Abstract

**Aim:** To evaluate the outcome and success of LASIK in Presbyopic patients

**Materials and methods:** Prospective analysis of 34 eyes of 17 patients over 40 years of age treated with Allegreto wavefront LASIK system. The study was conducted at MEDEA LASIK Centre, Little Flower hospital, Angamaly. Average patient age was 53.3 years. Pre operative refraction ranged from – 5.75 to + 2.25 diopters(D). Non dominant eyes underwent Presbyopic LASIK- an aspheric pupil size dependant LASIK to induce central corneal relative flattening and peripheral corneal relative steepening. Dominant eyes underwent monofocal refraction based LASIK. Analysis of the age at the time of surgery, gender, targeted out come and patient acceptance were studied for a follow up period ranging from 9 – 18 months.

**Results:** At final follow up, 91.3% of all patients reported complete spectacle independence. Distant unaided visual acuity was 6/6 in 76.9 % of the hyperopes and 70.7% of the myopes and 6/6 at 80 cm in 85.7% of the hyperopes and 84% of the myopes and 6/6 at 40 cm in 71.4% of the hyperopes and 65.3% of the myopes. The acceptance was higher in older patients.

**Conclusion:** Monovision LASIK is a valuable option for presbyopic patients considering refractive surgery.

Introduction

Monovision is a concept of correction for presbyopia that allows a patient to have one eye corrected for near vision and the other eye corrected for distance vision, eliminating or markedly reducing dependency on spectacles and contact lenses for most daily activities. Monovision has been used successfully for years by contact lens wearers and more recently has been applied to refractive surgery candidates. Although contact lens monovision has the advantage of less induced aniseikonia than spectacle monovision, intolerance to contact lenses and residual aniseikonia still limit its functionality. Contact lens monovision has a reported success rate of 60% to 80%, with increasing success rates when failures due to contact lens intolerance were excluded. By applying a refractive surgery approach to monovision, the problems of contact lens intolerance are avoided and an effective optical solution to presbyopia is achieved.

Success rates for monovision refractive laser correction range from 72% to 97.6%. Generally, 35- to 55-year-old patients who successfully adapt to monovision have good blur suppression (typically found in patients without strong sighting preferences), post treatment anisometropia < 2.50 diopters, successful distance correction of the dominant eye, relatively preserved stereoacuity, lack of esophoric shift, and good superego strength.

Possible reasons for higher monovision tolerance with refractive surgery are improved binocular adaptation with constant optical correction, less aniseikonia than with spectacles, and elimination of contact lens discomfort and/or complications. One study examined distance binocular vision, stereoacuity, contrast sensitivity, and convergence fusion amplitude in photorefractive keratectomy–induced monovision. No statistical difference was found between the monovision and control group, except that the monovision group had better near vision.

Typically, in refractive surgery for conventional monovision the dominant eye is corrected for emmetropia or distance vision and the nondominant eye is corrected for near vision. However, patient preference or unpredicted refractive surgical outcome may result in crossed monovision, in which the dominant eye is corrected for near vision.

In this study, we investigated the preoperative characteristics of presbyopic patients undergoing LASIK who elected monovision correction and their outcomes after the LASIK procedure. Patients elected to have one eye corrected for near vision and the other for distance vision. The current standard for monovision success, cited in several review articles, was the ability of the patient to adapt and accept the anisometropia after ≥ 3 weeks of acclimatization.

**Aim**

To evaluate the outcome and success of LASIK in Presbyopic patients

**Materials and methods**

This is a prospective, Interventional and non-comparative study conducted at MEDEA LASIK Centre, Little Flower Hospital, Angamaly. All patients 45 years or older were identified as having a goal of either monovision or bilateral full distance correction. Inclusion criteria were age minimum of 45 years, desire for spectacle independence, residual central corneal thickness of at least 290 μm, normal corneal topography patterns, significant presbyopic symptoms,
and no sign of cataract based on slit-lamp examination. Those with any contra indications for LASIK or any previous refractive surgeries were excluded from the study.

A trial of monovision was offered to patients who had no prior knowledge or experience with this strategy. The trial was done by trial lens simulation in a trial frame in the clinic. The dominant eye was identified by the “hole test” whereby the patient, using both eyes simultaneously, lines up an object through a hole, formed by the patient’s hands. When the hole is small enough to block out the view of one eye, the eye that continues to be aligned with the object and the hole is considered the dominant eye.

Peripheral presby LASIK was applied to each patient’s non-dominant eye. Refraction-based LASIK was done in the dominant eye. All the surgeries were done by the same surgeon with the Allegretto wave front LASIK system.

Measures of the effectiveness of surgery included the patient reporting of the number of hours per week that any form of spectacles was needed, visual acuity and near vision.

Patients had follow-up ranging from 9 to 18 months. Follow-up examinations included refraction, mesopic uncorrected visual acuity (UCVA), and near point acuity.

Results

The study comprised total 34 eyes of seventeen patients. Twelve were females and five were males. Of these, 11 were myopes with a mean preoperative spherical equivalent refraction of -3.72±2.41 D (range: -2.75 to 0.12 D) and 6 were hyperopes with a mean preoperative spherical equivalent refraction of +2.6±0.70 D (range: +1.5 to +2.75 D). Twelve patients were females and five were males Mean patient age among myopes was 52.3±6.7 years (range: 46.3 to 57.9 years) and 56.1±4.3 years (range: 47.9 to 55.4 years) among hyperopes (Table 1).

Among the myopes, at final measurement, 70.7% achieved distance visual acuity of at least 6/6, 84.0% achieved 6/6 at 80 cm, and 65.3% achieved 6/6 at 40 cm. At final follow-up, for the hypermetropes, binocular vision was as follows: 76.9% achieved 6/6 at distance, 85.7% achieved 6/6 at 80 cm, and 71.4% achieved 6/6 at 40 cm. Overall, 73.3% myopes and 75% hyperopes achieved a combination of binocular UCVA of at least 6/6 at distance, 40 cm, and 80 cm (Table 2).

Table 1 - Pre operative characteristics

<table>
<thead>
<tr>
<th></th>
<th>Myopes</th>
<th>Hypermetropes</th>
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<tbody>
<tr>
<td>Total number of eyes</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>Mean Refraction</td>
<td>-3.72±2.41</td>
<td>+2.6±0.70</td>
</tr>
<tr>
<td>Mean Age</td>
<td>52.3±6.7 years</td>
<td>56.1±4.3 years</td>
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Among the myopes, at the end of follow-up, 81.8% reported no spectacle use, 13.6% used spectacles for less than 1 hour per week, and 4.6% reported using spectacles >1 hour a week. Of the 6 hyperopes, 83.3% became completely spectacle free, 8.3% wore spectacles for 1 hour per week, and 8.3% wore spectacles >1 hours a week (Table 3, Graph 1).

Table 3 - Patient Acceptance at final follow up

<table>
<thead>
<tr>
<th>Spectacle Usage</th>
<th>Myopes (%)</th>
<th>Hypermetropes (%)</th>
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</thead>
<tbody>
<tr>
<td>Spectacle free</td>
<td>81.8%</td>
<td>83.3%</td>
</tr>
<tr>
<td>&lt; 1 hour</td>
<td>13.6%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Spectacles &gt; 1 hour</td>
<td>4.6%</td>
<td>8.3%</td>
</tr>
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Discussion

Patients now have a number of alternatives for the correction of presbyopia, bifocal contact lenses, conductive keratoplasty and refractive lens exchange with multimodal or accommodating intraocular lenses. For pre presbyopic and prepresbyopic individuals, the option of monovision offers the chance of freedom from glasses and contact lenses with functional distance and near vision. However, the decision for monovision correction must take into account potential compromises in contrast sensitivity, stereoacuity, binocular visual acuity, depth of focus, phorias, and task performance. Selection of patients who are likely to adapt to monovision is critical to the success of monovision. This study was performed to provide a better understanding of the pre-
refractive surgery and post–refractive surgery characteristics of patients and their outcomes with monovision correction.

In our review, we found that 67% of all LASIK patients over the age of 45 chose to be corrected for monovision. This represents a larger proportion of monovision patients than reported in any other study. This may reflect the bias of the practice and a growing recognition of the safety and efficacy of monovision correction. Alternatively, the slightly higher average age of our patients compared with other studies may influence this proportion, as older individuals have a higher prevalence of presbyopic symptoms. More women (70.58%) than men chose monovision in our study population, consistent with other studies showing a larger proportion of women interested in monovision correction. The cosmetic aspect of laser vision correction may influence the gender difference seen in multiple studies.

Mean ages for this cohort (52.3 + 6.7 years in Myopes and 56.1 + 4.3 I hypermetropes) were slightly higher than in other similar studies (48.0 years in Miranda and Krueger; 49.7 years in Jain et al; 44.1 years in Wright et al; possibly because our inclusion criteria required that patients be at least 45 years old. Although younger patients have undergone successful monovision treatment, we specifically focused on the presbyopic population. Increased average age may contribute to the success of monovision if we may assume that our patient cohort is more symptomatic from more advanced presbyopia. However, an older patient may also desire more near vision correction, thereby requiring increased anisometropia. Furthermore, younger patients may retain some accommodative reserve, which might inflate the perception of successful monovision. Our review of the literature and current study did not reveal a correlation between age and monovision success.

Hyperopic patients undergoing monovision treatment appear to do better than myopic patients in terms of refractive success (76.9% vs. 70.7%) and acceptance of monovision (83.7% vs. 81.8%). Goldberg has noted that hyperopes are more likely to have enhancements with a monovision target than with bilateral distance correction. Interestingly, every hyperopic patient, regardless of ocular dominance or crossed versus conventional treatment, selected the more hyperopic eye for near vision correction. This finding suggests that hyperopic patients may have developed a preference for distance vision with the clearer, less hyperopic eye.

Regardless of which type of monovision was chosen, conventional or crossed, patients seem to be more concerned with achieving optimal distance vision.

The data suggest that best LASIK-corrected distance vision was the primary goal of patients, whereas freedom from reading glasses was secondary. Patients depend on the distance eye for a majority of daily spatial–locomotor tasks such as walking, playing sports, or driving a car. Furthermore, given the age of our patients, some had enough accommodative reserve to allow at least transient satisfactory near vision.

The magnitude of ocular dominance may play a significant role in the success of monovision correction. In a review of the monovision literature, when the dominant eye was corrected for distance, the success rate was 76%. However, the success rate was lower in crossed monovision patients.

Reduced stereoacuity in monovision patients is well documented. Previous studies have shown that there are smaller reductions in distance binocular fusional ranges and a lower tendency for esophoric shift when the near correction was in the nondominant eye.

Conclusion

Monovision LASIK is a valuable option for presbyopic patients considering refractive surgery. LASIK monovision represents a well-established and highly satisfactory surgical correction to achieve functional near and distance vision without corrective lenses. Although the overall success of monovision was good, patient selection is extremely important, as not every patient can adapt to monovision. A trial of the targeted monovision correction is strongly encouraged when patient adaptation to monovision is in question.

References