Vertical Phaco Chop With the Infiniti

This technique uses minimal energy to fracture the nucleus.

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Techniques for nuclear emulsification and phacoemulsification platforms have evolved in recent years to allow ease of emulsification of dense or hard cataracts, subluxated lenses, and small pupils. The phaco procedure must be tailored to provide the most effective and safe technique for each case. Our preferred approach is microcoaxial surgery with a vertical chop technique for nucleus fracture using the Infiniti Vision System (Alcon Laboratories, Inc., Fort Worth, Texas) and Alcon's Ozil torsional ultrasound with Intelligent Phaco (IP). The advantages of each element of this triad enhance the performance of the other two, leading to maximum efficacy and safety during surgery.

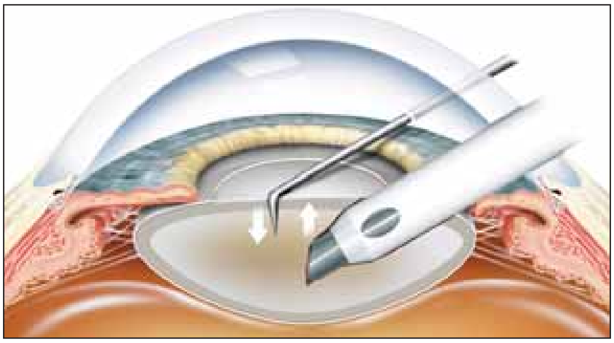

Figure 1. The phaco tip must be embedded deeply into the center of the nucleus, pointing toward the optic nerve.

MICROCOAXIAL SURGERY

Microcoaxial surgery offers the benefits of microincision cataract surgery (MICS), including less surgically induced astigmatism and square incisions with less risk of endophthalmitis, along with a short learning curve and easy IOL implantation. Because smaller incisions are associated with reduced inflow, there has been a trend to raise the irrigation bottle or to use forced infusion systems with the aim of maintaining anterior chamber stability. In this respect, the side-to-side movement of the phaco tip with torsional ultrasound produces minimal repulsion of lens fragments, resulting in improved followability and anterior chamber stability. Lower vacuum parameters can be used, and low fluidics parameters, such as lower aspiration flow rates and lower bottle heights, are equally effective. Therefore, fluid turbulence in the anterior chamber is significantly reduced. Additionally, the lateral oscillatory motion of the phaco tip results in improved cutting efficiency and decreased heat at the tip using the same power level.

With torsional ultrasound utilizing Ozil IP software, we are able to maintain fragments at the tip with minimal occlusion, which results in increased removal efficiency and a reduction in intraocular pressure (IOP) spikes. The main idea is to limit occlusion during fragment removal and keep the emulsification procedure on track. Torsional technology is an ideal partner for microcoaxial phaco.

VERTICAL CHOP

This dual technology provides maximum benefits when used in combination with the third element of the triad—vertical chop—to achieve nucleus fracture. Vertical chop is my preferred approach for medium and hard cataracts, with some variations for very hard lenses. Executing vertical chop requires expert understanding, management of fluidics, and an effective phacoemulsification platform.

The vertical chop technique takes advantage of the natural cleavage planes that exist within the nucleus to fracture it in several fragments using minimal energy. Compared with sculpting, vertical chop has several advantages, including (1) reduced use of phaco power and phaco time, which means less ultrasound energy use; (2) reduced stress on the zonules because the nucleus is held by the phaco tip, receiving all the stress induced by surgical maneuvers (this is particularly important in eyes with zonular weakness); (3) no need to depend on the red reflex to assess the deepness of the groove; and (4) the ability to perform nucleus fracture with all surgical maneuvers within the central 3 to 4 mm, which is especially helpful in the case of poorly dilated pupils. Overall, vertical chop is more efficient for standard cases compared with divide-and-conquer or horizontal chop techniques, but it is especially effective for complicated surgeries such as those with small pupils, loose zonules, brunescent nuclei, or mature white lenses.

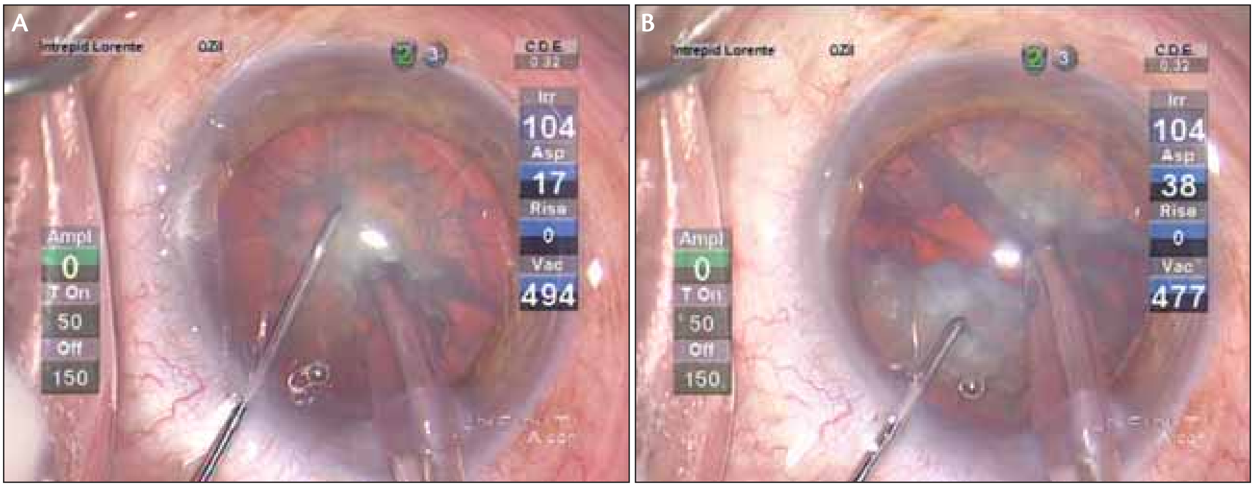

Figure 2. (A) The chopper moves downward while the phaco tip moves upward. (B) When the chopper and phaco tip are close together, a lateral movement splits the nucleus in half.

TECHNIQUE

Standard cases. We use topical anesthesia and intracameral lidocaine. After an injection of 0.3 cc intracameral preservative-free lidocaine 2% through a paracentesis, the anterior chamber is filled with a viscoadaptative ophthalmic viscosurgical device (OVD). We prefer DisCoVisc (Alcon Laboratories, Inc.) and a temporal clear corneal incision (2.2 X 1.75 mm). Should multifocal IOL implantation be planned, the incision is placed at the steepest meridian. A circular, well-centered 5.25-mm capsulorrhexis is performed with Utrata forceps (Duckworth & Kent, Ltd., Hertfordshire, England) followed by hydrodissection and hydrodelineation.

During phaco, we use Ozil IP and the 45° mini-flared Kelman tip (Alcon Laboratories, Inc.) to optimize the torsional effect, achieve better holdability, and avoid total occlusion. We find this to be the most efficient combination available. When using the IP feature, no settings changes are necessary.

We enable the Ozil IP feature only for quadrant removal and is activated only when a specified percentage of the vacuum threshold is reached. If the surgeon is using a 45° bevel tip, we recommend an Ozil IP vacuum threshold of 95%. If the surgeon is using a 30° bevel tip, we suggest a lower vacuum threshold of 90%. We also advise positioning the tip using an outside-in approach, as this is helpful in maintaining the ongoing emulsification of the lens material. The footpedal is adjusted to 18% to shorten the range of position 3.

Nucleus fracture. We perform vertical chop using a Rosen chopper (Katena Products, Inc., Denville, New Jersey) to divide the nucleus into six fragments. Proper placement of the phaco tip is crucial. It must be embedded deeply into the center of the nucleus, pointing toward the optic nerve, with high vaccum and burst mode (Figure 1). We use the following parameters: 90% torsional amplitude with burst mode (50 msec on/150 msec off); vacuum, 500 mm Hg; fixed flow, 35 cc/minute; and bottle height, 95 cm. We find burst mode particularly advantageous for chopping. Once the tip has reached the desired depth and is occluded, the footpedal is held in position 2 to stabilize the nucleus. The tip of the chopper is then stabbed into the nucleus 1 mm in front of the phaco tip. The chopper moves downward while the phaco tip moves upward (Figure 2A). When the chopper and phaco tip are close together, a lateral movement splits the nucleus into halves (Figure 2B).

Figure 3. Vertical chop can be performed in a small pupil.

Once the nucleus is divided, parameters are adapted to emulsify the fragments: continuous torsional ultrasound (maximum amplitude, 90%; starting amplitude, 20%); vacuum, 320 mm Hg; flow, 25 cc/minute; bottle height, 95 cm. During irrigation and aspiration, the cortex is aspirated with a curved silicone I/A tip (Alcon Laboratories, Inc.). Whenever subincisional cortex removal becomes difficult, it may be a

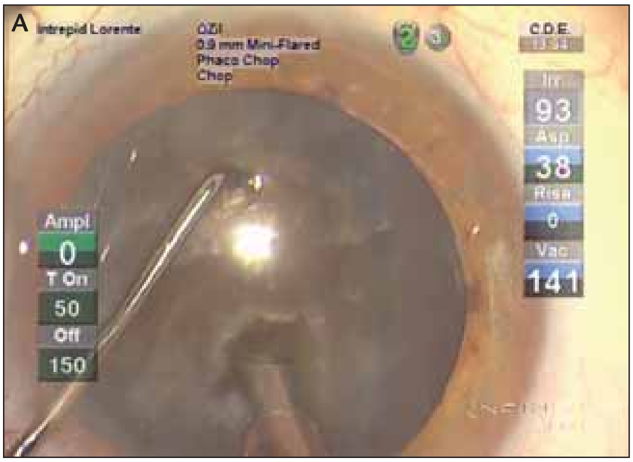

Figure 4. (A) In a hard nucleus, it is easier to begin vertical chop by sculpting a small, deep pit centrally, (B) allowing the nucleus to be impaled more deeply.

good option to use two separate cannulas, one for irrigating the anterior chamber and the other for aspirating cortical material. This bimanual I/A technique requires two paracenteses placed approximately 50º away from the main incision. We polish the posterior capsule with the silicone I/A tip or with an irrigating polisher. I typically implant the AcrySof IQ IOL (Alcon Laboratories, Inc.) with the Monarch III injector and the D cartridge (both Alcon Laboratories, Inc.). We do not enlarge the incision. Residual OVD trapped under the IOL is then removed. Vancomycin for infection prophylaxis is injected intracamerally at the end of the procedure.

Vertical phaco chop can be performed in small pupils (Figure 3) in which it may not be advisable or safe to take the sharp chopper peripherally toward the equator or where the groove of a divide-and-conquer technique cannot be extended safely to the periphery. Also, because the nucleus is held by the phaco tip and forces act in a vertical plane toward the tip, no stress is placed on the zonules. Minimizing stress to the zonular apparatus is of benefit in every cataract surgery, but particularly in cases with zonular weakness.

HARD CATARACTS

Handling the hard nucleus is a major challenge, even for an experienced surgeon. It requires higher-power ultrasound and prolonged phaco time. The main modifications of each surgical step for success with hard cataracts are as follows. Local anesthesia is recommended in cases with weak zonules, poor patient cooperation, or risk factors for intraoperative complications. When the red reflex is poor, we must stain the capsule with trypan blue 0.06% to enhance capsular visibility enough to create the capsulorrhexis and to visualize the edge of the rhexis during phacoemulsification. OVD plays an important role in protecting the endothelium in hard cataracts. We use Arshinoff's soft-shell technique with Viscoat (Alcon Laboratories, Inc.) to coat the endothelium and a highly cohesive OVD (ProVisc; Alcon Laboratories, Inc.) to maintain the anterior chamber.

Phacoemulsification of hard lenses presents two main risks: greater endothelial cell loss and increased risk of posterior capsular rupture. Furthermore, dividing the hard nucleus is difficult; posterior layer fibers can be cohesive and tenacious and resist all conventional methods of division. Extra precautions must be taken to protect the endothelium and the posterior capsule. Torsional ultrasound is the best technology to protect the endothelium due to its minimal repulsion and low turbulence in the anterior chamber. Our preferred technique is vertical chop because it causes less endothelial cell loss and less stress on the zonules compared with the divide-and-conquer technique. We do not change many parameters from the technique for medium cataracts, apart from elevating the torsional amplitude for chopping to 100% fixed and the starting torsional amplitude setting to 30% for fragment emulsification.

Technique variations. We use a karate chopper, which is longer and sharper than the Rosen chopper, to facilitate embedding the dense nucleus without displacing it. Also, the irrigation sleeve must be retracted more than usual. This exposes a longer segment of the metal needle and maximizes penetration of the tip, which is crucial for dividing the nucleus. It is easier to begin by sculpting a small, deep pit centrally (Figure 4A), which allows the nucleus to be impaled more deeply (Figure 4B). Additionally, it is more efficient to

TAKE-HOME MESSAGE

- Side-to-side movement of the torsional phaco tip produce minimal repulsion of lens fragments.
- Low vacuum and fluid parameters reduce fluid turbulence in the anterior chamber.

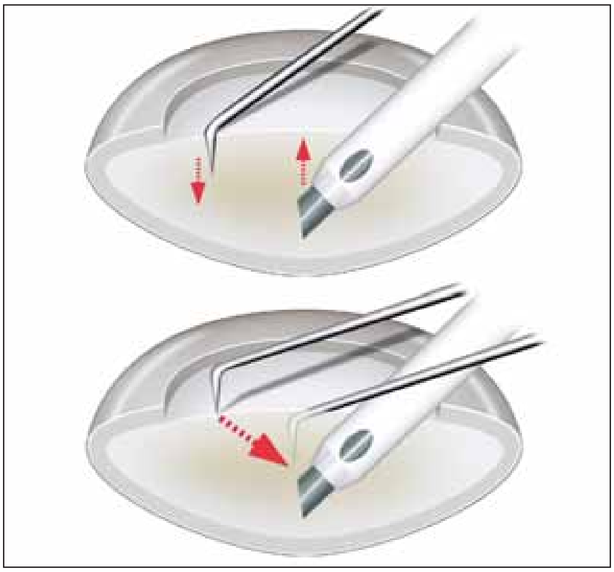

Figure 5. It is more efficient to alter the angle of the vertical chop slightly and approach the embedded phaco tip more diagonally in hard cataracts.

alter the angle of the vertical chop slightly and approach the embedded phaco tip more diagonally. This provides more of a horizontal vector that pushes the nucleus against the tip while the vertical vector initiates the downward fracture, combining the mechanical advantages of both strategies (Figure 5). If there are leathery fibers at the posterior layer, it is best to transect them with the chopper while the nucleus is engaged and stabilized by the vacuum of the phaco tip. The nucleus should be divided into smaller fragments so that they can be emulsified securely. Furthermore, to maximize endothelial protection, one should refill the anterior chamber with Viscoat during fragment emulsification. A dispersive OVD injected behind the last remaining fragments creates an artificial epinucleus to restrain the lax and fragile posterior capsule from trampolining toward the phaco tip, minimizing the risk of rupture. ■

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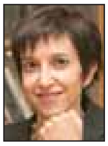

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