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Longitudinal Changes in Macular Thickness After Retropupillary Iris Claw Intraocular Lens Implantation: A 1-year Observational Study and Comparison with Scleral Fixated Intraocular Lenses

İris Kıskaçlı Arka Kamara Lens İmplantasyonu Sonrası Makula Kalınlığı Değişimi: Bir Yıllık İzlem ve Skleral Fiksasyon ile Karşılaştırma

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ABSTRACT Objective: To evaluate longitudinal changes in macular thickness after retropupillary iris claw intraocular lens (RP-ICIOL) implantation in eyes with post-cataract aphakia and to compare the results with scleral fixated intraocular lens (SFIOL). **Material and Methods:** The patients were enrolled between 2013 to 2016. Patients were divided into two groups as the ones with RP-ICIOL implanted eyes and SFIOL implanted eyes. Preoperatively and within 1 year postoperatively macular thickness were analysed. **Results:** RP-ICIOL group consisted of 22 eyes of 22 patients, SFIOL group consisted of 36 eyes of 36 patients. In RP-ICIOL group, statistically significant thickening in central foveal [1 mm, central foveal thickness (CFT)] macular thicknesses was observed firstly at 1st week and progressively increased during the 3 months ($p<0.001$). However mean CFT reduced to baseline values at 1 year postoperatively in RP-ICIOL group ($p=0.070$). No statistically significant difference was found in the macular thicknesses measurements between the groups during the 1 year follow-up ($p>0.050$). CME was observed in 1 eye in RP-ICIOL group (4.54%), and 2 eye in SFIOL group (5.55%). **Conclusion:** The transient and subclinical macular thickening presented in all macular zones after RP-ICIOL implantation. These thickening started at first week, and progressively increased in the period of 3 months, then it reduced to baseline values at 1 year postoperatively. RP-ICIOL and SFIOL have similar effects on macular thickening.

Keywords: Retropupillary fixated iris claw intraocular lens; macular thickness; scleral fixated intraocular lens; aphakia

ÖZET Amaç: Katarakt cerrahisi sonrası arka kamara iris kıskaçlı göz içi lensi (AİKGİL) yerleştirilen hastalarda ameliyat sonrası makula kalınlığındaki değişimin incelenmesi ve sonuçların skleral fiksasyon uygulanan hastalar ile karşılaştırılması. **Gereç ve Yöntemler:** 2013 ve 2016 yılları arasında görülen hastalar çalışmaya alındı. Hastalar, AİKGİL ve skleral fiksasyon göz içi lens (SFGİL) yerleştirilenler olmak üzere 2 gruba ayrıldı. Ameliyat öncesi ve 1 yıllık takip süresince makula kalınlığı istatistiksel olarak karşılaştırıldı. **Bulgular:** AİKGİL grubu 22 hastanın 22 gözünden; SFGİL grubu ise 36 hastanın 36 gözünden oluşmaktaydı. AİKGİL grubunda santral [1 mm, santral foveal kalınlık (central foveal thickness (CFT)] makuler zonda 1. haftada istatistiksel olarak anlamlı bir artış tespit edildi ve bunun 3 aylık takip boyunca ilerleyici olarak arttığı görüldü ($p<0,001$). Fakat AİKGİL grubunda ortalama santral foveal kalınlık post-operatif 1 yılda başlangıç değerlerine döndü ($p=0,070$). Bir yıllık izlemde gruplar arasında makuler kalınlık ölçümlerinin hiçbirinde istatistiksel olarak anlamlı fark görülmedi ($p>0,050$). Kistoid makula ödemi AİKGİL grubunda 1 gözde (%4,54), SFGİL grubunda ise 2 gözde (%5,55) görüldü. **Sonuç:** AİGİL implantasyonu sonrası geçici ve subklinik makuler kalınlık artışı oluşmaktadır. Bu artış 1. haftada başlamakta, 3. aya kadar progresif olarak artmakta ve 1. yılın sonunda başlangıç değerlerine dönmektedir. AİKGİL ve SFGİL'in makular kalınlığa etkileri benzerdir.

Anahtar Kelimeler: Arka kamara iris kıskaçlı lens; makuler kalınlık; skleral fiksasyon lensi; afaki

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Management of aphakia without capsular support after complicated cataract surgery still remains a challenge. Over the years, several surgical options have been described including secondary implantation of scleral fixated, angle supported and iris claw intraocular lenses.[1] However, there has been a tendency to avoid angle supported intraocular lenses due to its vision threatening complications such as endothelial decompensation and secondary glaucoma.[2] Therefore, posterior chamber intraocular lens implantation can be a reliable approach due to maintaining anatomical integrity.[3] Scleral-fixated intraocular lens (SFIOL) offers the advantage of posterior chamber implantation. However, the surgical technique takes a longer learning period.[4] Since 1972, when iris claw intraocular lens (IOL) was first used to correct myopia, several modifications were developed to its design over the time. Currently, retropupillary fixation of new generation of iris claw intraocular lens (RP-ICIOL) is used to correct aphakia with satisfactory results and it has gained popularity by many surgeon with the advantages of posterior chamber implantation, short operation time and relatively simple intraocular manipulation.[5]

Cystoid macular edema (CME) remains a significant cause of poorer visual outcomes after both cataract surgery and secondary IOL implantation.[6,7] Studies indicated that postoperative inflammation, vitreomacular traction, light toxicity and intraoperative surgical manipulations on uveal tissue could have caused CME.[8] Incidence of CME after SFIOLs were reported between 5.8% to 33%, where these rates are ranged from 0% to 25% after RP-ICIOLs.[6,9-12] Recently, Massa et al. reported a case series that underwent IOL exchange surgery for CME associated with iris claw IOLs and they hypothesized that sustained low grade inflammation can lead to chronic and resistant CME.[13] Although wide range of CME incidence have been reported with different studies, quantitative effect of RP-ICIOL on macular thickness has yet to be analyzed in detail. The purpose of the current study to investigate retinal thickness changes at central, inner and outer macular regions with spectral domain optical coherence tomography (SD-OCT) after RP-ICIOL implantation in aphakia patients who had previous complicated cataract surgery and also determine at which postoperative time supposedly the most macular thickening is observable. Moreover, we compared macular thickness changes after RP-ICIOL implantation with the results of SFIOL implanted eyes.

MATERIAL AND METHODS

Patients who underwent secondary intraocular lens implantation for the treatment of aphakia after cataract surgery with insufficient capsular support between 2013 to 2016 were retrospectively enrolled. The study was approved by the local ethics committee in accordance with Declaration of Helsinki and all patients gave informed consent (2019/135). The duration between secondary intraocular lens implantation and cataract surgery was at least 6 months in all patients. Exclusion criteria were concomitant macular diseases, retinopathy, glaucoma, and history of uveitis, previous intraocular surgery in the fellow eye within the 6 months.

Ophthalmic examination was done preoperatively and postoperatively at 1 week, at 1,3,6 months and 1 year postoperatively including logarithm of the minimum angle of resolution (logMAR) corrected distance visual acuity (CDVA), anterior and posterior segment biomicroscopy, and macular thickness analyses with SD- OCT (The Cirrus HD-OCT Model 4,000 Carl Zeiss Meditec Inc., Dublin, CA, USA). Macular thickness values were measured for nine sectors defined by Early Treatment Diabetic Retinopathy Study.[14] SD-OCT scans with a signal strength of at least six were accepted. Preoperative axial length was measured using the IOLMaster V.07 (Carl Zeiss Meditec Inc, Dublin, CA, USA). Preoperatively, the vitreoretinal adhesion was evaluated by both fundus examination and SD-OCT.

All RP-ICIOL (RP-ICIOL group), and SFIOL (SFIOL group) implantations were performed under local or general anesthesia. In RP-ICIOL group, polymethyl methacrylate artisan aphakia IOL (Ophtec BV, Groningen, The Netherlands) with 8.5 mm length and 5.4 mm optical zone was used. An IOL power calculation was made by using the SRK/T formula and a constant of 116.5 was used according to manufacturer's recommendation.[15] A corneascleral tunnel in-

cision was done at 12 o'clock and paracentesis was made at 3 and 9 o'clock positions. A cohesive viscosurgical device was given into anterior chamber. Anterior vitrectomy was performed if needed. Intraocular lens was inserted through a corneascleral tunnel rotated into a horizontal position from 3 o'clock to 9 o'clock and centered by aid of the Purkinje images. Then, acetylcholinechloride 1% (Miochol-E, Novartis Pharma Stein AG, Stein, Sweden) was injected into the anterior chamber and enclavation of lens claws to the posterior iris was made by using an manufacturer's own enclavation needle. Cohesive viscosurgical device was removed and corneascleral tunnel was sutured with 10/0 continuous sutures. In SFIOL group AcrySoft MA60AC three-piece IOL (Alcon Laboratories Inc, Fort Worth, United States) with a 13.00 mm length, 6 mm optical zone was used. A temporal 3.2 mm clear corneal tunnel was made, then a cohesive viscosurgical device was given in to anterior chamber. Anterior vitrectomy was performed if needed. The IOL was inserted by manufacturer's own injector and fixated to the sclera with knotless Z suture technique which was previously described.[16] A cohesive viscosurgical device was removed and corneal tunnel was closed with a single 10/0 butterfly suture. All eyes in both groups received moxifloxacin, dexamethasone and nepafenac ophthalmic drops and tapered over 1 months. If CME emerged, nepafenac drop was administered.

STATISTICAL ANALYSES

SPSS program (version 23.0, SPSS, Inc.) was used for the statistical analyses. Normality of the data was checked with the Shapiro-Wilk test and all data did not have a normal distribution. Descriptive statistics of the data were expressed as number (percentage) and median (minimum-maximum). Mean percentage change in each macular thickness parameter between preoperatively and all postoperative visits was used for intragroup and intergroup statistical analyses. Percentage change of the macular thicknesses were calculated with the formula $\left(\frac{postoperative\ value - preoperative\ value}{preoperative\ value} x100\right)$. Intragroup statistical analyses were performed with Wilcoxon signed rank test and intergroup comparative statistical analyses were performed with Mann-Whitney U test for all parameters. Spearman correlation coefficients were also calculated between CDVA and macular thickness changes at 1 year postoperatively. Posterior vitreus detachment rates (complete or incomplete) were compared with Fisher's exact test between groups. A p value less than 0.050 was considered statistically significant.

RESULTS

This study retrospectively evaluated 58 eyes of 58 patients who underwent secondary intraocular lens implantation due to the insufficient capsular support after cataract surgery. RP-ICIOL group consisted of 22 eyes of 22 patients with a median age of 69 years (52-84 years), SFIOL group consisted of 36 eyes of 36 patients with a median age of 69.5 years (53-89 years). Preoperative parameters were listed in Table 1. In both groups all IOL implantations were completed without complication. All eyes completed 1-year follow-up.

At the first postoperative week, first month, third month and sixth month statistically significant thickening in central, inner macular and outer macular zones was seen in both groups ($p<0.001$, Table 2 and Table 3). At the first year, there was no statistically significant difference in central, inner macular and outer macular thicknesses when compared to preoperative values in both groups (RP-ICIOL group: $p=0.070$ for central foveal thickness (CFT), $p=0.130$ for inner, $p=0.182$ for outer and SFIOL group: $p=0.081$ for CFT, $p=0.102$ for inner, $p=0.095$ for outer with Wilcoxon signed rank test). In both groups; central, inner and outer macular thickness changes were not found to be correlated with CDVA at first year ($p>0.05$, Table 4).

Table 5 demonstrates the comparison of two groups at different postoperative visits (mean percentage change in each parameter). There was no statistically significant difference between the RP-ICIOL and SFIOL groups at control visits ($p>0.05$, Table 5). CME was observed in 1 eye in RP-ICIOL group (4.54%) and 2 eyes in SFIOL group (5.55%) in the postoperative period. All 3 eyes in both groups responded well to topical nepafenac drop and CME was resolved. Preoperative and postopera-

TABLE 1: Comparison of demographic features and preoperative measurements in the retropupillary iris claw intraocular lens group and scleral fixated intraocular lens group.

Parameters	RP-ICIOL (n=22)	SFIOL (n=36)	p value
Age (years)*	69 (52-84)	69.50 (53-89)	0.688*
Axial length (millimeter)*	23.05 (22.36-24.78)	23.60 (22.30-25.71)	0.381*
Posterior vitreus n (%)**			
Complete PVD	20 (90.9)	32 (88.9)	1.000**
Incomplete PVD	2 (9.1)	4 (11.1)	
Macular thickness (µm)*			
CFT (1 mm)	231 (192-280)	229 (171-299)	0.981*
Inner (3 mm)	271.62 (235.5-357.5)	296.87 (227-357.5)	0.242*
0uter (6 mm)	249.25 (204.75-319)	253.37 (204.75-319)	0.316*
CDVA* (logMAR)	0.3 (0.1-0.7)	0.3 (0.1-0.7)	0.706*

RP-ICIOL: Retropupillary iris claw intraocular lens; SFIOL: Scleral fixated intraocular lens; PVD: Posterior vitreous detachment; CFT: Central foveal thickness; CDVA: Corrected distance visual acuity; µm: Micrometer; logMAR: Logarithm of the minimum angle of resolution; *: Mann-Whitney U test; **: Fisher's exact test;Values are shown as n (%) and median (minimum-maximum).

TABLE 2: Mean percentages of retinal thickness changes in central foveal thickness, inner (3 mm) and outer (6 mm) macular areas preoperatively to each postoperative visits in the retropupillary iris claw intraocular lens group.

	1st week	p value*	1st month	p value*	3rd month	p value*	6th month	p value*	1st year	p value*
CFT	1.3 (0.8-4.0)	<0.001	7.4 (3.2-21.9)	<0.001	9.8 (1.2-28.1)	<0.001	3.0 (-0.6-11.6)	<0.001	0.4 (-0.2-4.1)	0.070
Inner (3 mm)	2.3 (-0.4-9.1)	<0.001	6.3 (1.4-23.0)	<0.001	10.3 (4.1-24.0)	<0.001	3.2 (-0.1-11.1)	0.001	0.3 (-0.6-7.8)	0.130
Outer (6 mm)	1.1 (0.1-12.9)	<0.001	5.3 (0.1-18.3)	<0.001	8.9 (3.4-28.4)	<0.001	3.7 (-1.7-20.0)	0.001	0.3 (-1.2-3.2)	0.182

CFT: Central foveal thickness; *: Wilcoxon signed rank test; Values are shown as median (minimum-maximum).

TABLE 3: Mean percentages of retinal thickness changes in central foveal thickness, inner (3 mm) and outer (6 mm) macular areas preoperatively to each postoperative visits in the scleral fixated intraocular lens group.

	1st week	p value*	1st month	p value*	3rd month	p value*	6th month	p value*	1st year	p value*
CFT	1.3 (-3.9-11.1)	<0.001	7.3 (0.8-36.6)	<0.001	9.9 (0.1-38.6)	<0.001	3.5 (-1.2-23.9)	<0.001	0.4 (-3.0-8.4)	0.081
Inner (3 mm)	2.1 (-0.3-11.7)	<0.001	7.5 (3.7-18.8)	<0.001	11.1 (1.4-24.6)	<0.001	2.8 (0.2-11.6)	<0.001	0.2 (-1.5-2.1)	0.102
Outer (6 mm)	1.6 (-0.4-7.8)	<0.001	7.3 (0.7-18.6)	<0.001	8.4 (1.0-26.0)	<0.001	2.9 (0.3-14.5)	<0.001	0.4 (-2.5-1.5)	0.095

CFT: Central foveal thickness; *: Wilcoxon signed rank test; Values are shown as median (minimum-maximum).

TABLE 4: Spearman's correlation coefficents of retinal thickness changes in central foveal thickness, inner (3 mm) and outer (6mm) macular areas with corrected distance visual acuity at 1 year postoperatively in the retropupillary iris claw intraocular lens group and scleral fixated intraocular lens group.

	CFT and CDVA		Inner (3 mm) and CDVA		Outer (6 mm) and CDVA	
	r value	p value	r value	p value	r value	p value
RP-ICIOL (n=22 eyes)	-0.046	0.837	0.188	0.403	-0.365	0.094
SFIOL (n=36 eyes)	0.004	0.981	0.059	0.732	0.077	0.655

CFT: Central foveal thickness; CDVA: Corrected distance visual acuity; RP-ICIOL: Retropupillary iris claw intraocular lens;
SFIOL: Scleral fixated intraocular lens; r: Correlation coefficient.

TABLE 5: Mean percentages of retinal thickness changes in central foveal thickness, inner (3 mm) and outer (6 mm) macular areas in the retropupillary iris claw intraocular lens group and scleral fixated intraocular lens group during the follow-up.

Parameters (µm) Δ	RP-ICIOL (n=22 eyes)	SFIOL (n=36 eyes)	p value#
At 1st week			
CFT	1.3 (0.8-4.0)	1.3 (-3.9-11.1)	0.772
Inner (3 mm)	2.3 (-0.4-9.1)	2.1 (-0.3-11.7)	0.689
Outer (6 mm)	1.1 (0.1-12.9)	1.6 (-0.4-7.8)	0.451
At 1st month			
CFT	7.4 (3.2-21.9)	7.3 (0.8-36.6)	0.671
Inner (3 mm)	6.3 (1.4-23.0)	7.5 (3.7-18.8)	0.113
OUTER (6 mm)	5.3 (0.1-18.3)	7.3 (0.7-18.6)	0.671
At 3rd month			
CFT	9.8 (1.2-28.1)	9.9 (0.1-38.6)	0.712
Inner (3 mm)	10.3 (4.1-24.0)	11.1 (1.4-24.6)	0.690
Outer (6 mm)	8.9 (3.4-28.4)	8.4 (1.0-26.0)	0.767
At 6th month			
CFT	3.0 (-0.6-11.6)	3.5 (-1.2-23.9)	0.551
Inner (3 mm)	3.2 (-0.1-11.1)	2.8 (0.2-11.6)	0.949
OUTER (6 mm)	3.7 (-1.7-20.0)	2.9 (0.3-14.5)	0.480
At 1st year			
CFT	0.4 (-0.2-4.1)	0.4 (-3.0-8.4)	0.571
Inner (3 mm)	0.3 (-0.6-7.8)	0.2 (-1.5-2.1)	0.779
Outer (6 mm)	0.3 (-1.2-3.2)	0.4 (-2.5-1.5)	0.688

Δ: Mean percentage change in parameter preoperatively to each visit; RP-ICIOL: Retropupillary iris claw intraocular lens; SFIOL: Scleral fixated intraocular lens; CFT: Central foveal thickness; µm: Micrometer; #: Comparison of the groups for each parameter with Mann-Whitney U test; Values are shown as median (minimum-maximum).

tive mean central macular thickness values in the RP-ICIOL and SFIOL groups were demonstrated with Figure 1. Iris pigments on IOL surface was observed in 3 eyes and pupil ovalization was observed in 2 eyes in RP-ICIOL group (13.63% and 9.09%, respectively). Retinal detachment or vitreous hemorrhage did not occur in any eyes in both groups.

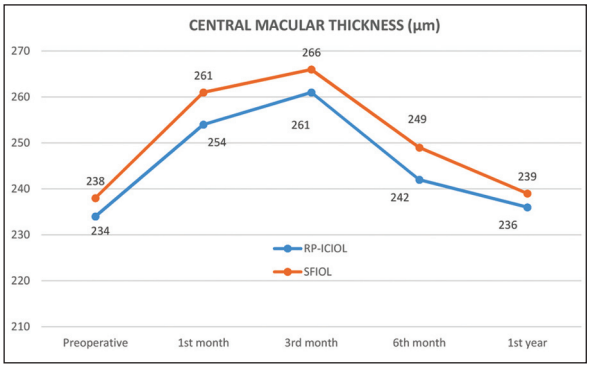

FIGURE 1: Central macular thickness in the retropupillary iris claw intraocular lens group and scleral fixated intraocular lens group during the follow-up.

DISCUSSION

With the introduction of the SD-OCT into routine ophthalmology practice, macular changes after different intraocular surgeries have been analyzed in more detail. Subclinical macular thickening have been shown after uncomplicated cataract surgery with a great number of clinical studies.[7,17,18] Low grade intraocular inflammation is the main predisposing factor that is held responsible for the pathogenesis.[18] Surgically induced trauma to the iris also damages the blood-aqueous barrier that results in release of inflammatory mediators such as prostaglandins, vascular endothelial growth factor, and others.[19] Therefore, it may be a concern that, RP-ICIOLs may theoretically induce inflammation postoperatively thus resulting in macular thickening as well as CME. In the current study, statistically significant increase in cen-

tral foveal (1 mm), inner (3 mm) and outer (6 mm) macular thicknesses were observed firstly at 1 week postoperatively and progressively increased during the 3 months in RP-ICIOL group. The mean thicknesses in all macular areas peaked at 3 months, tended to improve at 6 months, then it returned to baseline values at 1 year postoperatively. However, these increment in central, inner and outer macular areas at all postoperative visits did not correlate with the CDVA. Therefore, our results are in concordance with previous studies that focused on the subclinical macular thickening after uncomplicated cataract surgery.[7,17-19] More recently Frisina et al. developed a new implantation technique of RP-ICIOLs for the treatment of different causes of aphakia including blunt trauma, post-cataract and pseudoexfoliation. Although the course of the macular thickness changes were not analyzed in their study, a moderate increase in mean foveal thickness was shown 6 months after surgery.[20] A similar trend was also observed in the studies of Jare et al. after 6 months of follow-up.[21] Subclinical macular thickening after RP-ICIOL implantation may be formed as a result of prostaglandin and other inflammatory factors release into the vitreous cavity and disturbed blood-retinal barrier at the macula which eventually causes fluid accumulation in extracellular spaces. This mechanism also thought to be responsible for macular thickening after cataract surgery.[19]

Surgical results and postoperative complications including CME of RP-ICIOLs have been investigated with both short term and long-term studies. Schallenberg et al. did not see any CME in 31 eyes after 25 months follow up.[10] Gonnerman et al. reported the CME rate of 8.7% after 6.7 months.[11] This rate was also reported as 8.3% to 11.5% in similar studies.[20-22] More recently, Mora et al. compared the safety of anterior versus RP-ICIOL, and CME was observed in 25% of the eyes after 12 months in RP-ICIOL group.[12] In all of the related reports in the literature, the study groups consisted of the patients with different pathologies such as IOL or nucleus dislocation/subluxation due to the trauma, post-cataract complications (both congenital and senile), pseudoexfoliation and opacified IOLs etc. Surgical results and postoperative complications including CME of RP-ICIOLs have been investigated with both short term and long-term studies. Schallenberg et al. did not see any CME in 31 eyes after 25 months follow-up.[10] Gonnerman et al. reported the CME rate of 8.7% after 6.7 months.[11] This rate was also reported as 8.3% to 11.5% in similar studies.[20-22] More recently, Mora et al. compared the safety of anterior versus RP-ICIOL, and CME was observed in 25% of the eyes after 12 months in retropupillary group.[12] In all of the related reports in the literature, the study groups consisted of heterogeneous patient groups with different pathologies such as IOL or nucleus dislocation/subluxation due to the trauma, post-cataract complications (both congenital and senile), pseudoexfoliation and opacified IOLs etc. Therefore, wide range of (0 to 25%) CME incidence may be associated with these demographic differences between the study populations. Additionally, it is considered that the routine postoperative use of topical non-steroidal anti-inflammatory drugs after the intraocular surgeries can reduce the incidence of CME and, this disparency may be also due to the difference in postoperative treatment regimen between the studies. In the current study, CME was observed in 1 eye (4.5%) during 1 year follow-up in RP-ICIOL group and it responded well to topical non-steroidal anti-inflammatory drugs (NSAIDs). It should be kept in mind that only post-cataract aphakia patients without any ocular systemic conditions that affected the macula were included our study to avoid impact on SD-OCT results. Additionally, we routinely use the NSAID drops for 1 month in all eyes to reduce postoperative inflammation and blood-retinal barrier breakdown.[23,24]

In the present study, we also compared the macular thickness changes after RP-ICIOL implantation with the results after SFIOL implantation. SFIOLs closely simulate the normal anatomic localization of the crystalline lens and have been considered as the first choice in aphakia for many years. Moreover, the efficacy and safety of SFIOLs have been demonstrated with long term studies for both sutured and sutureless techniques.[6,16,25] In our study, similar to RP-ICIOL group, the SFIOL group showed statistically significant increase in macular thicknesses in all zones that started at 1 week and progressively increased during the first 3 months and it returned to

baseline values at 1 year. In comparison of the groups, we did not find a statistically significant difference in any of the macular thickness measurements during the 1 year follow-up. According to our results, RP-ICIOL implantation do not seem to induce more macular thickening than SFIOL implantation in post cataract aphakia patients. CME incidence was reported with a rate of 5.8 to 33% with different studies after SFIOL implantation.[6,9] More recently, Jing et al reported a meta-analysis that compared the safety and efficacy of RP-ICIOL and SFIOL implantation in correcting aphakia and their results showed no significant difference in terms of CME incidence.[26] Similar results were also demonstrated by Hazar et al.[22] In the present study, CME was observed in 2 eyes (5.5%) in SFIOL group and resolved completely with topical NSAID. Moreover, there was no statistically significant difference between the RP-ICIOL and SFIOL groups in respect to the CME incidence (4.5% versus 5.5%, respectively).

There are some limitations that should be mentioned with respect to our study. First is its retrospective design. The second issue is our sample size which may be considered as relatively small. However, it should be kept in mind that, we only included the eyes with aphakia after complicated phacoemulsification surgery for senile cataracts. We also did not include patients with any ocular and systemic conditions that might effect the macula such as diabetes, uncontrolled hypertension, glaucoma and age related macular degeneration to reach a more accurate conclusion. Therefore, it is well known that all these conditions are more frequent in elderly population and it may explain our relatively small sample size.

CONCLUSION

Our study demonstrated that the transient and subclinical macular thickening was observed in central, inner and outer macular zones after RP-ICIOL implantation in eyes with post-cataract aphakia. To the best of our knowledge, this study is first to show that thickening started at first week after surgery and progressively increased in the period of 3 months. However it tended to improve at 6 months and reduced to baseline values at 1 year postoperatively. This findings suggest that it may be associated with the surgically induced transient postoperative inflammation similar as post-cataract macular thickening. Moreover, we also observed that RP-ICIOL did not induce more macular thickening than SFIOL, therefore it may be reasonable to believe that the clamping of posterior iris seems to not have additional negative impact on macular thickness. Nevertheless, progressive and randomized clinical studies with a large number of cases are needed to make a definitive conclusion about this issue.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

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

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