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Research Article

Corneal Effects of Small Incision Extracapsular Cataract Extraction Versus Phacoemulsification

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Abstract

Purpose: To study the safety of small incision extracapsular cataract extraction (ECCE) and phacoemulsification on the cornea.

Methods: Sixty eyes of sixty patients were included in the study. Stop and chop phacoemulsification was performed in Thirty eyes while small incision extracapsular cataract extraction was performed in the other thirty eyes. All subjects underwent complete ophthalmological examination, nuclear grading, ultrasound, specular microscopy and corneal pachymetry.

Results: There were increase in corneal thickness in both groups. The difference between the two groups was insignificant. The density of endothelial cells decreased postoperative without any significant difference between two groups. Significant and equal endothelial cell losses occur following both studied techniques. Nuclear grade have positive correlation with higher endothelial cell loss. Age, sex and axial length (AL) do not affect endothelial cell loss (ECL).

Conclusion: Stop and chop technique is easier and has earlier postoperative visual recovery than ECCE.

Keywords: *Endothelial Cell Loss (ECL); Stop and Chop Technique; Axial Length (AL); Small Incision Extracapsular Cataract Extraction (ECCE)*

Introduction

Corneal endothelium is composed of a single layer of hexagonal cells forming an irregular polygonal mosaic [1]. There is a decline in central endothelial cell density with age where central endothelial cell density decrease to a linear steady rate of 0.3 - 0.6% per year, resulting in a cell density measurement around 2500/mm^2 in adulthood. Because the corneal endothelium maintains its continuity by migration and expansion of surviving cells, the percentage of hexagonal cells decreases (polymorphism) and the coefficient of variation of cell area increases (poly-megathism) with age [2].

The normal thickness and transparency of the cornea are maintained by the barrier function and the active fluid pump of the corneal endothelium. Endothelial alterations are considered important parameters of surgical trauma and are also essential for estimating the safety of surgical techniques. Endothelial cell density decreases at a greater rate after cataract surgery than it does in healthy, previously unoperated corneas [3].

Endothelial cell injury results in a linear increase in central corneal thickness (CCT) due to increase in hydration level of the corneal stroma. Corneal decompensation usually occur when central density values approach 500 cell/mm^2 (90% decrease in endothelium from birth or 80% decrease from healthy adulthood level) [4]. Corneal endothelium damage during cataract surgery can be caused by many factors such as irrigation flow, turbulence and movement of fluids, presence of air bubbles, direct trauma caused by instruments or lens fragments, capsule rupture and vitreous loss [5]. Several preoperative and intraoperative parameters can influence the risk for endothelial cell loss after cataract extraction by an experienced surgeon. A high nucleus grade, old age, long phaco time, high ultra-sound energy, type of IOL and short axial length are associated with an increased risk for endothelial cell damage [6].

In phacoemulsification beginning, the procedure was performed in the anterior chamber leading 20 - 30% endothelial cell loss during surgery. Then damage to corneal endothelial cells during cataract extraction has been minimized, to 4% to 15%, as a result of better instrumentation and improved surgical techniques [7,8].

Purpose of the Study

The purpose of this study was to evaluate and compare corneal endothelial cell loss between stop and chop phacoemulsification and small incision extracapsular cataract extraction.

Patients and Methods

This prospective study included 60 eyes of 60 patients attending the Outpatient Clinic of Mansoura Ophthalmic Center during the period from January 2018 to September 2020. Patients ≥ 50 years old with senile cataract with moderate nuclear firmness (nuclear grades from 2 - 4) were included in this study.

The following criteria were excluded: Patients age less than 50 years, eyes with very soft or very hard nuclei (grade 1 or 5), eyes with sunken globes and prominent supra orbital ridges, poorly dilated pupil. Eyes with ocular pathology such as corneal opacities, pseudoexfoliation syndrome, uveitis, glaucoma, ocular hypertension, posterior segment pathology as diabetic retinopathy or endothelial cell density less than 1500 cells/mm^2, eyes with previous intraocular surgery and eyes with previous ocular trauma. Other intra operative exclusion criteria were total surgical time of more than 25 minutes, total phaco-time of more than 20 second.

Patients who met eligibility criteria were informed verbally and in writing of the potential risks and benefits of both techniques, and those who agreed to participate signed a written informed consent form.

Patients were randomly assigned to two groups:

- Group I (included 30 eyes): In which extracapsular cataract extraction was performed.
- Group II (included 30 eyes): In which phacoemulsification was performed using the stop and chop technique.

The following was performed for every patient: history taking. (Included onset, course and duration of vision diminution, history of previous ocular trauma and history of previous ocular surgery), review of systemic diseases, detailed ophthalmic examination; including: visual acuity assessment using Landolt's broken rings chart, refraction: using Topcon automated refractometer or retinoscopy, measurement of the best corrected visual acuity (BCVA), slit lamp biomicroscopy to assess corneal clarity, depth of the anterior chamber, state of pupil dilatation, lens morphology and nuclear grading, fundus examination; slit lamp biomicroscopy, using non-contact Volk 90 lens, and indirect ophthalmoscopy, measuring ocular tension using the Goldman applanation tonometer, assessment of ocular movement, examination of ocular adnexa, assessment of macular and retinal functions in opaque media by light projection and color perception, nuclear grading, ultrasonography, corneal pachymetery, anterior segment photography.

Nuclear grading

The Lens Opacities Classification System III (LOCS III) [7] was used for nuclear grading.

A-B scan ultrasonography: For calculation of the intraocular lens (IOL) power, measurement of the axial length (AL) and evaluation of the posterior segment of the eye using Quantel medical compact II and Humphrey A/B scan system Model 835.

Corneal pachymetry and endothelial cell density measurements

Endothelial cell density was determined. Three readings were taken and their mean was recorded. Pachymetry readings were considered only when the cell borders appeared well defined on the monitor.

Central endothelial cell density (cells/mm^2) and central corneal thickness (CCT) were analyzed using a non-contact specular microscope (Tomy EM-3000). Three photographs were taken per eye at each examination and the mean of measurements was calculated.

Anterior segment photography

Using digital camera "Canon Power Shot A480 digital camera attached to the slit-lamp microscope".

Preoperative measures

1. Prophylactic topical antibiotic: Ofloxacin 0.3% eye drops was instilled at 6-hourly intervals (Four times) two in the eye to be operated.
2. Pupil dilatation: One hour before surgery the pupil was dilated with tropicamide 1%, cyclopentolate 1% and phenylephrine 2.5% every 15 minutes.

Anaesthesia

Anesthesia was achieved locally by retrobulbar injection of 2 ml mixture of lidocaine hydrochloride 2% and Bupivacaine 0.5% (1:1). Local anesthesia was enhanced by Facial akinesia (modified Van Lint).

Sterilization

Periocular skin sterilization was achieved by povidone iodine (betadine) 10%.

All patients were operated on by the same surgeon.

Technique of stop and chop

Was done using the Oertli CataRhex machine with a phaco tip 30 degree.

Two memory programs were used:

1. Memory 1 was used for sculpting (maximum 70% ultrasound (US) power, vacuum 20 mm Hg, flow rate 20 - 25 cc/min and bottle height 70 - 80 cm).
2. Memory 2 was used for quadrant removal (maximum 50% pulsed mode US power, maximum vacuum 350 mm Hg, flow rate 25 - 30 cc/min and bottle height 90 - 110 cm).

Technique: Application of wire speculum. Conjunctival sac washing with povidone iodine (betadine) 5%. Two clear corneal side port incisions were done using 20- gauge MVR knife 90 degrees from the main incision.

A superior or supero-temporal self-sealing clear corneal incision was done using 3.2 disposable metal keratome. The keratome was first passed for 2 mm inside the corneal stroma parallel to the iris plane before penetrating the descemet's membrane and entering the anterior chamber, Ophthalmic viscosurgical device (OVD), sodium hyaluronate 3.0%-chondroitin sulfate 4% (Viscoat®) was then injected to fill the anterior chamber, Capsulorhexis was initiated by a bent 27 gauge needle and the flap was then grasped by a capsulorhexis forceps to complete the rhexis, Hydrodissection followed by hydrodelineation was done using 25 gauge cannula, nuclear phacoemulsification: a central trench was first sculpted using memory 1 parameters, The nucleus was cracked into two halves. The nucleus was then rotated 90 degree and sculpting was stopped and chopping was started using memory 2 parameters. The inferior heminucleus was then engaged at about half depth by the phaco tip using 100mmHg vacuum. The vacuum was maintained, the gripped heminucleus was drawn centrally and upward into the rheris plane, the chopper was passed to the lens periphery, around the nucleus and was then drawn towards the phaco tip. Separating the two instruments fracture the heminucleus into two quadrants. The two quadrants were then emulsified. The superior heminucleus was rotated 180 degree to bring it into a suitable position for chopping and emulsification. The process of chopping and quadrant removal was repeated in the same way as for the first heminucleus, Irrigation/Aspiration (I/A) of the cortical matter was then done using bimanual I/A system, Sodium hyaluronate was injected into the anterior chamber to inflate the capsular bag, implantation of a foldable hydrophilic acrylic intraocular lens (IOL), Aspiration of the viscoat by the bimanual I/A system. Wound closure was done by stromal hydration of corneal incision and side ports edges by balanced salt solution. Water tightness of the wound was tested by applying gentle pressure on the posterior lip of the main incision after fluid injection through the side port entry and deepening of the anterior chamber, subconjunctival injection of dexamethasone and gentamicin.

Technique of small incision extracapsular

Application of wire speculum. Conjunctival sac washing with povidone iodine (betadine) 5%. A superior self-sealing clear corneal incision was done using knife, Ophthalmic viscosurgical device (OVD), sodium hyaluronate 3.0%-chondroitin sulfate 4% (Viscoat®) was then injected to fill the anterior chamber, Capsulorhexis was initiated by a bent 27 gauge needle and the flap was then grasped by a capsulorhexis forceps to complete the rhexis, Nucleus delivery, Irrigation/Aspiration of the cortical matter was then done using bimanual (I/A system). Sodium hyaluronate was injected into the anterior chamber to inflate the capsular bag. Implantation of a hydrophilic acrylic intraocular lens (IOL), Aspiration of the OVD by the bimanual I/A system, Wound closure was done by nylon suture Subconjunctival injection of 5 ml dexamethasone (4 mg/ml) and 0.5 ml gentamicin.

Postoperative care

Every patient received topical steroid-antibiotic drops 4 times daily for a week and then tapered over the next 3 weeks. All patients were followed up and examined postoperatively at one day, one week, one month and three months intervals.

The following were reported during surgery the total phaco time (seconds), the mean phaco power (%), the total phaco energy (the absolute phaco time, APT) was calculated by multiplying the phaco time (seconds) by the mean phaco power (%), any operative complication as posterior capsule rupture or iris trauma etc. and total surgical time.

Postoperative follow up

The following were done for every patient in each postoperative visit: Unaided visual acuity, Refraction and BCVA, Slit lamp examination to assess: *State of the cornea for edema, clarity and ulcers. *State of the main incision. *Aqueous flare or cells in the anterior chamber. *Shape of the pupil and its reaction. *Any iris abnormality. *The IOL regarding its position and any deposits on its surface. *Clarity of the posterior capsule, Fundus examination, Measurement of the ocular tension, Corneal pachymetry to measure CCT, Corneal specular microscopy to study endothelial cell changes. Photos taken on the 1st postoperative day were excluded due to their affection by corneal edema.

Endothelial cell loss (ECL) was then calculated as following:

ECL % = (The difference between postoperative and preoperative cell densities/preoperative cell density) X 100

Statistical analysis

Results were tabulated and analyzed using the SPSS (Statistical Package for Social Science) program, version 17, utilizing the following tests: Kruskal Wallis and One way ANOVA to compare parameters between groups, Paired-t-test for comparison within groups. Mann-Whitney test was used for paired-group comparison between studied groups. The relation between endothelial cell loss at 3 months postoperatively and age, sex, nuclear grade, AL and APT were tested using Pearson correlation coefficient. Rates were calculated by the following equation [Rate % = (The difference between preoperative and postoperative values) X 100/preoperative value]. P values of 0.05 or less were considered statistically significant.

Results

Demographic and preoperative data

This study included 60 eyes of 60 patients divided into 2 groups: group 1 (ECCE) included 30 eyes, group 2 (stop and chop) included 30 eyes. A thirty females and thirty males were included in this work. No significant difference between male and female (P = 0.472).

Patient ages ranged from 50 to 75 years with a mean of 60 ± 6.3 SD, means for each group were shown in table 1. The age ranged from 50 to 70 years in group I and from 50 to 75 years in group II. The ranged of AL was 20.9 - 32.1 mm and 21.3 - 31.2 mm for group I, group II respectively.

Means of axial length (AL) for each group were shown in table 1.

Variants	Group I	Group II
	Mean ± S.D	Mean ± S.D
Age (y)	60.3 ± 6.4	60.9 ± 7.8
AL (mm)	23.7 ± 4.9	24.1 ± 2.7
Cell density (cells/mm^2)	2764.8 ± 196.2	2851.7 ± 198.8
Average cell size	358.7 ±33.5	377.8 ±45
CCT (µm)	509.7 ± 31.8	507.5 ± 34.9
BCVA (decimal)	0.059 ± 0.04	0.060 ± 0.05
Nuclear Grade	3.2 ±0.4	3.1 ±0.5

Table 1: *Baseline preoperative data in the studied groups (p < 0,001).*
One way ANOVA test CCT= Central Corneal Thickness.

Table 1 shows that there was no statistical difference in the demographic and clinical data (age, axial length (AL), endothelial cell density, average cell size, central corneal thickness (CCT), preoperative best corrected visual acuity (BCVA), and nuclear grade among groups indicating absence of bias during patient selection.

Nuclear grades

According to LOCS III classification system, nuclear firmness was classified into three grades: grade 2, grade 3 and grade 4. Most cases (43 eyes) (71.7%) were of grade 3 (moderate nuclear firmness). Grade 2 was presented in 7 patients in group I and in 8 patients in group 2. One patient in group 1 and one patient in group 2 were of grade 4.

Absolute phaco time (APT)

Study of the ultrasound time consumed during the operation indicated by APT (US energy % X US duration in seconds) average 20.2 ± 10.4, Minimum 8.2, Maximum 40.

Operative complications

Peripheral extension of the anterior capsule flap during anterior capsulorhexis with iris trauma occurred in one case in group 2 (stop and chop) (Figure 1). One case in group 2 has improper IOL implantation with distortion of the anterior rhexis (Figure 2).

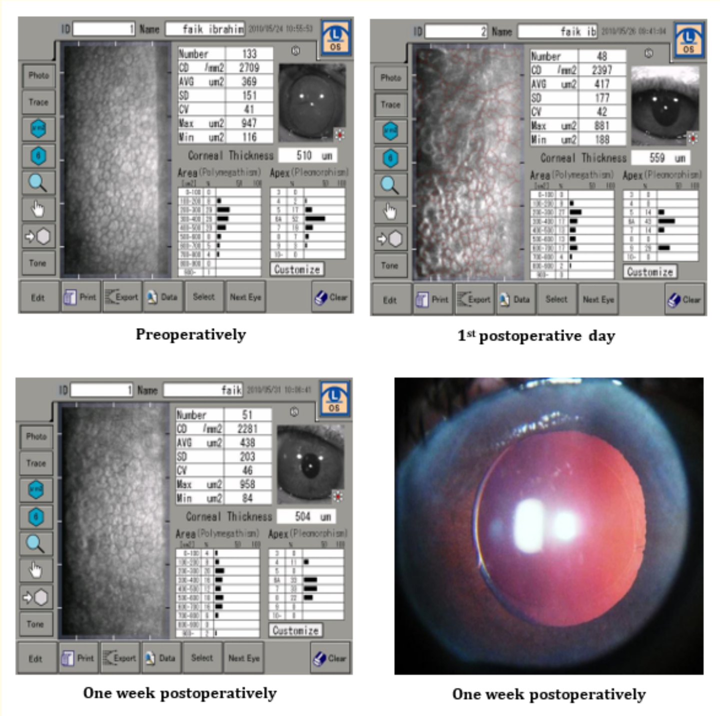

Figure 1: *A case having moderate postoperative corneal edema following stop and chop technique. There was moderate distortion of the endothelial cell mosaic in the specular photograph taken on the 1st postoperative day. The edema was cleared and the endothelial mosaic returned normal one week postoperatively.*

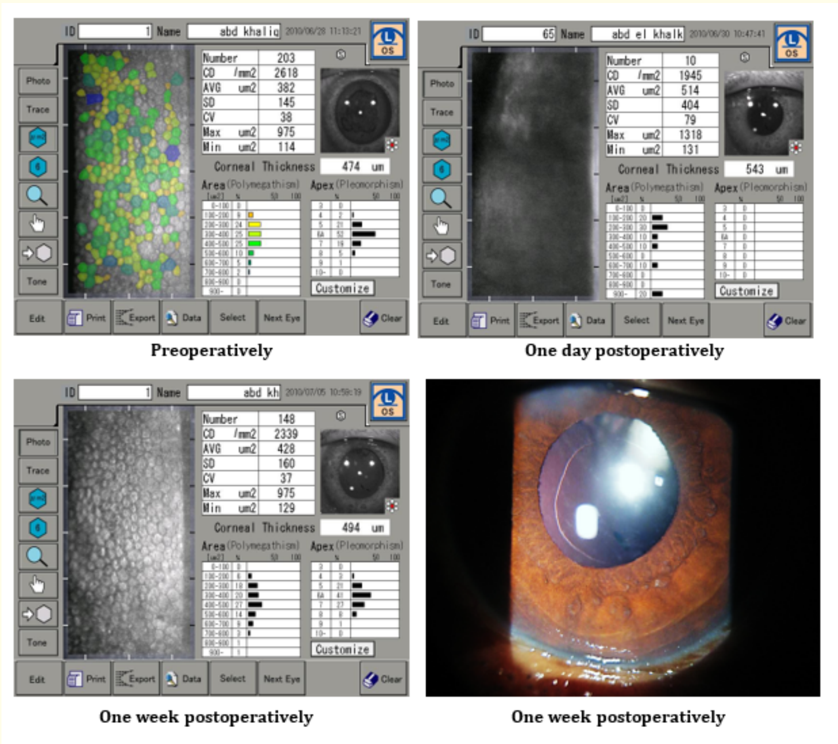

Figure 2: *A case having severe postoperative corneal edema following divide and conquer phacoemulsification. There was severe distortion of the endothelial cell mosaic in the specular photograph taken on the 1st postoperative day (hazy photo). The edema was cleared and the endothelial mosaic returned normal one week postoperatively.*

Endothelial cell density and endothelial cell loss (ECL)

Both groups had significant decrease in endothelial cell densities at week, month and 3 months postoperatively. Table 2 of endothelial cell densities preoperatively and during the follow up period. Means of endothelial cell loss (ECL) postoperatively also were included in table 2 and 3.

Groups	Group I		Group II	
	Mean ± SD	Mean ECL ± SD	Mean ± SD	Mean ECL ± SD
Preoperative	2764.8 ± 196.2		2851.7 ± 198.8	
One week	2509.6 ± 204.9	255.2 ± 113.5	2656.1 ± 210.3	195.6 ± 74.6
P value	0.009		0.011	
One month	2457.7 ± 131.5	307.1 ± 120.7	2598.5 ± 244.9	253.2 ± 123.5
P value	0.007		0.011	
3 months	2420.6 ± 213.8	344.2 ± 129.9	2573.1 ± 252.7	278.6 ± 129.4
P value	0.003		0.009	

Table 2: *Comparison between preoperative and postoperative endothelial cell densities and postoperative ECL in the studied groups.*

ECL	ECCE		Stop and chop	
	%	SD	%	SD
One week	9.2	± 3.9	7.3	± 2.5
One month	11.0	± 4.2	9.5	± 4.5
3 months	12.4	± 4.7	10.5	± 4.8

Table 3: *Comparison between postoperative rates of ECL among studied groups during the follow up period. Paired-t-test.*

Table 3 compares the postoperative endothelial cell loss among studied groups at 1 week, 1 month and 3 months postoperatively. There was no significant difference in postoperative ECL among the studied groups.

Both groups showed significant increase in endothelial cell size postoperatively throughout the follow up period (Table 4).

Groups	Group I (ECCE)	Group II (Stop and chop)
Time	Mean cell size ± S.D	Mean cell size ± S.D
Preoperative	368.7 ± 33.5	377.8 ± 45
One week PO	411.9 ± 40.4	413.4 ± 38.6
P value	0.001	0.002
One month PO	421.1 ± 37.5	425.9 ± 46.7
P value	0.001	0.001
3 months PO	428.9 ± 40.7	430.5 ± 53.9
P value	0.001	0.001

Table 4*: Comparison between preoperative and postoperative endothelial cell size during the follow up period in the studied groups.*

However, comparison between postoperative increased endothelial cell size between these groups revealed no significant difference.

Factors associated with higher ECL

Pearson correlation test for several preoperative parameters and ECL at 3 months postoperatively revealed that nuclear grade had positive correlation with higher ECL (P values were 0.037). However, the age, sex and AL had no significant association with higher ECL (P values were 0.494, 0.815 and 0.553, respectively).

Central corneal thickness (CCT)

Both groups showed significant increase in central corneal thickness. A maximum corneal thickness was reached at the first postoperative day and decreased gradually to reach values near to preoperative values by the 1st postoperative month.

Table 5 compares postoperative means of CCT to preoperative values in the studied groups. There was a significant difference between preoperative CCT and postoperative CCT at one day and one week postoperatively in both groups. There was no significant difference between preoperative CCT and postoperative CCT at one month and 3 months in both studied groups.

	Group I	Group II
Time	Mean CCT ± SD	Mean CCT ± SD
Preoperative	509.7 ± 31.8	507.5 ± 34.9
Day 1	541 ± 38.5	539.1 ± 37.8
P value	0.000	0.000
Week	519.7 ± 33.7	518.3 ± 33.4
P value	0.001	0.003
Month	519.9 ± 32.3	510.9 ± 35.7
P value	0. 61	0. 84
3 months	510.1 ± 31.8	508.1 ± 35.3
P value	0. 98	0.230

Table 5: *Comparison between preoperative and postoperative CCT during the follow up period in the studied groups. Paired-t-test.*

Best corrected visual acuity (BCVA)

Both groups gained improvement in visual acuity. The course of BCVA improvement through the postoperative follow up period was shown in table 6 and 7. Table 6 shows that 66.7%, 80 %, of eyes in group 1, 2, achieved BCVA between 0.25 - 0.50 in immediate postoperative day. Only 6.6%, 20% of eyes achieved BCVA more than 0.5 in group 1, and 2, respectively in the immediate postoperative day. BCVA of more than 0.50 was achieved in most eyes at one month postoperatively in both groups.

Visits	ECCE			Stop and chop		
	0.25 (6/24)	0.25 - 0.5 (6/24 - 6/12)	0.5 (6/12)	0.25 (6/24)	0.25 - 0.5 (6/24 - 6/12)	0.5 (6/12)
1 Day	26.17%	66.7%	6.6%	-	80%	20%
1 Week	3.3%	56.7%	40%	-	53.3%	46.7%
1 Month	0	26.7%	73%	-	20%	80%
3 months	0	23.3%	76.7%	-	17%	83%

Table 6: *Postoperative distribution of BCVA among studied groups.*

Table 7 compares the BCVA among studied groups. There was a significant difference between the studied groups at immediate postoperative day.

Groups	ECCE	Stop and chop
BCVA	Mean ± SD	Mean ± SD
Preoperative	0.059 ± 0.04	0.060 ± 0.05
One day PO	0.29 ± 0.15	0.40 ± 0.16
One week PO	0.57 ± 0.28	0.59 ± 0.24
1 Months	0.71 ± 0.69	0.76 ± 0.21
3 Months	0.76 ± 0.21	0.75 ± 0.20

Table 7: *Comparison of postoperative BCVA means among studied groups. Kruskal Wallis test. PO= Postoperatively.*

Group 2 had better BCVA than group 1 (ECCE) at 1st postoperative day indicating earlier visual recovery in this group (Z-value = 2.108 and P value = 0.035).

Postoperative complications

Postoperative mild corneal edema was observed by the slit lamp examination on the immediate postoperative day in 4 cases (13.3%) among group 1 and in 2 cases (6.6%) among group 2 (Figure 1 and 2). Paired-group comparison between both groups showed a significant difference (P = 0.018) in favor of stop and chop group. This indicates that the incidence of corneal edema in 1st postoperative day was less in stop and chop group than ECCE.

The quality of specular microscopic photographs taken on the 1st postoperative day was variable according to the severity of corneal edema. However, the photographs taken one week postoperatively were clear in almost all patients and the final outcome was excellent even for those having severe corneal edema.

Discussion

Comparing the preoperative parameters and clinical data regarding age, axial length, nuclear grade, endothelial cell density and size, CCT and BCVA revealed that there was no biased patient selection in the present study.

Endothelial cell damage following phacoemulsification was the main concern of many investigators since 1978 till present time [8]. The reported average losses after phacoemulsification vary between 4% and 25% [9,10].

Some studies showed low ECL after phacoemulsification [11-13].

Poyales-Galan and Pirazzoli [11], El-Sayed., *et al*. [12] and Crema., *et al*. [13] studies reported that ECL of 5.9%, 4.2% and 4.7%, at 3 months postoperatively [11-13]. Most operated eyes (83.3%) in Crema., *et al*. study had soft nuclei (grade 1 and 2) which may explain such low ECL [13].

While Hussein., *et al*. [14], Anwar., *et al*. [15], Abo El-Khir., *et al*. [2] and Heuermann., *et al*. [16] reported higher ECL at 3 months postoperatively (22.2%, 15.56%, 11.3% and 11.11%, respectively). However, results of these studies cannot be compared with the present study for 3 reasons. First, some authors did not mention their technique used during surgery. Second, other investigator used more than one technique for the same patient group. Third, some studies used techniques other than stop and chop.

In the present study the mean ECL after stop and chop technique at 3 months postoperatively was 10.5%. Park., *et al*. [17] and Gogate., *et al*. [18] reported higher ECL (13.2% after 8 weeks) and (15.5% after 8 weeks) respectively.

While Pereira., *et al*. [19] and Kongsap [20] reported lower ECL after stop and chop technique, 8.7% and 7.18% respectively, this discrepancy of results may be explained by the variation in surgeon's experiences and differences in the used phaco machines and instruments.

In present study, the mean ECL at 3 month in group1 was (12.4%). Geoge., *et al*. reported that mean ECL after ECCE and phacoemulsification was 4.72% and 5.41% respectively [21]. Geoge., *et al*. reported that there was no significant difference in endothelial cell loss between ECCE and phacoemulsification.

While Durovic [22] concluded that under the same conditions phacoemulsification caused reduced operative trauma of corneal endothelium. The obtained results revealed significant dissimilarity in endothelial call reduction after ECCE and phaco (9.17% and 4.72% respectively).

In addition, Diaz-valle [23] and others observed that no significant difference in postoperative loss of endothelial cells between ECCE and phacoemulsification. Mean cell loss 11.8% after phaco and 12.8% after ECCE [23-26].

The correlation between increased endothelial cell loss and age, nuclear grade, AL, and APT showed controversy in several studies. This attributed to the differences in clinical and preoperative parameters as nuclear grades and patient sample size. In the present study the APT had positive correlation with increased ECL.

Similar to the present study; Cho., *et al*. [9] found that nuclear firmness was a predictor factor for higher ECL. In the opposite, Walkow., *et al*. [10] did not confirm such a positive correlation.

In the present study, the age factor did not affect the rate of ECL. This is consistent with results of Pereira., *et al*. [19] and Al Sharkawy [21] Contrary to this, older age associated with higher ECL in Bourne., *et al* [5].

Significant loss of endothelial cells in the present study was associated with significant and equal postoperative change in cell morphology (significant increase in endothelial cell size) in the both groups.

In the present study the total ultrasound consumption (absolute phaco time, APT) in the stop and chop technique, was 20.2 which is comparable to APT mean reported by Can., *et al*. [27] 22.3, Contrary to this, Pereira., *et al*. [19].

Park., *et al*. [17] reported less APT means (4.9, 2.17 respectively).

The present study and others Storr-Paulsen., *et al*. [6] showed that there was no positive correlation between the total ultrasound energy and endothelial cell loss.

While Walkow., *et al*. [10] postulated that less total energy leads to less endothelial cell damage.

Factors other than APT may play important roles in endothelial cell loss may be mechanical contact with nuclear fragments, corneal distortion and free oxygen radicals produced during cataract surgery [26].

Measuring the difference in pachymetry at the first postoperative day is a useful way to assess the effects on the corneal endothelium exerted by the cataract extraction procedure. The increase in CCT seen on the first postoperative day is strongly correlated with the central corneal ECL at 3 months postoperatively [25,26]. In the present study there was a significant increase in CCT at the immediate postoperative day. There was no significant difference between both techniques.

The time interval of corneal recovery and returning to the preoperative pachymetry values was different in different studies, may be attributed to the different types of pachymetry devices used in measuring the CCT. In the present study and in Lundberg., *et al*. [28] study, the preoperative pachymetry values were resumed at one month postoperatively. Can., *et al*. [27] reported shorter time interval (10 - 14 day).

Transient postoperative corneal edema is sometimes noted after phacoemulsification surgery indicating affection of the corneal endothelial pump function. Results Lundberg., *et al*. [28] study indicated that clinically significant postoperative corneal edema was strongly associated with a clinically significant corneal endothelial cell loss. The incidence of postoperative corneal edema in the present study was 26.6% and 13.3% in ECCE and stop and chop.

In the present study, corneal edema was significantly lower and the time to return to the preoperative pachymetry values was also shorter after stop and chop technique in comparison to ECCE technique.

The current study showed low incidence of intraoperative complications in both techniques. There was no technique had an advantage of being having significant lower rate of intraoperative complications.

Similarly, Abdelmoaty., *et al*. [29] reported high success rate in terms of visual acuity outcome and postoperative complication were similar for both ECCE and phacoemulsification.

In the present study, the both groups achieved BCVA more than 0.5 (6/12) at one week postoperatively. Best corrected visual acuity more than 0.7 (6/9) was achieved at one month postoperatively in the both groups. Several studies Can., *et al*. [27], Pereira., *et al*. [19] and Park., *et al*. [17] showed BCVA means comparable to those of the present study.

Stop and chop groups in the present study showed better BCVA than ECCE group at the 1st postoperative day. The earlier visual recovery in stop and chop may be explained by the differences in rates of postoperative corneal edema and increased CCT, although most differences did not reach statistical significance.

Conclusion

Significant increase in the CCT was observed at the immediate postoperative day in both groups. There was no statistically significant difference between the groups. The postoperative CCT pachymetry values were returned to near preoperative values at one month postoperatively.

Both groups showed significant improvement in visual acuity with earlier visual improvement following stop and chop techniques. Best corrected visual acuity more than 6/9 was achieved in 76.7% in group I, 83% in group II the incidence of operative complications was low in both groups.

Conflict of Interest

No authors have proprietary interest.

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Ethical Approval

This study was approved by the Human Subjects Committee of the University of Mansoura and adhered to the Declaration of Helsinki. A written informed consent was obtained from all participants.

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