Binovision: A Novel Approach to Presbyopia Correction

Monocular and binocular correction after LAL implantation may provide patients with enhanced near, intermediate, and distance vision.

BY SYLVIA PAULIG, MD

As a large ophthalmic practice in Germany, the Paulig Eye Surgery Center aims to offer patients the latest procedures and use the latest technologies. We have been implanting the Light Adjustable Lens (LAL; CalhounVision, Inc., Pasadena, California) for the past 3 years with excellent results. This lens is implanted just like any other silicone IOL, but the lens power is then adjusted several days after implantation to improve visual performance. Today we can correct up to ±2.00 D of sphere and up to 2.00 D of cylinder.

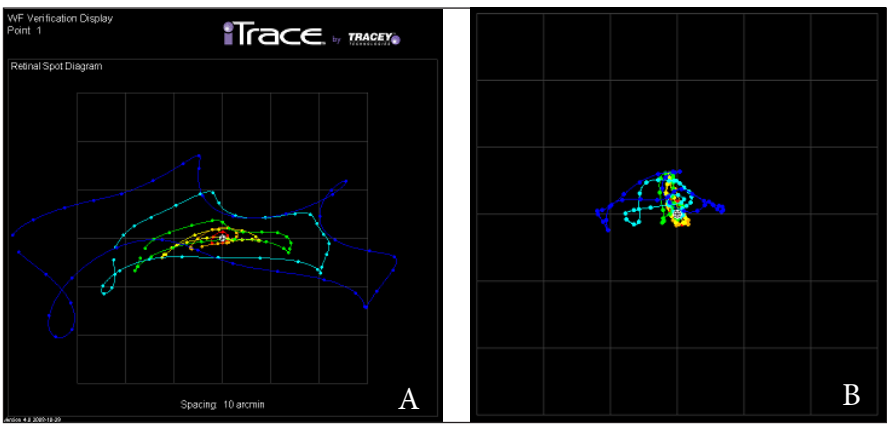

Figure 1. Effect of UV adjustment (A) before and (B) after irradiation.

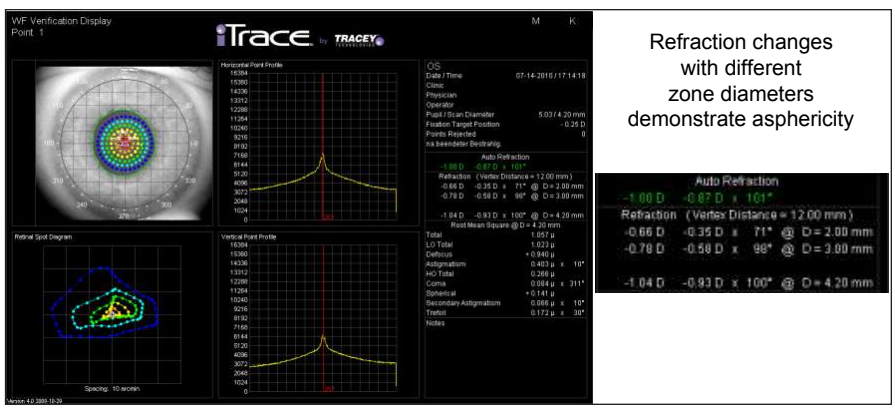

Figure 2. The irradiation causes the LAL to become aspheric.

Optimizing vision after LAL implantation requires the patient to return to the surgical center for noninvasive adjustments of the lens power. This is achieved by exposing the LAL—which is composed of photosensitive silicone molecules—to a special ultraviolet (UV) light source that polymerizes the silicone macromers. This process generates a diffusion gradient between the exposed and unexposed areas of the lens, allowing the unreacted macromer to diffuse into the irradiated area and inducing a change in shape that produces a predictable power change. Irradiation of the lens center results in thickening of the lens and thus increases its refractive power. Irradiation of the periphery leads to

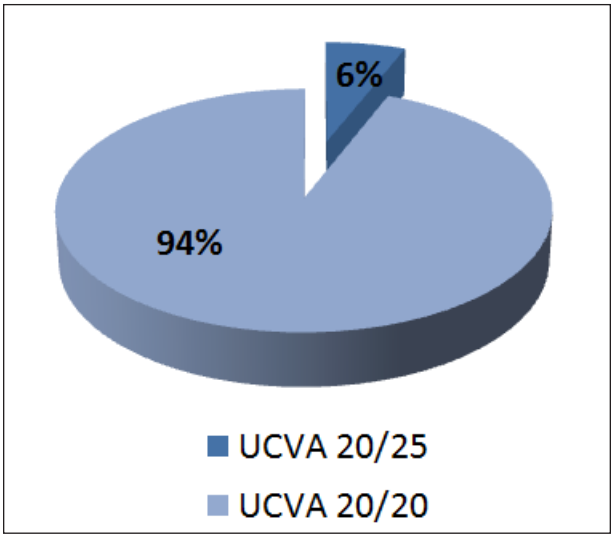

Figure 3. Distance vision results in 63 eyes.

thinning of the lens and consequently reduces its refractive power. Once the refractive power is optimized, the entire lens is again irradiated to lock in the IOL power.

One thing that we noticed as a byproduct of these adjustments is that the lens becomes aspheric, thus improving depth of field. The resulting visual performance is not only optimal for near, intermediate, and distance vision but also for normal stereoscopic vision. We have coined the term *binovision* as a new expression for this phenomenon.

THE PROCEDURE

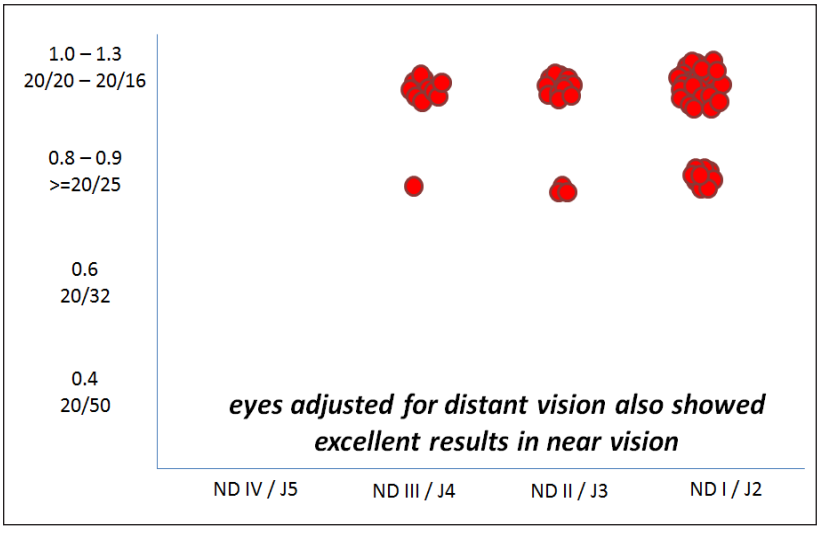

Figure 4. Distance versus near vision in 63 eyes.

TAKE-HOME MESSAGE

- UV irradiation in the center of the LAL induces an increase in refractive power whereas irradiation at the periphery decreases refractive power.
- A byproduct of the UV irradiation is asphericity, which improves depth of focus and provides monocular and binocular correction.

tive UV irradiation treatments. Of our first 107 eyes, performed between October 2008 and August 2010, 90 were a component of cataract surgery or clear lens extraction and the remaining 17 were in patients with complicated visual conditions such as anisometropia with amblyopia, strabismus, and age-related macular edema. In all cases, the LAL was implanted through a 3-mm incision, and corrective irradiation treatments with UV light began 3 weeks after surgery. In addition to optimizing the refractive power of the lens to induce spherical changes, these treatments were also used to correct astigmatism by focusing a pattern of UV light across the center of the lens and aligning the light beam along the desired axis of astigmatism (Figure 1).

Depending on the amount of residual correction required, we performed up to three adjustments followed by two lock-in treatments. A minimum of 48 hours was required between the first and second UV irradiation treatments; however the other irradiations were performed thereafter in intervals of 24 hours.

Between LAL implantation and 2 days after the last lock-in treatment, patients were counselled to wear UV-absorbing glasses provided by the manufacturer. We were initially concerned that the glasses were a cosmetic obstacle; however, it turned out that our LAL patients were proudly distinguishing themselves from the other cataract patients in the waiting room.

DISCUSSION

Aspheric changes occur after UV irradiation of the LAL, and we have turned this effect into an additional advantage, allowing us to correct patients monocularly and binocularly for near, intermediate, and distance vision with encouraging results. Because of the asphericity that results from the LAL's adjustment, the patient's depth of field in each eye increases enough to allow patients not only monocular but also binocular vision at nearly all dis-

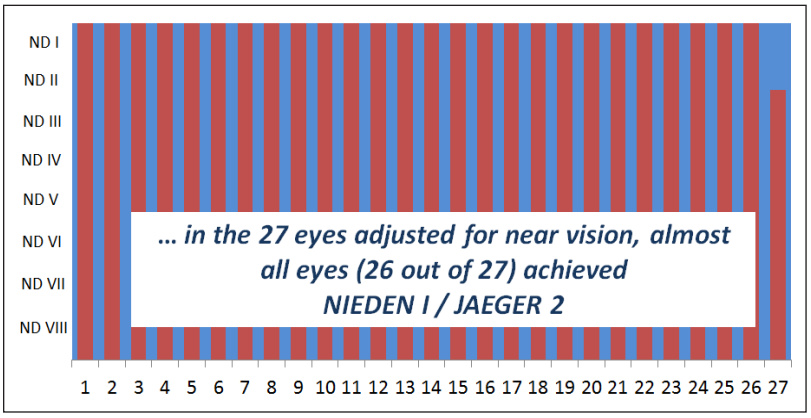

Figure 5. Adjustment of near vision in 27 eyes.

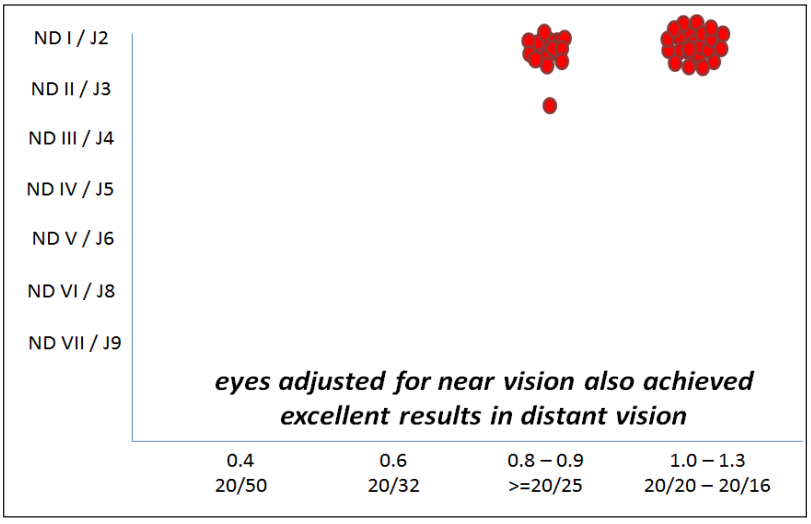

Figure 6. Near versus distance vision in the 27 eyes adjusted for near vision.

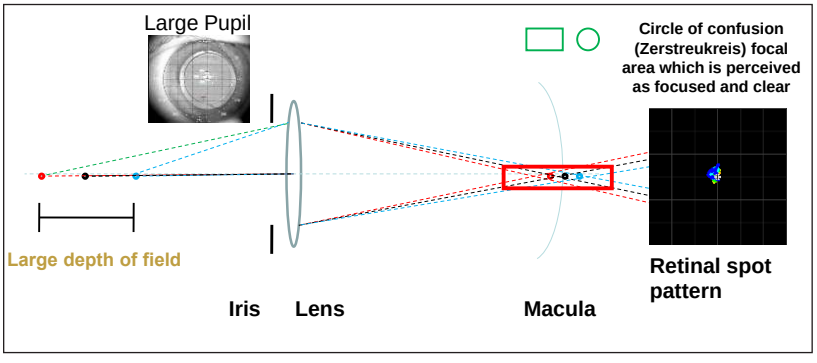

Figure 7. Depth perception with the LAL in the 27 eyes adjusted for near vision.

tances (Figure 2); stereoscopic vision remains normal. We have been able to confirm that the depth of field with the LAL is superior to the depth of field with standard or multifocal IOLs using aberrometry (iTRACE; Tracey Technologies, Corp., Houston).

Of 90 eyes treated with binovision, 63 were initially corrected for distance vision and 27 for near. In 59 of the 63 distance-corrected eyes, postoperative UCVA was 20/20 or better (Figure 3). These eyes, which were initially adjusted for distant vision, achieved excellent vision at near and intermediate in the same uncorrected eye (Figure 4). Of the 27 eyes adjusted for near vision, 26 were J2 uncorrected (Figure 5). Although these eyes had been adjusted for near vision, they also showed exciting results for distance vision (Figures 6 and 7). After we completed postoperative irradiation, all patients demonstrated normal stereoscopic vision (40 and 60 arc seconds).

CONCLUSION

Implantation of the LAL allows me to achieve the targeted refraction with high precision. Postoperative irradiation treatments, which create an aspheric surface that increases depth of field, allow me to correct patients both monocularly and binocularly so that they achieve excellent vision at near, intermediate, and far distances. In contrast with monovision techniques, this binovision technique provides the patient with binocular and stereoscopic vision at almost all distances with the LAL.

We are convinced that binovision with the LAL creates superior vision to that provided by other lens-based and refractive methods presently used. It constitutes a highly satisfying alternative for patients who desire presbyopia correction. ■

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