

Pseudophakic Monovision

Careful patient selection is crucial.

BY MISAE ITO, CO; AND KIMIYA SHIMIZU, MD, PhD

Corresponding to the advances in surgical techniques for cataract surgery, corneal and lens-based refractive surgery now also play a significant role in correcting presbyopia. Current options include multifocal and accommodating IOLs as well as the monovision method. Based on preliminary research findings, we recommend conventional monovision, in which the dominant eye is corrected for distant vision and the nondominant eye for near.

Monovision comprises both conventional¹⁻³ and crossed monovision,⁴ depending on what correction technique is used for the dominant eye. For conventional monovision, we determine sighting dominance for distant vision using the hole-in-card test; the nondominant eye is corrected for near vision, a method that has been in use following cataract surgery since 1999.⁵⁻⁸

Monovision studies published to date have focused on contact lenses for phakic eyes¹⁻³ and corneal refractive corrective surgery,^{4,9} but few reports have investigated correction in pseudophakic eyes.^{5-8,10,11} Pseudophakic monovision does not preserve accommodation, and therefore a large difference in refraction between eyes is necessary to obtain favorable distance and near visual acuity. Because no change in the degree of refraction is simple, its suitability must be carefully assessed. There

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continues to be much debate on the application of monovision due to the complexity of evaluating ocular dominance.

PATIENT SELECTION

Monovision causes a difference in bilateral refractive powers, which is known as *artificial anisometropia*. However, cataract patients cannot see clearly preoperatively. When a difference in bilateral preoperative visual acuity is identified, we make adjustments using a Bangerter filter (Ryser Optik AG, St. Gallen, Switzerland) to equalize vision between eyes and perform adjustment tests for maintaining postoperative visual performance. Below is a list of considerations when selecting appropriate patients for monovision.

Ocular disease and corneal astigmatism. Patients with ocular disease or a high degree of corneal astigmatism do not benefit from monovision because it obtains neither a better UCVA nor excellent binocular vision. Additionally, patient satisfaction relates to the distance UCVA of the dominant eye; it is important to correct corneal astigmatism to less than 1.00 D.

Ocular deviation. Careful patient selection is needed to exclude patients with a large exophoria. Using the alternate prism cover test, we measure the eye's position during near vision. Patients with strabismus and vertical deviation (ie, phoria) are excluded from monovision. In our experience, this includes those with near

TAKE-HOME MESSAGE

- Effective monovision has excellent distance UCVA in the dominant eye and a near exphoria angle up to 10.00 prism diopters and is acceptable in patients over 60 years of age and those with weak ocular dominance.
- Patient satisfaction relates to the distance UCVA of the dominant eye.

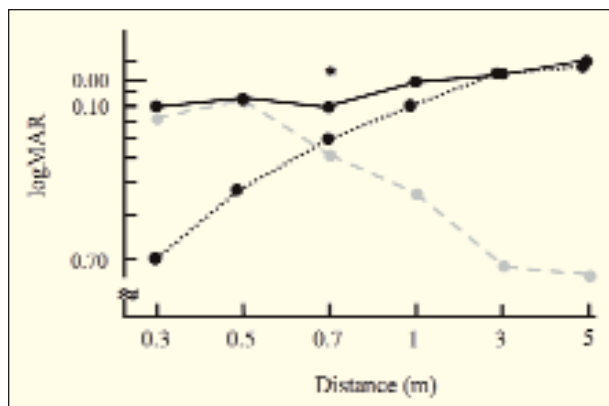


Figure 1. Binocular visual acuity of 0.1 logMAR or better at all distances (* = $P < .05$, Wilcoxon signed-rank test; solid black line = binocular; dotted black line = dominant eye; dotted gray line = nondominant eye).

stereopsis outside the normal range seen in patients with more than 10.00 prism diopters of near exophoria angle.

Ocular dominance. Weak ocular dominance is important for the success of monovision. When strong ocular dominance exists, the resulting anisometropia causes insufficient blur suppression and therefore decreases visual performance. Thus, patients with strong ocular dominance must be excluded from induced monovision.

We conducted a study that quantitatively evaluated sensory dominance using a balancing technique,⁶ whereby the contrast sensitivity in the dominant eye (during binocular rivalry) is decreased to the same level as that in the nondominant. We also measured the exclusive visibility time¹² of each eye during binocular rivalry. Currently, for quantitatively evaluating ocular dominance in cases of reduced visual acuity due to cataracts, a retinometer (Lambada 100; Heine Optotechnik GmbH & Co., Herrsching, Germany) is used to measure visibility time at the stimulated area.

Age and occupation. We have noticed that monovision is more beneficial for elderly patients.⁷ In patients with weak ocular dominance, when the target appears highly contrasted with the background under mesopic vision, blur suppression does not function sufficiently. Thus, we do not believe this method should be used in patients whose work requires precise vision under low illumination or nighttime driving.

SURGICAL PROCEDURE AND CLINICAL OUTCOMES

Cataract surgery was performed using topical anesthesia. After phacoemulsification through a 2.6- to 2.8-

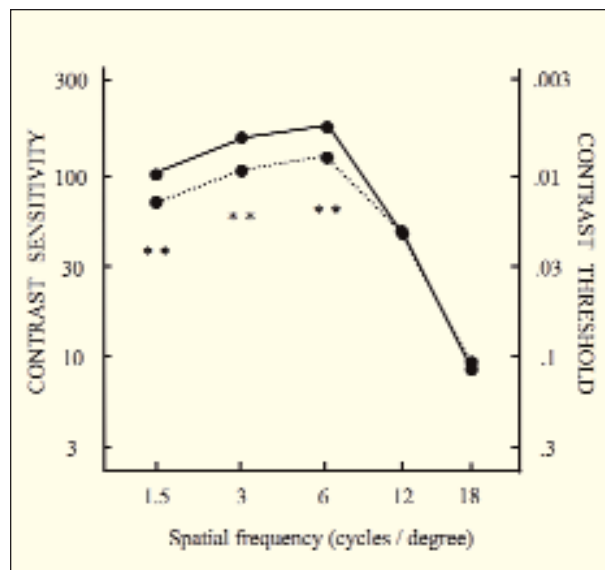


Figure 2. Contrast sensitivity (** = $P < .01$, Wilcoxon signed rank test; solid black line = binocular; dotted black line = dominant eye).

mm temporal corneal incision, a monofocal IOL was implanted. The IOL power was selected for emmetropia in the dominant eye (0.00 to 0.25 D) and myopia in the nondominant (-2.00 to -2.50 D). In patients with more than 1.00 D of corneal astigmatism who have a strong desire for pseudophakic monovision, we performed the cataract surgery with a limbal relaxing incision or photostigmatic keratectomy. Informed consent was obtained.

Our study included 82 patients (age range, 49–87 years) with postoperative follow-up of 12 to 31 months. The mean difference in spherical equivalent refractive power between each patient's two eyes postoperatively was 2.27 D. We evaluated the visual performance of pseudophakic monovision with monofocal IOLs and assessed the degree of patient satisfaction.^{7,8}

Visual acuity. The mean binocular visual acuity at all distances (Figure 1) was at least 0.1 logMAR (J2; revised Jaeger standard). The binocular results at intermediate distances (0.7 and 1 m) were statistically significantly better for the monocular results (0.7 m; $P < .05$).

Contrast sensitivity. In the lower to intermediate spatial frequency range (1.5–6 cycles per degree [cpd]), binocular summation was observed ($P < .01$); however, at high spatial frequencies (12 cpd), it was not (Figure 2).

Near stereopsis and near ocular deviation. Near stereopsis was measured using the Titmus stereo test. Eighty-seven percent of patients were in the normal range (up to 100 seconds of arc). The mean near ocular

deviation was 6.80 ± 4.70 prism diopters exophoria, in which no patients had diplopia; changes in ocular deviation were not observed up to the last follow-up.

Reading ability. The maximum reading speed (350.5 ± 62.3 characters per minute) was fixed when no further increase in reading speed occurred as the character size became larger. The smallest character size at which this maximum reading speed is attained was defined as the critical character size (0.24 ± 0.12 logMAR; J4–J5); the smallest character size, regardless of speed, that the patient could read was defined as their reading acuity (0.05 ± 0.12 logMAR; J1–J2). Because this character size of 0.4 logMAR (J6) compares with the lowercase letters in Japanese newsprint, this method is thought to be enough to read newsprint-sized characters at this speed.

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Patient satisfaction and spectacle dependence.

Most patients were satisfied with pseudophakic monovision, with the highest percentage of satisfied patients in the 70 years and older age group (total average, 81%; under 60 years, 64%; between 60 and 70 years, 87%; over 70 years, 94%). The highest percentage of dissatisfied patients was in patients younger than 60 years. The rate of spectacle use was highest in patients younger than 60 years; 23% of all patients required spectacles. The reasons for dissatisfaction most frequently cited were asthenopia and spectacle dependence. However, no retreatments, such as PRK or LASIK, were required to adjust the refractive outcomes. No patients required IOL exchange.

CUSTOMIZED MONOVISION

When pseudophakic monovision with monofocal IOLs is the targeted treatment, a large anisometropia is needed to obtain excellent near visual acuity; however, this situation also causes a relative decrease of near stereopsis. Therefore, we prefer customized monovision with multifocal IOLs to achieve the same effect with less anisometropia. The target refractions were emmetropia in the dominant eye and myopia (-1.00 D) in the nondominant. Near stereopsis within the normal range was maintained in 95% of patients, and spectacle dependence was 10%; however, contrast sensitivity decreased.¹³ When customized monovi-

sion using multifocal IOLs is adjusted, pupil diameter is essential.

Currently, we are using customized monovision with apparent accommodation in patients with a pupil diameter of less than 2.5 mm. This achieves the same positive effects with less anisometropia.¹⁴

CONCLUSION

Pseudophakic monovision is an effective approach for managing accommodative loss after cataract surgery; however, a careful selection process is required. Currently, for the successful use of this method, we propose the following three condition: (1) excellent distance UCVA in the dominant eye, (2) a near exophoria angle of up to 10.00 prism diopters, and (3) patients over 60 years of age. Additionally, various IOLs can be expected to enhance the diversity of monovision. ■

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