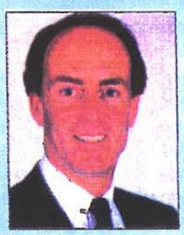
Managing astigmatism during cataract surgery

To explore developments in the management of astigmatism at cataract surgery, OCULAR SURGERY NEWS convened this roundtable discussion, moderated by Medical Editor William F. Maloney, MD, of Vista, Calif. In the conclusion of this two-part series, Noel A. Alpins, MD, of Melbourne, and Robert M. Kershner, MD, of Tucson, Ariz., discuss their techniques In part one, which appeared in the February 15 issue, participants were Randy J. Epstein, MD, of Chicago, Richard A. Fichman, MD, of Manchester, Conn., and R. Bruce Wallace III, MD, of Alexandria, La.

Each surgeon was asked to comment on astigmatic neutrality in terms of their incision; whether or not they use an astigmatically beneficial incision; and what they use for patients who have large amounts of astigmatism.



William F. Maloney

Robert M. Kershner

Noel A. Alpins

William F. Maloney, MD: Dr. Kershner, what is your cataract incision to achieve astigmatic neutrality?

Robert M. Kershner, MD: In my practice only about 27% of patients have enough visually significant astigmatism to even warrant this type of technique. About 80% of those patients will be 2 D or under and can be easily handled with a single arcuate keratotomy or the cataract incision itself. For the vast majority of our patients we do need to do good astigmatically neutral surgery. The best incision we have to date is a sutureless incision that is a tunnel incision off the dome of the cornea.

There is a marriage between the desire on the part of the surgeon to do less invasive surgery and not take down the conjunctiva and have to cauterize, with its potential for affecting astigmatism. You can still construct an astigmatically neutral incision on the cornea by doing it at the limbus just slightly anterior to the vascular arcade but constructing it in a nonastigmatically inducing fashion. Conversely, when you want to make that incision have an effect on astigmatism, you have to fashion it like an astigmatic or refractive keratotomy incision.

Making a corneal incision temporally is different than one superiorly. Although the cornea is geometrically circular, it is much wider horizontally than vertically, the proximity to the optical center of the eye is closer with an incision placed at the cornea superiorly than it is temporally.

The second phenomenon is the position of the extraocular muscles and the proximity of the muscle insertion to the optical axis, which will place forces on the incisions we place into the cornea. The astigmatically neutral incision is limbal. It can be clear corneal and it is going to be a planar incision as opposed to a stepped incision.

Maloney: What is the range of astigmatism in which you would use your astigmatically neutral approach?

Kershner: Astigmatism is clinically insignificant for 1 D and under. There is more to it than just the position of the incision. The larger the arcuate incision is, the more likely it is to induce astigmatism. All incisions in the cornea act as if tissue is added, which was first taught by Dr. Spencer Thornton. All incisions are potentially going to induce astigmatism if they are placed on the cornea. To be the least astigmatically inducing, it should be a flat planar incision and not in an arcuate fashion and placed as far out toward the limbus as is physically possible.

With patients with 2 D or more astigmatism, I use a systematized approach to correcting the preexisting astigmatism without overcorrecting it by using this method, which I call keratolenticuloplasty. This method reflects the remodeling of the cornea and the lens simultaneously to correct the preexisting refractive error. If I have a patient who has a 1 D or above of cylinder, the majority of those patients will fall under 2 D and can be corrected with a single arcuate incision placed strategically on the axis of steepest astigmatism.

For corrections greater than 2 D, I add an arcuate incision opposite the surgical incision for the cataract surgery to fully correct it. I feel the best time at which to correct astigmatism is at the beginning of the procedure before the eye has been changed.

Although you can do arcuate astigmatic keratotomy with K readings or with refraction, I do not recommend it. Ophthalmologists should treat the patient and not the topograph. However, if you have a patient with a refractive cylinder (which is decidedly different in axis or power from the topographic cylinder) beware. maybe it is best left alone.

Don't overcorrect. Do not operate off axis. If you cannot accurately measure the axis for the correction, it is best not to do it.

Maloney: Let's assume that we have measured astigmatism accurately and all of our attempts to measure it are consistent. How then to best locate it at the time you are ready to do the surgery?

Kershner: I like employing a reticle in the ocular of the microscope. This enables me to use the anatomical landmarks to orient the eye. Because I use topical anesthesia, I can enlist the patient's aid to fixate. Once the patient is fixated, I position my microscope to be able to identify the axis with a high degree of accuracy.

Then I'll keep the topographic map right next to the patient's head and I will consult that throughout the surgery.

My nomogram uses the concept of using the surgical incision for the bulk of the astigmatic correction and then marrying it with the paired arcuate keratotomy opposite it.

To enable surgeons to be able to accept this technology and to be able to use it and apply it inexpensively, I created a system with a simple set of nomograms that use basically two instruments, a set of arcuate keratotomy markers that allow you to position 3-mm arcuate marks onto the cornea from 5- to 9-mm OZ. Then using a triple-edged diamond keratome, incise those marks 2 to 3 mm in length depending upon the nomogram. Most astigmatism less than 2 D can be corrected with sizing your keratotomy for the cataract surgery, with an arcuate incision.

I prefer using pachymetry although standard depths for keratomes work nicely the majority of the time. Occasionally you will have a patient whose cornea is slightly thin in the area of the astigmatism. If you just arbitrarily set it at 550 or 600 µm, you can occasionally get a perforation. A perforation at the beginning of the case, can make visualization during phaco quite difficult and sometimes can make it very hard for lens implantation.

About the participants

Symposium moderator **William F. Maloney**, MD, is has been describing and teaching the elements of refractive cataract surgery since 1984; with offices at Ste. A, 2023 West Vista Way, Vista, CA 92083.

Robert M. Kershner, MD, is in private solo practice, specializing in cataract/IOL and anterior segment surgery; with offices at Ste. 303, 1905 West Orange Grove Rd., Tucson, AZ 85704-1117.

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A coupling factor with my nomogram can work in the surgeon's favor, because one advantage is that arcuate incisions closely follow the OZ. They are equal throughout their depth. You are more likely to get a more profound flattening in that meridian than you will with a simple transverse incision. Coupling phenomenon can be used to our advantage. If you have a patient who has a large degree of astigmatism, for which you need a single pair of AK incisions, we can anticipate that coupling will be close to one with arcuate astigmatic incisions. We are not going to affect the overall spherical component of the cornea by correcting the astigmatism and, do not have to change IOL power.

I prefer a triple-edged, square 1-mm diamond because it tracks the best when circumscribing the arcuate keratotomy. The maneuver is simple. Place the keratome in the edge of the mark, applanate the cornea keeping the keratome perpendicular to its surface, and then gently rotate it with a rotation between the thumb and index finger until you inscribe the length of arc required. A square-edged blade tracks evenly within the stroma of the cornea and allows a much cleaner incision which is squared off at either end.

Maloney: Dr. Alpins, describe your thoughts about astigmatic correction at cataract surgery. How do you treat these patients?

Noel A. Alpins, MD: My standard incision is a 5.1-mm scleral tunnel incision, about 1.5 mm back from the anatomical limbus. I do a three-plane self-sealing incision. At each meridian where the surgeon places the incision there will be a different flattening effect. When I place the incision superiorly I get the maximum amount of flattening effect, about 0.5 D. As I move that incision around to the tem-

less. As I move the incision toward the temporal side, the changeover occurs right about 30°/150° meridian. My astigmatically neutral incision is at 30° in the left eye and 150° in the right eye. When looking at my results I was surprised to find my temporal incisions I actually steepen the cornea. The mean for me is around about 0.2 D of actual steepening of the horizontal axis of the cornea. If I was going to operate on a patient who had against-the-rule incision, I would leave my incision 1.5 mm behind the limbus and do AK on a graduated basis or I would move that incision closer into the limbus.

Every surgeon's incisions have different constructions and effects. If I want to do an astigmatically neutral incision, I'm going to do it at 30° on the left eye and 150° on the right.

Kershner: Two factors contribute to this, getting further away from the OZ and getting between the superior and lateral rectus. You are having less gaping incisions. It is an anatomical phenomenon. All incisions onto the dome of the cornea will act as if tissue has been added. Now you are talking about scleral pocket off the dome of the cornea. All rules are off there. You have wound gape. How much wound gape are you going to get? If the wound gape is greatest, you will have the most flattening. With scleral incisions, you can get two different phenomena from the same incision. It depends on what you do with your closure.

Alpins: Certainly the anatomy of the limbus varies in different places, you have a narrow limbus temporally and you have a wider limbus vertically. I use a technique where I use virtually no diathermy so there is no contraction of tissue created in that way. You can even still get a certain amount of gape but with identically constructed incisions, without suturing, differences in astigmatic behavior do occur, even by the same surgeon operating on the same meridian. But there are trends evident.

For refractive cataract surgery, our surgical goal has moved from one of astigmatic neutrality to astigmatic reduction—whereas up until now we have been aiming for smaller and smaller surgically induced astigmatism. We are trying to tailor our incisions directly to start achieving higher amounts of SIA to induce more change from the incision.

In the patients who have 1 D of astigmatism or less, you can still improve their astigmatic state by using an incision to reduce it by placing the incision on the steepest axis. You can choose an incision which, by your own experience, you will know how much effect to expect. You may, for example, choose a 6.5-mm incision to give you the amount of flattening that is required for that cornea. That is you will choose the tool that will reduce the amount of astigmatism appropriately for that amount of preoperative astigmatism.

The trend now with astigmatic reduction as against astigmatic neutrality is to start using larger incisions rather than smaller incisions. When you start making larger incisions, there is a lesser desire to start using softer and foldable implants.

Maloney: What percentage of patients are astigmatically neutral in your practice vs. those in whom you would consider a larger incision?

Kershner: I think that 90% of my patients have 1 D or less of against-the-rule cylinder and I will get less astigmatic effect from a small-incision lens, so I have the best of both worlds. They have a small incision and it has an astigmatically beneficial effect.

Alpins: As other researchers have showed, in a myopic eye somebody between a 0.5- to 0.75-D with-the-rule astigmatism is the most favorable for vision at distance and for reading, that is the best compromise between the two.

Overall I would prefer an eye to have no astigmatism. The issue of overcorrection of astigmatism would not concern me if I was operating on a patient who was against-the-rule that I was concerned about, would I go for undercorrection or overcorrection? I would probably go for slight overcorrection to bump that patient up toward slightly with-the-rule. It is optically favorable to have with-the-rule astigmatism optically.

Maloney: If we go for that overcorrection and we get a little bit more than we expect we have 1.5 D and 2 D against in the other eye?

Alpins: In my experience it is meridional shifts caused by inadvertant off-axis incisions that cause problems of adaptation. An axis shift caused by an on-axis incision will only change by 90°—an overcorrection as you say.

Obtaining the full correction of astigmatism is as high a priority as the full correction of a significant spherical refractive error, in the expectation that the second eye is likely to require cataract surgery at some stage. If it is not anticipated soon, then the eye with 2-D against-the-rule astigmatism could undergo AK as a separate procedure.

Because of these meridional shifts, it is all the more important to bring the refraction into the surgical plan and not to operate entirely on the shape factor and leave the refraction out. If you know where you are targeting for both the refraction and for the shape, then you have better control over the outcome.

One of the bigger problems with AK isn't the actual undercorrection or overcorrection. I think the nomograms now available are excellent, enabling greater accuracy in there. I think the identification of the steepest axis at the time of surgery is the next hurdle to overcome. I certainly bring my topography maps into the operating room, I have them on the side of the phaco machine, I look at them. I look at the eye. In the end, even though you look at the AK incision after the operation and may be pleased with it anatomically, those incisions sometimes don't behave functionally as they should. AK still is a relatively gross operation to try to correct astigmatism because that patient's astigmatism incision may have been on the right spot and yet the astigmatism did show some axis shift.

I also believe in doing AK to correct astigmatism at the time of surgery because I don't think these patients appreciate two visits into the operating room. I will take 10 µm off the pachymetry for my blade setting with a double-edged blade and perform one or two arcuate cuts at the 7-mm OZ. I will choose the axis, once again as I mentioned a few moments ago, according to what I believe is to be the optimal balance between the topography and the refraction. I will bring the topography and the refraction into the surgical plan and this will help me decide at what axis to place the incision.

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> **—Robert M. Kershner**

I prefer the target astigmatism to be with-the-rule. If it is not with-the-rule, if it falls against-the-rule I will lessen the effect on the cornea by targeting close to a spherical cornea and leave that residual astigmatism (which you can't avoid because of these differences), in the refraction.

Maloney: If you have a situation where there is a discrepancy between astigmatism with topography and astigmatism by refraction, how can we not be sure that the difference isn't the result of lenticular astigmatism?

Alpins: By examining the oldest pair of glasses they've got. If these patients have got cataracts, there are going to be some changes in the last two or three years. If I am in any doubt about the veracity of their refractive astigmatism, I will go with the topography values. If those glasses are reliable as far as how long they've been used, and you can be satisfied that the refraction has been an accurate one I'll take it into account.

If lenticular astigmatism was the only reason that we are getting these differences, then after lens surgery all of these patients' refractive and topographical astigmatism would be aligned, but they are certainly not. Lenticular astigmatism is not the answer.

I deal with residual astigmatism by the graphics and by examining where the target is, I can shift the icon around and determine the best place for that incision.

After placing the incision, the critical thing isn't over then. I then look at all the results and see how all of those incisions are behaving at each of those axes. I see how much flattening or steepening is occurring at 15° axis steps. Then with the history of your last 20 incisions or your last 200 incisions, you know how an incision at that place will behave and then you can determine your targets more accurately and then you can target emmetropia.

We talked about the difficult patient for access at 40° on the right eye and 160° in the left eye. My boundaries are 225° right to 315° left. For a left eye which is 170° I'll go to 350° and right eye which is 40°, I'll go to 220° and I'll operate on the opposite side or meridian of the cornea. By going all the way down temporally and gaining 45° on either side, I've overcome those problems of the nose by operating infratemporally and do the analyses accordingly so that I determine my flattening and steepening profiles at all incision meridians. ■

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