Relaxing Incisions With Premium IOLs

Advice for getting started.

BY LOUIS D. "SKIP" NICHAMIN, MD

During the past decade, the term *refractive cataract surgery* has evolved from a rubric discussed at the podium by innovative anterior segment surgeons to a reality for all surgeons implanting IOLs. Experience with keratorefractive surgery has proven that astigmatism of as little as 0.75 D may leave a patient symptomatic with blur, ghosting, and halos. Today's surgeons must now target refractive accuracy of ±0.50 D for both spherical and astigmatic outcomes.[1] Newer toric IOL designs are gaining in popularity, but an incisional approach continues to be the most common technique for addressing preexisting cylinder. The latter also complements the use of any type of lens implant, including presbyopia-correcting designs. Excimer laser technology, although exquisitely capable of reducing astigmatism, will likely continue to be used mainly as an enhancement technique for the foreseeable future. If you wish to begin performing limbal relaxing incisions (LRIs), this article shares advice based on the author's experience.

OVERVIEW

The first steps are to obtain a nomogram and appropriate instrumentation, to commence accurately assessing astigmatism and corneal status (including the performance and an understanding of corneal topography), and to learn and practice the surgical technique itself. Excellent courses are available at most major ophthalmic meetings, but also consider observing colleagues who have experience performing LRIs.

Early on, it is advisable to choose patients with reasonable expectations such as ametropes with dense cataracts who have opted for a standard monofocal IOL. Seek moderate levels of regular astigmatism (in the range of 1.25 to 2.50 D) with consistent preoperative measurements to help facilitate surgical planning. Selecting cooperative patients with good exposure of the globe can aid the technical performance of your first cases, and you might consider waiving a monetary charge for LRIs until you become skilled at the technique. You need not be concerned about adjusting IOL power, as the spheroequivalent does not change with the addition of LRIs, unlike with astigmatic keratotomy that is performed at a smaller optical zone.

NOMOGRAMS

A number of popular nomograms are currently available. Choosing one is probably less important than performing careful measurements and planning and performing the relaxing incisions.[2] The nomogram that I developed originated from the work of Stephen Hollis, MD, and it incorporates concepts taught by Spencer Thornton, MD, particularly his age-related modifiers.[3] I align the patient's age with the amount of preoperative cylinder to be corrected to find the suggested arc length that the paired incisions should subtend (Table 1).

Surgeons commonly use an empiric blade-depth setting when performing LRIs—typically 600 µm. This historically has been a reasonable practice for cataract surgery. In the setting of refractive lens-based surgery with presbyopia-correcting IOLs—where ultimate precision is required—it is my preference to perform pachymetry and adjust the blade-depth setting. Pachymetry may be performed either preoperatively or at the time of surgery. Readings are taken over the entire arc length of the intended incision, and the surgeon then sets an adjustable micrometer diamond blade to approximately 90% of the thinnest reading obtained. Refinements to the blade-depth setting as well as adjustments of the nomogram may be necessary depending upon your surgical technique, the instruments you use, and, in particular, the style of the LRI blade. New technology such as intraoperative wavefront aberrometry (ORange; WaveTec Vision Systems, Inc., Aliso Viejo, CA) can be quite helpful when refining the placement and performance of both astigmatic relaxing incisions as well as toric IOLs.

TABLE 1. THE NICHAMIN AGE- AND PACHYMETRY-ADJUSTED (NAPA) INTRALIMBAL ARCUATE ASTIGMATIC NOMOGRAM

WITH-THE-RULE

(Steep Axis 45° to 135°)

PREOPERATIVE CYLINDER, D	PAIRED INCISIONS IN DEGREES OF ARC					
	20- to 30-yo	31- to 40-yo	41- to 50-yo	51- to 60-yo	61- to 70-yo	71- to 80-yo
0.75	40	35	35	30	30	
1.00	45	40	40	35	35	30
1.25	55	50	45	40	35	35
1.50	60	55	50	45	40	40
1.75	65	60	55	50	45	45
2.00	70	65	60	55	50	45
2.25	75	70	65	60	55	50
2.50	80	75	70	65	60	55
2.75	85	80	75	70	65	60
3.00	90	90	85	80	70	65

AGAINST-THE-RULE

(Steep Axis 0° to 44°/136° to 180°)

PREOPERATIVE CYLINDER, D	PAIRED INCISIONS IN DEGREES OF ARC					
	20- to 30-yo	31- to 40-yo	41- to 50-yo	51- to 60-yo	61- to 70-yo	71- to 80-yo
0.75	45	40	40	35	35	30
1.00	50	45	45	40	40	35
1.25	55	55	50	45	40	35
1.50	60	60	55	50	45	40
1.75	65	65	60	55	50	45
2.00	70	70	65	60	55	50
2.25	75	75	70	65	60	55
2.50	80	80	75	70	65	60
2.75	85	85	80	75	70	65
3.00	90	90	85	80	75	70

Blade depth setting is at 90% of the thinnest pachymetry.

Abbreviation: yo, year-old.

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TECHNICAL PEARLS

Proper centration of the incisions over the steep corneal meridian is of the utmost importance. Surgically induced astigmatism from the cataract incision may affect the axis of the LRI. The Web site www.lricalculator.com allows the user to enter the planned cataract incision. The program then uses vector analysis to calculate the proper position of the relaxing incisions and uses either the Nichamin or DONO nomogram to create a printable surgical plan.[2]

According to Euclidean geometry, an axial deviation of 5°, 10°, or 15° will result in a 17%, 33%, or 50% reduction in effect, respectively.[4] Also, increasing evidence supports the notion that significant cyclotorsion may occur when patients assume a supine position.[5] For these reasons, most surgeons advocate placing a limbal orientation

TABLE 2. POTENTIAL PROBLEMS

- Infection
- Weakening of the globe
- Perforation
- Decreased corneal sensation
- Induced irregular astigmatism
- Misalignment/axis shift
- Wound gape and discomfort
- Operating upon the wrong (opposite) axis!

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mark while the patient is in an upright position. From this known orientation point, you can use a Mendez Ring or similar degree gauge to identify the steep meridian over which you will place the LRIs. This steep meridian corresponds with the plus-cylinder axis of the patient's refractive error. Various marking instruments are available to delineate the extent of the arc to be incised.

The LRI should be placed at the most peripheral extent of clear corneal tissue. Avoid placing the incisions farther out at the true surgical limbus, because a significant reduction of effect will likely occur due to both thicker tissue and a variation in its composition. LRIs are therefore really intralimbal in nature. When creating the incision, it is important to hold the knife perpendicular to the corneal surface in order to achieve a consistent depth and effect. This positioning will also help to avoid gaping of the incision. Good hand and wrist support is important. For smooth arcuate incisions, hold the blade as if you were throwing a dart so that you can rotate the instrument between your thumb and index finger as it advances. Typically, surgeons use their right hand to create incisions on the right side of the globe and their left hand for incisions on the left side. In most cases, it is more efficient to pull the blade toward yourself, as opposed to pushing it away.

ENHANCEMENTS

LRIs lend themselves well to in-office touchups. In the case of an undercorrection after previous LRIs, inspect the length and positioning of the incisions. As noted earlier, placing the incisions too far out into the true anatomic limbus and beyond clear cornea will often lead to an undercorrection. In such a case, you can place new incisions inside the original LRIs but modestly reduce the arc length. If the original incisions' placement appears to be appropriate, you can simply extend them. Alternatively, if an empiric blade-depth setting was initially used, perform pachymetry and deepen the incisions as indicated.

When faced with an overcorrection, resist the temptation to place additional incisions in the opposite meridian. Doing so can destabilize the cornea with unpredictable refractive results or, worse, induce irregular astigmatism. Rather, consider modalities not involving incisions such as PRK and LASIK.

COMPLICATIONS

As with any surgical technique, potential complications exist with the use of LRIs (Table 2). Of these, the most likely is the placement of incisions upon the wrong axis. This problem typically takes the form of a 90º error with positioning upon the opposite, flat meridian, which results in an increase (likely a doubling) of the patient's preexisting cylinder. Compulsive attention is required in this regard. To prevent this frustrating complication from occurring, consider employing safety checks such as posting a properly oriented written plan in the OR.

Although rare, corneal perforation is possible. It may be due to improper setting of the blade's depth or a defect in the micrometer mechanism. The latter problem may arise after repeated autoclaving and many sterilizing runs. Periodic inspection and calibration are therefore warranted, even with preset single-depth knives. Unlike radial microperforations, these circumferential perforations will rarely self-seal and will likely require the placement of temporary sutures.

CONCLUSION

The correction of preexisting astigmatism has become an integral component of modern lens-based refractive surgery, and it is a key factor in determining a patient's satisfaction after the implantation of premium IOLs. Modern refractive cataract surgeons need to learn how to use LRIs. Fortunately, recent advances in technology and technique have made this procedure safer and more effective. In the author's experience, no other core technique can add more value to your surgical repertoire and/or patients' satisfaction. ■

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