Comparison of preoperative and postoperative ocular biometry in eyes with iris-fixated phakic intraocular lens implantations

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The Master's Thesis
submitted to the Department of Medicine,
the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree
of Master of Medical Science

Joo Youn Shin

December 2011

This certifies that the Master's Thesis of

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December 2011

ACKNOWLEDGEMENTS

First of all, I very much appreciate my thesis supervisor, Prof. Tae-im Kim for giving me great advice and guidance that has been helpful for taking a degree. I thank her for her supervision and encouragement to study this subject.

I also appreciate professors, Hye-Yeon Lee and Kyoung Yul Seo who gave me expert and warm support. And thanks to all members of our department for their helpful assistance and supports.

Finally, I would like to thank to my parents for allowing me to being me now. And I specially thank to my soul mate, Young-wook, who always believes and supports me. My babies; Seo-jin and Joo-won, I love you with all my heart.

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Abstract

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This study was designed to compare preoperative to postoperative ocular biometry in patients with two types of iris-fixated phakic intraocular lens (pIOLs); Artisan or Artiflex phakic IOL implantations.

This study included 40 eyes with Artisan pIOL implants and 36 eyes with Artiflex pIOL implants. Anterior chamber depth (ACD) and axial length (AL) were measured by applanation ultrasonography (A-scan) and partial coherence interferometry (IOLMaster) preoperatively and 3 months after pIOL implantation.

ACD measurements after Artisan or Artiflex pIOL implantation were smaller than preoperative measurements. After Artisan pIOL implantation, differences in AL measurements by A-scan were insignificant whereas postoperative AL measurements by IOLMaster were significantly longer than preoperative measurements. After Artiflex pIOL implantation, AL measurements by both A-scan and IOLMaster were significantly longer than preoperative

measurements. In Artiflex group, differences in AL measurements by A-scan correlated with the central thickness of the Artiflex pIOL. ACD and AL measurements were influenced by iris-fixated IOL implantation. Surgeons should consider potential errors caused by pIOLs when measuring ocular biometry after iris-fixated pIOL implantation.

Key words : ocular biometry, anterior chamber depth, axial length, iris-fixated phakic intraocular lens, Artisan, Artiflex

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I. INTRODUCTION

Phakic intraocular lenses (pIOLs) have become popular for correction of high refractive errors. They have been proven to be an effective and safe option for the treatment of high myopia. [1-3] However, complications have also been reported after pIOL implantation. These include cataract ,endothelial cell loss [4], retinal detachment [5], traumatic aniridia, IOL dislocation, pigment dispersion syndrome and glaucoma.[6] PIOL implantations may increase the speed of cataract development due to surgical trauma, postoperative inflammation, and the postoperative use of topical steroids. [6-8] There is a direct relationship between the development of lens opacity and high myopia.[6] With the increasing popularity of pIOLs, an increasing number of patients will present with cataracts, whether induced by the pIOLs or natural aging process.

In patients with a history of iris-fixated pIOL implantation, explantation of

the pIOL and cataract surgery can be done simultaneously or cataract extraction can be performed after adequate healing of the pIOL explantation. Combined surgery requires a shorter rehabilitation period but the surgeon should determine the IOL power with biometry measured before the pIOL explantation. Therefore, the surgeon needs to be aware of potential ocular biometry measurement errors in eyes with pIOLs.

The presence of a pIOL is known to affect ocular biometric measurement because the speed of the sound through the various materials of pIOLs is widely different and is different from the average velocity used to measure the eye. Although Hoffer[9] published a formula by which to correct this error, some studies have suggested that use of the correction factor may be inadvisable. [6, 10-12] One study reported that the AL measured by IOLMaster is not significantly affected by Visian ICL implantation.[10] Other authors concluded that the change in AL, as measured by the immersion A-scan after Visian ICL implantation, is statistically insignificant.[11] Another report reviewed several studies and found that the biometry and IOL power calculations are not distorted by the presence of a pIOL except in the case of silicone posterior chamber pIOLs.[6]

The aim of this study was to determine whether any biometric measurement errors occur after two types of iris-fixated pIOLs made of different materials: Artisan and Artiflex ; PMMA and silicone, respectively. In addition, we used both A-scan ultrasonography and IOLMaster to measure ocular biometry. These devices use different techniques for measuring ocular biometry, which aids in determining measurement errors are different based on measuring device and pIOL materials.

II. MATERIALS AND METHODS

1.Study design

This study included 76 eyes from 44 patients with iris-fixated pIOL implants. Subject were grouped by type of iris-fixated pIOL; Artisan and Artiflex group. Each group included 40 eyes from 24 patients with Artisan pIOL implantation and 36 eyes from 20 patients with Artiflex pIOL implantation. Both surgical treatments were performed by a single surgeon (J.B.Lee). Patient characteristics of both groups are shown in Table 1. The proportion of males to females and mean age of both groups were not significantly different.

Table 1. Patient characteristics

	Artisan	Artiflex	P-value
Eyes (n)	40	36	
Sex (M:F)	8 : 32	9 : 27	0.601†
Age [1]	31.75 ± 8.30 (21 ~ 50)	31.47 ± 6.39 (21 ~ 46)	0.872‡

M = male, F = female

[1] Data are presented as mean ± standard deviation and rage in the cautation

† Chi-square test

‡ Independent t-test

Before surgery, patients were given a detailed explanation of the surgery process and medical implications, and signed a written consent form in accordance with the Helsinki Declaration. Local Institutional Review Board (IRB) approval was obtained. Inclusion criteria consisted of patients with preoperative manifested refractive errors of -3.0 diopter to -15.0 diopter with no history of glaucoma; corneal, lenticular, or retinal diseases; or any medical

disease likely to alter vision. Patients who had contraindications for pIOL implantation were excluded. These included patients with anterior chamber depth less than 3.2 mm, patients who had any angle and iris abnormalities, corneal endothelial density less than 2000 cells/mm^2.

Ophthalmic examinations were performed preoperatively, including slit lamp microscopy, cycloplegic and manifest refractions, fundus examination and intraocular pressure measurement with Goldmann applanation tonometry. Uncorrected visual acuities and best corrected visual acuities were checked. Two weeks before surgery, patients received a peripheral iridectomy incision with a Nd:YAG laser, generally at the 12 o' clock position.

2. Artisan Phakic Intraocular Lens Implantation

The Artisan® pIOLs used in the study (models 206 and 204, Ophtec BV, Groningen, The Netherlands) are convex–concave iris-fixated lenses. The biomaterial of the single-piece compression-molded IOL is CQ-ultraviolet absorbing poly methyl methacrylate (PMMA). Both models have an overall length of 8.5 mm. The central thickness of the myopic Artisan pIOL (-3 D to 23 D) is 0.14 mm.

All procedures were done using topical anesthesia with 0.5% proparacaine hydrochloride (Alcane®, Alcon, Fort Worth, TX, USA). A scleral tunnel incision was made at the 12 o'clock position with a width of 5.2 or 6.2 mm, depending on the IOL diameter. Two lateral paracenteses were created in the cornea at the 10 o'clock and 2 o'clock position with a width of 1.5 mm. Acetylcholine was injected, and the anterior chamber was filled with an 1% sodium hyaluronate. The Artisan pIOL was inserted from the 12 o'clock position and rotated into a horizontal position. The lens haptic was enclavated to a fold of the midperipheral iris stroma using an enclavation needle at the 3 o'clock and 9 o'clock meridians.

The Artisan pIOL was centered over the pupil, and the remaining viscoelastic material was irrigated out of the anterior chamber. The incision was closed with a continuous 10-0 nylon suture.

Postoperative treatment included topical antibiotics and 0.1% fluorometholone applied four times daily for 2 weeks and then tapered.

3. Artiflex Phakic Intraocular Lens Implantation

The Artiflex® pIOL (Ophtec BV, Groningen, The Netherlands) used in the study is a three-piece lens. The flexible optic is made of ultraviolet absorbing silicone and the rigid haptics are made of Perspex CQ-ultraviolet absorbing PMMA. The optical part of the Artiflex pIOL has a 6.0-mm diameter. The lens has an overall length of 8.5 mm and a slight anterior and posterior vault. The central thickness of the myopic Artiflex pIOL is variable from 0.14 to 0.52 mm.

A 3.2 mm clear corneal incision was performed at the 12 o'clock position, and two stab incisions were placed at the 10 o'clock and 2 o'clock positions in the direction of the enclavation sites. Acetylcholine was injected, and the anterior chamber was filled with a 1% sodium hyaluronate. The Artiflex pIOL was inserted from the 12 o'clock position and rotated into a horizontal position. The lens haptic was enclavated to a fold of the midperipheral iris stroma using an enclavation needle at the 3 o'clock and 9 o'clock meridians. The Artiflex pIOL was centered over the pupil, and remaining viscoelastic material was irrigated out of the anterior chamber. The clear corneal incision site was self-sealed with hydration.

Postoperative treatment included topical antibiotics and 0.1% fluorometholone applied four times daily for 2 weeks and then tapered.

4. Ocular Biometry Measurement

Ocular biometry was measured by two devices; applanation ultrasonography; A-scan (Sonomed A/B scan 5500, Sonomed Inc., NY, USA) and partial coherence interferometry (IOLMaster® ;Carl Zeiss Meditec AG, Oberkochen, Germany).

A-scan does not measure length or distance directly. A-scan measures the time it takes the sound to traverse the eye and convert it to a linear value using a velocity formula where distance = velocity x time. The velocity of sound through the various materials is widely different and the average velocity for the normal range axial length eye is 1555 m/s. Meanwhile, IOLMaster uses partial coherence interferometry (PCI) to assess the axial length (AL), and anterior chamber depth (ACD) is determined by calculating the distance between the corneal and lens surfaces through lateral slit illumination. With the PCI technique, it is known that the AL measurement is less influenced by intraocular material (such as silicone oil) compared to A-scan ultrasonography.

Measurements were performed by a technician at baseline and 3 months after surgery with default settings for the phakic eye (phakic mode). Ocular biometry measurements were first performed by IOLMaster and then by A-scan. With IOLMaster, the predicted refractive errors, which means changes in goal diopter of IOL power required for emmetropia calculated postoperatively, were compared by various formulae; SRKII, SRK/T, Haigis and Holladay.

5. Statistical Analysis

A paired t-test was used to compare the difference between preoperative and postoperative ACD and AL measurements. Measurement differences were calculated by subtracting the preoperative biometry measurement from the postoperative biometry measurement. Pearson correlation was used to analyze

the relationship between the AL measurement difference , preoperative AL, and Artiflex pIOL central thickness. One-way analysis of variance (ANOVA) was used to compare the predicted refractive errors by multiple formulae. All analysis were conducted using SPSS for Windows (Statistical Product and Services Solutions, version 15.0, SPSS Inc, Chicago, IL, USA). A p value less than 0.05 was considered to indicate statistical significance.

III. RESULTS

Clinical data before and after iris-fixated pIOL implantation are shown in Table 2. The preoperative and postoperative spherical equivalent was different between the Artisan group and the Artiflex group ($p<0.001$ and $p=0.014$, respectively). whereas the difference for postoperative LogMAR UCVA was not significant ($p=0.509$).

Table 2. Clinical data before and after iris-fixated phakic intraocular lens implantations

	LogMAR UCVA[1]	LogMAR BCVA[2]	SE [3]
Preoperative			
Artisan	1.91 ± 0.20	-0.02 ± 0.04	-9.88 ± 2.19 D
	(1.30 ~ 2.00)	(-0.10 ~ 0.00)	(-15.00 ~ -5.75)
Artiflex	1.89 ± 0.19	-0.02 ± 0.04	-7.67 ± 1.92 D**
	(1.30 ~ 2.00)	(-0.10 ~ 0.00)	(-11.25 ~ -4.23)
Postoperative			
Artisan	0.02 ± 0.09	-0.07 ± 0.05	-0.98 ± 0.49 D
	(-0.10 ~ 0.22)	(-0.10 ~ 0.00)	(-2.13 ~ -0.25)
Artiflex	0.01 ± 0.08	-0.07 ± 0.04	-0.73 ± 0.39 D*
	(-0.10 ~ 0.15)	(-0.10 ~ 0.00)	(-1.63 ~ -0.25)

Data are presented as mean ± standard deviation and range is in the cautation

[1] LogMAR UCVA = logarithm of the minimal angle of resolution, uncorrected visual acuity

[2] BCVA = best corrected visual acuity

[3] SE = spherical equivalent, unit is Diopter (D)

* $p<0.05$, ** $p<0.001$ by the independent t-test between Artisan and Artiflex groups

ACD measurements after Artisan and Artiflex pIOL implantation were smaller than preoperative ACD measurements. The measurement differences of both pIOLs by A-scan were more than 1-mm whereas those for IOLMaster were less than 0.1-mm (Table 3).

Table 3. Comparison of anterior chamber depth before and after iris-fixated phakic intraocular lens implantations

	Preoperative	Postoperative
Artisan		
A-scan	3.86 ± 0.24 mm	2.80 ± 0.27 mm**
	(3.51 ~ 4.33 mm)	(2.40 ~ 3.38 mm)
IOLMaster	3.86 ± 0.25 mm	3.78 ± 0.28 mm**
	(3.48 ~ 4.38 mm)	(3.26 ~ 4.39 mm)
Artiflex		
A-scan	3.81 ± 0.16 mm	2.50 ± 0.16 mm**
	(3.52 ~ 4.27 mm)	(2.24 ~ 2.91 mm)
IOLMaster	3.84 ± 0.16mm	3.79 ± 0.15mm**
	(3.52 ~ 4.24 mm)	(3.50 ~ 4.20mm)

Data are presented as mean ± standard deviation and range is in cautation

** $p<0.001$ by the paired t-test between preoperative and postoperative data

Artisan pIOL implantation did not result in significant differences in AL measurement by A-scan, whereas postoperative AL measurements by IOLMaster were significantly longer than preoperative AL measurements. After Artiflex pIOL implantation, AL measurements by A-scan and IOLMaster were significantly longer than preoperative measurements (Table 4).

Table 4. Comparison of the axial length before and after iris-fixated phakic intraocular lens implantations

	Preoperative	Postoperative
Artisan		
A-scan	26.93 ± 1.26 mm	26.90 ± 1.27 mm
	(24.93 ~ 29.37 mm)	(24.80 ~ 29.45 mm)
IOLMaster	27.08 ± 1.31 mm	27.20 ± 1.33 mm**
	(25.01 ~ 29.47 mm)	(25.05 ~ 29.72 mm)
Artiflex		
A-scan	26.40 ± 1.20 mm	26.49 ± 1.18 mm*
	(24.01 ~ 29.43 mm)	(24.02 ~ 29.43 mm)
IOLMaster	26.55 ± 1.30mm	26.61 ± 1.26mm*
	(24.10 ~ 29.53mm)	(24.16 ~ 29.48mm)

Data are presented as mean ± standard deviation and range is in cautation

*$p<0.05$, ** $p<0.001$ by the paired t-test between preoperative and postoperative data

Preoperative to postoperative differences in ACD and AL, which mean postoperative biometry measurements minus preoperative biometry measurements, are shown in Figure 1 and Figure 2, respectively.

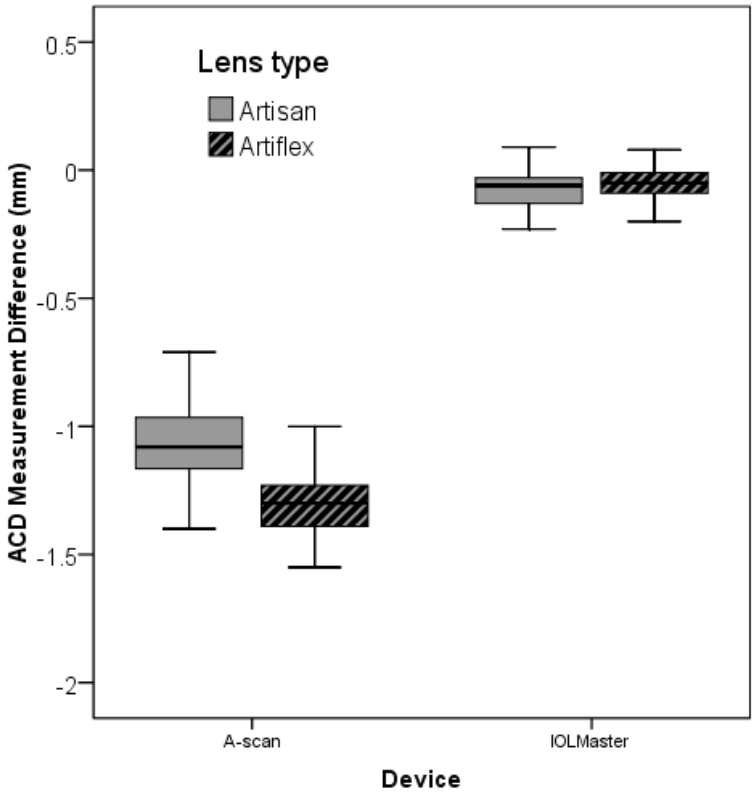

Figure 1. Pre to postoperative difference in anterior chamber depth (ACD) in eyes with iris-fixated phakic intraocular lens implantations. The difference measured by A-scan was larger than the data measured by the IOLMaster. The difference measured by A-scan was 1.07 mm after Artisan implantation and 1.31 mm after Artiflex implantation, while the data measured by the IOLMaster was 0.08 mm after Artisan implantation and 0.05 mm after Artiflex implantation. Box indicates median and inter-quartile range(IQR) and line indicates range of measurement difference.

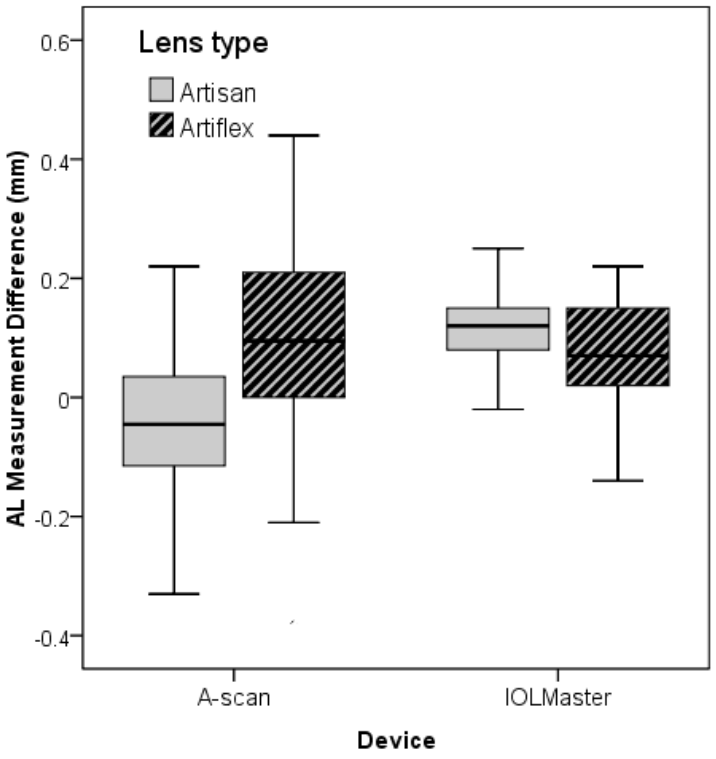

Figure 2. Pre to postoperative difference in axial length (AL) in eyes with iris-fixated phakic intraocular lens implantations. The difference measured by A-scan was -0.03 mm after Artisan implantation and 0.09 mm after Artiflex implantation, while the data measured by the IOLMaster was 0.12 mm after Artisan implantation and 0.07 mm after Artiflex implantation. Box indicates median and inter-quartile range(IQR) and line indicates range of measurement difference.

Pearson correlation was used to identify whether there were any correlation between measurement differences in AL and preoperative AL measurements. There was no correlation between the measurement difference in AL and preoperative AL (Table 5).

Table 5. Correlation between the difference[1] in axial length and preoperative axial length.

	Coefficient	p-value†
Artisan group		
Preoperative axial length by A-scan	-0.006	0.971
Preoperative axial length by IOLMaster	0.255	0.108
Artiflex group		
Preoperative axial length by A-scan	-0.225	0.174
Preoperative axial length by IOLMaster	-0.302	0.073

[1] Postoperative axial length measurement minus preoperative data.

† $p<0.05$ by Pearson correlation

In Artiflex implantation group, the central thickness measured by A-scan was correlated with measurement difference in AL. Meanwhile, there was no correlation between the measurement difference in AL and the central thickness of Artiflex pIOL measured by IOLMaster (Table 6).

Table 6. Correlation between the difference[1] in axial length and the central thickness in Artiflex implantation group.

Measurement tool	Coefficient	p-value
A-scan	0.356	0.028†
IOLMaster	-0.149	0.385

[1] Postoperative axial length measurement minus preoperative data.

† $p<0.05$ by Pearson correlation

With IOLMaster, predicted refractive errors, which mean changes in goal diopter of the IOL power required for emmetropia calculated postoperatively, were calculated by various formulas. In both Artisan and Artiflex pIOL implantation groups, there were no significant inter-formula differences between these 4 formulas (Table 7).

Table 7. Predicted refractive error[1] by various formulas by IOLMaster in eyes with iris-fixated phakic intraocular lens implantations

	Artisan	Artiflex
SRK II	0.32±0.04 D	0.31±0.19 D
	(-0.10~0.70 D)	(-0.20~0.70 D)
SRK/T	0.27±0.05 D	0.24±0.17 D
	(-0.15~0.64 D)	(-0.29~0.57 D)
Haigis	0.29±0.05 D	0.26±0.20 D
	(-0.19~0.84 D)	(-0.33~0.66 D)
Holladay1	0.28±0.04 D	0.24±0.19 D
	(-0.17~0.69 D)	(-0.32~0.64 D)

Data are presented as mean ± standard deviation and range is in the cautation

[1] Changes in goal diopter of the IOL power required for emmetropia calculated by IOLMaster postoperatively, unit is Diopter (D)

IV. DISCUSSION

Acquiring exact ocular biometry is very important in determining exact IOL power in cataract surgery. In eyes with pIOL implant, possible errors in ocular biometric measurements caused by the presence of a pIOL may influence the IOL power calculation. A previous study[13] showed that cataract surgery combined with explantation of the iris-fixated pIOL yielded acceptable predictability of spherical equivalents of -0.28 ± 1.11 diopters. Moreover, some studies suggested that the correction factor may be inadvisable when measuring ocular biometry after pIOL implantation.[6, 10-12] However, to our knowledge, there has been no study with Artiflex pIOL implantations until now. In addition, we used both applanation ultrasonography and IOLMaster for measurement of ocular biometry.

We evaluated ACD before and after iris-fixated pIOL implantation. The ACD measured by A-scan after iris-fixated pIOL implantation was approximately 1 mm (1.07 mm in the Artisan group and 1.31 mm in the Artiflex group) shallower than the preoperative ACD. A-scan automatically calculates ACD from the first ultrasound peak to the aqueous/ anterior lens interface peak.[14] In eyes with pIOLs, this instrument was thought to detect the aqueous/ phakic IOL interface as a second peak instead of the crystalline lens. By IOLMaster, ACD measurement differences after Artisan and Artiflex implantation were smaller than by A-scan(-0.08 mm in the Artisan group and -0.05 mm in the Artiflex group). The IOLMaster measures the ACD through lateral slit illumination and it cannot measure recent pseudophakes.[15] Considering the quantity of measurement differences, IOLMaster calculated the distance between the corneal and crystalline lens surface, and not the anterior surface of the iris-fixated pIOL. However, there were also significant changes in ACD measurement after pIOL implantation. These changes may be derived from pIOL reflections that

influenced IOLMaster ACD measurements.

We also compared AL before and after iris-fixated pIOL implantation. The optics biometerials are different between Artisan and Artiflex pIOLs: PMMA and silicone, respectively. The ultrasound velocities traveling through pIOLs are different from their materials. Hoffer published a method to correct the error by using the following formula: $AL_{corrected}=AL_{1555} + (C * T)$, where AL_{1555}=the measured AL of the eye at a sound velocity of 1555m/s, T=the central thickness of the pIOL, and C=the material specific correction factor. The correction factor was +0.42 for PMMA and -0.59 for silicone. Using this formula, the AL measurement difference (postoperative AL minus preoperative AL) by A-scan after myopic Artisan pIOL implantation would be approximately -0.06 mm, whereas the AL measurement difference by A-scan after myopic Artiflex pIOL implantation would be approximately 0.08 to 0.31 mm (depending on the central thickness). In our study, the AL measurement difference after Artisan pIOL implantation by A-scan was -0.03 ± 0.15 mm and that of Artiflex was 0.09 ± 0.16 mm. These were similar to Hoffer's findings[9] although the difference in the Artisan group was not statistically significant. Additionally, AL measurement differences by A-scan correlated with the central thickness of the Artiflex pIOL. Thus, surgeons should consider measurement errors especially in eyes with pIOLs with high central thickness. The average of the AL measurement differences may not have a major effect on IOL power. However, the range of differences was wide from -0.33 to +0.33 mm for Artisan pIOLs and from -0.38 to 0.44 mm for Artiflex pIOLs. Such differences may result in an IOL power calculation error. Other than the effect of ultrasound velocity, this result may be derived from the limitation of the errors in ultrasound accuracy, which may be more difficult to accomplish.

IOLMaster, partial coherence interferometry, is a highly precise, contact-free,

and observer independent technique.[16,17] Previous studies comparing contact ultrasonography with the IOLMaster agree that ultrasonic measurements are less repeatable and more variable.[18] Additionally intraocular filling materials, such as silicone oil, affect the AL less than by ultrasonography.[19] In this study, AL measurement differences by IOLMaster after Artisan and Artiflex implantation were 0.12 ± 0.07 mm and 0.07 ± 0.10 mm, respectively (AL measurements were lengthened after the surgery) and the differences between Artisan and Artiflex pIOL were statistically insignificant (p=0.155). These results indicated that AL measurements after pIOL implantation were longer than preoperative measurements by IOLMaster and material of pIOL seems to have a relative lack of influence. Further studies investigating various pIOLs would be helpful. In addition, the standard deviation of the measurement difference determined by IOLMaster was smaller than A-scan and this results showed advantage of IOLMaster over A-scan; effect of corneal indentation and patient's cooperation.

In addition to precise biometry, the accuracy of IOL power calculation formulae is important for predicting postoperative refractive outcome. In our study, we compared the predicted refractive error, which means changes in goal diopter of IOL power required for emmetropia calculated by four IOL calculation formulae with IOLMaster; SRKII, SRK/T, Haigis and Holladay 1. The second-generation formula, SRK II is a regression-derived IOL power formula while the third-generation theoretical formulas; Holladay 1 and SRK/T are based on thin-lens optical principles, and all require knowledge of AL and corneal power (K). Holladay 1 and SRK/T formula consider the relationship between predicted ACD and AL being linear. In Haigis formula, the ACD measurement is incorporated into the IOL calculation equation, negating the need to obtain the ACD by regression using second or third generation formulae. [20] Because of these differences, the IOL power calculated by different formulas may be influenced

after pIOL impaltations. However, in our study, there was no significant difference among these formulas. This result may be caused by the changes in ACD was too small to make inter-formula differences. Mean predicted errors after Artisan and Artiflex pIOL implantation were 0.27 to 0.32 diopter; that means axial length measured by IOLMaster phakic mode may resulted in postoperative hyperopic refractive outcome. Thus, this study suggested surgeons to consider target refraction adjustment.

V. CONCLUSION

This study was designed to compare preoperative to postoperative ocular biometry with patients with iris-fixated pIOL implantations. ACD and AL measurements by A-scan and IOLMaster were influenced by iris-fixated pIOL implantation. Surgeons should consider potential errors caused by iris-fixated pIOLs when measuring ocular biometry.

REFERENCES

1. Huang D, Schallhorn SC, Sugar A, Farjo A, Majmudar PA, Trattler WB, et al. Phakic intraocular lens implantation for the correction of myopia: a report by the American Academy of Ophthalmology. Ophthalmology 2009;116(11):2244-58.
2. Stulting RD, John ME, Maloney RK, Assil K, Arrowsmith PN, Thompson VM. Three-year results of Artisan/Verisyse phakic intraocular lens implantation. Results of the United States Food And Drug Administration clinical trial. Ophthalmology 2008;115(3):464-72.e1.
3. Dick HB, Budo C, Malecaze F, Gell JL, Marinho AA, Nuijts RM, et al. Foldable Artiflex phakic intraocular lens for the correction of myopia: two-year follow-up results of a prospective European multicenter study. Ophthalmology 2009;116(4):671-7.
4. Saxena R, Boekhoorn S, Mulder PG, Noordzij B, van Rij G, Luyten GP. Long-term follow-up of endothelial cell change after Artisan phakic intraocular lens implantation. Ophthalmology 2008;115(4):608-13.e1.
5. Georgalas I, Petrou P, Papaconstantinou D, Koutsandrea C, Ladas I. Bilateral giant tear-associated retinal detachment following Artisan phakic intraocular lens implantation for correction of moderate myopia. Acta ophthalmologica;88(4):e143-e4.
6. Chen L, Chang Y, Kuo JC, Rajagopal R, Azar DT. Metaanalysis of cataract development after phakic intraocular lens surgery. Journal of cataract and refractive surgery 2008;34(7):1181-200.
7. Moshirfar M, Mifflin M, Wong G, Chang JC. Cataract surgery following phakic intraocular lens implantation. Current opinion in ophthalmology;21(1):39-44.

8. Kohnen T, Kook D, Morral M, Gell JL. Phakic intraocular lenses: part 2: results and complications. Journal of cataract and refractive surgery;36(12):2168-94.

9. Hoffer KJ. Ultrasound axial length measurement in biphakic eyes. Journal of cataract and refractive surgery 2003;29(5):961-5.

10. Sanders DR, Bernitsky DA, Harton PJ, Rivera R. The Visian myopic implantable collamer lens does not significantly affect axial length measurement with the IOLMaster. Journal of Refractive Surgery 2008;24(9):957-9.

11. Khokhar SK, Agarwal T, Dave V. Comparison of preoperative and postoperative axial length measurement with immersion A-scan in ICL cases. Journal of cataract and refractive surgery 2009;35(12):2168-9.

12. Pitault G, Leboeuf C, Leroux les Jardins S, Auclin F, Chong Sit D, Baudouin C. [Optical biometry of eyes corrected by phakic intraocular lenses]. Journal français d'ophtalmologie 2005;28(10):1052-7.

13. de Vries NE, Tahzib NG, Budo CJ, Webers CA, de Boer R, Hendrikse F, et al. Results of cataract surgery after implantation of an iris-fixated phakic intraocular lens. Journal of cataract and refractive surgery 2009;35(1):121-6.

14. Vetrugno M, Cardascia N, Cardia L. Anterior chamber depth measured by two methods in myopic and hyperopic phakic IOL implant. British journal of ophthalmology 2000;84(10):1113-6.

15. Sheng H, Bottjer CA, Bullimore MA. Ocular component measurement using the Zeiss IOLMaster. Optometry and vision science 2004;81(1):27-34.

16. Eleftheriadis H. IOLMaster biometry: refractive results of 100 consecutive cases. British journal of ophthalmology 2003;87(8):960-3.

17. Rose LT, Moshegov CN. Comparison of the Zeiss IOLMaster and applanation A-scan ultrasound: biometry for intraocular lens calculation.

Clinical & experimental ophthalmology 2003;31(2):121-4.

18. Landers J, Goggin M. Comparison of refractive outcomes using immersion ultrasound biometry and IOLMaster biometry. Clinical & experimental ophthalmology 2009;37(6):566-9.

19. Parravano M, Oddone F, Sampalmieri M, Gazzaniga D. Reliability of the IOLMaster in axial length evaluation in silicone oil-filled eyes. Eye 2007;21(7):909-11.

20. Haigis W, Lege B, Miller N, Schneider B. Comparison of immersion ultrasound biometry and partial coherence interferometry for intraocular lens calculation according to Haigis. Graefe's archive for clinical and experimental ophthalmology 2000;238(9):765-73.

ABSTRACT(IN KOREAN)

홍채고정 안내렌즈 삽입술 시행 전후의 안구 생체 계측 비교

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신 주 연

본 연구는 홍채고정 안내렌즈인 알티산 (Artisan)과 알티플렉스 (Artiflex) 시행 전후의 안구 생체 계측을 비교하고자 계획되었다. 알티산 삽입술을 시행받은 40 안과 알티플렉스 삽입술을 시행받은 36 안을 대상으로 술전과 술후 3 개월에 접촉식 초음파(A-scan)와 부분결합간섭계(IOLMaster)를 이용하여 전방깊이 및 안축장을 측정하였다.

전방깊이 측정치는 알티산과 알티플렉스 삽입 후가 술전에 비해 작게 나타났다. 알티산 삽입 후, A-scan을 이용한 안축장 측정치는 술전과 비교해 유의한 차이가 없었으나, IOLMaster를 이용한 안축장 측정치는 술후 유의하게 길게 나타났다. 알티플렉스 삽입 후, 안축장은 술전에 비해 유의하게 길게 측정되었다. 알티플렉스 삽입 안에서 A-scan을 이용한 안축장의 측정치 차이는 안내렌즈의 중심두께와 연관성을 보였다.

전방깊이와 안축장의 측정값은 홍채고정 안내렌즈 삽입술 후 영향을

받는 것으로 나타났다. 따라서 술자는 홍채고정 안내렌즈 삽입술 후 안구 생체 계측을 시행할 때 발생 가능한 오차를 고려해야 한다.

핵심되는 말 : 안구 생체 계측, 전방깊이, 안축장, 홍채고정 안내렌즈 삽입술, 알티산, 알티플렉스