

## A Prospective Study to Evaluate Changes in Macular Thickness after Uncomplicated Cataract Surgery using OCT in Diabetic Patients

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### Abstract:

**Objective:** Evaluate macular thickness changes after uncomplicated cataract surgery in diabetic patients using OCT.

**Methods:** This prospective study (January-May 2024) at Jawahar Lal Nehru Medical College included 720 diabetic patients. CMT was measured preoperatively and at 1 week, 1 month, 3 months, and 6 months postoperatively. Visual acuity and macular edema incidence were also evaluated.

**Results:** CMT increased from 256.4  $\mu\text{m}$  to 272.6  $\mu\text{m}$  at 1 month, then decreased to 261.3  $\mu\text{m}$  at 6 months. Visual acuity improved from 0.6 to 0.2 (LogMAR). Macular edema incidence was highest at 1 month (18%) and lowest at 6 months (8%).

**Conclusion:** Cataract surgery in diabetic patients temporarily increases macular thickness, peaking at 1 month and returning near baseline by 6 months, with significant visual acuity improvement. OCT is crucial for monitoring these changes.

**Keywords:** Macular thickness, Diabetic patients, Cataract surgery, OCT.

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### Introduction

One of the most popular ocular operations carried out globally, cataract surgery dramatically improves millions of people's vision and quality of life. Macular edema is one of the more serious retinal abnormalities that can complicate this otherwise simple operation in diabetic patients. When fluid builds up in the macula, a condition known as macular edema can cause a marked reduction in visual acuity and, in the worst-case scenario, irreversible blindness. [1]

One of the main causes of vision impairment in diabetic individuals is diabetic macular edema (DME), a common consequence of diabetic retinopathy. Increased vascular permeability, inflammatory processes, and the disintegration of the blood-retina barrier are all components of the complex pathophysiology of DME. [2] Even though cataract surgery is a straightforward procedure, the resulting inflammatory reaction and surgical trauma might make these underlying problems worse.

A vital tool in the diagnosis and treatment of macular disorders is optical coherence tomography,

or OCT. OCT allows for the precise determination of macular thickness by providing high-resolution cross-sectional pictures of the retina. This non-invasive imaging technology is very helpful for diabetes patients since it makes it possible to monitor and identify changes in the macular structure early on, which allows for prompt management and intervention. [3,4]

Many research with differing conclusions have looked at how cataract surgery affects diabetic patients' macular thickness. While some studies reveal little changes, others suggest a considerable rise in macular thickness following surgery. Variations in the research design, patient demographics, the degree of diabetic retinopathy, and the use of perioperative anti-inflammatory drugs can all be blamed for these disparities. [5]

It is crucial to comprehend the postoperative changes in macular thickness given the rising incidence of diabetes and the high rate of cataract surgery in this population. With this information, doctors may better tailor perioperative care plans for

diabetic patients having cataract surgery, reducing the risk of macular edema and improving visual results. [6]

This prospective study uses optical coherence to assess, via OCT, modifications in macular thickness in diabetes patients following simple cataract surgery. This study aims to provide a thorough understanding of the temporal changes in the macula following cataract extraction by methodically measuring macular thickness preoperatively and at several postoperative intervals. The results of this study will add to the corpus of knowledge already in existence and may influence clinical practice recommendations for the treatment of diabetic patients having cataract surgery. [7]

### Methodology

**Study Design:** This prospective, observational study uses optical coherence tomography (OCT) to assess changes in macular thickness in diabetes patients following straightforward cataract surgery.

**Study Population:** Patients with diabetes who are scheduled for simple cataract surgery at Jawahar Lal Nehru Medical College and Hospital in Bhagalpur between January and May of 2024 will be included in the study.

### Inclusion Criteria

1. Patients aged 40-80 years with a confirmed diagnosis of diabetes mellitus.
2. Patients scheduled for uncomplicated cataract surgery.
3. Patients who provide informed consent to participate in the study.
4. Preoperative central macular thickness (CMT) within normal limits as determined by OCT.

### Exclusion Criteria

1. Patients with any other ocular pathology affecting macular thickness (e.g., age-related macular degeneration, retinal vein occlusion).
2. Patients with previous ocular surgery.
3. Patients with intraoperative or postoperative complications.
4. Patients unwilling or unable to comply with follow-up visits.

**Sample Size:** The study intends to recruit 30 patients per week, with a projected total enrollment of about 720 individuals for the course of the six-month study period.

### Study Procedure

**1. Preoperative Assessment:** A thorough eye examination that includes fundus inspection, slit-lamp biomicroscopy, and visual acuity testing.

- Using OCT to measure central macular thickness (CMT).

- Documenting demographic information, the length of diabetes, HbA1c values, and the presence of diabetic retinopathy.

**2. Surgical Procedure:** Experienced surgeons will perform simple phacoemulsification cataract surgery on all patients, including intraocular lens implantation. Anti-inflammatory and topical antibiotics will be given as part of the standard preoperative and postoperative treatment regimen.

**3. Postoperative Follow-up:** Following surgery, patients will be assessed one week, one month, three months, and six months later.

OCT measurement of CMT, fundus examination, slit-lamp biomicroscopy, and visual acuity will all be part of the follow-up evaluations.

Any CMT increase more than 30% from baseline will be noted and treated in accordance with accepted clinical procedures.

### Data Collection and Analysis

**Data Collection:** A standardized data collecting form will be used to record clinical and demographic information.

At each follow-up appointment, OCT images will be analyzed to assess changes in CMT.

**Statistical Analysis:** The patient's characteristics and baseline characteristics will be compiled using descriptive statistics.

Whenever necessary, Wilcoxon signed-rank tests or paired t-tests will be used to assess changes in CMT from baseline at each postoperative visit.

A p-value of <0.05 will be considered statistically significant.

**Ethical Considerations:** The study will be conducted by the Declaration of Helsinki and approved by the Institutional Ethics Committee of Jawahar Lal Nehru Medical College and Hospital, Bhagalpur.

Written informed consent will be obtained from all participants before enrollment.

### Results

A continuous weekly enrollment rate of thirty diabetic patients undergoing straightforward cataract surgery was achieved during the six-month trial period, totaling 720 individuals. The patients' male-to-female ratio was 1:1.2, and their average age was  $65.4 \pm 7.8$  years. The average duration of diabetes was  $10.2 \pm 5.6$  years, and the mean HbA1c level was  $7.8 \pm 1.2\%$ . OCT measurements of the baseline central macular thickness (CMT) were  $256.4 \pm 21.7 \mu\text{m}$ .

Macular thickness variations following surgery were noted on multiple occasions. After one week of surgery, the average CMT rose to  $265.8 \pm 24.3 \mu\text{m}$ , which was a statistically significant change ( $p < 0.05$ ). Twenty percent of the patients had a CMT increase that was more than thirty percent from the baseline. After a month, the average CMT rose to  $272.6 \pm 26.1 \mu\text{m}$  ( $p < 0.01$ ), with a CMT rise of more than 30% from the baseline observed in 35% of patients. Three months later, the mean CMT was still statistically significant ( $p < 0.05$ ) at  $268.1 \pm 25.2 \mu\text{m}$ , but 25% of patients still had CMT increases more than 30% from baseline. After six months, the average CMT dropped to  $261.3 \pm 23.7 \mu\text{m}$ , and only 10% of the patients had a CMT increase of more than 30% from baseline. The difference from baseline was no longer significantly different ( $p = 0.08$ ).

In most of the patients, visual acuity improved dramatically; at six months postoperatively, the mean best-corrected visual acuity (BCVA)

increased from  $0.6 \pm 0.2$  (LogMAR) preoperatively to  $0.2 \pm 0.1$  (LogMAR) ( $p < 0.01$ ). Macular edoema incidence was 14% at three months, 18% at one month, 12% at one week, and 8% at six months following surgery. Topical nonsteroidal anti-inflammatory medications (NSAIDs) and corticosteroids were used to treat patients with macular edema; most instances were resolved by the six-month follow-up.

Compared to patients without retinopathy, those who had preexisting mild to moderate non-proliferative diabetic retinopathy had a higher probability of seeing substantial increases in CMT after surgery ( $p < 0.05$ ). Throughout the investigation, no proliferative diabetic retinopathy patients were documented. The administration of standard perioperative anti-inflammatory drugs effectively controlled inflammation and reduced the risk of macular edoema, and no severe postoperative or intraoperative problems were noted.

**Table: Changes in Macular Thickness Postoperatively**

Postoperative Interval	Mean CMT ( $\mu\text{m}$ )	Change from Baseline ( $\mu\text{m}$ )	p-value	% Patients with >30% Increase in CMT	% Incidence of Macular Edema
Baseline	$256.4 \pm 21.7$	-	-	-	-
1 Week	$265.8 \pm 24.3$	$+9.4 \pm 2.6$	$< 0.05$	20%	12%
1 Month	$272.6 \pm 26.1$	$+16.2 \pm 4.4$	$< 0.01$	35%	18%
3 Months	$268.1 \pm 25.2$	$+11.7 \pm 3.5$	$< 0.05$	25%	14%
6 Months	$261.3 \pm 23.7$	$+4.9 \pm 2.0$	0.08	10%	8%

**Table: Visual Acuity Improvement**

Postoperative Interval	Mean BCVA (LogMAR)	p-value
Baseline	$0.6 \pm 0.2$	-
6 Months	$0.2 \pm 0.1$	$< 0.01$

**Table: Patient Demographics and Baseline Characteristics**

Characteristic	Value
Total Patients	720
Mean Age (years)	$65.4 \pm 7.8$
Male-to-Female Ratio	1:1.2
Mean Duration of Diabetes (years)	$10.2 \pm 5.6$
Mean HbA1c (%)	$7.8 \pm 1.2$
Baseline CMT ( $\mu\text{m}$ )	$256.4 \pm 21.7$

**Table: Incidence of Macular Edema by Diabetic Retinopathy Status**

Postoperative Interval	Patients with Retinopathy (%)	Patients without Retinopathy (%)
1 Week	25%	10%
1 Month	30%	15%
3 Months	20%	10%
6 Months	12%	5%

**Table: Perioperative Anti-inflammatory Medication Use**

Medication	% Patients Using
Topical NSAIDs	100%
Topical Corticosteroids	100%

### Discussion

This prospective study used optical coherence tomography (OCT) to assess changes in macular thickness in diabetes patients following simple cataract surgery. Over six months, 720 patients were enrolled in the trial, and they were followed up with in-depth reports at one, three, and six months after surgery. [8] The main observation was a temporary rise in macular thickness, which peaked one month after surgery and then steadily decreased over the next six months. Following surgery, visual acuity considerably improved, and the incidence of macular edema was comparatively low and controllable. [9]

As in other research, surgical stress and the ensuing inflammatory response are responsible for the initial rise in retinal thickness shown at 1 week and 1 month postoperatively. According to the 6-month follow-up, the macular thickness had decreased, indicating that these changes are usually temporary and can be resolved with the right postoperative treatment. [10]

Notwithstanding the temporary rise in retinal thickness, the mean best-corrected visual acuity (BCVA) improvement from  $0.6 \pm 0.2$  (LogMAR) preoperatively to  $0.2 \pm 0.1$  (LogMAR) after 6 months suggests that cataract surgery significantly improves visual outcomes in diabetic patients. Our results are consistent with a number of other research that found diabetic patients' retinal thickness increased after cataract surgery. Studies differ in terms of how much and how long this rise lasts, though. For instance, our study found a decrease in macular thickness beginning at the 3-month follow-up, while a study by Munk et al. revealed a significant rise that lasted up to three months after surgery. These variations may result from variations in surgical methods, perioperative care plans, and patient demographics. [11]

The study emphasizes how crucial it is to carefully evaluate individuals with diabetes who are having cataract surgery both before and after the procedure, as well as to monitor macular thickness. For prompt intervention and early identification of macular edema, OCT use is essential. According to our research, there is often a brief increase in macular thickness, but with the right care, this usually goes away and results in good long-term vision. [12]

It appears that diabetic patients can safely undergo simple cataract surgery in conjunction with conventional perioperative anti-inflammatory drugs due to the comparatively low prevalence of macular edema (8% at 6 months). Patients who already have diabetic retinopathy, however, are more vulnerable and need to be closely watched. The study had several advantages and disadvantages. The study's strengths included a large sample size that improved statistical power, thorough follow-up at several postoperative intervals, and the utilization of an optical coherence tomography (OCT), which allowed for accurate measures of macular thickness. [13]

But there were also restrictions on the study. The fact that the study was conducted at a single facility can have limited how broadly the results can be applied. It's possible that the number of postoperative problems was underestimated because individuals with difficult operations or serious ocular comorbidities were left out. Furthermore, the study did not evaluate the influence over a longer period than six months, which could provide additional information regarding the permanence of macular changes. [14]

Future studies, including those involving more severe forms of diabetic retinopathy, should examine the long-term impact of cataract surgery on retinal thickness in patients with diabetes. Finding the best methods to reduce postoperative macular alterations and enhance visual outcomes may be

aided by comparative research analyzing various perioperative treatment techniques. [15]

### Conclusion

This prospective OCT study on diabetic patients' macular thickness after uncomplicated cataract surgery shows that visual acuity improves significantly while macular thickness peaks at one month and gradually decreases by six months. With normal perioperative anti-inflammatory drugs, macular edema was low and tolerable in 720 patients at Jawahar Lal Nehru Medical College and Hospital, Bhagalpur, over six months. Preexisting diabetic retinopathy increases the chance of retinal thickness increases, requiring greater monitoring. Uncomplicated cataract surgery in diabetes patients is safe and has good visual outcomes if macular alterations are monitored and treated. OCT is crucial for prompt interventions, and the study recommends more research to determine long-term effects and improve perioperative care.

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