Lift and crack technique for risky cataract cases

Hanefi Cakir, MD, Canan Asli Utine, MD, MSc

We describe a technique to manage dense cataract cases. After a capsulorhexis of 6.0 to 7.0 mm diameter has been created, the phaco tip is inserted into the nucleus centrally and high vacuum is used to lift the nucleus and elevate it with a tilt to protrude outside the capsular bag distally. The chopper is used to segment the nucleus centripetally, starting from the lens equator or just behind, without applying stress to the capsular bag or zonules. Further phacoemulsification is maintained by holding the nucleus centrally and chopping it into smaller triangular sectoral pieces. In this horizontal chopping technique, which is done just outside the capsular bag, grasping the nucleus in the center and elevating it with high vacuum instead of depressing one edge of the nucleus to elevate the other edge prevents additional stress to the capsule and zonules.

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Dense cataracts pose a unique surgical challenge for even the most experienced cataract surgeons, particularly in the presence of incomplete capsulorhexis, zonular weakness, and/or a small pupil. In these cases, phacoemulsification must be performed with minimal ultrasound energy and minimal stress to the capsular bag and the zonules. Various techniques have been described for dense cataracts, including phaco chop and stop and chop (K. Nagahara, MD, "Phaco-Chop Technique Eliminates Central Sculpting and Allows Faster, Safer Phaco," Ocular Surgery News, International Edition, October 1993, pages 12–13).[1] We describe a technique for the surgical management of these cases that might be considered a modification of the nonsculpting technique.

SURGICAL TECHNIQUE

Under local or topical anesthesia, a temporal self-sealing clear corneal incision is created with a 2.8 mm wide diamond knife and one side port is created 60 to 90 degrees from the main incision with an MVR blade. Trypan blue is used to stain the anterior capsule. The soft-shell technique using sequential dispersive–cohesive ophthalmic viscosurgical devices (OVDs) is preferred as it is advantageous in complicated cases. Initially, a dispersive OVD (sodium hyaluronate 3.0%–chondroitin sulfate 4.0% [Viscoat]) is used to protect the endothelium. Since high intralenticular pressure in these eyes may lead to peripheral extension and an incomplete capsulorhexis, use of a cohesive OVD (sodium hyaluronate 1.0% [Provisc]) is essential to fill the anterior chamber and prevent its collapse and prevent an errant radial capsule tear. If a tear occurs, the capsulorhexis can be completed by creating a radial cut at the original starting point and then proceeding in the opposite direction to meet the errant tear. In this situation, nuclear fragmentation and phacoemulsification without significant stress on the capsular bag is more important. In all cases, an anterior capsulorhexis of 6.0 to 7.0 mm diameter is made.

After the initial anterior cortical cleaning, the phaco tip is inserted into the nucleus centrally with high vacuum (approximately 350 mm Hg). The nucleus is lifted and elevated with a tilt so it protrudes from the capsular bag (Figure 1). The chopper is used to segment the nucleus centripetally, starting from the lens equator or just behind (Figure 2). This uses the vector forces efficiently and cleaves the nucleus without applying stress to the capsular bag or the zonules (Figure 3). Further phacoemulsification is maintained by holding the nucleus centrally and chopping it into smaller triangular sectoral pieces in the same manner. The phacoemulsification parameters are as follows: vacuum 250 mm Hg to 400 mm Hg, aspiration flow rate 30 mL/min, infusion bottle height 120 mm. The

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From the Turkiye Hospital Eye Clinic (Cakir) and the Yeditepe University Eye Hospital (Utine), Istanbul, Turkey.

Corresponding author: Canan Asli Utine, MD, MSc, Yeditepe University Eye Hospital, Gazi Umur Pasa sok. No: 28, Besiktas Balmumcu 34349, Istanbul, Turkey. E-mail: cananutine@gmail.com.

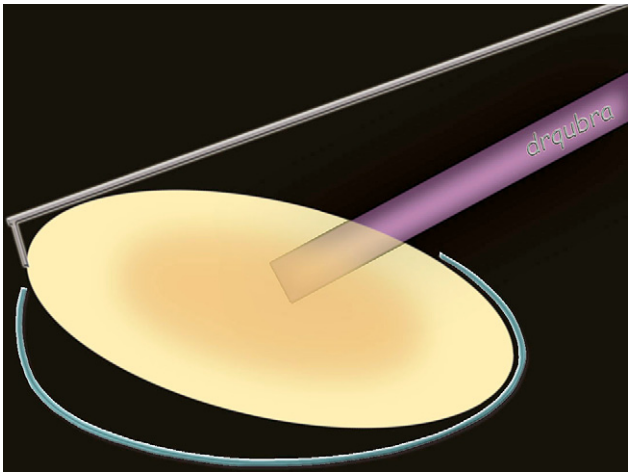

Figure 1. Illustration of the central lift of the nucleus with distal tilting.

phacoemulsification power is titrated according to the density of the nucleus and generally ranges from 25% to 60%. After the nuclear phacoemulsification is completed, the irrigation–aspiration tip is used to clean residual cortical material. The surgery is completed after the intraocular lens is implanted in the bag or the sulcus, with the haptics positioned perpendicular to the axis of the capsule defect to prevent additional tearing force.

DISCUSSION

The differences between the lift-and-crack technique and previous techniques are beneficial in dense cataracts, particularly in the presence of incomplete capsulorhexis, zonular weakness, or small pupil. We used a lift technique to move the nucleus partly out of the capsular bag instead of prolapsing the entire lens into the anterior chamber or performing the chopping and phacoemulsification procedures in the bag. In the presence of a 6.0 to 7.0 mm anterior capsulorhexis, lifting the distal nucleus partially through the anterior capsule opening using high vacuum applied to the central nucleus does not produce stress on the zonules. Keeping the nucleus partly in the bag and not prolapsing it into the anterior chamber allow us to perform the chopping and phacoemulsification at the pupillary plane, which protects the endothelium from the possibly deleterious effects of the procedure.

The chop techniques for easier mechanical nucleus separation were developed for safe and fast removal of dense cataracts and to reduce the damage to intraocular tissues by requiring less ultrasonic power. In conventional techniques such as divide and conquer and phaco chop, significant ultrasound energy is required for segmentation and complete removal of the dense nucleus. If the divide-and-conquer or vertical phaco-chop techniques are used in hard and large cataracts, a forceful outward separation of the nucleus by creating a central groove may transmit excessive stress to the capsular bag and zonules. The additional in-the-bag maneuvers to divide the nucleus into smaller pieces increases this stress. These maneuvers are frequently inefficient in separating the nuclear pieces completely and provide little space for efficient cracking and phacoemulsification. Under these conditions, proceeding to further phacoemulsification may lead to greater risk to capsule and zonule integrity. Particularly in cases of incomplete capsulorhexis with peripheral extension or zonular weakness, these techniques could lead to increased stress on the capsule and eventually to posterior capsule rupture or zonular dehiscence.

In the lift-and-crack technique, the initial crack is done by positioning the chopper equatorially or just behind the equatorial edge and moving it centrally after the central nucleus is held and lifted by the phaco tip using high vacuum. The optimum distance between the 2 instruments makes the vector forces that cleave the nucleus into 2 segments maximally efficient so unsuccessful cracking attempts are unlikely.

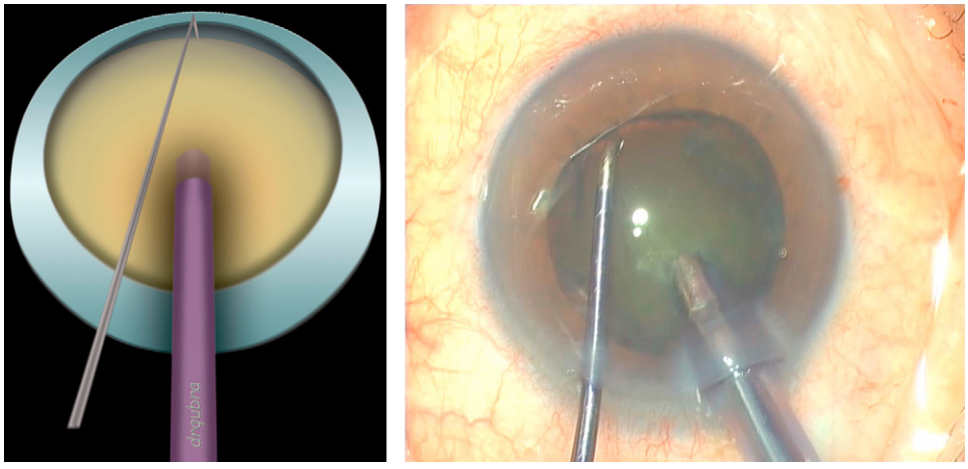

Figure 2. Illustration (*left*) and intraoperative view (*right*) of the initial placement of the chopper at the lens equatorial edge.

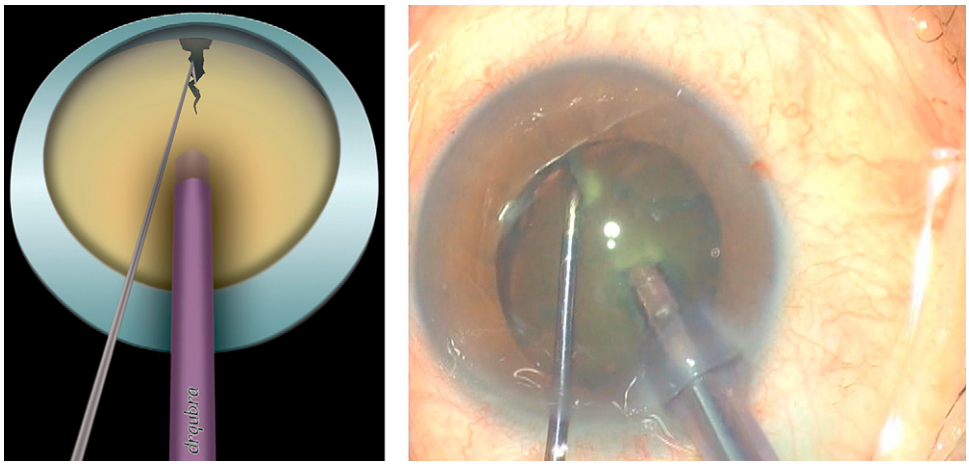

Figure 3. Illustration (*left*) and intraoperative view (*right*) of the horizontal chopping maneuver centripetally.

Cracking the nucleus into pieces by maximally efficient horizontal chopping removes the steps of grooving the central nucleus and decreases the phacoemulsification power considerably. Since the cracking maneuvers are made after the lens is lifted and the chopper does not pass beneath the nucleus, unlike in peripheral chopping technique;[2] the surgeon can continuously observe the tip of the chopper, which makes the technique safe for the capsular bag. In the peripheral chopping technique, any tilt of the nucleus may lead the chopper to slide over the nuclear surface and may risk posterior capsule integrity with an inadvertent chopper movement. Additionally, in cases with shallow anterior chambers, excessive tilt of the nucleus may lead to skimming over the corneal endothelium. However, in our technique, manipulations are performed in the pupillary plane to protect the capsular bag and zonules from excessive stress and the corneal endothelium from the deleterious effects of the phacoemulsification power.

Another technique, the tilt and chop, has a chopping maneuver that is similar to the one in our technique (U. Devgan, MD, FACS, "Chopping Techniques Beneficial for Nucleus Removal," Ocular Surgery News US edition, February 25, 2008. Available at: http://www.osnsupersite.com/view.aspx?rid=26492. Accessed December 8, 2009). By digging the phaco tip to the nucleus proximal to its center and pushing posteriorly, the distal edge of the nucleus is tilted out of the capsular bag. The chopper is then placed around the lens equator or even behind the nucleus. This is followed by a horizontal chop. However, this way of tilting the nucleus itself may add stress to the capsule and zonules at the time of depressing and tilting and at the time of performing horizontal chop. In our technique, since the nucleus is grasped centrally and lifted with high vacuum, the only stress applied during chopping is toward the phaco tip at the center, not inferiorly. Therefore, we suggest holding and grasping the nucleus from the center and lifting it using high vacuum but not depressing one edge of the nucleus to elevate the other edge.

In conclusion, chopping techniques have been developed to achieve fast and safe nucleus cracking in the shortest convenient time. The technique we present is a modification of the recent trends in chopping and is particularly helpful in cases of dense cataract with incomplete capsulorhexis or zonule weakness.

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