CASE REPORT

Light-adjustable intraocular lens in post-LASIK and post-traumatic cataract patient

Guillermo Rocha, MD, FRCSC, Zale D. Mednick, BA

The case illustrates the use of a light-adjustable intraocular lens (IOL) in a patient who had had refractive surgery and developed blunt trauma with resultant flap damage and traumatic cataract. Consistent with early reports of the light adjustable IOL, which show positive results in non-LASIK eyes, this case suggests that the light-adjustable IOL may have similar benefits in the post-LASIK eye and other complex situations.

Financial Disclosure: Neither author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2012; 38:1101–1104 © 2012 ASCRS and ESCRS

Laser in situ keratomileusis (LASIK) is the most common corneal refractive procedure in ophthalmology today. It continues to increase in popularity due to its effectiveness in reducing the need for glasses and contact lenses, as well as its low complication profile and quick results.

As the population ages, many patients who had LASIK over the past 2 decades now require cataract surgery. It is well documented[1–4] that calculating the appropriate intraocular lens (IOL) power to use in cataract surgery poses a particular challenge in the LASIK patient. Specifically, calculating the corneal power (keratometry [K] value) and predicting the effective IOL position are more difficult in patients who have had LASIK due to the corneal alterations in their eyes.[1,2] Using standard K values, those who had LASIK to correct myopia would end up hyperopic after cataract surgery and vice versa.

Many formulas and strategies to more accurately predict the correct IOL power for LASIK patients have been developed, although no single method is perfect. Various strategies such as the clinical history method, the Hamed method, and the Feiz-Mannis method are reliant on clinical history; that is, referencing the patient's optical information prior to LASIK.[2] While these approaches have merits, it is unrealistic to assume that LASIK patients will retain their pre-LASIK records until they develop cataracts.[3] Other strategies include contact lens over-refraction, the Maloney-Wang method, and the Shammas method.[2,3] More aggressive techniques calculate the autorefraction intraoperatively once the cataract has been removed.[3] Exemplifying that no one method is impervious to inaccuracies, the Consensus K technique was developed,[4] which determines the corneal power by taking the mean K value derived from the many reported formulas.

The light-adjustable IOL (Calhoun Vision, Inc.), developed to create an IOL whose power can be adjusted several weeks after surgery, represents a novel approach to achieving better refractive outcomes in the LASIK patient having cataract surgery. The IOL is composed of photosensitive silicone monomers embedded in ultraviolet (UV)-filtering silicone.[5] At some point after surgery, ranging from 10 to 21 days, the patient has 2 to 4 UV treatments to adjust and then stabilize the lens.[6] Based on the patient's postoperative visual acuity and manifest refraction, an appropriate wavelength of light is transmitted to the light-adjustable IOL for a customized amount of time. The UV light causes a chemical reaction in which the silicone polymerizes, altering the shape and thus the power of the IOL.[5,7] Such UV-light exposure has not been shown to cause any more endothelial cell loss than standard phacoemulsification surgery.[8]

Submitted: September 8, 2011.
Final revision submitted: November 8, 2011.
Accepted: November 8, 2011.

From the Faculty of Medicine, University of Manitoba (Rocha), Brandon Regional Health Center (Rocha), Brandon, Manitoba; and the Faculty of Medicine, University of Ottawa (Rocha), and the Medical School (Mednick), Queen's University, Kingston, Ontario, Canada.

Corresponding author: Guillermo Rocha, MD, FRCSC, GRMC Vision Centre, Suite 20, 144-6th Street, Brandon, Manitoba, Canada R7A 3N2. E-mail: rochag@wcgwave.ca.

Published by Elsevier Inc.

0886-3350/$ - see front matter
doi:10.1016/j.jcrs.2012.03.017

A minimum of 1 adjustment treatment, in which the IOL shape is altered to achieve a more desirable power, and 2 lock-in treatments, in which the IOL is secured in its new position, are required. A second adjustment treatment may be warranted, if further refractive and visual acuity is desired, before advancing to the lock-in sessions. From the time of surgery until the final lock-in procedure, the patient must wear a pair of UV-protective glasses to prevent premature UV light–induced changes to the IOL.[6]

Because of the difficulty of accurately predicting the optimal IOL power for LASIK patients, the light-adjustable IOL would theoretically be an appealing choice in patients who have had refractive surgery. Having the ability to alter the IOL power after cataract surgery decreases the need to rely on imperfect strategies and formulas for calculating K values. We believe this is the first report about the use of a light-adjustable IOL in a complex situation involving post-LASIK flap trauma with resultant traumatic cataract.

CASE REPORT

A 36-year-old man presented to our office for a second opinion regarding the left eye. He had had bilateral LASIK in April 1999. Prior to LASIK, refraction was −1.75 −1.25 × 110 with 20/20 corrected distance visual acuity (CDVA) in the right eye and −1.50 −1.75 × 85 with 20/20 CDVA in the left eye.

Several months after surgery, in June 1999, the patient experienced a work-related injury. Hydraulic fluid was expressed with significant force, injuring his left eye. The left corneal flap was reported to be completely off the bed and curled up in wrinkles. This was repaired by the original surgeon. Subsequently, the patient developed problems with high intraocular pressure, which was also managed. Over the following few years, the visual acuity in the left eye did not recover. When the patient presented in February 2011, the uncorrected distance visual acuity (UDVA) was 20/25 in the right eye and 20/160 in the left eye. There was poor pupil response in the left eye. Intraocular pressures were normal at 13 mm Hg and 15 mm Hg in the right eye and left eye, respectively. There was anisocoria, with the right pupil measuring 5.70 mm and the left pupil, 7.0 mm. Manifest refraction was −2.00 +0.50 × 5 with CDVA of 20/16 in the right eye and −4.75 +1.00 × 130 with CDVA of 20/16 in the left eye.

Slitlamp examination showed a superior hinged flap in each eye. The left flap had significant interface droplets, which were probably oil droplets from the hydraulic fluid. There was also evidence of superonasal iris sphincter damage, but the pupil remained round. There was evidence of anterior subcapsular and spoke-like cataract. There was no evidence of phacodonesis. Fundus examination showed normal disc vessels and macula in both eyes and an area of gliosis in the nasal aspect of the optic nerve in the left eye. Cup-to-disc ratio was 0.2 bilaterally.

The initial management consisted of lifting the flap and washing out the oil droplets. There was a significant improvement in higher-order aberrations (HOAs) between preoperatively and after the flap cleanup. The HOAs decreased from 0.313 μm to 0.165 μm, and there was a significant reduction in coma and trefoil, with coma decreasing from 0.24 μm to 0.112 μm and trefoil decreasing from 0.158 μm to 0.100 μm. Corneal topography remained stable but showed astigmatism of 1.27 at 126 degrees in the left eye. The appearance was somewhat irregular (Figures 1 and 2).

On follow-up, the manifest refraction was −5.50 +0.25 × 130 with a CDVA of 20/25; the UDVA was 20/200. The interface was completely clean. Pupil dilation revealed a 9.0 mm pupil.

Because of the subjective glare and the presence of a traumatic cataract, options were discussed, including a LASIK enhancement following conventional cataract surgery, but the decision was made to proceed with a cataract extraction plus IOL implantation using a light-adjustable IOL. Following adjustments and lock-ins, the patient achieved an end refraction of +0.50, producing a UDVA of 20/20.

DISCUSSION

Despite improvements in IOL refractive predictability, ophthalmologists still strive to achieve better results for their patients after cataract surgery. As patients' expectations increase, the ophthalmologist is challenged to achieve a postoperative refraction as close to emmetropia as possible. The light-adjustable IOL is a major stepping stone toward achieving this, and the results of early studies are promising. In a pilot study by Chayet et al.,[5] 93% of patients receiving the light-adjustable IOL achieved a refraction of less than 0.25 diopter (D) of the intended refraction at

Figure 1. Visual function analysis display showing HOAs before flap lift and cleanup.

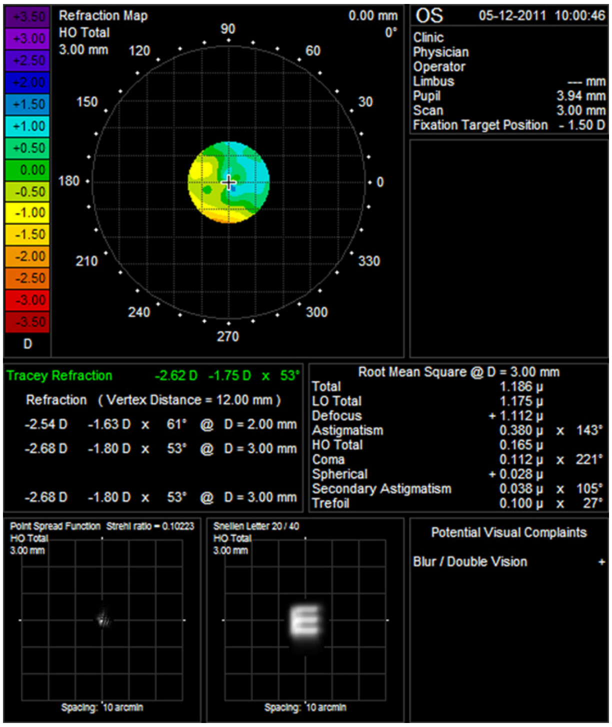

Figure 2. Visual function analysis display showing a reduction in HOAs after flap lift and cleanup and prior to cataract surgery.

9 months postoperatively. Salgado et al.[9] reported a reduction in spherical equivalent from +0.39 D before the adjustments to −0.07 D 6 months after the adjustments. A more recent study of 21 eyes by Hengerer et al.[10] showed positive results at 1 year postoperatively: 96% of eyes were within ±0.50 D of the intended refraction and 81% were within ±0.25 D. Winkler von Mohrenfels et al.[11] showed that such refractive accuracy converts to good visual outcomes, reporting a mean UDVA of 1.02 in eyes that had a light-adjustable IOL.

Our case is the first to comment on the possible role of the light-adjustable IOL in a complex patient who had had refractive surgery and subsequently developed flap dislocation and traumatic cataract. The other studies demonstrated that the light-adjustable IOL is beneficial in patients with unaltered corneas, but the potential for better refractive outcomes may be magnified when dealing with eyes whose corneas have had surgery. Formulas calculating the correct IOL power to use in eyes that have had LASIK have not yielded the refractive predictability that patients and ophthalmologists have come to expect.

The light-adjustable IOL may represent a new approach to refractive predictability in the post-refractive eye. Rather than focus further efforts on developing more accurate IOL formulas, perhaps the solution is to accept that the initial postoperative refraction will not be ideal. With the light-adjustable IOL, the focus can shift to tweaking the refraction via adjustments. Essentially, it is no longer as important to determine the correct corneal power before surgery; it may be simpler to accept that current formulas will lead to errors and use the light-adjustable IOL to correct such errors.

The case at hand illustrates it is possible to achieve good refractive results with the light-adjustable IOL in a post-LASIK patient. The patient in this case had even more corneal alterations than most LASIK patients would have, as he had had 2 additional procedures before proceeding to cataract surgery. His achievement of positive results suggests that such results would likely be replicable in LASIK patients with fewer complications.

A study by McCarthy et al.[12] compared various formulas used to calculate corneal power in the post-refractive patient. It showed that on the more accurate end of the spectrum, 58.8% of eyes were within ±0.50 D of the predicted refraction and 84.5% of eyes were within ±1.00 D of the predicted refraction. Poorer results included 53.8% of eyes within ±0.50 D of the intended refraction and 80.9% of eyes within ±1.00 D.[12] The patient in our case achieved an end refraction of 0.50 D, which falls in the range of greater refractive predictability according to the McCarthy et al. study.

At the 2011 annual meeting of the Canadian Ophthalmological Society, Brierley[A] presented data on a series of post-refractive eyes that had received light-adjustable IOLs at 3 centers. Based on results in the initial 16 eyes, the data demonstrated that 75% of eyes achieved a refraction within ±0.25 of the intended refraction and 94% of eyes, within ±0.50 D. These results preliminarily appear to be superior to those reported in the McCarthy et al. study.[12] As more post-refractive patients receive light-adjustable IOLs, it will be possible to report more confidently on the role that light-adjustable IOLs will play in cataract surgery in patients who have had LASIK.

REFERENCES

1. Sutton GL, Kim P. Laser in situ keratomileusis in 2010 – a review. Clin Exp Ophthalmol 2010; 38:192–210. Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1442-9071.2010.02227.x/pdf. Accessed December 1, 2011
2. Naseri A, McLeod SD. Cataract surgery after refractive surgery. Current Opin Ophthalmol 2010; 21:35–38
3. Diehl JW, Yu F, Olson MD, Moral JN, Miller KM. Intraocular lens power adjustment nomogram after laser in situ keratomileusis. J Cataract Refract Surg 2009; 35:1587–1590
4. Randleman JB, Foster JB, Loupe DN, Song CD, Stulting RD. Intraocular lens power calculations after refractive surgery: consensus-K technique. J Cataract Refract Surg 2007; 33:1892–1898

5. Chayet A, Sandstedt C, Chang S, Rhee P, Tsuchiyama B, Grubbs R, Schwartz D. Correction of myopia after cataract surgery with a light-adjustable lens. Ophthalmology 2009; 116:1432–1435. Available at: http://iogen.fi/files/LAL%20Myopia%20Clinical%20Paper.pdf. Accessed December 1, 2011
6. Hengerer FH, Conrad-Hengerer I, Buchner SE, Dick HB. Evaluation of the Calhoun vision UV light adjustable lens implanted following cataract removal. J Refract Surg 26:716–721
7. Hengerer FH, Mellein AC, Buchner SE, Burkhard DH. Die lichtadjustierbare Linse. Grundlagen und klinische Anwendung [The light-adjustable lens. Principles and clinical application]. Ophthalmologe 2009; 106:260–264
8. Lichtinger A, Sandstedt CA, Padilla K, Schwartz DM, Chayet AS. Corneal endothelial safety after ultraviolet light treatment of the light-adjustable intraocular lens. J Cataract Refract Surg 2011; 37:324–327
9. Salgado JP, Khoramnia R, Schweiger B, Lohmann C, Winkler von Mohrenfels C. Klinische 6-Monats-Ergebnisse einer Licht-adjustierbaren Linse [Six-month clinical results with the light adjustable lens]. Klin Monatsbl Augenheilkd 2010; 227:966–970
10. Hengerer RH, Hütz WW, Dick HB, Conrad-Hengerer I. Combined correction of sphere and astigmatism using the light-adjustable intraocular lens in eyes with axial myopia. J Cataract Refract Surg 2011; 37:317–323
11. Winkler von Mohrenfels C, Salgado J, Khoramnia R, Maier M, Lohmann CP. Clinical results with the light adjustable intraocular lens after cataract surgery. J Refract Surg 2010; 26:314–320
12. McCarthy M, Gavanski GM, Paton KE, Holland SP. Intraocular lens power calculations after myopic laser refractive surgery: A comparison of methods in 173 eyes. Ophthalmology 2011; 118:940–944

OTHER CITED MATERIAL

A. Brierley LA, “Precision of IOL Refractive Power Adjustment of the Light Adjustable Lens (LAL) in Post-Refractive Surgery Patients,” presented at the annual meeting of the Canadian Ophthalmological Society, Vancouver, British Columbia, Canada, June 2011

First author:
Guillermo Rocha, MD, FRCSC

GRMC Vision Centre,
Brandon, Manitoba, Canada