Axis or meridian?

Definitions

A spherical refractive surface or lens has equal dioptric power in all meridians. In contrast, a sphero-cylindrical “astigmatic” surface or lens has greatest refractive power in 1 meridian and least refractive power perpendicular to that meridian. Cylindrical lenses have zero refractive dioptric power in 1 meridian and maximal or minimal refractive power in the perpendicular meridian. The axis is the meridian with zero power.

In incisional refractive surgery, astigmatism-correcting incisions in the cornea must be placed on the steep meridian to flatten that meridian with intended coupling and, therefore, steepening of the flat meridian. To use the term axis (eg, on-axis incision) in this context is misleading. Unfortunately, in both clinical presentations and published articles in the ophthalmic literature, axis is used when the author actually means the steep meridian. To avoid confusion, why not say so? An example of this misuse (“on-axis phacoemulsification” and “on-axis incision”) is found in the article by Khan et al. about the prevalence of corneal astigmatism in routine cataract surgery patients (pages 1751–1755).

The Scope of the Problem?

Astigmatism correction is part of a surgeon’s expectation in the cataract surgical process. Increasingly, informed patients demand emmetropia as an outcome and emmetropia is the desired outcome with multifocal intraocular lenses (IOLs). Therefore, current techniques seek to avoid the induction of astigmatism by using smaller incisions and correcting preoperative astigmatism. What is the scope of the preoperative astigmatic problem? Khan et al. describe a total of 1230 eyes of 746 patients with a mean age of 75.54 years ± 10.71 (SD). In 79.5% of eyes, corneal astigmatism was 1.5 D or less; in 9.69%, more than 2.08 D; in 4.61%, more than 2.5 D; in 1.93%, 3.0 D or more; and in 0.96%, more than 3.5 D. In a series of 7500 eyes published in 1980, Hoffer reported that 23.6% of eyes having cataract surgery had more than 1.5 D of corneal astigmatism.1 Ferrer-Blasco et al.2 reported that almost a quarter of eyes (24.47%) had 0.5 D or less of corneal astigmatism, whereas 40.41% had more than 1.0 D of astigmatism. Most helpfully, they graphically illustrated the incidence of various degrees of astigmatism in 6 age groups from younger than 40 years to 90 years; eg, 35% at 0.75 to 2.0 D in the 80- to 90-year-old group and 39% between 0.75 D and 2.0 D in the younger than 40-year-old group.

Value of Corneal Topography and Treatment Options

Corneal topography before cataract surgery visually defines the steep meridian and provides a compelling guide for addressing any astigmatic error at the time of surgery, which, if successful, negates the need for secondary adjustment. The dimensions and location of the primary incision determine its effect on induced astigmatism. Small incisions less than 2.5 mm have only a local flattening effect in a near limbal clear corneal incision, whereas wider incisions create flattening toward and including the optical zone.3 If the primary cataract/refractive lens exchange incision is to be used to neutralize preexisting astigmatism, the incision must be elongated appropriately and for symmetry of effect, paired. Corneal topography also demonstrates asymmetry of corneal astigmatism when it exists, which allows planning of asymmetric paired relief incisions or limbal relaxing incisions; for higher degrees of astigmatism, opposite clear corneal incisions are most effective.4

The expectations and demands of modern cataract surgery require attention to astigmatism neutralization, which includes the option of toric IOL implantation. Excimer laser keratectomy and piggyback toric IOLs remain for secondary correction of residual or induced astigmatism.

Lens surgery incisions intended to be effective in neutralizing preexisting astigmatism should be placed on the steep meridian and should be defined so the term axis is reserved for the least refractive power perpendicular to that meridian.

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REFERENCES