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Original Research Article

To assess and compare the endothelial cell changes after cataract extraction by phacoemulsification and PCIOL implantation in type II diabetic patients versus age group matched non-diabetic patients

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Abstract

Background: Diabetes mellitus–related metabolic alterations compromise corneal endothelial integrity and reduce its functional reserve, making diabetic eyes particularly susceptible to endothelial cell loss and morphological changes during phacoemulsification. This study evaluates these specular microscopy parameters in North Indian type II diabetics versus non-diabetic controls to elucidate the impact of diabetes on postoperative endothelial health.

Aim and Objectives: To assess and compare the endothelial cell changes after Phacoemulsification with PCIOL in type II diabetic patients versus age group matched non-diabetic patients.

Materials and Methods: This comparative prospective observational follow-up study included 50 diabetic patients and 50 control patients without diabetes who underwent phacoemulsification with PCIOL. Preoperative, one day, one week, one month and three months post-surgery assessments of corneal endothelial cell changes were done using specular microscopy.

The software used for the statistical analysis was SPSS (statistical package for social sciences) version 25.0 and MedCalc software. The quantitative variables in both groups were expressed as mean ± SD and compared using STUDENT T test. The p-value was taken significant when less than 0.05 ($p<0.05$) and confidence interval of 95% was taken.

Results: One hundred eyes (57% male; mean age 60.8 ± 5.0 years [diabetics] vs. 60.4 ± 5.0 years [controls]) were enrolled. Preoperatively, diabetic corneas were significantly thicker (mean CCT 523.3 ± 31.1 µm vs. 502.5 ± 37.0 µm; $p = 0.003$) and had lower hexagonality (50.3 ± 3.5% vs. 56.1 ± 12.8%; $p = 0.003$), while endothelial cell density (ECD) and coefficient of variation (CV) did not differ.

Following phacoemulsification, both groups showed transient CCT increases, but diabetics maintained significantly higher CCT at day 1, week 1, month 1 and month 3 (all $p < 0.05$). By 3 months post-op, ECD had declined in both groups, with a greater loss in diabetics (−531 cells/mm² vs. −511 cells/mm²; $p < 0.001$). CV rose and hexagonality fell in both cohorts after surgery; however, diabetics experienced significantly larger postoperative increases in CV and decreases in hexagonality at all follow-up points (all $p < 0.01$).

These data indicate that diabetic corneas exhibit thicker baseline CCT, reduced hexagonality and a more pronounced endothelial response—manifested as sustained edema, greater cell loss and morphological derangement—after phacoemulsification.

Conclusion: The diabetic endothelium was found to be under greater metabolic stress and had less functional reserve after Phacoemulsification than the normal corneal endothelium.

Keywords: Phacoemulsification, Corneal endothelium, Diabetes mellitus, Central corneal thickness, Endothelial cell density.

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1. Introduction

In 2020, an estimated 596 million people worldwide had distance vision impairment and a further 510 million had uncorrected near vision impairment.[1] The World Health Organization estimates that 65.2 million people worldwide suffer from cataracts, the most common eye illness that results in blindness. Cataracts account for about 51% of blindness and are a major cause of poor eyesight in both industrialized and developing nations.[2]

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Although there are no effective medication treatments or ways for preventing cataracts, patients with cataracts can still see again once their opaque lens is surgically removed and an intraocular lens (IOL) is implanted. The most common eye operation performed globally is a cataract extraction. An annual total of around 26 million cataract operations are carried out.[3] Global standards are evolving for cataract surgery. The advancement of cataract surgery has been continuous, encompassing stages such as early intracapsular cataract extraction (ICCE), extracapsular cataract extraction (ECCE) and the present phacoemulsification procedure.[4] The medical community was greatly benefited by the introduction of phacoemulsification, which allowed for the emulsification of a cataractous lens through a small 2-3 mm incision, resulting in excellent visual results. Many changes have been made to the current method, but phacoemulsification still stands as the best approach for removing cataracts.[5]

Modern cataract surgery emphasizes quickly restoring vision and minimizing astigmatism caused by the procedure. Even with all the progress made, the issue of corneal endothelial loss continues to be worrisome.co corneal endothelial cell loss may occur during phacoemulsification due to ultrasound energy exposure.[6]

The endothelium is a monolayer of flattened, specialized cells with many mitochondria that covers the descemet's membrane and faces the anterior chamber of the eye. The cornea's dehydration and transparency are both crucially maintained by the corneal endothelium.[7] End othelial cell counts can be used to track the cornea's condition of dehydration. Oedema or increased corneal thickness, results from endothelial cell loss or injury and can eventually cause corneal decompensation and vision loss.

A high degree of surgical skills and accuracy in performing the technique is required to reduce endothelial cell damage. Systemic diseases like diabetes mellitus are also known to causes deleterious effect on corneal endothelium. One of the most common co morbidities among people with cataract is diabetes mellitus. We know that increased blood sugar levels affect eyes in many ways. Patients with diabetes have morphological abnormality such as polymegathism and pleomorphism in their cornea. Elderly diabetic population are also more prone to surgical trauma to corneal endothelium during phacoemulsification surgery.[9]

Worldwide, 537 million persons between the ages of 20 and 79 are expected to have diabetes (10.5% of all adults in this age range). It is anticipated that 643 million persons between the ages of 20 and 79 would have diabetes by 2030 and 783 million will by 2045. Therefore, the number of people with diabetes is expected to increase by 46% during this time, despite estimates that the global population will grow by 20%. It is projected that by 2045, low- and middle-income nations would account for 94% of the rise in the global diabetes population.[10] In India, the prevalence of diabetes in the age group 20-79 has increased from 9.2% in 2010 to 9.6% in 2021.Obviously, diabetes mellitus (DM) is becoming more prevalent and threatening than was previously thought. The diabetic cornea suffers from endothelium cellular dysfunction and dysfunctional repair mechanisms including corneal edema, delayed wound healing and so on.[11]

Unfortunately, in patients with systemic morbidities like diabetes, cataract surgery with phacoemulsification and lens implantation result in greater endothelial cell loss in these people. Additionally, because of factors like nuclear sclerosis and effective phacoemulsification time (EPT), surgery may have a negative effect on the corneal endothelium.[12] These factors coupled with the effect of DM indicate a great risk of long-term endothelium cell dysfunction with decompensation and the development of bullous keratopathy.[13]

Endothelial state and morphological parameters are more accurate in assessing the extent of surgical trauma. This is because the endothelium's notable functional ability delays the detection of corneal cell loss in corneal thickness measurements until a substantial reduction in corneal endothelial cell count occurs. Endothelial morphological changes, like alterations in endothelial cell density (ECD), coefficient of variation (CV) and percentage of hexagonal cells (HEX%), can impact the function of the cornea. Increased central corneal thickness (CCT) in conjunction with abnormal corneal endothelial cell shape is another indicator of endothelial cell dysfunction, which impairs visual performance by causing fluid imbalance, stromal swelling and loss of transparency.[14]

For patients participating in clinical trials, specular microscopy can offer a non- invasive morphological examination of the corneal endothelial cell layer. Although ECD is frequently used to assess corneal conditions following phacoemulsification, it is unable to capture the dynamics of the trauma healing process. There is a closer correlation between the dynamic of the corneal recovery process and the change in morphology.[15]

Specular microscopy offers a non-invasive way to analyze the morphology of the corneal endothelial cell layer in participants of clinical trials. ECD is frequently utilized to assess corneal condition post-phacoemulsification, however, it does not accurately depict the healing progression following trauma. The correlation between morphology change and corneal recovery dynamic is stronger.[15]

Although several studies have explored endothelial changes after phacoemulsification, few have focused on a North Indian population with suboptimal glycaemic control. This study aims to highlight the impact of diabetes on endothelial recovery postoperatively, thus offering region-specific insights and emphasizing the need for individualized surgical approaches in diabetic patients. In order to examine the corneal endothelial cell alterations (ECD loss, CCT,

HEX% and % CV) in individuals with type II diabetes both before and after phacoemulsification surgery, the study analysed the data and compared it to a sample of people without diabetes who were age matched. Thus, we aimed to improve the protocol for managing diabetic patients undergoing phacoemulsification and contribute to the body of scientific knowledge already present.

2. Materials and Methods

This prospective, comparative observational study was conducted over 1 year at the Regional Institute of Ophthalmology, Pt. B. D. Sharma PGIMS, Rohtak, in patients aged 40–80 years presenting with nuclear cataract. After Institutional Ethics Committee approval and written informed consent, 100 patients were enrolled and divided equally into two groups: Group A (type II diabetics) and Group B (non-diabetics). All underwent standard phacoemulsification with PCIOL implantation and follow-up specular microscopy.

2.1. Inclusion criteria

1. Age 40–80 years
2. Nuclear cataract up to Grade III (LOCS III)
3. Written consent

2.2. Exclusion criteria

1. Type I diabetes
2. Corneal disease or previous intraocular surgery
3. Pseudoexfoliation, glaucoma, uveitis, endothelial dystrophy
4. Intraoperative complications: posterior capsular rupture, vitreous loss, iris trauma, descemet's membrane detachment
5. Refusal to consent

2.3. Study protocol

Baseline history, ocular/systemic examinations, and investigations (including RBS, HbA1c) were performed. Specular microscopy measured endothelial cell density, coefficient of variation, hexagonality, and CCT pre-operatively, and on POD 1, week 1, and week 4.

2.4. Detailed evaluation

1. History: Age, symptoms, duration, systemic status.
2. Ocular Exam: VA (Snellen), slit-lamp biomicroscopy (cataract grading per LOCS III), IOP (Goldmann), specular microscopy, A-scan biometry, keratometry (SRK T).

2.5. Pre-operative preparations

Topical moxifloxacin 0.5% + Ketorolac 0.5% for 1–2 days; mydriatics (tropicamide 0.8% + phenylephrine 5%) 1 hour pre op; NPO status ensured.

2.6. Anesthesia

Peribulbar block with 6 mL 2% lignocaine and 4 mL 0.5% bupivacaine under asepsis.

2.7. Phacoemulsification

Single surgeon performed 2.8 mm clear-corneal incisions, CCC, hydrodissection, and phaco chop/divide-and-conquer phacoemulsification. Foldable hydrophobic IOLs were implanted; wounds hydrated; subconjunctival gentamycin and dexamethasone administered.

2.8. Post-operative management

Routine systemic and topical antibiotics, NSAIDs, steroids, and lubricants were prescribed. Specular microscopy was repeated on POD 1, week 1, week 4, and week 12

2.9. Stastical analysis

At the end of the study, the data was collected and tabulated using Microsoft Excel database and then subsequently exported to statistical software for analysis. Descriptive statistics was performed by calculating mean and standard deviation for the continuous variables. Categorical variables were presented as absolute numbers and percentage. The software used for the statistical analysis was SPSS (statistical package for social sciences) version 25.0 and MedCalc software. The quantitative variables in both groups were expressed as mean ± SD and compared using student T test. The p-value was taken significant when less than 0.05 ($p<0.05$) and confidence interval of 95% was taken.

3. Results

In the present study, the mean age distribution among patients with diabetes was 60.84±4.98 with range of 40 – 70 years. Among non-diabetic controls the mean age was 60.38±4.98 with range of 40 – 80 years. There were 57 (57%) males and 43 (43%) females out of sample size of 100.

3.1. Central corneal thickness (CCT)

Before the operation, there was a statistically significant difference in the CCT between the two groups ($P = 0.003$). There was significant variation in preoperative and postoperative CCT between the two groups at 1 week, 1 month and 3 months. At all post-operative times (day 1, week 1, week 4 and week 12), the average value was significantly higher in the diabetes group compared to the nondiabetic group ($P < 0.05$). (**Table 1**)

In terms of intragroup comparison, at every followup interval, both groups demonstrated an increase from baseline. At day 1 and week postoperative intervals, the diabetes group showed a statistically significant difference from baseline ($P < 0.00$), butthe nondiabetic group showed no significant increase in values from baseline at all of the followup intervals (**Table 2**).

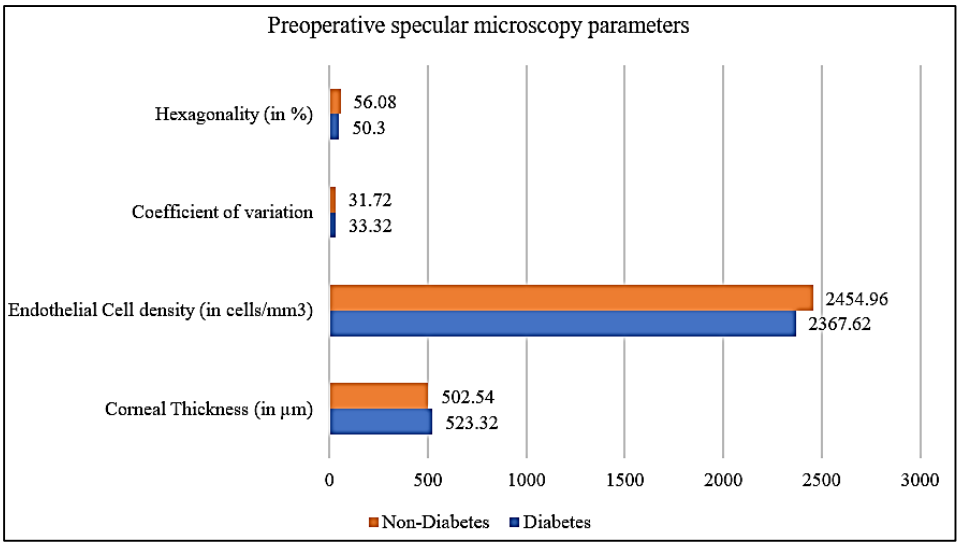

Figure 1: Describes the two study groups based on their preoperative specular microscopy parameters

Table 1: Comparison of the two groups in terms of change in CCT (µm) over time

CCT (in µm)	**Patients with Diabetes**	**Non-Diabetic controls**	**P value for the comparison of the two groups at each of the time points (independent t test)**
	Mean ± SD	Mean ± SD	
Pre-operative	523.32±31.14	502.54±36.98	0.003 (significant)
Post-Operative Day 1	559.2±18.56	540.62±32.95	0.001 (significant)
Post-Operative 1 week	550.6±28.55	528.98±34.53	0.001 (significant)
Post-Operative 1 month	532.38±22.84	515.28±25.5	0.001 (significant)
Post-Operative 3 months	527.46±20.28	508.68±25.03	<0.001 (significant)
P value for change in CCT at 3 months post-operative within each group (Repeated Measures ANOVA)	1.000	1.000	

Table 2: Table summarizing the mean change in CCT (µm) from the preoperative time point to the various follow-up time points along with the statistical comparison of the two groups in terms of the difference (p<0.05 is statistically significant)

Time point comparison	**Change in CCT (µm) from the preoperative to follow-up time points**				**Comparison of the two groups in terms of Change in CCT (µm) from the preoperative to follow-up time points**
	Patients with Diabetes		**Non-Diabetic controls**		
	Mean (SD) of Absolute Change	P value of change within the Group	Mean (SD) of Absolute Change	P value of change within the Group	P value of change between the two groups
Day 1 Postoperative	35.88±34.08	<0.001	38.08±34.05	<0.001	0.747
1 week Postoperative	27.28±32.55	<0.001	26.44±38.41	<0.001	0.906
1 month Postoperative	9.06±35.47	0.770	12.74±46.38	0.579	0.657
3 months Postoperative	4.14±32.54	1.000	6.14±43.28	1.000	0.795

3.2. Endothelial cell density (ECD)

The average ECD before surgery was similar in both the non-diabetic and diabetic groups, with no significant statistical difference noted (P = 0.207). After the operation, the average levels in the nondiabetic category were greater than the diabetic group and this variation was deemed statistically significant (P < 0.001). (**Table 3**) In terms of comparisons within the groups, the non-diabetic group displayed a notable difference from the initial measurement only after 1 and 4 weeks post-surgery, whereas the diabetic group indicated a significant difference from the baseline at all time points(P<0.001). At every follow- up, it was noticed that the mean decline gradually increased, with the largest change occurring at three months (**Table 4**).

3.3. Coefficient of variation (CV)

Diabetics and non-diabetics did not significantly differ in CV prior to surgery (P = 0.074). After surgery, the mean CV values were lower in the nondiabetic group compared to the diabetic group and this disparity was statistically significant at all postoperative time points (P < 0.001). (**Table 5**) One month after the procedure, both groups experienced the most significant change in CV from before surgery. Diabetic patients showed a notable variation in CV at day 1, week 1, month 1 and three months post-surgery compared to before the procedure (P < 0.0001). The Coefficient of Variation (CV) showed significant differences at postoperative 1 week, 1 month and 3 months in nondiabetic controls, compared to preoperative time. (P<0.001) (**Table 6**).

3.4. HexagonalitY (Hexagonal cells in %)

Before the operation, there was a notable difference in the mean % hexagonal cell values between the two groups, as indicated by a statistically significant P-value of 0.003. The greatest change in hexagonality (%) from before surgery occurred three months later in both groups. A notable change in the hexagonality (%) was observed in diabetic patients at day 1, week 1, month 1 and three months after surgery compared to before surgery (P<0.001). This difference was also seen in non-diabetic controls only at postoperative 1 week, 1 month and 3 months (P<0.05). (**Table 7**) Comparison of hexagonality (%) between the two groups significantly differed at the postoperative follow-up appointments of 1 month and 3 months compared to preoperative measurements. (**Table 8**)

Table 3: Comparison of the two groups in terms of change in ECD (cells/mm^2) over time

ECD (in mm^2)	**Patients with Diabetes**	**Non-Diabetic controls**	**P value for the comparison of the two groups at each of the time points (independent t test)**
	Mean ± SD	Mean ± SD	
Pre-operative	2367.62±156.96	2454.96±457.73	0.207
Post-Operative Day 1	2274.94±91.7	2341.38±379.93	0.235
Post-Operative 1 week	2111.08±82.99	2199.78±401.39	0.132
Post-Operative 1 month	1926.2±65.52	1993.24±305.41	0.135
Post-Operative 3 months	1836.65±120.96	1944.16±39.02	<0.001
P value for change in ECD at 3 months post-operative within each group (Repeated Measures ANOVA)	<0.001	<0.001	

Table 4: Table summarizing the mean change in ECD (cells/mm^2) from the preoperative time point to the various follow-up time points along with the statistical comparison of the two groups in terms of the difference (p<0.05 is statistically significant)

Time point comparison	**Change in ECD (cells/mm^2) from the preoperative to follow-up time points**				**Comparison of the two groups in terms of Change in ECD (cells/mm^2) from the preoperative to follow-up time points**
	Patients with Diabetes		Non-Diabetic controls		
	Mean (SD) of Absolute Change	P value of change within the Group	Mean (SD) of Absolute Change	P value of change within the Group	P value of change between the two groups
Day 1 Postoperative	-95.776	<0.001	-113.580	.899	0.797
1 week Postoperative	-259.633	<0.001	-255.180	.006	0.952
1 month Postoperative	-444.510	<0.001	-461.720	<0.001	0.799
3 months Postoperative	-534.061	<0.001	-510.800	<0.001	0.745

Table 5: Comparison of the two groups in terms of change in CV over time

Coefficient of Variation (CV)	**Patients with Diabetes**	**Non-Diabetic controls**	**P value for the comparison of the two groups at each of the time points (independent t test)**
	Mean ± SD	Mean ± SD	
Pre-operative	33.32±3.07	31.72±5.44	0.074
Post-Operative Day 1	38.26±3.71	33.58±3.33	<0.001
Post-Operative 1 week	40.96±3.66	36.76±4.69	<0.001
Post-Operative 1 month	44.06±3.43	38.84±4.25	<0.001
Post-Operative 3 months	42.46±5.14	38.32±4.11	<0.001
P value for change in CV at 3 months post-operative within each group (Repeated Measures ANOVA)	<0.001	<0.001	

Table 6: Table summarizing the mean change in Coefficient of Variation (CV) from the preoperative time point to the various follow-up time points along with the statistical comparison of the two groups in terms of the difference (p<0.05 is statistically significant)

Time point comparison	**Change in Coefficient of Variation (CV) from the preoperative to follow-up time points**				**Comparison of the two groups in terms of Change in Coefficient of Variation (CV) from the preoperative to follow-up time points**
	Patients with Diabetes		Non-Diabetic controls		
	Mean (SD) of Absolute Change	P value of change within the Group	Mean (SD) of Absolute Change	P value of change within the Group	P value of change between the two groups
Day 1 Postoperative	4.940	<0.001	1.860	.352	0.004
1 week Postoperative	7.640	<0.001	5.040	<0.001	0.023
1 month Postoperative	10.740	<0.001	7.120	<0.001	0.002
3 months Postoperative	9.140	<0.001	6.600	<0.001	0.037

Table 7: Comparison of the two groups in terms of change in hexagonality (%) over time

Hexagonality (%)	**Patients with Diabetes**	**Non-Diabetic controls**	**P value for the comparison of the two groups at each of the time points (independent t test)**
	Mean ± SD	Mean ± SD	
Pre-operative	50.3±3.48	56.08±12.79	0.003
Post-Operative Day 1	46.08±3.91	52.62±4.5	<0.001
Post-Operative 1 week	42.94±3.53	49.52±3.92	<0.001
Post-Operative 1 month	40.3±2.49	48.36±6.39	<0.001
Post-Operative 3 months	37.6±3.27	46.58±6.67	<0.001
P value for change in hexagonality at 3 months post-operative within each group (Repeated Measures ANOVA)	<.001	.001	

Table 8: Table summarizing the mean change in Hexagonality (%) from the preoperative time point to the various follow-up time points along with the statistical comparison of the two groups in terms of the difference (p<0.05 is statistically significant)

Time point comparison	Change in Hexagonality (%) from the preoperative to follow-up time points				Comparison of the two groups in terms of Change in Hexagonality (%) from the preoperative to follow-up time points
	Patients with Diabetes		Non-Diabetic controls		
	Mean (SD) of Absolute Change	P value of change within the Group	Mean (SD) of Absolute Change	P value of change within the Group	P value of change between the two groups
Day 1 Post-operative	-4.220	<0.001	-3.460	.901	0.722
1 week Post-operative	-7.360	<0.001	-6.560	.019	0.707
1 month Post-operative	-10.000	<0.001	-7.720	.011	0.325
3 month Post-operative	-12.700	<0.001	-9.500	.001	0.172

4. Discussion

4.1. Central corneal thickness

In our cohort, diabetic eyes exhibited significantly greater CCT than non-diabetics at all postoperative intervals ($P < 0.05$), with the largest rise from baseline seen on POD 1. Both groups showed significant intragroup increases at POD 1 and week 1 ($P < 0.001$), followed by gradual reductions toward baseline as surgical inflammation subsided. The persistent CCT elevation in diabetics is likely due to stromal accumulation of advanced glycation end-products and reduced Na^+/K^+-ATPase activity in the endothelium. Kudva et al.[16] similarly reported thicker diabetic corneas ($P = 0.0012$), and Lee et al.[17] found marginally higher diabetic CCT without preoperative differences ($P = 0.39$). Altintas et al.[18] observed peak thickness at 1 week post-op in both groups, while Morikubo et al.[19] quantified diabetic CCT rises of 3.9% (Day 1), 1.6% (Week 1), and 1.6% (Month 1) versus non-diabetic rises of 4.2%, 0.9%, and 0.04%, noting slower recovery in diabetics ($P = .03$). Chaurasia and Khasnavis[20] found no pre-op CCT difference ($P = 0.330$) but significantly higher diabetic CCT at Week 1 and Week 4 ($P < 0.05$), with no difference at 3 months ($P = 0.745$). Their mean HbA1c was 6.12% versus our 7.70%, which may explain their faster return to baseline.

4.2. Endothelial cell density

Preoperatively, ECD did not differ significantly between groups ($P = 0.207$), but by 3 months, non-diabetics retained higher ECD ($P < 0.001$). Both groups experienced significant ECD loss at each follow-up ($P < 0.001$), with the greatest cumulative decline at 3 months. Diabetics showed a larger percentage loss throughout. Kudva et al.[16] also reported greater postoperative endothelial loss in diabetics, and Chaurasia and Khasnavis[20] mirrored these findings ($P < 0.001$ post-op, intragroup $P < 0.001$). Dhasmana et al.[21] found even larger diabetic ECD loss (14.19% vs 8.05%, $P < 0.001$), attributing it to poorer glycaemic control. Tang et al.'s meta-analysis of 13 studies confirmed that diabetic patients generally have lower ECD than controls, though the magnitude varied.[22]

4.3. Coefficient of variation

Diabetic eyes had a significantly higher CV than non-diabetics at all postoperative points ($P < 0.001$). In non-diabetics, CV increases were significant at Week 1, Month 1, and Month 3 ($P < 0.001$); in diabetics, significant from POD 1 onward. Both groups peaked at Month 1 before trending back toward baseline, but recovery in diabetics was slower, indicating less robust endothelial repair. Chaurasia and Khasnavis[20] and Kudva et al.[16] also showed significant CV rises at 3 months ($P < 0.001$). Sahu et al.[23] reported similar postoperative %CV increases in both cohorts ($P < 0.001$). Contrastingly, Hugod et al.[24] noted a non-significant CV decrease (33.2% at 3 months vs 33.7% pre-op), and Lee et al.[17] and Morikubo et al.[19] found non-significant CV changes. Yan et al.[25] even observed CV falling below baseline in diabetics, possibly due to differences in diabetes duration or control.

4.4. Hexagonality

The percentage of hexagonal cells declined significantly from baseline in both groups ($P < 0.001$) but remained lower in diabetics at each follow-up ($P < 0.001$). Sahu et al.[23] saw

similar intragroup reductions without intergroup significance, perhaps reflecting heterogeneous diabetic profiles. Chaurasia and Khasnavis[20] found lower hexagonality in diabetics throughout follow-up ($P < 0.001$), aligning with our data. Kudva et al. reported significant hexagonality declines post-op in both groups but no pre-op differences ($P = 0.8493$).[16] Hugod et al. observed a marked hexagonality decrease in diabetics, suggesting ethnic or metabolic factors may modulate endothelial resilience.[24]

5. Future Research Direction

This study has tried to expand the current spectrum of understanding with respect to the effect of phacoemulsification on diabetic endothelium but unknowns remain that will require further research. More studies should be undertaken to study the impact of femtosecond laser-assisted phacoemulsification on the diabetic cornea and whether it provides some advantage vis-à-vis conventional phacoemulsification. Future research should also enquire about the role of hydrogen-enriched irrigation solutions and cold irrigating solutions in providing protection to corneal endothelium in diabetics by reducing the oxidative stress during phacoemulsification.

6. Conclusions

This study demonstrates that type II diabetic patients experience significantly greater corneal endothelial cell loss and morphological changes after phacoemulsification compared to non-diabetic patients. Compared to the normal corneal endothelium, the diabetic endothelium was found to have less functional reserve under metabolic stress. These findings highlight the need for meticulous surgical planning and protective strategies in diabetic individuals undergoing cataract surgery.

7. Source of Funding

None.

8. Conflicts of Interest

None.

9. Ethical Approval

Ethical No.: BREC/22/TH/Ophthal. -06.

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