

## Stereopsis and Patient Satisfaction in Myopic and Hyperopic Individuals Selecting Monovision Correction by LASIK or LASEK

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### Abstract

**Purpose:** This study was designed to measure binocular function, patient satisfaction and to evaluate postoperative outcomes of presbyopic patients selecting monovision correction either by laser *in situ* keratomileusis (LASIK) or Laser Assisted Sub-Epithelial Keratomileusis (LASEK).

**Methods:** We carried out a Retrospective chart review of 86 selected patients 40 years and older, treated with refractive laser monovision correction by LASIK or LASEK. Laser was performed with a Baush & Lomb Technolas 217 (Zyoptix or PlanoScan) Excimer laser. All patients had the dominant eye corrected for distance. The parameters used were distance & near corrected visual acuity, manifest refraction before and after surgery and near stereopsis postoperatively. Patient satisfaction was evaluated by questionnaire.

**Results:** Eighty six patients (51 hyperopes, 35 myopes) were included. Hyperopic mean refractive spherical equivalent (MRSE) in the distance-corrected eye was  $+1.90 \pm 0.79$  D and for the eye corrected for near vision MRSE  $+2.62 \pm 0.93$ . Myopic (MRSE) in the distance corrected eye was  $-4.15 \pm 1.06$  D and for the eye corrected for near vision MRSE  $-2.37 \pm 1.06$  D. All hyperopes and 7 myopes were treated with LASIK and the rest were treated with LASEK. After surgery 94% had distance binocular uncorrected visual acuity of 0.00 logmar or better and 93.2% of the patients had near binocular uncorrected visual acuity of N6 or better. The mean near stereoacuity was  $248 \pm 244$  S D seconds of arc. All patients chose their dominant eye to be corrected for distance. Of 35 myopes treated one patient underwent enhancement of the near eye to distance vision and one underwent enhancement for near after 4 months. Eighty-two patients were happy with their vision. Sixty-five percent of all patients had a mean near stereoacuity of  $\geq 100$  seconds of arc. Despite this eighty two patients are happy with their vision, satisfaction graded with a standardized questionnaire.

**Conclusion:** There is no ideal surgical approach to presbyopia. The ideal procedure is still at present monovision after LASIK or LASEK, although it is a long way off reduces stereopsis it results in high satisfaction for both myopic and hyperopic presbyopic individuals.

**Keywords:** Monovision; Stereopsis; LASIK; LASEK; Presbyopia

### Introduction

Presbyopia remains the biggest challenge in laser refractive surgery. Monovision is to decrease glasses dependence. It is achieved through contact lens, corneal laser surgery, conductive keratoplasty, corneal inlays and intraocular lenses. Contact lens monovision has a success rate of 76% [1]. But intolerance limits its usage. By contrast refractive surgery may provide better tolerance to monovision due to improved binocular adaptation with constant optical correction and less residual aniseikonia.

In this retrospective study we measured binocular function, patient satisfaction and evaluated postoperative outcomes of presbyopic patients selecting monovision correction either by laser *in situ* keratomileusis (LASIK) or Laser Assisted Sub-Epithelial Keratomileusis (LASEK).

### Materials and Methods

86 patients (172 eyes) underwent refractive surgery for monovision between May 2007 and July 2008. Inclusion criteria was age 40 years and above, no previous refractive surgery, and no previous squint surgery. We also excluded patients with certain occupations such as professional drivers and those who used microscopes, or spent most of their working day using computers. We recorded age, occupation, distance & near corrected visual acuity, manifest refraction before and after surgery ocular dominance and near stereopsis postoperatively. Stereopsis was measured using a multitarget red-green anaglyph stereo vision test and titmus fly test Data was analyzed using SPSS 16.0 software (Table 1).

All the patients had their dominant eye corrected for distance and the non-dominant eye was corrected for near. The dominant eye was identified by the hole-in-card test; the patient's holds a card with a hole in the middle using both hands and is asked to view a 6 meters target through the hole in the card. The subject moves the card slowly toward

his face without losing the alignment with the fixation point until the hole is over an eye. This is considered to be the dominant eye. We aim for 2.25 DS or less anisometropia in all the patients.

Patient satisfaction was evaluated by a visual function questionnaire (VFQ14). The VF-14 is a reliable, valid index of a patient's ability to perform 14 visual activities [2,3]. The score was based on all activities and the amount of difficulty reported in performing those activities [2]. Scores on all activities were then averaged, and the average score was multiplied by 25, resulting in a final score ranging between 0 (worst level of visual function) and 100 (best level of visual function). The VF-14 questionnaire was sent to all patients.

Demographics
29 Male : 59 Female
Age range: 40 – 67 yrs old Mean Age: 52.8 yrs old
Hyperopes: 51 Myopes: 35
Dominance: RE – 55 LE – 28
LASIK: 58 patients (51 Hyperopes and 7 Myopes)
LASEK: 28 patients (Myopes)
Pre-op Right BCVA (LogMar) range: -0.8 to 0.17
Pre-op Left BCVA (LogMar) range: -0.8 to 0.17
Pre-op Near Acuity range: N5 – N36
Pre-op MRSE RE Range: -6.35D to +3.25D
Pre-op MRSE LE Range: -6.25D to +3.25D

**Table 1:** Demographic data of patients that underwent monovision therapy (RE: Right Eye; LE: Left Eye, LASIK: Laser-Assisted In Situ Keratomileusis; LASEK: Laser Epithelial Keratomileusis; BCVA: Binocular Corrected Visual Acuity; MRSE: Manifest Refractive Spherical Equivalent.

## Results

One hundred and seventy-two eyes of 86 patients were included in the study (51 hyperopes, 35 myopes). The mean age was 52.8 years (range 40-67), including 29:57 male to female ratio. All hyperopes and 7 myopes were treated with LASIK and the rest (28) were treated with LASEK.

The mean myopic preoperative refractive spherical equivalent (MRSE) for distance eye was -4.15 D and -2.37 D in the eye corrected for near vision.

The hyperopic preoperative (MRSE) for distance eye was +1.90 D and +2.62 D in the eye corrected for near vision. The post-operative (MRSE) for distance eye -0.26 ± 1.08 D and -1.66 ± 1.13 for the eye corrected for near vision. Uncorrected logMAR distance visual acuity was 0.00 or better in 94%. Uncorrected near visual acuity was N6 or better in 93.2% (Figure 1).

The mean near stereoacuity was 248 ± 244 seconds of arc. One patient of the myopic group elected to have their near eye corrected to distance. One patient underwent enhancement for near after 4 months. None of the hyperopic group needed enhancement either for near or distance. No patient had preoperative contact lenses monovision trial.

The overall success with monovision in this study was 93%. The refractive success and acceptance of monovision was similar in both hyperopic and myopic patients. There was no significant correlation between age and monovision success and there was no statistical difference between the LASEK and LASIK groups (Figure 2).

## Discussion

Monovision reduces the dependence on glasses for the presbyopic population by the ability to suppress interocular blur at various distances in either eye [4].

Success rates for monovision refractive laser correction range from 72% to 92.6%.

It's difficult to quantify monovision success. And most studies report different methods.

Wright et al. used a scale of 1% to 100% to measure patients' satisfaction on 21 patients with monovision following myopic photorefractive keratectomy (PRK) [5]. The study demonstrated 86% satisfaction. Goldberg et al. in their questionnaire ask patients to rate their satisfaction on a scale from 1 to 10 [6]. In Goldberg questionnaire, study of 114 patients 96% was satisfied with monovision after LASIK.

Jain et al. used the patients general opinions and feelings regarding their visual outcome as a proxy for success of monovision and reported a success rate of 88% in a series of 42 myopic patients who underwent refractive surgery for monovision [7].

Reilly et al. success in refractive monovision as those patients who choose not to have their monovision reversed and who had J2 near vision or better. Therefore they reported a 97% success rate [8].

We achieved a 97% success rate. Study patient satisfaction was evaluated by a visual function questionnaire (VFQ14). The VF-14 is a reliable, valid index of a patient's ability to perform 14 visual activities [2,3]. The score was based on all activities and the amount of difficulty reported in performing those activities [2]. Scores on all activities were then averaged, and the average score was multiplied by 25, resulting in a final score ranging between 0 to 100. There was a 97% success rate.

Successful monovision is associated with a good visual outcome and reduction of stereopsis by less than 50 sec of arc. Several studies of binocular function in presbyopes with monovision corrections report disrupted binocular vision by a reduction of stereopsis. Although Wright et al reported mean stereopsis of 160 seconds of arc (range 40 to 800 seconds of arc), this was higher than our study that found the mean near stereopsis to be 248 ± 244 seconds of arc (range 40 to 800 seconds of arc).

Many refractive surgeons prefer lower degrees of anisometropia range from -0.5 to -1.50 diopters. Jain et al. note that lower degrees of anisometropia improve interocular blur suppression, stereopsis and contrast sensitivity [9]. The results of this study reinforced the finding of Goldberg et al., who found that some patients with greater induced anisometropia tolerated monovision very well [10-12]. He also noticed that none of his monovision rejection was due to high degrees of anisometropia.

There was similar refractive success and acceptance of monovision in both hyperopic and myopic groups alike. Braun et al. who also reported hyperopic and myopic monovision patients have equal refractive success and acceptance of monovision [13].

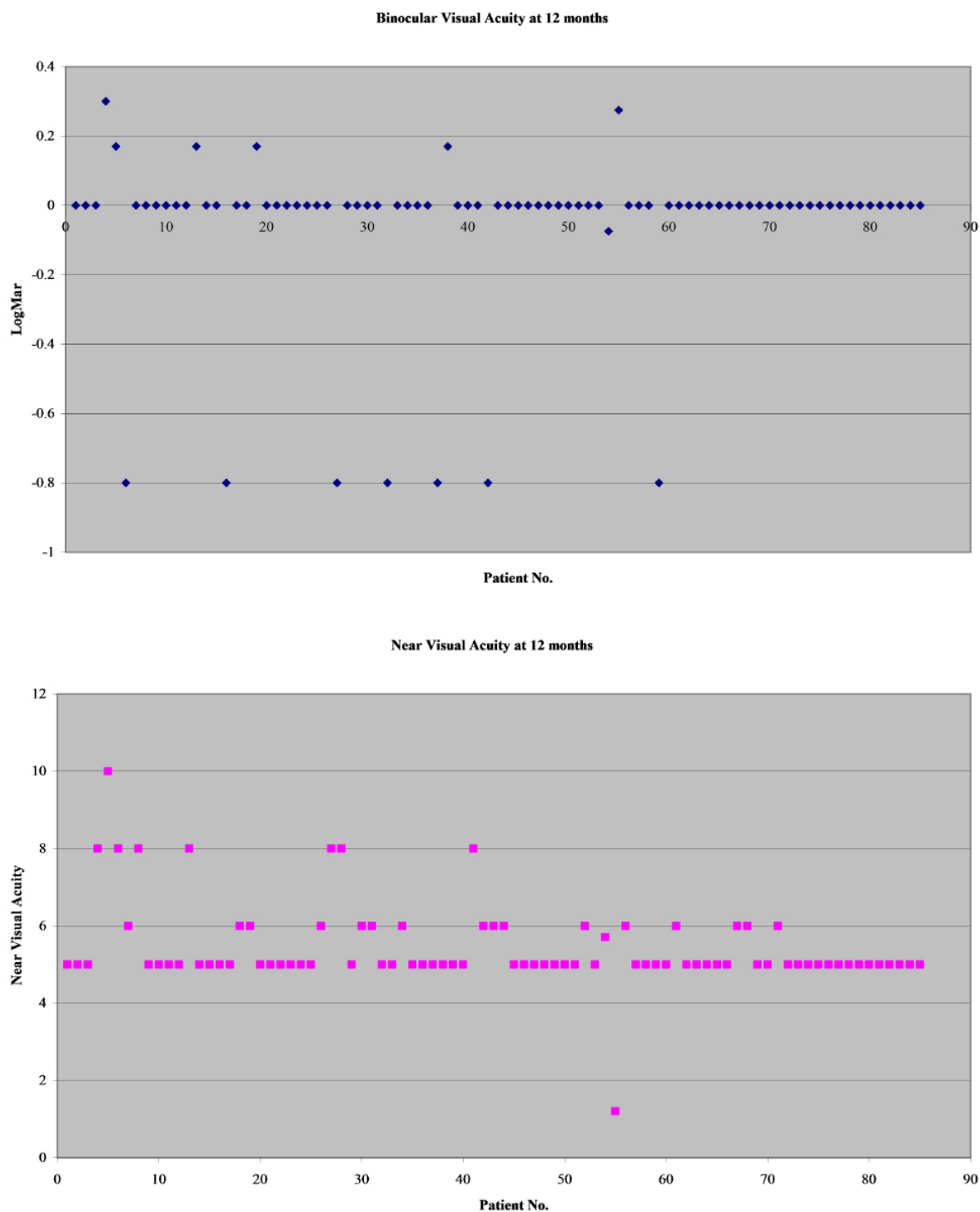
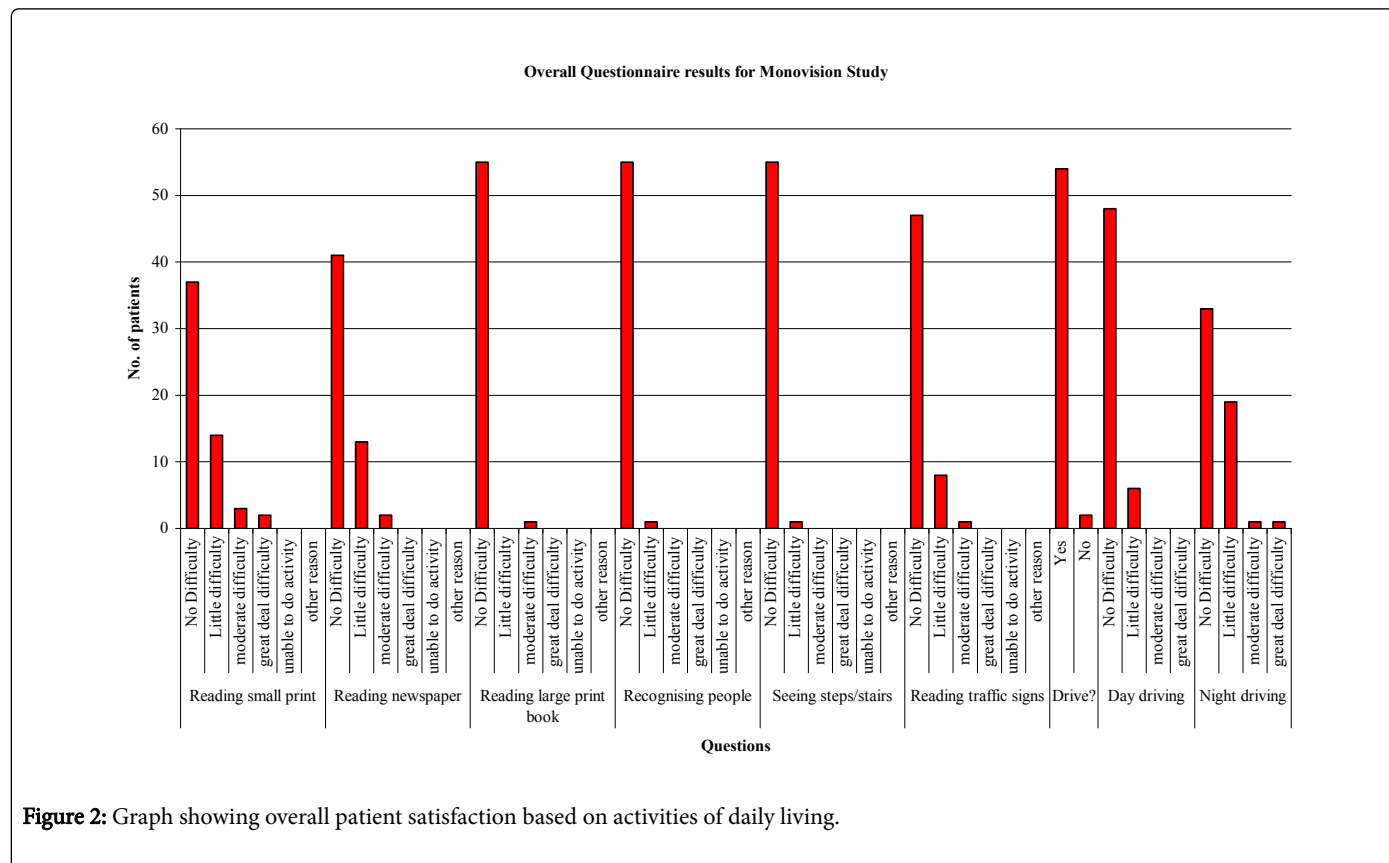


Figure 1: Graphs showing binocular visual acuity for distance and near 12 months after treatment.

We found no significant correlation between age and monovision success and there was no difference between the LASEK and LASIK groups.

Goldberg et al. that noted hyperopic monovision patients had slightly higher enhancement than both myopes and bilateral distance correction [12]. By contrast none of our hyperopic patients had any enhancement which is due to the fact that in our practice we treat

dominant eyes first follow by the non-dominant a week apart. This allowed us to check the result of the first eye and treat the second eye accordingly.



**Figure 2:** Graph showing overall patient satisfaction based on activities of daily living.

The questionnaire return rate was 75.5% (65 patients). Sixty-five percent of all patients had a mean near stereoacuity worse than 100 seconds of arc. Despite this 93% patients are happy with their vision.

### Summary

Our study represents the largest reported patient series of hyperopic monovision LASIK patients to date. Lasik and Lasek surgery to create monovision in hyperopic and myopic patients is very successful with careful patient's selection. There is Permanent loss of stereopsis but this does not create any functional problems [14].

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