Treating High Amounts of Astigmatism

Successfully addressing this refractive error produces deeply satisfied patients.

BY JOHN F. DOANE, MD

Treating significant amounts of astigmatism (greater than 3.00 D) is a task that produces great anxiety in many ophthalmic surgeons. To the lay community, astigmatism represents a condition yet to be tamed, let alone mastered, by surgeons. Although cylinder is usually congenital, there are cases of high levels of iatrogenic astigmatism from surgical procedures such as penetrating keratoplasty.

Numerous approaches effectively treat high astigmatism with modern technology. In our clinic, my colleagues and I routinely tackle astigmatism greater than 6.00 D and occasionally up to 10.00 D. Our patients are often surprised and always impressed when they learn that we can correct significant levels of astigmatism. They usually can recount many mediocre earlier attempts at its treatment. The differing meridional axial powers of glasses lead to distortion; soft contact lenses tend to rotate significantly with blinking, resulting in ever-changing visual acuity; and rigid contact lenses are uncomfortable. Surgeons who can provide predictably successful results with astigmatic correction significantly improve their patients' quality of life.

This article represents a road map on how to become a master at attacking and reducing (if not eliminating) high amounts of astigmatism.

ASTIGMATISM IN CORNEAL REFRACTIVE SURGERY

Patients seeking corneal refractive or cataract/IOL surgery may present with high astigmatism. I would first like to tackle the treatment of astigmatism at the level of the cornea.

I believe most surgeons would currently agree that tissue-removing surgery in the form of excimer laser corneal refractive surgery is more predictable and stable over time than incisional keratotomy. I think the latter has its place for lower levels of astigmatism associated with IOL implantation. For astigmatism greater than 3.00 D, however, the excimer laser becomes the primary surgical instrument. The important question is how to treat high amounts of astigmatism. Some surgeons will "debulk" high cylinder with a limbal relaxing incision (LRI) and then perform an excimer laser ablation 1 month later.

Early in the history of excimer lasers, surgeons created dysphotopsia with small ablation zones. This problem became particularly noticeable to patients when the short axis of the astigmatism was 4.5 mm or less. Many of these patients had moderate-to-marked unwanted symptoms under scotopic conditions. Additionally, it has been my experience that the small-diameter, short-astigmatic-axis treatments are more prone to regression of effect than larger short-axis treatments on the order of 5.5 to 6.0 mm or more.

Another factor to consider is whether one is going to treat the astigmatism in one cylinder convention (unimeridional) or with a mixed astigmatism or bitoric ablation. Over 10 years ago, I became interested in a bitoric approach while looking at the ablation designs of Paolo Vinciguerra, MD, of Milan, Italy, and Arturo Chayet, MD, of Tijuana, Mexico. My personal approach to these cases is to use two treatment cards until a 6-mm or larger short-axis treatment is available in the United States. In this country, the magnitude of astigmatic correction for customized ablations is approximately

BITORIC TREATMENT CALCULATIONS

Right Eye
- Fogged manifest refraction = -9.50 +5.25 X 119
- Treatment card No. 1: - 6.87 +2.75 X 29
- Treatment card No. 2: plano +2.5 X 119
- Maximal central depth of ablation: 101 µm
- Ablation dimensions: 5.5 X 8.5 mm

Left Eye
- Fogged manifest refraction = -11.75 +5.5 X 70
- Treatment card No. 1: - 9.0 -2.75 X 160
- Treatment card No. 2: plano +2.5 X 70
- Maximal central depth of ablation: 126 µm
- Ablation dimensions: 5.5 X 8.5 mm

3.00 to 4.00 D of compound myopic astigmatism; for a standard ablation, it is approximately 5.00 D for myopic cylinder and 4.00 D for hyperopic cylinder.

My technique involves treating half the astigmatism in a plus cylinder convention and half in a minus cylinder convention. I then address the spherical equivalent of the refraction, which is treated on the card of equivalent cylinder sign as the sphere. For example, a 31-year-old white male presented with a refraction of - 9.25 +5.25 X 119 = 20/25 OD and -11.75 +5.5 X 70 = 20/25 OS. His pachymetry readings were 570 µm OD and 567 µm OS. His simulated keratometry readings were 45.25 X 32/49.00 X 122 OD and 45.62 X 170/49.12 X 80 OS (see *Bitoric Treatment Calculations* for the treatment cards for the patient's two eyes). It is important to understand that the surgeon should use his or her typical nomogram for the spherical treatment. An ophthalmologist who reduces sphere by 10% for spherical myopic treatments should do likewise for bitoric ablations.

The benefits of the bitoric approach are that it enlarges the overall ablation and lengthens the short axis of the ablation from 5 to more than 6 mm. These changes decrease the chance of unwanted scotopic imagery and also minimize the regression of the astigmatic correction's effects.

ASTIGMATISM IN IOL IMPLANTATION

Surgeons can use all of the tips already described in combination with LRIs and toric IOLs. Alternatively, they can combine presbyopia-correcting IOLs with either LRIs or laser vision correction (PRK or LASIK). For corneal astigmatism that is greater than 2.50 D or against the rule, I favor implanting a toric IOL and/or performing laser vision correction.

If a patient desires a presbyopia-correcting IOL and he or she has greater than 2.50 D of corneal astigmatism, I will create bilateral corneal flaps with either a mechanical microkeratome or femtosecond laser (bioptics) and implant the lenses on the same day. I implant the IOLs 1 week apart if required by a third-party payer. I will lift the flaps and perform the laser ablation 4 weeks after the last IOL's implantation.

If a patient is not interested in receiving presbyopia-correcting IOLs and the level of astigmatism is 5.00 D or less and with the rule, I will implant a toric IOL and make an LRI. If the corneal astigmatism is greater than 5.00 D or is against the rule, I will implant a toric IOL and perform laser vision correction (PRK or LASIK) for the residual refractive astigmatism.

For example, a 58-year-old white female presented with visual degradation from cataract. Her habitual preoperative spectacle prescription was -6.25 +3.25 X 94 = 20/40 OD and -3.5 +5.0 X 85 = 20/50 OS. Manual keratometry measurements were -41.75 @ 10/45.75 @ 100 OD and 41.75 @ 1/45.50 @ 91 OS. Figure 1 shows the preoperative topography of her left eye. The patient had essentially 4.00 D of congenital corneal astigmatism. Currently, no toric IOL can resolve all of this astigmatic error, so a combined or bioptic technique was required. In this case, I planned to perform temporal clear corneal phacoemulsification and to place a 3.00 D toric IOL, which I expected would reduce the astigmatism by 2.00 to 2.25 D. I planned to correct another approximately 2.00 D of astigmatism with dual 6-mm LRIs. One year postoperatively, both eyes essentially have a plano spherical equivalent and refractive astigmatism of 0.25 D OD and 0.50 D OS. The patient is very happy with a UCVA of 20/20+ OU. I should note that LRIs and laser vision correction can also be successfully applied in a bioptics technique with phakic IOLs.

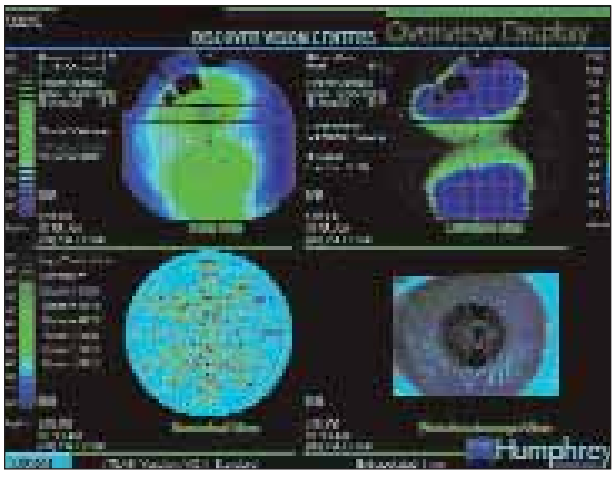

Figure 1. Topography of the patient's right eye. Note the marked amount of with-the-rule, symmetric, bowtie congenital astigmatism.

SUMMARY

Ophthalmic surgeons currently have the ability to combine corrective techniques to afford the highest level of refractive accuracy and visual performance. To patients with high levels of astigmatism, this achievement is nothing short of miraculous. The use of bitoric ablations or bioptics techniques for the treatment of high levels of congenital or surgically induced astigmatism represents a significant advance in refractive surgical care. ■

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