Update on light-adjustable intraocular lenses

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in San Francisco

THE light-adjustable intraocular lens might be the most effective and safe procedure for patients undergoing cataract surgery who desire optimised uncorrected visual acuity with minimal astigmatism, the first clinical study of this type of lens suggests.

Surgeons performed routine cataract surgery and light-adjustable lens implantation in 24 patients. Two weeks after the initial surgery, the researchers adjusted the lens power with UV light to correct any remaining spherical refractive error.

Twelve of the 24 patients required a positive adjustment for hyperopic correction. Eleven of them were within 0.25 dioptres of intended lens power after the correction and had uncorrected visual acuity of 20/30 or better. Seven of these patients ended up with uncorrected visual acuity of 20/25 or better. Residual astigmatism in this initial cohort was not treated.

The remaining 12 patients required a negative adjustment for myopic correction. In this group, 10 of the 12 patients had an uncorrected visual acuity of 20/25 or better after adjustment. Five patients even had 20/20 or better vision.

After the adjustment, the surgeons confirm the correct lens power and then lock it in to prevent any further changes in the lens power. In addition to the good visual results, the adjustment and lock in also seem to be very safe.

“We haven’t seen any eyes lose any best corrected visual acuity, so we are very satisfied with the safety,” said Arturo Chayet, MD, director of the Codet Aris Laser Vision Institute in Tijuana, Mexico, and the study’s lead investigator, who presented his results at the annual meeting of the ASCRS.

In a second study, two patients underwent phacoemulsification and lens implantation. Two weeks after the procedure, the first patient had a manifest refraction of -0.75 D-2.50 Dx175. A light adjustment was done with the refractive goal of -1.25 D sphere. One week later, the researchers confirmed a -1.25 D sphere and visual acuity of 20/30, locking in the lens power a day later. An additional test one day after lock-in confirmed that the lens power had remained stable.

In the second patient, the light adjustment was done with the refractive goal of plano. Before adjustment, the patient’s uncorrected visual acuity was 20/30 and refraction was +0.75-1.50 x 15, 20/25+. Two days after the adjustment, the uncorrected visual acuity was 20/20- and the refraction was plano-0.50 x 13.

“Revolutionary technology”

“This is a revolutionary technology rather than an evolutionary technology. It’s a new type of experimental IOL that allows postoperative modification of the lens power; it will allow us to provide emmetropia to our pseudo-phakic patients postoperatively in most cases most of the time,” said Nick Mamalis, MD, professor of ophthalmology at the University of Utah in Salt Lake City, Utah.

The light-adjustable lens is a 6.0mm square-edge lens made of customisable silicone. During the light adjustment, the surgeon uses a UV light to treat a specific area of the lens depending on the refractive goal.

For example, to treat myopia, the surgeon irradiates the lens’ edges, which leads to the polymerisation of photosensitive silicone macromers. Untreated macromer in the central portion of the lens then diffuses outward in the 12-15 hours following treatment. This reduces the volume of macromers in the central portion of the lens resulting in lens flattening and reduction of power.

For a hyperopic correction, the central portion of the lens is irradiated. This creates a concentration gradient between the peripheral, untreated portions of the light-adjustable lens and the irradiated central portions. In the next 12-15 hours following treatment, macromers diffuse down the gradient into the lens’ centre causing it to swell centrally, thus increasing its power. Based on the duration and power of exposure, differing amounts of hyperopia can be corrected.

Before locking the lens power in by shining UV light on the entire lens again, surgeons have to confirm they achieved the refractive goal. Further adjustments can be done, if the refraction is not satisfactory. However, the amount of adjustments possible is limited.

“Every time we adjust, we consume some of the silicone, so there is a limit. It’s probably 3.5 diopters, but we haven’t pushed it that far yet,” said Robert Maloney MD, Los Angeles, California, during a discussion on the light-adjustable lens at the meeting.

Dr Maloney also praised the fact that the lens can also correct small and large amounts of postoperative astigmatism with more accuracy than limbal relaxing incisions.

“Most intraocular lens patients have some residual astigmatism. In at least 40% of these patients, the astigmatism is one diopter or more. We put up with limbal relaxing incisions because it’s the best we’ve got, but they are notoriously inaccurate and often under-correct astigmatism,” he said.

Once the lens has been locked in, the power stays unchanged for the rest of the patient’s life. This has been confirmed in patients up to two years and also in the lab by repeatedly exposing a locked-in lens with UV light, said Dan Schwartz, MD, director of the Retina Division at the University of California in San Francisco and co-inventor of the lens, during an interview with EuroTimes.

In addition to the creation of the lens, a new digital light delivery device that allows correction of sphere, astigmatism and higher order aberrations, has been designed by Carl Zeiss-Meditec (Jena, Germany). The system is a modified slit lamp device in which the refractive error and desired refractive outcome are entered and irradiation is activated using either a foot pedal or joystick.

The lens, however, has one downside for patients in the first couple of weeks: patients are required to wear sunglasses whenever they are outside during the two weeks after surgery before adjustment, to prevent any changes to the lens through the sun’s UV light.

Despite this inconvenience, Dr Schwartz believes that the light-adjustable lens is a safer and easier alternative to the current practise of LASIK enhancements used to achieve emmetropia after implantation of presbyopic IOLs.

“Only 20% of cataract surgeons have a LASIK machine, so then another doctor across town who doesn’t even know the patient performs the LASIK procedure. It’s a logistical problem and inconvenient for patients,” Dan Schwartz MD

Looking ahead, Dr Schwartz and his colleagues are also working on a piggyback version of the lens to be placed in the sulcus in front of presbyopic IOLs.

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