

Comparative Study Of Macular Thickness After Uneventful Phacoemulsification Surgery In Nondiabetic And Diabetic Patients Without Retinopathy

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Abstract

Background: Diabetes mellitus is associated with several ocular complications, including increased susceptibility to postoperative retinal changes following cataract surgery.

Aim: To compare postoperative macular thickness after uncomplicated phacoemulsification surgery in non-diabetic patients and diabetic patients without diabetic retinopathy.

Materials and Methods: This comparative longitudinal study was conducted in the Department of Ophthalmology at a tertiary care hospital over 18 months. A total of 64 patients with senile cataract were enrolled, comprising 32 diabetic patients without diabetic retinopathy and 32 age-matched non-diabetic controls. All patients underwent uncomplicated phacoemulsification with posterior chamber intraocular lens implantation. Central macular thickness (CMT) was measured using spectral-domain OCT preoperatively and on postoperative day 1, at 4 weeks, and at 8 weeks. Best corrected visual acuity (BCVA) was also assessed during follow-up.

Results: The mean age and gender distribution were comparable between the two groups. Both groups demonstrated an increase in central macular thickness following surgery; however, the increase was significantly greater in diabetic patients without retinopathy, with maximum thickening observed at 4 weeks ($p < 0.05$). Although macular thickness decreased by 8 weeks, it remained higher than baseline values in both groups. Best corrected visual acuity improved significantly in both groups after surgery, but visual recovery was relatively slower in diabetic patients.

Conclusion: Uncomplicated phacoemulsification results in transient postoperative macular thickening in both diabetic and non-diabetic patients; however, diabetic patients without retinopathy exhibit significantly greater retinal thickening. Routine postoperative OCT evaluation may facilitate early detection of subclinical macular changes and improve postoperative management in diabetic patients.

Keywords: Diabetes mellitus, Phacoemulsification, Central macular thickness, Optical coherence tomography, Cataract surgery, Diabetic patients without retinopathy.

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I. Introduction

Diabetes mellitus (DM) is one of the most common metabolic disorders worldwide and is associated with several ocular complications, including cataract, diabetic retinopathy, and macular alterations that contribute significantly to visual impairment. Cataracts develop earlier and more frequently in diabetic patients due to chronic hyperglycemia-induced osmotic stress, oxidative damage, and non-enzymatic glycation of lens proteins. Nevertheless, phacoemulsification has become the standard technique for cataract extraction, providing excellent visual rehabilitation with minimal surgical trauma and rapid postoperative recovery, even in diabetic patients.^{1,2}

Despite advances in cataract surgery, postoperative inflammatory responses remain an important concern. Surgical manipulation induces the release of inflammatory mediators such as prostaglandins, cytokines, and vascular endothelial growth factor (VEGF), which may disrupt the blood-retinal barrier, increase retinal vascular permeability, and result in postoperative macular thickening or cystoid macular edema. These changes may delay visual recovery and adversely affect surgical outcomes. Diabetic patients, even in the absence of clinically detectable diabetic retinopathy, are particularly susceptible because of pre-existing microvascular dysfunction and increased vascular permeability associated with chronic hyperglycemia.^{3,4}

Optical coherence tomography (OCT) is a non-invasive, non-contact imaging modality that provides highly reproducible quantitative assessment of retinal thickness with high-resolution cross-sectional images of the macula. Owing to its high sensitivity, OCT can detect subtle postoperative retinal changes that are not clinically apparent, making it the preferred method for monitoring macular thickness following cataract surgery.⁵

Although several studies have evaluated postoperative macular changes after phacoemulsification, evidence comparing diabetic patients without diabetic retinopathy and non-diabetic individuals remains limited, particularly in the Indian population. Early identification of subclinical macular thickening may facilitate timely intervention, optimize postoperative monitoring, and improve visual outcomes. Therefore, the present study was undertaken to compare macular thickness after uneventful phacoemulsification surgery in non-diabetic patients and diabetic patients without diabetic retinopathy using optical coherence tomography. □, □

II. Materials And Methods

Study Design and Setting

This comparative longitudinal study was conducted in the Department of Ophthalmology at a tertiary care teaching hospital over a period of 18 months after obtaining approval from the Institutional Ethics Committee.

Study Population

The study included patients with age-related cataract who underwent uncomplicated phacoemulsification with posterior chamber intraocular lens implantation. Participants were divided into two groups:

- **Group I:** Non-diabetic patients with senile cataract.
- **Group II:** Patients with Type 2 diabetes mellitus without clinical diabetic retinopathy.

Sample Size

The sample size was calculated using OpenEpi version 3 based on the expected difference in mean central macular thickness between diabetic and non-diabetic patients reported in previous studies. Considering a mean central macular thickness of $271.04 \pm 21.77 \mu\text{m}$ in diabetic patients and $256.28 \pm 20.70 \mu\text{m}$ in non-diabetic controls, with 95% confidence level and 80% power, the minimum sample size was 64 participants, comprising 32 diabetic and 32 non-diabetic patients.

Inclusion Criteria

- Patients aged ≥ 40 years with senile cataract.
- Patients with Type 2 diabetes mellitus without clinical diabetic retinopathy.
- Non-diabetic patients with senile cataract.
- Patients undergoing uncomplicated phacoemulsification with posterior chamber intraocular lens implantation.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Pediatric, traumatic, complicated, mature, or brown cataracts.
- Pre-existing diabetic retinopathy or other retinal disorders including macular pathology.
- Corneal diseases, keratitis, uveitis, glaucoma, or high myopia.
- Previous ocular surgery or ocular trauma.
- Intraoperative complications during phacoemulsification.
- Poor-quality OCT images (signal strength < 4).
- Patients lost to follow-up.

Study Procedure

A detailed ophthalmic history and comprehensive ocular examination were performed for all participants. Preoperative assessment included best-corrected visual acuity (BCVA), slit-lamp biomicroscopy, cataract grading according to the Lens Opacities Classification System (LOCS II), fundus examination, and spectral-domain optical coherence tomography (SD-OCT) for measurement of central macular thickness. Glycated hemoglobin (HbA1c) was recorded for all diabetic patients.

All surgeries were performed by phacoemulsification with posterior chamber intraocular lens implantation using a standardized surgical technique. Only uncomplicated surgeries were included in the analysis.

Postoperative evaluation included BCVA and OCT assessment of central macular thickness on postoperative day 1, at 4 weeks, and at 8 weeks.

III. Results

Both the diabetic and non-diabetic groups comprised 32 patients each with comparable distributions of age, gender, and laterality of the operated eye. The majority of patients belonged to the 51–55 years age group

(28.1%), followed by 56–60 years (25.0%). Males constituted 56.3% of the study population, while females accounted for 43.7%. Right eye surgery was performed in 53.1% of patients. There were no statistically significant differences between the two groups regarding baseline demographic characteristics ($p > 0.05$). (Table 1)

The baseline CMT was slightly higher in diabetic patients than in non-diabetic patients; however, the difference was not statistically significant ($p = 0.212$). At postoperative day 30 and day 60, diabetic patients demonstrated significantly greater macular thickness compared to non-diabetic patients ($p = 0.019$ and $p = 0.001$, respectively), indicating a greater postoperative increase in retinal thickness among diabetics. (Table 2)

Table 3 demonstrates the postoperative changes in central macular thickness among non-diabetic patients. No significant change was observed on the first postoperative day compared with baseline. A slight increase in macular thickness was noted at postoperative day 30, which was not statistically significant ($p = 0.055$). However, by postoperative day 60, a small but statistically significant increase in central macular thickness was observed ($p = 0.049$).

Table 4 presents the postoperative changes in central macular thickness among diabetic patients without diabetic retinopathy. Similar to the non-diabetic group, no change was observed on the first postoperative day. However, a significant increase in macular thickness was observed at postoperative day 30 ($p = 0.010$), which further increased by postoperative day 60 ($p = 0.001$). These findings indicate that diabetic patients experienced a greater and earlier postoperative increase in macular thickness than non-diabetic patients.

Although both diabetic and non-diabetic patients showed an increase in macular thickness following uncomplicated phacoemulsification, the increase was more pronounced in diabetic patients. Significant postoperative thickening occurred only at day 60 in the non-diabetic group, whereas diabetic patients demonstrated significant increases from day 30 onwards, suggesting that diabetes, even in the absence of retinopathy, predisposes patients to greater postoperative retinal thickening. (Table 5)

IV. Discussion

Diabetes mellitus is associated with several ocular complications that may influence outcomes following cataract surgery. Although phacoemulsification is a safe and effective procedure, postoperative inflammation can lead to transient increases in macular thickness, particularly in diabetic patients. Optical coherence tomography (OCT) allows early detection of these subtle retinal changes.

Most participants in the present study were aged 51–60 years, followed by 61–70 years, with no significant difference between diabetic and non-diabetic groups ($p > 0.05$). Similar age distributions have been reported by Hasan et al., Suthar, and Anand et al., where cataract surgery was most commonly performed in the fifth and sixth decades of life.^{8–10}

Females were slightly more common than males, although the difference was not statistically significant. Comparable gender distribution was also reported by Spoorthy and Murthy and Hasan et al., indicating that gender had no significant influence on postoperative outcomes.^{10,11}

Both groups showed an increase in central macular thickness (CMT) after surgery, but the increase was significantly greater in diabetic patients without retinopathy. Peak thickening occurred at 4 weeks and declined slightly by 8 weeks, remaining above baseline values. Similar findings were reported by Suthar, Anand et al., Hasan et al., and Biro and Balla, who demonstrated greater postoperative retinal thickening in diabetic eyes despite the absence of diabetic retinopathy.^{8–10,12}

Visual acuity improved significantly after surgery in both groups. However, diabetic patients showed relatively slower visual recovery, likely due to greater postoperative macular thickening. Similar observations were reported by Hasan et al. and Roy, who found delayed visual recovery in diabetic patients despite successful surgery.^{10,13}

The present study demonstrates that diabetic patients without retinopathy develop greater postoperative macular thickening than non-diabetic individuals following uncomplicated phacoemulsification, although visual outcomes improved in both groups. These findings agree with previous studies and support routine postoperative OCT monitoring in diabetic patients for early detection of subclinical macular edema.^{8–13}

V. Conclusion

The present study demonstrated that uncomplicated phacoemulsification surgery resulted in a transient increase in central macular thickness in both diabetic and non-diabetic patients. However, the increase was significantly greater in diabetic patients without diabetic retinopathy, indicating increased retinal susceptibility despite the absence of clinically evident retinopathy. Visual acuity improved significantly in both groups following surgery, although diabetic patients showed relatively slower recovery.

Conflict Of Interest: Nil

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Tables

Table 1. Baseline Demographic Characteristics of the Study Participants (N = 64)

Variable	Diabetic (n=32)	Non-diabetic (n=32)	Total	p-value
Age (years)				
46–50	6	6	12 (18.8%)	
51–55	9	9	18 (28.1%)	
56–60	8	8	16 (25.0%)	
61–65	5	5	10 (15.6%)	
>65	4	4	8 (12.5%)	
Gender				
Male	18	18	36 (56.3%)	1.000
Female	14	14	28 (43.7%)	
Eye Operated				
Right	17	17	34 (53.1%)	1.000
Left	15	15	30 (46.9%)	

Table 2. Comparison of Mean Central Macular Thickness (μm) Between Diabetic and Non-diabetic Groups

Time Point	Non-diabetic (Mean $\pm$ SD)	Diabetic (Mean $\pm$ SD)	p-value
Preoperative	229.53 $\pm$ 16.31	235.00 $\pm$ 13.58	0.212
Postoperative Day 1	229.53 $\pm$ 16.31	235.00 $\pm$ 13.58	0.212
Postoperative Day 30	230.21 $\pm$ 15.98	238.40 $\pm$ 13.39	0.019
Postoperative Day 60	232.15 $\pm$ 15.98	241.56 $\pm$ 13.49	0.001

Table 3. Change in Central Macular Thickness from Baseline in Non-diabetic Group

Time Point	Mean CMT (μm)	Mean Change	p-value
Preoperative	229.53 $\pm$ 16.31	—	—
Postoperative Day 1	229.53 $\pm$ 16.31	0.00	0.999
Postoperative Day 30	230.21 $\pm$ 15.98	+0.68	0.055
Postoperative Day 60	232.15 $\pm$ 15.98	+2.62	0.049

Table 4. Change in Central Macular Thickness from Baseline in Diabetic Group

Time Point	Mean CMT (μm)	Mean Change	p-value
Preoperative	235.00 $\pm$ 13.58	—	—
Postoperative Day 1	235.00 $\pm$ 13.58	0.00	0.999
Postoperative Day 30	238.40 $\pm$ 13.39	+3.40	0.010
Postoperative Day 60	241.56 $\pm$ 13.49	+6.56	0.001

Table 5. Summary of Postoperative Increase in Central Macular Thickness

Parameter	Non-diabetic	Diabetic
Baseline CMT (μm)	229.53 ± 16.31	235.00 ± 13.58
Day 30 increase (μm)	+0.68	+3.40
Day 60 increase (μm)	+2.62	+6.56
Significant increase from baseline	Day 60 only	Day 30 and Day 60
Maximum postoperative CMT	232.15 ± 15.98	241.56 ± 13.49