Age-Optimized Vision Correction

Laser blended vision modulates spherical aberration with corneal ablation.

BY PATRICK VERSACE, MD

Presbyopia correction has been an elusive goal for laser refractive surgeons. Monovision works well for some patients, but its overall acceptance rate is approximately 60%.[1] Additionally, it carries the intrinsic compromise of reduced binocular fusion, leading to patient dissatisfaction with poor balance, blur, and visual confusion.

Several approaches exist for presbyopic laser correction, including multifocal and bifocal corneal optics created in various patterns. These approaches often provide reasonable near vision under ideal pupil conditions but are generally associated with some compromise in distance vision quality, contrast sensitivity, and patient satisfaction.[2] In this article, I describe the use of selective modulation of spherical aberration as a distinct and alternative approach to presby-LASIK.

Increasing spherical aberration—particularly in a negative direction—has a direct relationship with increased depth of focus.[3] Adaptive optics modeling has shown a linear relationship between increasing spherical aberration and increased depth of focus for values of Zernike coefficient Z(4,0) up to 0.6 µm (Figure 1).[4]

In practice, it is possible to modulate spherical aberration through corneal ablation. The improvement in depth of focus created with increased Z(4,0) alone is inadequate for functional near vision, but it can be combined with a small amount of myopic offset (ie, mini-monovision) to provide a useful range of near vision. With controlled induction of spherical aberration, depth of focus increases in each eye, so that a small amount of monovision can produce functional near vision and retain fusion and binocular function.

BLENDED VISION

Laser blended vision, a software module available with the MEL 80 excimer laser platform (Carl Zeiss Meditec, Jena, Germany), combines three components into the refractive correction to provide patients with functional near vision: (1) increased depth of focus through increased Zernike Z(4,0), (2) pseudoaccommodation with pupil miosis in the presence of increased Z(4,0),[5] and (3) myopic offset in the form of mini-monovision. These elements optimize near vision and minimize the compromise of distance vision.

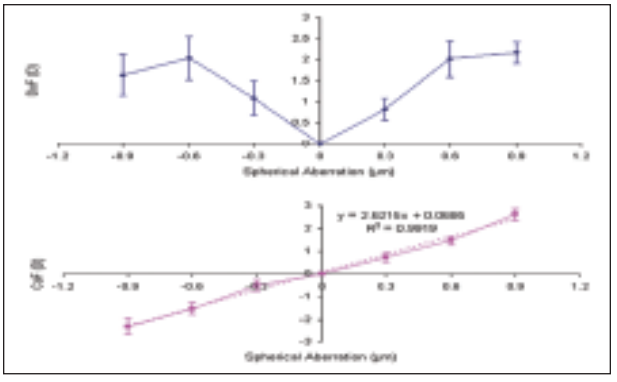

Figure 1. There is a linear relationship between increases in spherical aberration and depth of focus.

Combining increased Z(4,0) with small amounts of myopia has been shown to reduce myopic blur. As a result, patients maintain better distance vision in the myopic offset eye than would be expected.[6] We use the term *laser blended vision* to describe the expanded depth of focus created in both eyes; this treatment offers a bilateral ablation profile that both corrects refractive error and addresses presbyopia.

The laser-blended–vision approach to presbyopia correction has evolved over several years' experience. The laser blended vision software module on the MEL 80 laser platform induces a selective and controlled increase of spherical aberration. The user enters the patient's ocular dominance, monovision blur tolerance, and refraction. Wavefront and

TAKE-HOME MESSAGE

- The combination of increased spherical aberration and a small amount of myopic offset provides a useful range of near vision.
- The myopic offset produces a mini-monovision that maintains distance vision better than expected.

topography data can be imported to provide eye registration information and keratometry values, respectively. The default target refraction is 1.50 D for the near-preference eye, but this may be altered based on the patient's acceptance of monovision blur. Treatment planning is straightforward; the MEL 80 features an intuitive interface with built-in safety checks.

STUDY RESULTS

Dan Z. Reinstein, MD, MA(Cantab), FRCSC, DABO, FRCOphth, of the London Vision Clinic, has presented outcome data showing patient acceptance in greater than 90% of patients, with no patient experiencing loss of contrast sensitivity. All patients treated with laser blended vision in his study achieved distance UCVA of greater than 20/30, and 95% had distance UCVA better than 20/20. Combined binocular vision of 20/20 at distance and J2 at near was achieved in 94% of myopic patients.[6]

Similar results were found in our first treatments with laser blended vision. In 20 patients who required refractive correction between -7.75 and 2.75 D (spherical equivalent) with up to 2.75 D cylinder, all were within 0.75 D of intended outcome distance correction. All patients achieved 20/25 UCVA for distance, and mean near vision was J3 (range, J1–J5). No loss of BCVA occurred. The mean patient satisfaction score was 9.3 (range, 7–10), with 10 indicating most satisfied. This compares with a typical satisfaction score of 7.3 for patients with multifocal IOL implants.

CONCLUSION

Presby-LASIK treatments using laser blended vision open the possibility of incorporating presbyopia correction into our refractive procedures. The expanded depth of focus it provides makes this a preferable option compared with traditional monovision. ■

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