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Correlation between postoperative central corneal thickness and endothelial changes after cataract surgery by phacoemulsification in diabetic patients

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Abstract

Background: Diabetic individuals provide a specific problem because to their propensity for the premature development of cataracts. The objective of this research is to examine the association among characteristics after phacoemulsification in diabetic individuals, and postoperative central corneal thickness (CCT), alterations in density of corneal endothelial cell using specular microscopy.

Methods: This research was carried out on a cohort of forty individuals who had uncomplicated phacoemulsification surgery for the purpose of cataract extraction. The research design was prospective, selective non-randomized and interventional. The participants were allocated into two groups of equal size. In Group one, individuals with complex cataracts received a successful phacoemulsification procedure without any complications. Group two composed of non-diabetic individuals who received phacoemulsification for the treatment of senile cataract without any complications.

Results: In both non-diabetic and diabetic individuals, the preoperative corneal thickness (CCT) exhibited a positive association with the coefficient of variation (CV) and a negative association with endothelial cell count (ECC). Diabetic subjects had a negative correlation with CCT while healthy subjects had a favorable one. One and three months after surgery, CCT was negatively correlated with ECC and HEX and positively correlated with CV in the diabetes group. The logarithm of minimum angle of resolution (log MAR) of best-corrected visual acuity (BCVA) exhibited a positive correlation with central CCT at the one-month postoperative mark, and a negative correlation at the three-month postoperative mark. In the non-diabetic group, there was a positive association observed among BCVA and CCT when expressed in log form. Conversely, a negative correlation was found among CV and CCT. The correlation among CCT and HEX was shown to be positive at the three-month stage of postoperative and negative at the first-month stage of postoperative. There was a positive correlation observed among CCT and ECC during the first-month postoperative period. However, at the three-month postoperative period, a negative correlation was found between CCT and ECC.

Conclusions: There is an important variance of corneal endothelial loss after phacoemulsification between non-diabetic and diabetic population. Diabetic individuals demonstrated significantly more endothelial damage after phacoemulsification.

Keywords: CCT, endothelial changes, cataract surgery, phacoemulsification, diabetic patients

Introduction

The most common procedure for correcting cataracts is phacoemulsification, in which ultrasonic energy is used to emulsify the hazy lens, which is subsequently removed and replaced with an intraocular lens. Cataract surgery has come a long way because to the improvement of the phacoemulsification method [1, 2].

Rapid vision recovery is possible with phacoemulsification [3], less stimulated astigmatism [4], and better postoperative refraction predictability than with standard extracapsular cataract surgery (ECCE) [4].

After phacoemulsification surgery, some patients have a more significant and temporary ocular edema [5, 6] suggesting that corneal endothelial affection has an effect on the pumping ability of the cornea [7].

The endothelium of the cornea is essential for keeping the cornea clear. This is because it actively pumps fluids out of the corneal stroma and acts as a physical barrier to prevent water from entering. A decrease in corneal clarity outcomed from any disruption in these processes. Damage to the endothelium of corneal is a well-documented side effect of phacoemulsification. It is also well-known that the health of the endothelium deteriorates with age. Endothelial injury during surgery is becoming relevant as the average age of phacoemulsification patients rises along with the general population [7].

For years, researchers have debated whether the corneal swelling that occurs following phacoemulsification surgery is related to the loss of corneal endothelial cells [7]. Postoperative loss of corneal endothelial cells is a well-researched, very important characteristic, and for good reason: it increases the likelihood of long-term corneal decompensation (pseudo-phakic bullous keratopathy) [8]. The quantification of ECl necessitates the use of specular microscopy, together with the comparison of post and pre-operative pictures. However, this procedure is not often conducted in normal clinical settings [9].

Diabetic individuals provide a unique difficulty because to their increased susceptibility to early cataract improvement and the subsequent risk of corneal edema after cataract surgery. It has been shown that diabetes mellitus (DM) has adverse effects on the corneal endothelium. It has been demonstrated that individuals diagnosed with diabetes have morphologically abnormal endothelium, characterized by polymegethism and pleomorphism. Therefore, it is reasonable to assume that endothelium damage is more likely to occur in elderly diabetic individuals undergoing phacoemulsification [9].

The purpose of the research is to use specular microscopy to examine the changes in corneal endothelial cell characteristics following phacoemulsification in diabetic patients and their association with postoperative CCT.

Methods and Patients

This prospective selective non randomized and interventional research conducted on forty patients aged >fify years old, controlled diabetic patients with no evidence of diabetic retinopathy (DR) had significant complicated cataract (either cortical or nuclear “NI, NII, NIII” or posterior subcapcular “PSCI, PSCII”) affecting their daily activities, non-diabetic patients having cataract affecting their daily activities and visual acuity more than hand motion (HM).

The study was done after approval from the ethical committee Tanta University Hospitals. An informed written consent was obtained from the patient or relatives of the patients.

The exclusion criteria for this research included patients with total white cataract resulting in a visual acuity of HM, uncontrolled diabetes with evidence of diabetic retinopathy, a history of previous ocular surgery, and other ocular diseases such as corneal pathology, Fuchs dystrophy, uveitis, and glaucoma. Additionally, patients with systemic diseases that could potentially affect the corneal endothelium, such as endocrine disorders like Graves' disease, Addison's disease, and hyperparathyroidism, were also excluded, Infections caused by various viruses, such as SARS-CoV-2, herpes simplex, varicella zoster, HTLV-1, and Epstein-Barr virus, as well as bacterial infections like tuberculosis, syphilis, and Pseudomonas aeruginosa, are known to contribute to pathological conditions. Additionally, autoimmune and inflammatory diseases, including multiple sclerosis, Sjögren's syndrome, lupus erythematosus, gout, rheumatoid arthritis, atopic and vernal keratoconjunctivitis, granulomatosis with polyangiitis, sarcoidosis, Cogan's syndrome, and immunobullous diseases, have been identified as significant factors. Furthermore, corneal deposit disorders associated with Wilson's disease, cystinosis, Fabry disease, Meretoja's syndrome, mucopolysaccharidosis, and hyperlipoproteinemia, as well as genetic disorders like aniridia, Ehlers-Danlos syndromes, and Marfan syndrome, have been implicated. Lastly, the occurrence of complications following phacoemulsification surgery should also be considered. The individual's age is less than fifty years old.

Patients were categorized into two distinct equal groups: Group one Individuals with complex cataract conditions who received a successful phacoemulsification procedure. Group two (standard group): Patients without diabetes who had senile cataract and had a successful phacoemulsification procedure without complications. All participants underwent a comprehensive assessment, including a thorough review of their medical history, a comprehensive examination of their eyes, various diagnostic tests, and laboratory investigations. These investigations included measuring the fasting blood glucose level (FBG), the blood glucose level two hours after a meal (PPBG), the level of glycated hemoglobin in the serum (HBA1c), Renal function tests, a complete blood count (CBC), Hepatic function tests, an electrocardiogram (ECG), as well as consultations with dental and otorhinolaryngology (ENT) specialists to rule out any potential sources of infection.

Investigations

- IOL Master (Carl Zeiss IOL master 500 advanced technology V.7.1 (Carl Zeiss Meditec, Jena, Germany)).
- A-Scan Biometry (SONOMED PacScan Plus A-Scan, Sonomed Inc., New York, U.S.A) and manual keratometry using OM-4 Ophthalmometer keratometer (Manual keratometer Topcon Positioning Systems, Inc. California, United States) were used for IOL power calculation especially in cases of dense cataract which couldn’t be evaluated by IOL Master.
- B-Scan Ultrasonography was routinely performed in all cases with dense cataract obsecuring fundus examination using B-Scan Ultrasound system (Sonomed VuMAX II UBM and B-Scan ultrasound, Escalon Medical Corp, Sonomed Inc., Newyork, U.S.A) for assessment of the vitreoretinal and posterior segment evaluation to rule out posterior segment pathology as old retinal detachment (RD).
- The preoperative evaluation included the use of a Nidek cem-530 specular microscope (manufactured by NidekCo., LTD, Gamagori, Japan) to measure parameters such as ECC, Percent of HEX, CCT and CV. Preoperative corneal swaps for culture and sensitivity.

Preoperative preparation: topical antibiotic eye drops, topical Mydriatics and systemic antibiotics.

Technique

Phacoemulsification device utilized:(Alcon Infiniti Phacoemulsifier, Alcon Laboratories, Inc., Texas, U.S.A). All cases were carried out under peribulbar and topical local anesthesia. Micro corneal incision was made at superior limbus. A dispersive ophthalmic visco-surgical device (OVD) was injected. Side port was created using a twenty-gauge needle seventy to eighty degrees from the first. Capsulorhexis forceps were used to do continuous curvilinear. Hydrodissection and Hydrodelineation were done. A Nagahara chopper (horizontal chopper) was used to achieve an ideal verticalization of the crystalline nucleus. The phaco-emulsifier, the upper portion of the nucleus was emulsified and fractured while the nucleus was kept vertical or oblique with the vacuum of the pump and micro-manipulator. The identical method employed for the first half of the nucleus' phacoemulsification was subsequently used to the second half in the suprascapular space. Removal of debris, Injection of OVD and implantation of a foldable posterior chamber intra-ocular lens (PCIOL). At the end of the surgery, the anterior chamber was maintained with balanced salt solution and the OVD was removed. Topical antibiotic, Hydration of corneal wound and removal of eyelid speculum and covering the eye with eye pad. Postoperative treatment: topical and Systemic treatment **(**optic saline, antibiotic eye drops, anti-glaucomatous eye drops and steroid eye drop).

Follow up

- UCVA at first week until corneal edema resolved and then BCVA was measured at one month and three months postoperatively.
- Slit lamp bio-microscope and the following parameters were recorded [corneal edema grading, wound status, anterior chamber contents and depth to detect postoperative, inflammation by finding cells or flare, pupil regularity, a red reflex and IOL stability].
- IOP: was measured using Goldmann applanation tonometer.
- Binocular fundus examination: first month and third months.
- Specular microscopy: at first month and third months postoperatively using a non-contact specular microscopy (Nidek cem-530 specular microscope, NidekCo., LTD, Gamagori, Japan) in the two groups.
- Additional visits were scheduled: for any postoperative complications which were noted for all cases.

Statistical analysis

The statistical analysis was conducted using SPSS v26, a software developed by IBM Inc. in Chicago, IL, USA. The study used unpaired Student's t-test to compare the average and standard deviation (SD) of the quantitative variables between the two groups. The qualitative variables were expressed in terms of frequency and percentage (%) and subjected to analysis using either the Chi-square test or Fisher's exact test, as deemed suitable. A two-tailed P value less than 0.05 was deemed to be statistically significant. The correlation between different variables was assessed using the Pearson moment correlation equation for linear relationships among normally distributed variables, and the Spearman rank correlation equation for non-normal variables or non-linear monotonic relationships.

Results

Age, gender, which eye is operated, HTN, bronchial asthma, DVT and cardiac diseases have no statistically important variances in among both groups. DM had statistically important variances in among both groups. Table one

Table 1: Medical history and Demographic Data of the studied patients

		Diabetic Group	Non-diabetic Group	P-value
Age		62.850±5.976	63.600±6.303	0.702
Gender	Male	4(20.00%)	9(45.00%)	0.091
	Female	16(80.00%)	11(55.00%)	
Which Eye	Right	9(45.00%)	9(45.00%)	1.000
	Left	11(55.00%)	11(55.00%)	
Medical History	DM	20(100.00%)	0(0.00%)	<0.001*
	HTN	11(55.00%)	6(30.00%)	0.110
	Cardiac	5(25.00%)	5(25.00%)	1.000
	Bronchial Asthma	2(10.00%)	1(5.00%)	0.548
	DVT	0(0.00%)	1(5.00%)	0.311

Data are demonstrated as average ± SD or frequency (%). *: significant P value. DM, HTN, DVT: deep vein thrombosis.

Regarding degree of cataract: Cortical cataract, PSCI, NI and NII have no statistically important variances in among both groups. PSCII and NIII have statistically essential variances in among both groups. Regarding corneal edema: third month post-operative and first month post-operative had no statistically important variances among both groups (p = 0.123, 0.114 respectively). In both groups, there were statistically important variances among third and first month postoperative corneal edema (p =0.012*, 0.043* respectively). Table

Table 2: Degree of corneal edema and cataract density

		Diabetic Group	Non-diabetic Group	P-value
Degree of cataract density	Cortical	8 (40.00%)	9 (45.00%)	0.749
	NI	6 (30.00%)	6 (30.00%)	1.000
	NII	15 (75.00%)	11 (55.00%)	0.185
	NIII	5 (25.00%)	0 (0.00%)	0.017*
	PSCI	8 (40.00%)	5 (25.00%)	0.311
	PSCII	6 (30.00%)	1 (5.00%)	0.037*
Corneal Edema				
Post Operation first Month	No	6 (30.00%)	11 (55.00%)	0.123
	Mild	6 (30.00%)	8 (40.00%)	
	Moderate	5 (25.00%)	1 (5.00%)	
Post Operation third Months	No	14 (70.00%)	18 (90.00%)	0.114
	Mild	6 (30.00%)	2 (10.00%)	
	Moderate	0 (0.00%)	0 (0.00%)	
P-value		0.012*	0.043*	

Data are demonstrated as average ± SD or frequency (%). *: significant P value. NI: nuclear cataract grade I. NII: nuclear cataract grade II. NIII: nuclear cataract grade III. PSCI: posterior subcapsular cataract grade I.

There were no statistically important variances in UCVA between both groups preoperatively. There were statistically important variances in third month and first months postoperative BCVA between both groups. In diabetic group, there were statistically important visual acuity variances among preoperative, first month postoperative ($p<0.001$) and among preoperative, third month postoperative ($p<0.001$*) and between third and first month postoperatively (p = 0.004*). In the standard group, there were statistically important visual acuity variances among preoperative, first month postoperative ($p<0.001$*), among preoperative, third month postoperative ($p<0.001$*) and among third and first month postoperatively ($p<0.001$*). Figure one (A)

There were no statistically important variances in preoperative, third month and first month postoperative ECC among both groups preoperatively. The variances in ECC in non-diabetic and diabetic patients among preoperative and first month postoperative, preoperatively and third months postoperative and first month postoperatively and third months postoperative with statistically important variances ($p<0.001$*). Figure one (B)

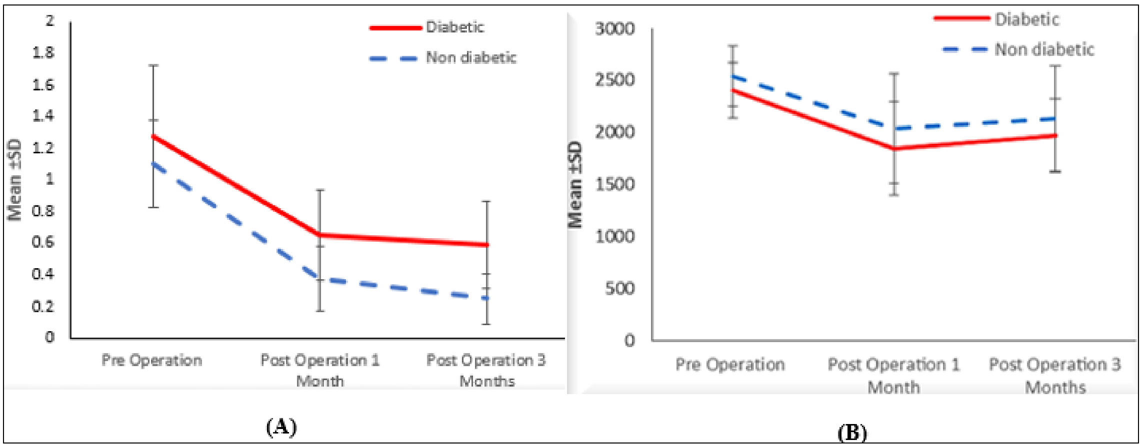
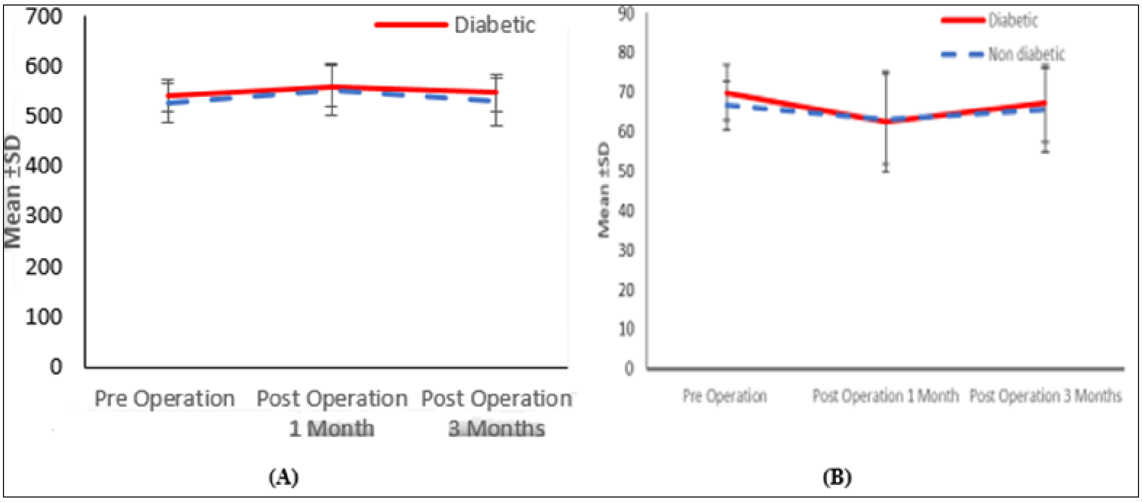


Fig 1: Line chart representing (A) Pre-operative visual acuity (UCVA) in logMAR and postoperative Visual Acuity (BCVA) in logMAR. (B): The endothelial cell count (ECC)

There were no statistically important variances in postoperative third month and preoperative, postoperative first month among both groups. The variances in CCT in diabetic patients between preoperative and first month postoperative, with statistically significant differences (p = 0.002*) while in non-diabetic patients among preoperative and first month postoperative with statistically important variances (p = 0.001*). There were no statistically important variances in CCT between three months postoperative and preoperative in both groups. The variances in CCT between three months postoperative and first month postoperative with statistically important variances in both groups (p = 0.003*, $p<0.001$* respectively). Figure two (A)

There were no statistically important variances in Preoperative, postoperative first month, postoperative third month HEX among both groups. The variances in HEX in diabetic patients among first month postoperative and preoperative with statistically important variances among them (p = 0.028*) while in non-diabetic patient with no statistically important variances and among three months postoperative and preoperative and among first month postoperative and three months postoperative without statistically important variances in both groups. Figure two (B)

There were no statistically important variances in postoperative and preoperative third month CV among both groups while in first month postoperative CV there were statistically important variances among the two groups (p = 0.004*). The variances in CV in diabetic patients among first month postoperative and preoperative, with statistically important variances among them ($p<0.001$*) while in non-diabetic was without statistically important. The variances in CV in diabetic patients among three months postoperative and first months postoperative with statistically important variances among them (p = 0.026*) while non-important in non-diabetic patients. Figure two (C).



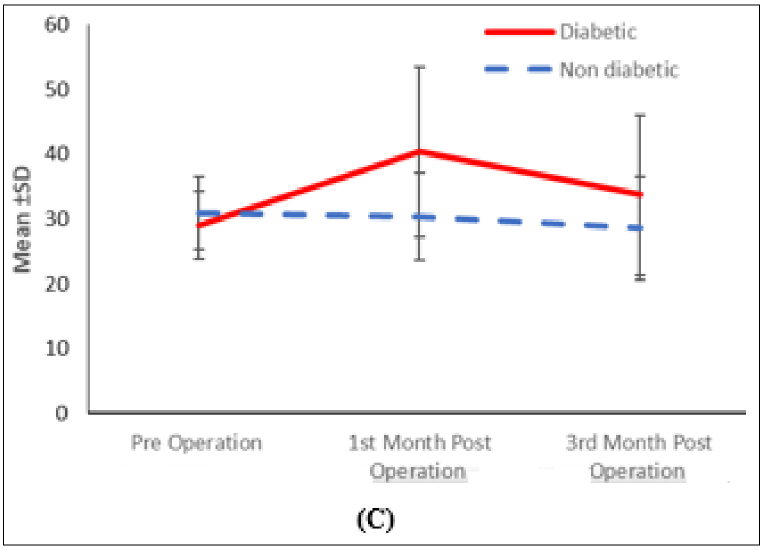


Fig 2: Line chart representing (A): The CCT. (B): The percent of HEX. (C): The CV

Regarding preoperative correlation

In diabetic group, there was negative correlation among ECC and CCT (r = -0.367), (p = 0.111) and among HEX and CCT (r = -0.260), (p = 0.268). There was positive correlation among CV and CCT (r = 0.110), (p= 0.644). In non-diabetic group, there was negative correlation among ECC and CCT (r = -0.166), (p = 0.484) and there was positive correlation among HEX and CCT (r = 0. 246), (p = 0.296) and CCV and CCT(r = 0.232), (p= 0.325). Table three

Table 3: Correlation among endothelial alteration and CCT in both groups

	Diabetic		Non diabetic	
	r	P-value	r	P-value
Preoperative Correlation				
ECC Pre-operation	-0.367	0.111	-0.166	0.484
HEX Pre-operation	-0.260	0.268	0.246	0.296
CV Pre Operation	0.110	0.644	0.232	0.325

*: significant P value. ECC, HEX, CV.

In first-month and three-month postoperative, in diabetic group, CCT demonstrated negative correlation with HEX (r = -0.556, -0.069 respectively) and ECC, (r = -0.167, -0.320 respectively) and positive correlation with CV (r = 0.622, 0.221 respectively). BCVA in log MAR (r =0.122) correlated positively (r =0.027) in first month postoperative and negatively (r =-0.063) in three-month postoperative with. In non-diabetic group, CCT demonstrated positive correlation with BCVA in log MAR (r =0.122, 0.189 respectively) and negative correlation with CV (r = -0.063, -0.013 respectively). HEX correlated negatively (r = -0.006) in first-month postoperative and positively (r = 0.195) in 3-month postoperative with CCT. ECC correlated positively (r = 0.014) in 1-month postoperative and negatively (r =-0.095) in three-month postoperative with CCT. Table four

Table 4: Correlation among third month endothelial changes and CCT in both groups

	Diabetic		Nondiabetic	
	r	P-value	r	P-value
ECC Post Operation first Month	-0.167	0.482	0.014	0.953
HEX Post Operation first Month	-0.556	0.011*	-0.006	0.981
CV Post Operation first Month	0.622	0.003*	-0.063	0.793
Visual Acuity Post Operation First Month	0.027	0.912	0.122	0.607
ECC Post Operation three Months	-0.320	0.169	-0.095	0.689
HEX Post Operation three Months	-0.069	0.773	0.195	0.411
CV Post Operation three Months	0.221	0.348	-0.013	0.958
Visual Acuity Post Operation Three Months	-0.063	0.792	0.189	0.424

*: significant P value. ECC, HEX, CV.

Discussion

The impacts of cataract surgery using phacoemulsification on the endothelium of corneal have been the subject of numerous researches. The endothelial status following surgery has been demonstrated to deteriorate in all of these studies. Only a few researches, however, have compared these alterations to those in diabetic patients.

This research found that there was a statistically important elevate in thickness of corneal over a month and an important constant decline in corneal endothelial corneal dystrophy (ECD). The CCT returned to its level of preoperative after 3 months, the percentage of HEX declined and was statistically important at that time, and the CV in cell size significantly elevated. The central cornea of the diabetic group (Group one) was thicker compared to the non-diabetic group (Group two). One month following surgery, CCT significantly elevated in both diabetic (Group one) and non-diabetic patients (Group two), and then gradually dropped to nearly preoperative levels 3 months later. The diabetic group (Group one) experienced an important postoperative elevate in the CV. Prior to surgery, there was no important variance among the non-diabetic group (Group two) and diabetic group (Group one) in the percentage of HEX. Within both groups, the postoperative alteration in the percentage of HEX was notable at 3 months after surgery.

Maadane *et al.* [10] found that preoperative endothelial cell status indicated by CD, variety of the CV size of the cells, the percentage of the CCT and HEX were similar in both groups, three months postoperative, there was a decline in the CD In diabetic group more than in the standard group, this was statistically important. Both groups demonstrated an elevate in the CV at the three-month postoperative follow-up, and these values were significantly variant from preoperative values, the increase was higher in the standard group and was statistically important. Both groups demonstrated a decrease in the percentage of HEX at the postoperative follow-up of three months. The percentage of HEX has demonstrated a consistent decline in both groups with a similar rate of change. The CCT, which was noticeably larger in diabetic group in the 1st week following surgery, elevated, and then gradually decreased. The CCT drop rate among the groups did not differ in a statistically meaningful way. This supports using phacoemulsification energy in diabetic patients more cautiously like the current research.

Also, Ganesan *et al.* [11] The study revealed a notable rise in the CV and CCT, a significant decline in the percentage of HEX, and no statistically significant variance in ECLamong diabetic patients following phacoemulsification, as compared to the control group. However, it is worth noting that both groups experienced a decrease in ECD, consistent with the findings of the current investigation.

Also, Kim YJ, *et al.* [12] found that the ECD and the HEX were significantly lower in diabetic group than in the control group, CV and CCT were significantly greater in diabetic group in the study like this study.

Also, Tang *et al.* [13] It has been shown that diabetic patients have a considerably reduce ECD compared to those without diabetes both before surgery and over the whole postoperative period. To examine the effect of phacoemulsification, the researchers also evaluated the percentage of ECD loss, which is calculated as the difference between preoperative and postoperative values. The ECL percentage was significantly variant among the non-DM group and the DM group at all postoperative periods. The CV of diabetic patients was found to be significantly higher than that of the non-diabetic group at all postoperative and preoperative time points as the current research. The variance among postoperative and preoperative appeared significantly larger in diabetic group compared to the non-diabetic group at first week following surgery and at first month following surgery, while no important variances were found at one day following surgery and three months following surgery. The of HEX percentage diabetic patients was found to be significantly lower at preoperative and all postoperative time periods and significantly higher (HEX% loss) (variance among postoperative and preoperative) at all postoperative time points compared to the non-diabetic group. The CCT of non-diabetic and diabetic patients did not significantly differ, but after phacoemulsification, the CCT of the diabetic group was significantly larger than that of the non-diabetic group at all postoperative time points. Additionally, the variance between postoperative and preoperative percentages, or CCT, showed no important differences among the diabetic group and the non-diabetic group at one day, one week, or three months after surgery. However, at one month after surgery, diabetic patients' CCT% was significantly higher than those of non-diabetic patients as the current research.

Also, Chen Z. *et al.* [14] found that in comparison to the non-diabetic group, the diabetes group experienced higher postoperative alterations in foveal thickness and corneal endothelial cells. There was no variance in the ECD, percentage of HEX, CCT, CV or CFT among the diabetic and non-diabetic groups preoperatively. After surgery, both groups experienced declined ECD, elevated CV, and elevated percentage of HEX over the duration of the six-month follow-up period. However, the diabetic group experienced more alteration in the ECD, percentage of CV and HEX than the non-diabetic group at each postoperative time point as well as the current research. CFT and CCT varied in both groups during the course of the follow-up, with the diabetic group experiencing individual peaks of CFT and CCT both at the first-week postoperative mark. Additionally, compared to the non-diabetic group, the diabetic group had a thicker central cornea throughout the first 6 months following surgery and a thicker central fovea during the first month.

Also, as well as the current research, He X. *et al.* [15] The study revealed that diabetes individuals had a higher degree of endothelial cell loss (ECL) in comparison to non-diabetic patients subsequent to undergoing cataract surgery. Nevertheless, the impact of managing diabetes on reducing the occurrence of ECL remains unclear. There was no statistically significant difference seen in the preoperative ECD between the two groups. Following the surgical procedure, the diabetic group had a notably elevated proportion of ECL in comparison to the non-diabetic group. At the one-month postoperative mark, there was no statistically significant change in CCT seen in either group as compared to their respective baseline measurements.

Also, Yang R. *et al.* [16] found that after surgery, the diabetic groups' rate of ECL was significantly higher than that of the control group, their percentage of HEX was significantly lower than that of the control group, and their CV was significantly higher than that of the control group like the present study, but they found that patients with DM are more susceptible to corneal endothelium damage carried on by phacoemulsification.

Also, Zhang *et al.* [17] found that the corneal ECD in patients with diabetes was lower than in the healthy population, which was of statistical difference. The CV of corneal endothelial cells in patients with DM was higher than in the healthy population, with statistical differences observed. The percentage of HEX in patients with DM was lower than in the healthy population, which exhibited statistical differences as the present study.

Also, Khalid M. *et al.* [18] found that after successful phacoemulsification cataract surgery, there was a significant difference between the diabetic population and the non-diabetic population in terms of corneal ECL. There was a statistically significant difference between the mean post-operative CED, mean change in CED, and mean frequency change in CED. In both groups, there was a statistically significant difference between the preoperative CED and the postoperative CED as the current research.

Also, Kang KH. *et al.* [18] found no alteration among the two groups in terms of intraoperative and preoperative variables, mean postoperative ECD, HEX, and CV. The CCT was significantly higher in diabetic group at one month after surgery, but at three months there was no discernible variance among the two groups

Also, Hugod M. *et al.* [19] found that three months following phacoemulsification with intraocular lens implantation, diabetic patients lost significantly more corneal endothelial cells than non-diabetic patients. There was an important variance in the ECL and the reduction of cells among the two groups (drop in percentage). The HEX percentage significantly declined in the diabetic individuals, showing that type 2 diabetes slows the rate of endothelial cell repair, while the CV and the CCT did not differ among the groups three months after surgery in contrast to the current research.

Also, Joo JH, *et al.* [20] found that one year after phacoemulsification, diabetes individuals lost more corneal endothelial cells than non-diabetic patients, but there were no statistically significant differences. The ECD In diabetic group and the control group both decreased significantly over the preoperative ECD in the operated eye, but neither group's ECD decreased significantly over the course of a year in the other non-operated eye. The diabetic group undergoing surgery experienced the largest mean ECD change, however there was no significant variance from the surgically operated-on control group, while the CCT, HEX, and CV did not demonstrate any appreciable differences between the two groups before and after surgery in contrast to the current research.

Also, in contrast to the study, Sahu PK. *et al.* [21] found that in comparison to non-diabetic controls, patients with diabetes have a much higher loss of ECD after phacoemulsification. ECD, percentage of cell size variability, percentage of HEX, and CCT all suggested similar preoperative endothelial cell status in both groups. ECD decreased more quickly in the diabetic patients' group than in the control group after three months postoperatively. This was statistically significant. The central ECC in both groups showed a similar trend following a steep loss shortly after phacoemulsification. The trend in the ECD was also tracked using the one week, one month, two months, and three months values. At three months postoperative, both groups displayed an elevation in the percentage of CV, and these values differed significantly from preoperative values like this research.

Also in contrast to the present study, the rise was statistically significant and larger in the control group. The diabetic group's trend of increase in the CV was noticeably slower than that of the control group. Also, at three months after surgery, the percentage of HEX decreased in both groups.

On the other hand, Beato JN. *et al.* [22] found that at any time point, In contrast to the findings of the current investigation, no statistically significant differences in CCT or corneal volume were seen between the groups of individuals with diabetes and those without diabetes. There was no significant change in the mean postoperative CCT at one and six months compared to the mean preoperative level in both the diabetic and non-diabetic groups. However, they did observe a significant decrease in ECD at both one- and six-month follow-up in both groups, compared to the preoperative value. In both cohorts, it was noted that the proportion of HEX was lower than the preoperative baseline at the one-month follow-up, but not at the six-month follow-up, as reported in the current investigation.

Also, Fernańdez-Mun˜ozE. *et al.* [23] revealed that, Nevertheless, there were no statistically significant disparities observed in the comparison of endothelial cell density (ECD) at each subsequent examination between diabetic patients without indications of high-risk proliferative diabetic retinopathy and non-diabetic patients who had phacoemulsification using the phaco-chop method. Substantial disparities were seen in the average endothelial cell density (ECD) values before and after surgical intervention. No statistically significant changes were seen in the average ECD among the groups. Significant variations were observed in the mean ECD values across the groups during the pre-surgical, first-month, and third-month follow-up visits. In comparison to the standard group consisting of non-diabetic individuals, the central cornea of the group with diabetes had a comparable thickness. Prior to the surgical procedure, there were no statistically significant differences seen in the measurements of CCT. In contrast to the findings of the current investigation, the follow-up CCT measures after one month did not reveal any statistically significant alterations among the groups.

ECL differs from research to research due to variant surgical methods, patient groups, and examination times of corneal endothelial cells following surgery.

According to the majority of the previous studies, diabetic patients who had phacoemulsification surgery experienced statistically significant ECL when compared to the control groups.

This study had some limitations: the sample size was relatively small and short follow up. Our study recommended that EPT analysis to research the impact of phacoemulsification on corneal endothelium, preoperative evaluation of corneal endothelium in diabetic patients before intraocular surgeries and use better instruments, more modern viscoelastic materials, and improved surgical methods.

Conclusions

There is an important variance of corneal endothelial loss after phacoemulsification between non-diabetic and diabetic population. Diabetic individuals demonstrated significantly more endothelial damage after phacoemulsification.

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