Correction for Individuals With High-Precision Jobs

EYES IN THE SKY: LASER EYE SURGERY TO ADDRESS THE DEMANDS OF PRESBYOPIC COMMERCIAL PILOTS

BY DAN Z. REINSTEIN, MD, MA(CANTAB), FRCSC, FRCOPHTH, DABO, FEBO

Whether they are pinpointing one of hundreds of dials and buttons in the cockpit, viewing radio and autopilot systems at multiple intermediate distances, or reading material in dim lighting conditions, pilots' vision is crucial not just to their safety but also their passengers'. As pilots age and presbyopia sets in, their near vision deteriorates.

Cockpits are multidimensional environments. Their visual distance requirements imply they were designed by nonpresbyopic engineers who failed to consult experts on vision correction (see *A Cockpit's Visual Requirements for the Flight Instrument Panel*). When emergencies occur in the air, pilots must react quickly, but their ability to do so can be hampered by the need to change glasses for different tasks. How can presbyopic pilots safely keep their wings?

Most people who present with presbyopia are prescribed progressive, bifocal, or trifocal glasses. These can offer visual clarity at two or three distances, but they can restrict a pilot's peripheral vision and require stiff, unnatural head movements.[1] Multifocal contact lenses and IOLs also have drawbacks, including a reduction of contrast sensitivity, halos, and glare.[2,3] For this reason, Class 1 certification does not permit pilots to wear multifocal contact lenses. It tolerates multifocal IOLs only if pilots can pass specific tests of visual function. If they fail, they must undergo an

SMILE HAS ADVANTAGES FOR INDIVIDUALS WITH HIGH-PRECISION JOBS

BY BRUCE A. RIVERS, MD

To gain recognition and widespread acceptance, technological advances in refractive surgery must offer additional benefits to prospective patients. SMILE meets these requirements for individuals who qualify for the procedure, and it has distinct benefits for individuals with high-precision jobs.

SMILE EXPERIENCE

Adoption. My experience with SMILE began shortly after its FDA approval. I was the director of the Warfighter Refractive Eye Surgery Program and Research Center (WRESP-RC) at Fort Belvoir in Virginia at the time. The US military investigates clinical outcomes as part of the WRESP.

Studies have described the learning curve for SMILE.[1-3] In my experience, the critical step was creating the 50 LASIK flaps to learn the nuances of gentle suction with a femtosecond laser before beginning to perform SMILE.

Patient selection. Offering an array of options allows the choice of surgery to be tailored to the patient (ie, candidacy) and their preferences. I have found that patients sometimes base their decisions on factors such as their friends' surgical experiences, their jobs, and their hobbies.

Comparisons to LASIK and PRK. Part of integrating SMILE into the WRESP's offerings was the initiation of a few studies to assess outcomes. A retrospective report on our first year of experience, for instance, compared the visual outcomes of SMILE, PRK, and LASIK.[4] SMILE was found to be a promising option for myopic patients. Their

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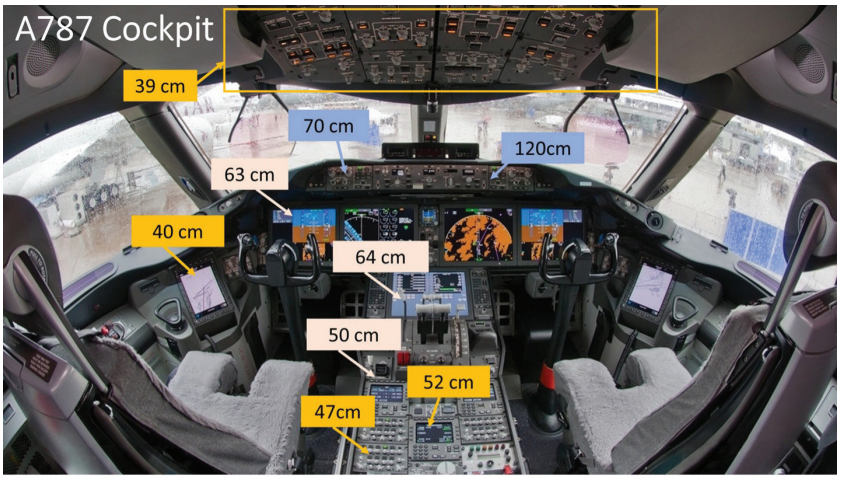
Is LASIK or SMILE better?

A COCKPIT'S VISUAL REQUIREMENTS FOR THE FLIGHT INSTRUMENT PANEL

- ▶ Navigational tablet (40 cm)
- ▶ Front panel controls (70 cm)
- ▶ Copilot's front panel controls (120 cm)
- ▶ Radio and gear systems in the center panel (50 cm)
- ▶ Ceiling panel buttons and controls (39 cm)
- ▶ Primary flight display (63 cm)
- ▶ Systems display (64 cm)
- ▶ Multipurpose display (52 cm)
- ▶ Flight management system (47 cm)
- ▶ Ring-binder or tablet with standard operating procedures
- ▶ Outside the window in daylight and nighttime conditions, including in settings with poor visibility



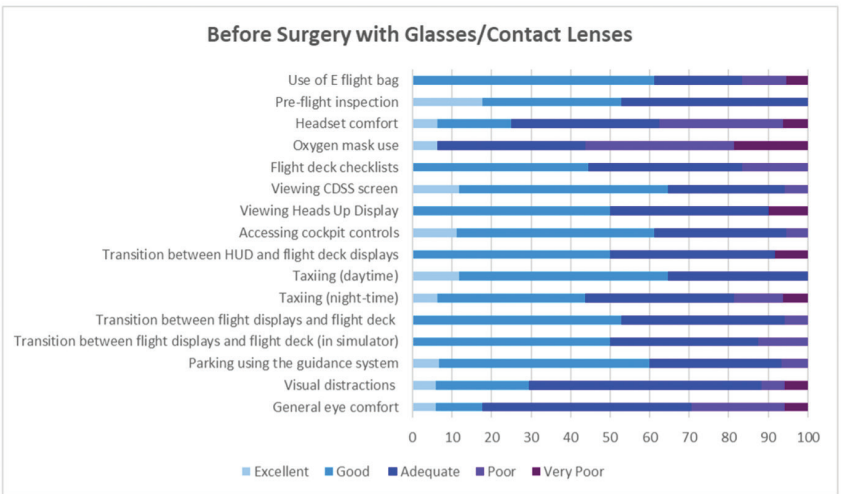
IOL exchange or lose their certification and thus their job.

The need to provide commercial and military pilots with an alternative solution to their presbyopia was the motivation for a recent study of Presbyond Laser Blended Vision LASIK, a procedure that I developed in the mid-2000s and that was commercialized by Carl Zeiss Meditec in 2009.[4-12]

RESULTS OF SURGERY

Visual outcomes. The aforementioned study found that 100% and 52% of pilots achieved a binocular uncorrected distance visual acuity of 20/20 or better and 20/16 or better, respectively.[4] Binocular uncorrected intermediate visual acuity of J3 or better and J5 or better was achieved in 73% and 95% of pilots, respectively. Binocular uncorrected near visual acuity of J1 or better and J2 or better was achieved in 78% and 100% of pilots, respectively. No eye lost 2 lines or more of corrected distance visual acuity—a decrease that might have prevented the pilot from being recertified.[4]

Postoperatively, patients' contrast sensitivity improved at 3, 6, 12, and 18 cycles per degree.[4] No statistically significant change was detected in the HD Analyzer (Keeler) objective scatter



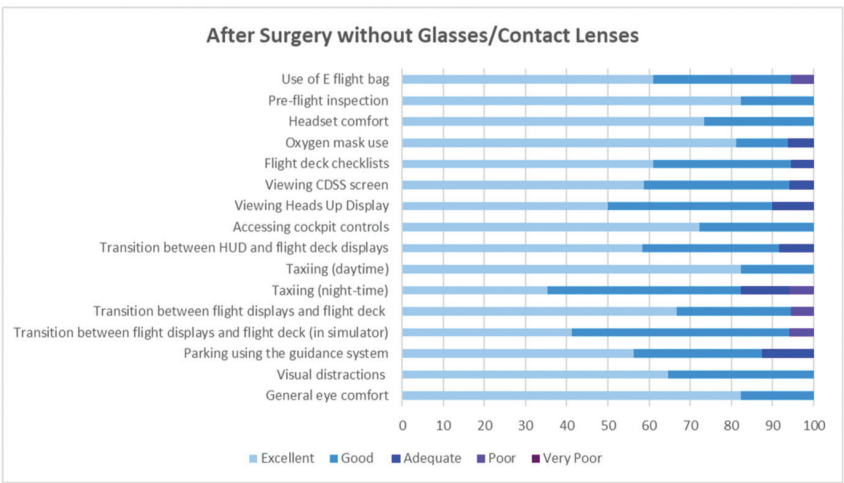


Figure. Results of a pilot vision questionnaire for functional task performance.

index or the C-Quant straylight log value (Oculus), indicating that patients maintained an excellent quality of vision after surgery.[13]

All published studies of Presbyond outcomes to date have found the procedure's safety to be equivalent to that of standard LASIK.[4-12]

Functional assessment changes. My colleagues and I developed a 16-point questionnaire to assess the functional performance of pilots and the impact of visual aids before and after surgery. The survey incorporated input from commercial airline pilots and the results of a thorough review of their presenting complaints and motivation to undergo surgery.

We found that pilots' functional activities improved significantly after surgery; 83.3% of Class 1 pilots reported they no longer required any form of vision correction while flying.[14] Their ocular comfort also improved significantly compared with preoperative levels, with 88% and 12% of pilots reporting greater comfort and no change, respectively. No pilot reported increased discomfort, decreased visual quality, or decreased visual performance (Figure).

MEETING THE VISUAL DEMANDS OF PRESBYOPIC PILOTS

Benefits. Pilots had a higher degree of functionality after Presbyond than with glasses or contact lenses because surgery minimized restrictions in the cockpit environment.[15] They also maintained binocular summation, reported greater eye comfort in their working conditions after surgery, and had better uncorrected distance visual acuity in their near eye than we expected given the myopic refraction of the near-preferred nondominant eye. This is why neural binocular summation was maintained after microanisometropia was achieved.

The findings are particularly important for commercial pilots, who rely on their depth perception to land aircraft safely.[16,17] We also observed a blend zone for clear vision across all distances between both eyes. In contrast, standard monovision correction can compromise intermediate distance acuity. Additionally, patients experienced a statistically significant improvement in contrast sensitivity—a unique advantage over multifocal corneal ablation options and IOLs.[3,18,19]

Limitations. Our study found that, although the procedure significantly improved patients' visual function, some pilots used glasses to see at near or intermediate distance in some circumstances. Given that the cockpit is a visually demanding presbyopic environment, however, we considered reducing the need for glasses to one pair only for certain tasks in 17% of pilots to be an excellent outcome.[20] All the pilots in our study had achieved the visual requirements for revalidation of their Class 1 medical certificate, as defined by the United Kingdom Civil Aviation Authority, by 1 month and were able to resume flying shortly thereafter.

A BROAD PERSPECTIVE

In refractive surgery, the keys to patient satisfaction are education and setting realistic expectations, candidate selection, and tailoring the procedure to patient characteristics, needs, and goals.

Qualification for the Presbyond procedure entails a 5-minute, in-office, +1.50 acceptance test. Because the refractive targets are similar for most patients who are at least 40 years old, it is not necessary to take their preferences and required working distances into account like it is for multifocal IOL selection. A truck driver, baker, lawyer, ophthalmologist, and airline pilot, for example, would generally have the same refractive targets with Presbyond.

Pilots have exceptional visual requirements and are not representative of standard patients. The success of Presbyond for pilots should therefore translate positively to the general presbyopic population. ■

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"FOR PATIENTS WHO QUALIFY, SMILE OFFERS THE BEST OF TWO ALTERNATIVE PROCEDURES: THE RAPID VISUAL RECOVERY OF LASIK AND THE REFRACTIVE STABILITY OF PRK."

(***SMILE Has Advantages for Individuals With High-Precision Jobs,*** *continued from page 67)*

postoperative visual recovery was similar to that seen after LASIK, and refractive stability was similar to that observed with PRK. These nuances are particularly important to military operations.

The disadvantages of PRK (eg, delayed visual recovery, the possibility of haze formation, and a prolonged steroid taper) may deter patients from undergoing surgery. LASIK flaps created with a femtosecond laser typically are stable even after a supersonic aircraft ejection.[5] In my experience, however, the flap dislocations service members experienced were not due to military operations but rather off-duty activities, including basketball injuries and mishaps involving toddlers and pets.

Equivalency is often overlooked in discussions of SMILE. A prospective study assessing patients' functional performance by evaluating their rifle marksmanship[1] showed no significant difference in median scores of their firing range performance with habitual correction preoperatively compared to without correction 6 to 8 weeks postoperatively. Previous firing studies of participants undergoing PRK and LASIK reported similar results.[6] The marksmanship of more than half of the SMILE patients improved, but various factors can affect performance (Figure). Patient-reported outcomes showed no negative impact on work productivity. Most patients were satisfied with their postoperative vision compared to their preoperative vision.[1]

Personal experience. Zachary Skurski, DO, the current director of the WRESP-RC, underwent SMILE just before his cornea fellowship at the Wilmer Eye Institute at Johns Hopkins (read about his experience in the sidebar).

CONCLUSION

I underwent PRK. My wife underwent LASIK in 2010. Last month, my son, Rohan, underwent SMILE. He participates in mixed martial arts and resumed practice 5 days after surgery.

For patients who qualify, SMILE offers the best of two alternative procedures: the rapid visual recovery of LASIK and the refractive stability of PRK. SMILE represents the next step in the evolution of laser refractive technology. ■

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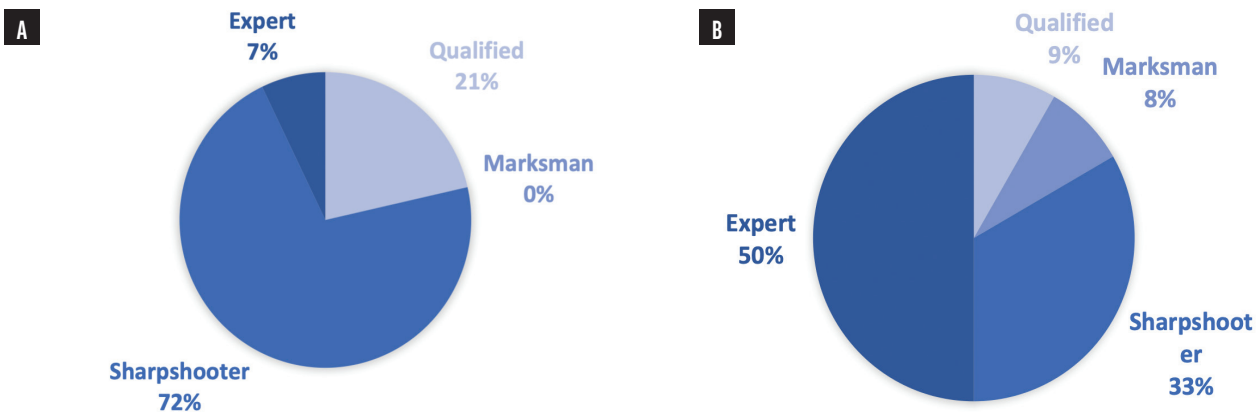

Figure. Firing range performance by category preoperatively (A) and 6 to 8 weeks postoperatively (B). Categories in order of expertise: qualified, marksman, sharpshooter, and expert.

SMILE FOR THE US MILITARY

BY ZACHARY P. SKURSKI, DO, FACS

As a military resident at Walter Reed Military Medical Center, I received robust training in refractive surgery. By the time I began my fellowship, I had performed hundreds of PRK and LASIK procedures.

My interest in SMILE began during medical school. Most appealing to me was that the speed of postoperative recovery was akin to that for LASIK but without the creation of a flap.

I worked with Bruce A. Rivers, MD, at Fort Belvoir and gained experience with SMILE as a surgeon. The outcomes with SMILE and LASIK were similar. Based on my observations and my candidacy, I was confident that SMILE was the right choice for me. Dr. Rivers performed my SMILE procedure in 2019. It was a game-changing decision that has allowed me to share my professional and personal experiences with other service members.

Since Dr. Rivers introduced SMILE at Fort Belvoir in 2017, procedural volume has increased each year. Currently, approximately 33% of patients who undergo laser vision correction choose SMILE (Figure). Different surgeons on rotation perform the treatments, and each completes 50 LASIK flaps before starting to offer SMILE. ■

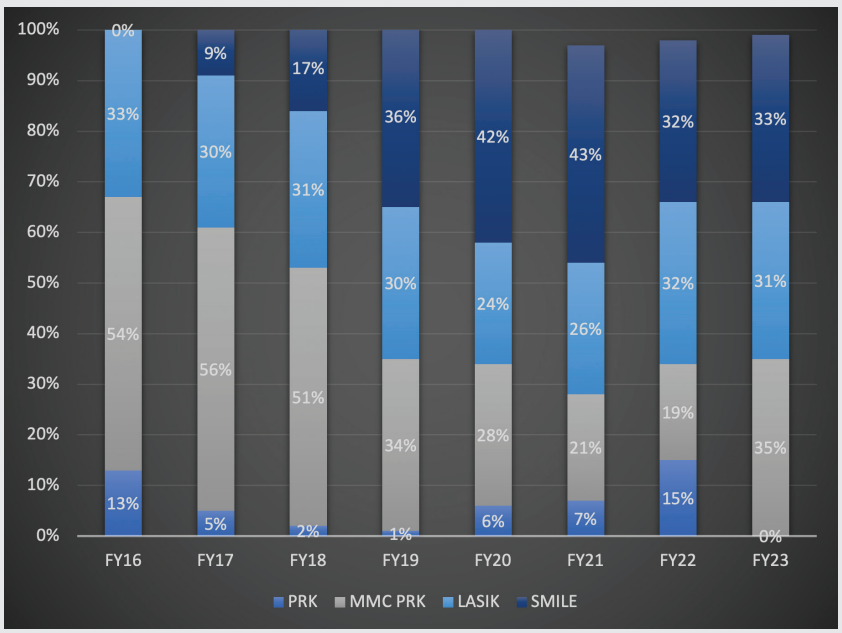

Figure. Treatments by procedure at the Warfighter Refractive Eye Surgery Program and Research Center in fiscal years 2016 to 2023.

Abbreviations: FY, fiscal year; MMC, mitomycin C

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