Visual outcomes and patient satisfaction with a rotational asymmetric refractive intraocular lens for emmetropic presbyopia

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PURPOSE: To evaluate the efficacy, safety, predictability, and patient satisfaction after refractive lens exchange with a zonal refractive intraocular lens (IOL) with an inferior reading addition in emmetropic patients.

SETTING: Optical Express, London, United Kingdom.

DESIGN: Retrospective case series.

METHODS: Emmetropic presbyopic patients who had implantation of a Lentis Mplus LS-313 MF30 IOL were evaluated. Inclusion criteria were sphere between −0.50 diopter (D) and +1.00 D with no more than 0.75 D of refractive cylinder and an uncorrected distance visual acuity (UDVA) of 6/6 or better in each eye. The main outcome measures were monocular and binocular UDVA, uncorrected near visual acuity (UNVA), corrected distance visual acuity (CDVA), and patient satisfaction. Three months data are presented.

RESULTS: Four hundred forty eyes of 220 patients were evaluated. The mean monocular UDVA changed from −0.04 logMAR ± 0.06 (SD) preoperatively to −0.04 ± 0.11 logMAR postoperatively ($P = .39$). The mean CDVA was −0.10 ± 0.05 logMAR preoperatively and −0.09 ± 0.06 logMAR postoperatively ($P = .06$). At 3 months, 99.7% of eyes were within ±1.00 D of emmetropia. The mean UNVA was 0.13 ± 0.14 logMAR monocularly and 0.10 ± 0.12 logMAR binocularly. On the patient satisfaction questionnaire, 91.9% of patients said the refractive procedure improved their lives and 93.5% were willing to recommend it to friends and family. Three patients requested IOL exchange because of severe night-vision phenomena or unsatisfactory quality of vision.

CONCLUSION: Refractive lens exchange with this zonal refractive IOL was safe in emmetropic presbyopic patients.

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Those with functional presbyopia cannot see clearly at near, and the condition affects more than 1 billion people.[1] According to worldwide census data, one third of the population is older than 40 years.[1–3] As the global population ages, the prevalence of presbyopia will increase. Although ready-made and prescription reading spectacles are quick and easy remedies, the demand for surgical correction of presbyopia continues to challenge ophthalmology. Although presbyopia-correcting intraocular lenses (IOLs) have proven to be effective in restoring near vision,[4] refractive lens exchange (RLE) is mostly confined to ametropic patients.

Most surgical options for presbyopic patients who are not dependent on distance correction (eg, those with emmetropia or low hyperopia) involve corneal procedures. These include corneal inlays,[5–11] conductive keratoplasty (CK),[12,13] monovision laser in situ keratomileusis (LASIK),[12,14] and femtosecond intrastromal presbyopic treatment (Intracor, Technolas Perfect Vision GmbH).[15,16] These procedures, however,

do not target the main cause of presbyopia; that is, crystalline lens deterioration.

In our study, we evaluated the refractive and visual outcomes, patient satisfaction levels, and complications of emmetropic patients who had bilateral RLE with a new-generation zonal refractive intraocular lens (IOL).

PATIENTS AND METHODS

This retrospective study enrolled naturally emmetropic patients who had bilateral phacoemulsification followed by implantation of a zonal refractive IOL (Lentis Mplus, Oculentis GmbH) between January 2011 and April 2013. Inclusion criteria were an age of 45 years or older, sphere between −0.50 D and +1.00 D with no more than 0.75 D of refractive cylinder, and an uncorrected distance visual acuity (UDVA) of at least 6/6 in each eye. Patients included in this study reported being able to function without distance correction and had a near addition (add) of at least 1.50 D.

Exclusion criteria were a history of glaucoma or retinal detachment (RD), corneal disease, corneal surgery, ocular inflammation, neuro-ophthalmic disease, macular degeneration, or retinopathy. All patients provided informed consent.

Patient Assessment

The preoperative examination included autorefraction and tonometry (Tonoref II, Nidek Co. Ltd.), corneal topography (Pentacam, Oculus, Inc.), endothelial cell count (SP 2000P specular microscope, Topcon Europe BV), biometry (IOLMaster, Carl Zeiss Meditec AG), retinal optical coherence tomography (Cirrus 4000 OCT, Carl Zeiss Meditec AG), UDVA, corrected distance visual acuity (CDVA), uncorrected near visual acuity (UNVA), subjective and cycloplegic refractions, slitlamp evaluation, and dilated fundoscopy. Visual acuity was measured at distance with a Snellen visual acuity chart and at near with a logarithmic near visual acuity chart (Early Treatment Diabetic Retinopathy Study) at 40 cm. Near visual acuity was recorded in Snellen distance equivalent (meters). The Haigis formula[17] was used for IOL calculation, and all eyes were targeted for emmetropia.

Postoperatively, patients were evaluated at 1 day, 1 week, and 1 and 3 months. At each visit, refraction, CDVA, UDVA, and UNVA were measured. At the 3-month evaluation, patients completed a purpose-developed satisfaction questionnaire. It was self-administered by the patient using a password-protected and secure computer terminal in an isolated area of the clinic. The questionnaire responses were stored in the secured central database, which is compliant with International Organization for Standardization 27001[18] for information security management systems. All response fields used a Likert scale to obtain the patient's preferences or degree of agreement. Visual phenomena, such as star burst, halo, glare, ghost images/double vision, were rated on a scale between 1 (no difficulty) and 7 (severe difficulty), and the mean and standard deviation were calculated.

Intraocular Lens

The Lentis Mplus IOL model LS-313 MF30 was used in all cases. This foldable IOL has an overall length of 12.0 mm, an optic diameter of 6.0 mm, and a plate-haptic design. The IOL is of a hydrophilic acrylic material with a hydrophobic surface (Benz25 UV). It is a rotationally asymmetric multifocal IOL with a refractive design, combining an aspheric distance vision zone with a sector-shaped near vision zone with a +3.00 D add (Figure 1).

Surgical Technique

The procedures were performed at 1 of 5 surgical centers across the United Kingdom by 1 of 5 experienced surgeons. A sub-Tenon anesthetic block was given in all cases, and the patient was prepared and draped for surgery. Most incisions were made on the steepest corneal meridian to neutralize corneal astigmatism. After phacoemulsification, the IOL was inserted in the capsular bag through a 2.75 mm corneal incision using a Viscoject 2.2 injector (Cartridge-Set LP604240M, Oculentis GmbH) with the reading add placed inferiorly. Surgery in the second eye was usually performed 1 week later.

Postoperatively, patients were instructed to instill 1 drop of levofloxacin 0.5% (Oftaquix) 4 times daily for 2 weeks, 1 drop of dexamethasone 0.1% (Maxidex) 4 times daily for 2 weeks, and 1 drop of ketorolac trometamol 0.5 % (Acular) 4 times daily for 1 month.

Statistical Analysis

Snellen visual acuity was converted into logMAR notation for statistical analysis. Refractive and visual acuity outcomes were analyzed at 3 months. All continuous variables were described as the mean, standard deviation, and range. The 2-sided *t* test for paired data was used to compare preoperative data and postoperative data. All data were analyzed using the Microsoft Office Excel 2007 software (Microsoft Corp.). A level of significance of $P = .05$ was used.

RESULTS

The study included 220 consecutive patients. Ninety four (42.7%) patients were women, and 126 (57.3%) were men. Table 1 shows the preoperative and postoperative data. Of 440 eyes, 370 (84.1% [185 patients]) were available for the 3-month postoperative visit.

Refraction

Figure 2 shows the preoperative spherical equivalent (SE) and postoperative SE. Postoperatively, 329 eyes (88.9%) were within ±0.50 D of emmetropia, 354 eyes (95.7%) were within ±0.75 D, and 369 eyes (99.7%) were within ±1.00 D. The mean SE was statistically significantly lower 3 months postoperatively

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Figure 1. Rotational asymmetric refractive IOL with +3.00 D inferior sector-shaped add.

Table 1. Preoperative and postoperative data.

Parameter	Preoperative (440 Eyes)	Postoperative (370 Eyes)	*P* Value
Age (y)			
Mean ± SD	53.7 ± 5.4	—	—
Range	45, 70	—	
IOL power (D)			
Mean ± SD	20.96 ± 1.40	—	—
Range	17.00, 25.00		
Sphere (D)			
Mean ± SD	+0.51 ± 0.34	+0.20 ± 0.38	<.01
Range	–0.50, +1.00	–0.75, +1.50	
Cylinder (D)			
Mean ± SD	–0.28 ± 0.24	–0.35 ± 0.38	.006
Range	–0.75, 0.00	–2.25, 0.00	
SE (D)			
Mean ± SD	+0.36 ± 0.35	+0.03 ± 0.37	<.01
Range	–0.75, +1.00	–1.00, +1.25	
UDVA* (logMAR)			
Mean ± SD	–0.04 ± 0.06	–0.04 ± 0.11	.39
Range	–0.2, 0.0	–0.2, 0.4	
UNVA* (logMAR)			
Mean ± SD	0.79 ± 0.27	0.13 ± 0.14	<.01
Range	0.4, 1.3	–0.2, 0.6	
CDVA* (logMAR)			
Mean ± SD	–0.10 ± 0.05	–0.9 ± 0.06	.06
Range	–0.2, 0.0	–0.2, 0.1	

CDVA = corrected distance visual acuity; IOL = intraocular lens; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UNVA = uncorrected near visual acuity
*Monocular values

than preoperatively ($P < .01$). This is because patients had a slightly hyperopic SE preoperatively (Figure 2), which was corrected by an RLE.

Visual Acuity

There was no statistically significant difference in the mean monocular UDVA between preoperatively and postoperatively ($P = .39$). The mean binocular UDVA at 3 months was −0.10 ± 0.09 logMAR. Figure 3 plots the preoperative UDVA against postoperative UDVA. Postoperatively, 311 eyes (84.1%) achieved a UDVA of 6/6 or better monocularly and 344 (93.0%) achieved 6/6 or better binocularly.

There was no statistically significant difference in the mean monocular CDVA between preoperatively and postoperatively ($P = .06$). Figure 4 shows the preoperative versus postoperative CDVA. Eight eyes (2.2%) lost 2 lines of CDVA, and 53 eyes (14.3%) gained 1 line or more of CDVA.

At 3 months, the mean binocular UNVA was 0.10 ± 0.12 logMAR. Figure 5 plots the cumulative postoperative UNVA. The postoperative UNVA was 6/9 (approximately J3) or better in 312 eyes (84.3%) monocularly and in 343 eyes (92.7%) binocularly.

Complications

No intraoperative complications occurred in this study. Postoperative complications included 7 cases of cystoid macular edema (CME), 1 sterile hypopyon that resolved within 2 weeks postoperatively, and 11

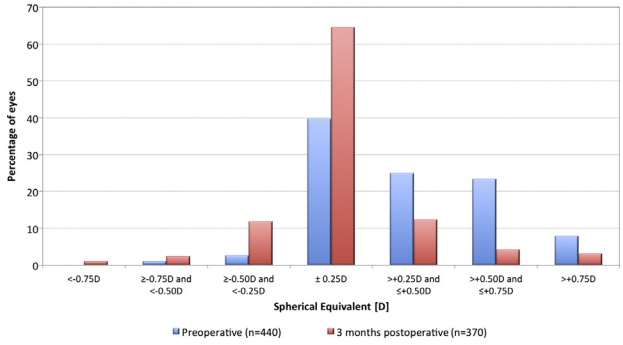

Figure 2. Refractive outcome: preoperative and 3 months postoperative SE.

cases of late-onset iritis, persisting no longer than 3 months postoperatively. No sight-threatening postoperative complications, such as persistent CME, RD, or endophthalmitis, occurred. Four eyes developed posterior capsule opacification (PCO) within the first 6 months; however, a neodymium:YAG capsulotomy was considered at 6 months only. Nineteen eyes had corneal refractive surgery for residual refractive error (18 eyes LASIK, 1 eye femtosecond laser–assisted astigmatic keratotomy). No IOL decentration was noted during the follow-up.

Evaluation of the 8 eyes (2.2%) that lost 2 lines of CDVA at 3 months showed the following: 1 eye developed PCO, 2 eyes had slight CME at the time of the 3-month follow-up, and 5 eyes had a preoperative CDVA recorded as 6/4 that decreased to 6/6 postoperatively for no obvious reason.

Patient Satisfaction

Figure 6 shows the results of the satisfaction questionnaire of 185 patients available for the 3-month postoperative check. In addition, the mean scores for visual phenomena measured on the scale from 1 (no difficulty) to 7 (severe difficulty) were 3.5 ± 1.9 for star burst, 3.5 ± 1.9 for glare, 3.6 ± 1.9 for halos, and 2.8 ± 1.8 for double vision or ghost images.

Intraocular Lens Exchanges

Three patients found their night-vision phenomena and quality-of-vision issues bothersome to the point that they requested an IOL exchange. One patient had bilateral IOL exchange to a monofocal IOL. In 2 patients, IOL exchange in the dominant eye was sufficient to relieve the symptoms. All 3 patients had a postoperative CDVA of 6/6 or better after the IOL exchange, and no significant complications occurred.

In addition to the 440 eyes of 220 patients in which the Lentis Mplus IOL was bilaterally implanted, 9 patients who were originally scheduled for bilateral surgery decided not to proceed with second eye. Five experienced some night-vision phenomena but said that the improvement in their near vision compensated adequately. They declined second-eye treatment because of the associated risk for increased night-vision problems. Four patients were dissatisfied with their quality of vision and decided to wait for neuroadaptation before making a decision.

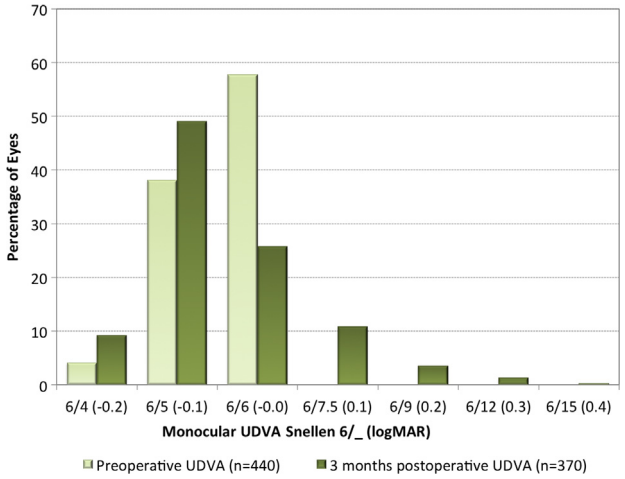

Figure 3. Preoperative and 3-month postoperative monocular UDVA (UDVA = uncorrected distance visual acuity).

DISCUSSION

Refractive lens exchange to surgically correct presbyopia is probably the most effective and permanent

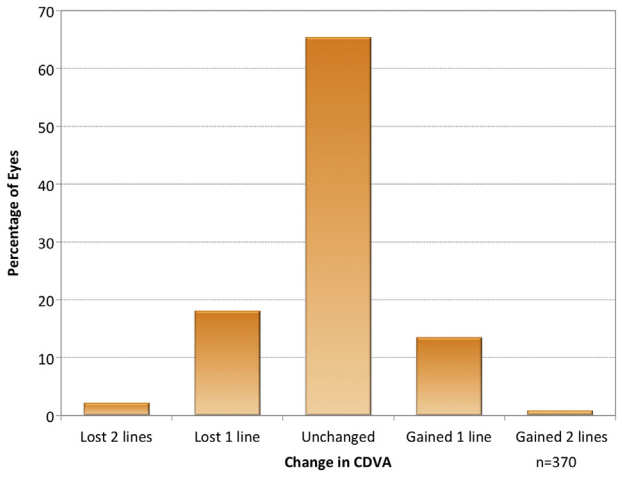

Figure 4. Preoperative versus 3-month postoperative CDVA (safety) (CDVA = corrected distance visual acuity).

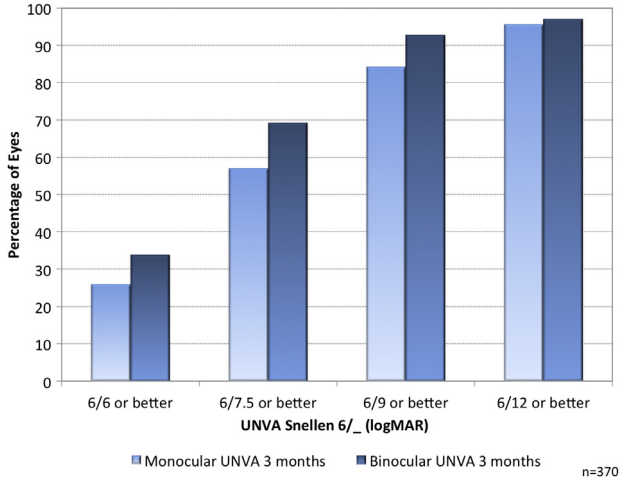

Figure 5. Cumulative postoperative monocular and binocular UNVA (UNVA = uncorrected near visual acuity).

Thinking about your vision during the last week, if you had to do it over, would you have vision correction surgery again?				
Yes		No		
93.0%		7.0%		
Has surgery improved your quality of life?				
Yes		No		
91.9%		8.1%		
Would you recommend vision correction surgery to your friends and relatives?				
Yes		No		
93.5%		6.5%		
Because of your eyesight, how much difficulty do you have driving at night?				
No difficulty at all	A little difficulty	Moderate difficulty	A lot of difficulty	Don't drive
23.2%	22.2%	35.1%	12.4%	7.1%
Because of your eyesight, how much difficulty do you have doing work or hobbies that require you to see things clearly that are close to you (like cooking, fixing things around the house, sewing, using hand tools, reading or working with a computer)?				
No difficulty at all	A little difficulty	Moderate difficulty	A lot of difficulty	Unable to do these tasks without spectacles
59.5 %	26.5 %	7.0%	4.3 %	2.7%

Figure 6. Patient satisfaction questionnaire results.

solution because it focuses on the main reason for developing presbyopia; that is, deterioration of the crystalline lens. However, many surgeons would consider RLE in an emmetropic presbyopic patient to be controversial. The aim of this study was to evaluate the refractive and visual outcomes, possibility of unwanted optical side effects, and satisfaction levels in emmetropic presbyopic patients with a Lentis Mplus segmented refractive multifocal IOL.

Correction of presbyopia by implanting a multifocal IOL is widely used[4]; however, it is mostly performed in patients with refractive error. To our knowledge, there is only 1 study of RLE in emmetropic presbyopic patients. Alfonso et al.[19] reported results of 23 emmetropic patients with an Acrysof Restor IOL (Alcon Laboratories, Inc.), proving that the procedure was safe and effective in emmetropic patients using this hybrid refractive–diffractive IOL.

Since the introduction of the new concept of rotationally asymmetric IOLs, several studies have evaluated their advantages and disadvantages and compared their performance with traditionally designed rotationally symmetric IOLs.[20–25] In theory, having only 1 transition zone between distance vision and near vision should mean less loss of energy, a reduced source of light scattering, and therefore improved contrast sensitivity and minimal induction of aberrations, halos, and glare. As with any other multifocal IOL design developed to date, it is not possible to completely eliminate night-vision phenomena. We previously published a report of 9366 consecutive ametropic eyes with this rotationally asymmetric IOL.[25] Although excellent results were achieved in a large patient cohort, we highlighted possible complications, including glare, halos, and star burst, and the rate of IOL exchange to a monofocal IOL design in a small percentage of dissatisfied patients. Despite these drawbacks, high patient satisfaction was achieved in the study and the experience with this IOL design led us to extend the suitability criteria to carefully counseled emmetropic patients demanding RLE for presbyopia.

In our current study of emmetropic presbyopic patients, we achieved excellent visual outcomes, with most patients retaining their preoperative CDVA or UDVA. The mean postoperative UNVA was 0.13 ± 0.14 logMAR monocularly and 0.10 ± 0.12 logMAR binocularly. This result is better than in our report of 9366 ametropic eyes with the same segmented refractive IOL,[25] in which the mean monocular and binocular UNVA was 0.213 ± 0.173 logMAR and 0.155 ± 0.144 logMAR, respectively. When comparing the 2 studies, better predictability and postoperative UDVA results were also achieved in the group of emmetropic presbyopic patients. This is expected because a much wider range of axial lengths was treated in the group of 9366 ametropic patients. However, there seemed to be a higher incidence of glare, halo, and star burst in the emmetropic presbyopic patients than in the ametropic presbyopic patients with the same multifocal IOL with an inferior reading add. In the current study, if we selected patients scoring 7 (severe difficulty) on the scale of visual phenomena, the percentages would be 10.3% for severe star burst, 11.4% for severe glare, and 11.4% for severe halo. In our ametropic group,[25] only 5.7% of patients reported having severe glare and 7.1% severe star burst and halo 3 months postoperatively. In theory, emmetropic presbyopic patients might be more prone to night-vision phenomena. Unlike patients with refractive error, emmetropic patients never experienced aberrations from spectacles or contact lens wear, and the induction of unwanted optical side effects with a multifocal IOL might be more bothersome. The general satisfaction scores reflect this. The percentage of patients willing to recommend the procedure to their family or friends was 97.5% in the ametropic group[25] and 93.5% in the emmetropic group.

Direct comparison with the only available study of IOL exchange in emmetropic presbyopic patients[19] shows similar postoperative SE results. The mean postoperative SE was +0.14 ± 0.22 D with the Acrysof Restor SN60D3 IOL versus our result of +0.03 ± 0.37 D. The study achieved somewhat better UNVA of 0.95 ± 0.07 (approximately 0.02 logMAR) compared with our UNVA of 0.13 ± 0.14 logMAR, which is expected with an IOL with a stronger near add (+4.00 D in SN60D3 model). Both studies found no loss of mean UDVA or CDVA postoperatively. When comparing

Table 2. Near and distance visual acuities in studies of surgical correction of emmetropia.

Study*	Method of Surgical Correction	Patients (n)	Follow-up	Mean UNVA (LogMAR)	
				Monocular in Operated Eye	Binocular
Waring[5]	Kamra corneal inlay (Acufocus Inc)	507	18 mo	0.139	NR
Dexl[6]	Kamra corneal inlay	24	12 mo	NR	0.10
Seyeddain[7]	Kamra corneal inlay	32	3 y	0.0	0.0
Seyeddain[8]	Kamra corneal inlay	24	2 y	0.1	0.1
Limnopoulou[9]	Flexivue Micro-Lens corneal inlay (Presbia Coöperatief U.A.)	47	12 mo	0.14	0.13
Bouzoukis[10]	Invue Lens corneal inlay (Biovision AG)	45	12 mo	NR	NR
Barragan Garza[11]	Raindrop corneal inlay (Revision Optics, Inc.)	20	12 mo	NR	0.03 (at 1 mo)
Ayoubi[12]	Femtosecond LASIK monovision	32	12 mo	NR	0.19
	CK	32	12 mo	NR	0.44
Stahl[13]	CK	10	3 y	0.18	NR
Reinstein[14]	LASIK-induced micro-monovision	148	12 mo	0.05	0.05
Thomas[15]	Intracor (Technolas Perfect Vision)	20	12 mo	0.1	NR
Menassa[16]	IntraCor	25	18 mo	NR	0.2 (median)
Alfonso[19]	RLE with Acrysof Restor Natural (SN60D; Alcon Laboratories, Inc.)	23	6 mo	0.02	NR
Current	RLE with Lentis Mplus LS-313 MF30 (Oculentis GmbH)	220	3 mo	0.13	0.10

CK = conductive keratoplasty; CDVA = corrected distance visual acuity; LASIK = laser in situ keratomileusis; NR = measurement not reported; RLE = refractive lens exchange; UDVA = uncorrected distance visual acuity; UNVA = uncorrected near visual acuity
*First author

night-vision phenomena, the authors[19] evaluated glare and halos on a scale from 1 to 4 (1 = none, 2 = mild, 3 = moderate, and 4 = severe); the mean score was 1.2 ± 0.6 for glare and 2.5 ± 0.5 for halos. This is similar to our scores, which ranged between 2.8 and 3.6 measured on a scale from 1 to 7. The patient satisfaction questionnaire was distributed at 6 months in the study of the Acrysof Restor IOL, whereas 3-month data are presented in our study; thus, neuroadaptation might further improve the scores for night-vision phenomena[26] in patients with the segmented refractive IOL. It would be interesting to compare contrast sensitivity and intermediate vision between the 2 IOLs; however, we were unable to obtain these variables in this retrospective study.

At present, emmetropic presbyopia is mostly treated with cornea-based surgical options. These can be divided into 2 categories; that is, treatments that use a small device, such as an inlay implanted in the cornea, and cornea-reshaping surgical options. A comparison of our results with those of corneal methods for treating emmetropic presbyopia is difficult, mostly because the majority of the published studies were performed on a small patient cohort and some of them do not report one of the most important aspects of treating this challenging population—patient satisfaction. Table 2 shows visual acuities achieved with published surgical techniques performed on naturally emmetropic and presbyopic patients as well as reported loss of UDVA and CDVA in the operated eye.[5–16,19]

Corneal inlays are based on 3 principles; that is, small-aperture optic inlays that work through increasing the depth of focus without changing the refractive status of the cornea,[5–8] refractive inlays with a near add power,[9,10] and inlays designed to alter the curvature of the cornea overlying the implant.[11] Recent studies of the most commonly used small-aperture corneal inlay (Kamra, Acufocus, Inc.) report a mean postoperative UNVA in the range between J1

Table 2. (Cont.)

Mean UDVA			
Monocular in Operated Eye (LogMAR)	Binocular (LogMAR)	Loss Reported in Operated Eye	Reported Loss of CDVA in Operated Eye
0.011	NR	3 letter	NR
0.0	–0.1	1 line	1 line: 16.7% ≥2 lines: 4.2%
0.0	–0.1	1 line	1 line: 28.3% ≥2 lines: 3.1%
0.0	–0.1	1 line	1 line: 16.7% ≥2 lines: 0%
0.38	NR	3 line	1 line: 36.2% ≥2 lines: 0%
NR	NR	NR	1 line: 6.7% ≥2 lines: 0%
0.14 (at 1 wk)	0.01 (at 1 mo)	NR	1 line: NR ≥2 lines: 0%
NR	NR	NR	None
NR	NR	NR	None
0.30	NR	2 line	None
0.43	–0.07	3.5 line	1 line: 12.8% ≥2 lines: 0%
NR	NR	NR	1 line: 45% ≥2 lines: 15%
NR	0.201 (median)	NR	1 line: 52% ≥2 lines: 24%
0.02	NR	None	1 line: 21.7% ≥2 lines: 0%
–0.04	–0.10	None	1 line: 18.1% ≥2 lines: 2.2%

and J3 (0.0 to 0.139 logMAR),[5–8] with a 1-line decrease in UDVA in the operated eye (Table 2). The percentage of patients willing to have the procedure again was 75.0% at 1 year[6] and 84.5% at 3 years[7] in 2 separate studies by the same authors; the remaining patients were mostly undecided. Severe visual phenomena are not often reported as a major issue with this type of inlay, although in a study by Seyeddain et al.,[7] 15.6% of patients reported night-vision problems 3 years postoperatively. Other types of currently available inlays show promising results in terms of gains in UNVA, with almost all eyes achieving a UNVA of 0.3 logMAR or better.[9–11] However, because of their nature, they significantly affect UDVA in the operated eye (Table 2). Long-term biocompatibility of these devices has yet to be investigated.

Cornea-reshaping surgical options for emmetropic presbyopia include CK,[12,13] femtosecond intrastromal presbyopic treatment,[15,16] and monovision LASIK.[12,14] These procedures were not developed exclusively for emmetropic presbyopic patients but are also performed on patients with refractive errors. The literature reports variable patient satisfaction levels with the CK procedure for plano presbyopia. For example, in a study by Ayoubi et al.[12] comparing femtosecond LASIK monovision with CK, only 46.9% of the patients were very satisfied or satisfied with the results compared with 93.8% for monovision LASIK. On the other hand, in a 3-year study of CK,[13] all patients indicated that they would have the procedure again and would also recommend it to others. Here, patients achieved a mean UNVA of J3.[13] Monovision induced by an excimer laser is also often performed on patients with refractive errors; however, reports of LASIK-induced monovision on naturally emmetropic and presbyopic patients exist.[12,14] For example, a recent study of 148 emmetropic patients who had LASIK-induced monovision using an aspheric ablation profile[14] had a mean binocular UNVA of 0.05 ± 0.07 logMAR and a mean UDVA of −0.07 ± 0.18 logMAR

1 year postoperatively (Table 2). These are comparable with our results of a mean UNVA of 0.10 ± 0.12 logMAR and a mean UDVA of −0.10 ± 0.09 logMAR binocularly. Patient satisfaction was, however, not reported in this study. Another emerging corneal option for treatment of emmetropic presbyopia (Intracor) corrects near vision by making intrastromal corneal cuts, leading to a multifocal cornea and increasing the central corneal steepness while preserving the corneal epithelium. Although significant improvement in UNVA has been recorded, loss of CDVA still seems to be a concern, with 1 study reporting the loss of 2 lines or more of CDVA in 15% of treated eyes[15] and in 24% in another study[16] (Table 2). Another cornea-reshaping surgical form of presbyopia treatment is presbyopic LASIK.[27,28] Different concentric zones for distance and near vision created by this technique are, in principle, similar to multifocal IOL technology. In general, the 2 main methods are central presbyopic LASIK (hyper-positive central area for near vision and periphery for distance) and peripheral presbyopic LASIK (central cornea for distance and midperiphery for near). Multifocal corneal ablation is often difficult to perform without altering patient refraction and has mostly been restricted to ametropic patients. To date, none of the options for the treatment of presbyopic emmetropia has became widely established—certainly not to the extent of distance-correction surgical procedures, such as LASIK.

In conclusion, excellent visual acuities and refractive outcomes were achieved in this study; however, patient satisfaction scores were lower than those of ametropic patients with the same IOL design. There have been recent discussions about whether positioning rotationally asymmetric IOLs in relation to the angle κ (near segment of IOL placed opposite to the quadrant where the decentered visual axis is detected) would reduce unwanted optical side effects.[A] This might improve patient satisfaction scores, and it would be an interesting topic for future studies. The summary of the literature on procedures available to plano presbyopic patients, together with results in this study, indicate there is no ultimate solution to emmetropic presbyopia without the possibility of unwanted side effects and a certain percentage of patients still requiring reading spectacles. Refractive lens exchange in emmetropic presbyopic patients might offer a more permanent solution than cornea-based approaches and retain preoperative distance visual acuity. On the other hand, disadvantages include irreversibility and the possibility of sight-threatening complications associated with intraocular surgery, such as endophthalmitis[29,30] RD,[31] or persistent CME,[32] which can be devastating for an emmetropic presbyopic person. Because of a higher incidence of night-vision phenomena in these patients than in ametropic patients, thorough preoperative counseling of this specific group is essential.

WHAT WAS KNOWN

- Naturally emmetropic and presbyopic patients are challenging to treat. Most currently available surgical options struggle to improve near vision without compromising distance vision in the operated eye.
- Surgical options for emmetropic presbyopic patients mostly involve the cornea. Reports of RLE with a multifocal IOL in these patients are rare.

WHAT THIS PAPER ADDS

- In 440 consecutive eyes, RLE proved to be safe and efficient at restoring near vision while preserving distance vision in emmetropic presbyopic patients.
- Because of a higher incidence of visual phenomena and lower satisfaction scores than with ametropic patients with the same rotational asymmetric IOL, careful patient selection and preoperative counseling are necessary.

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