Techniques and Instrumentation

for Bimanual Microincisional Cataract Surgery

A review of the modalities used to maximize microincisional cataract surgery outcomes and to reduce the incidence of complications.

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If microincisional cataract surgery is to become ophthalmologists' technique of choice, it must allow the lenses used to offer the same advantages for the patient as those implanted following current, standard, coaxial phacoemulsification. To this end, manufacturers are offering new instruments and machines with features to assist in safe microincisional cataract surgery. There are certain advantages that this surgery provides in terms of enhanced fluidics, which will encourage some surgeons to adopt it as their standard even before appropriate IOLs are readily available.

BASIC REQUIREMENTS

Incision

I prefer using steel knives to make the incisions because sharpening diamond knives will alter their size. Alcon Laboratories, Inc. (Fort Worth, TX), offers a range of sideport knives from 1.0 to 1.5 mm. Katena Products, Inc. (Denville, NJ), has a specially designed trapezoidal diamond knife that is marked to allow the surgeon to choose the incision size by the distance that the blade is inserted into the eye. The size needed is determined by the magnitude of the irrigating device and the phaco tip's diameter.

I typically make the incisions between 70º and 80º apart. I bisect the angle between the two openings to allow for comfortable tissue manipulation and chopping.

Viscoelastic Use

Whereas many surgeons may prefer Viscoat (Alcon Laboratories, Inc.) as part of the Arshinoff Soft Shell technique, this dispersive viscoelastic should not be used prior to capsulorhexis creation because it is difficult to flush out of the eye. Although Viscoat is useful for protecting the corneal endothelium, it can cause problems during hydrodissection in microincisional cataract surgery by not allowing the eye to decompress as fluid is injected into the capsular bag. I prefer to use sodium hyaluronate 1% (Healon; Advanced Medical Optics, Inc., Santa Ana, CA; or Provisc; Alcon Laboratories, Inc.) because it will exit the eye as hydrodissection proceeds and thus prevent too much

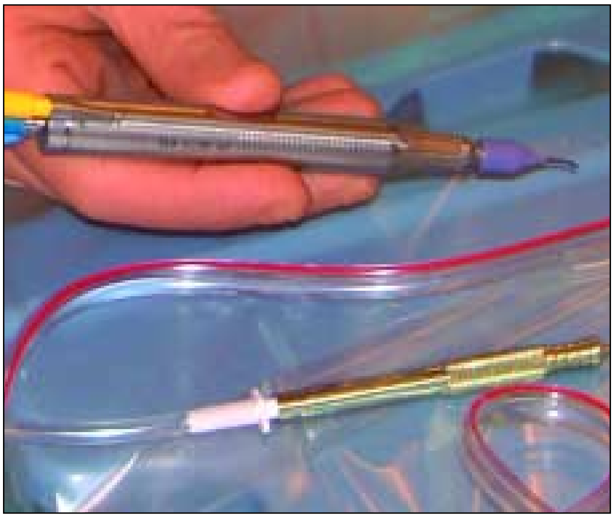

Figure 1. The irrigation inlet of the phaco handpiece for the Infiniti Vision System for microincisional cataract surgery avoids the drainage of fluid out of the eye.

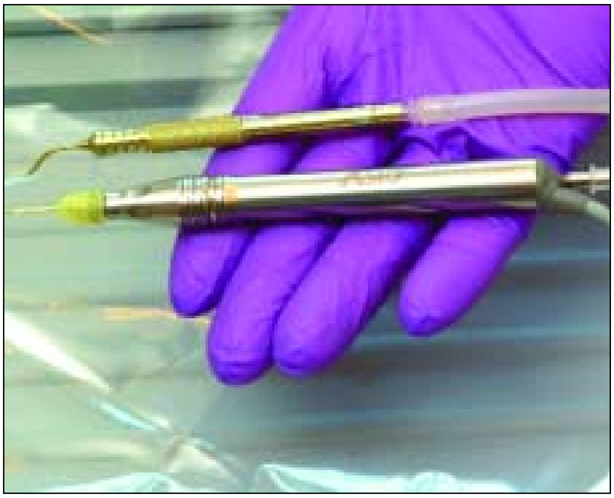

Figure 2. The Whitestar microincisional cataract surgery handpiece on the Sovereign phaco machine uses no irrigation.

compression of the chamber.

If I am using Viscoat, I introduce it into the eye under the cornea after hydrodissection and before phacoemulsification. To prevent tip occlusion and rapid heating of the phaco tip, the latter of which can cause wound burn, I create a cavity in the middle of the viscoelastic with suction before applying phaco power.

Capsulorhexis

Surgeons who routinely use a needle to perform the capsulorhexis will not need to change capsulotomy techniques, but forceps users will have to acquire new instrumentation. I use coaxial capsulorhexis forceps from Duckworth & Kent, Ltd. (Hertfordshire, England), to tear the capsule to create a flap. It is important to precisely pick up the flap near the tear because the forceps' blades do not open very far. If the red reflex is absent, I use a capsular dye to enhance visualization.

Hydrodissection

During hydrodissection, I allow the eye to decompress as I inject fluid. This step is particularly important with large, mature nuclei for which there is little cortex or epinucleus to compress. By depressing the wound, I permit some viscoelastic to escape before injecting any fluid. It is critical to achieve mobility within the capsular bag, because adhesions between the posterior capsule and the nucleus can occasionally occur and may cause a rupture during rotation with phacoemulsification.

I place a cannula under the capsule at the 9-o'clock position and lift it before injecting fluid into the anterior chamber. I shift my hand to hold the syringe in the same manner as I would a pencil, with pressure applied to the nucleus to spread the fluid underneath, and I rotate the nucleus in the bag. Changing my hand's position gives me greater purchase on and control of the nucleus.

Phaco Power Delivery, Tips, and Fluidics

It is possible to use conventional phacoemulsification for microincisional cataract surgery, but the technique is not suitable for mature cataracts due to tip heating. Either pulse or burst mode must be employed when using conventional phacoemulsification to avoid an increase in heat, but the recently developed micropulsing technology is more efficient. Micropulsing permits effective cutting at the phaco tip and allows it time to cool in between pulses. By varying the cooling period, the surgeon controls the duty cycle. Micropulsing greatly reduces the energy expended in the eye, minimizes the heat and chatter associated with conventional pulse mode when used with hard nuclei, and enhances followability.

A curved Kelman-style tip cuts efficiently and enhances tissue manipulation due to its curvature and more comfortable hand position. Flared phaco tips are of no use, because they will allow leakage around the shaft in the wound. Aspiration bypass system tips cannot be used because the port can suck in iris and they do not achieve full occlusion. The hub of the phaco needle should be covered to avoid spraying, but the sleeve should be removed.

When removing hard nuclei, surgeons should minimize turbulence in the anterior chamber to avoid damaging other ocular structures, most particularly the corneal endothelium. I prefer phaco machines with peristaltic pumps such as the Sovereign System and the

Figure 3. The author used an irrigating chopper and inserted a bare phaco needle into eye at the start of phacoemulsification.

Figure 4. Following deep sculpting of the nucleus, the author achieved separation of the nucleus using a vertical karate chop.

Infiniti Vision System (Alcon Laboratories, Inc.), which have better surge control and safely allow levels of high vacuum. Machines with Venturi pumps and dual-linear controls can work, particularly if they offer micropulsing. High vacuum is important when chopping hard nuclei, because the surgeon may both hold and separate nuclear pieces for removal. The two phaco machines mentioned have the ability to separate unoccluded and occluded settings.

Surgeons must plug the irrigation inflow on the phaco handpiece to avoid siphoning fluid from the eye and causing chamber instability (Figure 1). The Whitestar handpiece is a special instrument that uses no irrigation (Figure 2).

Irrigating Choppers

Removing hard nuclei requires some sort of irrigating chopper. To provide a stable chamber, the instrument must have adequate flow (at least 70 mL/min) to compensate for any wound leakage and the fluidics settings on the machine. For easy cracking of hard nuclei, I recommend horizontal or vertical chopping. I designed the Packard irrigating chopper (Duckworth & Kent, Ltd.) with three irrigating ports near the tip and the ability to pass fluid at 82 mL/minute (Figure 3). It is also an efficient chopper for vertical karate chopping. Surgeons new to microincisional cataract surgery need to try a number of choppers in order to decide which one fits their needs.

NUCLEAR REMOVAL TECHNIQUES

Mature Nuclei

After filling the eye with viscoelastic, I insert the irrigating chopper by introducing the end of the instrument upside down and then twisting it until it passes through the wound. When the tip is safely in the eye, I start irrigation. I insert the phaco tip vertically and upside down using the end of the bevel as a guide. I engage the wound and then it is swivelled round to allow the tip to enter the eye. When both instruments are in place (Figure 3), I remove the epinucleus and cortex (if any) covering the nucleus.

Next, I sculpt a short trench in the nucleus until it is at least 50% of the thickness of the central area. The question is then whether to chop the nucleus or crack it into heminuclei. If the nucleus is very dense, it may not come apart easily with chopping because of its leathery base plate. It seems sensible in this situation to sculpt deeply, pushing the two halves of the nucleus away from each other, and continuing to sculpt until I reach the base plate. I can then chop the two halves individually using the karate chop technique (Figure 4).

I engage the heminucleus with the phaco needle using a small amount of ultrasound power. When occlusion is achieved, I bring the chopper's tip down onto the nucleus as the phaco tip rises against it, thus creating the chop. A clean separation of the nuclear lamellae is only achievable by using the tip of the chopper. I make another chop 2 clock hours away and remove the separated piece of nucleus. This piece acts as the keystone and facilitates, by its removal, my approach to the rest of the nucleus by creating vital space to chop, separate, and emulsify the remaining pieces of nucleus.

For surgeons who find it unnecessary to create heminuclei, the emulsified short trench will act as the entry point for engaging the nucleus for chopping. I hold the nucleus here using occlusion and high vacuum and lift it as I lower the irrigating chopper tip down on it. It is important with hard nuclei to allow the chop to propagate. I turn the nucleus to create sequential chops until it breaks into four to five pieces, and I emulsify the smallest piece to allow space for removing the others. If any of the remaining nuclear fragments seem too big for removal, I will chop them further (Figure 4). The use of micropulsing and excellent machine fluidics, in conjunction with tight wounds and adequate irrigation flow, can result in a stable chamber and safe environment for these maneuvers.

Medium Nuclei

If the nucleus is too soft for adequate chopping, the Kelman Victory V technique is a good alternative. With this technique, I sculpt two long trenches to create a V, with its apex below the phaco wound. Next, I split the nucleus using the chopper and the phaco tip in the trench, and I remove the central one-third of the nucleus. I then turn the nucleus 180° and separate the remaining two-thirds. Micropulsing with 1:3 or 1:4 ratios releases only small amounts of energy in the eye, and with an efficient use of vacuum I can minimize energy further.

Soft Nuclei

I use a technique for soft nuclei with coaxial phacoemulsification called *soft slice*. In this variation on the prechop technique, I preslice the nucleus using a second instrument and then separate the two parts of the nucleus. At this point, I do not need to complete the separation because, when I apply high vacuum, the nucleus peels apart toward the center. There is no need for ultrasound in this situation.

CONCLUSION

With these new techniques and instrumentation, all nuclei that are regularly removed using standard coaxial phacoemulsification can safely and efficiently be removed using microincisional cataract surgery. There are certain equipment modifications required, such as micropulsing phaco power and adequate irrigation flow, for the effective removal of all nuclei using microincisional cataract surgery. With appropriate IOLs available, the nearly universal application of microincisional cataract surgery on almost all nuclei is inevitable. ■

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