Techniques to Improve Phaco After Laser Cataract Surgery

Many adjustments must be made to transform the traditional procedure.

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We are now in the process of watching the development of cataract surgery as it moves toward femtosecond laser surgery. The advantages of laser cataract surgery have been described in great detail and include (1) the ability to take the precision of a laser in creating self-sealing incisions, (2) arcuate keratotomies that can be titrated and adjusted, (3) reproducible and perfectly round capsulorhexes that can be centered with optical coherence tomography control, and (4) the ability to divide the lens into quadrants to reduce phacoemulsification time and energy. All of these attributes of laser cataract surgery will allow us to improve upon the limitations of current surgery and provide a more optimized cataract extraction procedure. With laser cataract surgery, phacoemulsification continues to play an important role in the surgical process. The purpose of this article is to discuss the differences in phacoemulsification in a conventional case versus laser cataract surgery.

ADJUSTMENTS TO TECHNIQUE

The goal of laser cataract surgery is to enhance refractive outcomes, the safety profile, and patients' comfort and satisfaction by making the surgery more precise and accurate, improving the cataract incisions, decreasing disruption of the lens, and providing a more precise and accurate relaxing incision. As with all new technologies, there are also potential new issues in the procedure. Laser cataract surgery, in our experience, demands major changes in the phacoemulsification surgical process to improve outcomes. When we first performed laser cataract surgery with the LenSx Laser (Alcon Laboratories, Inc.), our surgical technique was virtually identical to that used in traditional cataract surgery—this was the experience of many pioneers in this procedure. We learned over time, however, that changes needed to be made.

Topical Anesthesia

The first change we noted happened the first day we performed laser cataract surgery. We continued our tradition of using lidocaine gel to provide surface anesthesia prior to surgery. The gel significantly reduced the ability of the suction interfaces to adhere to the ocular surface, and without adequate suction, we were not able to achieve accurate incisions. Removing gels and ointments from my preoperative regimen has allowed significantly improved suction during surgery.

Dilation

One of the next aspects of the procedure we noted was that if the capsulorhexis were within 0.5 mm of the iris, very frequently, the iris would constrict, and if the femtosecond energy actually struck the iris, it would cause immediate pupil miosis, thus forcing us to discontinue the procedure. For this reason, we always seek to optimize our preoperative dilation and will constrict the capsulorhexis to leave a 1-mm cushion between the outer edge of the capsulorhexis and the pupillary margin.

Incisions

Corneal incisions made with a laser have major advantages. For example, they can be created in multiple planes to allow true self-sealing incisions. When the incisions reach the limbus with blood vessels, the incisions cannot be opened easily, and in many of these cases, a conventional blade must be used. Rarely, the corneal incisions are located too central, and in this case, they should not be opened. These incisions should be left intact where

they will heal normally, and a separate incision should be made with a manual keratome at the time of surgery.

Pupillary Constriction

Once the anterior chamber has been entered, in cases with a considerable amount of time between the laser's use and the start of cataract surgery, the pupil may constrict. This situation happens more commonly in patients who have small pupils to begin with and in patients who are taking tamsulosin (Flomax; Boehringer Ingelheim Pharmaceuticals) and related medications. If there is pupil constriction, we add intracameral epinephrine with a concentration of 1:4,000 using nonpreserved epinephrine, which immediately will open the pupil to its preoperative level of dilation.

Capsulotomy

A perfect capsulotomy is one of the major advantages of laser cataract surgery. Unless the capsule is completely free-floating, the surgeon should always assume that the capsule has an adhesion; therefore, simply grabbing the anterior capsule and pulling it may result in a radial tear. We track along the capsulorhexis as performing a traditional capsulorhexis, making certain that any adhesions are open in a circumferential manner.

SIGNIFICANT FACTORS

Dropped Nuclei

One of the most significant complications seen early on with laser cataract surgery is the dropped nucleus, which occurs with aggressive hydrodissection.[1] With a manual capsulorhexis, the capsule is always mildly irregular, so that during hydrodissection, fluid can escape from the irregularities in the anterior surface of the capsule. With a perfectly round, symmetric capsulorhexis (which is usually smaller when created with a laser), the hydrodissection will cause the lens nucleus to vault forward, blocking the egress of fluid through the anterior capsule and causing a pupillary block. This can cause the posterior capsule to rupture and the nucleus to fall into the vitreous. For this reason, we perform very gentle hydrodissection. Many surgeons have stopped doing hydrodissection altogether, using pneumodissection created by the laser to allow the nucleus to be dissected away from the capsule.[1]

Gas Bubbles

Another aspect of laser cataract surgery to be taken into account is that gas bubbles are created in the capsular bag. By bringing the dissection of the lens up to the surface of the capsule, these bubbles can easily reach the anterior chamber, where they reduce pressure on the posterior capsule. Early on, we left a 500-µm cushion between the anterior capsule and the lens dissection. By bringing the lens dissection to the surface, we now allow the gas bubbles to escape into the anterior chamber, which has also reduced pressure on the posterior capsule. These bubbles, however, sometimes can occlude visualization of the anterior chamber and should be aspirated during surgery as they present.

Figure 1. The Donnenfeld curved chopper separates the quadrants.

PHACO TECHNIQUES

Finally, when it comes to phacoemulsification, we have tried many different techniques, including dividing the lens nucleus into quadrants and creating various ablation patterns to find the optimal laser lens dissection technique. Currently, we divide the lens into quarters and create a 2.5-mm central ring or core that can be phacoemulsified under sculpting mode, creating a central hole in the nucleus of approximately 2.5 mm. We dissect down until we no longer see the cross pattern in the lens, which signifies that there are 500 µm of lens left before we reach the posterior capsule.

A major advantage of laser cataract surgery is the ability to visualize the thickness of the lens during the laser portion of the procedure, which provides guidance as to the depth that can be safely performed with phacoemulsification. Once the central core has been created, the lens can be split into quadrants very easily (Figure 1). For the phacoemulsification settings that we prefer to use with laser cataract surgery, we favor a Venturi setting, which allows us to bring the nucleus into the visual axis, rather than having to go after the lens quadrants in the periphery. These free-floating quadrants easily come to the phacoemulsification tip and provide very rapid and efficient lens removal.

Finally, once the nucleus has been removed, one of the unique challenges of laser cataract surgery is the cortical cleanup, which is the only aspect we find more difficult to perform than in conventional cataract surgery. This is because the edges of the cortex have been chopped neatly, and there are no loose areas to grasp with irrigation

Figure 2. Hydrodissection of the cortex after the nucleus has been removed.

and aspiration. For this reason, we have started performing hydrodissection after the lens nucleus has been removed (Figure 2), which permits dissection of the cortex away from the capsule, allowing the cortex to be removed easily.

CONCLUSION

In summary, we have made many changes in our phacoemulsification technique with our LenSx laser. These techniques have improved our abilities as surgeons and have added safety, reliability, and accuracy to the cataract surgical procedure.[2] As we become more comfortable with this new technology, we believe additional changes in the phacoemulsification technique will also follow, as well as IOL designs, which will incorporate the advantages of laser cataract surgery to achieve better surgical outcomes. ■

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