Capsular bag performance of a hydrophobic acrylic 1-piece intraocular lens

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PURPOSE: To compare parameters after 1-piece and 3-piece intraocular lens (IOL) implantation.

SETTING: Moorfields West End Clinic, London, United Kingdom, and Hanusch Hospital, Vienna, Austria.

DESIGN: Prospective randomized controlled trial.

METHODS: Each eye of patients having bilateral surgery for age-related cataract was randomized to have implantation of a 1-piece IOL (Tecnis ZCB00) or a 3-piece IOL (Tecnis ZA9003). Changes in visual acuity, refraction, and anterior chamber depth (ACD) were evaluated during a 2-year follow-up. Intraocular lens tilt and decentration were evaluated using a Purkinje meter. Regeneratory posterior capsule opacification (PCO) was analyzed using retroillumination photographs in Automated Quantification of After-Cataract image-analysis software.

RESULTS: This study comprised 100 eyes of 50 patients. No statistically significant differences were found in IOL tilt or decentration between groups ($P \geq .06$). Minimal but statistically significant changes were observed in the vertical tilt component 12 months postoperatively in the 3-piece IOL group ($P < .01$). The tilt and decentration components did not correlate with changes in sphere or the regeneratory PCO score ($r = 0.38$, $P \geq .06$). The ACD decreased significantly between 1 day and 1 month postoperatively in both groups ($P < .01$), with no significant changes afterward ($P \geq .22$). The anterior chamber was significantly deeper in the 1-piece group at all follow-up visits ($P < .01$).

CONCLUSIONS: Both the 1-piece IOL and the 3-piece IOL showed excellent positional stability in the capsular bag, resulting in good clinical outcomes. Regeneratory PCO levels were low and comparable between the IOLs.

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The behavior of an intraocular lens (IOL) in the capsular bag is crucial for the IOL's general performance because it influences the postoperative anterior chamber depth (ACD); IOL shift, tilt, and decentration; and the most common long-term complication of cataract surgery, namely posterior capsule opacification (PCO). The aim of modern cataract surgery is a low, predictable ACD shift after surgery as well as low degrees of IOL tilt and decentration. These parameters are mainly influenced by the interaction between the IOL and the lens capsule, especially during the time of capsule collapse and capsule shrinkage.

After cataract surgery, there is great variability in the shift in ACD with different IOL designs.[1–4] Inaccurate prediction of the postoperative ACD remains the main source of error in IOL power calculation[5] and results in myopia or hyperopia.[6] This has an impact on the spectacle dependence of patients, a factor that is especially important when IOLs designed to decrease spectacle dependence (eg, multifocal or toric models) are implanted. In addition, capsule fibrosis and shrinkage lead to IOL tilt and decentration, which can hinder the otherwise better optical performance of aspheric IOLs over conventional spheric IOLs.[7]

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According to the International Organization for Standardization 11979-3:2006,[8] the sum of the arithmetic mean of IOL optic decentration should not exceed 10% of the clear optic and the sum of the arithmetic mean of the optic tilt should not exceed 5 degrees. Theoretically, the positive optical effect of an aspheric IOL is lost when there is more than 7 degrees of tilt or more than 0.4 mm of decentration.[9] Piers et al.[10] observed this loss of effect when the IOL tilt was more than 10 degrees or the decentration was more than 0.8 mm.

Another aspect of capsular bag performance of an IOL is PCO. The main type of PCO—regeneratory—is caused by proliferation of equatorial lens epithelial cells (LECs). This results in pearl formation on the posterior capsule.[11] A sharp posterior IOL optic edge design significantly reduces the development of PCO; the decrease occurs because the posterior capsule bends at the sharp posterior optic edge.[12] As shown in previous studies,[13,14] LECs mainly begin their migration toward the space between the IOL and the posterior capsule at the optic–haptic junction. The optic–haptic junction zones of 1-piece IOLs are larger than those of 3-piece IOLs. This can cause a loss of effective bending of the posterior capsule, leading to the question of whether 1-piece IOLs have poorer PCO performance than 3-piece IOLs.

The purpose of the current study was to compare the ACD shift, IOL tilt and decentration, as well as PCO formation after implantation of a 1-piece IOL and a 3-piece IOL of the same material.

PATIENTS AND METHODS

This randomized bilateral paired-eye controlled patient- and examiner-masked study included patients who were scheduled for cataract surgery. The study adhered to the tenets of the Declaration of Helsinki and was reviewed by the local ethics committee. After receiving information on the scope of the study, all patients signed a consent form.

Exclusion criteria were glaucoma, corneal opacity, cornea guttata, an abnormal iris, significant macular degeneration or other retinopathy, previous posterior segment surgery, a history of ocular inflammation, pseudoexfoliation syndrome, pigment dispersion syndrome, a history of ocular trauma, and other ocular comorbidities that can affect capsular bag performance.

Preoperative Assessment

Preoperatively, all patients had a full ophthalmologic examination including refractive status, uncorrected (UDVA) and corrected (CDVA) distance visual acuities, slitlamp evaluation, and optical biometry measurements by partial coherence interferometry (PCI) (IOLMaster, Carl Zeiss Meditec AG). Furthermore, another PCI device (ACMaster, Carl Zeiss Meditec AG) was used to measure the ACD. Partial coherence interferometry has been found to be very precise and reproducible for this purpose.[15,16]

Intraocular Lenses and Power Calculation

A 1-piece IOL (Tecnis ZCB00 1-piece IOL) was implanted in 1 eye and a 3-piece IOL (Tecnis ZA9003) (both Abbott Medical Optics, Inc.) in the fellow eye of the same patient. The 1-piece IOL has a 6.0 mm biconvex optic, an overall diameter of 13.0 mm, and an anterior aspheric surface. The optic has a continuous 360-degree square frosted edge. The C-shaped haptics are offset from the optic for 3-point fixation. The optic and haptics are of an ultraviolet light–filtering hydrophobic acrylic material.

The 3-piece IOL has a 6.0 mm biconvex optic made of the same material as the 1-piece model with a similar aspheric surface and an overall diameter of 13.0 mm. The optic has a rounded anterior edge designed to avoid edge glare phenomena and a squared posterior edge designed to facilitate 360-degree contact with the capsule. The haptics are of 60% blue core poly(methyl methacrylate) (PMMA) monofilament.

Which IOL model was to be implanted first was randomized using a sealed-envelope technique derived and supplied by the clinical trials unit of Moorfields Eye Hospital, London, United Kingdom. Patients and examiners were masked to this randomization throughout the trial. The surgeons were masked until just before the IOL was implanted.

For IOL power calculation, the Hoffer Q formula[17] was used for eyes with an axial length (AL) below 22.0 mm; the SRK/T formula[18] was used for all other eyes. Constants were taken from the User Group for Laser Interference Biometry database[A]; the A-constant was 119.3 for the 1-piece IOL and 119.1 for the 3-piece IOL and the ACD was 5.61 and 5.80, respectively.

Surgical Technique

One of 2 experienced surgeons (O.F., V.M.) performed all cataract surgeries using a standardized sutureless technique. The surgeries were performed using the same setting and the same operating room. The technique included a 3.2 mm temporal limbal incision, a capsulorhexis diameter of approximately 5.0 mm, hydrodissection, phacoemulsification, irrigation/aspiration of cortical remnants, IOL implantation in the capsular bag, and intracameral injection of an antibiotic agent. The side port was hydrated in all cases; the other incisions were hydrated only if necessary.

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Postoperative Assessment

Postoperatively, patients were evaluated at 1 day, 1 and 3 months, and 1 and 2 years. One day after surgery, the ACD was measured using PCI. At the remaining postoperative visits, the protocol used for the preoperative examination was followed. In addition, at the 12-month and 24-month visits, IOL decentration and tilt were measured with a Purkinje meter (prototype, designed by Juan Tabernero and Pablo Artal, Murcia, Spain) after pupil dilation with phenylephrine 2.5% (Minims) and tropicamide 0.5% (Minims) eyedrops. For the measurement, the patient fixated on a light with the eye being measured and a photograph of the reflections of the semicircular array of light-emitting diodes was taken. The photographs taken with the Purkinje meter show 3 Purkinje reflexes; the first and second Purkinje reflexes are superimposed and represent the anterior and posterior corneal surface, the third and fourth Purkinje reflex derive from the anterior and posterior IOL surface, respectively. The Purkinje reflexes and the pupil margin were manually marked, and the dedicated software calculated the position of the IOL as well as the angle κ. Intraocular lens decentration and tilt were calculated relative to the pupillary axis. The technical details of the Purkinje meter system have been described.[19] The technique is noncontact, does not use a flash, is quick and easy to perform, and is highly reproducible.[20]

To assess PCO, retroillumination images were taken at all postoperative follow-ups. Images were acquired using a digital camera (EOS 5D, Canon, Inc.) mounted on a modified Zeiss 30 slitlamp (Carl Zeiss Meditec AG) with an external flashlight source that provides coaxial illumination from a flash pack through a fiber-optic cable to the camera.[21] This produces even illumination over the entire image with relatively small flash artifacts[22] and has been shown to be highly reproducible.[23] All digital images were transferred to a personal computer and stored on a hard disk for later evaluation. Posterior capsule opacification was objectively evaluated by measuring the entropy of the retroillumination images using automated image-analysis software (Automated Quantification of After-Cataract [AQUA]); the score was between 0 to 10, with 0 indicating a clear capsule and 10 indicating severe PCO.[24]

Statistical Analysis

Statistical analysis was performed using SPSS for Windows software (version 19.0, International Business Machines Corp.). Normality of all data samples was first evaluated using the Kolmogorov-Smirnov test. When parametric analysis was possible, repeated-measures analysis of variance (ANOVA) was performed for data comparisons between consecutive examinations, whereas the unpaired Student *t* test was used for data comparisons between the 1-piece group and the 3-piece group. When parametric analysis was not possible, the Friedman test was applied to assess the significance of differences between consecutive examination data, whereas the Mann-Whitney U test was used to compare the analyzed parameters between groups. The paired Student *t* test and Wilcoxon test were used as post hoc tests with the Bonferroni adjustment to avoid the experimental error rate for parametric statistics and nonparametric statistics, respectively. For all statistical tests, the level of significance was $P<.05$. The Pearson or Spearman coefficient (depending on normality) was used to assess the correlation between variables.

Table 1. Preoperative anatomic characteristics by groups and *P* values for between-group comparisons.

Parameter	Mean ± SD: 1-Piece Group (50 Eyes)	Mean ± SD: 3-Piece Group (50 Eyes)	*P* Value*
KM (D)	43.68 ± 1.56	43.69 ± 1.57	.98
CCT (μm)	519.70 ± 32.85	515.58 ± 31.12	.54
ACD (mm)	3.20 ± 0.38	3.19 ± 0.39	.78
LT (mm)	4.44 ± 0.40	4.44 ± 0.41	.99
AL (mm)	23.49 ± 0.71	23.44 ± 0.68	.71

ACD = anterior chamber depth; AL = axial length; CCT = central corneal thickness; KM = mean keratometry; LT = lens thickness
*Unpaired Student *t* test

RESULTS

The mean age of the 26 women (52%) and 24 men (48%) was 70.5 years (range 48 to 87 years). Table 1 shows the patients' preoperative descriptive data by IOL group. There were no statistically significant between-group differences in preoperative keratometry, central corneal thickness, ACD, lens thickness, or AL.

Refraction and Keratometry

Table 2 shows the 3-month postoperative visual, refractive, and keratometric results by group. Table 3 shows those results at 12 months.

In the 1-piece group, there was a statistically significant change in the sphere and spherical equivalent (SE) throughout the follow-up ($P<.01$, Friedman test). Specifically, a statistically significant change toward myopia was observed between the 3-month and 12-month examinations ($P<.0001$, adjusted

Table 2. Between-group comparison of 3-month postoperative visual, refractive, and keratometric results.

Parameter	Mean ± SD: 1-Piece Group (49 Eyes)	Mean ± SD: 3-Piece Group (49 Eyes)	*P* Value
LogMAR UDVA	0.14 ± 0.14	0.17 ± 0.13	.14*
Sphere (D)	+0.17 ± 0.50	−0.20 ± 0.53	<.0001*
Cylinder (D)	−0.84 ± 0.53	−0.88 ± 0.51	.44*
SE (D)	−0.25 ± 0.50	−0.65 ± 0.47	<.0001*
KM (D)	43.76 ± 1.57	43.82 ± 1.63	.84†
LogMAR CDVA	0.01 ± 0.09)	0.014 ± 0.09)	.74*

CDVA = corrected distance visual acuity; KM = mean keratometry; SE = spherical equivalent; UDVA = uncorrected distance visual acuity
*Mann-Whitney *U* test
†Unpaired Student *t* test

Table 3. Between-group comparison of 12-month postoperative visual, refractive, and keratometric results.

Parameter	1-Piece Group (48 Eyes)	3-Piece Group (47 Eyes)	*P* Value
LogMAR UDVA	0.11 ± 0.15	0.13 ± 0.18	.35*
Sphere (D)	0.05 ± 0.39	0.01 ± 0.51	.92*
Cylinder (D)	−0.90 ± 0.48	−0.96 ± 0.58	.73*
SE (D)	−0.38 ± 0.52	−0.47 ± 0.60	.72*
KM (D)	43.62 ± 1.48	43.73 ± 1.55	.72†
LogMAR CDVA	0.02 ± 0.04	0.02 ± 0.16	.48*

CDVA = corrected distance visual acuity; KM = mean keratometry; SE = spherical equivalent; UDVA = uncorrected distance visual acuity
*Mann-Whitney *U* test
†Unpaired Student *t* test

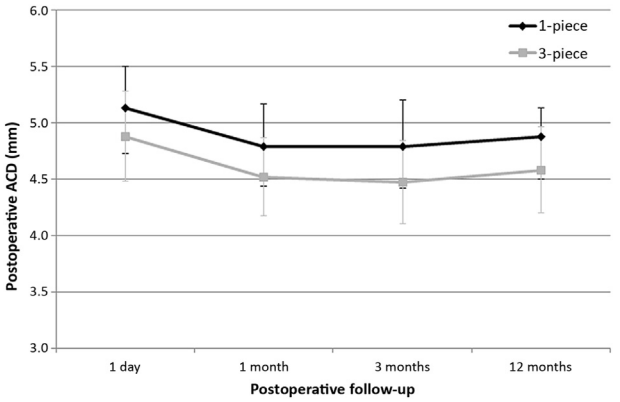

Figure 1. Changes in postoperative ACD during the follow-up by group (ACD = anterior chamber depth).

Wilcoxon test). No statistically significant changes in cylinder ($P=.27$, Friedman test) or keratometry ($P=.17$, repeated-measures ANOVA) were observed during the follow-up. In addition, no statistically significant keratometric changes were observed between the preoperative visit and the 1-month postoperative visit ($P=.25$, Bonferroni test).

Postoperatively, in the 3-piece group, no significant changes were found in manifest refraction (sphere, $P=.65$, repeated-measures ANOVA; cylinder, $P=.10$, Friedman test; SE, $P=.58$, repeated-measures ANOVA). There was also no statistically significant change in keratometry ($P=.38$, repeated-measures ANOVA). The postoperative sphere and SE were significantly more myopic in the 3-piece group than in the 1-piece group at 3 months ($P<.001$, Mann-Whitney *U* test). The postoperative manifest cylinder and mean keratometry did not differ significantly between the 2 groups ($P\geq.25$, unpaired Student *t* and Mann-Whitney *U* tests).

Visual Acuity

There were no statistically significant differences in the 12-month postoperative UDVA or CDVA between groups ($P=.35$ and $P=.48$, respectively; Mann-Whitney *U* test) (Table 3). At 2 years, the mean UDVA was 0.11 ± 0.09 logMAR in the 1-piece group (n = 41) and 0.13 ± 0.04 logMAR in the 3-piece group (n = 41) and the mean CDVA, 0.02 ± 0.02 logMAR and 0.02 ± 0.10 logMAR, respectively. The differences between groups were not statistically significant ($P=.35$ and $P=.67$, respectively; Mann-Whitney *U* test).

Change in Postoperative Anterior Chamber Depth

Statistically significant changes in postoperative ACD were detected during the follow-up in the 1-piece group ($P<.01$, Friedman test) and the 3-piece group ($P<.01$, repeated-measures ANOVA). Specifically, a significantly shallower anterior chamber was observed between the day after surgery and 1 month postoperatively in both groups (1-piece: $P<.01$, adjusted Wilcoxon test; 3-piece: $P<.01$, adjusted paired Student *t* test), with no significant changes thereafter ($P=0.22$ and $P=.48$, respectively; adjusted paired Student *t* test) (Figure 1).

This mean reduction in ACD in the first 3 postoperative months was −0.36 ± 0.50 mm in the 1-piece group (n = 48) and −0.39 ± 0.487 mm in the 3-piece group (n = 47). The mean change in ACD from 1 month to 12 months (0.09 ± 0.34 mm versus 0.07 ± 0.34 mm) did not differ significantly between groups ($P=.85$, Mann-Whitney *U* test). The anterior chamber was significantly deeper in the 1-piece group than in the 3-piece group at all postoperative visits ($P<.01$, unpaired Student *t* and Mann-Whitney *U* tests) (Figure 1).

The postoperative ACD was significantly correlated with the preoperative ACD in both groups (Table 4). No correlation was found between the change in ACD and the sphere in either group (1-piece: $r = -0.001$, $P=.99$; 3-piece: $r = 0.097$, $P=.53$).

Intraocular Lens Tilt and Decentration

Figure 2 shows the distribution of tilt components and Table 5 the mean tilt values 12 months and 24 months postoperatively by group. The tilt components were more scattered in the 3-piece group at both postoperative visits. The mean vertical tilt was statistically significantly higher in the 3-piece group at 12 months. However, no statistically significant differences in horizontal tilt were found between the 2 groups.

Figure 3 shows the distribution of the decentration components and Table 5 the mean decentration values 12 months and 24 months postoperatively by group.

Table 4. Correlation between postoperative ACD and preoperative ACD.

Group/Postop Exam	*r* Value	*P* Value
1-piece IOL		
1 day	0.65	<.01
1 month	0.64	<.01
3 months	0.45	<.01
12 months	0.52	<.01
3-piece IOL		
1 day	0.44	<.01
1 month	0.41	<.01
3 months	0.41	<.01
12 months	0.31	.04

IOL = intraocular lens

Again, the decentration components were more scattered in the 3-piece group at both postoperative visits. The horizontal decentration and vertical decentration were statistically significantly higher in the 3-piece group at 12 month but not at 24 months.

There were no statistically significant between-group differences in the magnitude of change in the horizontal or vertical tilt or decentration components ($P \geq .52$, Mann-Whitney test). In the 1-piece group, no significant correlations were found between the change in sphere and the change in the horizontal and vertical tilt and decentration components ($r = -0.20$, $P \geq .31$). The finding was similar in the 3-piece group ($r = 0.38$, $P \geq .06$).

Posterior Capsule Opacification

Two years after surgery, the mean AQUA scores were 2.331 ± 1.512 (n = 35) and 2.193 ± 1.358 (n = 35) in the 1-piece group and 3-piece group, respectively. There was no statistically significant difference between the groups ($P = .63$). Two neodymium:YAG laser capsulotomies (4%) were performed in the 1-piece group and 1 (2%) in the 3-piece group. There was no significant correlation between the AQUA score and the tilt and decentration components in either group ($r = 0.38$, $P \geq .06$).

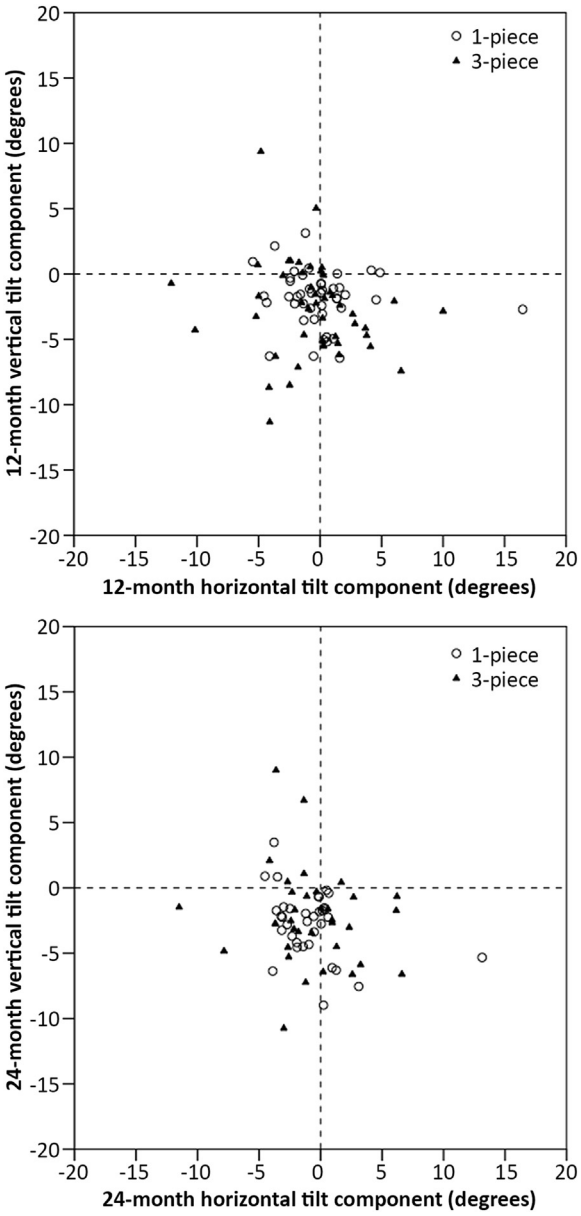

Figure 2. Distribution of the tilt components at 12 months and 24 months by group.

DISCUSSION

In the current study, the analysis of refractive outcomes during the 2-year period showed no significant changes between early examinations and later follow-up examinations except for a small, but statistically significant, myopic shift in the 1-piece IOL group between 3 months and 12 months postoperatively. This rather small myopic change in the 1-piece group had no significant impact on the UDVA and did not correlate with changes in the ACD. A previous study[25] found evidence of spherical refractive changes with some types of acrylic IOLs after cataract surgery. The changes did not correlate with IOL axial position changes, suggesting that other factors, such as IOL tilt or decentration and the corresponding changes in ocular higher-order aberrations, contribute to this small shift.

In addition, the myopic shift in our study was small. Also, small, but statistically significant between-group differences were detected in sphere 3 months after surgery, with a more myopic residual spherical error in eyes with the 3-piece IOL. It is likely that one of the main reasons for the difference in postoperative

Table 5. Between-group comparison of postoperative IOL tilt and decentration at 12 months (48 eyes in each group) and 24 months (35 eyes in each group).

	Tilt (Degrees)			Decentration (mm)		
	Mean ± SD			Mean ± SD		
Parameter/Postop Exam	1-Piece IOL	3-Piece IOL	*P* Value	1-Piece IOL	3-Piece IOL	*P* Value
Horizontal						
12 months	2.27 ± 3.07	2.71 ± 2.73	.3548	0.16 ± 0.14	0.25 ± 0.19	.0128
24 months	2.02 ± 2.36	2.79 ± 2.40	.1502	0.23 ± 0.13	0.27 ± 0.20	.2566
Vertical						
12 months	2.28 ± 1.80	4.12 ± 5.08	.0186	0.17 ± 0.14	0.29 ± 0.25	.0047
24 months	−3.04 ± 2.13	3.41 ± 2.66	.5336	0.20 ± 0.18	0.124 ± 0.20	.3925

IOL = intraocular lens

sphere between groups was that the constants used for IOL power calculation did not account for different positions of the 2 IOLs in the eye. Partial coherence interferometry detected significant differences in the ACD between groups at all postoperative visits, with a slightly shallower anterior chamber in eyes with the 3-piece IOL.

A significant reduction in ACD 1 day and 1 month postoperatively occurred in both groups. This was consistent with findings in studies of other models of acrylic IOLs.[1–3] Koeppl et al.[1] found a linear shortening of the ACD during the first week after implantation of an acrylic 3-piece IOL with a haptic design identical to that of the IOL used in our study; after the first week, the IOL position was relatively stable. Furthermore, Koeppl et al. found that the IOL shift in the early postoperative period was less in myopic eyes with large capsular bags than in hyperopic eyes with smaller capsular bags. Wirtitsch et al.[2] compared the positional stability of a 1-piece IOL and that of a multipiece IOL of a similar hydrophobic acrylic material and found that the 1-piece IOL shifted significantly less, especially from 1 day to 1 month.

Capsular bag shrinkage and fibrotic reaction of the capsular bag after IOL implantation seemed to be different between the 2 types of IOLs. Although both IOLs have C-shaped open-loop haptics, the 1-piece IOL has an offset haptic design whereas the 3-piece IOL has haptic angulation of 5 degrees. Theoretically, both designs should push the IOL against the posterior capsule. Another explanation could be the difference in haptic material and haptic shape memory. The offset for the fixation of the haptics and the possibly higher level of flexibility of these haptics contribute to the more posterior position of the 1-piece IOL. After the initial shallowing of the ACD in both groups in the current study, no further significant IOL axial displacements were observed. This is in contrast to findings in studies of other 1-piece and 3-piece IOL models. In a previous study,[26] the longitudinal movement of a 1-piece acrylic IOL with soft acrylic loops was less than the movement of a 3-piece acrylic IOL with rigid PMMA loops, resulting in less of a postoperative myopic shift. Nejima et al.[27] found similar results in their comparison of other 1-piece and 3-piece IOL models. Differences between our results and those in previous studies might be attributable to differences in the haptic material and haptic design of the IOLs as well as in the methodology for analyzing IOL movement.

On average, horizontal and vertical tilt relative to the pupil as well as decentration did not differ significantly between the 1-piece IOL and the 3-piece IOL in our study. However, more variability in the tilt and decentration components occurred in the 3-piece group, suggesting less predictability during the first 2 years after surgery. There are many reports of tilt and decentration of a great variety of IOL models. However, comparison of these results is difficult because the studies used different methods to measure tilt and decentration and there are no data regarding the comparability of different devices used for such measurements. Although many studies used Scheimpflug images for tilt measurements, in our hands, this method gave inaccurate results. In a comparative study, Crnej et al.[28] used the same Purkinje meter we used. They found that a 3-piece acrylic IOL with thin loops had a greater tendency toward decentration than a 1-piece IOL with the same optic material. The authors concluded that the slight deformation of 1 or both haptics during implantation or inaccuracies in the production process of 3-piece IOLs when the haptics are manually placed into the optic might be the factors in this finding. Our results indicate that the interaction between the IOL haptics and postoperative capsular bag shrinkage was the main

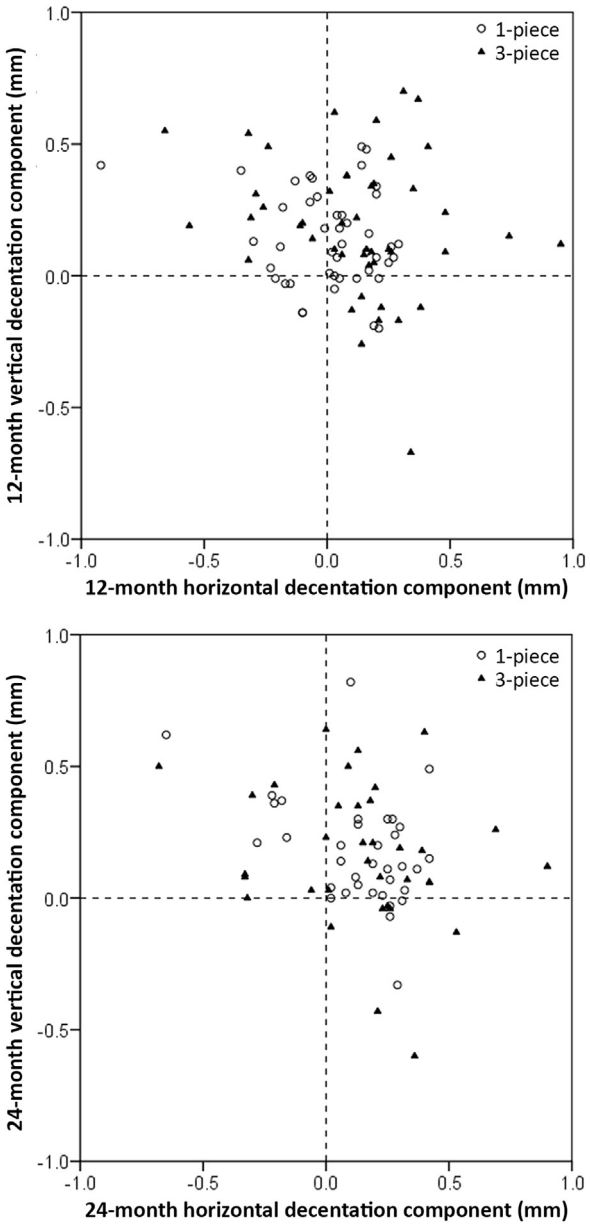

Figure 3. Distribution of the decentration components at 12 months and 24 months by group.

factor in IOL decentration. In a study by Kurz et al.,[29] reducing capsular bag shrinkage by implanting a capsular tension ring reduced IOL dislocation and tilt. Other studies[30,31] found no change in the levels of tilt and decentration 12 months after implantation of IOL models with different haptic designs.

Finally, we sought to determine what role IOL design plays in the occurrence of PCO and the relationship between PCO and IOL tilt and decentration. There were no significant differences in the numerical AQUA score between the 1-piece IOL group and the 3-piece IOL group, suggesting that differences in IOL haptic design had little influence on PCO development for up to 2 years postoperatively and that the sharp posterior edge helped delay or prevent PCO in both IOL groups. Likewise, no significant correlation between the AQUA score and tilt or decentration was found in either group. To our knowledge, this is the first study attempting to correlate IOL tilt and decentration with an objective PCO score.

In conclusion, the 1-piece IOL and the 3-piece IOL were comparable in terms of capsular bag performance. There was a tendency toward greater variability in IOL decentration and tilt in the 3-piece IOL group, indicating that the manual placement of 3-piece IOLs, the slight deformation of the thin haptics with less memory during the implantation, or both are be the cause.

WHAT WAS KNOWN

- Misalignment of IOLs has a significant effect on the postoperative refraction.
- Correcting corneal asphericity with an IOL increases visual quality.

WHAT THIS PAPER ADDS

- The 1-piece version of the IOL showed less tilt and decentration than the 3-piece design of the same IOL.
- The anterior chamber was significantly deeper in the 1-piece group than in the 3-piece group.
- No differences in PCO were observed between the 2 IOL designs.

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