Presbyopic Commercial Airline Pilot Finds a Class One Medical Approved Corneal Refractive Surgery Solution for Presbyopia

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CASE HISTORY

A 58-year-old woman presented with a request to explore options for vision correction that would meet the vision needs in her occupation as a commercial airline pilot. The patient, who is also a medical doctor, has a dual career as an Aeromedical Examiner. She had moderate myopia with low astigmatism in both eyes. Her uncorrected distance visual acuity (UDVA) was 20/160 in the right eye and 20/125 in the left eye. Her manifest refraction was 3.50 -0.50 x 146 (20/20) in the right eye and -2.25 -0.75 x 10 (20/20) in the left eye. Near vision was N10/J4 binocularly. She was using varifocal glasses for distance and near vision and single vision glasses for intermediate vision.

As a pilot, she works in a complex visual environment that necessitates clear vision at a variety of distances. Near and various intermediate visual distances are important for the controls and displays within the cockpit (Figure). When wearing varifocal glasses, viewing the controls above the head was particularly challenging as it is difficult to look through the near vision portion of the lens. Viewing an iPad for navigation to the side and buttons above, below, and in front prove challenging for any presbyopic pilot. Clear vision at very far distance is also needed for safe operation while taxiing, landing, and parking the plane, including in low visibility conditions (Figure).

Figure. Pilots work in a complex visual environment requiring clear vision at a variety of distances inside and outside of the cockpit. Arrows indicate controls and displays located at near and various intermediate visual distances.

PREOPERATIVE ASSESSMENT AND TREATMENT PLAN

The patient underwent a full diagnostic evaluation to determine her suitability for corneal laser refractive surgery using PRESBYOND Laser Blended Vision , Carl Zeiss Meditec AG, Jena/Germany. The examination included manifest and cycloplegic refraction, mesopic contrast sensitivity, corneal topography and corneal wavefront (ATLAS 9000, Carl Zeiss Meditec , AG, Jena/Germany), tomography (Pentacam, OCULUS Optikgeräte GmbH, Wetzlar/Germany; Orbscan, Bausch + Lomb GmbH, Munich/Germany), whole eye aberrometry (WASCA, Johnson & Johnson, New Brunswick, New Jersey/USA), dynamic pupillometry (Procyon), epithelial mapping (RTVue, Optovue , Fremont, CA/USA), and straylight scatter measurement (C-Quant, OCULUS Optikgeräte GmbH, Wetzlar/Germany). In addition, the patient was evaluated for eye dominance and tolerance to anisometropia of up to -1.50 D using the PRESBYOND tolerance assessment protocol (ZEISS PRESBYOND Practical Guide).

The findings from her examination showed the patient was suitable for PRESBYOND and all diagnostics were normal in both eyes. She was right eye dominant and able to tolerate -1.50 D of anisometropia with minimal cross-blur symptoms. Surgery was planned with a refractive target of plano in the right eye and -1.50 D in the left eye. Total treatment was -3.50 -0.50 x 146 in the right eye and -0.75 -0.75 x 10 in the left eye.

OUTCOME

By 1 month after surgery, the patient's binocular vision was $20/16^{-1}$ at distance, J3 at intermediate and J1 at near. The manifest refraction was +0.75 DS (20/16) in the right eye and -1.50 DS ($20/20^{-2}$) in the left eye. The UDVA in the right eye was 20/50, which was better than expected for the nominal -1.50 DS refraction. Contrast sensitivity was unchanged or slightly increased for 3, 6, 12, and 18 cpd. Stray light scatter by C-Quant had returned to the preoperative level. Subjectively, the patient reported night vision to be unchanged from before surgery.

Two months after surgery, the patient passed the United Kingdom Civil Aviation Authority vision standards for a Class 1 medical certificate without spectacle restrictions,[1] with UDVA in the left eye improving another line to 20/40. The result has been stable in the longer term with the same binocular vision at the most recent follow-up, 3.5 years after surgery. The manifest refraction was +0.50 -0.50 x 7 ($20/16^{-2}$) in the right eye and -1.75 DS ($20/16^{-2}$) in the left eye. UDVA in the left eye had even improved slightly further to $20/32^{-2}$. Contrast sensitivity was also stable in the high normal range, equal to or above the preoperative level. The objective scatter index (OSI) (HD Analyzer, Visiometrics Costa Mesa, CA/USA) was 0.6 in both eyes, demonstrating excellent optical quality.

DISCUSSION

An ideal surgical treatment for presbyopia in patients with a clear lens would simultaneously correct refractive error to provide clear vision at distance, allow continuous vision to intermediate and near, maintain binocularity and optical quality, and have a short adaptation time with a good safety profile. Such a treatment should also be correctable in the event the patient is not happy with the outcome and adjustable to compensate for progressive presbyopia or future changes in refraction. PRESBYOND successfully met the complex visual needs of the patient in this case.

PRESBYOND is a laser procedure that combines a small functional anisometropia (≤1.5 D) with a non-linear aspheric ablation profile that induces a controlled amount of spherical aberration to increase depth of field. The anisometropia is small enough that patients maintain functional stereo-acuity uncorrected and do not lose best spectacle corrected stereo-acuity. Compared with refractive lens exchange, PRESBYOND does not expose patients to the low but potential risks for vision-threatening complications that can occur with intraocular surgery . If a patient experiences halo or glare from the small anisometropia in PRESBYOND, this is almost always reversed by a pair of spectacles that reduce the anisometropia given that sperical aberration is controlled within neural filtration limits; but this in contradistinction to the commonly reported side effects of glare and halo after multifocal IOLs which if not neuro-adapted to, cannot be reversed without further surgery.[2, 3] Unlike other corneal refractive laser approaches that create a multifocal cornea, PRESBYOND provides a continuous range of vision from near to far, maintains contrast sensitivity, and is associated with a very high patient satisfaction rate.[4-7] Therefore, in my experience after performing 15,000 treatments over the last 12 years, I feel PRESBYOND provides better vision quality for my patients.

Compared with LASIK treatment for presbyopia performed with conventional monovision refractive targets, the modified binocular vision created with PRESBYOND is better tolerated by patients overall and easier to adapt to. Only about 66% of patients tolerate traditional monovision.[8] In contrast, about 97% of patients with presbyopia are good candidates for PREBYOND.[6]

PRESBYOND offers the advantage of being a routine bilateral laser procedure performed in 10 minutes, with patients being able to read and watch TV within a few hours and return to most activities the next day as is the case in general for LASIK the world over. The ablation is performed using the MEL 80 or MEL 90 excimer laser (Carl Zeiss Meditec AG, Jena/Germany) based on a profile created using proprietary software for the CRS-Master workstation (Carl Zeiss Meditec AG, Jena/Germany). The treatment plan for each patient is customized for preoperative ametropia (including plano presbyopia) and pupil size and takes into account preoperative spherical aberration and functional age of the eye. The ablation creates a continuous refractive power gradient for the entire optical zone.

CONCLUSION

PRESBYOND using a nonlinear aspheric ablation profile with a well-tolerated modified binocular vision approach delivers continuous quality vision from near to far along with the refractive accuracy and safety of a standard LASIK procedure. The outcomes and advantages are highlighted by this case where the very demanding visual needs of a presbyopic commercial airline pilot were achieved. By contrast, use of multifocal and diffractive IOLs are currently not compatible with pilot certification in the United Kingdom.[1]

The outcome for this patient is also echoed by my own personal experience and that of 17 other ophthalmic surgeons who underwent PRESBYOND at London Vision Clinic, representing another category of patients with very demanding visual needs!

Dan Z Reinstein, MD is a consultant to and receives travel expenses from Carl Zeiss Meditec AG and has a financial interest in ArcScan Inc.

References
1. Guidance following eye surgery.
2. Mendicute J, Kapp A, Levy P, Krommes G, Arias-Puente A, Tomalla M, Barraquer E, Rozot P, Bouchut P. Evaluation of visual outcomes and patient satisfaction after implantation of a diffractive trifocal intraocular lens. J Cataract Refract Surg. 2016;42:203-210.
3. Eydelman M, Hilmantel G, Tarver ME, Hofmeister EM, May J, Hammel K, Hays RD, Ferris F, 3rd. Symptoms and Satisfaction of Patients in the Patient-Reported Outcomes With Laser In Situ Keratomileusis (PROWL) Studies. JAMA Ophthalmol. 2017;135:13-22.
4. Reinstein DZ, Carp GI, Archer TJ, Gobbe M. LASIK for the correction of presbyopia in emmetropic patients using aspheric ablation profiles and a micro-monovision protocol with the Carl Zeiss Meditec MEL80 and VisuMax. J Refract Surg. 2012;28:531-541.
5. Reinstein DZ, Archer TJ, Gobbe M. LASIK for Myopic Astigmatism and Presbyopia Using Non-Linear Aspheric Micro-Monovision with the Carl Zeiss Meditec MEL 80 Platform. J Refract Surg. 2011;27:23-37.
6. Reinstein DZ, Couch DG, Archer TJ. LASIK for Hyperopic Astigmatism and Presbyopia Using Micro-monovision With the Carl Zeiss Meditec MEL80. J Refract Surg. 2009;25:37-58.
7. Falcon C, Norero Martinez M, Sancho Miralles Y. [Laser Blended Vision for presbyopia: Results after 3 years]. J Fr Ophtalmol. 2015;38:431-439.
8. Evans BJ. Monovision: a review. Ophthalmic Physiol Opt. 2007;27:417-439.

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