Comparison of Three Different Intraocular Lens Implantation Method for Eyes with Deficient Capsular Support

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ABSTRACT

Purpose: The aim of this study was to compare three different intraocular lens (IOL) implantation methods performed primary or secondary in eyes with deficient capsular support.

Materials and Methods: The records of patients who underwent IOL implantation due to deficient capsular support were analyzed. The patients were first separated into primary and secondary IOL implantation group (PIG and SIG, respectively), then divided into three subgroups among themselves as iris-claw IOL (IC-IOL), scleral fixated IOL (SF-IOL), and anterior chamber IOL (AC-IOL). Data were compared according to the groups.

Results: The most important cause of IOL implantation was perioperative capsule rupture and insufficient capsular support (61.7%, n=29) in PIG, aphakia (55.8%, n=24) in SIG. The most preoperative comorbid condition was iridodonesis (30.4%, n=14) in PIG and IOL subluxation (93.8%, n=15) in SIG. The mean BCVA in the 3rd months was significantly better in the IC-IOL subgroup than AC-IOL subgroups (p=0.001) in PIG. The mean BCVA at the last follow-up was significantly better in the SF-IOL group than the AC-IOL group (p<0.001) in PIG. Postoperative complication rate was 38.3% in PIG and 27.9% in SIG. There was no significant difference among subgroups in postoperative complications in both groups (p>0.05, Chi-square test).

Conclusion: All three methods have advantages and disadvantages. The surgeon should consider the patient's condition when determining the implantation method to be chosen. Future long-term studies comparing the different methods with a large number of patients may provide more information about the most appropriate method to use in eyes with insufficient capsular support.

Keywords: Anterior chamber lens, Aphakia, Capsular support, Iris-claw lens, Scleral fixated lens.

INTRODUCTION

An intraocular lens (IOL) implantation can be difficult in individuals with Marfan syndrome, zonular dialysis, lens subluxation, and postoperative complicated cataract surgery due to the lack of posterior capsular support.[1] Currently, some methods are being used in the absence of capsular support. The surgeon's experience and the eye's status determine the procedure of choice.

Scleral fixated IOL (SF-IOL), iris-claw IOL (IC-IOL), and anterior chamber IOL (AC-IOL) implantations are the most common alternatives. In aphakic patients with insufficient capsular support, the SF-IOL is the most preferred method in the absence of iris tissue. It is also an effective method in monocular aphakic children who are unable to tolerate contact lenses.[2,3] However, it has some disadvantages. For example, the surgical technique is more difficult when compared with AC-IOLs, and there is a need for more IOL manipulation.[4] The most important long-term complication of SF-IOL implantation in children is suture breakage and IOL dislocation.[5,6] If the iris tissue is intact, the IC-IOL implantation is an effective method, and it has

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some advantages, such as a good visual outcome and easy placement; however, ischemic and inflammatory ocular disorders, such as vascular occlusive uveitis cases, are contraindications.[7,8] Previous studies have established that AC-IOLs carry a high risk of postoperative complications, such as corneal endothelial damage, cystoid macular edema, uveitis, glaucoma, and hyphema.[7,9] However, modern, flexible, open-loop AC-IOL implantations are valuable alternatives to SF-IOLs.[10]

To our knowledge, there is only one previous study comparing these three methods[11]. The aim of the present study is to evaluate and compare the safety and visual outcomes of primary and secondary three different implantation methods in eyes with deficient capsular support due to various causes.

MATERIALS AND METHODS

Study Design

This retrospective study included in patients with deficient capsular support who underwent primary or secondary IOL implantations between January 2012 and September 2018 at the Van Yüzüncü Yıl University Ophthalmology Clinic. The local research ethics committee approved the study, and it adhered to the tenets of the Declaration of Helsinki.

Those patients who underwent cataract surgeries in the absence of stable capsular support were included in this study. The patients undergoing the IOL implantations were divided into two groups: primary and secondary IOL implantation groups. These groups were separated into three subgroups: IC-IOL, SF-IOL, and open-loop polymethyl methacrylate (PMMA) AC-IOL groups. Those patients older than seven years with a minimum follow-up time of at least one month were included in this study. Patients with stable capsular support, ocular traumas, and corneal pathologies were excluded from the study.

In this study, the primary or secondary IOL implantations were performed due to aphakia, Marfan syndrome, subluxated lenses, or complicated cataract surgeries. The data were evaluated as follows: surgery causes, preoperative comorbid conditions, postoperative complications, axial lengths (AL) before surgery, post-operative refractions after suture removal using an auto refractometer (ARK-510A; Nidek Co. Ltd., Aichi, Japan), preoperative and postoperative best-corrected visual acuities (BCVA) with the LogMAR, preoperative and postoperative intraocular pressures (IOP), and anterior and posterior segment evaluations using slit-lamp biomicroscopy. The preoperative and postoperative findings in the first month, third month, and last control examinations were recorded. The ocular biometry was performed using an ultrasonic biometer (EchoScan-US 1800; Nidek Co., Ltd., Aichi, Japan), and the SRK-T formula was used to calculate the IOL power.

Surgical Procedures

For the IC-IOL implantations, a superior 5.5 mm clear corneal incision was created. Then, the PMMA IC-IOL was implanted in the posterior chamber and fixated to the iris. A peripheral iridectomy was performed to prevent secondary glaucoma. If there was vitreous in the anterior chamber, an anterior vitrectomy was performed.

For the SF-IOL implantations, single-piece PMMA SF-IOL implantations were performed. The fornix-based conjunctival peritomies were prepared at 2 o'clock and 8 o'clock using Westcott scissors and tissue forceps. Two triangular scleral flaps were created at 2 o'clock and 8 o'clock, 2 mm posterior to the limbus. The microsurgical knife was inserted into the anterior chamber, and the wound was extended using corneoscleral scissors to create a biplanar incision. If necessary, a bimanual anterior vitrectomy was performed. The anterior chamber was filled with viscoelastic, and then, the IOL was implanted with a looped 10-0 polypropylene suture with an attached curved needle, and it was fixated in the ciliary sulcus.

For the AC-IOL implantation, a superior clear corneal incision was made. The anterior chamber was filled with viscoelastic, and the corneal incision was enlarged to 6.0 mm. The AC-IOL was implanted, superior peripheral iridectomy was performed, and the corneal incision was closed with 10-0 polypropylene sutures.

While the above procedures were applied for secondary IOL implantations, these procedures were applied in a similar manner following cataract removal surgery for primary IOL implantation when insufficient capsular support occurred after secondary complications during lens extraction.

Statistical Analysis

The statistical analyses were performed using IBM SPSS Statistics for Windows, (version 23.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were used in the calculations of the means and standard deviations of data. The Kolmogorov-Smirnov test was used to evaluate the data distribution, and the Wilcoxon test or paired t-test was used to compare the preoperative and postoperative BCVA and IOP values. The chi-squared test was used to compare the postoperative complications among the groups. A one-

way analysis of variance (ANOVA) or the Kruskal Wallis test was used to compare the age, IOL implantation method, spherical equivalent (SE), BCVA, and IOP values among the groups. Analysis of covariance (ANCOVA) was used to adjust for confounding variables that affect the outcome results. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

This study included 90 eyes of 84 patients with a mean age of 69.2±18.52 (8-96) years old. Forty-two patients (50%) were males, and 42 patients (50%) were females. Primary IOL implantation group (PIG) included in 47 (52.2%) eyes, and secondary IOL group (SIG) included in 43 (47.8%) eyes. The demographic data of the patients according to their groups and subgroups, are shown in Table 1. There was no significant difference among subgroups in PIG concerning age. However, in the SIG group, the mean age of patients in the AC-IOL subgroup was significantly higher than SF-IOL and IC-IOL subgroups (p=0.002 and p=0.029, respectively). Therefore, adjusted values for age were used to compare data. One patient in PIG and five patients in SIG underwent surgeries on both eyes. Overall, the right eye was more affected in the both group [n=28 (59.6%) and n=19 (40.4%) in PIG, n=23 (53.5%) right eyes and n=20 (46.5%) left eyes in SIG]. Anterior vitrectomy was performed in 33 (70.2%) of 47 eyes in PIG, 13 (30.2%) of 43 eyes in SIG (p=0.005, Chi-square).

The most important cause of IOL implantation was perioperative capsule rupture and insufficient capsular support (61.7%, n=29), followed by coexistence irido-phacodonesis with cataract (23.4%, n=11) in PIG, and aphakia (55.8%, n=24), followed by IOL subluxation (37.2%, n=16) in SIG. The causes of IOL implantation surgery, according to the groups, are shown in Table 2.

The most preoperative comorbid condition was iridodonesis (30.4%, n=14) in PIG and IOL subluxation (93.8%, n=15) in SIG. The preoperative comorbid conditions are shown in Table 3.

Mean BCVA, IOP, AL and SE values in PIG and SIG are shown in Table 4. In PIG, there was a significant

Table 1A: *Demographic data of patients in patients with primary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Mean age (year)	68.67±7.82 (60-80)	69.86±21.02 (23-81)	77.19±9.69 (45-96)	74.91±12.10 (23-96)
Sex (male, female)	5 male (83.3%), 1 female (16.7%)	3 male (37.5%), 5 female (62.5%)	13 male (40.6%), 19 female (59.4%)	21 male (45.7%), 25 female (54.3%)
Mean follow-up time (month)	26±17.54 (1-48)	9.44±3.97 (2-12)	7.70±10.15 (1-42)	10.37±11.94 (1-48)

Table 1B: *Demographic data of patients in patients with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Mean age (year)	65.75±14.45 (32-84)	47.93±26.26 (8-81)	79,50±6.09 (68-84)	61.65±22.64 (8-84)
Sex (male, female)	6 male (50%), 6 female (50%)	10 male (55.6%), 8 female (44.4%)	5 male (62.5%), 3 female (37.5%)	21 male (55.3%), 17 female (44.7%)
Mean follow-up time (month)	5.15±4.54 (1-14)	12.95±11.57 (1-60)	11.19±12.15 (2-36)	10.27±10.46 (1-60)

Table 2A: *Causes of surgery according to groups in eyes with primary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Perioperative capsule rupture and insufficient capsular support	4 (66.7%)	2 (22.2%)	23 (71.9%)	29
Lens subluxation	-	1 (11.1%)	1 (3.1%)	2
Coexistence irido-phacodonesis with cataract	2 (33.3%)	1 (11.1%)	8 (25%)	11
Marfan Syndrome	-	2 (22.2%)	-	2
Zonular dialysis	-	2 (22.2%)	-	2
Not known	-	1 (11.1%)	-	1
Total	6	9	32	47

IOL: Intraocular lens, SF-IOL: Scleral fixated intraocular lens, IC-IOL: Iris-claw intraocular lens, AC-IOL: Anterior chamber intraocular lens

Table 2B: *Causes of surgery according to groups in eyes with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Aphakia	8 (61.5%)	11 (50%)	5 (62.5%)	24
IOL subluxation	5 (38.5%)	8 (36.4%)	3 (37.5%)	16
Not known	-	3 (13.6%)	-	3
Total	13	22	8	43

Table 3A: *Preoperative comorbid conditions according to groups in eyes with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Ocular hypertension	1 (16.7%)	-	7 (19.4%)	8
Lens subluxation	-	-	1 (2.8%)	1
Mature cataract	2 (33.3%)	2 (50%)	9 (25%)	13
Zonular dialysis	-	1 (25%)	-	1
Pseudoexfoliation syndrome	-	-	8 (22.2%)	8
Iridodonesis	3 (50%)	1 (25%)	10 (27.8%)	14
Corneal nephelion			1 (2.8%)	1
Total	6 (100%)	4 (100%)	36 (100%)	46

Table 3B: *Preoperative comorbid conditions according to groups in eyes with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
Ocular hypertension	1 (%)	-	-	1
IOL subluxation	5 (%)	7 (100%)	3 (100%)	15
Total	6 (100%)	7 (100%)	3 (100%)	16

IOL: Intraocular lens, SF-IOL: Scleral fixated intraocular lens, IC-IOL: Iris-claw intraocular lens, AC-IOL: Anterior chamber intraocular lens.

Table 4A: *Mean best correct visual acuity, intraocular pressure, axial length and spherical equivalent values in primary IOL implantation.*

	IC-IOL group (M±SD)	P value	SF-IOL group (M±SD)	P value	AC-IOL group (M±SD)	P value
Preoperative BCVA (LogMar)	2.37±0.84		1.87±0.78		2.24±0.80	
Postoperative 1st month BCVA (LogMar)	0.97±0.51	***0.043**	0.81±0.69	*>0.05	1.56±0.60	*>0.05
Postoperative 3rd month BCVA (LogMar)	0.36±0.19	*>0.05	0.60±0.28	*>0.05	1.32±0.50	***0.005**
Postoperative last follow-up BCVA (LogMar)	1.30±1.05	*>0.05	0.42±0.43	***0.007**	1.33±0.79	***0.002**
Preoperative IOP (mmHg)	18.50±11.93		16		19.85±8.66	
Postoperative IOP (mmHg)	14.83±2.93	>0.05	11.33±5.69	>0.05	14.89±5.53	**0.01**
Preoperative AL (mm)	23.29±1.20		22.03±0.77		22.93±0.92	
P value among subgroups	>0.05					
Postoperative SE (Diopters)	-2.08±1.80		-0.50±1.85		+1.96±1.48	
P value among subgroups	>0.05					

*Changes from preoperative values.
BCVA: Best Corrected Visual Acuity, IOP: Intraocular Pressure, AL: Axial Length, SE: Spherical Equivalent, M±SD: Mean±Standard Deviation.

Table 4B: *Mean Best Correct Visual Acuity, Intraocular Pressure, Axial Length and Spherical Equivalent Values in SIG.*

	IC-IOL group (M±SEM)	P value	SF-IOL group (M±SEM)	P value	AC-IOL group (M±SEM)	P value
Preoperative BCVA (LogMar)	1.31±0.23		1.39±0.23		1.38±0.31	
Postoperative 1st month BCVA (LogMar)	1.00±0.15	>0.05*	1.02±0.23	>0.05*	1.46±0.19	>0.05
Postoperative 3rd month BCVA (LogMar)	0.77±0.20	>0.05*	0.72±0.22	>0.05*	0.75±0.25	>0.05
Postoperative last follow-up BCVA (LogMar)	0.71±0.20	**0.028***	0.54±0.20	**0.001***	1.40±0.27	>0.05
Preoperative IOP (mmHg)	14.61±1.72		18.50±3.42		17.55±3.49	
Postoperative IOP (mmHg)	13.29±1.24	>0.05	9.46±1.84	p>0.05	11.78±1.41	p>0.05
Preoperative AL (mm)	23.05±0.99		22.27±0.75		23.26±0.63	
P value among subgroups	>0.05					
Postoperative SE (Diopters)	-2.52±2.83		-0.71±2.74		+0.50	
P value among subgroups	>0.05					

*Changes from preoperative values.
BCVA: Best Corrected Visual Acuity, IOP: Intraocular Pressure, AL: Axial Length, SE: Spherical Equivalent, M±SEM: Mean±Standard Error of the Mean.

improvement in the postoperative 1st-month BCVA values when compared with the preoperative value in IC-IOL group (p=0.043). There were significant improvements in the last follow-up BCVA values when compared with the preoperative value in SF-IOL subgroup (p=0.007). There were significant improvements in the postoperative 3rd-month and last follow-up BCVA values when compared with the preoperative value in AC-IOL subgroup (p=0.005, p=0.002, respectively). The mean BCVA in the 3rd months was significantly better in the IC-IOL group than AC-IOL group (p=0.001). The mean BCVA at the last follow-up was significantly better in the SF-IOL group than the AC-IOL group (p<0.001).

In SIG, the last follow-up BCVA was significantly better than preoperative BCVA in IC-IOL group (p=0.028). The last follow-up BCVA was significantly better than preoperative BCVA in SF-IOL group (p=0.001). There is no difference in adjusted preoperative and postoperative BCVA among subgroups.

Overall, the BCVA improved in 32 eyes (86.5%), was the same in 2 eyes (5.4%), and worsened in 3 eyes (8.1%) of the 37 eyes in which the preoperative and postoperative BCVA measurements could be performed in the PIG group. In the IC-IOL group, bullous keratopathy was found in 1 eye with decreased BCVA. In the AC-IOL group, two eyes with decreased BCVA had an IOL dislocation and a suprachoroidal hemorrhage. There is no eye with decreased BCVA in the SF-IOL group. The BCVA improved in 26 eyes (72.2%), was the same in 3 eyes (8.3%), and worsened in 7 eyes (19.4%) of the 36 eyes in which the preoperative and postoperative BCVA measurements could be performed in the SIG group. In the IC-IOL group, IOL dislocation was found in 1 eye with decreased BCVA. In the SF-IOL group, two eyes with decreased BCVA had an IOL dislocation. In the AC-IOL group, there was cystoid macular edema in 2 eyes, retinal detachment in 1 eye, and vitreous hemorrhage in 1 eye with decreased BCVA.

In the PIG, the mean preoperative and postoperative IOP values were 19.85±8.66 mmHg and 14.89±5.53 mmHg in the AC-IOL group, respectively (p=0.01). There was no significant difference in preoperative and postoperative IOP values among subgroups. There was ocular hypertension in 8 patients preoperatively (one patient in the IC-IOL group and seven patients in the AC-IOL group) and two patients postoperatively (Two patients in the AC-IOL group). In the SIG, there was no significant difference in preoperative and postoperative IOP values among subgroups.

In the PIG and SIG, there was no significant difference among subgroups in the mean ALs. In the PIG and SIG, there was no significant difference among subgroups in the SEs.

The most frequently seen retinal abnormalities were retinal pigment epithelium changes in both groups. However, there was no data for 25 of the patients. The fundus findings, according to the groups, are shown in Table 5.

Table 5A: *Fundus findings in patients according to groups in eyes with primary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
No data	1 (16.7%)	4 (44.4%)	1 (3.1%)	6
Normal	1 (16.7%)	2 (22.2%)	6 (18.8%)	9
Age-related macular degeneration	-	2 (22.2%)	3 (9.4%)	5
RPE changes	2 (33.3%)	1 (11.1%)	7 (21.9%)	10
Increased Cup/Disc Ratio	1 (16.7%)	-	7 (21.9%)	8
Maculopathy	-	-	3 (9.4%)	3
Degenerative myopia	1 (16.7%)	-	3 (9.4%)	4
Suprachoroidal hemorrhage	-	-	1 (3.1%)	1
Vitreous hemorrhage	-	-	1 (3.1%)	1
Total	6 (100%)	9 (100%)	32 (100%)	47

Table 5B: *Fundus findings in patients according to groups in eyes with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
No data	1 (7.7%)	17 (77.3%)	1 (12.5%)	19
Normal	6 (46.2%)	3 (13.6%)	2 (25%)	11
Age-related macular degeneration	1 (7.7%)	-	-	1
RPE changes	2 (15.4%)	2 (9.1%)	4 (50%)	8
Increased Cup/Disc Ratio	1 (7.7%)	-	1 (12.5%)	2
Maculopathy	1 (7.7%)	-		1
Papillitis	1 (7.7%)	-		1
Total	13 (100%)	22 (100%)	8 (100%)	43

IOL: Intraocular lens, SF-IOL: Scleral fixated intraocular lens, IC-IOL: Iris-claw intraocular lens, AC-IOL: Anterior chamber intraocular lens, RPE: Retinal pigment epithelium.

In the PIG group, 4 of 6 eyes (66.7%) had postoperative complications in the IC-IOL subgroup, 1 of 9 eyes (11.1%) in SF-IOL subgroup, and 13 of 32 eyes (40.6%) in AC-IOL subgroups. There is no significant difference among subgroups in postoperative complications in PIG ($p>0.05$, Chi-square test). In the SIG, 4 of 13 eyes (30.8%) had postoperative complications in the IC-IOL subgroup, 4 of 22 eyes (18.2%) in SF-IOL subgroup, 4 of 8 eyes (50%) in AC-IOL subgroup. There is no significant difference among subgroups in postoperative complications in SIG ($p>0.05$, Chi-square test). The complications, according to the groups, are shown in Table 6.

DISCUSSION

The choice of which IOL to be implanted in cases where there is no or insufficient capsular support is still

Table 6A: *Postoperative complications according to groups in eyes with primary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
None	2 (33.3%)	8 (88.9%)	19 (59.4 %)	29
IOP increase	2 (33.3%)	-	5 (15.6 %)	7
IOL dislocation	-	-	2 (6.3 %)	2
Bullous keratopathy	1 (16.7 %)	1 (11.1%)	1 (3.1 %)	3
Vitreous hemorrhage	-	-	2 (6.3 %)	2
Vitreous prolapse	-	-	1 (3.1 %)	1
Cystoid macular edema	1 (16.7%)	-	2 (6.3 %)	3
Total	6	9	32	47

IOL: Intraocular lens, SF-IOL: Scleral fixated intraocular lens, IC-IOL: Iris-claw intraocular lens, AC-IOL: Anterior chamber intraocular lens

Table 6B: *Postoperative complications according to groups in eyes with secondary IOL implantation.*

	IC-IOL group	SF-IOL group	AC-IOL group	Total
None	9 (69.2 %)	18 (81.9%)	4 (50 %)	31
IOP increase	1 (7.7 %)	-	-	1
IOL dislocation	1 (7.7 %)	2 (9.1 %)	-	3
Vitreous hemorrhage	-	1 (4.5 %)	1 (12.5 %)	2
Retinal detachment	-	1 (4.5 %)	1 (12.5 %)	2
Vitreous prolapse	1 (7.7 %)	-	-	1
Cystoid macular edema	1 (7.7 %)	-	2 (25 %)	3
Total	13	22	8	43

IOL: Intraocular lens, SF-IOL: Scleral fixated intraocular lens, IC-IOL: Iris-claw intraocular lens, AC-IOL: Anterior chamber intraocular lens.

a controversial issue among ophthalmic surgeons. The insertion of a three-piece IOL into the ciliary sulcus is the best method if there is appropriate partial capsular support.[12,13] However, an IOL implantation into the sulcus is impossible in patients without capsular support due to trauma or complicated cataract surgery. In these cases, IC-IOL, SF-IOL, and AC-IOL implantations are alternative options.[14] Each of these three methods has its advantages and disadvantages. For example, AC-IOL implantation is a choice for patients with a normal endothelial cell count and anterior segment anatomy; however, there are potential risks for these patients, such as bullous keratopathy and cystoid macular edema.[15] Besides, iris fixated lenses may result in iris chafing, uveitis, and pupillary constriction.[16] The most common complications associated with SF-IOL are the late subluxation of the IOL and the rupture of the suture, especially in young patients.[7,17]

In the present study, in the PIG group, we found that the mean BCVA in the 3rd months was significantly better in the IC-IOL subgroup than the AC-IOL subgroup (p=0.001). The mean BCVA at the last follow-up was significantly better in the SF-IOL subgroup than the AC-IOL subgroup (p<0.001). Although the postoperative complication rate was lower in the SIG group (27.9%) than in the PIG group (38.3%), the proportion of patients with decreased BCVA was higher in the SIG (19.4%) than the PIG group (8.1%). The postoperative complication rate was highest in the IC-IOL subgroup (66.7%) in the PIG group, and the highest in the AC-IOL subgroup (50%) in the SIG group. The rate of patients with decreased BCVA in the PIG group was highest in the IC-IOL subgroup (16.7%), whereas in the SIG group, it was the highest in the AC-IOL subgroup (57.1%). Anterior vitrectomy was required more in the PIG group than in the SIG group (p=0.005).

In their study, Bayramlar et al.[18] found posterior capsule rupture and vitreous loss (91%) as the most cause of primary AC-IOL implantation. In the study of Kwong et al.[19], primary AC-IOL and SF-IOL implantations were compared. The most reason for failed capsular IOL implantation was found as posterior capsule rupture in both groups. In a study evaluating secondary IOL implantations, IOL subluxation was the most common surgical indication, followed by aphakia[11]. In another study, 61 of 68 aphakic eyes undergoing secondary IOL implantations were operated on due to aphakia secondary to a previous cataract surgery.[20] In our study, the major surgical indication was a posterior capsular rupture in PIG and aphakia in SIG, similar to the literature.

Brunin et al.[11] found that glaucoma was the most frequently seen preoperative comorbid condition in patients who underwent secondary IOL implantations. Menezo et al.[16] found that diabetic retinopathy and myopia were the most frequently seen pre-existing pathologies in their study. In our study, iridodonesis was the most frequently seen preoperative comorbid condition in the PIG, and IOL subluxation was in the SIG.

In studies investigating the results of IC-IOL implantations, a significant increase was found in the visual acuity after the IOL implantation.[21-23] Previously, it has been shown that there was a visual acuity increase after the implantation of an SF-IOL.[24-26] In two separate studies comparing AC-IOL and SF-IOL implantations, there was a significant increase in postoperative visual acuity when compared with the preoperative values in both groups, but there was no statistical difference between the groups.[10,27] In the study performed by Menezo et al.[16], in 82.9% of the eyes with IC-IOL implantations, the visual acuity was increased or maintained in the patients with secondary IOL

implantations, whereas this rate was 92.3% in the eyes with SF-IOL implantations. In a study comparing secondary IOL implantation methods[11], the incidence of the loss of at least two lines in the BCVA was higher in the patients in the SF-IOL and IC-IOL groups when compared with the AC-IOL and sulcus implanted groups. In our study, there were significant increases in the last follow up BCVA in SF-IOL and AC-IOL subgroup in PIG. However, there was no significant increase in the IC-IOL subgroup. This may be due to a higher postoperative complication rate and vision-decreasing complications in two patients (bullous keratopathy in one patient and cystoid macular edema in the other) and a relatively low number of patients (6 patients in total). There were significant increases in the last follow up BCVA in IC-IOL and SF-IOL in SIG. However, there was no increase in the AC-IOL subgroup. That may be due to the high postoperative complication rate. The mean BCVA in the 3rd months was significantly lower in the AC-IOL group than IC-IOL groups (p=0.001) in PIG. The mean BCVA at the last follow-up was significantly lower in the AC-IOL group than the SF-IOL group (p<0.001) in PIG. The rate of patients with decreased BCVA in the PIG group was highest in the IC-IOL subgroup (16.7%), whereas in the SIG group, it was the highest in the AC-IOL subgroup (57.1%).

In the study performed by Menezo et al.[16], the patients who underwent primary or secondary IF-IOL and SF-IOL implantations were compared. There was no significant increase in the IOP between the groups in the patients undergoing primary IOL implantations. However, the IOP increase in the patients undergoing secondary IOL implantations was significantly higher in the SF-IOL group. In the present study, there was only a significant decrease in the AC-IOL subgroup in PIG (p=0.01). There was no significant difference among subgroups in both groups.

In a study comparing IF-IOL and SF-IOL implantations[28], the mean postoperative SE was found to be myopic in both groups (-2.3±1.3 and -1.8±0.8 D, respectively). However, there was no statistically significant difference between the groups (p=0.28). In a study comparing primary AF-IOL and secondary SF-IOL implantations[29], the absolute postoperative SE was found to be hyperopic in both groups (1.38±1.03 and 1.63±1.11 D, respectively). However, there was no statistical difference between the groups. In this study, the postoperative SE values were myopic in the IC-IOL and SF-IOL subgroups (-2.08±1.80 and -0.50±1.85 D, respectively), but hyperopic in the AC-IOL subgroup (+1.96±1.48 D) in PIG. The postoperative SE values were myopic in the IC-IOL and SF-IOL subgroups (-2.52±2.83 and -0.71±2.74 D, respectively), but hyperopic in the AC-IOL subgroup (+0.50 D) in SIG. Although the least refractive error was in the SF-IOL subgroups, there was no significant difference among the subgroups in both groups. These refractive errors may be related to the IOL power calculation.

There were some limiting factors in this study. The relatively small number of patients in subgroups and the short follow-up period for some of the patients were limitations. Another limiting factor was the lack of endothelial cell count. Lack of data related with phaco parameters is a limitation of study.

In conclusion, all three methods are preferable for patients with insufficient capsule support. Although AC-IOL implantation seems to be easier than the other two methods in terms of the application, it ought not to be the first preferable method due to worse visual outcomes in the lack of capsular support. Future long-term studies comparing the different methods with a large number of patients may provide more information about the most appropriate method to use in eyes without capsular support.

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