

A Prospective Study on Macular Thickness Changes Following Uncomplicated Cataract Surgery in Diabetic Patients Using OCT

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Abstract:

Background: Cataract surgery in diabetic patients often results in postoperative changes in macular thickness, potentially impacting visual recovery. Optical Coherence Tomography (OCT) provides a reliable means to monitor these changes. While previous studies suggest a temporary thickening of the macula after surgery, the extent and clinical significance of these changes remain unclear.

Aim: This study aimed to evaluate macular thickness changes following uncomplicated cataract surgery in diabetic patients using OCT and to identify any factors influencing the postoperative recovery process.

Methods: A prospective observational study was conducted on 100 diabetic patients undergoing uncomplicated cataract surgery. Macular thickness was measured using OCT preoperatively, and at one month and three months postoperatively. Data were analyzed using SPSS version 23.0, with paired t-tests to compare pre- and postoperative thickness values, and subgroup analyses to examine the impact of diabetes duration, age, and sex on outcomes.

Results: The mean macular thickness increased from 252 ± 20.3 microns at baseline to 264 ± 24.8 microns at one month postoperatively ($p < 0.01$). By three months, the mean thickness decreased to 254 ± 22.7 microns, showing no statistically significant difference from baseline ($p = 0.18$). No significant variations in thickness changes were observed across different age groups, sexes, or diabetes duration categories.

Conclusion: Macular thickening following cataract surgery in diabetic patients appears to be a transient phenomenon, peaking at one month and resolving by three months postoperatively. This self-limiting process does not seem to be influenced by age, sex, or diabetes duration.

Recommendations: Routine OCT imaging within the first postoperative month can help monitor macular changes in diabetic patients, facilitating early intervention if needed. Further studies exploring preventive strategies and their cost-effectiveness are recommended.

Keywords: Diabetes, cataract surgery, macular thickness, optical coherence tomography, post-operative changes

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Introduction

Diabetic patients undergoing cataract surgery often face unique challenges due to the interplay between systemic disease and ocular health. Cataract, a common complication of diabetes mellitus, frequently requires surgical intervention to restore vision. While cataract surgery is generally safe and effective, the diabetic eye is more susceptible to postoperative complications, including changes in macular thickness that can impair visual outcomes. Optical Coherence Tomography (OCT) has emerged as a vital imaging modality, allowing clinicians to quantitatively measure these changes with high precision [1,2].

Postoperative macular thickening in diabetic patients can result from multiple factors. Surgical trauma, inflammation, and alterations in the blood-retinal barrier may all contribute to transient macular edema, even in the absence of diabetic retinopathy [3]. In cases where pre-existing diabetic retinopathy is present, the risk of postoperative macular edema increases, making careful monitoring and management essential [4,5]. The introduction of OCT technology has revolutionized this aspect of care, offering unparalleled resolution and enabling early detection of subtle changes that might otherwise go unnoticed.

Recent studies have focused on understanding the dynamics of macular thickness changes following cataract surgery in diabetic individuals. For instance, Yildirim et al. [6] reported that macular thickening generally peaks within the first month after surgery, gradually returning to baseline over subsequent months. This finding underscores the importance of short-term follow-up using OCT, particularly during the critical postoperative period. Similarly, Keenan et al. [7] demonstrated that while diabetic patients experience a predictable increase in macular thickness, this often resolves spontaneously without long-term adverse

effects on vision, provided that there are no complicating factors.

Despite these advances, unanswered questions remain. For instance, how do factors such as diabetes duration, glycemic control, and preoperative retinal health influence the magnitude and trajectory of postoperative macular thickening? Furthermore, what role do emerging therapeutic strategies, including pharmacological interventions, play in preventing or mitigating these changes? Addressing these questions requires robust, prospective data collected in real-world settings. This study aimed to evaluate macular thickness changes following uncomplicated cataract surgery in diabetic patients using OCT and to identify any factors influencing the postoperative recovery process

Methodology

Study Design

This was a hospital-based, prospective, observational study.

Study Setting

The study was carried out at ESIC Medical College and Hospital, Bihta, over a six-month duration.

Participants

A total of 100 patients were included in the study. All patients had diabetes mellitus and were scheduled for cataract surgery. Informed consent was obtained from each participant prior to inclusion in the study.

Inclusion and Exclusion Criteria

Inclusion criteria were: diabetic patients aged 40–80 years undergoing uncomplicated cataract surgery, with no prior history of retinal surgery or macular pathology. Exclusion criteria were: patients with pre-existing macular diseases, significant ocular co-morbidities, recent intraocular procedures, or those who failed to provide informed consent.

Bias

To minimize selection bias, patients were consecutively enrolled based on the order of their surgery schedule, rather than choosing participants based on specific characteristics. Observational bias was reduced by having OCT measurements taken by a technician blinded to the patient's clinical details.

Data Collection

Data were collected prospectively. Baseline demographics, diabetes history, and preoperative OCT measurements were recorded prior to surgery. Postoperative OCT measurements were obtained at regular intervals, as per study protocol, and any changes in macular thickness were noted.

Procedure

All cataract surgeries were performed by experienced ophthalmic surgeons using standard phacoemulsification techniques and a foldable intraocular lens. Preoperative OCT scans of the macula were obtained, and follow-up scans were performed at one month and three months' post-surgery. The same OCT device was used throughout the study to ensure consistency in measurements.

Statistical Analysis

Data were analyzed using SPSS version 23.0. Continuous variables, such as macular thickness, were expressed as mean \pm standard deviation. Comparisons of macular thickness before and after surgery

were made using paired t-tests. Categorical variables were analyzed using chi-square tests. A p-value of <0.05 was considered statistically significant.

Results

A total of 100 diabetic patients (58 males, 42 females) aged between 50 and 78 years (mean age: 64 ± 7.1 years) participated in the study. All patients underwent uncomplicated cataract surgery and completed the follow-up assessments.

Baseline Characteristics

At baseline, the mean macular thickness (central subfield) was 252 ± 20.3 microns. There was no significant difference in baseline macular thickness between male and female participants (male: 254 ± 21.5 microns, female: 250 ± 18.7 microns; $p=0.32$).

Postoperative Macular Thickness Changes

At one month post-surgery, the mean central macular thickness increased to 264 ± 24.8 microns, representing a mean increase of 12 microns from baseline ($p<0.01$). By three months, the mean macular thickness had returned closer to baseline levels, measured at 254 ± 22.7 microns. A paired t-test revealed that the increase at one month was statistically significant ($p<0.01$), while the difference at three months compared to baseline was not statistically significant ($p=0.18$).

Table 1: Mean Macular Thickness at Baseline and Follow-Up

Timepoint	Mean Macular Thickness (microns)	Standard Deviation	p-value (vs. Baseline)
Baseline	252.0	20.3	-
1 Month Post-op	264.0	24.8	<0.01
3 Months Post-op	254.0	22.7	0.18

Diabetic Duration and Macular Thickness

Subgroup analysis showed that patients with longer durations of diabetes (>10 years) experienced slightly greater macular

thickening at one month postoperatively (mean increase: 14 microns) compared to those with diabetes for ≤ 10 years (mean

increase: 10 microns). However, this difference was not statistically significant ($p=0.09$).

Table 2: Macular Thickness Change by Diabetes Duration

Diabetes Duration	Mean Increase at 1 Month (microns)	Standard Deviation	p-value
≤ 10 years	10	4.5	-
> 10 years	14	5.7	0.09

Sex-Based Analysis

When comparing male and female patients, no significant differences in the degree of

macular thickness change were observed. Both groups showed similar patterns of thickening at one month and stabilization by three months.

Table 3: Macular Thickness Change by Sex

Sex	Mean Thickness at 1 Month (microns)	Mean Change from Baseline (microns)	p-value
Male	266	12	0.33
Female	262	12	0.33

Table 4: Distribution of Patients by Age Group and Macular Thickness Changes

Age Group (Years)	Number of Patients	Baseline Thickness (microns)	1-Month Thickness (microns)	3-Month Thickness (microns)	Mean Change at 1 Month (microns)	p-value (vs. Baseline)
50–60	30	248 \pm 17.6	260 \pm 20.1	251 \pm 18.3	12 \pm 2.5	< 0.01
61–70	45	253 \pm 20.2	265 \pm 23.4	255 \pm 21.7	12 \pm 3.2	< 0.01
71–78	25	257 \pm 22.4	268 \pm 26.5	256 \pm 23.9	11 \pm 4.1	< 0.01

This table stratifies patients into age groups and presents their mean macular thickness at baseline, one month, and three months post-surgery. It also shows the average thickness change at one month and the corresponding p-value. The data indicate that all age groups experienced a statistically significant increase in macular thickness at one month, with slight variations in the degree of thickening among the different age ranges.

Discussion

The study observed a significant temporary increase in macular thickness in diabetic patients following uncomplicated cataract surgery, as measured by OCT. On average, macular thickness rose by 12 microns at the one-month mark, a statistically significant change ($p < 0.01$). By the three-month

follow-up, this thickening had largely resolved, with macular thickness returning to levels comparable to baseline ($p=0.18$). The results were consistent across both sexes and across different age groups, with all cohorts showing a similar pattern of initial thickening and subsequent stabilization.

Patients with a longer history of diabetes (> 10 years) demonstrated a slightly greater mean increase in macular thickness at one month than those with diabetes for 10 years or less, though this difference did not reach statistical significance ($p=0.09$). Similarly, age group analysis showed uniform trends of temporary thickening, without any particular age range experiencing a disproportionately higher increase.

Optical coherence tomography (OCT) has been instrumental in evaluating macular thickness changes following cataract surgery in diabetic patients. Several recent studies have examined how diabetes influences postoperative macular edema and visual outcomes, with a focus on the role of diabetic retinopathy (DR) and glycemic control.

Jamaiyar et al. conducted a prospective study comparing macular thickness changes in diabetic and non-diabetic patients after cataract surgery. Their findings indicated a significant increase in foveal thickness at six weeks, particularly in patients with diabetic retinopathy. Additionally, 26% of diabetic patients developed macular edema compared to only 4% in the non-diabetic group. A positive correlation was found between HbA1C levels and macular thickness alterations, highlighting the influence of glycemic control on postoperative outcomes [8]. Similarly, Murthy found that macular thickness increased steadily over time in both diabetic and non-diabetic groups, but the increase was significantly higher in diabetics. The study emphasized OCT's role in distinguishing between diabetic macular edema (DME) and postoperative cystoid macular edema (CME) [9].

Suthar analyzed macular thickness progression in diabetic patient's post-cataract surgery. The study noted a significant increase in central foveal thickness at one month postoperatively in diabetic patients compared to non-diabetics. However, at three months, the difference was no longer significant, suggesting a temporary macular response to surgery. The study concluded that while cataract surgery does not necessarily worsen DR, it does lead to transient macular thickening in diabetics [10]. In a similar study, Segura et al. examined macular thickness changes up to six months post-surgery and reported increased thickness in both diabetics and non-diabetics. However, no significant difference was observed between the two groups, indicating that well-

controlled diabetics without DR may not be at a higher risk of long-term macular thickening [11].

Hassanin et al. investigated the impact of cataract surgery on central macular thickness in diabetics and non-diabetics. Their findings showed a progressive increase in macular thickness post-surgery, with the highest values recorded at one month. The study also highlighted a significant correlation between macular edema and the duration of diabetes, reinforcing the importance of preoperative diabetes management [12].

Conclusion

These findings suggest that while diabetic patients may experience a short-term increase in macular thickness after cataract surgery, this change appears to be self-limiting and resolves by the three-month mark. The lack of significant differences in thickening patterns between sexes, age groups, and diabetes duration supports the idea that this response is likely a common postoperative phenomenon rather than one influenced by demographic or disease duration factors. Clinically, these results provide reassurance that diabetic patients undergoing uncomplicated cataract surgery typically do not face prolonged macular thickening. Nonetheless, the transient increase observed at one month highlights the importance of close monitoring in the immediate postoperative period, particularly for patients with pre-existing macular concerns or those who are at higher risk of developing macular edema.

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