

Surgeons who have been performing on-the-axis incisions are witnessing dramatic improvement in postoperative astigmatism. Early proponents of this approach, such as Drs. Terry and Gills, have found the effect to be stable many years out. This month's columnist, Dr. Noel Alpíns, has assembled an impressive computer software program, ASSORT, with windows for following postoperative astigmatism. Tracking astigmatism after cataract surgery helps demonstrate the value of techniques such as on-the-axis incisions.

—R. Bruce Wallace III, MD

What type of cataract surgeon are you?

by Noel A. Alpíns, MD
Special to OCULAR SURGERY NEWS

Are you one of the majority of cataract surgeons operating at the traditional position at the head of the patient, with the incision placed near the 12-o'clock position? Have you changed in recent times to operate from the temporal side, and moved your incision to the limbus or clear cornea? Or are you one of the number of versatile surgeons with compliant operating room staff who varies the incision placement according to the prevailing corneal shape?

The answer to these questions will frequently be reflected in a surgeon's own philosophy on the effect one's incision has on the corneal shape. Each surgeon has a choice available for each surgery performed, namely—is my surgical goal to maintain astigmatic neutrality, or is it to reduce existing astigmatism? This can be stated another way—do I want to maintain the preoperative shape of the eye, or do I want to change it?

The variety of choices available for incision placement can be puzzling if one does not follow the guiding principle, that in all forms of refractive surgery, including astigmatism surgery, one has to be very clear and precise about the surgical goal. To be able to specify this goal, each surgeon must know his or her own astigmatism profile for each incision and closure type, as it will vary between surgeons according to individual variations in wound construction, location and closure.



Noel A. Alpíns

Incision suture profile

For example, using a selection of incision suture profiles, a 4- and 5.1-mm incision with continuous cross-stitch (CXS) suturing is close to astigmatically neutral, whereas a 6.5-mm no-stitch configuration induces the greatest against-the-wound (ATW) shift.

Preoperative astigmatism is the most important factor: whatever your philosophy of incision placement, astigmatism can only be properly addressed by selecting the incision and closure method from one's profile which takes account of the preoperative astigmatism.

The amount of corneal change expected (as shown by one's past experience with the performance of the incision) determines the target-induced astigmatism (TIA). In the case of a spherical cornea, all three types of surgeons would, in most cases, favor astigmatic neutrality, with a TIA of zero.

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TARGET EMMETROPIA

Refining the refractive outcome of ocular surgery

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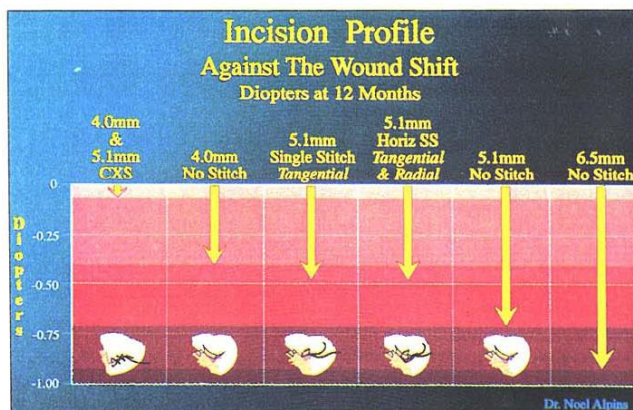
The goal of the surgeon who places his incision at the steepest corneal axis is astigmatic reduction, with a TIA chosen to approximate as closely as possible the preoperative astigmatism.

The cataract surgeon who places his incision on the temporal side of the eye commonly uses a 4-mm or smaller incision, with a consequential lesser amount of induced astigmatism in the with-the-rule (WTR) direction. When greater amounts of astigmatism are present with the steep axis horizontal, that is, against-the-rule (ATR), he or she may deliberately use larger incisions to induce a greater change. Inducing some ATW shift does not usually concern these surgeons when the cornea is spherical or mildly with-the-rule (steeper vertically), because they would argue that with a 4-mm sutureless incision a resultant small (0.4 D) change leaving a small amount of WTR astigmatism is not an unfavorable optical result.

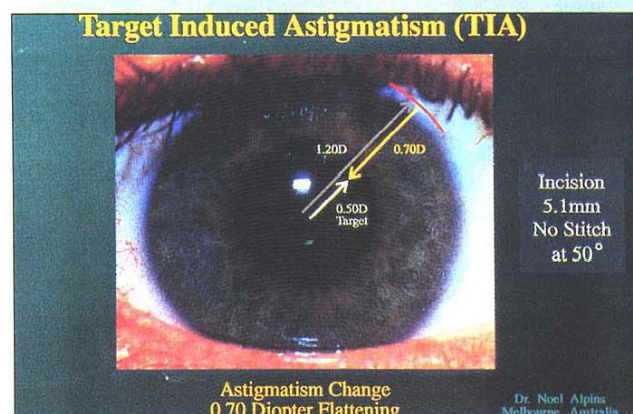
When the incision is placed at the 12-o'clock meridian, the ATW forces at work all flow in an against-the-rule direction. Suture tightening can only temporarily reverse this effect. Surgeons placing their incisions here recognize this trend and will plan for astigmatic neutrality with a spherical cornea, or with any small amounts of preexisting ATR astigmatism; for larger amounts, they will consider transverse astigmatic keratotomy. If more than a 0.5 D of WTR astigmatism is present, then they may also harness the characteristics of the appropriate incision (which determines the TIA), to reduce the pre-existing astigmatism.

Polar axes

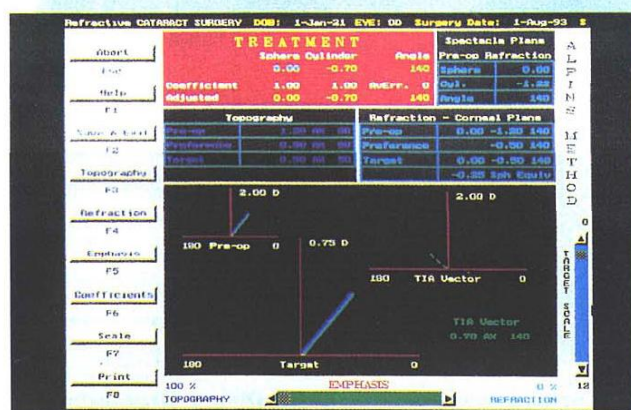
All the surgeons who work at the polar axes, (vertical, 90°—and horizontal, 180°—meridian), do not address the problem of obliquely placed astigmatism; furthermore, they have not had the means to calculate what astigmatism result they are targeting when their incision and resultant TIA is oblique to the preoperative state. Influencing the axis of the pre-existing astigmatism to rotate it in a clockwise or counterclockwise direction by wound manipulation is uncharted territory to date.



Using a selection of incision suture profiles, a 4- and 5.1-mm incision with continuous cross-stitch suturing are close to astigmatically neutral.



A no-stitch technique with a 5.1-mm incision may have a mean ATW effect of 0.7 D.



When cataract surgeons have astigmatic neutrality as their goal, the analysis of their results is best performed by Naeser's formula for the changes on the polar axes, and Jaffe's method for surgically induced astigmatism (SIA) as a measure of the unwanted change, whatever the SIA's orientation. Naeser's method provides two sets of useful information—the first is the status of the cornea in a WTR/ATR sense before and after surgery, and second, the surgical change induced by obtaining the difference between postop and preop values.

However, the introduction of the concept of refractive cataract surgery has initiated a shift of the surgical goal from one of astigmatic neutrality to one of astigmatism reduction. Certainly, the overall astigmatism of any group of eyes will be reduced using this technique. However, this recently popularized practice (the benefits of which have been known for some time) has resulted in an inability of our current planning and analysis capabilities to keep

pace with our needs. In this situation, when the incision is set off the polar axes, we cannot use the polar formulae of Naeser and Cravy.

We need to know more than what happened—we need to also know how this differed from what we wanted to happen; by comparing the SIA calculated after surgery with the TIA determined in the surgical plan, we can accurately measure our success. Was the incision placed according to plan, or was it shifted clockwise or counter-clockwise? Did the selected incision type perform on target, or has it been correcting more or less astigmatism than anticipated?

Relaxing effect

By locating the incision on the steepest corneal meridian, its known relaxing effect on the cornea can be graded against the amount of astigmatism at the steepest axis. As a general rule, the larger the incision and the less the amount of suturing, the greater the effect. To illustrate with an example, a no-stitch technique with a 5.1-mm incision may

have a mean ATW effect of 0.7 D. If the preoperative astigmatism readings for a patient shows, for example, 1.2 D at axis 50°, then that surgeon, by placing the midpoint of his incision at axis 50°, would be targeting a postoperative 0.5-D axis 50°. If this is not achieved, then the incision may have been placed off the desired axis, or may have induced more or less corneal relaxation than planned; consequently there would be an angle of error, a magnitude of error or both. If a trend shows over a number of cases, then appropriate adjustments can be made for future surgeries.

The goals of refractive cataract surgery are no different from other refractive procedures that we perform, such as astigmatic keratotomy and excimer laser surgery—that is, to eliminate the need for glasses by changing the corneal shape. When planning cataract and implant surgery—the most common operation we perform—and analyzing the results obtained, we can also choose to incorporate the precataract cylindrical refraction, when it is available, into our surgical plan.

Wherever the cataract surgeon places his incision, it is more likely, in time, that he or she will examine the preoperative and targeted astigmatism prior to surgery. This trend will bring refractive cataract surgery into line with all other forms of refractive surgery, in seeking to achieve the optimal astigmatic result by aiming for a surgical goal.