The Impact of Iris Registration

Reducing enhancement rates after wavefront-guided laser vision correction.

BY CHRISTOPHER L. BLANTON, MD

Iris registration (IR) is the method employed by the Visx CustomVue system (Abbott Medical Optics Inc.) for registering wavefront-guided treatments to the cornea using iris landmarks. The system looks for multiple matching reference points from the WaveScan image and the intraoperative laser image of the iris (Figure 1) in order to verify that the treatment is properly aligned. The system also compensates for any shift in the pupil centroid. The technology is not new, but its importance is often overlooked. Several individuals have even suggested that IR makes no difference at all.[1,2]

I conducted a retrospective review of consecutive myopic wavefront-guided LASIK procedures with femtosecond laser-created flaps. Eyes with amblyopia or ocular surface disease were excluded, as were patients who were pregnant or who had a visual acuity of less than 20/20 preoperatively. IR was planned for all cases. In all, 222 myopic eyes were available for analysis. Of these, 177 eyes were treated with IR and 45 without IR. There was no statistically significant difference between the two groups preoperatively.

Postoperatively, both groups achieved excellent results. More than half of the eyes could see 20/16 or better uncorrected on the first postoperative day (Figure 2A). By 3 months, approximately 90% of the eyes saw 20/16 or better (Figure 2C). The standard deviation in visual acuities was tighter in the IR group (Figure 2B). At every examination, the IR eyes had better visual acuity, but the differences were too small to be statistically significant. This finding demonstrates that the precision of the platform is very high with or without IR and may be why some feel the registration technology makes little difference.

According to Fisher's exact test, however, there was a statistically significant difference (P=.0060) in the rate of enhancement (Figure 3). In the group with IR, only one of the 177 eyes needed an enhancement, a rate of 0.565%, versus nearly 9% of the eyes (4/45) in the non-IR group.

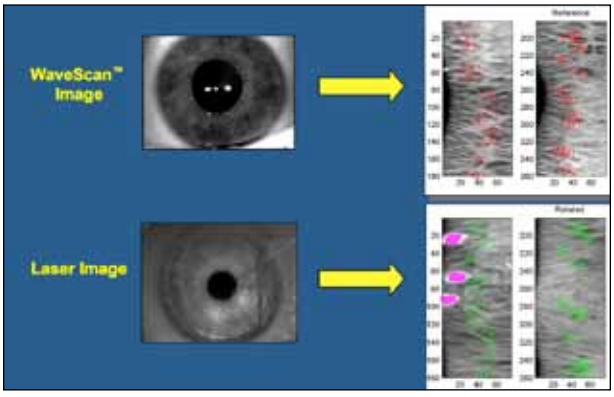

Figure 1. Iris registration properly aligns the treatment by matching iris features in the laser image with those identified previously in the wavefront image.

REASONS FOR NOT USING IR

In my study, 15 eyes (6%) were ineligible for IR from the start. One eye had an iris nevus that prevented the use of registration, but a displaced outer iris boundary was the problem in most cases. The outer iris boundary can be displaced in eyes with unusually large white-to-white measurements and large irides. The software perceives a shadow on the iris that prevents the system from attempting to initiate IR at the WaveScan. When this happens, repeat imaging usually is not helpful, because the problem tends to recur.

Of the remaining 207 eyes with successful IR image capture at the WaveScan, 15% (30 eyes) could not be captured at the laser. I typically attempt capture three times at the start of the surgery but then proceed with-

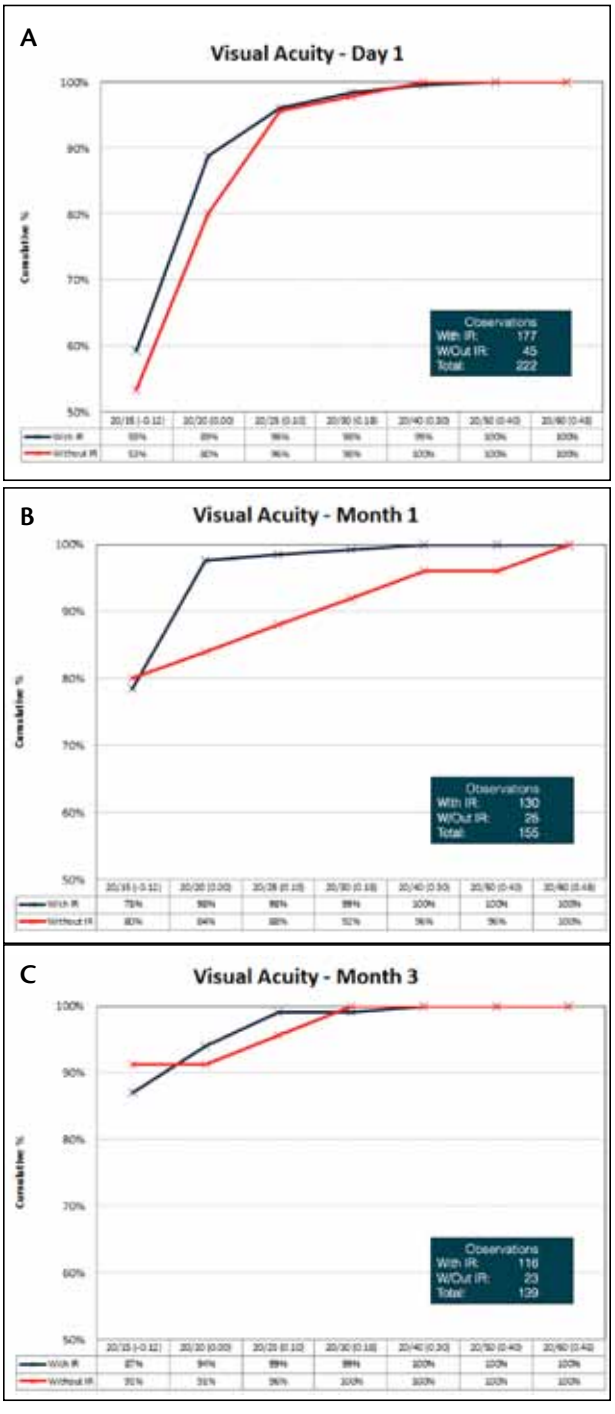

Figure 2. Visual acuity results at day 1 (A), month 1 (B), and month 3 (C) show excellent uncorrected acuity, with most patients in both groups seeing better than 20/20, even as early as the first postoperative day. Although the IR group does slightly better than the non-IR group, only the degree of variation in the results is statistically significant (at 1 week and 1 month); the differences in mean visual acuity are too small to be significant at any time point.

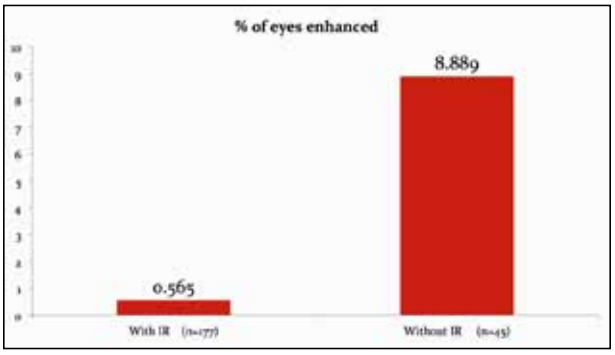

Figure 3. There is a dramatic increase in the rate of enhancement among eyes treated without IR.

out IR if those attempts fail. In reviewing what happened in those cases, the problem in about one-third was insufficient or poor-quality iris detail. This can happen in very pale, featureless irides or when images are not fully in focus. The problem can be avoided by a careful review of the images at the WaveScan during surgical planning. Another 10 eyes lacked sufficient iris exposure due to lid anatomy or narrow fissures. The remaining one-third either had very large pupils (four eyes), or the reason for failed capture could not be determined.

LESSONS LEARNED

The first lesson in these data is that it is worth measuring beyond 20/20 visual acuity in the exam lane. This study confirms observations from the military and from large corporate laser centers in the United States and Europe: the vast majority of patients now see better than 20/20 uncorrected after laser vision correction.[3-6] Pushing patients to go farther down the eye chart will help surgeons pick up on subtle inaccuracies and improve results.

Second, the reduction in enhancements with IR is impressive. Touch-ups cost the surgeon and patient time and money, and they risk potential complications during the second procedure. In addition, patients perceive enhancements as failures, which has a negative impact on word-of-mouth referrals for the practice.

In the past 10 to 15 years, overall enhancement rates have plummeted, thanks to the introduction of wavefront-guided surgery; laser-created flaps that provide consistently dry, smooth stromal beds; and the development of age-appropriate nomograms.[7] With some surgeons touching up only 2% to 3% of their cases,[7,8] it can be hard to anecdotally determine the contributing factors. The sharp difference in enhancement rates in my study (< 1% with IR vs 9% without) suggests that IR also plays a significant role.

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I think this study serves as a useful reminder of the importance of getting the highest-quality preoperative images possible. I usually tell surgeons to expect an IR capture rate of 90% or better. The fact that it was a little lower (85.5%) in this review suggests that ophthalmologists could be more vigilant about image quality while planning treatment, when they have the greatest opportunity to improve capture rates. I believe this is one of the most important reasons for surgeons to plan treatment themselves rather than delegate that responsibility to a technician. By paying careful attention to the quality of the IR image, surgeons can avert problems before they occur. If the eyelids are obscuring too much of the iris, the iris is very large, or the image is a little fuzzy, a repeat WaveScan image may be the key to capturing an image at the laser later.

Finally, the nonrandomized nature of the study leaves room for some valid criticism. For example, the reasons for noncapture of IR may be the same as for the difference in enhancement rates. I have enumerated the causes of noncapture, so I leave it to readers to draw their own conclusions. ■

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