Comparison of visual outcomes of 2 diffractive trifocal intraocular lenses

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PURPOSE: To compare the visual outcomes after cataract surgery with bilateral implantation of 1 of 2 diffractive trifocal intraocular lenses (IOLs).

SETTING: Two clinical centers, Lisbon, Portugal.

DESIGN: Prospective comparative case series.

METHODS: Phacoemulsification with bilateral implantation of a Finevision Micro F IOL (Group 1) or an AT Lisa tri 839 MP IOL (Group 2) was performed. Over a 3-month follow-up, the main outcome measures were uncorrected distance visual acuity (UDVA), corrected monocular and binocular distance visual acuity, uncorrected intermediate visual acuity at 80 cm, distance-corrected intermediate visual acuity (DCIVA), uncorrected near visual acuity at 40 cm, distance-corrected near visual acuity (DCNVA), spherical equivalent (SE) refraction, defocus curves, contrast sensitivity, presence of dysphotopsia, and use of spectacles.

RESULTS: Each group comprised 30 eyes (15 patients). The mean values at 3 months were UDVA, 0.03 logMAR $\pm$ 0.08 (SD) (Group 1) and 0.08 $\pm$ 0.12 (Group 2) (P = .765); DCIVA, 0.04 $\pm$ 0.07 logMAR and 0.18 $\pm$ 0.18 logMAR, respectively (P = .048); DCNVA, 0.03 $\pm$ 0.06 logMAR and 0.11 $\pm$ 0.08 logMAR, respectively (P = .032); SE, -0.25 $\pm$ 0.30 diopter (D) and -0.02 ± 0.39 D, respectively (P = .087). There was no significant difference in contrast sensitivity or dysphotopic phenomena between groups.

CONCLUSIONS: Both trifocal IOL models provided excellent distance, intermediate, and near visual outcomes. Monocular DCIVA and DCNVA appeared slightly better in Group 1. Predictability of the refractive results and optical performance were excellent, and all patients achieved spectacle independence.

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In recent years, achieving spectacle independence has become an objective of cataract surgery. Multifocal intraocular lenses (IOLs) have different depth-of-focus capabilities within the optical zone and are an effective way of achieving good visual acuity for far, intermediate, and near distances with spectacle independence.[1]

Multifocal IOLs use a refractive design, a diffractive design, or a combination or use segmented asymmetric optics. Refraction is based on a shift in direction of the light rays due to the thickness, curvature, and optical density of the material transmitting the light rays. Diffraction occurs when light encountering an edge in the material in which it is traveling scatters in different directions.[2] The main disadvantage of

refractive multifocal IOLs is their pupil dependence. The loss of energy is the main disadvantage of diffractive designs. Diffractive multifocal IOLs have been shown to result in good distance and near visual acuities, with increased levels of spectacle independence than with monofocal IOLs.[3] Furthermore, on optical bench testing, diffractive IOLs provided better optical quality, better contrast sensitivity, and less photic phenomena than refractive IOLs.[4,5]

Classic multifocal IOLs are bifocal and thus dependent on 2 focal points that represent the 2 working distances (far and near) at which they produce a sharp image on the retina. The intermediate working distance, such as that used for computer work, falls between these 2 focal points, which results in poor

intermediate visual acuity and the need for spectacles for intermediate vision in many cases.[6–9]

Trifocal multifocal IOLs were recently introduced. The objective of including a third focal point in the IOL optic is to provide better visual acuity at the intermediate distance while maintaining good far and near vision.

The purpose of this study was to compare the visual outcomes after cataract surgery with implantation of 1 of 2 commercially available diffractive trifocal IOLs; that is, the Finevision Micro F (PhysIOL S.A.) and the AT Lisa tri 839MP (Carl Zeiss Meditec AG).

PATIENTS AND METHODS

This prospective comparative case-series study was performed at the Cruz Vermelha and Egas Moniz Hospitals, Lisbon, Portugal. The study was performed in accordance with the principles of the Declaration of Helsinki. All patients provided written informed consent.

Inclusion criteria were senile cataract with corneal astigmatism equal to or less than 0.75 diopters (D) and IOL power calculation between $+10.00$ D and $+32.00$ D. Exclusion criteria were corneal astigmatism more than 0.75 D, irregular astigmatism, corneal dystrophy, tear-film or pupillary abnormalities, history of glaucoma or intraocular inflammation, macular disease or retinopathy, neuro-ophthalmic disease, and intraoperative or postoperative complications.

Patient Allocation and Intraocular Lenses

Patients scheduled for implantation of Finevision Micro F or AT Lisa tri 839MP IOLs were sequentially allocated to 1 of 2 study groups. The Finevision Micro F is a single-piece aspheric trifocal IOL of hydrophilic acrylic material with a 25% water content at the equilibrium and a blue- and ultraviolet-light filter. It is compatible with microincision cataract surgery (incision size 1.8 mm). The total diameter is 10.75 mm and the optic diameter, 6.15 mm. The haptic angulation is 5 degrees. The available powers are between $+10.00$ D and $+35.00$ D in 0.50 D increments. The addition (add) powers at the IOL plane are $+3.50$ D for near vision and $+1.75$ D for intermediate distance. The optic is apodized and designed to increase the distance vision dominance with increasing pupil size. The light-energy distribution for a 20.0 D IOL and a 3.0 mm pupil diameter is 42%, 29%, and 15% for distance, near, and intermediate vision, respectively.

The AT Lisa tri 839 MP is a single-piece aspheric trifocal IOL of hydrophilic acrylic material (25%) with a

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hydrophobic surface. It is compatible with injection through a 1.8 mm incision. The total diameter is 11.0 mm and the optic diameter, 6.0 mm. The haptic angulation is 0 degrees. The available powers are 0.00 to $+32.00$ D in 0.50 D increments. The add powers are $+3.33$ D for near and $+1.66$ D for intermediate vision. The light distribution is 50%, 20%, and 30% for distance, intermediate, and near foci, respectively.

Preoperative Assessment

Preoperatively, all patients had a full ophthalmologic examination including uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), uncorrected intermediate visual acuity (UIVA) and distance-corrected intermediate visual acuity at 80 cm; uncorrected near visual acuity (UNVA) and distance-corrected near visual acuity at 40 cm (all measured using logMAR acuity charts under photopic conditions at 85 candelas [cd]/m^2); manifest refraction; slitlamp biomicroscopy; Goldmann applanation tonometry; and fundoscopy under cycloplegia.

The IOL power was calculated using the SRK/T[10] and Holladay 2[11] formulas, according to the surgeons' experience with an A-constant of 118.8 for both the Finevision Micro F and the AT Lisa tri 839 MP with the SRK/T. The refractive goal was emmetropia. All values were obtained using partial coherence interferometry (IOLMaster 500, Carl Zeiss Meditec AG).

Surgical Technique

One of 2 experienced surgeons (E.M., T.F.) performed all surgeries using topical anesthesia and a standard coaxial phacoemulsification technique with a 2.4 mm temporal clear corneal incision. The IOLs were implanted with an injector (Accuject 2.0, Medicel AG, in Group 1; Bluemixs 180, Carl Zeiss Meditec AG, in Group 2). Postoperative medications were topical moxifloxacin 0.5%, prednisolone acetate 1.0%, and ketorolac 0.5%.

Postoperative Assessment

Postoperative examinations were performed at 1 day, 1 week, and 1 and 3 months and included the same tests performed in the preoperative assessment. At the 3-month visit, the binocular defocus curve was evaluated under photopic conditions (85 cd/m^2) using defocusing lenses from $+1.00$ to -4.00 D in 0.50 D steps. Defocus lenses were inserted into a trial frame accounting for the manifest distance refractive error. Magnification effects were accounted for in the analysis. Contrast sensitivity was tested binocularly under photopic conditions (85 cd/m^2) at spatial frequencies of 3, 6, 12, and 18 cycles per degree using the CVS-1000 contrast sensitivity test (VectorVision).

Preoperatively, patients were shown pictures representing dysphotopic phenomena—specifically halos, glare, and starbursts—and informed about their presence and meaning. At the 3-month follow-up visit, the same pictures were shown and patients were asked to classify each of these 3 visual symptoms according to a 5-point Likert scale (0 = no trouble; 1 = minimal trouble; 2 = moderate trouble; 3 = considerable trouble; 4 = overwhelming trouble).

At the 3-month visit, patients were asked, "Do you wear spectacles for distance/intermediate/near?" They were given 4 response options (never; sometimes; often; always).

Statistical Analysis

All data were collected in an Excel database (Office 2010, Microsoft Corp.). All statistical analyses were performed using SPSS for Windows software (version 16.0, SPSS, Inc.). Normality of all data was evaluated using the Kolmogorov-Smirnov test. When the data were normally distributed, parametric statistics were used. The Student *t* test for paired samples was used to compare preoperative data and postoperative data. The Student *t* test for independent samples was used for comparisons between groups. One-way analysis of variance with repeated measures was used for contrast sensitivity analysis. When parametric analysis was not possible, the differences between preoperative data and postoperative data were evaluated with the Wilcoxon rank-sum test. The Mann-Whitney *U* test was used for comparisons between groups. The results are expressed as the mean $\pm$ standard deviation. A *P* value less than 0.05 was considered statistically significant.

RESULTS

Each IOL group comprised 30 eyes of 15 patients. Each group had 2 men (13%).

Table 1 shows the patients' demographics and IOL models by IOL group. There was no statistically significant difference in any parameter between Group 1 and Group 2. All patients completed the 3-month follow-up. No eye was excluded from analysis because of intraoperative or postoperative complications.

Visual Acuity and Refraction

Apart from the UDVA at 1 day (*P* = .05 relative to 3 months), no statistically significant differences were found in uncorrected or corrected monocular or binocular visual acuity between the examinations during the follow-period (*P* > .05 for all values in both groups).

Table 2 shows the postoperative monocular visual acuity and refraction at 3-month follow-up. Table 3 shows the postoperative binocular visual acuity at 3-month follow-up.

Figure 1, *A*, shows the percentage of eyes in each group with a cumulative Snellen visual acuity of 20/× or better after the surgery. The UDVA was 0.3 logMAR or better (Snellen equivalent 20/40 or better) in 30 eyes (100%) in the Group 1 and 29 eyes (97%) in Group 2. All eyes in both groups achieved 0.1 logMAR or better CDVA (Snellen equivalent 20/25 or better). The UIVA at 80 cm was 0.3 logMAR or better in 29 eyes (97%) in Group 1 and 30 eyes (100%) in Group 2 and 0.1 logMAR or better in 20 eyes (67%) in Group 1 and 15 eyes (50%) in Group 2. The UNVA at 40 cm was 0.3 logMAR or better in all eyes in both groups, being 0.1 logMAR or better in 28 (93%) eyes in Group 1 and 20 (67%) eyes in Group 2.

Figure 1, *B*, shows the change in Snellen lines of CDVA. All eyes in both groups gained lines of CDVA.

Table 1. Patient demographics and clinical information.

Parameter	Group 1	Group 2	P Value
Age (y)			
Mean $\pm$ SD	71 $\pm$ 7	70 $\pm$ 5	.795
Range	59, 81	59, 78	
Axial length (mm)			
Mean $\pm$ SD	23.15 $\pm$ 0.81	23.89 $\pm$ 1.89	.208
Range	21.60, 24.30	23.10, 26.65	
Mean K (D)			
Mean $\pm$ SD	43.93 $\pm$ 1.56	43.40 $\pm$ 1.33	.310
Range	42.98, 46.01	42.96, 47.00	
UDVA (logMAR)			
Mean $\pm$ SD	1.29 $\pm$ 0.32	1.33 $\pm$ 0.45	.086
Range	2.0, 1.0	2.0, 1.0	
CDVA (logMAR)			
Mean $\pm$ SD	0.55 $\pm$ 0.70	0.50 $\pm$ 0.71	.056
Range	1.0, 0.15	2.0, 0.1	
UIVA (logMAR)			
Mean $\pm$ SD	1.21 $\pm$ 0.49	1.31 $\pm$ 0.79	.453
Range	2.0, 1.0	2.0, 1.0	
DCIVA (logMAR)			
Mean $\pm$ SD	0.42 $\pm$ 0.16	0.44 $\pm$ 0.19	.543
Range	0.7, 0.22	0.7, 0.22	
UNVA (logMAR)			
Mean $\pm$ SD	1.29 $\pm$ 0.42	1.39 $\pm$ 0.57	.325
Range	2.0, 1.0	2.0, 1.0	
DCNVA (logMAR)			
Mean $\pm$ SD	0.42 $\pm$ 0.13	0.39 $\pm$ 0.23	.532
Range	0.70, 0.22	0.70, 0.22	
SE (D)			
Mean $\pm$ SD	0.73 $\pm$ 3.89	−0.93 $\pm$ 3.92	.286
Range	−16.00, 6.00	−13.75, 4.00	
IOL power (D)			
Mean $\pm$ SD	21.81 $\pm$ 2.73	20.03 $\pm$ 4.40	.314
Range	16.00, 30.00	6.50, 23.50	

CDVA = corrected distance visual acuity; DCIVA = distance-corrected intermediate visual acuity; DCNVA = distance-corrected near visual acuity; IOL = intraocular lens; K = keratometry; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UIVA = uncorrected intermediate visual acuity; UNVA = uncorrected near visual acuity

Figure 1, *C*, shows the attempted versus achieved spherical equivalent (SE) refraction. Figure 1, *D*, shows the SE refractive accuracy, which was similar in the 2 IOL groups (*P* = .087). Figure 1, *E*, shows the postoperative refractive astigmatism. Figure 1, *F*, shows the stability of SE refraction over time. At the 3-month follow-up, the spherical refraction was within ±0.50 D of the attempted spherical correction in 28 eyes (93%) in Group 1 and 27 eyes (90%) in Group 2. All eyes in both groups were within ±1.00 D. Refractive cylinder was ±0.50 D in 24 eyes (80%) in Group 1 and 23 eyes (76%) in Group 2 and ±1.00 D in 29 eyes (97%) in both groups. The postoperative SE

Table 2. Monocular visual acuity and refractive results.

Parameter	Result	P Value Preop Vs Postop	P Value Between Groups
UDVA (logMAR)			.765
Group 1			
Mean ± SD	0.03 ± 0.08	.001	
Range	0.10, −0.12		
Group 2			
Mean ± SD	0.08 ± 0.12	.001	
Range	0.54, −0.02		
CDVA (logMAR)			.099
Group 1			
Mean ± SD	−0.02 ± 0.07	.001	
Range	0.10, −0.14		
Group 2			
Mean ± SD	0.04 ± 0.10	.001	
Range	0.40, −0.04		
UIVA (logMAR)			.549
Group 1			
Mean ± SD	0.09 ± 0.13	.001	
Range	0.36, −0.04		
Group 2			
Mean ± SD	0.14 ± 0.09	.001	
Range	0.24, 0.02		
DCIVA (logMAR)			.048
Group 1			
Mean ± SD	0.04 ± 0.07	.001	
Range	0.10, −0.02		
Group 2			
Mean ± SD	0.18 ± 0.18	.001	
Range	0.34, −0.02		
UNVA (logMAR)			.002
Group 1			
Mean ± SD	0.04 ± 0.09	.001	
Range	0.24, −0.10		
Group 2			
Mean ± SD	0.22 ± 0.07	.001	
Range	0.30, 0.10		
DCNVA (logMAR)			.032
Group 1			
Mean ± SD	0.03 ± 0.06	.001	
Range	0.14, −0.06		
Group 2			
Mean ± SD	0.11 ± 0.08	.001	
Range	0.24, 0.06		
Sphere (D)			.069
Group 1			
Mean ± SD	−0.10 ± 0.41	.001	
Range	−0.50, 1.00		
Group 2			
Mean ± SD	0.42 ± 0.51	.001	
Range	−0.25, 1.00		
Cylinder (D)			.654
Group 1			
Mean ± SD	−0.50 ± 0.33	.447	
Range	−1.50, 0.00		

(continued on next page)

Table 2. (Cont.)

Parameter	Result	P Value	
		Preop Vs Postop	Between Groups
Group 2			
Mean ± SD	−0.56 ± 0.53	.180	
Range	−1.50, 0.75		
SE (D)			.087
Group 1			
Mean ± SD	−0.25 ± 0.30	.367	
Range	−1.00, 0.50		
Group 2			
Mean ± SD	−0.02 ± 0.39	.205	
Range	−0.50, 1.00		

CDVA = corrected distance visual acuity; DCIVA = distance-corrected intermediate visual acuity; DCNVA = distance-corrected near visual acuity; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UIVA = uncorrected intermediate visual acuity; UNVA = uncorrected near visual acuity

refraction was within ±0.50 D of the attempted correction in 27 eyes (90%) in Group 1 and 28 eyes (93%) in Group 2 and within ±1.00 D in all eyes in both groups.

Defocus Curves

Figure 2 shows the binocular mean defocus curves under photopic conditions. The curves were similar between the 2 groups, with the best visual acuity results obtained at 0.00 D defocus (equivalent to distance vision). In both groups, a second peak was observed at −2.50 D, equivalent to the near vision at 40 cm. In the intermediate zone (between +1.00 D and −2.50 D of defocus), there was no distinct peak in either group. However, in this interval, the curve was in the zone of 0.2 logMAR or better visual acuity without a sharp drop; this corresponds to useful vision at intermediate distance.

Contrast Sensitivity

Figure 3 shows the binocular glare and no glare contrast sensitivity under photopic conditions. At all the spatial frequencies tested, the binocular contrast sensitivity values were similar between the 2 groups ($P > .05$).

Dysphotopic Phenomena and Spectacle Independence Evaluation

Table 4 shows the mean dysphotopic phenomena scores. There were no significant differences in mean scores between groups. One patient in Group 2 reported a score of 3 (considerable trouble) for halos and glare in both eyes. No patient reported a score of 4 (overwhelming trouble) for any visual symptoms evaluated. All patients in both groups reported never using spectacles for any evaluated distance.

DISCUSSION

Multifocal IOLs can provide spectacle independence to patients who have cataract or refractive lens surgery. The classic design of a multifocal IOL allows bifocality with good visual function at distance and near but with poor intermediate vision. More recent models were designed to have lower near adds in an attempt to improve the intermediate vision. However, these IOLs still provide only average visual results for intermediate distances or improve intermediate vision at the cost of losing good near visual acuity.[13,14]

Dysphotopic phenomena such as glare, halos, or ghost images are common with multifocal IOLs. The new trifocal IOLs introduce an intermediate focus in the optical zone, which translates into a peak in the intermediate range of the through-focus modulation transfer function (MTF) that is not present with monofocal and bifocal IOLs.[15] Clinically, these IOLs provide better intermediate vision than bifocal IOLs without compromising distance or near performance.[16]

We compared the visual outcomes after implantation 2 newer diffractive trifocal IOL designs, the Finevision Micro F and the AT Lisa tri 839MP. To our knowledge, this is the first study to directly compare these 2 IOLs in a clinical setting. Ruiz-Alcocer et al.[17] compared the in vitro optical quality of these IOLs. They found that although both IOLs showed 3 MTF peaks, corresponding to far, intermediate, and near focal points, the Finevision Micro F provided better results at far focal points and at −3.00 D. The AT Lisa tri 839MP provided better results at intermediate

Table 3. Binocular visual acuity results.

Parameter	Result	P Value Preop Vs Postop	Between Groups
UDVA (logMAR)			.840
Group 1			
Mean ± SD	0.02 ± 0.02	.001	
Range	0.06, −0.02		
Group 2			
Mean ± SD	0.00 ± 0.01	.001	
Range	0.10, −0.02		
CDVA (logMAR)			.840
Group 1			
Mean ± SD	−0.02 ± 0.04	.001	
Range	0.10, −0.14		
Group 2			
Mean ± SD	−0.03 ± 0.04	.001	
Range	0.00, −0.14		
UIVA (logMAR)			.053
Group 1			
Mean ± SD	0.03 ± 0.05	.001	
Range	0.06, −0.04		
Group 2			
Mean ± SD	0.13 ± 0.42	.001	
Range	0.16, 0.02		
DCIVA (logMAR)			.172
Group 1			
Mean ± SD	0.02 ± 0.05	.001	
Range	0.08, −0.06		
Group 2			
Mean ± SD	0.09 ± 0.04	.001	
Range	0.08, −0.06		
UNVA (logMAR)			.009
Group 1			
Mean ± SD	0.02 ± 0.02	.001	
Range	0.02, 0.00		
Group 2			
Mean ± SD	0.13 ± 0.05	.001	
Range	0.08, 0.00		
DCNVA (logMAR)			.331
Group 1			
Mean ± SD	0.01 ± 0.05	.001	
Range	0.10, −0.06		
Group 2			
Mean ± SD	0.05 ± 0.04	.001	
Range	0.00, 0.08		

CDVA = corrected distance visual acuity; DCIVA = distance-corrected intermediate visual acuity; DCNVA = distance-corrected near visual acuity; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UIVA = uncorrected intermediate visual acuity; UNVA = uncorrected near visual acuity

distance and −3.50 D focal points and was less pupil dependent.[17]

The Finevision IOL Micro F has an additional focus for intermediate vision at +1.75 D relative to bifocal IOLs. Independent of the pupil size, the dif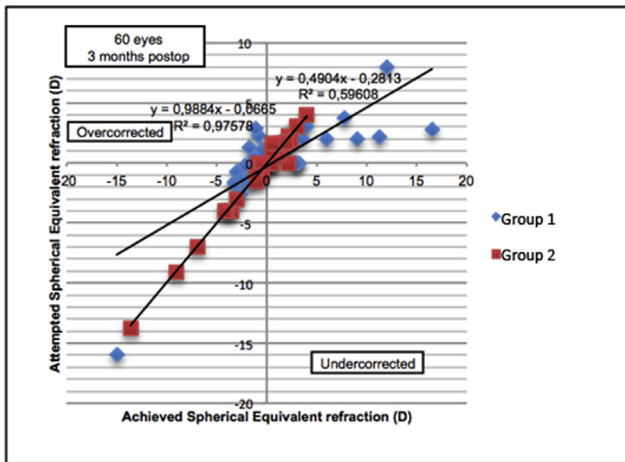fractive structure of this trifocal IOL was designed to limit the amount of energy allocated to intermediate vision compared with the allocation for far and near vision. The design of this IOL was described in detail by Gatinel et al.[18] Several clinical studies[19–21] found the IOL improved intermediate visual acuity while maintaining good distance and
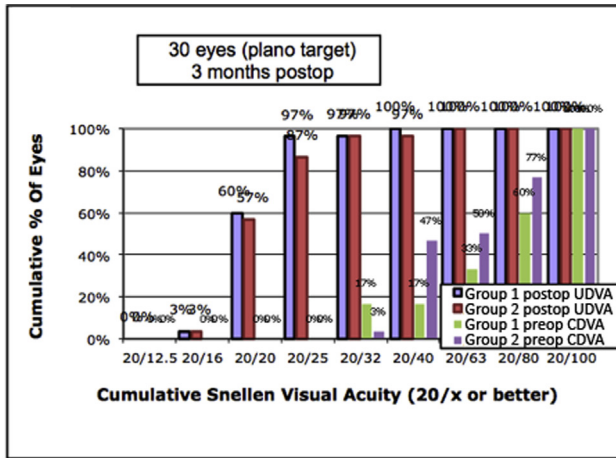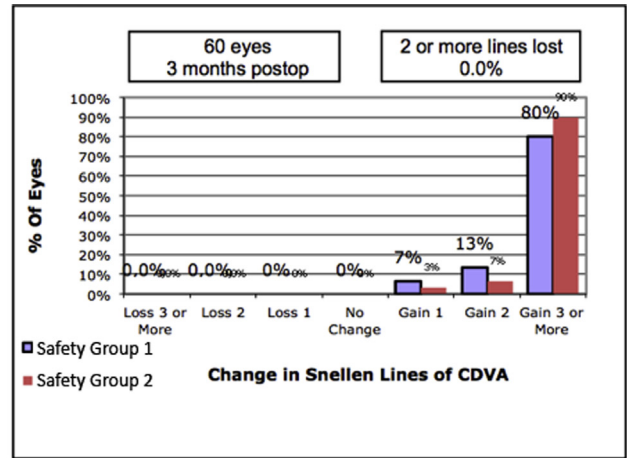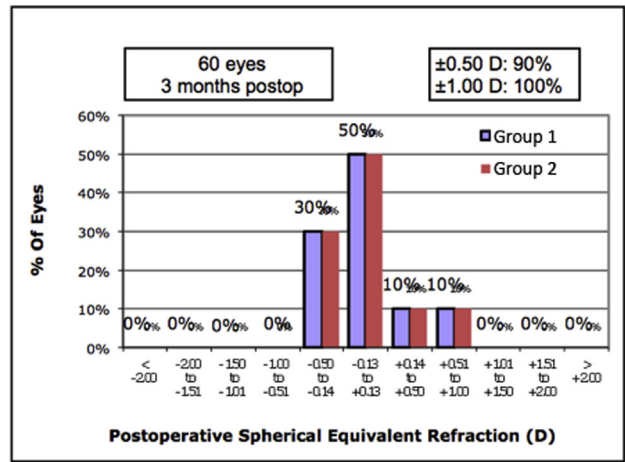
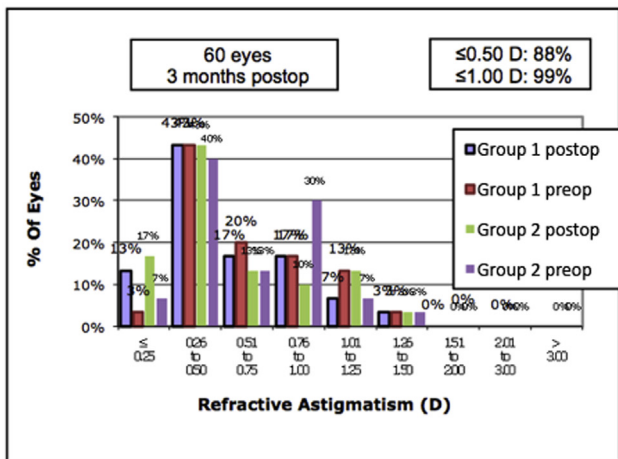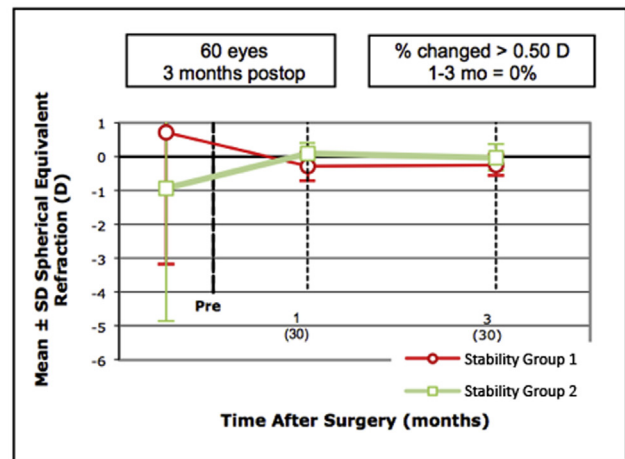**Figure 1.** Visual acuity and refractive results (CDVA = corrected distance visual acuity; UDVA = uncorrected distance visual acuity).

near vision. In our study, visual acuity results for far, intermediate, and near distances were similar to those previously reported.

The AT Lisa tri 839MP was designed to improve intermediate vision with a +1.66 D intermediate add. Ruiz-Alcocer et al.[17] evaluated the IOL on the optical
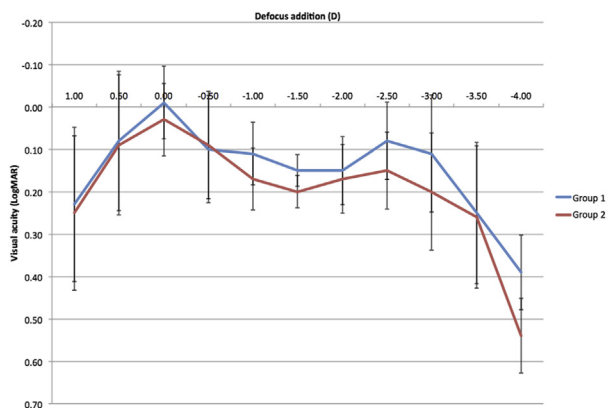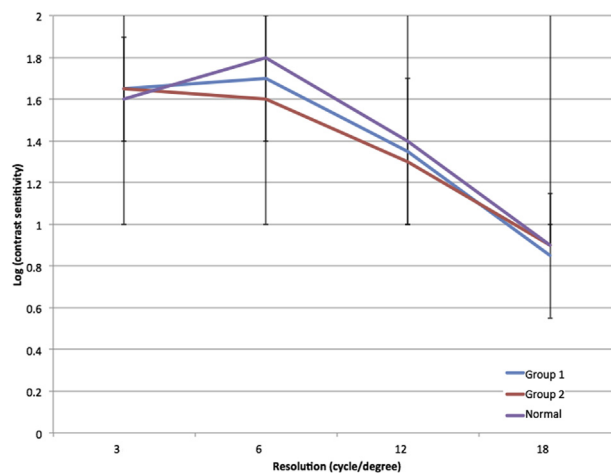
Figure 2. Binocular defocus curves under photopic conditions.

Figure 3. Binocular glare and no glare contrast sensitivity under photopic conditions. Normal data from Pomerance and Evans.[12]

bench and found better MTF values than those obtained with bifocal IOLs between the −1.50 D and −3.50 D focal points for various pupil apertures. The clinical results of this IOL, which were recently reported by Mojzis et al.,[22] are similar to those found in our study.

We compared the 2 diffractive trifocal IOLs in a clinical setting. In our study, both IOLs provided excellent distance, intermediate, and near visual outcomes. The UDVA was 0.3 logMAR or better (Snellen equivalent 20/40 or better) in 30 eyes (100%) in the Finevision Micro F group and 29 eyes (97%) in the AT Lisa tri 839MP group. The UIVA at 80 cm was 0.3 logMAR or better in 29 eyes (97%) and 30 eyes (100%), respectively. The UNVA at 40 cm was 0.3 logMAR or better in all eyes in both groups. Although monocular intermediate and near visual acuity appeared to be slightly better in the Finevision Micro F group, binocular intermediate and near visual acuities were similar in both groups. At the 3-month follow-up, all patients in both groups reported being independent for all distances.

Refractive results were excellent in both groups, with postoperative SE refraction within ±0.50 D of the attempted correction in 27 eyes (90%) in the Finevision Micro F group and 28 eyes (93%) in the AT Lisa tri 839MP group.

The classic defocus curve of a bifocal IOL shows 2 peaks corresponding to far and near vision with a loss in image quality at the intermediate distance. Typically, as been reported for the Acrysof Restor +3.0 D and Acrysof Restor +4.0 D IOLs (Alcon Laboratories, Inc.), the Tecnis ZM 900 multifocal IOL (Abbott Medical Optics, Inc.), and the Acri.Lisa 366 D IOL (Carl Zeiss Meditec, AG), there is a drop of at least 2 lines of visual acuity at a vergence of −1.5 D.[13,23–26] In our study, binocular defocus curves were similar in the 2 IOL groups, with some decrease in visual acuity in the intermediate vision range. However, despite the decrease, useful intermediate vision was maintained in this range, without the distinct drop in the defocus curve of bifocal IOLs.

Although multifocal IOLs are have been known to cause a reduction in contrast sensitivity, the binocular contrast sensitivity values in our study are similar to the normal values reported in older adults by Pieh et al.[27] and Pomerance and Evans.[12] This is true even though our cohort was older than those in the 2 previous studies.

Dysphotopic phenomena are more common with multifocal IOLs than with monofocal IOLs. This is inherent in the design (ie, edges of the steps of different ring zones) of diffractive multifocal IOLs.[3] With both trifocal IOLs we evaluated, the mean dysphotopic phenomena evaluation scores were relatively low and comparable between the 2 IOL groups. Only 1 patient in the AT Lisa tri 839MP group reported a score of 3 for halos and glare (considerable trouble), and no patients in either group reported a score of 4

Table 4. Dysphotopic phenomena scores.

Parameter	Group 1	Group 2	*P* Value
Halos			
Mean ± SD	0.72 ± 0.24	0.81 ± 0.33	.521
Range	0, 2	0, 3	
Glare			
Mean ± SD	0.90 ± 0.67	0.96 ± 0.62	.639
Range	0, 2	0, 3	
Starbursts			
Mean ± SD	0.28 ± 0.45	0.34 ± 0.61	.612
Range	0, 1	0, 1	

(overwhelming trouble) for any visual symptom evaluated. We recently evaluated dysphotopic phenomena with the Acrysof Restor toric IOL in a study with a similar design.[14] The dysphotopic phenomena scores with both trifocal IOLs in the present study were lower than the scores for the Acrysof Restor toric IOL. The trifocal IOL designs might explain the difference. The Finevision Micro F IOL might minimize the patient's perception of halos and glare by the increasing distance domination as the pupil size increases. Also, the design has convoluted diffractive steps. The AT Lisa tri 839MP IOL has fewer rings on the surface then some multifocal IOLs (eg, 32 on the Tecnis multifocal and 28 on the AT Lisa) and no sharp angles in the optical surface.

In summary, both trifocal IOLs provided excellent distance, intermediate, and near visual outcomes in patients having cataract surgery. Although monocular UIVA and UNVA appeared to be slightly better in the Finevision Micro F group, the binocular visual results were similar in the 2 groups. The predictability of the refractive results and the optical performance were excellent and similar between the 2 IOLs. In addition, the patients achieved spectacle independence postoperatively.

WHAT WAS KNOWN

- Bifocal IOLs are effective in achieving a good visual acuity for distance and near after phacoemulsification.

- Trifocal IOLs improve the visual acuity at intermediate distance while maintaining good far and near performance.

WHAT THIS PAPER ADDS

- Both trifocal IOLs evaluated provided excellent distance, intermediate, and near vision in a clinical setting.

- The predictability of the refractive results and optical performance were comparable between the 2 IOLs.

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