Case Report

SAGE Open Medical Case Reports

SAGE Open Medical Case Reports
Volume 6: 1–6

DOI: 10.1177/2050313X17750336
journals.sagepub.com/home/sco
SAGE

Secondary multifocal intraocular lens implantation: A novel management strategy for white cataracts

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Abstract

Objectives: This study was designed to analyse the outcomes of secondary multifocal intraocular lens implantation in eyes with white cataracts.

Methods: White cataract patients undergoing secondary multifocal intraocular lens implantation between June 2014 and January 2015 were evaluated prospectively. As opposed to a conventional primary intraocular lens implantation for an optimal patient, the white cataract was first extracted, followed by optical biometry measurements. Whether or not the patient had adequate visual acuity was identified, and the multifocal intraocular lens was implanted secondarily. A total of five appropriate white cataract patients were enrolled in this secondary multifocal intraocular lens implantation study and were retrospectively reviewed.

Results: All five secondary implantations of the multifocal intraocular lenses were successful, without obvious adverse events. The uncorrected near visual acuity LogMAR was 0.4–0.5, and the distance visual acuity was −0.1 to 0.1 after 12 months of the multifocal intraocular lens implantation. All patients achieved satisfactory near and distance visual acuities and spectacle freedom.

Conclusion: Two-stage multifocal intraocular lens implantation is a safe and novel technique for the management of white cataract patients to optimise near and distance visual acuities.

Keywords

White cataract, multifocal intraocular lens, phacoemulsification

Date received: 26 July 2017; accepted: 29 November 2017

Introduction

A certain proportion of cataract patients in developing countries have white cataracts[1,2] due to a variety of reasons, including delayed systemic disease, poor economic conditions and a lack of medical staff and medicine, with good vision in the contralateral eyes. Most patients with white cataracts must forgo refractive intraocular lens (IOL) implantation because of the limited accuracy of the axial length and IOL power. However, white cataract patients can choose a refractive IOL and obtain satisfactory uncorrected distance and near visual acuities (VAs) independent of spectacle use after cataract surgery if the axial length can be detected precisely.

Usually, the IOL is spontaneously implanted following cataract extraction in most cataract surgeries. However, for a congenital cataract, traumatic cataract and cataract with fundus disease or severe complications, the IOL implantation is often delayed (two stages) or abandoned. The main treatment for congenital cataracts, especially for those within 2 years, includes a two-stage surgery: stage I simplex cataract extraction and stage II IOL implantation.[3]

Here, we report a new optimised flow for white cataract patients. For this type of patient, the white cataract was first extracted, followed by optical biometry measurements. We

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observed the refractive and visual outcomes following cataract extraction, and secondarily, implanted a multifocal IOL to assess the performance of the new optimised flow.

Patients and methods

This prospective observation included seven patients (two women and five men). The first selected condition was to seek satisfactory postoperative distance and near VAs of white cataract patients. The average patient age was 53.43 ± 13.70 years old (range: 35–69 years), and all of the patients were Chinese. The exclusion criteria were ocular diseases (such as previous high myopia and high astigmatism (greater than −1.00 D), acute and chronic ocular inflammation, corneal opacities, dry eye, amblyopia, anisometropia, glaucoma and retinal abnormalities), history of ocular trauma, surgical complications, active systemic organic disease, psychotic disorders or lack of follow-up. This study was conducted according to the established ethical standards for clinical research.

The preoperative ocular examinations included a VA exam, a detailed biomicroscopic exam, crystalline lens measurements using A-scan ultrasonography, noncontact tonometry and axial length measurements. In addition, a contact B-mode ultrasonographic examination was performed to detect the posterior segment. Corneal keratometry was conducted using corneal topography and an auto refractor. Written informed consent was obtained from all patients prior to the cataract surgery.

All surgeries were performed between June 2014 and January 2015 by the same senior surgeon who used the same technique, and all surgeries included topical anaesthesia using eye drops (Alcaine 1%, proparacaine hydrochloride ophthalmic solution) and compounded tropicamide eye drops (Mydrin-P; Santen Pharmaceutical Co., Ltd., Japan) for mydriasis, applied three times 1 h before surgery. A three-step, clear corneal tunnel, self-sealing incision was made with a 2.2-mm disposable metal blade on the steepest axis, and a side port incision was made with a disposable 15° metal blade. After injecting the cohesive ophthalmic viscosurgical devices (Provisc, sodium hyaluronate; Alcon Laboratories, Inc., Fort Worth, TS, USA) into the anterior chamber of the white cataract eye, capsulorhexis forceps were used to grasp the capsule and perform a capsulorhexis of 5.0–5.5 mm. If the capsulorhexis tear was directed towards the periphery, additional viscoelastic agents were applied to that part of the anterior capsule.

Uneventful standard endocapsular phacoemulsifications were performed in all eyes using the Infiniti Vision System (Alcon Laboratories, Inc.) phacoemulsification unit. On days 1 and 3 after phacoemulsification, the ocular biometric parameters were detected using the IOL Master (Carl Zeiss Meditec AG, Jena, Germany), and the IOL power was calculated using the Sanders–Retzlaff–Kraff theoretical (SRK/T) formula. The IOL power was based on a target of either emmetropia or +0.25. After 5 postoperative days, the best corrected distance VA was observed in the surgery eye. A dilated fundoscopic examination and optical coherence tomography (OCT) were performed to exclude fundus diseases. Under normal circumstances, a foldable hydrophobic acrylic multifocal IOL (AcrySof ReSTOR SN6AD3; Alcon Laboratories, Inc.) was secondarily implanted intracapsularly through the initial corneal incision 1 week after the cataract extraction. Starting on postoperative day 1, each patient was given topical Levofloxacin eye drops (Santen Pharmaceutical Co., Ltd., Osaka, Japan) four times a day for 7 days, as well as steroids (TobraDex® eye drops; Alcon Laboratories, Inc, Fort Worth, Tex) four times a day, with a decreasing dose over a 30-day period. The postoperative examinations were conducted at 1, 7 and 30 days and 3, 6 and 12 months.

Results

Seven patients (five males and two females), for a total of seven eyes with white cataracts, underwent cataract surgery under topical anaesthesia over a half-year period. Hypertension and diabetes mellitus were noted in three (42.86%) and two (28.57%) patients, respectively. Five (71.43%) of the patients had bilateral cataracts at the time of presentation. For one patient, the representative anterior segment photos before and after the surgery are shown in Figure 1.

Corneal keratometry values

Table 1 shows that the average preoperative corneal keratometry measurement using the IOL Master was 43.69 ± 1.40 D, and the average corneal keratometry measurements on postoperative days 1 and 3 were 43.39 ± 1.46 D and 43.33 ± 1.46 D, respectively. A significant difference was found between the 3-day post-cataract extraction and preoperative corneal keratometry values (paired t-test, $p = 0.04$). However, no statistical difference was found between postoperative days 1 and 3 (paired t-test, $p = 0.338$).

Given the condition of each patient's preoperative corneal astigmatism, the orientation of the corneal incision was slightly different; therefore, for some patients, especially those needing corneal incision axis adjustments, there were differences in the corneal keratometry values between the preoperative and postoperative states. However, at the early postoperative time points (days 1 and 3), the corneal keratometry values exhibited no obvious changes, suggesting the stability of the postoperative corneal keratometry values, even at an early stage after cataract extraction. This created favourable conditions for the multifocal IOL early-phase implantation.

Axial length biometry

Before cataract extraction, the ocular axial length cannot be measured with the IOL Master or Lenstar because of the density of the lens. Table 2 shows that the average axial length measured by the A-scan ultrasound was 24.11 ± 1.90 mm.

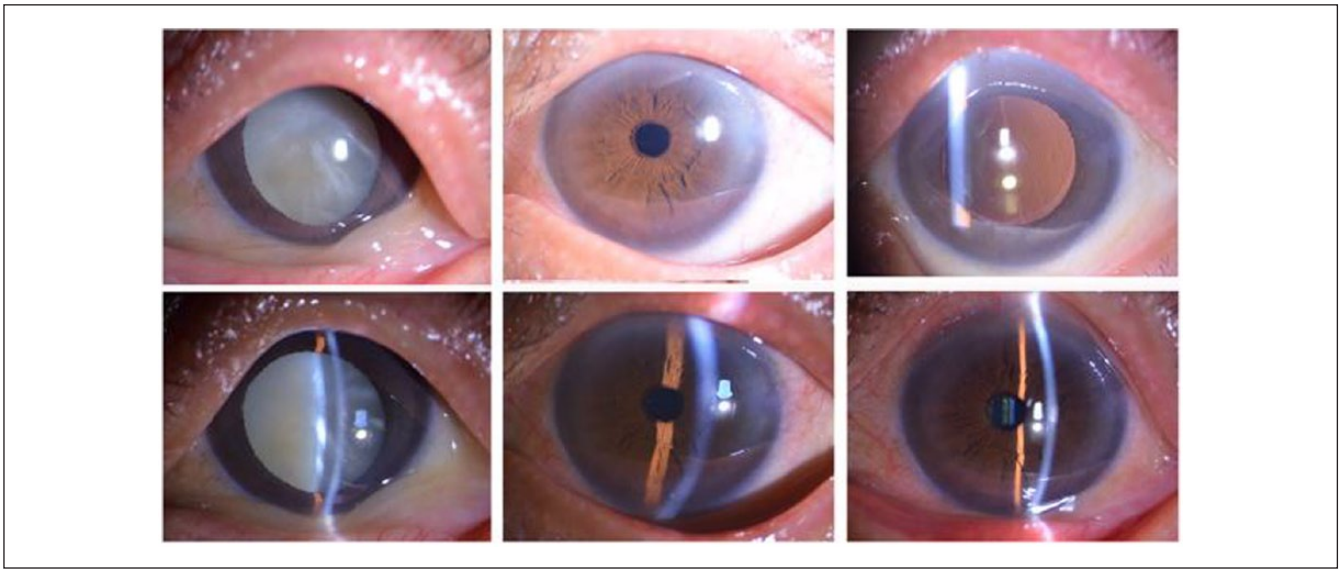

Figure 1. The left panel shows a preoperative photograph of a white cataract in the left eye. The middle panel shows a slit-lamp photograph of the same eye 5 days after primary cataract extraction. The right panel shows the eye 6 months after secondary multifocal IOL implantation.

Table 1. Corneal keratometry detected by IOL Master.

Patient	Preoperative	Postoperative day 1	Postoperative day 3	Change pre/post day 3	Change day 1/day 3
1	44.50	44.12	44.33	0.17	0.21
2	44.75	44.61	44.41	0.34	0.20
3	44.59	44.50	44.25	0.34	0.25
4	42.94	41.82	41.80	1.14	0.02
5	41.16	41.16	41.03	0.13	0.13
6	44.95	44.73	44.70	0.25	0.03
7	42.91	42.81	42.81	0.10	0
Average	43.69 ± 1.40	43.39 ± 1.46	43.33 ± 1.46		

Postoperative: after cataract extraction.

The average axial lengths measured by the IOL Master 1 and 3 days after the cataract extraction were 24.21 ± 1.73 mm and 24.19 ± 1.73 mm, respectively. The lack of significant differences in the axial lengths measured by the IOL Master in the early postoperative days (1 and 3) suggested postoperative axial stability and created favourable conditions for the early measurement of the axial and IOL power, as well as early multifocal IOL implantation. Based on the A-scan ultrasound-detected axial value, the three cases (42.86%) of eye axis errors above 0.33 mm (IOL power error above 1.0 D) suggested that a proportion of the patients would not obtain good outcomes if the multifocal IOL power based on the A-scan ultrasound measurement was used.

IOL power

Table 3 shows the IOL power calculated based on the A-scan ultrasound-detected axial length before cataract extraction, compared with that measured postoperatively by the IOL Master. Five (71.43%) patients had errors of 0.5 D, one (14.29%) had an error of 1.0 D and only one (14.29%) had no obvious errors. A multifocal IOL error that is greater than 0.5 D will significantly influence the postoperative effect. These results also showed that a proportion of the patients (six cases, 85.71%) would not achieve good outcomes if the multifocal IOL power based on the A-scan ultrasound measurement was used.

Surgery complications

All patients were followed up for more than 12 months. No patients suffered obvious surgical complications, including intraoperative bleeding, capsulorhexis discontinuity, posterior capsular rupture, postoperative corneal incision leakage, corneal oedema, fibrous reaction, IOL deviation, high intraocular pressure, intraocular infection or retinal detachment.

Table 2. The axis length detected by an A-ultrascan and IOL Master before and after cataract extraction.

Patient	Preoperative by A-scan	Postoperative Day 1 by IOL Master	Postoperative Day 3 by IOL Master	Difference A-scan vs Day 3	Difference Day 1 vs Day 3
1	22.80	22.92	22.89	0.09	0.03
2	22.96	23.32	23.30	0.66	0.02
3	23.30	a	23.42		
4	27.07	26.57	26.55	0.52	0.02
5	25.13	25.18	25.15	0.02	0.03
6	21.93	22.01	21.98	0.05	0.03
7	24.79	25.28	25.27	0.48	0.01
Average	24.11 ± 1.90	24.21 ± 1.73	24.19 ± 1.73		

[a]Optical coherence tomography (OCT) showed intra-retinal cyst.

Table 3. IOL power detected before and after cataract extraction.

Patient	IOL power before PHACO	IOL power after PHACO	IOL power difference (D)
1	22.0	22.5	0.5
2	21.5	21.0	0.5
3	20.5	20.5	0
4	12.0	13.5	0.5
5	18.5	19.0	0.5
6	24.5	25.0	0.5
7	17.5	16.5	1.0

IOL: intraocular lens; PHACO: phacoemulsification.

Table 4. Visual acuity (LogMAR) outcomes.

Patient	Preoperative visual	BCVA after PHACO	UNVA after IOL implant	UDVA after IOL implant
1	HM	+13.0 DS→0.0	+0.5	+0.1
2	HM	+11.5 DS→0.0	+0.4	−0.1
3	HM	+8.0 DS→+0.1	+0.4	0.0
4	HM	+13.0 DS→0.0	+0.4	+0.1
5	FC/30 cm	+9.0 D 0.75 D × 5→−0.1	+0.4	0.0

BCVA after PHACO: best corrected visual acuity 3 days after cataract extraction by phacoemulsification; UNVA: uncorrected near visual acuity; UDVA: uncorrected distance visual acuity; HM: hand motion; FC: figure counting.

VA outcomes

The VA results are shown in Table 4. The preoperative corrected VA was light perception to figure counting (FC)/30 cm, and the contralateral eye sight was FC/20 cm to 0.0. Because the corrected VA after cataract extraction was abnormal and the OCT indicated a retinal cyst, one patient gave up the multifocal IOL. In addition, one patient with a normal corrected VA did not accept the multifocal IOL implantation because of personal reasons. Therefore, five cases were able to receive the multifocal IOL and were implanted secondarily (four in week 1 and one in week 2) after the cataract extraction. The uncorrected near VA (40 cm) LogMAR was 0.4–0.5 (mean 0.42 ± 0.04), and the distance VA (5 m) LogMAR was −0.1 to 0.1 (mean 0.02 ± 0.08) 12 months after the multifocal IOL implantation. All five patients were followed up for more than 12 months and were satisfied with their states of vision and spectacle independence. The outcomes showed that our optimised process for white cataract patients resulted in satisfactory postoperative near and distance VAs.

Discussion

Advancements in both surgical techniques and instrumentation have led to the safe and uneventful treatment of white cataracts. Cataract surgery with multifocal IOLs provides patients with an excellent uncorrected distance and near VA, and thus, they achieve spectacle independence.[4–9] However, premium IOLs, such as multifocal IOLs, have rarely been used in white cataract patients because of two major obstacles. First, the accurate calculation of the IOL power based

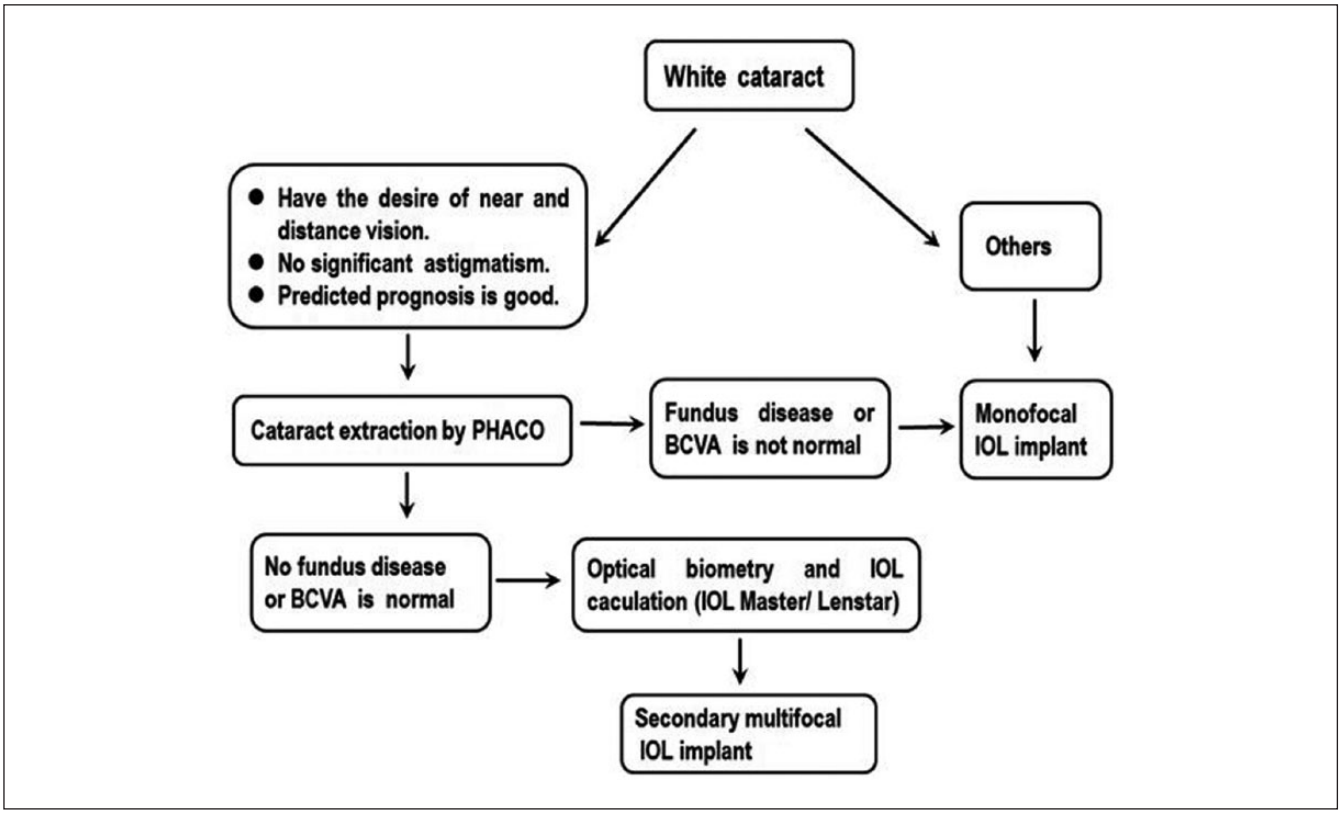

Figure 2. Overview of a flowchart for white cataract patients.

on the precise measurements of the ocular parameters is crucial to attain high levels of patient satisfaction. The IOL Master can obtain the axial length with high precision and is considered to be one of the first standard modern optical biometry devices.[10–13] However, achieving good optical biometry measurements is close to impossible for white cataract patients. Ultrasound measurements are less accurate and require greater examiner expertise.[14] Second, white cataracts make fundus examinations and potential acuity measurements more difficult. Multifocal IOLs have been improperly used in some conditions, such as in patients with active macular disease, so the potential problems are twofold: unsatisfied visual results for the patient and impaired fundus visualisation for the retinal physician.[15] Thus, these patients are generally advised by doctors not to try multifocal IOLs. However, a qualified oculist cannot refuse white cataract patients who desire multifocal IOLs and satisfactory visual results.

For white cataract patients, the multifocal IOL power cannot be precisely measured because the preoperative ocular axis cannot be measured by the IOL Master or Lenstar. Commercial optical ocular axial length–measuring equipment following cataract extraction is still not available, and even with such equipment, a number of different powers of multifocal IOLs must be prepared, resulting in difficulties in clinical practice.

To this end, we performed phacoemulsification to extract the white cataract, followed by an axial length measurement using the IOL Master, and we measured the multifocal IOL power precisely. Then, we secondarily implanted the multifocal IOL in the white cataract patient. This change has the following advantages: the axial length and IOL power can be accurately measured by optical biometry, such as with the IOL Master, the fundus can be directly observed, and the fundus function can be easily assessed to detect the best corrected VA. However, it also has the following disadvantages: the original single operation becomes two operations, an increased rate of intraocular infection exists and the cost of treatment is increased. In the end, some patients remain unsuitable for multifocal IOL implantation.

The time point of the secondary multifocal IOL implantation depends mainly on the effects of the cataract extraction on the eye (e.g. corneal keratometry and axial length). Adept phacoemulsification techniques lessen the impact of cataract removal on the eye, and the recovery time is short. On our postoperative days 1 and 3, the ocular biometry values suggested that the changes to the corneal keratometry measurements soon after the cataract extraction are limited, and this creates favourable conditions for early multifocal IOL implantation. In fact, most of our patients underwent secondary multifocal IOL implantation 1 week after the cataract extraction. For the corneal incision of a secondary multifocal

IOL, we usually chose the original incision. When the secondary IOL implantation was performed more than 2 weeks after the cataract extraction, the corneal incision was usually sealed, so we made a new incision on the steeper axis of the cornea to reduce astigmatism.

Specifically, we highlight the fact that this new strategy for white cataract patients must be carefully considered. First, the patient must have a strong desire for satisfactory uncorrected near and distance VAs after the surgery. Second, their corneal astigmatism must not be obvious, and the preliminarily judged fundus features must be normal. Third, the patient's fully informed consent must be obtained. Finally, the surgeon must be skilled in phacoemulsification techniques, such as the two-stage continuous curvilinear capsulorhexis technique, to prevent unexpected radial tears of the anterior capsule in patients with high intracapsular pressure.[16] Young white cataract patients should be carefully incorporated into this treatment scheme since published data suggest that type 1 diabetes mellitus maybe the cause of bilateral white cataracts in young patients.[17,18]

Figure 2 shows our optimised flowchart for white cataract patients. As a two-step surgery, it may carry additional risks, and we must do our best to reduce these risks by strictly setting and following the inclusion criteria, strengthening the patients' education and increasing patient compliance. Only in this way can this new strategy be safely and effectively used for white cataract patients. Although the number of patients in our study was limited, our novel technology provides a feasible option for white cataract, high-grade cataract or cataract nigra patients' expectations of an enhanced lifestyle with spectacle independence.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported in part by Jiangsu Province's Outstanding Medical Academic Leader Program (CXTDA2017039) and the Soochow Scholar Project of Soochow University.

Informed consent

Written informed consent was obtained from the patient(s) for their anonymised information to be published in this article.

References

1. Chakrabarti A and Singh S. Phacoemulsification in eyes with white cataract. *J Cataract Refract Surg* 2000; 26: 1041–1047.
2. Vajpayee RB, Bansal A, Sharma N, et al. Phacoemulsification of white hypermature cataract. *J Cataract Refract Surg* 1999; 25: 1157–1160.
3. Li Y and Lin H. Pattern of refractive correction and timing of stage II IOL implantation after congenital cataract extraction. *Eye Sci* 2014; 29: 237–242.
4. Liu JW and Haw WW. Optimizing outcomes of multifocal intraocular lenses. *Curr Opin Ophthalmol* 2014; 25: 44–48.
5. Zelichowska B, Rekas M, Stankiewicz A, et al. Apodized diffractive versus refractive multifocal intraocular lenses: optical and visual evaluation. *J Cataract Refract Surg* 2008; 34: 2036–2042.
6. Alfonso JF, Fernández-Vega L, Baamonde MB, et al. Prospective visual evaluation of apodized diffractive intraocular lenses. *J Cataract Refract Surg* 2007; 33: 1235–1243.
7. Pepose JS, Qazi MA, Davies J, et al. Visual performance of patients with bilateral vs combination Crystalens, ReZoom, and ReSTOR intraocular lens implants. *Am J Ophthalmol* 2007; 144: 347–357.
8. Kohnen T, Allen D, Boureau C, et al. European multicenter study of the Acrysof ReSTOR apodized diffractive intraocular lens. *Ophthalmology* 2006; 113(4): 584.e1.
9. Weghaupt H, Pieh S and Skorpik C. Visual properties of the foldable array multifocal intraocular lens. *J Cataract Refract Surg* 1996; 22(Suppl. 2): 1313–1317.
10. Sheng H, Bottjer CA and Bullimore MA. Ocular component measurement using the Zeiss IOLMaster. *Optom Vis Sci* 2004; 81: 27–34.
11. Vogel A, Dick HB and Krummenauer F. Reproducibility of optical biometry using partial coherence interferometry: intraobserver and interobserver reliability. *J Cataract Refract Surg* 2001; 27: 1961–1968.
12. Kunavisarut P, Poopattanakul P, Intarated C, et al. Accuracy and reliability of IOL master and A-scan immersion biometry in silicone oil-filled eyes. *Eye* 2012; 26: 1344–1348.
13. Fontes BM, Fontes BM and Castro E. Intraocular lens power calculation by measuring axial length with partial optical coherence and ultrasonic biometry. *Arq Bras Oftalmol* 2011; 74: 166–170.
14. Findl O, Kriechbaum K, Sacu S, et al. Influence of operator experience on the performance of ultrasound biometry compared to optical biometry before cataract surgery. *J Cataract Refract Surg* 2003; 29: 1950–1955.
15. Yoshino M, Inoue M, Kitamura N, et al. Diffractive multifocal intraocular lens interferes with intraoperative view. *Clin Ophthalmol* 2010; 4: 467–469.
16. Kara-Junior N, de Santhiago MR, Kawakami A, et al. Minirhexis for white intumescent cataracts. *Clinics* 2009; 64: 309–312.
17. Yuen KC, Day JL, Flannagan DW, et al. Diabetic neuropathic cachexia and acute bilateral cataract formation following rapid glycaemic control in a newly diagnosed type 1 diabetic patient. *Diabet Med* 2001; 18: 854–857.
18. White FA and Richert HM. Accelerated bilateral cataract formation in insulin-dependent diabetes mellitus. *Diabetes Care* 1984; 7: 186–187.