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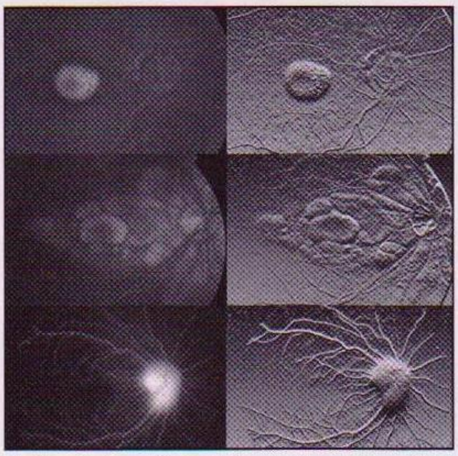

Representative fluorescein angiographic digital photographs (left) and their corresponding bas relief filter processed images (right) of RPE detachment (top), exudative retinal detachment in Vogt–Koyanagi–Harada syndrome (center), and optic neuritis (bottom).

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Half-Moon Supracapsular Nucleofractis Phacoemulsification Technique

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ABSTRACT

Many nucleofractis techniques introduced to date have both advantages and disadvantages. Therefore, the search for the most effective, functional, and safest technique continues. The half-moon supracapsular phacoemulsification technique, which the authors define as a new method, is a hybrid technique derived from both chopping and supracapsular techniques. This technique allows the endonucleus to partially prolapse out of the capsulorhexis rim into the anterior chamber during hydrodissection, to be chopped under direct vision, and to continue the quadrant-removal stage endocapsularly after sending the heminuclei back into the capsular bag. The nucleus-splitting stage is performed in the anterior chamber, and the quadrant-removal stage continues in the capsular bag away from the corneal endothelium, which is again the safest place. The half-moon supracapsular phacoemulsification technique achieves the two stages of nucleus removal in the safest location with the most effective method and therefore may provide some advantages in terms of efficacy, safety, and functionality. **[Ophthalmic Surg Lasers Imaging 2010;41:390-393.]**

INTRODUCTION

Since phacoemulsification was introduced by Kelman, many operative techniques have been developed and put into practice to make the process safer and easier. Ease of application, a short learning period, effects on prevention or causation of complications, and the results of surgery have played a role in the proposed methods finding acceptance, and some of these techniques have become widely used by eye surgeons.

The half-moon supracapsular phacoemulsification technique[1] we present here is a hybrid technique derived from the combination of the horizontal phaco-chop,[2] supracapsular phacoemulsification,[3] and pop-and-chop[4] techniques. In this technique, the first stage of the operation until nucleofractis is performed partially supracapsularly and the following quadrant-removal stage is performed endocapsularly.

TECHNIQUE

Preoperative Preparation and Anesthesia

A dilation regimen of cyclopentolate hydrochloride 1% (Sikloplejin; Abdi Ibrahim, Istanbul, Turkey), phenylephrine hydrochloride 2.5% (Mydfrin; Alcon, Hunenberg, Switzerland), and ketorolac tromethamine 0.5% (Acular LS; Allergan, Irvine, CA) is used 30 minutes before the operations. Topical anesthesia is performed with lidocaine hydrochloride plus adrenaline (Jetokain; Adeka, Samsun, Turkey) and bupivacaine hydrochloride 0.5% (Marcaine; AstraZeneca, Istanbul, Turkey) mixture.

Main Incision

This technique can be performed with 1.4-mm incisions for biaxial microincisional cataract surgery,

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with 2.0- to 2.8-mm incisions for microcoaxial phacoemulsification, and with 2.8-mm or wider incisions for conventional phacoemulsification.

Side-Port Incisions

Two side-port incisions are made with a 20-gauge microvitreoretinectomy knife, 90° away from the main incision. A 1.4-mm incision is used as a second incision in biaxial surgery.

Capsulorhexis

Capsulorhexis, ideally 4.5 to 5.0 mm in diameter, is performed following the injection of suitable viscoelastic material into the anterior chamber. Marking the cornea with a Hoffmann marker before capsulorhexis may be helpful to maintain the ideal size and keep it centralized. Smaller capsulorhexis has the potential risk of capsular block syndrome, whereas larger capsulorhexis will probably make the partial prolapse of the nucleus difficult during hydrodissection (Fig. A).

Hydroprocedure

Before this procedure, it is useful to take some of the viscoelastic material out of the eye by pressing on the wound lips to prevent capsular block syndrome or iris prolapse.

Hydrodelineation is performed with a 27-gauge angled flat hydrodissection cannula through the nucleus–epinucleus junction by fluid flowing inferiorly. Hydrodelineation is not essential for half-moon supracapsular phacoemulsification, but if it is performed, it would be easier to partially prolapse the endocapsular nucleus.

Hydrodissection is performed with the same cannula by upward injection of fluid just under the capsule at the edge of the capsulorhexis (Fig. B). Hydrodissection is continued without interruption until the prolapse of the distal pole of the nucleus out of the capsulorhexis rim is seen. Prolapse of only the distal pole of the nucleus is enough for the procedure. The proximal part is left behind the capsulorhexis rim and looks like a half-moon (Fig. C). It should not be forgotten that the force that pushes the nucleus forward is the fluid captured between the nucleus and posterior capsule. As the diameter of the capsulorhexis increases, the amount of fluid captured decreases and forward movement becomes difficult. As the diameter of the capsulorhexis gets smaller, the captured fluid may rupture the posterior capsule because the nucleus cannot prolapse.

Nucleotomy

While the phaco tip is buried in the nucleus with high vacuum parameters, the nucleus is divided lengthwise beginning from the edge of the nucleus with a chopper (preferably Chang's microfinger chopper, which is appropriate for nucleus edge) introduced into the anterior chamber from the side port (Fig. D).

Sending Heminuclei Back Into the Bag

The heminuclei are sent back into the bag with the help of the phaco tip or fluid flow after removing a wedge of nucleus to obtain space if necessary (in small nuclei it is not necessary) (Fig. E). The easy rotation of heminuclei ensures that they are in the capsular bag.

Quadrant Removal

Quadrant removal is completed in the capsular bag with small chops as in the stop-and-chop technique (Fig. F).

Irrigation-Aspiration and Intraocular Lens Implantation

The remaining part of the operation is not different from the standard techniques.

DISCUSSION

Nagahara's horizontal chopping technique offers safer phacoemulsification by holding phaco instruments centrally during both nucleotomy and the entire phaco process, and by decreasing zonular tension as a consequence of avoiding centrifugal forces.[5] However, because the technique involves the dividing of the nucleus with the chopper used peripherally without direct vision, it has the potential risk for damaging the zonules or the capsule. Thus, it has a critical learning period and is usually frightening for many surgeons. Furthermore, because splitting is performed within the capsular bag, the chopped heminuclei may remain interlocked in the bag like jigsaw puzzle pieces, which causes difficulties in quadrant removal that reduce the efficacy of the technique. To solve this problem, Koch et al.[6] made a central groove in the beginning to create a potential space in his stop-and-chop technique and, after dividing the nucleus, the quadrant-removal stage could be performed more easily in the acquired space.[7] But ultrasound energy, which can be harmful for adjacent tissues, is overly used to make a groove and this reduces the safety of the technique.

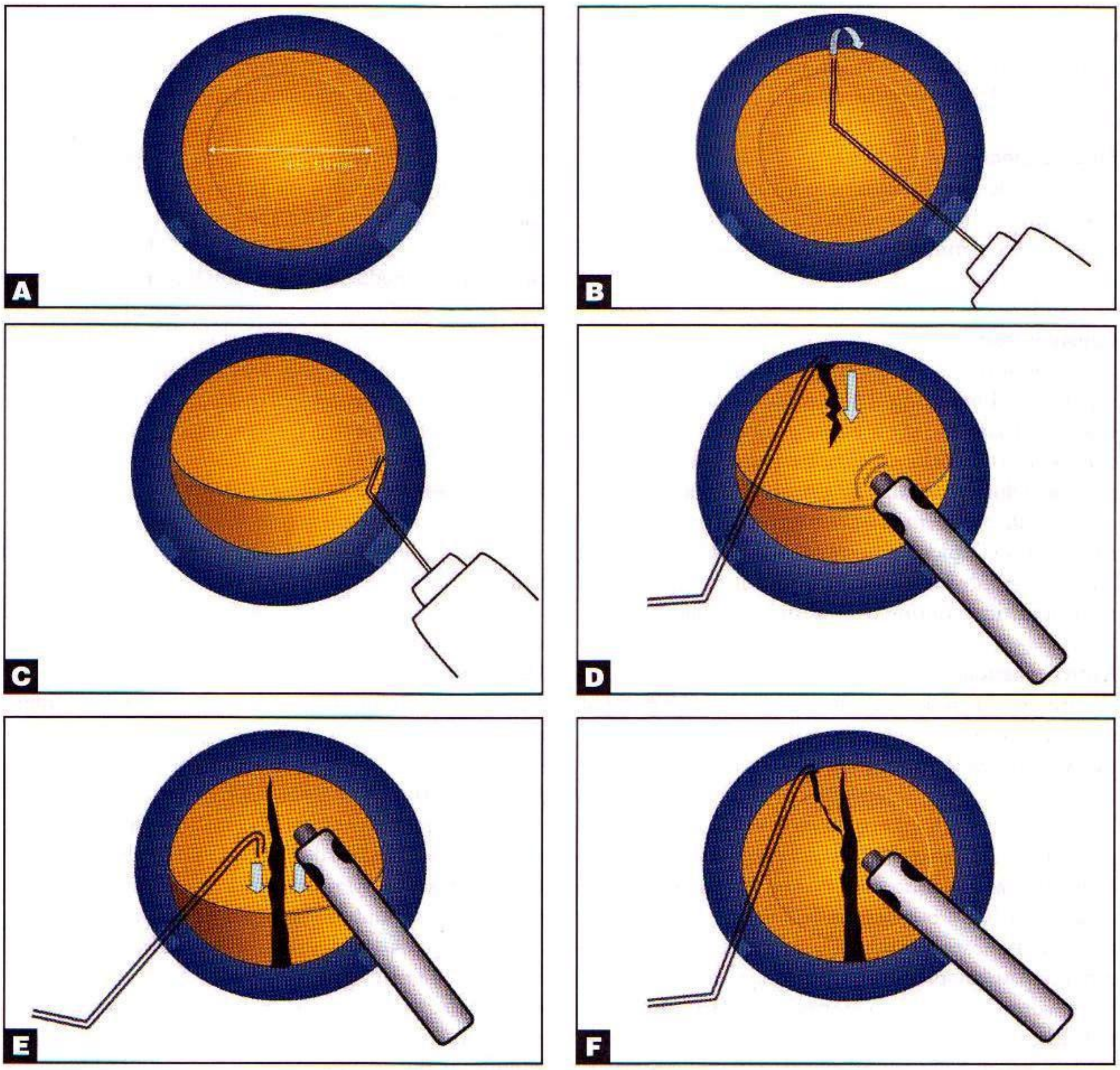

Figure. (A) Capsulorhexis, ideally 4.5 to 5.0 mm diameter. (B) Hydrodissection. The partial prolapse procedure will be easier if hydrodelineation is performed previously. (C) Partial prolapse of endonucleus from the capsulorhexis opening by hydrodissection (appearance looks like a half-moon). (D) Horizontal chopping of partially prolapsed endonucleus under direct sight, without zonular or capsular stress. (E) Sending split heminuclei back into the capsular bag. (F) Continuing phacoemulsification endocapsularly.

In supracapsular techniques, the nucleus is taken into the anterior chamber and the phacoemulsification procedure continues there. The reason these techniques have not been accepted widely is that phacoemulsification performed in the anterior chamber has more risks for endothelial cell loss because it is so close to the cornea. The half-moon supracapsular phacoemulsification technique[1] is a hybrid method derived from the combination of Nagahara's[2] horizontal chop, Maloney et al.'s[3] supracapsular phacoemulsification, and Pandit and Oetting's[4] pop-and-chop techniques. It differs from Nagahara's horizontal chop technique by performing chopping under direct vision and from Maloney et al.'s[3] supracapsular technique by continu-

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ing the procedure in the capsular bag. The half-moon supracapsular phacoemulsification technique resembles Pandit and Oetting's[4] pop-and-chop technique much more, but differs from it by partial prolapse of the nucleus and by continuing the procedure after chopping in the capsular bag instead of the anterior chamber. Both Maloney et al.[3] and Pandit and Oetting[4] suggest a larger capsulorhexis, but we recommend a smaller capsulorhexis of 4.5 to 5.0 mm in diameter to facilitate partial prolapse.

Fine et al.,[5] Pirazzoli et al.,[7] DeBry et al.,[8] Ram et al.,[9] and Wong et al.[10] compared divide-and-conquer and chopping techniques in terms of phaco time and power, and showed the benefits of chop techniques. In our previous study[11] comparing Nagahara's horizontal chop and stop-and-chop techniques for the same parameters, we reported significantly lower values of mean phaco time, phaco power, and effective phaco time in the horizontal chop group. In our 2008 study comparing half-moon supracapsular and stop-and-chop phacoemulsification, we have also seen that previously mentioned advantages continue.[1] The new technique is not different from the stop-and-chop technique in terms of final visual acuity, contrast sensitivity values, and functionality. We can say that the half-moon supracapsular phacoemulsification technique shares the same advantages of Nagahara's horizontal chop technique by using low ultrasound energy.

When we evaluate the positive and negative aspects of frequently used nucleofractis techniques, the half-moon supracapsular nucleofractis and phacoemulsification method offers advantages except being close to the corneal endothelium in partial prolapse and splitting nucleus stages. Other advantages are its applicability with biaxial microincisional phacoemulsification surgery and it is not affected from the negative aspects of the operation such as inflow deficiency and surge probability.

Half-moon supracapsular phacoemulsification seems to simplify the operations and decrease the complication rates in challenging cases such as extremely soft or hard cataracts, eyes with pseudoexfoliation, high myopia, glaucoma, history of trauma, and especially cataracts with zonular deficiency because it avoids zonular tension by using centripetal forces and applies no force on zonules and capsule during the splitting stage.

REFERENCES

1. Can I, Takmaz T, Genç I. Half-moon supracapsular nucleofractis phacoemulsification: safety, efficacy, and functionality. *J Cataract Refract Surg.* 2008;34:1958-1965.
2. Chang DF. Why learn chopping? In: Chang DF, ed. *Phaco Chop: Mastering Techniques, Optimizing Technology, and Avoiding Complications.* Thorofore, NJ: SLACK Incorporated; 2004:3-12.
3. Maloney WF, Dillman DM, Nichamin LD. Supracapsular phacoemulsification: a capsule-free posterior chamber approach. *J Cataract Refract Surg.* 1997;23:323-328.
4. Pandit RT, Oetting TA. Pop and chop nucleofractis. *J Cataract Refract Surg.* 2003;29:2054-2056.
5. Fine IH, Packer M, Hoffman RS. Use of power modulations in phacoemulsification: choo-choo chop and flip phacoemulsification. *J Cataract Refract Surg.* 2001;27:188-197.
6. Koch PS, Katzen LE. Stop and chop phacoemulsification. *J Cataract Refract Surg.* 1994;20:566-570.
7. Pirazzoli G, D'Eliseo D, Ziosi M, Acciarri R. Effects of phacoemulsification time on the corneal endothelium using phacofracture and phaco chop techniques. *J Cataract Refract Surg.* 1996;22:967-969.
8. DeBry P, Olson RJ, Crandall AS. Comparison of energy required for phaco-chop and divide and conquer phacoemulsification. *J Cataract Refract Surg.* 1998;24:689-692.
9. Ram J, Wesendahl TA, Auffarth GU, Apple DJ. Evaluation of in situ fracture versus phaco chop techniques. *J Cataract Refract Surg.* 1998;24:1464-1468.
10. Wong T, Hingorani M, Lee V. Phacoemulsification time and power requirements in phaco chop and divide and conquer nucleofractis techniques. *J Cataract Refract Surg.* 2000;26:1374-1378.
11. Can I, Takmaz T, Cakici F, Ozgül M. Comparison of Nagahara phaco-chop and stop and-chop phacoemulsification nucleotomy techniques. *J Cataract Refract Surg.* 2004;30:663-668.