

Achieving a Watertight Incision

Three surgeons share their approaches.

David R. Hardten, MD



For lens implantation, especially with the newest presbyopia-correcting IOLs, all aspects of the cataract surgical procedure should be of the highest quality to achieve the goal of rapid visual recovery. Safety must also be a high priority, as surgeons try to perfect all of the procedure's steps to meet patients' ever-rising expectations. A crucial component of success is a wound that seals well. It is at times difficult to create an incision that is astigmatically neutral, self-sealing, and comfortable.

I have found that both diamond and metal blades are acceptable for creating incisions that are typically self-sealing and watertight. The newer metal blades are quite sharp, have trapezoid edges, and provide an economical way to make an incision. When keratomes are taken care of by a conscientious staff, I prefer diamond blades, as I believe the incisions I create with them are more reproducible. In a hospital setting or in a multispecialty ambulatory surgery center, however, the breakage and damage rate is such that I use metal blades.

INCISION'S SIZE AND LOCATION

Although surgeons tend to think that smaller wounds seal more easily, I prefer to create an incision that is 0.1 to 0.2 mm larger than the minimum required for the phaco sleeve or the IOL injector. I find that stretching the wound is more damaging to its self-sealing properties than its size.

I teach a groove's creation first, however, to beginning residents. I find that it is difficult for less experienced surgeons to control the starting point of the incision with a paracentesis-style beginning. I typically use a 2.6- to 2.8-mm blade, and I prefer to create a groove that is approximately 2.2- to 2.4-mm long.

In my hands, a slightly rectangular incision permits a watertight seal, yet it is still located far enough away from the center of the cornea to achieve an average 0.28 D drift of cylinder against the incision. This allows enhanced predictability for toric IOLs and corneal relaxing incisions.

There are proponents of wound creation at various locations depending upon the surgical limbus, but I prefer to begin my incision with a paracentesis-style incision (ie, no groove) located at the edge of the blood vessels. I believe the incision likely heals better when it is located in vascular tissue versus clear cornea.

WOUND CARE, PHACOEMULSIFICATION

Surgeons should take care to prevent stretching and heating the incision during the case. I currently use the Whitestar Signature System with the Ellips Fx handpiece (Abbott Medical Optics Inc., Santa Ana, CA). With the settings customized to achieve the right balance of phaco energy and fluidics, I find thermal damage extremely rare. Short phaco times are also important and can be achieved with current machines for most nuclei.

If gentle hydration of the incision at the end of the case does not provide a watertight seal at physiologic pressures, I will place a suture. I prefer a 10-0 Vicryl suture (Ethicon, Inc., Somerville, NJ), which I can either allow to dissolve or remove in a few days. If a permanent suture such as nylon is used, then I think it should be removed in the first month or so. I have observed late abscesses from forgotten sutures; patients may present with significant inflammation as long as several years after their cataract surgery.

CONCLUSION

Creating and maintaining a watertight incision after cataract-IOL surgery is essential to satisfying patients' expectations. Attention to detail can facilitate surgeons' success in the majority of cases. In the future, adhesives such as the ReSure (Ocular Therapeutix, Inc., Bedford, MA) may prove useful.

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Steven Dewey, MD



How many reasons are there for not suturing incisions in cataract surgery? There are many if the incisions are properly constructed, including less induced astigmatism, shorter procedural times, a decreased potential for phototoxicity, and of course, no late, broken sutures. My preferred incision is a self-sealing, limbal hinge created on the steep astigmatic axis with a steel blade. The incision is designed to allow insertion of the Tecnis 1-Piece IOL (Abbott Medical Optics Inc., Santa Ana, CA) with minimal stretching. Creating a self-sealing incision is relatively simple if a few rules are followed.

CREATING THE INCISION

With the globe appropriately firm, I start the incision with a groove and use an angled, steel crescent blade with a dual bevel and a 2.2-mm width. Placing the tip of the blade against the limbus, I create a groove to about two-thirds to three-quarters the depth of the tissue (Figure 1). I then flip the blade to place the flat aspect against the sclera and “tadpole” the blade forward until I have achieved a tunnel of desired length (Figure 2). I place the tip of a 2.8-mm dual-beveled keratome at precisely the desired entry point within the tunnel. By simply dimpling Descemet’s membrane posteriorly with the tip of the keratome, I can enter the anterior chamber (Figure 3).

LENGTH AND OARLOCKING

The best watertight incisions are also astigmatically neutral due to their geometry. These incisions seem almost as long as they are wide. I prefer an incision that

has a length that is at least three-quarters its width to achieve both a watertight seal and relative astigmatic neutrality.

Long incisions help ensure the chamber’s stability and assist in maintaining proper iris placement. Incisions located closer to the base of the iris may increase its tendency to prolapse. A long incision extending farther away from the iris’ base does not prevent its prolapse but does make it easier to reposition the iris and coax it into behaving without moving the incision.

The term *oarlocking* refers to the induction of corneal striae when working through an incision that is too small. The problem is more likely with a long incision, but using a bent phaco needle will minimize this phenomenon. Kenneth Rosenthal, MD, uses a different technique. During biaxial phacoemulsification, he creates an hourglass-shaped incision with a large internal and external opening. He uses a narrow portion in the middle of the cut to preserve the effect of the small incision. According to Dr. Rosenthal, this approach allows for greater movement of instruments without inducing corneal striae.

POSITION OF THE INCISIONS, TYPE OF BLADE

Most of the studies and surveys I have read about incisions characterize their position as either clear corneal or scleral. I prefer the limbus, which is posterior enough to allow a long tunnel incision without moving into the visual axis. Both limbal and corneal incisions offer easy access, but the former has the advantage of fibrovascular healing of the groove. Fibrovascular healing creates an external seal and potentially anchors the base of the incision more successfully than a purely corneal incision.

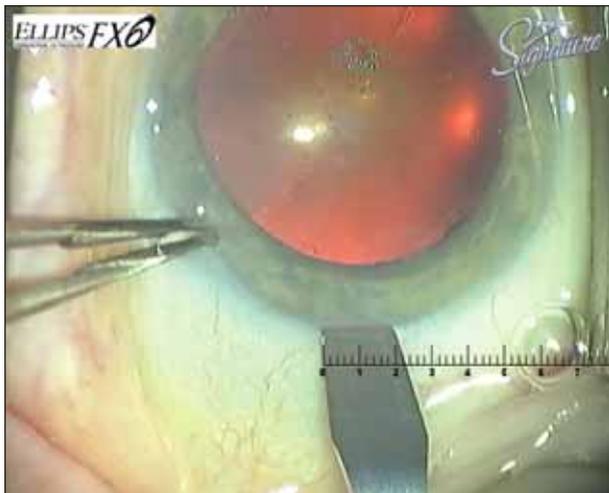


Figure 1. The angled crescent blade is oriented perpendicular to the limbus, just anterior to the vessels, and a groove is created to about two-thirds depth.

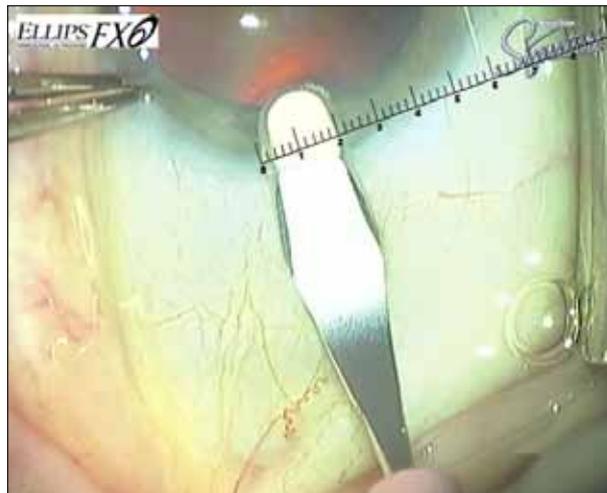


Figure 2. The blade is placed flat against the wall of the globe and “tadpoled” forward to create a tunnel. The starting point of the incision is roughly half thickness.

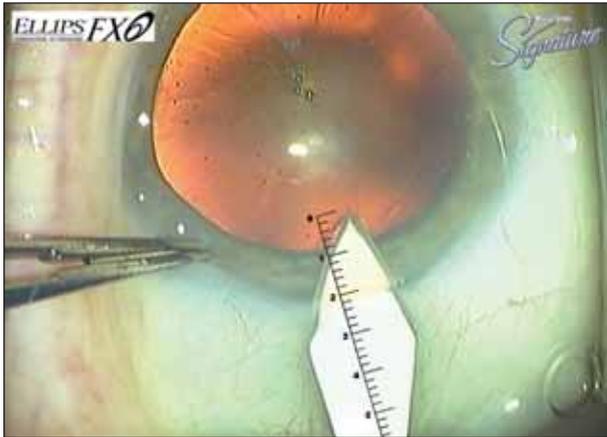


Figure 3. The tip of the keratome is placed at the desired point of entry and depressed posteriorly into the anterior chamber. This creates an incision with a 2.2-mm tunnel and an unenlarged width of 2.8 mm. At the completion of surgery, the incision seals without stromal hydration or suturing.

This incisional location is essentially a scleral tunnel advanced anteriorly, but the limbal incision typically avoids cutting conjunctiva. On rare occasions, intraoper-

ative chemosis will require me to nick the conjunctiva to release the fluid, but this occurs less frequently than it might with scleral incisions.

The question of steel versus diamond blades arises frequently. Steel blades are very easy to maintain, and when properly constructed and labeled, they can last for seven to 10 uses. Diamond blades are renowned for creating exceedingly smooth cut surfaces. I believe that, for primary cataract incisions, the rough surfaces created by steel blades provide greater surface area for adhesion and potentially less slippage between the two surfaces, which may contribute to late astigmatic shifts.

MEASURING THE INCISION

One of the most interesting aspects of the incision's creation is its measurement once it is made. Metal keratomes do not have precision close to 0.01 mm; at best, measuring a keratome to 0.10 mm is reasonable, still only giving only a ballpark figure. The second problem is how straight in and straight out the keratome is applied. Tilting/canting the blade slightly will change the incision's size. In an unpublished study, I simply measured the incision created by two different 2.8-mm keratomes

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in 10 cases each. Using a set of Deacon-Steinert gauges, I found that most of the incisions were 2.8 mm; several were 2.9 mm, however, and two were 3.0 mm. I was fairly certain I had entered each incision straight on, but as seen in Figure 3, a small angle to the entry of the keratome is very hard to avoid in every case.

A third issue in terms of the incision's creation is stretching. Continuing with the study of incision's measurement, I measured the surgical incision after phacoemulsification and prior to the IOL's implantation. Although I did not perceive the incisions as tight, only a few remained at 2.8 mm, and most were either 2.9 or 3.0 mm. Incisions' sizes after the IOLs' insertion were mainly 3.0 mm, with some at 2.9 mm and some at 3.1 mm. Thus, when a specifically sized keratome is used to create an incision and the entire procedure is performed through that incision, it is appropriate to state that the incision is "unenlarged." This does not accurately reflect on the incision's final size, however, which may help explain the issues that seem to persist even as the wound's size is theoretically reduced by the use of smaller blades.

MANIPULATION AND DAMAGE

Aside from stretching, another factor that can compromise an incision's integrity is manipulation, for example, from grasping the lips of the incision to stabilize the globe. I only use the sideport for stability when needed. I prefer a 1.1-mm microvitreal blade to create a sideport, which I fashion 2 clock hours clockwise away from the primary incision. The microvitreal blade allows me to place the incision specifically where I want it and is more precise than a 15° blade.

Unintentional damage to the incision can occur from wound burn during phacoemulsification. An incision that is too small can restrict the flow of irrigation and defeat the surgeon's attempt to reduce the incision's size. Since I began using the Sovereign (Abbott Medical Optics Inc., Santa Ana, CA) in 2001, and now the company's Whitestar Signature System, I have not experienced a wound burn. I attribute this to the advanced power modulations with micropulse Whitestar and now with the company's Ellips FX technology. In addition, adequate irrigating flow and the appropriate use of viscoelastics have also been shown to reduce the incidence of wound burns.¹

WHEN IN DOUBT, SUTURE

Regardless of their construction, the first rule of watertight incisions is always to suture them when in doubt of their seal. Stromal hydration is no substitute for a suture. If the needed suture is unplanned (ie, due

to bad geometry) and I expect to remove it, I prefer a 10–0 nylon suture, which may degrade over time. If I intend to suture the incision, for example, in the case of a large incision or a young patient, I use a 10–0 Mersilene suture (Ethicon, Inc., Somerville, NJ).

It is important to maintain the incision during the recovery process. First, I ensure a normal IOP to maintain the internal stability of the wound. IOP that is too low may allow ingress from the ocular surface during the postoperative period. For the first week, patients should be instructed not to rub their eyes or engage in wet, dirty, or strenuous activities. After this time, the external incision is epithelialized, and patients may resume normal activities.

CONCLUSION

Sutureless watertight incisions are the current standard of care for phacoemulsification. Success in creating these incisions is more a matter of proper construction than size. Small incisions induce less astigmatism and offer greater astigmatic stability, but these advantages can be lost entirely when surgeons try to do too much through an incision that is too small. Sizing the incision properly from the outset will provide more consistent results.

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Ehud I. Assia, MD



When using current techniques that employ clear corneal mini-incisions (< 2.5 mm), a watertight seal is no longer a real clinical issue. Corneal incisions are characterized by three parameters: construction, location, and size.

CONSTRUCTION

Numerous variations on corneal incisions have been developed, including three- and two-beveled techniques, but general clinical experience has demonstrated that a simple uniplanar stab incision is the most practical approach. This incision is also highly effective and safe. In their elegant study using anterior-segment optical coherence tomography, Fine and colleagues demonstrated that a straight incision creates an arcuate configuration that increases the wound's stability.¹ I create a straight stab incision with either a diamond or a metal keratome, pointed slightly upward, to form a short corneal tunnel.

LOCATION

An incision that opens superiorly is often uncomfortable for the surgeon. Temporal incisions are probably associated with more surgically induced astigmatism and a higher rate of leakage (and thus a higher risk for endophthalmitis). In an eye without astigmatism, I prefer to use an oblique (upper-right, 120°-130°) incision. In eyes with pre-existing astigmatism, I find that an incision at the steep meridian will slightly reduce (by approximately 0.50 D) or at least not increase the astigmatism. An opposite clear corneal incision works fine for astigmatism of up to 1.50 D. For astigmatism of greater than 1.50 D, I create my routine oblique incision and correct the astigmatism with limbal relaxing incisions or a toric lens.

SIZE

Reducing the diameter of the incision does not necessarily mean that it will be more watertight. The main corneal incision often seals better than the smaller sideport incisions, even though the latter are half the diameter of the former.² In most cases, there is no need to hydrate the corneal stroma to seal the main (phacoemulsification) opening at the end of the procedure,

whereas sideport incisions usually require hydration.

Most of the currently available foldable IOLs (hydrophobic and hydrophilic) can be inserted through a 2.2-mm incision. Forceful injection of the lens may distort and even tear the edges of the incision, however, so using an opening of 2.4 mm may allow a safer and smoother implantation with no significant effect on the amount of astigmatism induced. Some lenses were developed for incisions as small as 1.5 to 1.8 mm. Their implantation is more difficult, however, and the final diameter of the incision is often larger than its original size in my experience. With coaxial phaco machines, I prefer a 2.4-mm incision, which typically seals well without hydration and induces 0.25 to 0.50 D of astigmatism.

ALTERNATIVE TECHNIQUE FOR A MICROINCISION

My colleagues and I recently studied an alternative technique for microincisional cataract surgery in which the cataractous lens is removed through three 1.1-mm incisions. In the Tri-MICS (microincisional cataract surgery) technique, a specialized large-bore anterior chamber maintainer serves as the only source

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CREATING A WATERTIGHT INCISION

of fluid and is inserted through the third inferotemporal incision. After the lens' removal using a sleeveless phaco tip, the incision is enlarged to allow the IOL's implantation. The 1.1-mm openings usually require stromal hydration to seal the wound but remain watertight thereafter.

RISK FOR WOUND LEAK

Another potential risk for wound leak is a corneal burn caused by excessive heating of the tissue by the phaco tip. Localized coagulation of the tissue creates a distortion and gaping of the wound, and it often requires sutures. Corneal burns occur more commonly in deep-set eyes, because bending of the handpiece may press the tip and the sleeve against the incision's walls and temporarily block fluid irrigation. Many surgeons are reluctant to perform microincisional surgery, because they fear that the direct contact between the exposed phaco tip and the corneal tissue may cause thermal damage. Clinical experience has shown that does not happen in practice. Recently, my colleagues and I demonstrated, in laboratory settings, that a sleeveless tip is associated with significantly less elevation in temperature than the coaxial sleeved tip.³ Intraoperative leakage around the naked vibrating tip cools it, whereas a sleeve prevents fluid leakage. Thus, microincisional techniques using sleeveless phaco tips (bimanual and Tri-MICS techniques) seem to be associated with a lower risk of corneal thermal damage than coaxial techniques.

AGE CONSIDERATION

Young eyes behave differently than adult eyes. In pediatric patients, especially those in the first decade of life, the cornea and sclera are very elastic and often do not seal spontaneously. All incisions should be sutured, including sideport incisions, preferably using absorbable sutures. ■

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