decompensation	11 (21.6%)
Pupil distortion	6 (11.7%)
Pigment dispersion	27 (52.9%)
Transient hemorrhage	11 (21.5%)
Cystoid macular edema	6 (11.8%)
Retinal detachment	3 (5.9%)

DISCUSSION

The first choice for IOL implantation is intracapsular implantation. If the posterior capsule is insufficient, IOL can be implanted into the sulcus if the capsule rim is intact.[3,10] If the remaining capsule is not enough for IOL implantation, various implantation techniques can be chosen, such as an ACIOL, an IOL with iris-claw, an IOL with iris-sutured, an IOL with PC iris-sutured, an IOL with scleral-sutured.[1-5,8,11] Each of these methods is safe and effective but has procedure-specific limitations. Therefore, a complex decision on the best implantation technique must be made by the surgeons according to their experience, the ocular condition of each patient, and the accessible operating room equipment and keeping in mind all possible risks of the technique.

Aphakic eyes have a high refractive error, therefore correction of them with spectacle lenses can limit preoperative BCVA levels due to higher spherical aberration. IOL implantation decreases optical aberrations and provides significant improvements in visual acuity. The mean postoperative BCVA was found to be 0.22 LogMAR with same implantation technique, as reported by Kükner et al.[9], between 0.32 and 0.56 LogMAR with ACIOL implantation[12-14], between 0.34 and 0.67 LogMAR with SF PCIOL.[2,7,14,15] In this study, the mean postoperative BCVA was found to be 0.49 LogMAR and increased statistically significantly at all postoperative visits compared to baseline. The mean postoperative BCVA was comparable to SF IOL and ACIOL but lower than the same

implantation technique reported by Kükner et al.[9] The postoperative BCVA in the study by Kükner et al.[9] could have been higher due to the absence of traumatic eyes and the relatively small number of patients.

Ocular astigmatism can occur due to a wide corneal incision, or decentration or tilting of the IOLs.[16] The mean corneal astigmatism was reported to be 1.35±1.41 D with iris claw IOL[17], and -2.15±1.70 D with SF IOL[2]. Kandemir Beşek et al.[2] reported that the mean lenticular astigmatism was 0.68 ± 0.45 D and higher values of the astigmatism were observed in traumatic eyes with SF IOL. The mean postoperative corneal astigmatism was found to be – 2.42 ± 1.37 D and the mean lenticular astigmatism was calculated to be 0.96 ± 0.78 D and the highest values of lenticular astigmatism were observed in traumatic eyes in this study. Because of the relatively high number of traumatic eyes, the mean postoperative astigmatism could have been higher than in the literature. The position of the IOL could change in later periods, as trauma could cause disruption of the ocular structures.[2,7,17] Furthermore, haptic dislocation of IOL could cause the higher rate of astigmatism, so haptics must be sutured to the iris.

Iris suturing can increase pigment dispersion and chronic inflammation, and the risk of uveitis. Postoperative uveitis was reported in less than 5% of the eyes with iris sutured IOL [1]. However, it was reported to be higher (7.7%) with iris-claw IOL.[18] Postoperative uveitis was found to be higher in the ACIOL implantation group (20%) than in the scleral sutured group (0%) by Dadeya et al.[19] Another comparative study reported opposite finding with 1.1% chronic uveitis in the ACIOL group and 5.4% in the scleral-sutured PCIOL group.[14] Kükner et al.[9] observed that none of the patients had uveitis with same implantation technique. Based on these studies, it is not clear whether ACIOL implantation causes more uveitis. Moderate pigment dispersion as the rate of 15.7%, mild iris atrophy as the rate of 27.5%, and chronic uveitis as the rate of 11.8% were observed in this study. Chronic uveitis was observed more frequently in this study compared to scleral-sutured PCIOLs; however, it was comparable to ACIOLs. Iridectomy and rubbing of the haptics to the posterior surface of the iris could cause excess pigment dispersion and chronic uveitis in this IOL implantation technique. The lower rates of uveitis observed in the same implantation technique reported by Kükner et al.[9] could be related to the short follow-up period.

Glaucoma was observed to be higher in traumatic and aphakic eyes[1]. The rate of glaucoma was thought to be higher in ACIOL implantation.[1] However, in comparative studies, glaucoma was observed similarly between ACIOL (0%-16.7%) and scleral sutured PCIOL (0%-23%) implantation techniques.[14,19–22] Kristianslund et al.[23] reported a rate of glaucoma of 27.9% in the scleral sutured PCIOL implantation. Kükner et al.[9] reported a rate of glaucoma of 12.1% in same implantation technique. In our study, postoperative glaucoma was observed in 11 (21.6%) eyes. These findings could be related to the higher number of traumatic eyes in our study. Glaucoma could be more related to angle damage due to previous surgery or trauma than IOL implantation techniques in eyes with aphakia.

Corneal decompensation has been a controversial topic with ACIOL implantation since they were first described. The decrease in endothelial cell count with ACIOL implantation was argued in previous studies.[24,25] However, this point is controversial; surgical trauma could result in greater endothelial cell loss than implanted ACIOL.[26] Mahapatra et al.[12] reported that no patient developed corneal decompensation with ACIOL implantation. Kükner et al.[9] also reported that no patient had corneal decompensation. In this study, the mean ACD was measured as 3.03 ± 0.29 mm. Corneal decompensation was observed in 11 eyes (21.6%) in long-term follow-up. Of 11 eyes, 6 eyes (11.7%) had an ACD of less than 3.00 mm. There was a statistically significant correlation between postoperative ACD and corneal decompensation. The lack of corneal endothelial cell count was the main limitation of this study. However, if ACD was observed to be less than 3.00 mm, it should be considered that corneal decompensation could develop with this technique. Although there was no significant correlation between haptic dislocation and corneal decompensation, if haptic dislocation occurred, corneal decompensation could develop due to touching of the haptics to the endothelium. A haptic must be sutured to the iris to prevent touching the haptics to the endothelium.

Cystoid macular edema could be observed due to vitreous retraction or increased inflammation in aphakia management. The CME range was reported to be 0% to 28% in previous studies with all types of IOLs [1]. The highest rate of CME (28%) was reported with iris-sutured IOLs.[27] Todorich et al.[28] reported a rate of CME as 21% with intrascleral haptic fixation PCIOLs. Kükner et al.[9] reported a rate of CME as 6%. In this study, the CME rate was observed to be 11.8%, which is lower than iris sutured and intrascleral haptic fixation IOLs. The low incidence of CME could be due to the absence of vitreous traction observed in posterior segment IOL placements. The lower incidence of CME observed in the same implantation

technique reported by Kükner et al.[9] could be related to the short follow-up period and the lack of traumatic eyes in the study.

Retinal detachment could be observed in eyes with vitreous disruption or traction. The highest rates of RD were reported with scleral-sutured IOLs (4.2%-8.2%). Lower rates (0.5%-5.5%) were observed with iris-sutured PCIOLs due to lack of contact with the vitreous base.[1] Kükner et al.[9] reported that there was no RD in same implantation technique. In this study, RD rate was found to be 5.9% comparable to scleral sutured PCIOLs. This finding was more relevant with vitreous loss or traction than with the IOL implantation technique. The reason why RD was not observed in the Kükner et al.[9] study could be due to the short follow-up period.

Although AC IOLs are easily implanted, corneal complications are a higher rate due to the corneal endothelium's proximity.[20,29,30] SF IOLs implantation technique is difficult, and extensive experience and specific IOLs are required to perform the technique.[31,32] Iris-claw IOLs can be a useful alternative; however, their cost limits the common usage.[33] With a PC IOL implantation into AC haptics passing through two iridectomies, IOL was implanted far from the corneal endothelium. Haptic dislocation could be observed due to large or inappropriate positions of the opposed iridectomies. If iridectomies were performed in an appropriate position and size, stabilisation of the IOL could be good without sutures. Furthermore, the haptics of the IOL could be repositioned easily with suturing to the iris.

The main limitation of this study was that we did not evaluate corneal endothelial cell count pre-postoperatively. Other limitations of the study include its retrospective nature and the lack of comparison with other secondary IOL techniques. However, the long term follow-up period was the most powerful side of the study.

CONCLUSION

We obtained comparable visual outcomes to other IOL implantation techniques in aphakia treatment. The advantage of using the foldable PCIOL to treat aphakia was the lack of the need for special design IOLs; however, the ACD must be greater than 3 mm for this technique to be used. The technique can be useful in aphakia treatment especially in developing countries.

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