The concept of refractive cataract surgery has received increased attention from surgeons over the past several years. Astigmatism of up to 0.75 D may leave a patient symptomatic with visual blur, ghosting, and halos. For this reason, managing preexisting astigmatism has become a requisite of modern phacoemulsification.

Although toric IOLs have helped to address preexisting astigmatism in cataract patients, they have not diminished the need for incisional surgery intraoperatively to control astigmatism. Preoperative astigmatism can be controlled and modified with incision parameters, including size, configuration and construction, location, and closure; astigmatic keratotomy; and limbal relaxing incisions (LRIs) in addition to toric IOLs. Of these, modification of the site and size of the incision is the most straightforward method to correct mild to moderate amounts of astigmatism. The technique is associated with predictable outcomes without the need for special instrumentation.

**PATIENT SELECTION**

It is estimated that approximately 70% of the general cataract population has at least 1.00 D of astigmatism, and approximately 33% of patients undergoing cataract surgery are eligible for treatment of preexisting astigmatism. The main parameters to be considered before astigmatism correction include the location of the cylinder, the patient’s age, and the status of the fellow eye. Most patients with age-related cataract have against-the-rule astigmatism. Residual with-the-rule astigmatism may favor better distance UCVA, and residual against-the-rule cylinder may improve near UCVA.

**ASTIGMATIC TARGETING**

Preexisting corneal astigmatism identified by corneal topography can be surgically corrected at the time of cataract surgery. With an on-meridian approach, the incision is made on the steepest axis of corneal astigmatism to reduce the dioptric power of that axis. However, the surgically induced astigmatism of a standard corneal incision is small, and, when combined with rapid wound stabilization, the effect is small and unpredictable. A temporal corneal tunnel combined with a paired LRI placed at the steep keratometric axis at the time of cataract surgery has been shown to have a more favorable and lasting effect. Arcuate keratotomy has also delivered favorable results when performed at the time of cataract surgery. Individual sur-
geons use their preferred technique or a combination of techniques to optimize their results.

On the basis of the magnitude of astigmatism measured by corneal topography, a systematic stepwise approach to surgical astigmatism correction should be adopted. For less than 1.00 D of astigmatism, the phaco incision can be placed on the steep axis (Figure 1). This is accomplished by centering the incision on the steep corneal meridian. By varying incision size and design, the surgeon can produce a desired amount of wound flattening to decrease cylinder. Surgeons should determine the effects of their incisions on surgically induced astigmatism. A good general rule is that a 3.2-mm clear corneal phaco incision results in surgically induced astigmatism of 0.50 D (95% confidence interval of 0.40 to 0.60 D).8 Hill suggests that incisions less than 2.4 mm wide do not reduce surgically induced astigmatism much below 0.50 D, as these incisions stretch during IOL implantation.9 For patients receiving monofocal IOLs with less than 1.00 D of preexisting corneal astigmatism, an incision on the steep axis is usually sufficient.

**TEMPORAL CATARACT SURGERY**

For some surgeons, the on-axis technique has largely been replaced by a consistent and astigmatically neutral phaco incision combined with supplemental LRIs. Kaufmann et al6 concluded that LRIs in combination with a temporal clear corneal incision provided superior astigmatic outcomes compared with on-axis surgery.

Many surgeons choose to operate temporally on all eyes. Jiang et al10 conducted a prospective trial of 44 eyes randomly separated into groups of temporal versus on-axis incisions. They found significantly better UCVA in the on-axis group. Altan-Yaycioglu et al11 reported a significant increase in surgically induced astigmatism with nasal quadrant incisions compared with eyes with temporal or superior incisions.

Some right-handed surgeons prefer to make superotemporal incisions in right eyes and superonasal incisions in left eyes.12 Although the mean surgically induced astigmatism by vector addition may not differ significantly between groups, individual patient outcomes can vary widely when the incision is made in the same location regardless of preoperative corneal astigmatism.

**TAKE-HOME MESSAGE**

- Modification of the site and size of the incision is the most straightforward method to modify mild to moderate amounts of astigmatism.
- The on-axis approach appears simple; however, it presents logistical challenges.

**CONCLUSION**

Refinement of the refractive outcome is one of the most important challenges faced by cataract surgeons. Along with spherical error, preexisting astigmatism may now be safely and effectively reduced at the time of cataract surgery. The on-axis approach appears simple; however, it provides logistical challenges, including movement around the surgical table, which often produces awkward hand positions. Additionally, instrumentation needs may vary from case to case. The surgeon must consider ergonomic issues such as wrist support, legroom beneath the operating table, and the position of the operating microscope when considering on-axis phacoemulsification.

The effect of the phaco incision may not be significant in cases with more than 0.75 D of astigmatism. Toric IOLs, which have been shown to be safe and accurate for treating astigmatism during cataract surgery,13 have largely supplanted the use of other techniques for tackling preexisting astigmatism in these cases.

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