Cystotome-assisted prechop technique

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We describe a manual prechop technique to divide the nucleus using a cystotome. In the cystotome-assisted prechop technique, after the capsulorhexis, the surgeon-bent cystotome is inserted into the lens while the Nagahara chopper is set around the lens equator. The cystotome and the chopper are then brought together in the center to create a bisecting crack in the nucleus, dividing it cleanly into 2 hemispheres.

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The prechop technique, first described by Akahoshi in 1998,1 revolutionized the chop technique in cataract surgery. Prior to this, energy was delivered during the chop procedure, which could lead to damage to the corneal endothelium or other ocular structures. Since then, many prechop techniques have been described: bimanual twin instruments approach for counter chopping,2A cross-action cracking forceps,3,4 the modified cystotomes for middle prechop,5 the Fukasaku hydrochopping cannula, the Escaf ultrasonic ultrachopper,2B even the femtosecond laser.7 Although these prechop techniques allow the surgeons to skip the difficult sculpting and chopping steps to fracture the nucleus,2 they require additional special instruments.

The cystotome-assisted prechop approach uses a surgeon-bent cystotome to break up the nucleus in the capsular bag with the traditional Nagahara chopper, available for moderate-density nuclei cases. It simplifies the horizontal phaco chop technique while retaining its benefits. It also does not require special instruments such as the Akahoshi prechopper or the additional expensive femtosecond-laser platform, and it requires less in-and-out anterior chamber manipulation than other prechop techniques. We propose that this alternative technique is smooth, safe, and effective, with a short learning curve and excellent early postoperative visual outcomes.

SURGICAL TECHNIQUE

A Barraquer needle holder is used to bend one-fourth to one-half of a 27-gauge needle tip down while holding the bevel up. Then, while maintaining the needle orientation, the needle is bent up near the hub. The preferred angle is from 60 degrees to 90 degrees at the tip, according to personal experience, and slightly less than this angle at the hub (Figure 1).

After the capsulorhexis is completed using the surgeon-bent cystotome, the long Nagahara chopper is introduced into the anterior chamber through the paracentesis. The nucleus is gently engaged by the cystotome at the anterior pole, followed by a slight pull toward the main incision. Simultaneously, the chopper in the surgeon’s left hand is slid under the cortex and capsule and rotated so the blade is
perpendicular to the equator of the nucleus, resting at 5 o’clock in the bag, maintaining the hook tip toward the optic nerve (Figure 2). By this time, the cystotome has been repositioned and inserted into the endo-nucleus just inside the capsular rim at 11 o’clock (Figure 3).

The Nagahara chopper and the cystotome are kept in apposition at the same radial meridian. The chopper is pulled obliquely up toward the center along the lens fiber, while the cystotome is pushed slightly obliquely down to provide a counterforce. Once they meet, the 2 instruments are gently separated laterally so the nucleus will split completely into 2 hemispheres (Figure 4). The Nagahara chopper and cystotome are then used together to bimanually rotate the nucleus 90 degrees with moderate force. The chopper is slid under the capsule again and pulled to the center, creating 2 quadrants (Figure 5). This procedure is repeated in the other hemisphere (Video 1, available at: http://jcrsjournal.org). Alternatively, the surgeon can perform the hydproceedure before rotation, followed by the classic phaco-chop procedure.

Results
The cystotome-assisted prechop technique was first introduced by one of the authors (B.L.), who has completed more than 30,000 cases using this technique since 2001. After visiting Dr. Liu’s practice, many surgeons (Y.X., Y.Q., X.H., and others) made a transition to the cystotome-assisted prechop technique. All the surgeons found that chopping the nucleus into pieces was easier than anticipated, while
the phaco time and energy decreased significantly. In only a few cases did they encounter zonular dialysis or a broken posterior capsule, especially in the initial stage of transition.

DISCUSSION

In our experience, this nucleofractis technique has worked well in moderate-density nuclei. Some experienced surgeons have used the cystotome-assisted prechop technique in soft or hard nuclei cases (Video 2, available at: http://jcrsjournal.org) and small pupil cases (Video 3, available at: http://jcrsjournal.org), but these cases are inappropriate for beginners. Brunescent cataracts and the loose capsule with zonular dialysis are relative contraindications for performing this technique according to the experience of the surgeon and the extent of the zonular dialysis. A white cataract is considered a limitation for the cystotome-assisted prechop technique because the moveable dense nucleus is difficult to hold and fails to split because the posterior plate is often fibrous or leathery.

Comparing various prechop techniques, there is no need for specialized instruments such as the Akahoshi combo prechopper or the expensive femtosecond platform. Since the capsulorhexis was created, surgeons can use the same cystotome to complete the prechop without changing to special instruments in and out of the anterior chamber or transporting patients between the laser and operating rooms, which makes the procedure smoother.

No phaco energy is wasted in the cystotome-assisted prechop procedure. Although the popular phaco chop can decrease the phaco energy for creating grooves in the divide-and-conquer technique, it requires energy to bury the phaco tip deeply into the endonucleus. Another significant benefit of the cystotome-assisted prechop technique for phaco beginners is that it is not necessary to build the occlusion in the endonucleus with precise pedal control and a high vacuum, which eliminates the difficulty in the chopping procedure. It is also easier to learn and control than the other manual prechop techniques such as the Akahoshi prechop or the hydrochop.

The cystotome-assisted prechop technique replaces the phaco needle with a fine cystotome, while the chopping maneuver is almost the same as the phaco-chop technique. This minor modification has the advantage of having a shorter learning curve. A new chop can be tried if the beginner fails to divide the nucleus at the first prechop, which is generally caused by superficial location of the Nagahara tip. However, the surgeon should promptly switch to the traditional phaco-chop process, avoiding several attempts that may decrease the central nucleus mass, making it more difficult to obtain a good grip with the phaco needle.

The most common complication of the cystotome-assisted prechop beginner is zonular dialysis, which is often caused by improper location of the chopper and the cystotome, or excessive maneuvering of the nucleus. Compared with the downward pressure of the Karate forceps, invented by Akahoshi, the cystotome-assisted prechop technique reverses the main chopping force from the equator toward the center, instead of toward the posterior capsule and the zonule. The mechanical force is similar to that in the phaco chop, unlike the classic divide-and-conquer technique, which adds stress to the zonule. The stress may be less in the cystotome-assisted technique than in the
middle prechop technique, which also uses the cystotome. This is due to the cystotome being directed centripetally against the chopper instead of being pressed down and incised in the nucleus in the middle prechop approach. When the chopper is halfway to the center, more pressure is exerted horizontally by the cystotome to further bisect the nucleus. Thus, the risk for zonular dialysis of the cystotome-assisted technique could be minimized with the correct maneuver.

Along with zonular dialysis, the rupture of the posterior capsule is a major and feared complication during the learning stage. This is a rare iatrogenic injury because the lens thickness is about 4.0 mm at the center and nearly 2.0 mm at the capsulorhexis rim, while the bent needle tip never exceeds 1.0 mm. During the chopping procedure, the chopper cuts through the mild-to-moderate density nucleus while the sharp cystotome moves slightly inward to the nucleus center to provide a counterforce in a safety area (Figure 6).

We performed the bisection without hydrodissection because after hydrodissection, the endonucleus may be rotatable, which makes holding and bisecting it difficult or impossible. Berger et al. made the same point that the fracture could be controlled better without the hydrodissection process in the 2-cystotome middle prechop technique. After the bisection, the hydrodissection is optional. The expert surgeon can use the chopper and the cystotome to bimanually rotate the nucleus. In this situation, the cystotome instead of the capsular bag becomes the counterfixating fulcrum around which to rotate the nucleus, which reduces capsular-bag torque and displacement. In addition, cracking the nucleus and performing the bimanual rotation actions with appropriate force allow the fluid to pass through the natural cleft in the epinucleus and the cortex lamellae. This creates analogous hydrodissection and makes endonucleus mobilization or rotation less difficult. The surgeon can also choose to perform additional hydrodissection after the nucleus bisection procedure, especially in difficult cases. Additional hydrodissection should reduce the stress on the zonule and prevent intracapsular hypertension and other complications. Subsequently, each hemisphere is dealt with in a standard phaco-chop manner. Combining the 2 techniques in this way seems to offer the advantage of an easy breakup of the nucleus into halves with the additional benefit of reducing the amount of phaco power used, similar to the stop-and-chop technique. In the case of diffuse zonular laxity, it the cystotome-assisted prechop technique can be combined with other techniques even using the retractor to fixate the capsular bag.

In summary, by combining the cystotome and the Nagahara phaco-chop technique, the cystotome-assisted prechop technique could simplify the previous prechop techniques. It is time saving, has a short learning curve, and an excellent healthcare economic outcome. It is currently a good alternative choice in accordance with today’s cataract surgery concepts: microincision, single-use instrumentation, and cost reduction.

WHAT WAS KNOWN

- The prechop technique is a highly efficient method for removing cataracts. Many prechop techniques have been developed to fracture the nucleus without grooving or sculpting, which decrease the ultrasound energy delivered.

WHAT THIS PAPER ADDS

- Based on the phaco-chop technique, the cystotome-assisted prechop technique uses a surgeon-bent cystotome to bisect the nucleus with the Nagahara chopper. The technique does not require special instruments, simplifies previous prechop techniques with a short learning curve, and has good intraoperative performance and excellent postoperative outcomes.

REFERENCES


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