e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(8); 1970-1980

Original Research Article

Central Macular Thickness and Visual Outcomes After Manual Small Incision Cataract Surgery in Diabetic and Non-Diabetic Patients: An Observational OCT Study

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Received: 06-08-2026 / Revised: 19-08-2026 / Accepted: 22-08-2026

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Conflict of interest: Nil

Abstract:

Background: Postoperative macular thickening and cystoid macular edema (CME) are recognized complications of cataract surgery and may contribute to delayed or suboptimal visual recovery. Optical coherence tomography (OCT) permits sensitive detection of subtle postoperative changes in central macular thickness (CMT), including subclinical macular edema. Diabetes mellitus may increase susceptibility to postoperative macular changes even in the absence of clinically detectable diabetic retinopathy. This study evaluated changes in CMT and visual outcomes following uneventful manual small incision cataract surgery (M-SICS) and compared postoperative macular edema between diabetic and non-diabetic patients.

Materials and Methods: This hospital-based observational study was conducted in the Regional Institute of Ophthalmology and Postgraduate Department of Ophthalmology, S.C.B. Medical College and Hospital, Cuttack, Odisha, India. A total of 172 patients (172 eyes) undergoing uneventful M-SICS were included, comprising 86 patients with type 2 diabetes mellitus without clinically detectable diabetic retinopathy (Group I) and 86 non-diabetic patients (Group II). Only one eye was included per patient. CMT was measured using Heidelberg Spectralis spectral-domain OCT preoperatively and on postoperative day 1, at 1 month, and at 3 months. Best-corrected visual acuity (BCVA) was assessed using a Snellen chart and converted to logarithm of the minimum angle of resolution (LogMAR) units for analysis. Postoperative macular edema, including CME and subclinical CME, was assessed using OCT. Statistical analysis was performed using IBM SPSS Statistics version 25, with a two-sided $p<0.05$ considered statistically significant.

Results: The mean age of the study population was 63.74 ± 9.10 years, with mean ages of 64.94 ± 9.28 years in the diabetic group and 62.54 ± 8.82 years in the non-diabetic group. Mean preoperative CMT was 254.40 ± 10.94 µm in diabetic patients and 247.49 ± 8.54 µm in non-diabetic patients. CMT increased to 255.98 ± 11.15 µm and 248.94 ± 8.52 µm on postoperative day 1, 290.40 ± 32.47 µm and 265.32 ± 10.81 µm at 1 month, and 282.74 ± 32.87 µm and 256.52 ± 10.54 µm at 3 months in the diabetic and non-diabetic groups, respectively. The between-group differences in CMT were statistically significant at all assessed time points ($p<0.001$). The maximum increase from baseline occurred at 1 month, measuring +36.00 µm in diabetic patients and +17.83 µm in non-diabetic patients. At 3 months, CMT remained above baseline by +28.33 µm and +9.03 µm, respectively. Postoperative macular edema was detected in 17 (19.8%) diabetic patients and 10 (11.6%) non-diabetic patients, with a statistically significant between-group difference ($p=0.04$). Both groups demonstrated significant postoperative improvement in BCVA ($p<0.001$), although the non-diabetic group showed better visual recovery at postoperative follow-up.

Conclusion: Uneventful M-SICS was associated with postoperative increases in CMT in both diabetic patients without clinically detectable diabetic retinopathy and non-diabetic patients. The magnitude and persistence of macular thickening were greater in diabetic patients, who also had a significantly higher frequency of postoperative macular edema. Both groups experienced significant postoperative visual improvement, although recovery was comparatively better among non-diabetic patients. OCT-based postoperative monitoring may therefore be useful for detecting macular changes following M-SICS, particularly among patients with diabetes.

Keywords: cataract; manual small incision cataract surgery; diabetes mellitus; optical coherence tomography; central macular thickness; cystoid macular edema; pseudophakic macular edema; visual acuity.

DOI: 10.25258/ijcpr.18.8.290

Introduction

Cataract is one of the major causes of visual impairment worldwide, and cataract extraction remains one of the most commonly performed ophthalmic surgical procedures. Manual small incision cataract surgery (M-SICS) is an established technique for cataract extraction, particularly in high-volume and resource-constrained settings, because it provides effective visual rehabilitation with relatively low cost and limited dependence on advanced surgical infrastructure. Comparative studies have demonstrated that M-SICS can provide satisfactory visual outcomes while producing measurable postoperative changes in macular thickness. [1]

Although uncomplicated cataract surgery generally results in substantial improvement in visual acuity, transient structural changes in the macula may occur during the postoperative period. Cystoid macular edema (CME), also termed pseudophakic macular edema, is an important cause of delayed or suboptimal visual recovery after cataract surgery. Postoperative inflammation and disruption of the blood-retinal barrier can increase retinal vascular permeability, resulting in accumulation of fluid within the macular region and an increase in retinal thickness. [2]

Optical coherence tomography (OCT) provides a sensitive, non-invasive method for detecting and monitoring postoperative macular changes. Subtle increases in retinal thickness and intraretinal cystic changes may be detected by OCT even when the macula appears normal on routine clinical examination. OCT therefore provides an objective method for assessing central macular thickness (CMT) and identifying both clinically evident and subclinical postoperative macular edema. [2]

Postoperative changes in macular thickness have been reported following different cataract-surgical techniques. Ghosh et al. conducted a prospective randomized comparative study evaluating macular thickness following phacoemulsification and M-SICS and demonstrated postoperative increases in macular thickness following cataract surgery, including M-SICS. [1] These findings indicate that postoperative macular thickening may occur even after an uncomplicated surgical procedure.

Diabetes mellitus is an important systemic risk factor for postoperative macular edema. Diabetic eyes may have pre-existing alterations in retinal microvascular function and blood-retinal barrier integrity, potentially increasing their susceptibility to postoperative macular changes. In a large database study involving 81,984 eyes, Chu et al. demonstrated that diabetes was associated with an increased risk of macular edema after cataract surgery. Importantly, diabetic patients without clinically detectable diabetic retinopathy also demonstrated an increased risk compared with patients without diabetes. [4]

OCT-based investigations have further demonstrated postoperative macular thickening in diabetic patients. Kim et al. evaluated macular edema following cataract surgery in patients with diabetes using OCT and reported postoperative macular changes in diabetic eyes, with greater macular thickening associated with postoperative visual recovery. [3] Similarly, Chen et al. reported postoperative macular edema in diabetic eyes evaluated using OCT, supporting the usefulness of OCT for identifying postoperative retinal changes in this population. [5]

Recent evidence continues to support diabetes as an important risk factor for pseudophakic macular edema following cataract surgery. A 2025 systematic review evaluating the incidence, risk factors, pathogenesis and treatment of cystoid macular edema after cataract surgery reported that diabetes is associated with an increased risk of postoperative macular edema. [6] Systematic-review evidence evaluating preventive strategies has likewise highlighted the increased susceptibility of diabetic patients to postoperative macular edema. [7,8]

Despite these observations, relatively limited data are available regarding the longitudinal pattern of CMT changes following uncomplicated M-SICS specifically among diabetic patients without clinically detectable diabetic retinopathy, particularly when compared directly with non-diabetic patients. This distinction is clinically important because the absence of clinically apparent diabetic retinopathy does not necessarily indicate the absence of subtle retinal vascular or structural abnormalities.

The present study was therefore undertaken to evaluate changes in CMT and visual outcomes following uneventful M-SICS in diabetic patients without clinically detectable diabetic retinopathy and non-diabetic patients. The study also aimed to compare the frequency of postoperative macular edema, including clinically evident and subclinical macular edema, between the two groups using OCT-based assessment.

Objectives

Primary Objective: To evaluate changes in central macular thickness and visual outcomes following uneventful manual small incision cataract surgery.

Secondary Objective: To evaluate and compare postoperative cystoid macular edema and subclinical macular edema in diabetic and non-diabetic patients undergoing M-SICS using optical coherence tomography.

Materials and Methods

Study Design and Setting: This was a hospital-based observational study conducted in the Regional Institute of Ophthalmology and Postgraduate Department of Ophthalmology, S.C.B. Medical College and Hospital, Cuttack, Odisha, India, under the Odisha University of Health Sciences.

Study Period: The study was conducted from December 2024 to December 2025.

Study Population: Patients diagnosed with senile cataract and scheduled for M-SICS with posterior chamber intraocular lens implantation were considered for inclusion.

A total of 172 patients (172 eyes) were included in the final analysis. Only one eye from each patient was included.

The study population was divided into two groups:

- **Group I:** 86 patients with type 2 diabetes mellitus without clinically detectable diabetic retinopathy.
- **Group II:** 86 non-diabetic patients.

Sample Size: The final sample comprised 172 patients, with 86 patients in each study group, according to the predefined eligibility criteria.

Inclusion Criteria: Patients were eligible if they fulfilled the following criteria:

- Adults aged ≥41 years undergoing cataract surgery.
- Diagnosed senile cataract planned for M-SICS.
- Type 2 diabetes mellitus without clinically detectable diabetic retinopathy for inclusion in Group I.
- Absence of diabetes mellitus for inclusion in Group II.
- Uneventful M-SICS with posterior chamber intraocular lens implantation.
- Written informed consent for participation and follow-up.

Exclusion Criteria

Patients were excluded if they had:

1. Diabetic retinopathy or other retinal pathology.
2. Glaucoma, uveitis, severe hypertension, nephropathy or other systemic conditions considered capable of affecting retinal status.
3. Traumatic or complicated cataract.
4. Intraoperative complications, including posterior capsular rupture, vitreous loss or significant iris trauma.
5. Mature or hypermature cataract or advanced nuclear sclerosis producing media opacity that prevented reliable OCT assessment.

Preoperative Evaluation: All participants underwent detailed systemic and ophthalmic evaluation before surgery. The ophthalmic assessment included best-corrected visual acuity using a Snellen chart, with conversion to LogMAR units for statistical analysis, slit-lamp examination of the anterior segment, intraocular pressure measurement by applanation tonometry and dilated fundus examination by indirect ophthalmoscopy.

Diabetic patients were evaluated to exclude clinically detectable diabetic retinopathy before inclusion. Routine hematological and biochemical investigations were performed as part of the preoperative assessment.

Optical Coherence Tomography Assessment: Central macular thickness was assessed using Heidelberg Spectralis spectral-domain optical coherence tomography (Heidelberg Engineering, Germany).

CMT was defined as the mean retinal thickness within the central 1-mm diameter zone of the Early Treatment Diabetic Retinopathy Study macular grid. The standardized macular acquisition protocol was used for all participants. Automated retinal segmentation provided by the device software was used for thickness measurement.

OCT scans with inadequate signal quality, significant motion artifact or unreliable segmentation were excluded from analysis. The same OCT system and standardized scanning protocol were used during all examinations to minimize measurement variability.

Surgical Procedure: All patients underwent M-SICS under peribulbar anesthesia using standard aseptic precautions. Manual small incision cataract extraction followed by posterior chamber intraocular lens implantation was performed by experienced surgeons using a standardized operative technique.

Only eyes with an uneventful intraoperative course were included in the final analysis. Patients with posterior capsular rupture, vitreous loss, significant iris trauma or other major intraoperative complications were excluded.

Postoperative Treatment: All patients received the institutional postoperative regimen consisting of topical moxifloxacin 0.5%, topical dexamethasone 0.1% and topical flurbiprofen, administered four times daily with subsequent steroid tapering according to institutional protocol.

Follow-up: Participants were evaluated at the following time points:

1. Preoperative assessment
2. Postoperative day 1
3. Postoperative 1 month
4. Postoperative 3 months

At each scheduled postoperative assessment, BCVA and CMT were recorded. OCT was additionally assessed for postoperative macular thickening and the presence of cystoid or subclinical macular edema.

Outcome Measures: The primary outcome was change in CMT following M-SICS.

Secondary outcomes included:

- Incidence of postoperative macular edema.
- Change in BCVA.
- Comparison of CMT changes between diabetic and non-diabetic groups.
- Association of postoperative CMT changes with age and sex.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25.

Continuous variables were expressed as mean±standard deviation, while categorical variables were expressed as frequencies and percentages.

Independent-group comparisons were performed using the independent-samples t-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate.

Changes in continuous variables between baseline and postoperative measurements were assessed using paired statistical testing. Comparisons involving more than two age categories were performed using one-way analysis of variance.

A two-sided p value <0.05 was considered statistically significant, while $p<0.001$ was considered highly statistically significant.

Ethical Considerations: The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee, S.C.B. Medical College and Hospital, Cuttack, Odisha before commencement of the study. Written informed consent was obtained from all participants.

Results

Baseline Characteristics: A total of 172 patients (172 eyes) were included in the final analysis, comprising 86 diabetic patients without clinically detectable diabetic retinopathy (Group I) and 86 non-diabetic patients (Group II).

The overall mean age of the study population was 63.74 ± 9.10 years. The mean age was 64.94 ± 9.28 years in Group I and 62.54 ± 8.82 years in Group II. The largest proportion of participants belonged to the 61–70-year age group, accounting for 39.5% of Group I and 41.9% of Group II. The 51–60-year age group represented 29.1% of participants in each group. The age distribution is presented in Table 1 and illustrated in Figure 1.

Table 1: Age distribution of patients in the two study groups

Age group (years)	Group I: Diabetic (n=86)	Group II: Non-diabetic (n=86)	Total (n=172)
41–50	5 (5.8%)	12 (14.0%)	17 (9.9%)
51–60	25 (29.1%)	25 (29.1%)	50 (29.1%)
61–70	34 (39.5%)	36 (41.9%)	70 (40.7%)
71–80	17 (19.8%)	13 (15.1%)	30 (17.4%)
>80	5 (5.8%)	0 (0%)	5 (2.9%)
Total	**86 (100%)**	**86 (100%)**	**172 (100%)**
Mean ± SD	**64.94 ± 9.28**	**62.54 ± 8.82**	**63.74 ± 9.10**

Gender Distribution: The gender distribution was broadly comparable between the two groups. Males constituted 51.2% of Group I and 53.5% of Group II, whereas females accounted for 48.8% and 46.5%, respectively. Overall, 90 participants (52.3%) were male and 82 (47.7%) were female.

Table 2: Gender distribution of patients in the two study groups

Gender	Group I: Diabetic (n=86)	Group II: Non-diabetic (n=86)	Total (n=172)
Female	42 (48.8%)	40 (46.5%)	82 (47.7%)
Male	44 (51.2%)	46 (53.5%)	90 (52.3%)
Total	**86 (100%)**	**86 (100%)**	**172 (100%)**

Eye Involvement: Right-eye involvement was more frequent than left-eye involvement in both groups. Right-eye involvement was observed in 58 (67.4%) diabetic patients and 49 (57.0%) non-diabetic patients. Overall, 107 (62.2%) study eyes were right eyes and 65 (37.8%) were left eyes.

Table 3: Distribution according to eye involved

Eye involved	Group I: Diabetic (n=86)	Group II: Non-diabetic (n=86)	Total (n=172)
Left	28 (32.6%)	37 (43.0%)	65 (37.8%)
Right	58 (67.4%)	49 (57.0%)	107 (62.2%)
Total	**86 (100%)**	**86 (100%)**	**172 (100%)**

Intraocular Pressure: The majority of patients in both groups had intraocular pressure (IOP) between 11 and 20 mmHg, comprising 75 (87.2%) patients in each group. Low IOP (1–10 mmHg) was observed in 11 (12.8%) patients in Group I and 9 (10.5%) patients in Group II, while IOP >20 mmHg was observed in 2 (2.3%) patients in Group II and none in Group I.

The mean IOP was 14.48 ± 3.04 mmHg in Group I and 13.89 ± 2.80 mmHg in Group II. The difference was not statistically significant (p=0.256).

Table 4: Distribution of intraocular pressure in the two study groups

IOP (mmHg)	Group I: Diabetic (n=86)	Group II: Non-diabetic (n=86)	Total (n=172)
1–10	11 (12.8%)	9 (10.5%)	20 (11.6%)
11–20	75 (87.2%)	75 (87.2%)	150 (87.2%)
>20	0 (0%)	2 (2.3%)	2 (1.2%)
Total	**86 (100%)**	**86 (100%)**	**172 (100%)**
Mean ± SD	**14.48 ± 3.04**	**13.89 ± 2.80**	**14.18 ± 2.92**

Between-group comparison: p=0.256.

Postoperative Macular Edema: No patient in either group demonstrated macular edema preoperatively. Following M-SICS, postoperative macular edema, comprising CME and subclinical CME, was detected in 17 (19.8%) diabetic patients compared with 10 (11.6%) non-diabetic patients.

The proportion of patients without postoperative macular edema was 69 (80.2%) in Group I and 76 (88.4%) in Group II. The difference in the occurrence of postoperative macular edema between the two groups was statistically significant (p=0.04).

Thus, postoperative macular edema occurred more frequently among diabetic patients despite the absence of clinically detectable diabetic retinopathy before surgery. The findings are presented in Table 5 and illustrated in Figure 2.

Table 5: Postoperative macular edema in diabetic and non-diabetic groups

Macular edema	Group I: Diabetic (n=86)	Group II: Non-diabetic (n=86)
Preoperative		
No	86 (100%)	86 (100%)
Yes	0 (0%)	0 (0%)
Postoperative		
No	69 (80.2%)	76 (88.4%)
Yes: CME + subclinical CME	17 (19.8%)	10 (11.6%)

Postoperative comparison: p=0.04.

Central Macular Thickness: The mean preoperative central macular thickness (CMT) was 254.40 ± 10.94 µm in the diabetic group and 247.49 ± 8.54 µm in the non-diabetic group.

On postoperative day 1, CMT increased slightly to 255.98 ± 11.15 µm in Group I and 248.94 ± 8.52 µm in Group II. At postoperative 1 month, CMT increased substantially to 290.40 ± 32.47 µm in diabetic patients and 265.32 ± 10.81 µm in non-diabetic patients.

At postoperative 3 months, CMT decreased slightly compared with the 1-month measurements but remained above the preoperative values, measuring 282.74 ± 32.87 µm in Group I and 256.52 ± 10.54 µm in Group II.

The difference in CMT between the two groups was statistically significant at all assessed time points (p<0.001). The longitudinal changes are presented in Table 6 and illustrated in Figures 3 and 4.

Table 6: Comparison of central macular thickness between diabetic and non-diabetic patients

Time point	Group I: Diabetic, µm	Group II: Non-diabetic, µm	Overall, µm	Between-group p-value
Preoperative	254.40 ± 10.94	247.49 ± 8.54	250.95 ± 10.37	<0.001
Postoperative day 1	255.98 ± 11.15	248.94 ± 8.52	252.46 ± 10.50	<0.001
Postoperative 1 month	290.40 ± 32.47	265.32 ± 10.81	277.86 ± 27.20	<0.001
Postoperative 3 months	282.74 ± 32.87	256.52 ± 10.54	269.63 ± 27.65	<0.001

Table 7: Change in central macular thickness from baseline

Follow-up	Group I: Diabetic, µm	Group II: Non-diabetic, µm	Overall, µm
Postoperative day 1	+1.58	+1.45	+1.52
Postoperative 1 month	+36.00	+17.83	+26.91
Postoperative 3 months	+28.33	+9.03	+18.68

The greatest increase in CMT occurred at 1 month in both groups. Although a reduction was observed at 3 months, CMT remained above baseline values. The magnitude of postoperative thickening was greater and more sustained in diabetic patients (Table 7).

Visual Acuity: Both study groups demonstrated significant improvement in best-corrected visual acuity (BCVA) following M-SICS (Table 8). BCVA was analyzed using LogMAR units, with lower values representing better visual acuity (Table 9).

Table 8: Comparison of best-corrected visual acuity between diabetic and non-diabetic groups

Time point	Group I: Diabetic, LogMAR (mean ± SD)	Group II: Non-diabetic, LogMAR (mean ± SD)	Between-group p-value
Preoperative	0.82 ± 0.28	0.79 ± 0.27	0.482
Postoperative day 1	0.46 ± 0.19	0.40 ± 0.17	0.034
Postoperative 1 month	0.31 ± 0.15	0.25 ± 0.12	0.006
Postoperative 3 months	0.27 ± 0.14	0.21 ± 0.11	0.004

Table 9: Change in BCVA from baseline

Follow-up	Group I: Diabetic, LogMAR change	Group II: Non-diabetic, LogMAR change	Interpretation
Postoperative day 1	−0.36	−0.39	Improvement
Postoperative 1 month	−0.51	−0.54	Improvement
Postoperative 3 months	−0.55	−0.58	Improvement

Lower LogMAR values indicate better visual acuity; therefore, negative changes from baseline represent improvement.

Table 10: Within-group comparison of BCVA over follow-up

Group	Preoperative vs day 1	Preoperative vs 1 month	Preoperative vs 3 months
Group I: Diabetic	<0.001	<0.001	<0.001
Group II: Non-diabetic	<0.001	<0.001	<0.001

Both groups demonstrated statistically significant improvement in BCVA from baseline at all postoperative assessments ($p<0.001$) (Table 10). The non-diabetic group demonstrated lower mean LogMAR values than the diabetic group at postoperative day 1, 1 month and 3 months, indicating comparatively better visual recovery.

The longitudinal change in BCVA is illustrated in Figure 5**.**

CMT According to Age: The analysis of CMT according to age group showed no statistically significant difference across the reported age categories at the postoperative assessment points ($p>0.05$).

Although postoperative CMT increased across the age categories, the magnitude and temporal pattern of change were broadly similar. At postoperative 1 month and 3 months, no statistically significant difference in mean CMT was observed across the age categories.

These findings suggest that, within the available study population, age was not significantly associated with postoperative CMT changes.

CMT According to Gender: Male participants demonstrated higher mean CMT than female participants during the preoperative period and on postoperative day 1, with the reported differences being statistically significant ($p<0.001$).

At postoperative 1 month and 3 months, males continued to demonstrate numerically higher CMT values than females; however, the differences were no longer statistically significant, with reported p-values of 0.143 and 0.064, respectively.

Thus, gender-related differences in CMT were most apparent during the early postoperative period, whereas the differences were not statistically significant at later follow-up assessments.

Overall Findings: Overall, M-SICS was associated with a significant postoperative increase in CMT in both diabetic and non-diabetic patients. The increase was most pronounced at 1 month, followed by a partial reduction at 3 months, although CMT remained above baseline values in both groups.

The magnitude of postoperative CMT increase was consistently greater in diabetic patients without clinically detectable diabetic retinopathy than in non-diabetic patients. Similarly, postoperative macular edema occurred more frequently in diabetic patients (19.8%) than in non-diabetic patients (11.6%), with the between-group difference being statistically significant (p=0.04).

Both groups demonstrated significant postoperative improvement in BCVA (p<0.001). The non-diabetic group demonstrated comparatively better visual recovery, with lower mean LogMAR values at postoperative day 1, 1 month and 3 months.

Figures

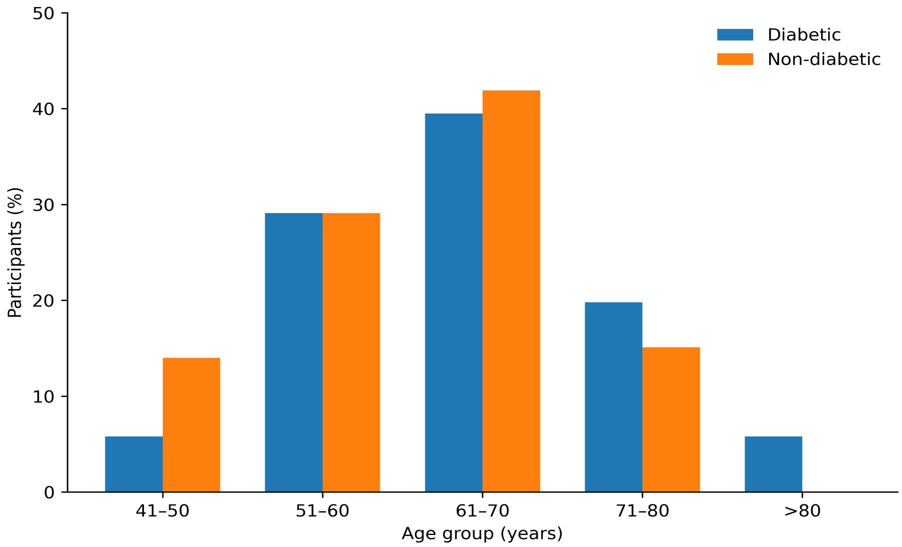

Figure 1: Age distribution of patients in the diabetic and non-diabetic study groups.

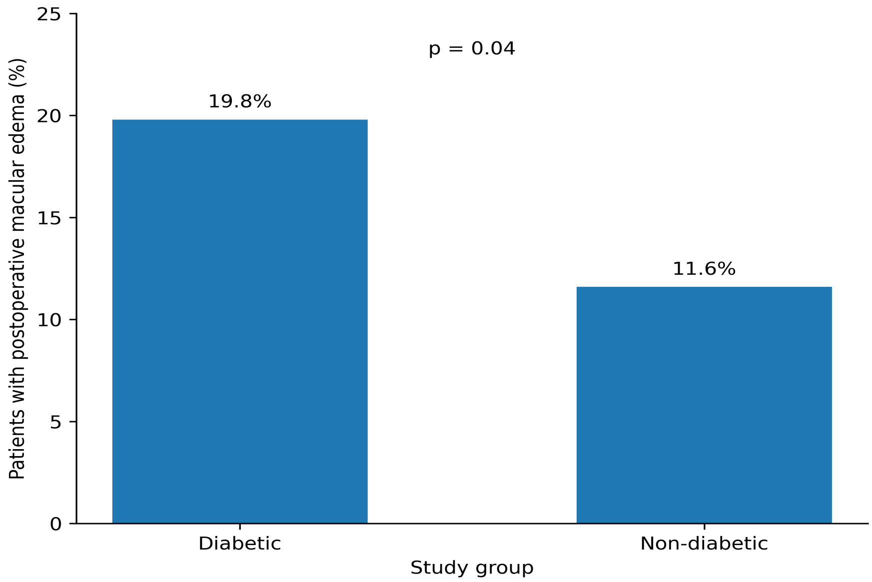

Figure 2: Frequency of postoperative macular edema in diabetic and non-diabetic patients. Postoperative macular edema included cystoid macular edema (CME) and subclinical CME; p=0.04.

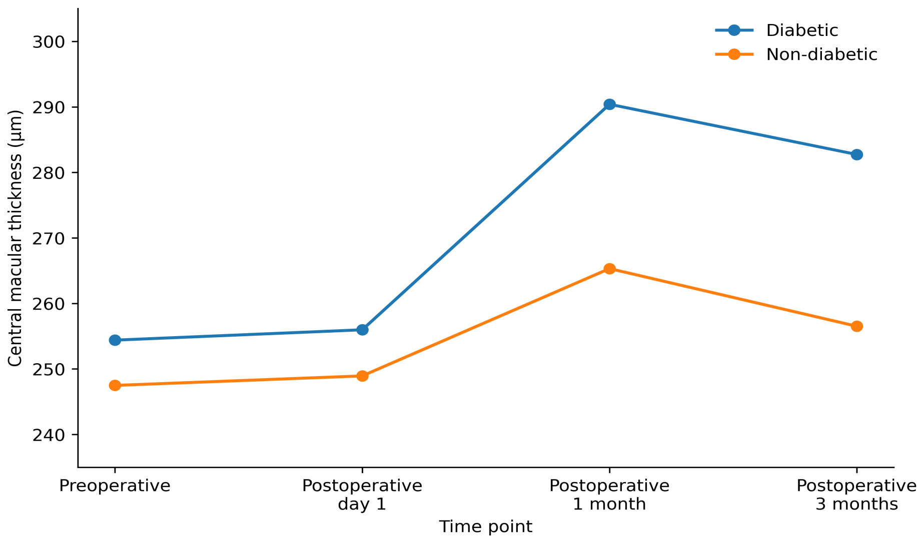

Figure 3: Longitudinal changes in central macular thickness (CMT) following manual small incision cataract surgery in diabetic and non-diabetic patients.

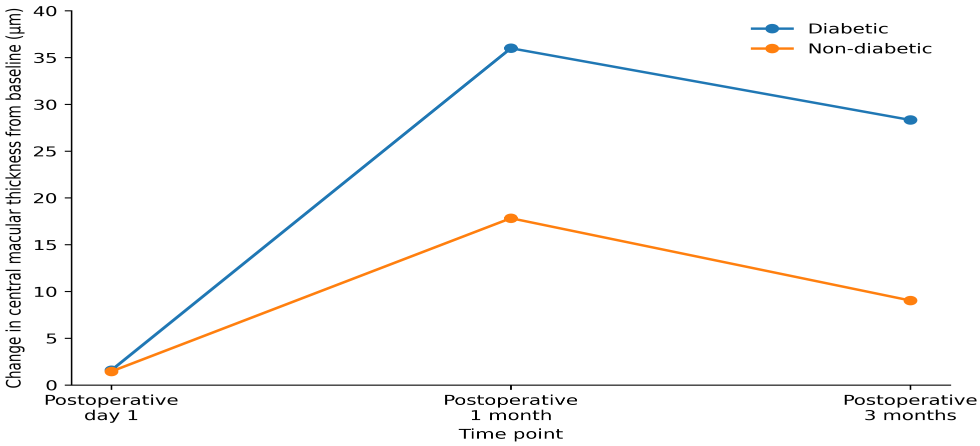

Figure 4: Change in central macular thickness (CMT) from baseline following manual small incision cataract surgery in diabetic and non-diabetic patients.

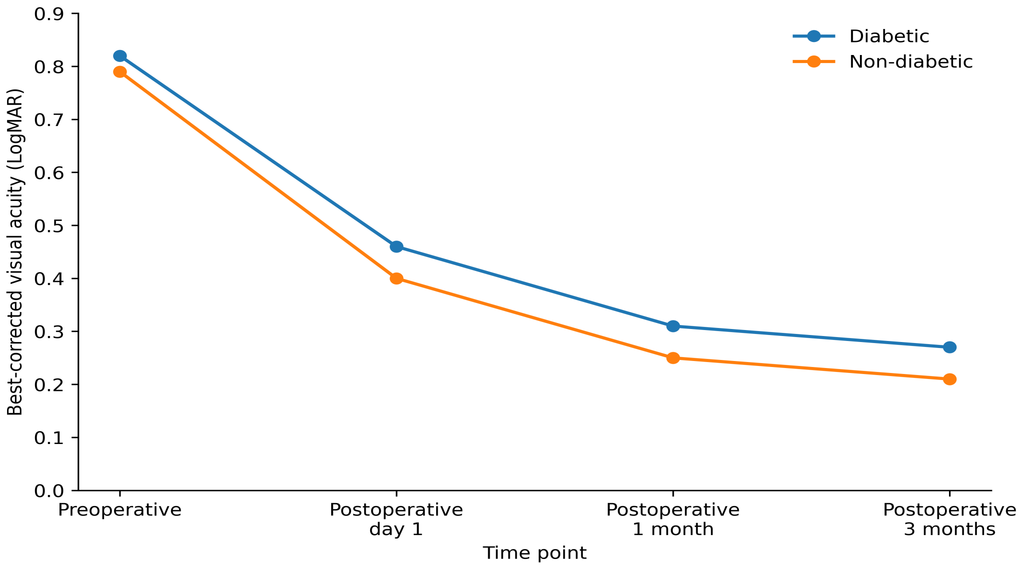

Figure 5. Longitudinal changes in best-corrected visual acuity (BCVA), expressed in LogMAR units, following manual small incision cataract surgery in diabetic and non-diabetic patients. Lower LogMAR values indicate better visual acuity.

Discussion

The present observational study evaluated postoperative changes in central macular thickness and visual outcomes following uneventful manual small incision cataract surgery in diabetic patients without clinically detectable diabetic retinopathy and non-diabetic patients. The principal findings were that CMT increased following surgery in both groups, the magnitude of increase was substantially greater among diabetic patients, and postoperative macular edema occurred more frequently in diabetic patients. Both groups demonstrated postoperative improvement in visual acuity, although visual recovery was comparatively better in the non-diabetic group.

The postoperative increase in CMT observed in the present study is consistent with the known retinal response to cataract surgery. Surgical manipulation can induce an inflammatory response and transient disruption of the blood-retinal barrier, resulting in increased vascular permeability and accumulation of fluid within the macular tissue. OCT allows these structural changes to be detected quantitatively, even when clinically apparent macular edema is absent. [2]

In the present study, CMT increased only slightly on postoperative day 1 but demonstrated a substantially greater increase at 1 month. In diabetic patients, mean CMT increased from 254.40 ± 10.94 µm preoperatively to 290.40 ± 32.47 µm at 1 month, representing an increase of 36.00 µm. In non-diabetic patients, CMT increased from 247.49 ± 8.54 µm to 265.32 ± 10.81 µm, representing an increase of 17.83 µm. Thus, the magnitude of postoperative macular thickening was approximately twice as great in the diabetic group at 1 month.

The greater increase in CMT among diabetic patients is consistent with previous evidence demonstrating increased susceptibility of diabetic eyes to postoperative macular changes. Kim et al. evaluated macular edema after cataract surgery in diabetic patients using OCT and demonstrated postoperative macular thickening, particularly among eyes developing macular edema. [3]

Their findings also suggested an association between postoperative macular changes and visual recovery. The findings of the present study similarly demonstrate greater postoperative macular thickening in diabetic patients despite the absence of clinically detectable diabetic retinopathy before surgery.

The increased susceptibility of diabetic patients is also supported by the large database study conducted by Chu et al., which included 81,984 eyes. The study identified diabetes as an important risk factor for postoperative macular edema and demonstrated that increased risk was present even among diabetic eyes without clinically documented diabetic retinopathy. [4] This observation is particularly relevant to the present study because the diabetic group specifically comprised patients without clinically detectable diabetic retinopathy.

Postoperative macular edema was detected in 17 (19.8%) diabetic patients compared with 10 (11.6%) non-diabetic patients, and the difference was statistically significant (p=0.04). These findings indicate that diabetes may increase susceptibility to postoperative macular edema even in the absence of clinically detectable diabetic retinal disease. The observed frequency in the present study may also reflect the use of OCT, which permits detection of subclinical retinal thickening and cystic changes that may not be apparent on routine fundus examination.

The findings are broadly consistent with recent systematic-review evidence. Ferro Desideri et al. reviewed the incidence, pathogenesis and risk factors for cystoid macular edema following cataract surgery and identified diabetes among the important risk factors associated with postoperative macular edema. [6] Randomized evidence from the ESCRS PREMED study also supports the importance of preventive strategies for postoperative cystoid macular edema in diabetic patients. [8] The higher frequency of postoperative macular edema observed in diabetic patients in the present study therefore supports the broader evidence that diabetes represents an important risk factor, even when clinically apparent diabetic retinopathy is absent.

The temporal pattern of CMT change is another important finding of the present study. CMT reached its highest mean value at 1 month in both groups and subsequently decreased at 3 months. In diabetic patients, CMT decreased from 290.40 µm at 1 month to 282.74 µm at 3 months, while in non-diabetic patients it decreased from 265.32 µm to 256.52 µm. Despite this partial reduction, CMT remained above baseline at 3 months in both groups. This pattern suggests that postoperative macular thickening may become most prominent during the early postoperative weeks before gradually declining.

The postoperative increase in CMT among non-diabetic patients is also noteworthy. Although the increase was smaller than that observed in diabetic patients, non-diabetic eyes demonstrated an increase from 247.49 µm at baseline to 265.32 µm at 1 month. This finding indicates that postoperative macular thickening is not restricted to diabetic eyes and may occur as part of the inflammatory response following uncomplicated cataract surgery. Ghosh et al. demonstrated postoperative changes in macular thickness following M-SICS in a prospective randomized comparative study, supporting the occurrence of measurable macular structural changes following this surgical technique. [1]

The magnitude of the postoperative increase was nevertheless consistently greater in the diabetic group. At 3 months, CMT remained 28.33 µm above baseline in diabetic patients compared with 9.03 µm above baseline in non-diabetic patients. This persistent difference suggests that diabetes may influence not only the magnitude of postoperative macular thickening but also the rate of subsequent resolution.

The visual acuity findings demonstrated significant postoperative improvement in both study groups. The improvement was evident from postoperative day 1 and remained significant at subsequent follow-up assessments. However, the non-diabetic group demonstrated better postoperative visual recovery than the diabetic group. The comparatively poorer visual recovery among diabetic patients may partly reflect the greater degree of postoperative macular thickening observed in this group. Kim et al. similarly reported an association between postoperative macular changes and visual recovery in diabetic eyes. [3]

The present study also evaluated CMT according to age. No statistically significant difference in postoperative CMT was observed among the reported age categories. Although CMT increased after surgery across the age groups, the magnitude and temporal pattern of postoperative changes were broadly similar. These findings suggest that, within the present study population, age was not a major determinant of postoperative CMT changes.

Gender-related analysis demonstrated higher CMT among male participants during the preoperative period and on postoperative day 1, with the differences reported as statistically significant. However, at 1 month and 3 months, although males continued to demonstrate numerically higher CMT values, the differences were no longer statistically significant. The reported p-values of 0.143 at 1 month and 0.064 at 3 months suggest that the early sex-related difference did not persist during later postoperative follow-up. These findings should be interpreted cautiously because the study was not specifically powered to investigate sex-based differences in retinal thickness.

An important strength of the present study is the use of standardized OCT assessment at multiple postoperative time points. Assessment at baseline, postoperative day 1, 1 month and 3 months allowed characterization of the temporal pattern of macular thickness changes rather than relying on a single postoperative measurement. Another strength is the inclusion of diabetic patients without clinically detectable diabetic retinopathy, allowing assessment of postoperative macular changes before the confounding influence of established diabetic retinal disease.

The study also has several limitations. First, it was a single-centre observational study, which may limit the generalizability of the findings to other populations and surgical settings. Second, the sample size of 172 patients was moderate and may have limited the ability to evaluate relatively uncommon postoperative complications. Third, detailed diabetes-related variables, including duration of diabetes, glycated hemoglobin, antidiabetic treatment and other metabolic parameters, were not included in the study. These factors could potentially influence postoperative macular changes and visual recovery.

Overall, the findings suggest that uneventful M-SICS is associated with measurable postoperative macular thickening in both diabetic and non-diabetic patients, but the magnitude and persistence of this change are greater among diabetic patients without clinically detectable diabetic retinopathy. The higher frequency of postoperative macular edema in diabetic patients further supports the value of OCT-based postoperative monitoring in this population. Nevertheless, larger prospective multicentre studies incorporating detailed metabolic variables, standardized OCT diagnostic criteria and appropriate longitudinal statistical models are required to confirm these findings and determine their long-term clinical significance.

Conclusion

Uneventful manual small incision cataract surgery was associated with an increase in central macular thickness in both diabetic patients without clinically detectable diabetic retinopathy and non-diabetic patients.

The increase in CMT was greater among diabetic patients, with the maximum thickening occurring at 1 month after surgery. Although CMT decreased by the third postoperative month, it remained above baseline values in both groups.

Postoperative macular edema was detected more frequently in diabetic patients than in non-diabetic patients. Both groups experienced significant postoperative improvement in visual acuity, although visual recovery was comparatively better among non-diabetic patients.

These findings suggest that diabetes may increase susceptibility to postoperative macular thickening and edema even in the absence of clinically detectable diabetic retinopathy. OCT therefore provides a useful objective method for detecting and monitoring postoperative macular changes following M-SICS, particularly in patients with diabetes.

Further prospective multicentre studies with larger sample sizes, standardized OCT-based diagnostic criteria and detailed assessment of glycemic control are warranted to determine the clinical significance of these postoperative macular changes.

Acknowledgements

The authors acknowledge the support of the Department of Ophthalmology, Regional Institute of Ophthalmology and Postgraduate Department of Ophthalmology, S.C.B. Medical College and Hospital, Cuttack, Odisha, for providing the clinical facilities required for this study.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki. Approval was obtained from the Institutional Ethics Committee, S.C.B. Medical College and Hospital, Cuttack, Odisha before commencement of the study.

Informed Consent

Written informed consent was obtained from all participants before enrolment in the study.

Conflict of Interest

The authors declare that they have no conflict of interest related to this study.

Funding

No external funding was received for this study.

Data Availability

The data generated and/or analyzed during the present study are available from the corresponding author on reasonable request, subject to institutional policies, ethical requirements and patient confidentiality.

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