

Predictive value of pupillography on intraoperative floppy iris syndrome in preoperative period

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Abstract

• **AIM:** To present the frequency of intraoperative floppy iris syndrome (IFIS) in cataract patients who taking alpha 1-a receptor antagonist (ARA) drugs, and evaluate the predictive value of pupil diameter (PD) changes in IFIS patients.

• **METHODS:** Male cataract patients who are under treatment with alpha-1a-ARAs (alfuzosin, tamsulosin) intraoperatively were evaluated and were grouped as with/without IFIS. The preoperative PD values were compared with controls. Also, the intraoperative manipulations and early/late complications were recorded.

• **RESULTS:** A total of 77 patients (77 eyes) of 94 benign prostate hyperplasia (BPH) patients have been defined as IFIS (81.91%) and 40 patients (40 eyes) were taking tamsulosin and 37 patients (37 eyes) were taking alfuzosin. During the cataract surgery, the rate of posterior capsular rupture ($P=0.754$), vitreous loss ($P=0.585$), iris tears ($P=0.004$), and iris catching ($P=0.000$) were higher in IFIS group, but the difference was significant only in the iris catching. At the postoperative first-month visit, persistent IOP rise and iris stromal tears were more frequent in IFIS group, but the difference was not significant ($P=0.311$, $P=0.146$; respectively). In contrast, Descemet membrane detachment was insignificantly more frequent in controls ($P=0.311$). In IFIS and control patients, PDs were 9.54 ± 1.78 and 9.72 ± 1.57 mm ($P=0.255$) under scotopic illumination, 8.54 ± 1.43 and 8.74 ± 1.25 mm ($P=0.289$) under mesopic illumination, 6.99 ± 1.35 and 7.27 ± 1.39 mm ($P=0.662$) under photopic illumination, respectively. However PDs were lower in IFIS under all illumination degrees, no significant difference was detected between groups.

• **CONCLUSION:** IFIS is a significant clinical syndrome with an increased intraoperative/postoperative complication ratio. The prediction of this syndrome is important because of prevention required precautions against possible complications. There is no association between IFIS and preoperative PD.

• **KEYWORDS:** cataract; intraoperative floppy iris syndrome; pupillography; alpha-1 adrenergic receptor antagonists

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INTRODUCTION

Intraoperative floppy iris syndrome (IFIS) is a novel description in ophthalmology history, it has been described nearly 15 years ago. Chang and Campbell^[1] defined a clinical triad characterized by 1) a flaccid iris stroma, 2) a propensity for iris prolapse toward the phaco and side-port incisions, and 3) progressive intraoperative pupil constriction during cataract surgery. In initial studies of Chang *et al*^[2], they resulted that 93% of the patients with IFIS either were on tamsulosin or had a history of tamsulosin usage. According to the American Society of Cataract and Refractive Surgery, there is a significant association between IFIS and oral administration of the alpha1-adrenergic receptor antagonists (ARAs). Tamsulosin, a commonly prescribed medication for the treatment of benign prostatic hyperplasia (BPH), is a selective alpha1A-1D ARAs in the prostate^[1,3-5]. These drugs show impact by relaxing the smooth muscle of the prostatic urethra and bladder neck, thereby increasing the urinary outflow. As shown in animal studies, the iris dilator muscle contains mainly alpha1A-ARAs^[6]. It is proposed that a constant blockage of the receptors with alpha1A-ARAs drugs could result in diffuse atrophy in the iris dilator smooth muscle^[1]. Similarly, the other non-subtype-specific alpha1-ARAs such as alfuzosin, terazosin, and doxazosin might also cause IFIS. There are a few reports about the relationship between IFIS and drugs such as zuclopenthixol, a dopamine D2-receptor, and alpha-adrenergic blocker doxazosin, a nonselective alpha1-

Table 1 Standardized parameters for each step of phacoemulsification and irrigation/aspiration

Parameters	Sculpt	Chop	Quad	Epi	Cortex	Polish
Phacoemulsification						
Bottle height (cm)	90	90	90	90	-	-
Phaco power (%)	50	35	40	10	-	-
Vacuum (mm Hg)	60	420	350	200	-	-
Aspiration flow rate (mL/min)	24	32	32	30	-	-
Torsional amplitude (%)	0	50	50	25	-	-
Irrigation/aspiration						
Bottle height (cm)	-	-	-	-	75	75
Vacuum (mm Hg)	-	-	-	-	450	35
Aspiration flow rate (mL/min)	-	-	-	-	30	10

ARAs and naftopidil^[7-8], a selective alpha1A- and alpha1D-ARAs. Alfuzosin, although not alpha-1A subtype-selective, is the only other alpha1-ARAs to display uroselective properties *in vivo*.

It is quite important for ophthalmologists and surgeons to be aware of IFIS, because it may lead to intraoperative and postoperative complications. Fortunately, the rates of complications turn to baseline values when IFIS is suspected and the appropriate precautions are required^[9]. Because of the increased ratio of possible complications; several alterations have been suggested to avoid its complexity and facilitate its management preoperatively or intraoperatively.

The pupil dilatation capacity and pupillary elasticity may predict the presence of IFIS preoperatively. The function of the pupil dilator muscle can be quantified objectively by measuring the pupil diameter (PD) through infrared pupillometry. Because of increased intraoperative and postoperative complications, identifying IFIS preoperatively would provide a significant advantage for patients who are under high risk. In the light of these information, we aimed to investigate the effects of alpha1A-ARAs (tamsulosin or alfuzosin) treatment on PD size. We hypothesized that alpha1A-ARAs treatment may cause smaller PDs than controls without pharmacological dilatation and we can predict IFIS in the preoperative period by measuring PD under scotopic, mesopic, and photopic illuminations through infrared pupillography.

SUBJECTS AND METHODS

Ethical Approval This study was conducted in Balikesir University between January and December 2017. All procedures performed in the study were in accordance with the ethical standards of the Institutional Research Committee in Balikesir University. The study adhered to the tenets of the Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from the patients or their kin after a detailed explanation of the research.

Ninety-four male patients who applied to our clinic for cataract surgery with the comorbidity of BPH and undertreatment with

alfuzosin (10 mg/d) or tamsulosin (0.4 mg/d) at least for six months were included in this prospective, randomized, clinical trial. Demographic data included age, treatment period for systemic alpha1A-ARAs, medical/ocular history, and systemic comorbidities were recorded. Patients with pseudo or true exfoliation syndrome, pigment dispersion syndrome, diabetes mellitus (DM), previous angle-closure glaucoma, uveitis, ocular trauma, who had a history of using any miotic, alpha-1 adrenergic agonist drop or mydriatics and previous intraocular surgery or laser iridoplasty were excluded from the study. After routine ophthalmic examination including Snellen best-corrected visual acuity (BCVA), intraocular pressure (IOP; Goldmann applanation tonometer), slit-lamp biomicroscopy, and undilated fundus examination was performed in all subjects at preoperative period. The grading of cataract was determined with the LOCS III grading system by the same surgeon. Additionally, the measurement of PD was evaluated through infrared pupillometry (Scheimpflug/Placido photography-based topography system in the pupillometer mode, CSO, Sirius, Italy) under photopic (40 lx), mesopic (4 lx), and scotopic (0.04 lx) conditions. All measurements were repeated at least three times by the same technician, and the average of the values was considered valid. The age-sex matched 85 non-IFIS patients who met the inclusion criteria were accepted as control, and all these examinations have been repeated for control subjects.

Surgical Technique All patients received five drops of proparacaine hydrochloride 0.5% (Alcaine, Alcon Inc., Forth Worth, TX, USA), four drops of tropicamide 1% (Tropamid, Bilim Ilac, Istanbul, Turkey), and four drops of cyclopentolate hydrochloride 1% (Sikloplejin, Abdi İbrahim Ilac, Istanbul, Turkey) at 2-min intervals before the surgery. All investigators and surgeons were masked to the randomization. In all groups, one surgeon (Vural GS) performed standard divide-and-conquer phacoemulsification. Phacoemulsification settings and irrigation-aspiration parameters were standardized for every case and are summarized in Table 1. The changes in parameters

during surgery were recorded. A temporal 2.8 mm clear corneal incision and sodium hyaluronate 1.5% (Z Hyalin Plus, Carl Zeiss Meditec) was used in all procedures. At the end of the operation, the surgeon always confirmed that the intraocular lens was implanted in the capsular bag. Viscoelastic was removed from the anterior and posterior chambers. Balanced salt solution was used to re-inflate the anterior chamber, and corneal incisions were checked for leakage. At the end of the surgery, all patients have received an intracameral injection of moxifloxacin. At the postoperative period, patients have received a standardized postoperative treatment scheme including moxifloxacin 0.5% (Vigamox, Alcon Inc., Fort Worth, TX, USA) and prednisolone acetate 1% (Predforte, Allergan, Irvine, CA, USA) eye drops four times a day for 2wk. Prednisolone acetate 1% eye drops were tapered off within a month.

IFIS was defined according to the intraoperative iris behavior with the criteria as 1) billowing of a flaccid iris stroma, 2) a propensity for iris prolapse toward the phaco and side-port incisions, and 3) progressive intraoperative pupil constriction. At least, the presence of two criteria was accepted as IFIS positive. Intraoperative requirements [iris retractor equipment, pupil expansion ring, ophthalmic viscoelastic devices (OVD) with low fluid parametric, intracameral atropine], intraoperative complications [posterior capsular rupture (PCR), vitreous loss, iris tears, iris catching, iridodialysis, hyphema, and Descemet membrane detachment under the main incision], cumulative dissipated energy (CDE) during surgery were recorded intraoperatively. The follow-up was performed on 1st day, 1st week, and 1st month, and first-month measurements were accepted as postoperative values. The postoperative complications such as persistent uveitis, clinically significant macular edema, pupil distortion, posterior synechia, iridodialysis, iris stromal atrophy, iris transillumination defect, permanent mydriasis, Descemet membrane detachment were evaluated at the first-month visit.

Statistical Analysis Data obtained from cases were encoded and they were transferred to the computer program. SPSS 23.0 software (SPSS Inc., Chicago, IL, USA) was used for statistical evaluation. Data distribution were tested using Kolmogorov-Smirnov test. Baseline values were compared by using independent samples *t*-test between two groups, and the significance level of *P*-value was accepted as 0.05 (*P*≤0.05).

RESULTS

Ninety-four eyes of 94 male BPH patients were enrolled in this study and all patients underwent uncomplicated cataract surgery with the standard surgical technique by the same surgeon (Vural GS) and grouped as with/without IFIS according to IFIS criteria as mentioned above. Seventy-seven patients (77 eyes) have been defined as IFIS (81.91%) and

Table 2 Demographic features in groups

Parameters	IFIS (n=77)	Control (n=85)	<i>P</i>
Age (y)	66.95±9.22	66.29±7.87	0.148
Visual acuity	0.17±0.13	0.18±0.14	0.505
Intraocular pressure (mm Hg)	16.24±2.54	16.40±2.85	0.443
Spherical error (D)	-1.14±2.85 ^a	-0.68±2.72 ^a	0.648
LOCS III	2.61±0.65	2.86±0.64	0.131
CDE (%-sec)	12.22±7.09	10.97±5.25	0.141

CDE: Cumulative dissipated energy. ^aMean of patients who can be measured with refractometry.

Table 3 PD measurements under scotopic, mesopic, and photopic illumination conditions in groups

PD, mm	IFIS (n=77)	Control (n=85)	<i>P</i>
Scotopic PD	9.54±1.78	9.72±1.57	0.255
Mesopic PD	8.54±1.43	8.74±1.25	0.289
Photopic PD	6.99±1.35	7.27±1.39	0.662

PD: Pupil diameter; IFIS: Intraoperative floppy iris syndrome.

40 patients (51.9%) were taking tamsulosin and 37 patients (48.0%) were taking alfuzosin. Age-matched 85 patients have been defined as control and showed none of IFIS criteria described above. The follow-up was completed in all participants.

The mean age, BCVA, IOP, spherical error, LOCS III, and CDE was summarized in Table 2. There was no significant difference in all these parameters. The PDs under different illumination conditions were showed in Table 3. However pupillographic measurements in all conditions were significantly lower in IFIS group, there was no statistically significant difference between groups (*P*>0.05).

The manipulations during surgery were summarized in Table 4. Although all of these alterations were more frequent in IFIS group, the difference was not significant (*P*>0.05). Besides, intraoperative and early/late postoperative complications were summarized in Table 5. During the cataract surgery, the rate of PCR, vitreous loss, iris tears, and iris catching were higher in IFIS group, but the difference was significant only in the iris catching (*P*<0.05). Iridodialysis was observed in none of the patients. At the postoperative first-month visit, persistent IOP rise and iris stromal tears were more frequent in IFIS group, but the difference was not significant (*P*=0.311, *P*=0.146; respectively). In contrast, Descemet membrane detachment was insignificantly more frequent in controls (*P*=0.311). The other postoperative complications such as hyphema, persistent uveitis, clinically significant macular edema, pupillary distortion, posterior synechia, iris transillumination defects, and permanent mydriasis have been observed in none of the patients.

DISCUSSION

In this study, we evaluated the predictive importance of PD

Table 4 The intraoperative manipulations during surgery in groups

Items	IFIS (n=77)	Control (n=85)	P
Iris retractors	0.01±0.114	0	0.176
Pupil expansion ring	0.03±0.16	0	0.052
OVD with low fluid parametrics	0.19±0.39	0.14±0.35	0.174
Preoperative atropine	0	0	0

OVD: Ophthalmic viscoelastic devices; IFIS: Intraoperative floppy iris syndrome.

Table 5 Early-late complications (intraoperative, postoperative) in groups

Items	IFIS (n=77)	Control (n=85)	P
PCR	0.06±0.24	0.06±0.23	0.754
Vitreous loss	0.04±0.19	0.03±0.16	0.585
Iris tears	0.05±0.22	0	0.004
Iris catching	0.27±0.44	0.03±0.16	0
Iridodialysis	0.03±0.162	0	0.053
Descemet membrane detachment	0.03±0.162	0	0.052

PCR: Posterior capsular rupture; IFIS: Intraoperative floppy iris syndrome.

changes in IFIS patients through a Scheimpflug/Placido photography-based topography system. We included only male patients because alpha1-ARA drugs are the first described medications that are proven to give rise to IFIS, and these drugs are preferred for treatment of BPH. Although the incidence of IFIS is rarer in female patients, it has also to be expected in females with a variety of concurrent medications^[10] such as angiotensin II receptor blockers^[11]. Also, it might significantly give rise to an increase in intraoperative complications by affecting the final visual outcome correlating with the severity grade of its appearance. In both sexes, predisposing factors may vary, so the surgeons should be aware of potentially catastrophic consequences of unforeseen IFIS. Because of possible consequences, several parameters have been tried to use for evaluating the presence of IFIS in the preoperative period similar to our hypothesis^[12].

Ophthalmologists routinely examine the pupil by observing and measuring pupil size, shape, symmetry, light response, and response to near reflex in their daily routine. The pupillary examination can help clinicians to guide for many ocular and neurological disorders, and pupillary changes may relate to history of medication, surgery, or trauma^[13-14]. In previous studies, various parameters such as the dilated pupil to limbal diameter ratio were proposed as an objective measurement for IFIS prediction^[12]. Moreover, pupillary measurement is a subjective method that can be affected by significant inter-observer variability due to the factors such as differences in ambient illumination, the intensity of the light stimulus, accommodative status, sensorial/emotional conditions,

and the examiner's experience^[15]. For certain results, PDs should be measured through automatic, multiple, quantitative measurements of pupillary response to light under controlled, ambient lighting conditions. That improves the repeatability of the measurements, provides solutions for examiner-dependent errors, and reduces false-negative responses^[16-19]. In this study, we obtained PDs after repetitive three measurements by the same technician, and the average values were considered as valid to improve reliability.

Floppy iris syndrome firstly appears during hydrodissection and it is usually too late to place iris retractors or pupil dilation devices^[1,20]. Therefore, predicting IFIS preoperatively would be very important and helpful. Miotic pupil or insufficient reaction to cycloplegic drops is a significant predictive factor for IFIS but many types of systemic or ocular condition such as inappropriate application of cycloplegics, glaucoma history, pseudoexfoliation, DM, *etc.* may cause insufficient pupillary dilatation. In addition to miosis, iris floppiness, billowing, and tendency to prolapse may be seen in IFIS and only be detected intraoperatively. However, determining the pupil functions and poor dilatation capacity before surgery in patients who are taking alpha1-ARAs might be useful for predicting a tendency toward IFIS. There are several kinds of drugs which is associated with IFIS include saw palmetto, an herbal supplement used for BPH, finasteride, antipsychotic drugs, and some beta-blockers with particular alpha-blocking properties^[15,21]. On the basis of previous reports, we could claim that there is a strong association between IFIS and alpha-blocker drugs^[1,3-4,22]. Most of these studies compare pupil size changes with tamsulosin and alfuzosin because of being the most popular drugs associated with IFIS. The blockage of alpha1-ARAs in the iris dilator muscle is thought to lead to poor muscle tone and subsequent pupil constriction, fluttering and billowing of the iris stroma, and a propensity for iris prolapse during cataract surgery^[23]. Floppy iris behavior can be seen only in particular patients since not all patients have been under treatment with tamsulosin and alfuzosin^[1,24]. It has been reported that 57%-100% of patients taking tamsulosin show at least one classic sign of IFIS during cataract surgery as IFIS (81.91%)^[25]. On the other hand, it has been proposed that not all patients taking tamsulosin experience IFIS in a large-scaled review that identifies reports from 2001 to 2017^[26]. Cheung *et al*^[27] have been investigated the prevalence of tamsulosin-associated IFIS. Their study included 15 patients (17 eyes) who were taking tamsulosin in 2390 cataract cases and observed full-blown IFIS in 5 eyes (29.4%). We detected 77 IFIS patients (77 eyes) in 94 male BPH patient who has been taking tamsulosin/alfuzosin at a higher ratio. This result may be related that we have not grouped IFIS patients' severity and accepted the presence of at least two criteria (flaccid iris

stroma, a propensity for iris prolapse toward the phaco and side-port incisions, and progressive intraoperative pupil constriction) as IFIS. Our results agree with the literature which reported the incidence of IFIS about 43%-100% in patients treated with tamsulosin^[1,10-11,28]. Chang and Campbell^[1] have proposed that tamsulosin does not only block the iris dilator muscle function, and causes a semipermanent loss of muscle tone. According to this pathophysiological approach, the usage of alpha-ARAs drugs may cause changes in pupillary response and diameters. Altan-Yaycioglu *et al*^[29] reported that both alpha-ARAs (tamsulosin, alfuzosin) decreased PDs in scotopic, photopic, and mesopic conditions during six-month follow-up and did not conclude any significant difference between tamsulosin and alfuzosin. As a result of these data we included patients who have been taking both alpha-ARAs treatment (tamsulosin, alfuzosin) at least for six months and IFIS patients were undertreatment with both tamsulosin, alfuzosin at similar proportions (51.9% $n=40$ tamsulosin; 48% $n=37$ alfuzosin; totally 77 patients. In contrast, Doğan *et al*^[30] have been claimed that patients who are under treatment with alfuzosin represented smaller PDs. They argued that systemic tamsulosin did not significantly affect pupil size and it should be emphasized that tamsulosin has selectivity of alpha1A-ARAs which is seen as the primary regulator of smooth muscle tone in the human urinary system. The importance of predicting IFIS before phacoemulsification is significant since we have been investigated PDs in different light conditions to foresee IFIS. Thus, we measured PD under photopic, mesopic, and scotopic illumination in high-risk patients for IFIS. IFIS patients resulted in decreased PD in all conditions but there was no statistically significant difference. Similarly, Safir *et al*^[31] hypothesized that there is a relationship between mydriatic PD and IFIS. They investigated retrospectively the association between structural features and IFIS and they resulted that decreased mydriatic PDs were associated with increased IFIS risk. Both drugs (tamsulosin and alfuzosin) have only small effects on PD, which may not have major clinical relevance since the differences in PD between lighting conditions and within groups was much larger to be realized in daily practice. For example, PD difference was 0.18 mm in scotopic, 0.20 mm in mesopic, and 0.28 mm in photopic conditions compared with control group. Altan-Yaycioglu *et al*^[29] have been reported a study that compared PDs after dilatation with tropicamide or tropicamide/phenylephrine combination in rats that undertreatment with alpha-ARAs and observed that a reduction in PD occurred shortly after the initiation of treatment with tamsulosin and doxazosin. After 1-month treatment and a 1-month washout period, they repeated measurements and observed that an insignificant increase in PD just in eyes dilated with tropicamide/phenylephrine combination. They

suggested that it was possible that the alpha 1-receptors might be up-regulated during the 1-month treatment period with alpha1-ARAs and remained up during the wash-out period resulting in larger PD values after 1 month of wash-out^[32]. This theory could also explain why not all IFIS cases have poorly dilated pupils preoperatively. Tamsulosin may cause IFIS in a different way unrelated to the effect on pupil dilation. This may be due to the complexity of the biology of the aging iris in which multiple factors affect pupil functionality and could overcome the alpha1-ARAs effect. Also, Issa and Dages^[33] reported similar results with our study and noted that increased duration of treatment does not seem to change the effect that these drugs have on PD. In an experimental study, the discontinuation of tamsulosin for one-month reduced the occurrence of IFIS and concluded that switching the BPH treatment with another class of drugs that do not interact with the iris receptors before cataract surgery may reduce the rate of complications^[34]. Unlike earlier studies, no significant difference in pupil mydriasis was noted between control patients and those on systemic alpha1-blockers. Even when limiting the analysis to patients on tamsulosin, the drug originally held responsible for IFIS, no significant difference was found. The non-subtype-selective alpha1-ARAs do not seem to affect preoperative PDs either. In a prospective study, the use of tamsulosin and finasteride was found significantly associated with IFIS while doxazosin, non-selective alpha1-ARAs was not^[35]. According to our results, the preoperative PD should not be relied on to estimate the risk of significant intraoperative iris behavioral changes due to IFIS. In contrast, Mylona *et al*^[36] investigated prospectively the effect of PD on IFIS related complications and concluded that the increased PD is a significant factor to prevent IFIS. As a result of our study, we strongly recommend a detailed medical history before cataract surgery related to the insignificant differences in PDs. Until a reliable clinical tool is revealed, all risk factors which have been associated with IFIS should be evaluated^[37]. Therefore, careful dilated-pupil measurements still should become the main part of the preoperative protocol in preparation for surgery. A dilated pupil of 7.0 mm or smaller in a patient not affected by diabetes, glaucoma, or pseudoexfoliation increases the risk for IFIS, even without a clear history of alpha1-ARAs administration^[38]. The prediction of IFIS is significant because it can increase the risk of intraoperative complications if not detected and managed before cataract surgery^[1,11]. According to the peer-reviewed literature, predicting IFIS makes a significant difference in decreasing the rate of intraoperative complications^[11]. Not only progressive miosis, but also other complications are seen more frequently in IFIS patients such as PCR, vitreous loss, iris prolapse, iris stroma atrophy, iris

catching, iridodialysis, capsulorhexis tear, anterior chamber hemorrhage, and Descemet membrane detachment. To deal with possible complications, several manipulations have been described. The corneal incisions may be preferred longer-tunnel shaped in high-risk IFIS patients^[39] or micro-incision cataract surgery (incision less than 2 mm) may prevent iris prolapsus and tissue damage by stabilizing anterior chamber and as a result, the postoperative intraocular inflammation reduces. Besides, OVDs provide iris stability by covering anterior segment structures and creates potential space for pupillary expansion devices^[25]. Adding the mixture of 1.0% phenylephrine and 0.3% ketorolac into irrigation solution during surgery may prevent iris prolapsus and may reduce the severity of IFIS^[25]. An alternative option for prophylaxis is the usage of low-concentration, bisulphite-containing epinephrine. It has been revealed to be effective in preventing IFIS without damaging corneal endothelium through preservative substrates. It could be reliable prophylaxis if preservative-free epinephrine is not available^[40]. Some authors advised keeping PD as large as possible by using intracameral epinephrine to prevent possible complications^[36]. The pupillary expansion devices have also been preferred to blockage the iris prolapsus and miosis. Lockington *et al*^[41] designed theoretical mathematical modeling and computer simulations to assess billowing/buckling patterns of the iris under loading pressures for floppy iris with/without a mechanical pupillary ring. They resulted that the Malyugin ring device significantly increased critical initiating buckling pressures and iris stability even under high intraocular pressure in the IFIS. A modification in hydrodissection has also been presented. The hydrodissection through the side-port incision has been performed simultaneously with the closure of the main incision with a phacoemulsification tip. The obstruction of the main incision inhibits the prolapsus of the iris in high-risk patients such as IFIS^[42]. Alternative management techniques, such as preoperative topical nonsteroidal anti-inflammatory drugs, cyclopentolate, atropine, intracameral epinephrine, or pupil expansion rings could cause efficient results with fewer complication ratios. In this study, the requirement of iris retractors, pupil expansion ring, OVDs with low fluid parametric was increased in IFIS group but no significant difference was detected. ($P=0.176$, 0.052 , 0.174 respectively). In both groups, preoperative atropine has not been needed. The ratio of intraoperative complications such as vitreous loss, iris tears, iris catching was much higher in IFIS group but that was statistically significant except for iris tears ($P=0.004$). The frequency of PCR was similar between groups (0.06% in both; $P=0.754$). None of the participants have been displayed intraoperative complications such as iridodialysis and hyphema. The rate of complications in this study was within

the limits previously reported for high-volume experienced surgeons and similar to the reported rate after standard phacoemulsification with IOL implantation^[9]. Furthermore, patients using alpha1-ARAs should be operated on by experienced surgeons who have the required skills for dealing with possible complications and for managing preoperative or intraoperative preventive strategies^[43-44].

Although we were failed to find a difference between PDs in IFIS patients, further studies on the effects of alpha1-ARAs are needed to investigate whether the differences in PD measurements can serve as a predictive marker for the preoperative estimation of IFIS.

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