

## A Comparative Evaluation of Corneal Endothelium between Diabetic & Non-Diabetic Patients Undergoing Phacoemulsification in a Tertiary Hospital

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### Abstract

**Objective:** To compare changes of corneal endothelium after phacoemulsification in diabetic patient comparison to non-diabetic patient. **Methods:** This prospective observational study was conducted over 100 patients in a tertiary hospital from 01st January to 30th July 2020. Patients were selected purposively based on specific selection criteria. Patients were allocated into two groups: Group-I: cataract patient without diabetes mellitus and Group-II: cataract patient with diabetes mellitus. Selected patients underwent detailed ophthalmic and systemic examination as well as relevant laboratory investigation. Phacoemulsification was done in every patient by a single experienced surgeon under local anesthesia. Patients were evaluated pre-operatively, 7<sup>th</sup> POD and after one month post-operatively. In each visit, visual acuity, endothelial cell count, endothelial hexagonality, cell variability and central corneal thickness were recorded. All the relevant data were recorded in a pre-designed data collection sheet. **Results:** The mean age of patients in group I and II were 54.40+3.22(SD) and 54.86+3.07(SD) years respectively. In group I, 29 (58%) were male and 21(42%) were female whereas in group II, 33 (66%) were male and 17(34%) were female. In Group-I, visual acuity in preoperative period, 7<sup>th</sup> POD and after one month were 0.734, 0.232 and 0.148 respectively and in Group-II, preoperatively, 7<sup>th</sup> POD and after one month were - 0.730, 0.260 and 0.148 respectively. In group I, Endothelial cell count per square millimeter in preoperative, 7<sup>th</sup> POD and after one month were- 2681.76, 2543.62 and 2518.68 respectively and in Group-II, preoperative, 7<sup>th</sup> POD and after one month were - 2596.62, 2378.84 and 2270.46 respectively. Hexagonality of endothelial cell count in group-I, pre-operative, 7<sup>th</sup> POD and after one month value were 64.34, 61.08 and 59.12; in group-II, pre-operative, 7<sup>th</sup> POD and after one month value were 63.80, 56.04 and 53.10 respectively. Cell size variability in group-I, pre-operative, 7<sup>th</sup> POD and after one month value were 30.76, 33.96 and 35.42; in group-II, pre-operative, 7<sup>th</sup> POD and after one month value were 29.58, 33.90 and 35.98 respectively. Central corneal thickness in group-I, pre-operative, 7<sup>th</sup> POD and after one month value were 534.04, 589.12 and 560.68; in group-II, pre-operative, 7<sup>th</sup> POD and after one month value were 530.12, 630.24 and 569.94 respectively. **Conclusion:** By analyzing the results and findings, it may be concluded that corneal endothelium was greatly changed after phacoemulsification in diabetic patient in compare to non-diabetic patient.

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### Introduction

Cataract has been documented to be the most significant cause of bilateral blindness. It is currently the main cause of avoidable blindness especially in the developing world accounting for about three-quarters of blindness. Phacoemulsification is nowadays the preferred technique for most types of cataract due to less astigmatism, less postoperative inflammation and rapid visual recovery.<sup>1</sup>

Corneal endothelium after cataract surgery is a matter of special interest to the ophthalmologists. Several studies have indicated an increased corneal vulnerability in diabetic subjects to

intraocular surgical stress. It is likely that this phenomenon occurs because of chronic metabolic changes on the cellular level that primarily seems to affect the monolayer of corneal endothelial cells.<sup>2</sup> Several studies have indicated an increased corneal vulnerability in diabetic subjects to intraocular surgical stress. It is likely that this phenomenon occurs because of chronic metabolic changes on the cellular level that primarily seems to affect the monolayer of corneal endothelial cells.<sup>3</sup> The hexagonal cells of the endothelium are responsible for maintaining the clarity of the cornea by actively removing the water, these cells have limited mitotic capacity, and any disturbance in the endothelial homeostasis might therefore have a profound effect on the clarity of the cornea.

Phacoemulsification with intraocular lens implantation is one of the most common surgical procedures performed. The patients are usually elderly, and this might have a negative impact on the surgical outcome because increasing age is associated with loss of endothelial cells. There are two important parameters, age and the presence of diabetes compromise the status of the endothelium, which may have a negative impact on the final visual outcome in case of surgery.<sup>4</sup> The corneal endothelium is evaluated by central corneal thickness, corneal endothelial cell density, and morphology preoperatively and postoperatively.<sup>5</sup>

Diabetes mellitus is a metabolic disorder which is the leading cause of blindness and 25 times more prone to cause cataract and other ocular diseases. The diabetic corneas tended to be thicker and had more pleomorphism and polymorphism.<sup>6</sup> Duration of diabetes mellitus correlated significantly with the corneal changes. This suggests that corneal changes should be evaluated and confirmed before intraocular surgery in chronic diabetic patients.<sup>7</sup> On this background this study is designed to see effect of

diabetes mellitus on corneal endothelium after phacoemulsification cataract surgery and if so; it may help to take necessary measure to protect corneal endothelium of diabetes patient who is undergoing cataract surgery.

The purpose of this study was to evaluate and compare the corneal endothelial changes between diabetic and non-diabetic population before and after phacoemulsification surgery using Specular Microscope, which would open a gateway for the future researchers on the topic and help in patient's evidence based care.

### Materials and methods

This was a prospective observational study conducted in a tertiary hospital in Department of ophthalmology from 01<sup>st</sup> January 2020 to 30<sup>th</sup> July 2020 (Six months). Depending on the inclusion and exclusion criteria, 100 patients were taken for the study who had undergone for phacoemulsification surgery. Sample was taken in purposive method. All the patients and their attendants were informed appropriately about the procedure and gave informed written consent for participating in this study. This study was approved by the Ethical committee of that tertiary hospital. A case study proforma was designed for each patient. Demographic information such as age, sex and detailed history were collected. All study participants underwent systemic and preliminary ocular examination. Endothelial changes was assessed by assessing visual acuity changes, cell size variability, hexagonality of endothelium, central corneal thickness and endothelial cell count - preoperatively, on 7<sup>th</sup> POD, and after one month. Data were processed manually and analyzed with the help of SPSS (Statistical Package for Social Science) 23.0 Version. To find out association between qualitative data, chi-square test and between quantitative data, unpaired t test were used. A probability value (p) of <0.05 was considered statistically significant.

## Results

**Table-I.** Distribution of age of the study subjects

Criteria	Group I (n = 50)	Group II (n = 50)	p value
<b>Age (in years)</b>			
Mean± SD	54.40± 3.22	54.86± 3.07	0.467 <sup>a</sup>
Range	50-65	50-65	
<b>Gender</b>			
Male	29 (58%)	33 (66%)	0.410 <sup>b</sup>
Female	21(42%)	17(34%)	

<sup>a</sup> indicated unpaired t test, <sup>b</sup> indicated chi-square test

The mean age of patients in group I and II were 54.40+3.22(SD) and 54.86+3.07(SD) years respectively. In group I, 29 (58%) were male while in group II, 33 (66%) were male (Table I).

**Table-II.** Distribution of mean visual acuity (in logMAR) among the study subjects

Visual acuity (in logMAR)	Group-I (n=50) Mean± SD	Group-II (n=50) Mean± SD	p value
Pre-operative	0.734 ± 0.084	0.730 ± 0.083	0.813 <sup>a</sup>
7 <sup>th</sup> POD	0.232 ± 0.065	0.260 ± 0.080	0.060 <sup>a</sup>
After 1 month	0.148 ± 0.076	0.148 ± 0.076	0.999 <sup>a</sup>

<sup>a</sup> indicated unpaired t test

In Group-I, visual acuity in preoperative period, 7<sup>th</sup> POD and after 1 month were 0.734+0.084, 0.232+0.065 and 0.148+0.076 respectively. In Group-II, visual acuity in baseline period preoperatively, 7<sup>th</sup> POD and after 1 month was- 0.730+0.083, 0.260+0.080 and 0.148+0.076 respectively. No significant statistical difference was observed between the groups at any time point regarding visual acuity (Table II).

**Table-III.** Distribution of endothelial cell count of the study subjects

Endothelial cell count	Group-I (n=50) Mean± SD	Group-II (n=50) Mean± SD	p value
Pre-operative	2681.76± 296.27	2596.62 ± 227.60	0.110 <sup>a</sup>
7 <sup>th</sup> POD	2543.62 ± 267.78	2378.84 ± 229.49	0.001 <sup>a</sup>
After 1 month	2518.68 ± 270.82	2270.46 ± 232.97	<0.001 <sup>a</sup>

<sup>a</sup> indicated unpaired t test

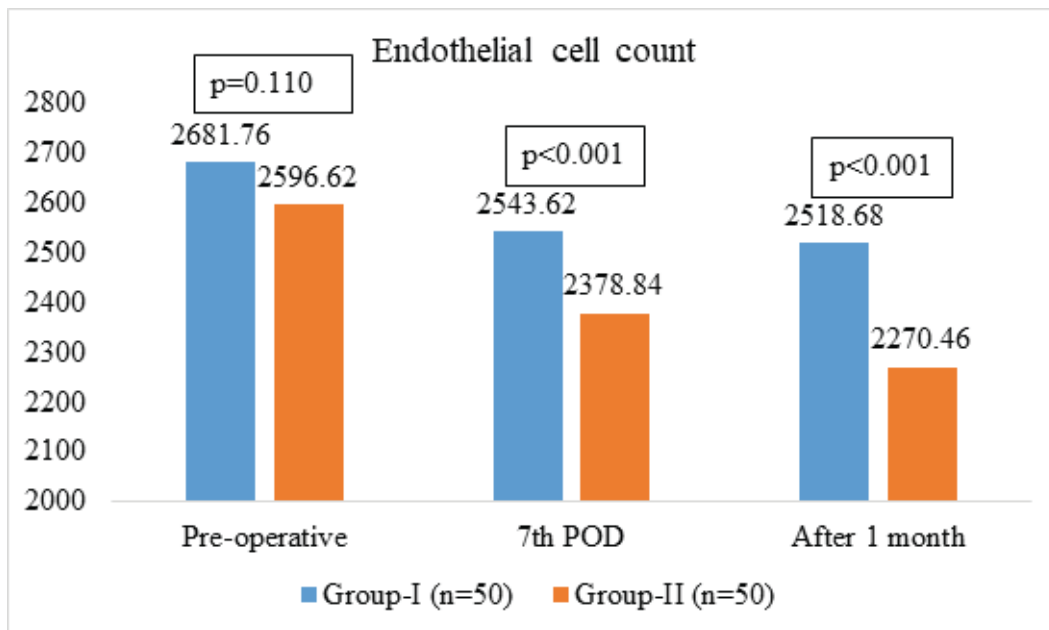


Figure I: Mean endothelial cell count in group-I and group II

In preoperative period, the mean endothelial cell count (in per square millimeter) in group-I and group II were  $2681.76 \pm 296.27$  and  $2596.62 \pm 227.60$  respectively ( $p=0.110$ ). In 7<sup>th</sup> POD, the endothelial cell count (in per square millimeter) significantly decreased in group II compared to group I ( $p=0.001$ ). After one month of surgery, the endothelial cell count (in per square millimeter) was significantly decreased in group II compared to group I ( $p<0.001$ ) (figure I).

**Table-III.** Distribution of hexagonality of endothelial cell of the study subjects

Hexagonality of endothelial cell	Group-I (n=50) Mean± SD	Group-II (n=50) Mean± SD	p value
Pre-operative	$64.34 \pm 3.77$	$63.80 \pm 4.32$	0.083 <sup>a</sup>
7 <sup>th</sup> POD	$61.08 \pm 3.36$	$56.04 \pm 4.43$	<0.001 <sup>a</sup>
After 1 month	$59.12 \pm 4.19$	$53.10 \pm 4.48$	<0.001 <sup>a</sup>

<sup>a</sup> indicated unpaired t test

In preoperative period, the hexagonality of endothelial cell in group-I and group II were  $64.34 \pm 3.77$  and  $63.80 \pm 4.32$  respectively ( $p=0.083$ ). In 7<sup>th</sup> POD, the hexagonality of endothelial cell significantly decreased in group II compared to group I ( $p<0.001$ ). After one month of surgery, the hexagonality of endothelial cell was significantly further decreased in group II compared to group I ( $p<0.001$ ) (table III).

**Table-IV.** Distribution of cell size variability (polymegathism) of the study subjects

Cell size variability (in %)	Group-I (n=50) Mean± SD	Group-II (n=50)	p value
Pre-operative	30.76 ± 2.44	29.58 ± 2.65	0.063 <sup>a</sup>
7 <sup>th</sup> POD	33.96 ± 3.88	33.90 ± 2.51	0.027 <sup>a</sup>
After 1 month	35.42 ± 4.01	35.98 ± 2.38	0.038 <sup>a</sup>

In preoperative period, no significant difference was observed between the groups regarding cell size variability as  $p=0.063$ . In 7<sup>th</sup> POD and after one month of surgery, the cell size variability significantly decreased in group II compared to group I ( $p<0.05$ ) (table IV).

**Table- V.** Distribution of central corneal thickness among study group

Central corneal thickness	Group-I (n=50) Mean± SD	Group-II (n=50) Mean± SD	p value
Pre-operative	534.04 ± 32.08	530.12 ± 24.84	0.496 <sup>a</sup>
7 <sup>th</sup> POD	589.12 ± 36.01	630.24 ± 33.22	<0.001 <sup>a</sup>
After 1 month	560.68 ± 31.11	569.94 ± 26.90	0.011 <sup>a</sup>

In preoperative period, no significant difference was observed between the groups regarding central corneal thickness as  $p=0.496$ . In 7<sup>th</sup> POD and after one month of surgery, the central corneal thickness significantly decreased in group II compared to group I ( $p<0.05$ ) (table V).

## Discussion

Cataract has been found to be the leading cause of blindness in the world. People with diabetes are tend to develop cataract more earlier. After cataract surgery, one of the important causes of delayed visual restoration is endothelial decompensation. Diabetes mellitus affects structural and functional changes in corneal endothelial cells and their thickness. Many studies have suggested that diabetic patients have corneal abnormalities such as higher auto-fluorescence, lower corneal sensitivity, greater corneal thickness, less corneal ECD, and increased endothelial permeability.

Corneal endothelium can be adversely affected by surgery due to factors like lens nuclear sclerosis, effective phacoemulsification time (EPT), phacoemulsification energy, and IOL implantation. These factors coupled with the effect of DM indicate a greater risk of long term endothelium cell dysfunction with de-compensation and the development of bullous keratopathy.

Corneal endothelial abnormalities in diabetic patients have been reported. However, these are morphological abnormalities, such as

polymegethism and pleomorphism. On this basis the study is designed and result is formulated.

Endothelial cell count difference among two groups in post-operative visits were statistically significant. Dhasmanaet et al.<sup>8</sup> showed a severe increase in ECL% in the DM group compared to the control after cataract surgery. The results showed that DM patients have a significantly greater ECL% than non-DM patients from the first day to 3 months postoperatively ( $P < 0.01$ ) confirming that diabetic patients are more susceptible to corneal endothelial damage after phacoemulsification. These findings are consistent with my study findings This signifies that diabetes mellitus is a causative factor for more endothelial cell loss after phacoemulsification.

Cell variability among two groups were significant statistically. Similar finding was shown by Hugodet et al.<sup>9</sup> that a significant decline in the percentage of hexagonal cells among the diabetic patients only. Kaufman et al.<sup>10</sup> found there is endothelial cell damages after cataract surgery. These findings are consistent with my study findings.

Cell variability among two groups were significant statistically. Studies by Morikuboet et al.<sup>11</sup> and Lee et al.<sup>12</sup> also demonstrated significant differences in the %CV change. This result is unique to our study and supports the theory that the endothelium in diabetic patients has slower and poor healing response.

In group-I pre operative and 7<sup>th</sup> POD, 1<sup>st</sup> month after POD value were 534.04,589.12 and 560.68; In group-II pre operative and 7<sup>th</sup> POD,1 month after POD value were 530.12,630.24, and 569.94 respectively. Altintas et al.<sup>13</sup> demonstrated that corneal thicknesses were greater in both diabetic and non-diabetic patients 1 week postoperatively than in later follow up, while there were no differences in corneal thickness according to phaco time or diabetic status. Nevertheless, most studies mentioned a delayed recovery of postoperative corneal edema in diabetics compared to normal controls. This analysis observed significant differences between the two groups at all postoperative times from 1 day to 3

months. These findings are consistent with my study findings.

Clear cornea is the desired post-operative outcome for the ophthalmologist to give expected better vision to patient after phacoemulsification. Corneal endothelium plays the most important role to fulfill the desire. Corneal endothelium is metabolically active and plays an imperative role in maintaining the corneal transparency. Diabetes mellitus is associated with structural changes in corneal endothelial cells and their thickness. It is also the most vulnerable structure to undergo damage by the process of phacoemulsification. Corneal endothelial de-compensation after cataract extraction is a well-known complication after all types of cataract surgery, the overall incidence is less than 1%.

Patients with diabetes have morphologically abnormal cells such as polymegathism and pleomorphism in their cornea. Elderly diabetic population more prone to surgical trauma to corneal endothelium during phacoemulsification surgery. This study was conducted to analyze the corneal endothelial cell changes (Hexagonality, CCT and % CV) in patients with type II diabetes before and after phacoemulsification surgery and to compare them with age matched non diabetic population.

However there is every chance to develop complication later in diabetic cornea; because endothelial cell plays the major role to maintain corneal integrity. As diabetic cornea losses its endothelial cell more in proportionate to non-diabetic cornea, we should deal the diabetic cornea very carefully. Focus should be doing minimum damage to corneal endothelium while performing phacoemulsification to preserve endothelial cell as much as we can. Use of dispersive ocular viscosurgical device, changes of phacoemulsification parameters might be helpful to fulfill the purpose.

### **Limitations of the study**

Duration of the study was very short so long-term outcome could not be assessed. Study was not representative as sample was purposively selected. Sample size was less due to time constrain, which could be a bias. This is a single



centered study, so universal conclusion cannot be drawn. Parameters to evaluate glycemic status other than blood glucose level was not done.

### Recommendations

Further study should be done in multiple centre involving larger population to draw universal conclusion. Special care (i.e. use of dispersive ocular viscosurgical device, changes of phacoemulsification parameters) should be taken for diabetic patients.

### Conflicts of interest

There were no financial or other conflicts of interest.

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