Half-moon supracapsular nucleofractis phacoemulsification: Safety, efficacy, and functionality

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PURPOSE: To compare the safety, efficacy, and functionality of half-moon supracapsular phacoemulsification, a variation of the nucleofractis technique, with those of the stop-and-chop technique.

SETTING: Atatürk Training and Research Hospital, 2nd Ophthalmology Department, Ankara, Turkey.

METHODS: This prospective randomized study comprised 100 eyes having phacoemulsification with the half-moon supracapsular (Group 1, 50 eyes) or stop-and-chop (Group 2, 50 eyes) technique. The half-moon supracapsular technique is based on hydrodissection-assisted partial prolapse of the nucleus. After the prolapsed nucleus is chopped horizontally and the first wedge removed, quadrant removal is performed endocapsularly. Follow-up examinations were at 1, 7, 30, and 90 days.

RESULTS: The 2 groups were similar in demographic features and surgical difficulty factors. There was no difference in the complication rate. The phaco time (mean: Group 1, 0.2 minutes $\pm$ 0.1 (SD); Group 2, 0.4 $\pm$ 0.4 minutes), average power (mean 11.3% $\pm$ 6.9% and 18.3% $\pm$ 7.3%, respectively), effective phaco time (1.7 $\pm$ 1.8 seconds and 4.8 $\pm$ 6.5 seconds, respectively), and total operation time (12.3 $\pm$ 3.2 minutes and 14.3 $\pm$ 4.3 minutes, respectively) were significantly lower in Group 1 than in Group 2. One day postoperatively, the increase in central corneal thickness increase was significantly greater in Group 1 ($P = 0.011$), with no significant differences thereafter. The visual acuity increase and contrast sensitivity scores at 90 days were similar in the groups.

CONCLUSIONS: The half moon supracapsular technique shortened the phacoemulsification procedure and lowered phaco energy, indicating it protects surrounding intraocular tissue. There was no difference between techniques in reliability and functionality.

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Diverse nucleofractis techniques have evolved to divide the nucleus into smaller pieces and remove it through a capsulorhexis approximately half the diameter of the nucleus.[1–6] Two main forces are used to split the nucleus: the ultrasound (US) energy of phacoemulsification or the manual force generated by a chopper or another instrument. Chang[7] classified nucleofractis techniques into 2 main groups based on the force used. For example, there are 2 approaches to splitting a wooden log: sawing through most of the diameter until the last connecting bridge is weak enough to be cracked or placing the log upright and using an axe to chop it. This analogy conveys the 2 most popular nucleofractis techniques; divide-and-conquer using US energy would be analogous to sawing through a wooden log, and chopping or phaco chop using a chopper would be analogous to placing the log upright and chopping it with an axe.[1] In the chopping technique, energy used to divide the nucleus into smaller pieces is transferred manually with an instrument, replacing the US energy, which may be harmful to the surrounding tissues.

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Many studies have found less US energy is required with chopping techniques.[8–12] There are other advantages of chopping techniques. For example, released energy is centripetal compared with the centrifugal direction of the divide-and-conquer technique; this reduces the stress on the zonules and capsular bag. In addition, holding the phaco tip centrally and working far from the posterior capsule and iris make phacoemulsification safer. Other advantages of chopping are that the exact depth of the phaco tip in the anterior chamber is known, which diminishes the dependence on the red reflex, and the surgeon can work supracapsularly when necessary. Disadvantages of the phaco-chop technique are that chopped pieces might remain interlocked in the capsular bag, like jigsaw puzzle pieces. This problem was solved by the stop-and-chop technique introduced by Koch and Katzen.[1] In this technique, which is a combination of phaco chop and divide and conquer, a single central groove is sculpted first and the nucleus is then split in half. Making a single central groove creates a potential space into which the heminucleus can be pulled; however, this technique uses more US energy than pure chopping. The most significant problem of horizontal chopping is the potential for damaging the anterior capsule or zonules by misplacing the chop instrument while moving the chopper to the lens equator under the iris and capsulorhexis (K. Nagahara, MD, "Phaco-Chop Technique Eliminates Central Sculpting and Allows Faster, Safer Phaco," Ocular Surgery News, International Edition, October 1993, pages 12–13).

To solve this problem, vertical chopping was developed and, in time, supracapsular techniques were introduced.[2,6,13,14] These include Maloney et al.'s[2] supracapsular phacoemulsification, Davis and Lindstrom's[3] tilt-and-tumble technique, and Pandit and Oetting's[4] pop-and-chop technique, which is a combination of chop and supracapsular techniques.

We describe a new technique called half-moon supracapsular phacoemulsification, which refers to the prolapsed position of the nucleus before it is divided. In the technique, the distal opposite pole of the nucleus is first prolapsed out of the capsulorhexis rim anteriorly; then, the nucleus is divided in 2 beginning from the equator of the lens using the horizontal chopping technique. Next, and in some cases after a wedge of nucleus is removed, the heminuclei are placed back in the capsular bag, after which phacoemulsification continues in the capsular bag. This prospective study evaluated the safety, efficacy, and functionality of half-moon supracapsular phacoemulsification and compared them with those of the stop-and-chop technique.

PATIENTS AND METHODS

In this prospective randomized study, phacoemulsification was performed in 100 eyes of 92 patients using the half-moon supracapsular technique (Group 1) or the stop-and-chop technique (Group 2). The study was performed at Ankara Atatürk Training and Research Hospital, 2nd Ophthalmology Department, between August 2006 and April 2007.

All patients in the study agreed to participate, met the inclusion criteria, and signed an informed consent agreement before any procedure was performed. The study was approved by the hospital's ethics committee and was performed in accordance with the ethical principles described in the Declaration of Helsinki. Patients who had previous eye surgery or eye disease that might affect visual acuity (eg, amblyopia, retinal abnormalities, glaucoma, diabetic retinopathy, age-related macular degeneration, corneal opacities or irregularity) were not included in the study.

A complete ophthalmologic examination including best spectacle-corrected visual acuity, biomicroscopy, applanation tonometry, fundus examination, corneal topography, and pachymetry were performed in all patients preoperatively and postoperatively. Central corneal thickness (CCT) was measured with a US pachymeter (BV International). Corneal topographic analysis was performed using the Placido disk–based Keratron Scout corneal analyzer (Optikon 2000). Lens hardness was evaluated using the Lens Opacity Classification System III.[15,16] Pupil diameters were measured and recorded just before surgery. Contrast sensitivity testing was performed postoperatively using the CSV 1000E instrument (Vector Vision), which has a printed chart using sine-wave gratings to measure spatial frequencies of 3, 6, 12, and 18 cycles per degree (cpd).

All patients received a standard dilation regimen of cyclopentolate hydrochloride 1% (Sikloplejin), phenylephrine hydrochloride (Mydfrin 2.5%), and ketorolac tromethamine 0.5% (Acular) 30 minutes before surgery. The operations were performed by the same surgeon (I.C.) using topical anesthesia comprising lidocaine hydrochloride plus adrenaline (Jetokain) and bupivacaine hydrochloride (Marcaine 0.5%).

Operations were performed through a 2.2 mm incision using a microcoaxial phacoemulsification technique or 2.8 mm incisions using a standard coaxial technique. Phacoemulsification began with 2.2 or 2.8 mm clear corneal incisions created on the steep axis with diamond knives (Accutome, Accutome, Inc., or Rumex, Ophthalmic Instruments) according to the corneal topography measurements. In eyes with the steep axis between 20 degrees and 60 degrees, corneal incisions were made in the temporal quadrant in right eyes and in the superonasal quadrant in left eyes. Next, 2 side ports were made with a 20-gauge microvitreoretinal blade 90 degrees from the main incision. After chondroitin sulfate 4%–sodium hyaluronate 3% (Viscoat) was injected into the anterior chamber, a continuous curvilinear capsulorhexis with a diameter not exceeding 5.0 mm was created with a Utrata forceps. The capsulorhexis diameters were measured and recorded. Hydrodissection was performed with a 27-gauge, angled, flat hydrodissection cannula. After the fluid wave passed completely across the posterior surface of the nucleus, fluid was injected under the anterior capsular rim, continuing until the distal opposite pole of the nucleus prolapsed out of the capsulorhexis rim anteriorly in Group 1 (Figure 1, *A* to *C*, and Figure 2). After hydrodissection and most hydrodelineation were complete, phacoemulsification was performed with the Infiniti unit (Alcon Laboratories). In all cases, a 0.9 mm, flared, 30-degree aspiration

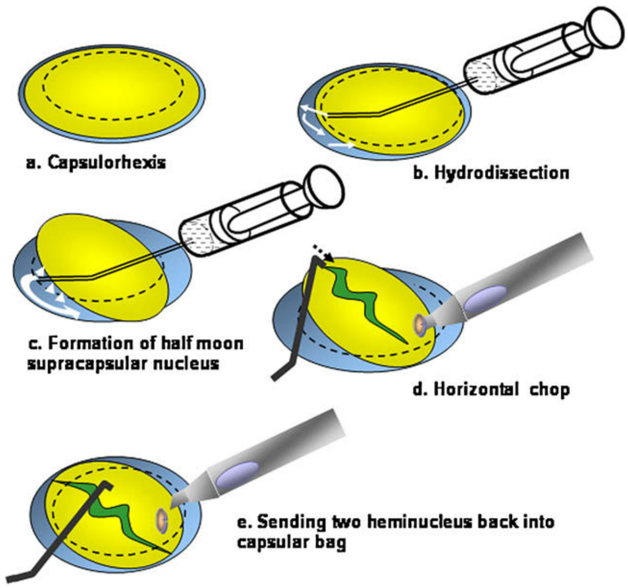

Figure 1. Steps of half-moon supracapsular nucleofractis technique.

bypass system Kelman microtip was used. An ultrasleeve was used in eyes with a 2.2 mm incision and a standard sleeve in eyes with 2.8 mm incisions.

Table 1 shows the surgical parameters used during phacoemulsification. The same phaco parameters were used in both techniques, except during the groove stage of stop and chop, to allow standardized comparison of the 2 techniques. In Group 1, the phaco microtip was buried in the nucleus directly, after which the nucleus was divided in 2 beginning from the equator of the lens using the chop technique and a Rosen phaco splitter or Chang microfinger choppers (Katena Instruments) (Figure 1, *D*, and Figure 3). After the chopping procedure or after a wedge of nucleus was removed in the same way, the remainder of the lens was placed back in the capsular bag with the chopper or flow of infusion fluid (Figure 1, *E*). At this time, endocapsular phacoemulsification was performed with the same parameters and the conventional chopping technique was repeated to remove the remainder of the nucleus.

In Group 2, the standard stop-and-chop technique was used. After a central groove was created, the nucleus was split in half. Sculpting was then stopped, and the technique was changed to a chopping method in which the nuclear halves were cut into fragments, emulsified, and aspirated. Parameters used during quadrant removing were the same as in Group 1 (Table 1).

Removal of the epinucleus and cortex was performed with bimanual infusion–aspiration cannulas in both groups. In all cases, sodium hyaluronate 2% (Cohaerens) was injected into the anterior chamber, after which an AcrySof Naturale SN60AT or AcrySof IQ SN60WF intraocular lens (Alcon Laboratories) was implanted in the capsular bag with a Royale injector (ASICO) or Monarch II injector (Alcon Laboratories) through a C cartridge (Alcon Laboratories). The ophthalmic viscosurgical device (OVD) was carefully removed from the anterior chamber until no OVD was visible. Before the procedure was completed, the corneal incision length was measured with a Tsuneoka microincision gauge (ASICO). Then, 1 mg/0.1 mL of cefuroxime was injected into the anterior chamber and the incisions were closed by stromal hydration.

In all cases, the time between creation of the corneal incision and closure of the incision by stromal hydration was recorded as total operation time. The following intraoperative phaco parameters were recorded: phaco time in minutes, mean phaco power (ie, average power) as a percentage, and effective phaco time (EPT) (calculated time required if 100% power had been used throughout). The EPT was calculated using the following formula: phaco time $\times$ mean phaco power/100.[12] Intraoperative complications were recorded. Three parameters that likely affect phaco time and the difficulty of phacoemulsification were evaluated; the parameters were mean lens hardness, mean pupil diameter, and mean capsulorhexis diameter.

Complete ophthalmic postoperative examinations were performed at 1, 7, 30, and 90 days. Postoperative complications were recorded. Contrast sensitivity testing was performed on at 90 days.

Statistical analysis was performed using SPSS for Windows (version 13.0, SPSS, Inc.). Chi-square, Fischer exact

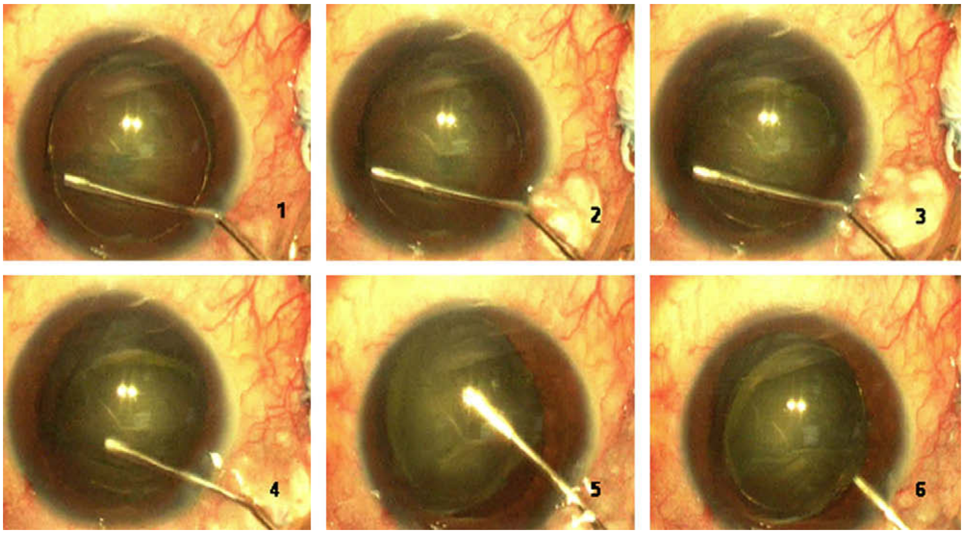

Figure 2. Prolapsing distal pole of the nucleus supracapsularly with hydrodissection.

Table 1. Parameters used during phacoemulsification.

Parameter	Phacoemulsification Technique HMSC (n = 50)	S&C (n = 50)
Prephaco (groove)		
Power (%)	—	50 (L)
Pulse rate (pulses per second)	—	100
% time on	—	55
Vacuum (mmHg)	—	120 (L)
Aspiration rate (cc/min)	—	30 (L)
Bottle height (cm)	—	80
Chop		
Power (%)	50 (L)	50 (L)
Burst on (ms)	30	30
Burst off (ms)	5	5
Vacuum (mm Hg)	400 (F)	400 (F)
Aspiration rate (cc/min)	42 (F)	42 (F)
Bottle height (cm)	110	110
Epinucleus removal		
Power (%)	15 (L)	15 (L)
Vacuum (mm Hg)	250 (L)	250 (L)
Aspiration rate (cc/min)	30 (L)	30 (L)
Bottle height (cm)	80	80
Cortex/OVD removal		
Vacuum (mm Hg)	600 (L)	600 (L)
Aspiration rate (cc/min)	60 (L)	60 (L)
Bottle height (cm)	110	110

F = fixed; HMSC = half-moon supracapsular; L = linear; OVD = ophthalmic visocsurgical device; S&C = stop and chop

test, and *t* tests were used to compare the parameters. Two-way analysis was used for all tests; *P* values less than 0.05 were considered statistically significant.

RESULTS

Ninety-two patients were enrolled in the study. Group 1 (half-moon supracapsular technique) comprised 50 eyes of 47 patients and Group 2 (stop-and-chop technique), 50 eyes of 45 patients. There was no statistically significant difference between groups in age, sex, nucleus hardness, laterality, preoperative visual acuity, or preoperative pachymetry ($P > .05$) (Tables 2 to 4).

The microcoaxial technique through 2.2 mm incisions was used in 38 eyes in Group 1 and 34 eyes in Group 2 and the standard coaxial technique through a 2.8 mm incision in 12 eyes and 16 eyes, respectively ($P = .373$). There was no difference between the 2 groups in the incision sizes used (Table 5). There was no statistically significant difference in final incision size between eyes with 2.2 mm incisions and eyes with 2.8 mm incisions or between groups (Table 6).

There was no statistically significant difference between Group 1 and Group 2 in mean lens hardness, mean pupil diameter, or mean capsulorhexis diameter ($P > .05$) (Tables 2 and 5). Although these parameters were similar, intraoperative phaco parameters (phaco time, mean phaco power, and EPT) were statistically lower in Group 1 ($P < .01$) (Table 5). Mean total operation time was also lower in Group 1 ($P = .010$) (Table 5).

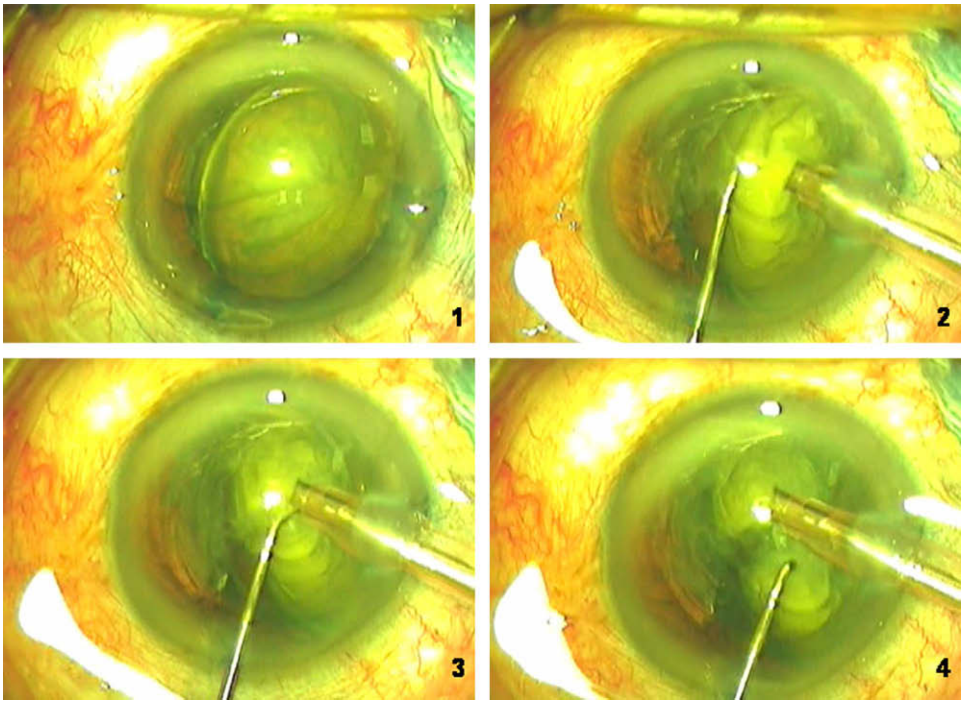

Figure 3. Dividing the nucleus tilted supracapsularly (half moon) into 2 pieces using a chopping technique.

Table 2. Preoperative group comparisons.

Parameter	HMSC (n = 50)	S&C (n = 50)	*P* Value
	Phacoemulsification Technique		
Mean age (y) ± SD	65.9 ± 12.4	69.6 ± 11.1	.112
Sex			.686
Male	26	23	
Female	21	22	
Laterality of eyes			.227
Right	31	25	
Left	19	25	
Mean nuclear hardness ± SD	2.7 ± 1.1	2.7 ± 0.8	.842

HMSC = half-moon supracapsular; S&C = stop and chop

Intraoperatively, there were no cases of anterior chamber stability decrease (surge), anterior chamber collapse, or other significant complications. One eye in Group 2 had mild zonular damage. There was no statistically significant difference between groups in intraoperative complications ($P = 1.000$). No eye had early or late postoperative complications such as incision site burn, incision leakage, Descemet membrane detachment, corneal incision leakage, infection, clinically significant corneal edema, or anterior chamber reaction (flare and cells in anterior chamber, membrane formation).

Table 3 shows the preoperative and postoperative logMAR visual acuities. There were no statistically significant differences between the 2 groups ($P > .05$).

Table 3. Visual acuity and contrast sensitivity values preoperatively and 90 days postoperatively

Parameter	HMSC (n = 50)	S&C (n = 50)	*P* Value
	Phacoemulsification Technique		
Mean BCVA (logMAR) ± SD			
Preop	0.51 ± 0.27	0.49 ± 0.25	.686
90 d postop	0.09 ± 0.16	0.12 ± 0.19	.388
90 d postop − preop	−0.41 ± 0.28	−0.36 ± 0.25	.332
Mean contrast sensitivity ± SD			
3 cpd	1.4 ± 0.2	1.5 ± 0.3	.137
6 cpd	1.6 ± 0.2	1.7 ± 0.3	.854
12 cpd	1.3 ± 0.3	1.2 ± 0.4	.714
18 cpd	0.9 ± 0.3	0.8 ± 0.3	.382

BCVA = best corrected visual acuity; cpd = cycles per degree; HMSC = half-moon supracapsular; S&C = stop and chop

Table 4. Preoperative and postoperative CCT measurements.

Pachymetry (μm) (Mean ± SD)	HMSC (n = 50)	S&C (n = 50)	*P* Value
	Mean ± SD		
Preop	541.3 ± 29.5	541.6 ± 37.9	.966
Postop			
1 d	586.2 ± 43.9	571.6 ± 44.9	.107
7 d	561.1 ± 40.0	559.2 ± 38.9	.816
30 d	543.6 ± 36.1	546.5 ± 37.1	.696
90 d	542.1 ± 33.9	540.2 ± 36.8	.790
Difference			
1 d postop − preop	44.9 ± 34.5	30.1 ± 21.1	.011
7 d postop − preop	19.8 ± 26.9	17.7 ± 16.9	.635
30 d postop − preop	2.3 ± 19.4	4.9 ± 17.3	.482
90 d postop − preop	0.8 ± 18.8	−1.4 ± 16.2	.534

CCT = central corneal thickness; HMSC = half-moon supracapsular; S&C = stop and chop

The preoperative CCT values were similar in the 2 groups ($P > .05$). The increase in CCT from preoperatively to 1 day postoperatively was statistically significantly higher in Group 1 than in Group 2 ($P = .011$); there were no significant differences between groups thereafter ($P > .05$) (Table 4 and Figure 4).

Contrast sensitivity testing at 90 days showed no statistically significant differences between groups at any spatial frequency ($P > .05$) (Table 3).

DISCUSSION

We call our new technique half-moon supracapsular phacoemulsification as it combines the advantages

Table 5. Intraoperative parameters.

Parameter	HMSC (n = 50)	S&C (n = 50)	*P* Value
	Phacoemulsification Technique		
Mean pupil diameter (mm)	7.3 ± 1.1	6.9 ± 1.2	.098
Incision size (n)			.373
2.2 mm	38	34	
2.8 mm	12	16	
Mean capsulorhexis diameter (mm)	5.3 ± 0.8	5.1 ± 0.5	.145
Mean total operation time (min)	12.3 ± 3.2	14.3 ± 4.3	.010
Mean phaco time (min)	0.2 ± 0.1	0.4 ± 0.4	.001
Mean phaco power (%)	11.3 ± 6.9	18.3 ± 7.3	.001
Mean EPT (s)	1.7 ± 1.8	4.8 ± 6.5	.003

Means ± SD
EPT = effective phaco time; HMSC = half-moon supracapsular; S&C = stop and chop

Table 6. Parameters used during phacoemulsification.

Group	Number of Eyes HMSC	S&C	*P* Value
Initial incision 2.2 mm			.955
Final incision			
2.2 mm	9	7	
2.3 mm	18	16	
2.4 mm	6	5	
2.5 mm	5	6	
Initial incision 2.8 mm			.576
Final incision			
2.8 mm	8	9	
2.9 mm	4	7	

HMSC = half-moon supracapsular; S&C = stop and chop

of Nagahara's horizontal phaco-chopping technique (K. Nagahara, MD, "Phaco-Chop Technique Eliminates Central Sculpting and Allows Faster, Safer Phaco," Ocular Surgery News, International Edition, October 1993, pages 12–13), Maloney et al.'s[2] supracapsular phacoemulsification technique, and Pandit and Oetting's[4] pop-and-chop technique. Although some benefits of the previous techniques, such as dividing the nucleus in 2 without using US energy (as in Nagahara's horizontal chopping technique), the new technique is performed in the central area and releases continuous centripetal energy, which prevents interlocking of the remaining nucleus halves. It also makes chopping safer than other techniques, in which the surgeon cannot see the periphery of the nucleus under the iris and capsulorhexis. In addition, supracapsular techniques significantly lower the risk for endothelial cell damage because the surgeon works in the anterior chamber over the capsulorhexis.

The half-moon supracapsular technique mainly resembles Pandit and Oetting's[4] pop-and-chop technique. However, it differs from pop-and-chop and other supracapsular techniques because we prefer a small capsulorhexis and endocapsular phacoemulsification after the nucleus is divided.

In this study, we compared the safety, efficacy, and functionality of the half-moon supracapsular technique (Group 1) and the stop-and-chop technique (Group 2).

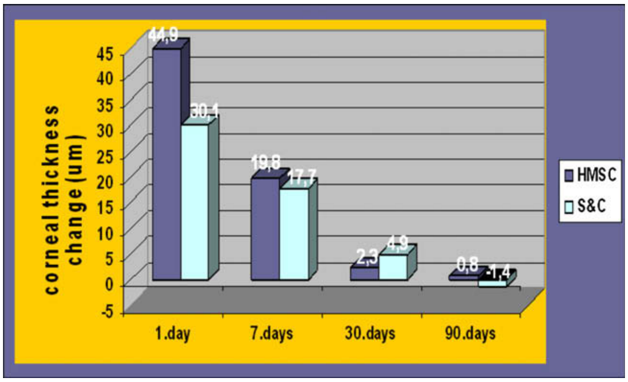

Figure 4. Postoperative corneal thickness change in both groups (HMSC = half-moon supracapsular; S&C = stop and chop).

Safety

The mean phaco time, phaco power, and EPT were statistically lower in Group 1 than in Group 2, which shows the half-moon supracapsular technique is safer. Several studies[8–10,17,18] have compared phaco time and power between divide-and-conquer and chop techniques and found benefits of the chop technique. In 2004,[11] we compared phaco chop with the Nagahara horizontal stop-and-chop technique and found that mean phaco time, phaco power, and EPT were significantly lower in the horizontal chop group. In this study, we found the half-moon supracapsular technique conferred advantages over the stop-and-chop technique similar to those of the horizontal chop technique. One advantage is the use of lower US energy.

The second important parameter in the safety of a technique is damage to the corneal endothelium. To evaluate this parameter, we measured CCT preoperatively and postoperatively. Pachymetry measurements are clinically important as they show the amount of endothelial damage a technique causes. Lundberg et al.[19] found that an increase in CCT on the first postoperative day directly correlated with surgical trauma to the endothelium. Endothelial damage during surgery can be better analyzed using specular microscopy. Endothelial cell loss, mean endothelial cell density, the change in cell size variation coefficient, and the percentage of hexagonality give more valuable results in terms of comparison of techniques. Although we did not measure corneal endothelial cell density or morphology in our study, clinical corneal findings can vary according to not only the morphological change but also the functional performance of the cells. That is why we believe that the change in corneal pachymetry, which gives direct clinical results, was sufficient to compare the safety of the 2 techniques we evaluated. In our study, although the increase in CCT was greater in Group 1 than in Group 2 during the first week, the difference between groups was not statistically significant after the first postoperative day. At 90 days, the CCT was similar to preoperatively in both groups. In another study,[11] we found that the increase in CCT after phacoemulsification was significantly lower with the Nagahara chop technique than with the stop-and-chop technique. These findings indicate that the effect of the half-moon supracapsular technique on the corneal endothelium is not as low as that of the Nagahara chop technique. We believe this may be because chopping is performed closer to the corneal endothelium at the beginning of the surgery.

The third important safety parameter is the incidence of intraoperative complications. Complications occurred in 2% of the stop-and-chop procedures; however, there was no significant difference between groups and the only complication, partial zonular dialysis in 1 eye in Group 2, did not affect the functional outcomes of the surgery. This supports the hypothesis that the chop technique reduces stress on the zonules.

Efficacy

In our study, we measured the time between the creation of the first corneal incision and closure of the incision by stromal hydration and recorded it as the total operation time. The total operation time was statistically significantly lower with the half-moon supracapsular technique than with the stop-and-chop technique. This is because with the former technique, there is no loss of time or phaco energy as the groove is created, the nucleus is chopped anterior to the capsulorhexis plane, and a segment is removed before chopping, making manipulation and rotation of the remaining nucleus easier.

There is a learning curve involved for prolapsing the distal pole of the nucleus with hydrodissection in the half-moon supracapsular technique. The force pushing the nucleus anteriorly is the fluid captured between the nucleus and the capsule. After approximately 10 cases, we found that because of the increased fluid pressure behind the nucleus, it was easier to prolapse the distal nucleus in eyes with a smaller capsulorhexis (approximately 5.0 mm), contrary to Maloney et al.,[2] who found the technique to be easier with a larger capsulorhexis. However, precautions must be taken during prolapse of the distal nucleus, especially by inexperienced surgeons. The remaining part of the operation requires no learning period for surgeons who have used the Nagahara or stop-and-chop technique.

In both groups in our study, surgery was performed through a 2.2 mm incision using the microcoaxial phacoemulsification technique or through a 2.8 mm incision using the standard coaxial technique with the same phaco parameters. There was no difference between the groups in the difficulty of techniques.

Functionality

To evaluate the functionality of the technique, visual acuity and quality of vision were also assessed. In both groups, the increase in visual acuity postoperatively was significant and the contrast sensitivity values were high and not different between the groups. This indicates there is no difference between the half-moon supracapsular and stop-and-chop techniques in functionality.

CONCLUSION

Results in the current study and a comparison with results in other studies indicate that the half-moon supracapsular technique shortens the phacoemulsification procedure and increases efficacy. The safety and functionality results of the new technique were similar to those of the stop-and-chop technique except that the increase in CCT on the first postoperative day was greater in eyes in which the half-moon supracapsular technique was used. The new technique shortens the EPT and total operation time, which decreases the incidence of cystoid macular edema, inflammation, photic retinopathy from the operating room microscope, endophthalmitis, and intraoperative complications. The half-moon supracapsular technique seems to maintain the advantages of the Nagahara horizontal chopping technique, especially in difficult cases with hard nuclei, small pupils, or zonular insufficiency. The learning curve is also short.

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