Journal of Animal and Veterinary Advances 11 (12): 2097-2105, 2012
ISSN: 1680-5593

Mini-Monovision with Multifocal PresbyLASIK for Myopic Presbyopes

Xiao-Xiong Wang, Yi-Qiao Xing and Xiao-Jiao Liu
Department of Ophthalmology, Renmin Hospital of Wuhan University, 430060 Wuhan, China

Abstract: To evaluate the outcomes of mini-monovision peripheral presbyLASIK in presbyopic myopes. Twenty eight subjects (56 eyes) were included in this prospective study. The mean age of the cohort was 51 years (range, 45-62 years). Mean Spherical Equivalent refraction (SE) of the dominant eyes was -7.00±2.04D (range, -11.00 to -4.00D) and -7.11±1.99D (range, -11.13 to -4.25D) for non-dominant eyes. Mini-monovision peripheral presbyLASIK was performed with the dominant eye corrected for distance vision and the non-dominant eye for near vision using the NIDEK EC-5000 CXα excimer laser. The target refraction was -0.25D for the dominant eyes and -0.75D for the non-dominant eyes. Data are reported for the last postoperative visit (6 months or later). The mean postoperative SE was -0.58±0.45D (range, -1.38 to +0.50D) with 71% within ±0.50D of the intended SE for the dominant eyes. In the non-dominant eyes, mean postoperative SE was -1.00±0.44D (range, -1.75 to 0D) with 71% within ±0.50D of the intended SE. All subjects achieved binocular Uncorrected Distance Visual Acuity (UDVA) of 0.8 or better, 82% achieved binocular Uncorrected near Visual Acuity (UNVA) of 0.8 or better and 93% achieved 0.5 or better. No eyes lost more than one line of BCVA and there were no serious complications after surgery. Mini-monovision peripheral presbyLASIK was safe, effective and highly predictable for myopic presbyopes.

Key words: Mini-monovision, refraction, dominant eye, binocular, complication

INTRODUCTION

Presbyopia or the loss of accommodation with age affects a significant proportion of the world's population. Hence, the demand for the treatment of presbyopia is considerable. Treatment for presbyopia involves two general choices, spectacles or surgery. Laser *In situ* Keratomileusis (LASIK) is a successful approach for the management of presbyopia using either monovision or multifocal corneal ablation (presbyLASIK) (Mantry and Shah, 2004).

Monovision correction leaves one eye with residual myopia for near vision. For example, one eye is fully corrected for distance vision and the other eye remains myopic with approximately 1.25-2.50D for near vision (Cox and Krueger, 2006). Patients who can tolerate this level of anisometropia, report a high degree of satisfaction with monovision (Cox and Krueger, 2006; Goldberg, 2003; Miranda and Krueger, 2004; Reilly *et al*., 2006). However, some patients experience decreased stereopsis and have difficulty with night driving after monovision correction (Cox and Krueger, 2006; Goldberg, 2003; Miranda and Krueger, 2004; Reilly *et al*., 2006).

Multifocal corneal ablation is a procedure based on multistep and multizone laser ablation that creates a progressive multifocal cornea that results in pseudoaccommodation (Telandro and Steile, 2006). Previous studies of multifocal corneal ablation or presbyLASIK have reported safety and efficacy of this ablation profile (Wang *et al*., 2007; Telandro, 2004; Cantu *et al*., 2004, 2005; Alio *et al*., 2006). In the experience with peripheral presbyLASIK, researchers found that some patients with minor anisometropia had better postoperative efficacy because their vision of both eyes would compensate for each other and the patients seemed satisfied. Based on these observations, researchers designed a study to evaluate the safety, predictability and efficacy of a mini-monovision (Reinstein *et al*., 2011) peripheral presbyLASIK (Telandro and Steile, 2006; Telandro, 2004) treatments. The mini-monovision peripheral presbyLASIK treatment is a bilateral multifocal ablation with the dominant eye corrected for distance vision and the non-dominant eye for near vision.

MATERIALS AND METHODS

Study design: This study was a prospective, non-comparative clinical study. All subjects underwent an informed consent procedure and were required to sign a consent document prior to surgery. This study conformed to the tenets of the Declaration of Helsinki and the study

Corresponding Author: Xiao-Xiong Wang, Department of Ophthalmology, Renmin Hospital of Wuhan University, 430060 Wuhan, China

was approved by the Human Studies Review Board of Wuhan University, Wuhan, China. Surgeries were performed from June 2006 to December 2007.

Subjects and examination: To be included in the study, subjects had to be 45-65 years of age with at least -4.00D myopia and cylinder no greater than -5.50D, Corrected Distance Visual Acuity (CDVA) of each eye ≥0.8 (decimal notation) and medically suitable for LASIK and free of corneal or retinal disease that would preclude LASIK. Subjects who listed driver as their main occupation were excluded.

The preoperative examinations for all subjects included measurement of Uncorrected Distance Visual Acuity (UDVA), CDVA, manifest refraction, slit-lamp examination, funduscopic examination, combined corneal topography, aberrometry (6 mm pupil diameter, 8th Zernike order) and pupillometry (OPD-Scan, Nidek Co., Ltd. Gamagori, Japan), intraocular pressure (TX-F Full Auto Tonometer, Canon Inc., Tokyo, Japan), accommodative amplitude, contrast sensitivity (Functional Acuity Contrast Test, Stereo Optical Co., Inc., Chicago, Il, USA), ocular dominance testing (Miranda and Krueger, 2004) and ultrasound pachymetry (UP-1000 Ultrasonic Pachymeter, Nidek Co., Ltd. Gamagori, Japan).

UDVA and CDVA were tested using the decimal scale distance visual acuity chart. Near visual acuity was tested at 40 cm using the decimal scale near visual acuity chart. Uncorrected visual acuity was tested binocularly and monocularly whereas CDVA was tested monocularly only. Ocular dominance was tested with the subject binocularly aligning a distant object through a hole in a card while keeping still and alternately closing one eye then the other. The eye with which the subject could see the object through the hole was deemed the dominant eye.

The subjective minus to Blur Method (Ostrin and Glasser, 2004) was used to measure accommodative amplitude. The subject wore distance correction based on the manifest refraction and focused on the line above the CDVA line of the decimal scale distance visual acuity chart at 5 m with one eye while the other eye was occluded. Minus lens power was added in front of the eye in 0.25D increments until the subject reported the line could no longer be held in clear focus. The minus-lens power added over distance correction was recorded as the accommodative amplitude.

Postoperative examinations were performed at 1 day and 10 days and 1, 3, 6 and 12 months. Postoperative examinations included measurement of monocular and binocular uncorrected visual acuity at both distance and near, slit-lamp examination and computerized corneal topography. Intraocular pressure measurements were performed at 1, 3 and 6 months postoperatively. Measurement of manifest refraction, CDVA, accommodative amplitude and contrast sensitivity was performed at 6 and 12 months postoperatively.

A questionnaire was used to investigate the quality of distance and near visual acuity, the degree of the subject's satisfaction and dependence on glasses after surgery. The degree of satisfaction was rated by the subject as satisfactory, acceptable or unsatisfactory.

Surgical procedure: All surgeries were performed by the same experienced surgeon (X-xW). Bilateral LASIK surgery was performed in all subjects using the multifocal corneal ablation profile. Hinged corneal flaps were created with the Hansatome microkeratome (Bausch and Lomb Inc., Rochester, NY, USA) with an intended flap diameter of 8.5 mm and a flap thickness of 160 μm. The refractive ablation was performed with the EC-5000 CXα excimer laser platform (NIDEK Co., Ltd. Gamagori, Japan) with the manufacturer's nomogram.

The dominant eye was targeted for -0.25D in all cases and the non-dominant eye was targeted for -0.75D. All corrections were based on preoperative manifest refraction. The profile was created using the multistep laser ablation as follows: the myopic sphere was corrected in 2 steps; first the spherical value (-2.75D was subtracted from the manifest sphere in the dominant eye and -3.25D was subtracted from the manifest sphere in the non-dominant eye) was corrected at 6/7 mm Optical Zone/Transition Zone (OZ/TZ). The second step was the correction of -2.50D at 3-3.5/4-5 mm OZ/TZ. The cylinder was fully corrected with a 6 mm OZ and 7 mm TZ in all cases.

Sample laser data entry for a subject with manifest refraction of -6.00−2×180 OD (dominant eye) and −6.50−2×165 OS are shown.

Dominant eye:

- Step 1: −3.25−2.00×180 6/7 mm (OZ/TZ)
- Step 2: −2.50 sphere only 3.5/5 mm (OZ/TZ)

Non dominant eye (OS):

- Step 1: −3.25−2.00×165 6/7mm (OZ/TZ)
- Step 2: −2.50 sphere only 3/4 mm (OZ/TZ)

After surgery, subjects were instructed to instill antibiotic eye drops four times daily for the 1st week fluorometholone 0.1% (Allergan Inc., Ireland) eye drops on a tapering dose of four times daily for the 1st week,

then three times daily for the next week, two times daily for the following week and once daily for an additional week. Artificial tears were instilled three times daily for 1 month postoperatively.

Data collection and analysis: Statistical analysis of the results was performed with SPSS11.0 for windows (SPSS, Chicago). Visual acuity data were converted to the logarithm of the minimum angle of resolution value for data analysis. The paired sample t-test was used to compare ocular (whole eye) spherical aberration and accommodative amplitude preoperatively and postoperatively. A nonparametric test (Wilcoxon signed rank test) was used to compare preoperative visual acuity to postoperative visual acuity and the change in contrast sensitivity from preoperatively to postoperatively. The difference was considered statistically significant when $p<0.05$. Data at the last postoperative visit are reported.

RESULTS AND DISCUSSION

The study cohort was comprised of 28 subjects (6 men and 22 women, 56 eyes). Mean subject age was 51 years (range, 45-62 years). Preoperatively, the mean myopia was -6.73±1.96D (range, -11.00 to -4.00D), mean cylinder was -0.64±0.80D (range, -5.50-0D) and mean Spherical Equivalent refraction (SE) was -7.05±2.00D (range, -11.13 to -4.00D). Pupil diameter was successfully measured on 26 subjects (52 eyes) preoperatively. The mean preoperative photopic pupil diameter was 3.53±0.42 mm (range, 2.63-4.24 mm) and the mesopic pupil diameter 5.61±0.87mm (range, 3.12-7.37mm). Postoperatively, the pupil diameter was successfully measured on 26 subjects (52 eyes). The mean postoperative photopic pupil diameter was 3.46±0.44 mm (range, 2.54-4.22 mm) and mean mesopic diameter was 5.52±0.89 mm (range, 3.84-7.46 mm).

All 28 subjects (including one eye that underwent retreatment) completed a minimum follow up of 6 months. Mean follow-up was 8.14±2.51 months (range, 6-13 months).

Efficacy: The preoperative UDVA of all eyes was <0.2. The postoperative monocular and binocular UDVA is shown in Fig. 1. The postoperative UDVA of all eyes increased. The number of eyes with UDVA of 1.0-1.5 or better is shown in Table 1.

The preoperative Uncorrected Near Visual Acuity (UNVA) for dominant eyes, non-dominant eyes and binocularly is shown in Fig. 2 and the postoperative UNVA is shown in Fig. 3. The postoperative UNVA of the non-dominant eyes did not change significantly compared to preoperatively ($Z = -0.269$, $p = 0.788$) (Fig. 2 and 3). The

Table 1: Uncorrected Distance Visual Acuity (UDVA) after mini-monovision peripheral presbyLASIK

UDVA	Dominant eyes (n = 28 eyes)	Non-dominant eyes (n = 28 eyes)	Binocular (n = 28 subjects)
≥1.0	16 (57%)	9 (32%)	20 (71%)
≥1.2	9 (32%)	3 (11%)	13 (46%)
≥1.5	0	0	1 (4%)

≥: greater than or equal to

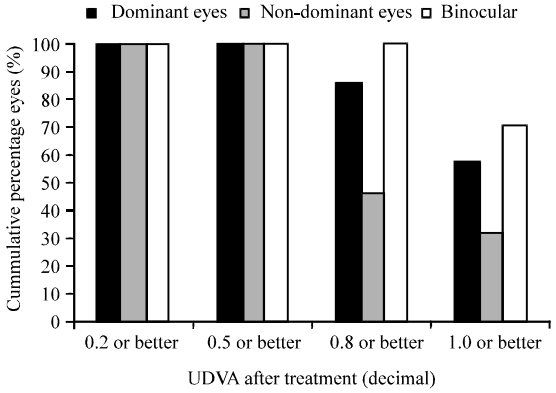

Fig. 1: Cumulative histogram for Uncorrected Distance Visual Acuity (UDVA) after mini-monovision peripheral presbyLASIK for myopia and presbyopia, grouped into dominant eyes (100, 100, 86 and 57%), non-dominant eyes (100, 100, 46 and 32%) and binocularly (100, 100, 100 and 71%). Percentages are calculated for 28 dominant eyes, 28 non-dominant eyes of 28 subjects

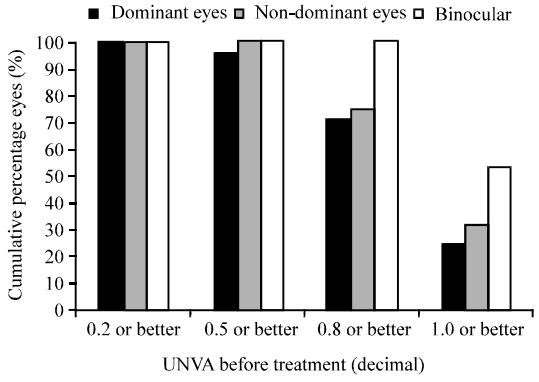

Fig. 2: Cumulative histogram for Uncorrected Near Visual Acuity (UNVA) before treatment, grouped into dominant eyes (100, 96, 71 and 25%), non-dominant eyes (100, 100, 75 and 32%) and binocularly (100, 100, 100 and 54%). Percentages are calculated for 28 dominant eyes, 28 non-dominant eyes of 28 subjects

UNVA of dominant eyes and the binocular UNVA decreased statistically significantly compared to preoperatively (Z = -2.673, p = 0.008; Z = -2.145, p = 0.032, respectively) (Fig. 2 and 3).

The postoperative binocular UNVA of subjects with binocular UDVA = 0.8 and ≥1.0 is shown in Fig. 4. The postoperative binocular UNVA with the binocular UDVA = 0.8 was 0.5 or better in 93% of subjects and 0.8 or better in 82% of subjects. After surgery, the binocular UDVA was better than the dominant eye UDVA (Z = -3.500, p<0.001) and the binocular UNVA was better than the non-dominant eye UNVA (Z = -3.317, p = 0.001).

Safety: Postoperatively, 4 eyes (7%) lost 1 line of CDVA and none lost >1 line and 16 eyes (29%) gained 1 line of CDVA. No intraoperative complications occurred during this study. Postoperatively, there were no serious complications such as infection, epithelium ingrowth, corneal ectasia and severe dry eye. The results of mean contrast sensitivity are shown in Fig. 5. No significant change occurred at 1.5, 3, 6, 12 cycles/degree (Z = -1.225, -1.347, -1.000, -1.284; p = 0.221, 0.178, 0.317, 0.199, respectively). The contrast sensitivity at 18 cycles/degree decreased statistically significantly compared to preoperatively (Z = -2.466; p = 0.014).

Predictability: Mean SE and mean cylindrical refraction before and after treatment are shown in Table 2 of the

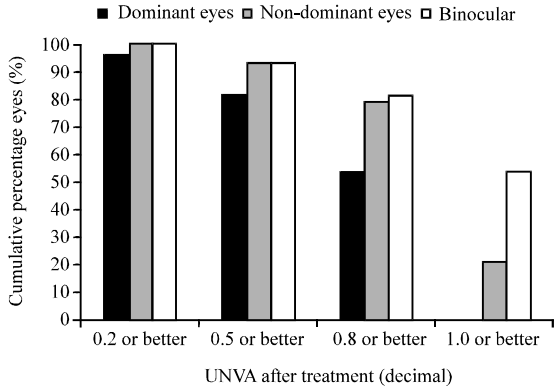

Fig. 3: Cumulative histogram for Uncorrected Near Visual Acuity (UNVA) after mini-monovision peripheral presbyLASIK for myopia and presbyopia, grouped into dominant eyes (96, 82, 54 and 0%), non-dominant eyes (100, 93, 79 and 21%) and binocularly (100, 93, 82 and 54%). Percentages are calculated for 28 dominant eyes, 28 non-dominant eyes and 28 subjects

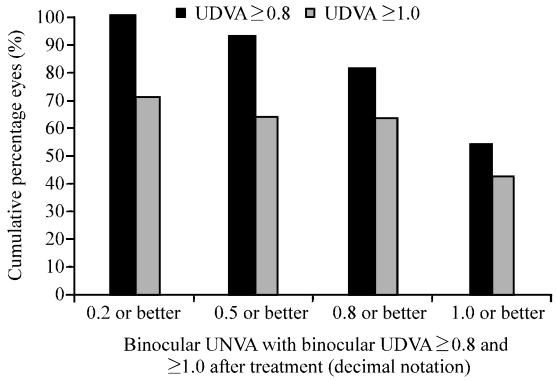

Fig. 4: Cumulative histogram for binocular Uncorrected Near Visual Acuity (UNVA) after mini-monovision peripheral presbyLASIK for myopia and presbyopia, grouped into binocular UNVA with binocular Uncorrected Distance Visual Acuity (UDVA) ≥0.8 (100, 93, 82 and 54%) and with binocular UDVA ≥1.0 (71, 64, 64 and 43%)

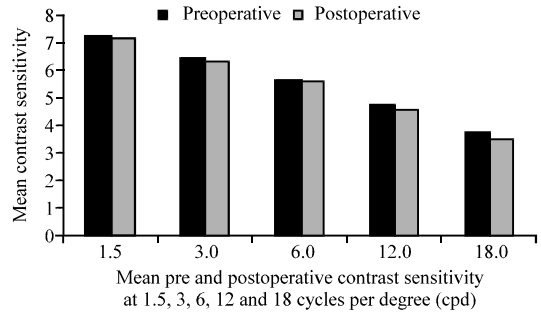

Fig. 5: Mean pre- and postoperative contrast sensitivity at 1.5, 3, 6, 12 and 18 cycles per degree (cpd) of eyes that underwent mini-monovision peripheral presbyLASIK for myopia and presbyopia. Preoperative (7.27±0.77, 6.46±0.71, 5.68±0.54, 4.77±0.91 and 3.75±0.90) and Postoperative (7.16±0.89, 6.34±0.79, 5.59±0.73, 4.63±0.73 and 3.48±0.63)

Table 2: Mean spherical equivalent refraction and mean cylindrical refraction before and after mini-monovision peripheral presbyLASIK

	Mean spherical equivalent refraction (D)			Mean cylindrical refraction (D)	
Eye pattern (n = 28)	Preoperative	Target	Postoperative	Preoperative	Postoperative
Dominant eyes	-7.00±2.04	-0.25	-0.58±0.45	-0.64±1.06	-0.20±0.28
	(-11.00 to -4.00)		(-1.38 to+0.50)	(-5.50 to 0)	(-0.75 to 0)
Non-dominant eyes	-7.11±1.99	-0.75	-1.00±0.44	-0.64±0.43	-0.24±0.33
	(-11.13 to -4.25)		(-1.75 to 0)	(-1.50 to 0)	(-1.00 to 0)

dominant eyes, 20 eyes (71%) were within ±0.50D of the intended target and 27 eyes (96%) were within ±1.00D. Of the non-dominant eyes, 20 eyes (71%) were within ±0.50D of intended target and 28 eyes (100%) were within ±1.00D. Scatterplot of attempted versus achieved SE are shown in Fig. 6.

Spherical aberration: The spherical aberration changed from -0.10±0.31 μm (range, -1.41-0.31 μm) preoperatively to 0.16±0.38 μm (range, -0.98-0.71 μm) postoperatively. The change in spherical aberration was statistically significant ($t = -6.517$, $p<0.001$).

Accommodative amplitude: The accommodative amplitude increased from 1.58±0.53D (range, 0.50D-2.75D) preoperatively to 1.93±0.65D (range, 0.50D-3.00D) postoperatively ($t = -8.464$, $p<0.001$). Figure 7 plots mean accommodative amplitude preoperatively and postoperatively in age matched subjects.

Retreatments: The dominant eye of one patient underwent retreatment for distance vision and the etreatment rate was 2%. After primary treatment, the spherical equivalent refraction of the patient's dominant eye was -1.75D and the UDVA was 0.3. After retreatment, the spherical equivalent refraction of the eye was -0.75D, and the UDVA was 1.0.

Subjective survey: The need for distance glasses and reading glasses are shown in Fig. 8. All subjects reported that their postoperative UDVA was better thanpreoperatively. Three subjects (11%) reported their postoperative UNVA was better, 10 subjects (36%) reported that their postoperative UNVA was worse and 15 subjects (54%) noticed no change in their postoperative UNVA. Twenty four subjects (86%) were satisfied with the postoperative outcome, 3 subjects (11%) reported the postoperative outcome was acceptable and 1 subject (4%) was unsatisfied with the postoperative outcome.

Sample maps: Sample OPD maps and difference maps are shown in Fig. 9. The postoperative OPD map shows myopic power peripherally (Fig. 9). Sample topographic

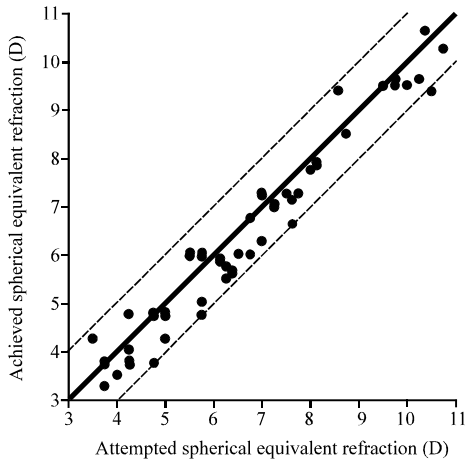

Fig. 6: Scatterplot of the attempted versus achieved spherical equivalent refraction after mini-monovision peripheral presbyLASIK for myopia and presbyopia

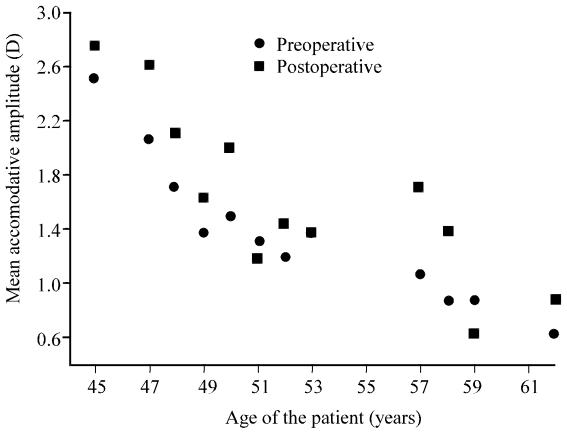

Fig. 7: Mean accommodative amplitude of all eyes matched for subjects who were the same age. All subjects underwent mini-monovision peripheral presbyLASIK for myopia and presbyopia

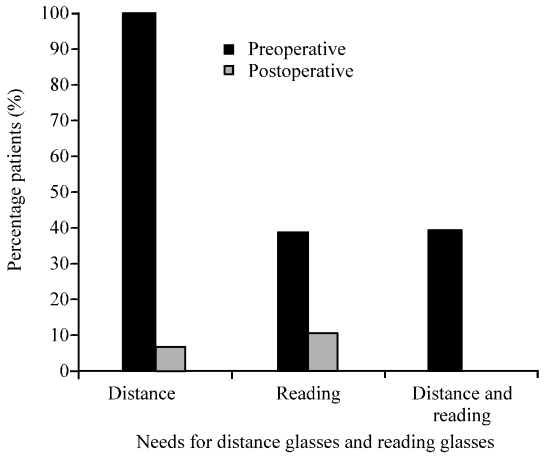

Fig. 8: The need for distance glasses and reading glasses before and after mini-monovision peripheral presbyLASIK for myopia and presbyopia. Preoperative (100, 39 and 39%), Postoperative (7, 11 and 0%)

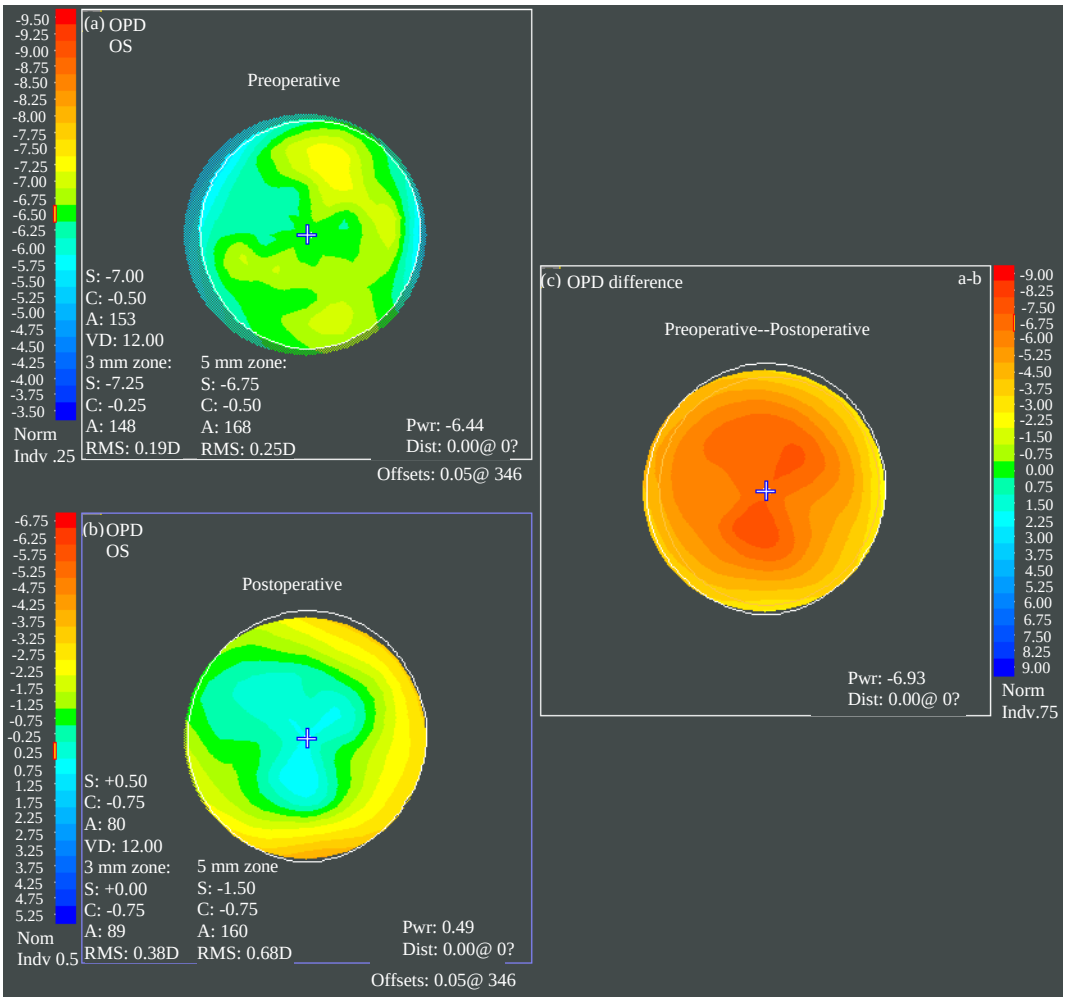

Fig. 9: Sample refractive aberrometry maps (optical path difference maps) preoperatively and postoperatively. The difference map indicates the difference between the preoperative and postoperative maps

and difference maps are shown in Fig. 10. Mini-monovision peripheral presbyLASIK for presbyopia is based on two concepts. The first is the creation of pseudoaccommodation through multifocal corneal ablation (Telandro and Steile, 2006). The second is to make the vision of both eyes compensate for each other through asymmetric correction on both eyes. In the current study, this compensation was achieved as indicated by the postoperative binocular UDVA which was better than the dominant eye UDVA and the postoperative binocular UNVA which was better than the non-dominant eye UNVA.

As expected, the postoperative near vision should be adequate however there may be diminution in distance vision in a strategy that targets mild myopia. The results of the current study indicate that mini-monovision peripheral presbyLASIK was safe, effective and highly predictable for presbyopic myopes. Postoperatively, no eyes in the entire cohort lost 2 or more lines of CDVA. Although, the uncorrected near vision decreased, the majority of the subjects reported that their near vision was better or there was no change compared to preoperatively. This outcome was likely due to the improvement of intermediate distance vision. However, studies reporting intermediate vision data are required to verify this observation.

Previous studies (Wang *et al*., 2007; Telandro, 2004; Cantu *et al*., 2004, 2005) report multifocal corneal ablation is safe and effective for presbyopic myopes. In the previous study (Wang *et al*., 2007) 10 myopes (20 eyes) with presbyopia (mean age 52 years and mean preoperative SE -4.90±2.30D) were treated with multifocal LASIK. In the previous study researchers found that the postoperative UDVA ranged between 0.3-1.2, the UNVA

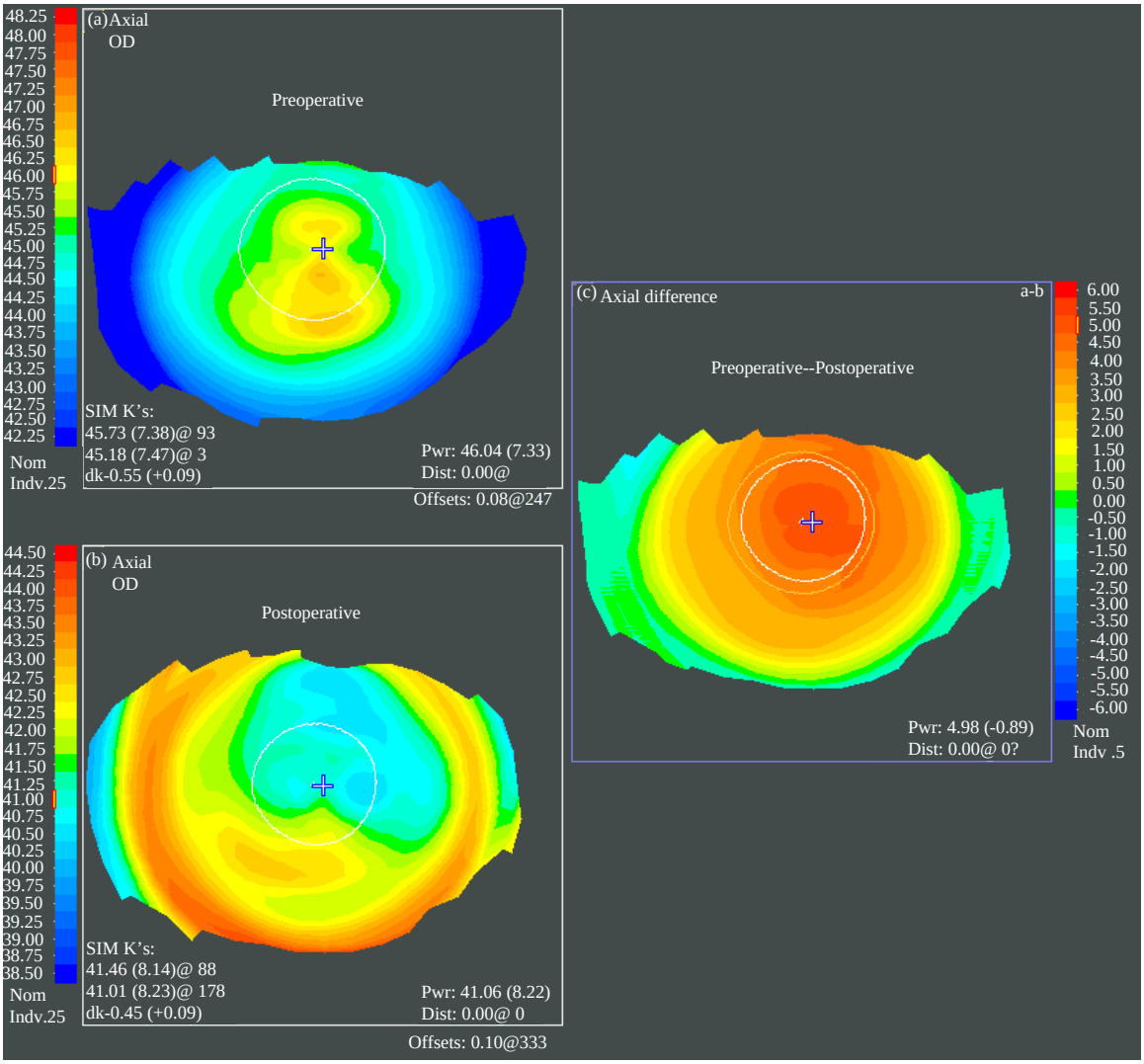

Fig. 10: Sample corneal topography preoperatively and postoperatively. The difference map indicates the difference between the preoperative and postoperative maps

ranged between 0.4-1.0, 80% eyes were within ±1.00D of intended SE and 70% subjects were satisfied with the surgery (Wang *et al*., 2007). The current study had better predictability and efficacy compared to our previous experience (Wang *et al*., 2007). This may indicate that mini-monovision peripheral presbyLASIK is advantageous over multifocal LASIK. For example, 86% of the subjects in the current study were satisfied postoperatively which is 16% higher than the previous study (Wang *et al*., 2007). Additionally, more demanding patients may be satisfied with the treatment strategy because target for both eyes are myopic. The outcomes from the current study compare favorably to previous investigations of presbyLASIK or LASIK induced micro-monovision. Epstein and Gurgos (2009) prospectively investigated monocular peripheral presbyLASIK on the non dominant eye with monofocal correction on the dominant eye of presbyopic myopes. They reported that 20/20 or better binocular UDVA was achieved by 70.7% of subjects which is similar to the outcome of 71% ((Epstein and Gurgos, 2009). Epstein and Gurgos (2009) found that 65.3% of subjects achieved 20/20 or better binocular UNVA which similar to 54% reported in the current study (Table 3). In the current study, 54% of subjects achieved binocular UNVA of 20/20 or better. Recent studies of LASIK for presbyopia using various ablation monovision type or presbyLASIK report 45-65% of subjects achieved UNVA of 20/20 or better (Table 3). Retreatment rates ranging from 10-19% have been reported after LASIK for presbyopia which is

Table 3: Summary of safety, binocular distance and near uncorrected visual acuities of studies of myopic presbyopes undergoing PresbyLASIK or monovision laser *in situ* keratomileusis

Study	Excimer laser	Type of presbyopic ablation	Mean preop MRSE (D)	Loss of CDVA ≥1 line (%)	Binocular UDVA≥20/20	Binocular UNVA≥20/20	Retreatment rate (%)
Current study (Wang *et al.*,2007)	NIDEK EC 5000 CX II	Mini-monovision peripheral presbyLASIK	-7.05±2.00	7	71%	54%	2.0
Epstein and Gurgos (2009)	VISX S4	Monocular presbyLASIK	-3.72±2.41	14.6	70.7%	65.3%	16.6
Reinstein *et al.* (2011)	Zeiss Meditec MEL 80	Micro-monovision	-4.22 ±1.67	7.4	90.4%	89% (≥20/25) ≥20/20 not reported	19.0
Gordon (2010)	Wavelight Allegretto	PresbyLASIK	-5 to +3 Sphere with +3 cylinder	Not reported	75%	45%	10.0

Preop denotes preoperative; LASIK: Laser *In situ* Keratomileusis; CDVA: Corrected Distance Visual Acuity; UDVA: Uncorrected Distance Visual Acuity, UNVA: Uncorrected Near Visual Acuity; MRSE: Manifest Refractive Spherical Equivalent, ≥: greater than or equal to

considerably >2% reported in the current study. However, varying criteria for performing retreatment may account for differences (Table 3) (Reinstein *et al.*, 2011; Epstein and Gurgos, 2009; Gordon, 2010).

Monovision corrects presbyopia using the concept of unequal correction of one eye versus the other. The dominant eye is typically fully corrected for distance vision and the non-dominant eye still retains myopia between 1.25-2.50D for near vision (Cox and Krueger, 2006; Goldberg, 2003; Miranda and Krueger, 2004; Reilly *et al.*, 2006). For subjects who can tolerate this anisometropia between eyes, there is a high degree of satisfaction. However, stereopsis decreases and 80% of monovision subjects have reported difficulty with night driving and others simply cannot tolerate monovision (Cox and Krueger, 2006; Goldberg, 2003; Miranda and Krueger, 2004; Reilly *et al.*, 2006). In the current study, mini-monovision (or micro-monovision) reduces the anisometropia between eyes which may increase tolerance for anisometropia.

A concern with peripheral presbyLASIK is the mitigation of the near effect due to pupillary miosis. However, pseudoaccommodation occurs due to the effect of mini-monovision, the increased depth of field due to pupillary miosis and the induced spherical aberration. Hence, there are some compensatory effects to ensure the peripheral presbyLASIK profile maintain functional near vision despite pupillary miosis. In the current study, spherical aberration changed by 0.26 μm, becoming positive postoperatively. This similar in sign and magnitude (0.20 μm) to the change reported for micro-monovision by Reinstein *et al.* (2011). The induction of positive spherical aberration has been associated to an increase in the accommodative range and near acuity (Artola *et al.*, 2006). In the current study, the positive spherical aberration may contribute to an improvement in the depth of field as proposed by Reinstein *et al.* (2011). Corneal asphericity may also contribute to increased depth of field however, the lack of data on asphericity in this study is a limitation.

In the current study, theoretically, stereopsis remains unaffected due to the small difference between eyes. However, further study is necessary to validate this observation. This mitigation of the loss of stereopsis may play a role in the high levels of subject satisfaction postoperatively. In the current study, researchers maintained 0.50D of anisometropia based on a pilot study. This is a markedly lower magnitude of anisometropia compared to monovision correction (Reilly *et al.*, 2006). Additionally we selected subjects with myopia of -4.00D or lower because many presbyopes with higher myopia require more than one pair of glasses for daily tasks as shown in Fig. 8. Drivers were excluded from participating in this study because the data on the effect of multifocal corneal ablation on night driving remains unclear.

As the basic mechanism of accommodation remains under study, current surgical strategies largely focus on presbyopia compensation rather than restoring accommodation. In the current study, the increase in postoperative accommodative amplitude is most likely related to the increase in postoperative pseudoaccommodation. Accommodative amplitude increased in the majority of subjects in the current study, however it still remained a function of age. Based on this observation, older presbyopes may require greater anisometropia between eyes, perhaps 1.00D for functional near vision. Hence, it is somewhat difficult for subjects to absolutely discontinue spectacle use despite mini-monovision peripheral presbyLASIK. Subjects should be counseled that there is a compromise between the binocular distance vision and the binocular near vision according to their specific requirements.

CONCLUSION

The current study indicated that mini-monovision peripheral presbyLASIK is a safe, effective and highly predictable surgery for myopic patients with presbyopia but further studies are necessary to evaluate long term stability and a determine more suitable multifocal corneal ablation profile.

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