Original Research Article

Comparison of Phaco-Chop and Divide and Conquer Methods in Grade 3-4 Cataract Patients

Abstract

PURPOSE:
To compare the outcomes of Grade3-4 cataract surgery performed with 2 phacoemulsification techniques (phaco-chop and divide-and-conquer)

SETTING:
Ministry of Health Tuzla State Hospital, Istanbul, Turkey.

DESIGN:
Prospective randomized clinical trial.

METHODS:
This is a prospective and randomized study cataract surgery using two different techniques of nucleofractis performed at the Tuzla State Hospital.100 patients eye with nuclear density from grade 3 to 4 were randomly subdivided into 2 groups (phaco-chop and divide-and-conquer). Intraoperative measurements included Phaco time (PT), effective phaco time(EPT),mean phaco power(MPP). Clinical measurements included preoperative and 1 day, 1 month, and 2 month postoperative corrected distance visual acuity(BCVA), time to achieve BCVA, corneal edema rate and time to disappear corneal edema.

RESULTS:
Intraoperative measurements showed significantly less PT, EPT, and corneal edema with the phaco-chop technique than divide-and-conquer techniques in the grade 3-4 cataract density group ($P<0.05$).

CONCLUSIONS:
2 techniques may be effective for cataract surgery in mild and moderate cataracts. However, in eyes with hard cataract the phaco-chop technique can be more effective for lens removal, with less Phaco time and corneal edema, than the divide-and-conquer technique.

FINANCIAL DISCLOSURE:
No author has a financial or proprietary interest in any material, method or device mentioned.

Introduction:
Since its introduction by Howard Gimbel in 1991, Divide and Conquer has become the one of the basic nucleofracture technique facilitate subdivision of the nucleus into small pieces so that they could be removed more efficiently. This technique basicaly defined deep sculpting until a fracture is possible, nucleofractis of the nuclear rim and posterior plate of the nucleus, fracturing again and breaking away a wedge-shaped section of nuclear material for emulsification, and rotation or repositioning of the nucleus for further fracturing and emulsification.(1) Phaco chop is a nuclear fracture technique that is performed under viscoelastic material prior to phacoemulsification. Akahoshi in 1993 divided the nucleus manually into four pieces before phaco. With a high vacuum and high flow setting; each divided nuclear fragment is aspirated and phacoemulsified one by one. (2)

Patients and methods:

This prospective study was conducted at a single center (The Tuzla State Hospital Ophthalmology Dept., Istanbul, Turkey) from april 2017 to November 2017. Study comprised 100 eyes of to 100 patients with cataract who were randomly assigned to have phacoemulsification using the Nagahara phaco-chop technique or the divide and conquer technique performed by same surgeon and same device. (Bausch & Lomb, Inc.) In the preoperative biomicroscopic examination, the nucleus of cataract eyes were classified according to their stiffness using the lens opacities classification system (LOCS III).(3) Only grade 3-4 cataract patients were included in terms of prevent chop difficulties. Visual acuity of the patients included in the study according to the Snellen chart. Intraocular pressures were measured by applanation tonometer,pachymetry corneal thickness measured by tonoref 3, anterior segment with biomicroscopic examination and 90 diopter noncontact lens fundus examinations done. In cases where fundus details cannot be selected B mode USG was performed. Exclusion criteria were corneal disease or opacity, glaucoma, uveitis, pupillary dilation problem, and previous ocular trauma or surgery. In all cases, surgery began with a clear corneal incision made with a 2.7 slit knife then two side-port incisions were made with the 20-gauge MVR knife 90 degrees from the main incision. Following the injection of chondroitin sulfate 4%–sodium hyaluronate 3% into the anterior chamber, a capsulorhexis was performed. Hydrodissection was done with a 27-gauge flat cannula, and phacoemulsification was performed.
In Phaco-chop method phacoemulsification parameters vacuum 500 mmhg, flow 24cc/min, phaco power %40 and bottle height 75 cm was applied. In divide-and-conquer technique, 4 trenches were sculpted (with vacuum set at 0 mm Hg) so the nucleus could be cracked bimanually into 4 segments. The 4 quadrants were emulsified in the capsular bag using increased vacuum (up to 90 mm Hg). The rest of the procedure was similar to that used in the phaco-chop technique. The intraoperative metric chosen as the primary outcome measure was EPT. EPT is displayed automatically on the interface of stellaris and its measured in percent-seconds. EPT is the total energy dissipated at the wound site in foot position 3, including a combination of torsional and longitudinal ultrasound energies.

The chi-square test and the independent-samples t test were used to compare the groups for statistical significance. All tests were 2-sided, and P values of 0.05 or less were considered statistically significant.

Results:

100 cataract cases were evaluated in 2 groups of 50 each. The demographic comparison of the patients included in the study are demonstrated in Table 1

PHACO-CHOP AND DİVİDE AND CONQUER NUCLEOTOMY TECHNIQUES

Table 1. Patients' characteristics.

Characteristic	Group 1 (phaco-chop) n:50	Group 2 (divide and conquer) n:50	p values
Age (y)	65.3±10.5	64.9±9.3	0.406
Sex (male/female)	27/23	30/20	0.359
Right eye/left eye	30/20	29/21	0.399

Initial visual acuity	0.17±0.34	0.23±0.25	0.246
Follow-up period (d)	130.4±38.2	140.2±22.6	0.358
Nuclear density	3.7±0.3	3.9±0.6	0.381

There was no statistically significant difference in demografic measurement among the patients. Mean phaco power was % 30.2 ±2.2% (range 15% to 50%) in the phaco chop group and % 32.9 ±%1.7 (range %18 to %53) in the divide and conquer group. . Although phaco chop group seemed to need less phaco energy, the difference was not statistically significant.(p:0.0701) Comparing to the phaco time,there was a statistically significant(p:0.016) differences between two groups. In Phaco-Chop group PT was 41.2± 20.12 and in Divide and Conquer group PT was 63±19.14. Effective Phaco Time in phaco chop and divide and conquer were 22.54±11.76 and 30.62±15.13 respectively. Table 2 demonsrates alteration between two variations during the procedures.(table 2)

Table 2: Average phaco time and average effective phaco time by groups

	Phaco Time	Effective Phaco Time
Group 1(Phaco-chop)	41.2± 20.12	63±19.14
Group 2(divide and conquer)	22.54±11.76	30.62±15.13
P values	0.013	0.024

Temporary corneal edema rate statistically significant lower and disappeared time statistically significant faster in phaco chop goup than divide and conquer group. Temporary corneal edema and mean disappearing time comparison between 2 groups demonsrated in table 3

Table 3:Corneal edema and disappearing time by groups

	Corneal edema	Mean Dissappering time(day)
Phaco-chop group(n:50)	10(%20)	5.12±13.5
Divide and conquer group (n:50)	17(%34)	9.36±14.1 P:(0.011)

BCVA and time to achieve BCVA(day) measured and there were no statistically significant differences between these variations and it can be seen in table 4

Table 4:BCVA changes and time to achive BCVA

	Preoperative Visual Acuity	Postoperative BCVA	Time to Achieve BCVA
Phaco-Chop	0.17±0.34	0.74±0.34	7.51±3.47
Divide and Conquer	0.23±0.25	0.68±0.21	8.62±4.57
P values	0.246	0.352	0.104

Discussion:

Nagahara introduced the phaco-chop technique concept at the ASCRS Symposium in1993.(4) This technique is mainly based on the fact that the phaco tip is embedded into the nucleus and cut into small pieces by the chopper. The phaco-chop technique can reduce phaco time and power because manual chopping is used to divide the nucleus into manageable fragments and the only significant use of phaco energy is during fragment emulsification.(5)

The divide-and-conquer technique introduced to crack the nucleus and facilitate phacoemulsification.(1) This technique requires additional phaco energy for sculpting to divide the nucleus before the fragments are emulsified.(1) Therefore, different nuclear-chopping techniques were introduced to further decrease postoperative complications.(5)

The phaco chop technique is related to reduced phaco time and power because manual chopping is used to divide the nucleus into manageable fragments and the only significant use of phaco energy is during fragment emulsification.(5-10-11) The divide and conquer technique requires additional phaco energy for sculpting to divide the nucleus before the fragments are emulsified.(1) In our study, we found the phaco and effective phaco time significantly lower in phaco chop technique. In addition, the phaco chop technique prone to direct the ultrasound energy away from the cornea, yet the phaco tip is farther from the posterior capsule than in divide and conquer.(6-7) Phaco chop also requires fewer intraocular surgical maneuvers and it is associated with a fewer ocular complications than the divide and-conquer and stop-and-chop techniques.(7-8-10) Wong et al. (8) used a Legacy system (Alcon) and found a mean phacoemulsification time of 1.2 minutes for the phaco-chop technique and 2.4 minutes for the divide-and-conquer technique. (8) Although we didn't measure endothelial cell shorter case times have been reported to be associated with less endothelial cell loss and fewer surgical complications. (7-12-13)

Nevertheless, divide and conquer has been practiced successfully,safely and more established technique than phaco chop.(1) Potential drawbacks to phaco chop include greater generation of heat during the occlusion phase of chopping, as it requires phaco energy during occlusion, and technical difficulty in dislodging the tightly packed segments so that the first nuclear fragments may have to be pulled up into the anterior chamber for emulsification. (5)

Comparing the Phaco techniques studies are common. Park Juwan et al. compared the microincision 3 methods phaco surgery in their study and compared the biggest deficiency of our study endothelial cell count preoperatively and postoperatively. Although the percentage loss of endothelial cells appears to be less in the Phaco chop group, the difference was not statistically significant. They also found less ultrasound time (UST), mean cumulative dissipated energy (CDE), and balanced salt solution use in phaco chop than divide and conquer and sop and chop which was similar to our study. (9) Wong et al. found phaco chop technique required less phaco time than divide and conquer. However they found no significant difference in phaco power required between those two techniques.(8) In our study we found phaco chop technique less required phaco time and effective phaco time.(p:0.013 and 0.024 respectively), however comparing the phaco power was not statistically significant.(p:0.0701)

To conclude,in this study, we tried to compare two phaco techniques. Our findings show that phoco chop technique is more practical in terms of phaco time , effective phaco time and corenal edema formation and disappearance time than divide and conquer. In our study, there were some limitations: the most important of

these were endothelial cell counting, inability to show results with different devices, and not to compare with other nucleus breaking techniques.

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