

A Comparison of Central Corneal Thickness in Diabetic and Non-Diabetic Patients before and after Cataract Surgery

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Abstract

Purpose : To compare preoperative and postoperative central corneal thickness (CCT), epithelial thickness (ET) and visual acuity (VA) changes in diabetic and non-diabetic patients undergoing cataract surgery.

Methods : A prospective, observational study was conducted at the Regional Institute of Ophthalmology, Banaras Hindu University, from November 2019 to May 2021. A total of 100 patients (50 diabetics and 50 non-diabetics) who underwent uneventful cataract surgery were included in the study after ethical committee approval and informed written consent. Preoperative and postoperative assessments were done at Day 1, 7, 30 and 90. AS-OCT was used for CCT and ET measurements, while Snellen's chart assessed VA. Data were analyzed using SPSS v18, with independent t-tests and paired t-tests applied for intergroup and intragroup comparisons.

Results : Diabetic patients exhibited significantly higher CCT preoperatively (533.00 μ m whereas 505.00 μ m in non-diabetics, $p < 0.05$) and delayed postoperative corneal recovery. The highest CCT increase occurred on Day 1, followed by gradual resolution. At Day 30, CCT remained 1.31% above baseline in diabetics whereas 0.245% in non-diabetics ($p = 0.0001$). ET followed a similar trend, showing prolonged healing in diabetics. However, VA improvement was comparable between both groups, with no significant differences at three months.

Conclusion : Diabetes leads to delayed corneal recovery post-cataract surgery, with prolonged CCT and ET changes, though visual outcomes remain unaffected. Postoperative monitoring is crucial for diabetic patients to ensure optimal corneal healing.

Keywords : Central Corneal Thickness; Corneal Edema; Cataract Surgery; Diabetes Mellitus; Visual Acuity.

Introduction

The global prevalence of diabetes mellitus (DM) is rising rapidly, with estimates predicting 366 million cases by 2030.¹⁻³ Diabetes is associated with complications affecting multiple organ systems, including the ocular surface.⁴ Among these, diabetic keratopathy, retinopathy, cataract, and optic neuropathy significantly impact visual function. While diabetic retinopathy has been extensively studied, diabetes-induced corneal changes remain under explored despite well documented biochemical and ultrastructural abnormalities in the cornea of diabetic patients.

Diabetes alters corneal endothelial function, leading to impaired wound healing, increased edema, and delayed recovery.⁵⁻⁶ Hyperglycemia promotes aldose reductase activation, matrix metalloproteinase (MMP) overexpression, and advanced glycation end product (AGE) accumulation,⁷

which disrupts endothelial function. Studies suggest that aldose reductase inhibition reduces corneal endothelial changes,⁸⁻⁹ while elevated MMPs degrade the basement membrane, impairing healing.¹⁰ AGE accumulation further weakens cell adhesion, making the cornea vulnerable to damage.¹¹

Cataract surgery can lead to corneal endothelial cell loss and postoperative corneal decompensation. Corneal edema serves as an indirect marker of endothelial dysfunction, affecting transparency and visual recovery.¹² CCT and endothelial cell

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morphology (ECD, CV, HC %) are key indicators of corneal health, with increased CCT and endothelial dysfunction contributing to fluid imbalance, stromal swelling, and impaired vision.¹³⁻¹⁴

Despite diabetes affecting corneal physiology, limited data exist on its impact on CCT after cataract surgery in India. This study evaluates postoperative CCT changes in diabetics and non-diabetics to optimize surgical strategies and enhance visual outcomes.

MATERIAL AND METHODS

This prospective, observational study was conducted at the Regional Institute of Ophthalmology, Banaras Hindu University, from November 2019 to May 2021. The study included 100 patients, divided into two groups: 50 diabetic and 50 non-diabetic patients, who underwent uneventful cataract surgery.

Inclusion Criteria:

1. Patients aged 50–70 years.
2. Diagnosed cases of cataract, categorized into diabetic and non-diabetic groups.
3. Patients who underwent standard, uncomplicated cataract surgery.
4. Willingness to comply with a 3 month follow-up.

Exclusion Criteria:

1. Any deviation from standard operative steps.
2. Intra-operative complications.
3. Prolonged surgery time beyond 15–20 minutes.
4. Presence of glaucoma or corneal pathology.
5. Postoperative trauma or infection.
6. Failure to follow up within the study period.

Ethical Considerations:

The study was conducted after obtaining approval from the Ethical Committee of the Institute of Medical Sciences, Banaras Hindu University. Written informed consent was obtained from all participants before enrolment.

Data Collection and Examination:

Each patient's demographic details and medical history, including presenting symptoms, duration, and systemic conditions, were recorded. A thorough ocular and systemic examination was performed to rule out any confounding illnesses.

Ophthalmic Examination And Measurements

The following diagnostic tools and techniques were used:

1. Snellen's Visual Acuity Chart – To assess vision preoperatively and postoperatively.
2. Slit Lamp Examination – For detailed anterior segment evaluation and cataract grading.
3. Direct and Indirect Ophthalmoscopy – To examine the

posterior segment.

4. Schiottz Tonometer – For measuring intraocular pressure (IOP).
5. Anterior Segment Optical Coherence Tomography (AS-OCT)- For measuring central corneal thickness (CCT) and epithelial thickness. (Figure1)

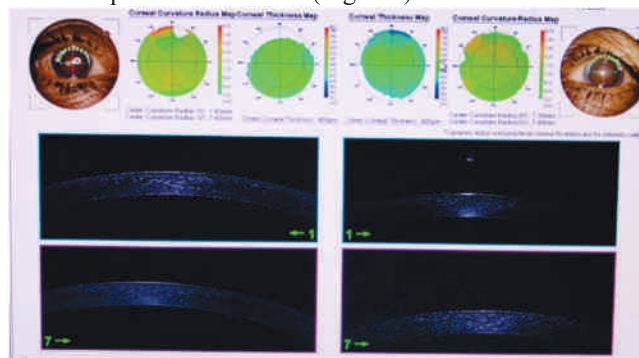


Figure 1 : Central Corneal thickness by ASOCT

6. Keratometry and A-Scan Ultrasonography (USG A-Scan) – To determine intraocular lens (IOL) power using the SRK formula.
7. Fasting and Postprandial Blood Sugar Tests – For glycaemic status evaluation.

Follow-Up Protocol:

Postoperative assessment was conducted at four designated time points: Day 1, Day 7, Day 30, and Day 90. These follow-ups were crucial for evaluating changes in central corneal thickness (CCT), endothelial function, and overall visual recovery in both diabetic and non-diabetic patients. Regular monitoring ensured early detection of any postoperative complications, including corneal edema or delayed healing, which are more prevalent in diabetic individuals.

Statistical Analysis:

All collected data were analyzed using SPSS version 18 and Microsoft Excel 2016. The results were presented as mean \pm standard deviation (SD) to provide a comprehensive statistical representation. For comparing diabetic and non-diabetic groups, the independent Student's t-test was employed, allowing for an objective evaluation of intergroup differences. Additionally, the paired t-test was used to assess intragroup variations before and after surgery, enabling a precise measurement of the impact of cataract surgery on CCT over time.

RESULTS

1. Baseline preoperative characteristic parameters of diabetic and non-diabetic patients undergoing cataract surgery: Diabetic patients exhibited higher fasting and postprandial blood sugar levels compared to the non-diabetic group. Additionally, slight variations were noted in intraocular pressure (IOP) and intraocular lens (IOL) power between the groups as shown in Table 1.

Parameters	Diabetic (Mean ± SD)	Non-Diabetic (Mean ± SD)
Age (years)	62.22 ± 9.59	58.56 ± 9.74
Fasting Blood Sugar (mg/dl)	109.5 ± 17.09	88.36 ± 14.6
Postprandial Blood Sugar (mg/dl)	153.7 ± 17.03	118.34 ± 17.7
Intraocular Pressure (mmHg)	14.46 ± 1.75	14.68 ± 1.85
Intraocular Lens Power (diopters)	23.27 ± 1.63	23.358 ± 1.64

Table 1: Comparison of Preoperative characteristics parameters between Diabetic and Non-Diabetic Patients:

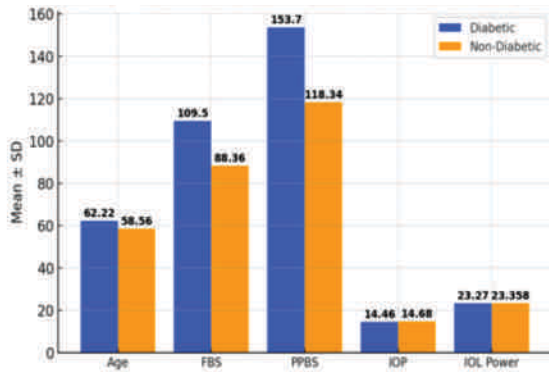


Figure 2: Comparison of Preoperative Characteristics between Diabetic and Non-Diabetic Groups

2. Postoperative variations in CCT, ET and VA (logMAR) in diabetic and non-diabetic patients at different follow-up intervals:

The results indicated that CCT remained significantly higher in diabetic patients at all time points, while ET and VA showed mild but notable differences. The statistically significant p-values for CCT and ET highlight the impact of diabetes on corneal recovery post-cataract surgery as shown in Table 2.

Post-Op Day	CCT (Diabetic) (µm)	CCT (Non-Diabetic) (µm)	p-value (CCT)	ET (Diabetic) (µm)	ET (Non-Diabetic) (µm)	p-value (ET)	VA (Diabetic) (logMAR)	VA (Non-Diabetic) (logMAR)	p-value (VA)
Day 1	557.1 ± 13	525.4 ± 21.9	0.000	66.3 ± 4	64.7 ± 4.1	0.052	0.6 ± 0.2	0.6 ± 0.2	0.881
Day 7	541.4 ± 12	512.1 ± 18.3	0.000	63.9 ± 3.6	61.7 ± 5.1	0.018	0.5 ± 0.1	0.5 ± 0.1	0.943
Day 30	540 ± 7.7	506.4 ± 17.3	0.000	63.8 ± 3.6	60.5 ± 4.7	0.000	0.3 ± 0.1	0.3 ± 0.2	0.779
Day 90	533.6 ± 6.3	506 ± 15.5	0.000	62.9 ± 2.7	60.4 ± 4.8	0.0018	0.2 ± 0.08	0.26 ± 0.18	0.0337

Table 2 : Postoperative Comparison of CCT, ET, and VA in Diabetic and Non-Diabetic Patients

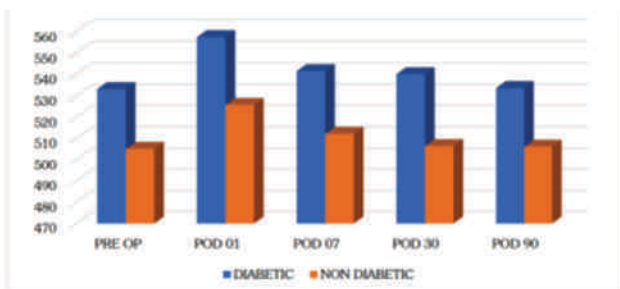


Figure 3: Pre and Post Operative CCT

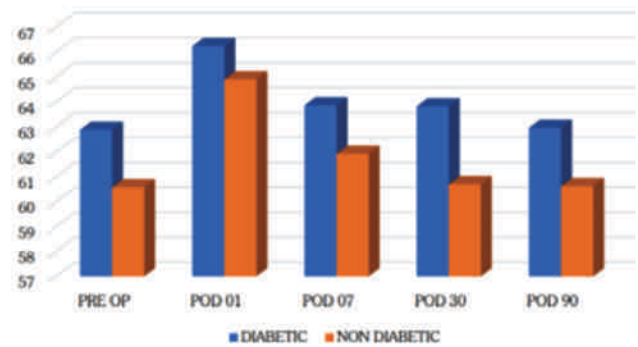


Figure 4: Comparison of Preoperative and postop Epithelial Thickness

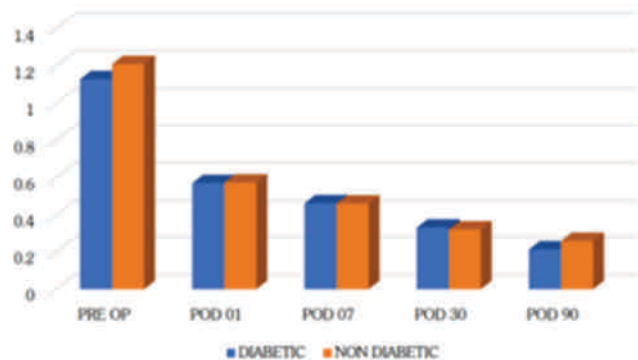


Figure 5 : Pre and Post op VA in Logmar

3. The percentage change in CCT, ET and VA postoperatively in diabetic and non-diabetic groups:

CCT and ET changes were more pronounced in diabetics, while VA improvement was comparable in both groups. The significant p-values for certain parameters indicate the impact of diabetes on postoperative corneal recovery as shown in Table 3.

Post-Op Day	CCT Change (%) (Diabetic)	CCT Change (%) (Non-Diabetic)	p-value (CCT)	ET Change (%) (Diabetic)	ET Change (%) (Non-Diabetic)	p-value (ET)	VA Change (%) (Diabetic)	VA Change (%) (Non-Diabetic)	p-value (VA)
Day 1	4.57	4.06	0.607	5.53	7.30	0.154	46.05	50.51	0.233
Day 7	1.58	1.38	0.641	1.64	2.23	0.520	56.48	59.80	0.265
Day 30	1.31	0.245	0.0001	1.56	0.20	0.079	69.03	72.69	0.185
Day 90	0.09	0.194	0.79	0.15	0.06	0.907	79.60	78.20	0.578

Table 3 : Postoperative Percentage change in CCT, ET and VA in Diabetic and Non-Diabetic Patients:

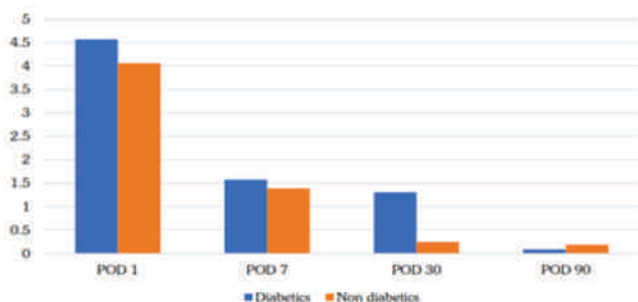


Figure 6 : Percentage change in CCT

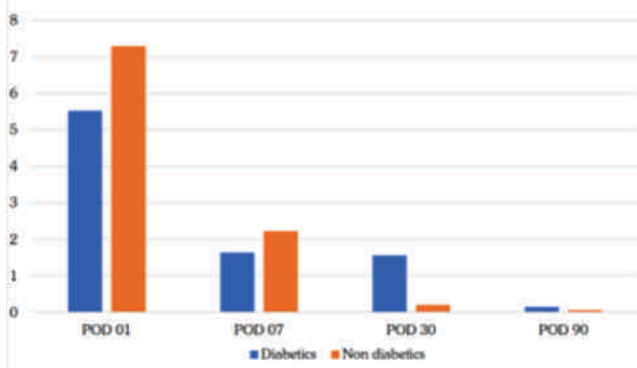


Figure 7 : Percentage change in ET

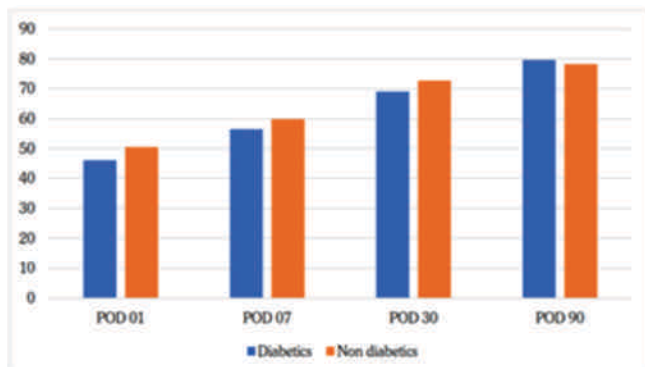


Figure 8 : Percentage change in VA

CONCLUSION

The present study concluded that diabetic patients exhibit significantly higher CCT and ET preoperatively compared to non-diabetic patients, with delayed postoperative corneal recovery observed in the diabetic group. The increase in CCT was most pronounced on Day 1, followed by a gradual decline, yet recovery remained significantly slower in diabetics, with CCT and ET taking longer to return to baseline. Despite these differences, visual acuity improvement was comparable in both groups, with no significant impact of diabetes on long-term visual outcomes. Hence, results of the study emphasize the importance of careful postoperative monitoring and management in diabetic patients to ensure optimal corneal healing and visual rehabilitation following cataract surgery.

Conflict of Interest : None.

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