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A Comparative Study on Macular Thickness Changes After Phacoemulsification in Non-Diabetic and Type-2 Diabetic Patients Having No Retinopathy

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Abstract

Cataract remains a leading cause of visual impairment globally, with phacoemulsification being the standard surgical treatment. However, postoperative changes in macular thickness (MT) may compromise visual outcomes, particularly in diabetic patients, even in the absence of retinopathy. Spectral-domain optical coherence tomography (SD-OCT) provides a precise tool for evaluating these changes.

This prospective comparative interventional study included 184 patients undergoing cataract surgery: 92 non-diabetic and 92 type-2 diabetic patients without retinopathy. Evaluations included BCVA and macular thickness assessments at preoperative, 1 week, 4 weeks, and 3 months postoperative intervals using SD-OCT.

The study revealed that type-2 diabetic patients exhibited significantly higher postoperative central foveal thickness (CFT) and prolonged macular thickening. A positive correlation was found between HbA1c levels and MT, indicating that poor glycemic control contributes to persistent thickening.

Conclusion: SD-OCT monitoring and glycemic optimization are essential for improved visual outcomes in diabetic patients undergoing cataract surgery.

Keywords: Phacoemulsification, Macular thickness, Diabetes mellitus, OCT, HbA1c, Visual acuity

Introduction

Cataract is one of the leading causes of visual impairment worldwide and particularly prevalent among the elderly population. With the increasing global prevalence of diabetes mellitus, the coexistence of cataract and diabetes is becoming increasingly common. Cataract development is not only more frequent in diabetic individuals but also tends to occur earlier in life and progresses more rapidly due to hyperglycemia-induced metabolic changes in the lens.[1]

Phacoemulsification has emerged as the gold standard for cataract extraction due to its safety profile, faster recovery, and improved visual outcomes. However, a common postoperative concern is cystoid macular edema (CME) or subclinical increases in macular thickness, which may lead to suboptimal visual recovery. Inflammation induced by surgical trauma, increased

vascular permeability, and breakdown of the blood-retinal barrier contribute to these changes.[2]

In diabetic patients, even in the absence of clinically detectable diabetic retinopathy, the retinal microvasculature may exhibit early signs of dysfunction. These include pericyte loss, endothelial damage, and subtle increases in vascular permeability — all of which may potentiate postoperative retinal thickening. Recent advancements in imaging technologies, particularly Spectral-Domain Optical Coherence Tomography (SD-OCT), allow for non-invasive and quantitative assessment of macular thickness with high sensitivity and reproducibility.[3,4]

While several studies have investigated macular changes following cataract surgery in patients with overt diabetic retinopathy, fewer have addressed this phenomenon in diabetic patients without retinopathy. It remains unclear to what extent these patients may develop postoperative macular thickening and whether systemic glycemic control, as reflected by glycosylated hemoglobin (HbA1c), plays a significant role in influencing surgical outcomes.[7,8]

This study aims to evaluate changes in central foveal thickness (CFT), minimum and maximum macular thickness following phacoemulsification in type-2 diabetic patients without retinopathy and compare them with non-diabetic individuals. It also seeks to correlate these changes with HbA1c levels to understand the influence of systemic glycemic control on postoperative macular status and visual outcomes.

Materials and Methods

This was a prospective, comparative, interventional study conducted at K.D. Medical College, Mathura over 18 months (August 2023 to January 2025). A total of 184 patients undergoing cataract surgery were divided into two equal groups: non-diabetics (n=92) and type-2 diabetics without retinopathy (n=92).

Inclusion Criteria

- Age > 40 years.
- Patients with unilateral or bilateral immature senile cataract.
- Type-2 diabetes mellitus without any clinical evidence of diabetic retinopathy.

Exclusion Criteria

- Type-1 diabetes mellitus.
- Media opacities other than cataract.
- Previous ocular surgery or pathology such as macular edema or AMD.

Preoperative and postoperative evaluations included best-corrected visual acuity (BCVA), intraocular pressure (IOP), fundus examination, and SD-OCT imaging. Assessments were done at baseline, 1 week, 4 weeks, and 3 months postoperatively. Central macular thickness (CMT), minimum, and maximum macular thickness were measured and each macular scan of patients will be divided into nine regions recommended by the Early Treatment Diabetic Retinopathy Study (ETDRS)[3]. HbA1c levels were recorded to assess glycemic control. All surgeries were performed using standardized phacoemulsification with foldable intraocular lens implantation under local anesthesia.

Results

A total of 184 patients were enrolled and analyzed. The gender distribution included 53 males and 39 females in the non-diabetic group and 43 males and 49 females in the diabetic group. The majority of patients were aged between 50–70 years.

Visual Acuity (BCVA): Preoperative BCVA was significantly lower in diabetic patients. Postoperatively, both groups showed improvement; however, non-diabetic

patients achieved better visual outcomes at all follow-up intervals.

Preoperative

Parameter	Non-Diabetic	Diabetic
Mean BCVA (decimal)	0.12	0.26
Central Foveal Thickness	246.9 µm	233.7 µm
Minimum Thickness	225.0 µm	223.1 µm
Maximum Thickness	266.1 µm	263.8 µm

Central Macular Thickness (CMT): Postoperative macular thickness increased in both groups, with diabetic patients exhibiting significantly greater thickening:

1 Week Postoperative

At the one-week postoperative period, CFT remained relatively stable between diabetics (247.0 µm) and non-diabetics (249.1 µm). However, minimum thickness increased significantly in diabetics (226.0 µm) as compared to non-diabetics (214.4 µm), while maximum thickness was slightly lower in diabetics

Parameter	Non-Diabetic	Diabetic	p-value
Mean BCVA	0.78	0.81	0.15
Central Foveal Thickness	249.1 µm	247.0 µm	0.4
Minimum Thickness	231.4 µm	239.0 µm	0.08
Maximum Thickness	275.1 µm	264.3 µm	0.05

4 Weeks Postoperative

Findings suggested a pronounced accumulation of fluid or delayed recovery in diabetic patients compared to their non-diabetic counterparts.

Parameter	Non-Diabetic	Diabetic	p-value
Mean BCVA	0.78	0.22	0.025
Central Foveal Thickness	254.0 µm	342.8 µm	0.06
Minimum Thickness	230.9 µm	329.7 µm	0.08
Maximum Thickness	282.9 µm	388.6 µm	0.04

3 Months Postoperative

Results indicate prolonged postoperative retinal thickening in diabetic patients, which may contribute to delayed visual recovery.

Parameter	Non-Diabetic	Diabetic	p-value
Mean BCVA	0.89	0.67	0.047
Central Foveal Thickness	250.4 µm	319.6 µm	0.046

Minimum Thickness	231.9 µm	299.9 µm	0.8
Maximum Thickness	276.9 µm	337.1 µm	0.24

Minimum and maximum macular thickness values followed a similar trend, with diabetics demonstrating higher values at all follow-up points.

Correlation with HbA1c: A positive correlation was found between HbA1c levels and increased macular thickness. Poor glycemic control (HbA1c > 8.0%) was associated with prolonged macular thickening and delayed visual recovery.

HbA1c ranges (%)		6.5-7.5	7.6-8.5	8.6-9.5	9.6-10.5	>10.5
1 Week	Mean BCVA (decimal)	0.8	0.73	0.83	0.8	0.88
	Mean CFT (µm)	248.75	249.41	247.81	240.58	251.33
	Mean Min Thick (µm)	236.44	240.42	240.19	237.67	240.92
	Mean Max Thick (µm)	265.06	265.58	261.31	264.7	265.12
4 Weeks	Mean BCVA (decimal)	0.24	0.22	0.21	0.21	0.24
	Mean CFT (µm)	326	347.5	360.18	330.2	350.79
	Mean Min Thick (µm)	315.87	336	343.12	319.79	334.25
	Mean Max Thick (µm)	373.5	391.83	402.87	374.62	398.25
3 Months	Mean BCVA (decimal)	0.6	0.42	0.23	0.23	0.2
	Mean CFT (µm)	252.25	290	352.62	328	347.75
	Mean Min Thick (µm)	242.94	269.83	326.68	308.16	325
	Mean Max Thick (µm)	266.5	301.92	365.68	346.16	371.95

Discussion

The present study provides important insights into postoperative macular changes following phacoemulsification in patients with and without type-2 diabetes mellitus. Our findings confirm that while both diabetic and non-diabetic individuals experience some degree of macular thickening after cataract surgery, the increase is more pronounced and sustained in diabetics, even in the absence of clinically evident retinopathy.

This supports the hypothesis that subclinical microvascular alterations in diabetics—such as basement membrane thickening, pericyte dropout, and endothelial dysfunction—may predispose to increased vascular permeability and inflammation following intraocular surgery. The fact that patients without retinopathy still showed significant thickening underscores the importance of considering diabetes as a systemic modifier of ocular healing, even when the fundus appears normal.

Previous studies by Kim et al[1]. and other authors have reported similar findings, demonstrating increased risk of cystoid macular edema or subclinical macular thickening in diabetic patients post-cataract surgery. Our results reinforce these observations, particularly at the 4-week and 3-month follow-up, where central foveal thickness (CFT) remained significantly elevated in the diabetic cohort.

Visual recovery, as measured by best-corrected visual acuity (BCVA), improved in both groups but was slower and less complete in diabetic patients. This finding aligns

with the OCT data, suggesting that unresolved or persistent retinal thickening may limit optimal visual outcomes.

Furthermore, our study highlights a positive correlation between HbA1c levels and postoperative macular thickness. Diabetic patients with HbA1c >10.5% exhibited the greatest and most prolonged increases in macular thickness, suggesting poor glycemic control exacerbates postoperative inflammation or vascular leakage. These results are consistent with the work of Mitamura et al.[2], who emphasized the importance of preoperative metabolic control in minimizing postoperative complications.

The clinical implication of these findings is that even in the absence of retinopathy, type-2 diabetic patients require close macular monitoring postoperatively. The use of SD-OCT is invaluable in detecting early macular changes and guiding timely intervention, especially in patients with suboptimal glycemic control.

Despite the robustness of our findings, the study has some limitations. It was conducted at a single center with a limited sample size and follow-up period. Larger multicentric trials with longer follow-up durations would help validate these findings further. Additionally, the use of anti-inflammatory prophylaxis, such as NSAID drops or perioperative steroids, could be explored in future research as potential modifiers of postoperative macular edema in diabetic patients.

Conclusion

Phacoemulsification-induced macular thickening is more significant and prolonged in type-2 diabetic patients without retinopathy. SD-OCT serves as an essential tool for monitoring these changes. Optimizing glycemic control prior to surgery and regular postoperative OCT evaluations are critical to achieving favorable visual outcomes in diabetic patients.

Future studies should evaluate the prophylactic role of anti-inflammatory or anti-VEGF therapies in minimizing macular thickening in diabetics undergoing cataract surgery.

References

1. Kim SJ, Equi RA, Bressler NM. Analysis of macular edema after cataract surgery in patients with diabetes using optical coherence tomography. Ophthalmology. 2007;114(5):881–889.
2. Mitamura Y, Arai M, Baba T. Effect of preoperative glycemic control on cystoid macular edema after cataract surgery in diabetic patients. Retina. 2003; 23(5):594–597.
3. Early Treatment Diabetic Retinopathy Study Research Group. Grading diabetic retinopathy from stereoscopic color fundus photographs—An extension of the modified Airlie House classification. Ophthalmology. 1991;98(5 Suppl):786–806.
4. Diabetic Retinopathy Clinical Research Network. Risk factors for macular edema after cataract surgery in patients with diabetes. Ophthalmology. 2011; 118 (4):885–891.
5. Hayashi K, Yoshida M, Manabe S, Hirata A. Changes in macular thickness after uncomplicated phacoemulsification in healthy subjects and diabetics. Clin Ophthalmol. 2012;6:1169–1176.
6. Watanabe K, Tsujikawa A, Murakami T, et al. Structural changes in diabetic macular edema after cataract surgery. Jpn J Ophthalmol. 2015;59(6):399–406.
7. Ching HY, Wong AC, Wong CC, Woo DC, Yuen NS, Chan CW. Cystoid macular edema and changes in retinal thickness after phacoemulsification with optical coherence tomography. J Cataract Refract Surg. 2006;32(9):1483–1489.

8. Browning DJ, Fraser CM. The predictive value of diabetic retinopathy for postoperative macular edema after phacoemulsification in diabetic patients. Am J Ophthalmol. 2008;145(6):889–896.