Laser Blended Vision-LASIK for Presbyopia and Initial Clinical Experience in 100 Indian Patients

K Krishna Prasad¹, T Suchi Smitha², Shamanth S Shetty³, Paresh Poojary⁴

ABSTRACT
Aim: The aim was to study the visual results of laser blended vision (LBV), (LASIK with a nonlinear aspheric monovision protocol) for presbyopia correction.

Materials and Methods: Binocular and unilocular vision and postoperative outcome of 100 patients undergoing LBV were studied. The study included myopes (−0.25 to −7.25 DS), hypermetropes (+0.25 to +4 DS) and emmetropic presbyopes between ages 39 and 55 years (mean 47) with a minimum follow-up of 6 months.

Results: Binocular distance vision: 83% read 6/6 or better, 100% read 6/9 or better at 6 months. Near vision: 96% read near n6, remaining read n8. All patients had an intermediate vision (n6). An adaptation rate of more than 95% within first 3 months was noted without significant loss of visual acuity due to the procedure.

Conclusion: LBV may be a safe approach to presbyopic LASIK treatment with high adaptation rates. Long-term studies are needed to establish the stability of treatment results over time.

KEY WORDS: Laser blended vision, LASIK, presbyopia

INTRODUCTION
Presbyopic treatment has become a new frontier for the refractive surgeon, as many new developments continue to evolve. However, most treatment methods rely on multifocality which results in a significant number of unhappy patients. Besides, the longevity of the existing presbyopic LASIK methods are still questionable. Laser blended vision (LBV) by Carl Zeiss, Germany, a concept introduced by Dan Reinstein is reported to have high adaptation rates (>95%) compared to adaptation rates in other methods of laser vision correction available for presbyopia at this time.¹²

MATERIALS AND METHODS
The study is a prospective cohort of 100 consecutive patients (200 eyes) with a mean age of 47 years (range 39-55 years) undergoing LBV, who were followed up for a minimum period of 6 months following the procedure. Myopia (mean 2.32 D ± 1.78) range (−0.25 to −7.25), myopic astigmatism (−0.9 ± 1.1) range (−0.25 to −2.5), hypermetropia (1.27 ± 0.28) range (0.25-4), and emmetropia with presbyopia were included. The distribution of the patients is summarized in Figure 1. The dominant eye was made emmetropic in all cases, while the non-dominant
eye was targeted for myopia of −1.5 DS (in 40%), −1.75 DS (in 53%), and −1.25 DS in 7% depending on age and micro-monovision acceptance testing, after a thorough standard pre LASIK evaluation. In presbyopes up to 41 years, myopia of 1.25 D was targeted in the non-dominant eye and in ages from 42 to 46, a myopia of 1.5 D and after 46 years, 1.75 D was targeted. This served as a baseline during the preoperative micro-monovision acceptance test and was at least twice before treatment. Where possible, for the longevity of the treatment results, we targeted a slightly higher myopic refraction where possible, depending on patient acceptance. All treatments were carried out using Carl Zeiss Meditec MEL 80 excimer laser system incorporating CRS master software for treatment planning (Carl Zeiss meditec AG, Germany) and the Amadeus II microkeratome (Zeimer, Switzerland). All treatments were performed by one of two surgeons. Pre- and post-operative uncorrected and best-corrected visual acuity both uniciularly and binocularly were recorded at distance, intermediate, and near. Adaptation was assessed by recording subjective symptoms including difficulty in performing day-to-day activities, immediately after the treatment and at each follow-up visit. Patients were interviewed at each follow-up for postoperative dysphotopsias, night vision disturbance, and specifically, cross blur. They were asked whether they can see clearly at all distances or they perceived diplopia, confusion or blur at certain distances.

RESULTS

Three months follow-up data is summarized in Figures 1 and 2.

Distance vision (unicular): Dominant eye: 68% read 6/6 or better. 98% of distance corrected eyes read 6/9 or better. 100% read 6/12 or better. Non-dominant eye: At least 75% of eyes could read 6/18 or better, 20% read 6/9. Binocular Distance Vision: 83% read 6/6 or better, 100% read 6/9 at least. Near Vision: 96% read near n6, remaining read n8.

All patients had a satisfactory intermediate vision (n6), which corresponds to the targeted myopia in the non-dominant eye. Pre- and postoperative refraction in spherical equivalents is summarized in Table 1.

Complications and safety of the treatment: None of the patients lost more than 1/2 Snellen’s line for distance acuity following treatment. There was one eye with peripheral microstriae, 1 deep lamellar keratitis (resolved with topical steroids) and 5 eyes with

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-operative spherical equivalent</th>
<th>Postoperative spherical equivalent</th>
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<tbody>
<tr>
<td>Myopia</td>
<td>−2.55 (3.25)</td>
<td>0.0 (0.21)</td>
</tr>
<tr>
<td>Hypermetropia</td>
<td>1.35 (0.66)</td>
<td>−0.43 (0.35)</td>
</tr>
<tr>
<td>Emmetropia</td>
<td>0.00 (0.00)</td>
<td>−0.08 (0.24)</td>
</tr>
</tbody>
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SD: Standard deviation

Figure 1: Results of the study showing unciular and binocular distance uncorrected visual acuity at 3 months post-surgery

Figure 2: Results of study showing visual acuity loss (Snellen lines) at 3 months post laser blended vision
intraoperative epithelial defects (Figure 2). None of the LASIK LBV patients in our series needed enhancement procedures. Binocular distance vision subjectively checked was better than unocular distance vision in significant number of people (60%). Furthermore, a higher number of patients read 6/6 binocularly (83%) than when checked through the dominant eye alone (68%) (Figure 1).

**DISCUSSION**

LBV is based on the principle of mild monovision (micro-monovision) and increased depth of focus (spherical aberration modification). The dominant eye is targeted for emmetropia and the non-dominant eye for myopia of approximately 1.5 DS. Non-linear aspheric ablation profiles were used for both distance and near, which incorporate a pre-compensation factor for the induction of spherical aberration. The profiles are intended to reduce but not eliminate, the induction of spherical aberration so that postoperative spherical aberrations falls within a range that provides an increased depth of field, without compromising contrast sensitivity and quality of vision.\(^1\) By creating a myopia of 1.5 DS in the non-dominant eye using blended vision, very impressive near and intermediate acuities are attained without disturbing distance binocular vision even in presbyopes above 45 years of age. Younger patients may need adjustment in target refraction of the non-dominant eye to 1.25 DS or less. Binocular distance visual acuity after LBV was found to be better than unocular distance vision which corroborates with Reinstein et al.\(^3\) Near vision was much better than expected in most people. (e.g.: n6 even with near target of 1.5 in a 50 year old), probably as a result of increased depth of focus.

Enhancement rate was significant (23%) in the initial studies on LBV by Reinstein, especially for higher hypermetropes.\(^2\) However we did not observe this in our study, probably due to the lower degrees of hypermetropia in our cohort. According to Reinstein et al. an estimation that 60% were fully adapted at 1 month, 85% at 3 months, and 98% at 6 months was made, making fast adaptation one of the main advantages of this treatment.\(^1\) In our study, most patients adapted well by the third month. Myopes beyond 42 years of age adapted very easily to this treatment in our experience by the end of the first month itself. However, hyperopes, emmetropic presbyopes, and young patients (less than 40 years) took 2-3 months, to completely adapt. Only two patients had occasional adaptation issues, i.e. cross blur for distance, one patient reported confusion while reading fine print after this period which improved with lubricants. Unlike multifocal treatments, there is no night vision problems associated with LBV. There is no reduction of contrast sensitivity and a functional amount of stereoscopy and binocularity is maintained.\(^1\)

The long-term stability of LBV needs to be tested as in any newer presbyopic treatment. The refraction at 1-year, have been reported to be stable so far.\(^1\)

Our study limitations need mention. Firstly, there are a small number of patients who had emmetropia and hyperopia. Secondly, we have groups with different target myopia in the non-dominant eye. These need long term follow-up to understand and modify this treatment to suit various age groups. And finally, a longer follow-up period will be required to evaluate refractive stability of this treatment modality.

**REFERENCES**


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