Two-hook technique for nucleus extraction in manual sutureless extracapsular cataract extraction

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Nucleus extraction in manual sutureless extracapsular cataract extraction (ECCE) using the 2-hook technique is described. After capsulorhexis and hydrodissection are performed, the nucleus is moved into the anterior chamber and extracted by pulling with a Sinskey hook and pressuring the scleral bed with a Kuglen hook. In a series of 1320 eyes, 85% achieved a corrected visual acuity of 5/10 or better postoperatively. Complications were posterior capsule rupture, vitreous loss, and transient corneal edema. Manual sutureless ECCE using the 2-hook technique is safe and efficient and does not require expensive instrumentation.

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Online Video

In modern cataract surgery, a small incision is the primary factor in faster and safer postoperative healing and reduced complications such as suture-induced astigmatism. Small-incision surgery is currently almost always used with phacoemulsification. However, despite advances in equipment and technique, phacoemulsification remains an intimidating procedure for many ophthalmologists as it is one of the more difficult surgical techniques to learn. Instrumentation and disposable matter are increasingly expensive. The latter is a serious obstacle, especially in developing countries.[1]

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Manual sutureless techniques (eg, mini-nuc and phacosection[1–5]) have been developed to overcome the obstacles. We describe a new technique to deliver nuclei with Sinskey and Kuglen hooks.

SURGICAL TECHNIQUE

After topical anesthesia has been administered, a fornix-based conjunctival flap is made. A 7.0 mm to 8.0 mm straight scleral incision 1.5 mm from the limbus is marked with calipers on the surface of the sclera, avoiding major scleral vessels. A superficial scleral tunnel is dissected in clear cornea with a crescent scalpel and the anterior chamber entered in clear cornea with a keratome. Paracenteses are made at 10 o'clock with a stiletto knife. The side-port entry site is made at 9 o'clock. The anterior chamber is filled with an ophthalmic viscosurgical device, and a 7.0 mm capsulorhexis is then performed with a cystotome modified from a 26-gauge needle. A can-opener capsulotomy is performed when the capsulorhexis is unsuccessful. When the capsulorhexis has been completed, the wound is enlarged internally to 9.0 to 10.0 mm based on the nucleus size.

After hydrodissection of the nucleus by filtered balanced salt solution, a Sinskey hook is embedded in the center of the nucleus and pushed toward 7 o'clock. At the same time, a Kuglen hook held in the left hand

is pulled slightly against the edge of the anterior capsule opening toward the periphery until the equator of the nucleus can be seen. The Kuglen hook, which has a clover-leaf extension at the tip, is often used to adjust the intraocular lens (IOL) position during implantation. Once the superior pole of the nucleus is visualized, the Kuglen hook is inserted under it and supports it from beneath. Both instruments are passed through the main wound itself. The pole is then tipped up with the Kuglen hook. The nucleus is dialed out of the capsular bag by engaging the equator with the Sinskey hook and Kuglen hook alternately.

To extract the nucleus, the Sinskey hook is held in right hand and the Kuglen hook in the left hand. The Sinskey hook is inserted into the anterior chamber between the nucleus and the cornea, and the tip is then embedded in the center of the nucleus. When the main wound is opened in a fish-mouth shape as the end of the Sinskey hook is lifted, the 2 hands move at the same time, the right hand pulling the nucleus and the left hand pressuring the scleral bed 2.0 mm behind the posterior flap. As a result of the increased intraocular pressure and the pull of the Sinskey hook, the entire nucleus is dislodged out of the eye without being fragmented in the anterior chamber or tunnel. The force on the scleral bed should be exerted continuously and slowly (Figure 1 and Video [available at http://jcrsjournal.org]).

Throughout the procedure, special care should be taken to avoid grasping iris or capsule. The residual epinucleus is hydroexpressed with a Simcoe cannula through the scleral incision. After cortex aspiration, a poly(methyl methacrylate) IOL is implanted in the capsular bag whether a capsulorhexis or can-opener capsulotomy is done. The IOL is implanted and the incision checked to ensure it is self-sealing. No suture is placed. If the wound is not sufficiently watertight, 1 to 2 interrupted sutures are used.

Results

Manual sutureless ECCE was performed using the 2-hook technique in 1320 eyes of 1200 consecutive patients between January 2009 and December 2010. The mean age of the patients at surgery was 76.8 years (range 59 to 92 years). The mean follow-up was 3 months (range 1 to 5 months). The Emery-Little classification yielded the following degrees of nucleus hardness: 56 eyes = 1; 180 eyes = 2; 262 eyes = 3; 358 eyes = 4; and 464 eyes = 5. The mean operating time for the entire surgery was 8 minutes (range 5 to 14 minutes) and for prolapse of the nucleus into the anterior chamber and nucleus extraction using 2 hooks, 15.8 seconds (range 6 to 33 seconds).

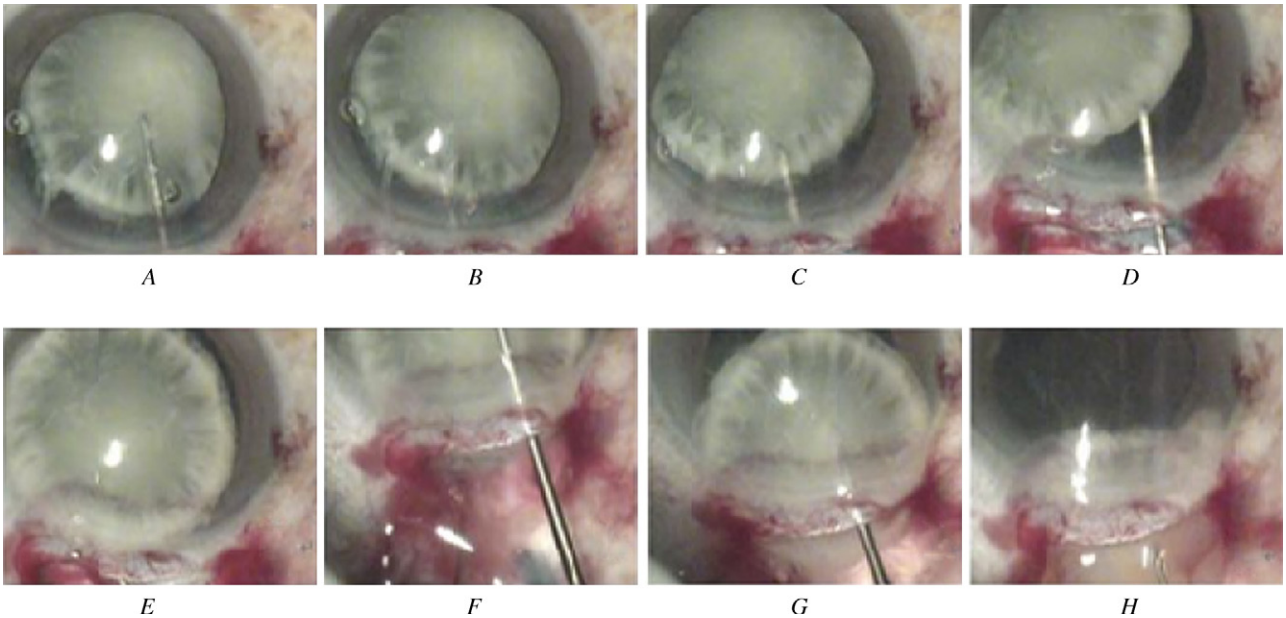

Figure 1. *A*: Sinskey hook is embedded in the nucleus and pushed toward 7 o'clock. Once the superior pole of the nucleus is visualized, a Kuglen hook is inserted beneath the pole. *B–E*: The pole is tipped up with the Kuglen hook, and the nucleus is dialed out of the capsular bag by repeatedly engaging the equator with the Sinskey hook. *F*: The Sinskey hook is inserted into the anterior chamber between the nucleus and the cornea, and the tip of the hook is embedded in the center of the nucleus. When the end of the Sinskey hook is lifted, the main wound is opened in a fish-mouth shape. *G–H*: The increased intraocular pressure and pull of the Sinskey hook dislodge the entire nucleus out of the eye without fragmentation.

All the operations were performed by the same experienced surgeon (J-w.D.). Posterior chamber IOLs were implanted in the capsular bag in all cases despite a posterior capsule rupture smaller than 1 quadrant in 4 eyes (0.30%). Vitreous loss or dislocation of the nucleus into the vitreous did not occur in any case. Transient corneal edema was noted in 12 eyes (0.91%); it resolved within the first week. In 1175 eyes (89%), a corrected distance visual acuity of 20/40 or better was achieved 2 months postoperatively.

DISCUSSION

In manual tunnel-incision cataract surgery, removing the nucleus from the capsular bag safely and smoothly has remained a crucial issue and challenge. It is also the step in which serious complications easily occur, especially with a large dense nucleus and for beginning cataract surgeons.

The literature suggests there are a variety of techniques for nucleus extraction. The most widely adopted is the irrigating vectis technique, in which an irrigation vectis is inserted behind the nucleus with or without irrigating water and the nucleus is then removed from the eye. Other techniques include phaco fracture,[4] phaco sandwich,[6] modified Blumenthal,[7] and fishhook (the hook, made of a 1 mL syringe needle, is placed under the nucleus during the procedure and the nucleus is hooked out of the eye).

All these techniques are practical. Moreover, among them, the irrigating vectis technique is the standard textbook method. Due to precise structure of the eye, it is crucial that the force is released safely and effectively in this narrow space, the anterior segment, without side injury to the zonule, capsule, endothelium of cornea, and iris. Well-known instruments such as an irrigation vectis cannot solve the problem presented by a large nucleus and relatively narrow anterior segment space or a patient's lack of cooperation.

The ideal extraction should be characterized by the following: (1) minimal time, (2) minimal movements, (3) no damage to the posterior capsule, (4) no rigid contact with the corneal endothelium, (5) no excessive stress directed to the zonule, (6) no damage to the iris, and (7) most importantly, it must be easy to learn and control and suitable for all rather than just some cases. To explore a safe, effective, easy-to-learn extraction technique is important in vision recovery work in China.

The senior author has developed a practical nucleus extraction technique (2-hook technique of nucleus extraction) and made it proficient, resulting in a good clinical outcome. The 2-hook technique has advantages over conventional methods of nucleus extraction. During cataract surgery, only the 2 most commonly used hooks (Sinskey and Kuglen) are needed. Thus, the irrigation vectis can be abandoned. The hook is small, occupying minimal space in the anterior chamber, and the tip is blunt so is less likely to injure the endothelial cells and iris or the posterior capsule. The entire extraction procedure is performed under direct view since the Sinskey hook is put between the cornea and the nucleus, preventing vital structures from touching.

The key concept of the 2-hook technique is that the force driving the nucleus is broken down into a minor component force by using 2 hooks scientifically; this causes only the nucleus to move, with minimal damage to intraocular structures. During the operation, the nucleus is dialed out of the capsular bag by engaging the equator with the Sinskey hook and Kuglen hook alternately, preventing the nucleus from falling back into the bag repeatedly due to inertia when using only 1 hand, which is prone to cause a broken zonule. By using 2 hooks, especially a Sinskey hook in the right hand, and changing the application point from time to time, applying several types of minor composite forces like hooking, lifting, and spinning, extraction of the nucleus can be fast and safe to a surprising extent. Sometimes it takes only 6 seconds for a nucleus to be dislodged out of the eyeball safely from the capsular bag. This minimal trauma is beneficial for quick recovery. Nearly all corneas are totally transparent on the first day postoperatively.

We characterize the 2-hook technique for nucleus extraction as follows: It is not a high-class technique. Due to congenital limitations, astigmatism caused by making an incision is inevitable, which somewhat restricts the application value. However, in the context of major vision-recovery work in basic medical institutions that lack equipment and the phacoemulsification or nucleus-splitting techniques and of cases of thick dense nuclei, this technique has incomparable advantages. If regarded as a basic technique for all cataract surgeons, iatrogenic blindness due to incorrect surgery would be largely avoided, and perhaps fewer surgeons in basic medical institutions would be frustrated. We believe the technique will become popular outside of China.

The 2-hook manual sutureless ECCE is a safe and effective method. It is easy to learn and perform and uses simple inexpensive instruments. It can be used to provide universal small-incision benefits without the expense and complexity of phacoemulsification.

WHAT WAS KNOWN

- When the most widely adopted techniques of nucleus extraction are performed in modern cataract surgery, the space-occupying instruments are put between the nucleus and posterior capsule blindly, which might increase the occurrence of damage to vital structures such as endothelial cells of cornea, iris, and posterior capsule. A safer, more effective method is needed.

WHAT THIS PAPER ADDS

- The 2-hook nucleus extraction technique can be easily and effectively performed in manual sutureless ECCE under direct view in which only the tip of the Sinskey hook is put into the anterior chamber, with minimal force exerted on vital tissues or structures inside the eye, and no extra instrumentation is needed. The technique is suitable for all eyes, even those with dense large cataracts.

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