Pakistan Journal of Intensive Care Medicine
eISSN: 2708-2261; pISSN: 2958-4728
www.pjicm.com
DOI: https://doi.org/10.54112/pjicm.v5i02.196
*Pak. J. Inten. Care Med., volume 5(2), **2025**: 196*
Original Research Article

OCT-BASED ANALYSIS OF MACULAR THICKNESS CHANGES AFTER UNCOMPLICATED PHACOEMULSIFICATION IN A TERTIARY CARE HOSPITAL

ULLAH A*, JAN S, ORAKZAI BK

Department of Ophthalmology, MTI Hayatabad Medical Complex, Peshawar, Pakistan
**Corresponding author email address:* drasmatullah41@gmail.com

(Received, 05th August 2025, Revised 28th September 2025, Accepted 6th November, Published 18th November 2025)

ABSTRACT

Background: *Phacoemulsification is the standard technique for cataract surgery, offering rapid postoperative visual recovery. However, subtle macular changes, such as postoperative macular edema, can occur and may influence visual outcomes. Optical coherence tomography (OCT) allows precise assessment of retinal structural changes following surgery.* ***Objective:*** *To assess changes in central macular thickness (CMT) using OCT following uncomplicated phacoemulsification and correlate these changes with postoperative visual outcomes.* ***Study Design:*** *Prospective observational study.* ***Setting:*** *Department of Ophthalmology at Hayatabad Medical Complex, Peshawar, Pakistan.* ***Duration of Study:*** *02-January-2025—02-August-2025.* ***Methods:*** *Sixty-one patients undergoing uncomplicated phacoemulsification were enrolled. Preoperative baseline CMT measurements were obtained using spectral-domain OCT. Postoperative follow-up included CMT and best-corrected visual acuity (BCVA) assessment at 1, 4, and 8 weeks. The association between CMT and BCVA at 8 weeks was analyzed. Statistical significance was set at $p \leq 0.05$.* ***Results:*** *The mean age of participants was 59.70 ± 11.78 years, with 57.4% males. The mean preoperative CMT was 190.91 ± 6.32 µm, which increased significantly to 210.81 ± 6.06 µm at 1 week ($p = 0.0001$), peaked at 225.65 ± 1.06 µm at 4 weeks ($p = 0.0001$), and reduced to 213.86 ± 3.83 µm by week 8 ($p = 0.0001$). BCVA at 8 weeks demonstrated excellent improvement (0.04 ± 0.03 logMAR). No significant correlation was found between final CMT and BCVA ($r = –0.06$, $p = 0.61$).* ***Conclusion:*** *Uncomplicated phacoemulsification results in a transient increase in macular thickness, peaking approximately 1 month after surgery and resolving. Despite structural changes, visual acuity outcomes remain excellent, and CMT alterations do not correlate with postoperative vision.*

Keywords: Phacoemulsification, Central Macular Thickness, Optical Coherence Tomography, Cystoid Macular Edema, Visual Acuity, Postoperative Complications

INTRODUCTION

Cataract symbolises a prevalent cause of vision impairment worldwide, with surgical intervention being the sole treatment option. Cataract surgery is among the most widely performed and successful surgical procedures worldwide. Phacoemulsification is the procedure of choice for cataract therapy (1, 2). Macular oedema constitutes a frequent and serious complication that can occur after uncomplicated cataract surgery, which can negatively impact visual results. Pseudophakic cystoid macular oedema occurs due to movement and damage within the vitreous cavity, leading to the discharge of inflammatory mediators through disruption of the blood-aqueous barrier (3-5). Cataract surgery offers a unique array of complications, especially when considering high patient turnover along with economic challenges. One complication reported is that, despite the minimally invasive nature of the procedure, subclinical changes in macular thickness have been observed post-surgery, likely due to postoperative inflammation and breakdown of the blood-retinal barrier (6, 7).

The involvement of surgical trauma within pseudophakic macular oedema has become significant as it leads to the release of prostaglandins as well as perifoveal vascular leakage. Pseudophakic macular oedema remains the primary cause and most common reason for adverse visual outcomes after uncomplicated cataract surgery (8, 9). Optical coherence tomography (OCT) has become an essential tool in ophthalmology, providing a noninvasive imaging modality that produces high-resolution images of the retina. This document provides detailed insights into structural changes in the retina, with a particular focus on the macula, both before and during ocular surgeries. OCT has been used to study macular alterations following uncomplicated cataract surgery, with findings differing across multiple studies. Some studies report a rise in retinal thickness, while others report a decrease (10).

This study aims to evaluate temporal changes in macular thickness after uncomplicated phacoemulsification at a tertiary care hospital, providing insights into postoperative retinal responses in our local population.

METHODOLOGY

This cross-sectional study was conducted in the Department of Ophthalmology at Hayatabad Medical Complex, Peshawar, from [02-January-2025—02-August-2025]. Patient selection employed a non-probability consecutive sampling methodology. The inclusion criteria comprised 61 patients aged 40 to 80 years who underwent uncomplicated phacoemulsification procedures with IOL implantation and who demonstrated clear preoperative optical coherence tomography scans. Exclusion parameters included patients with pre-existing retinal pathology such as diabetic macular edema or age-related macular degeneration, those with historical ocular trauma, uveitis, or previous intraocular surgical interventions, and cases where surgical complications occurred either during or after the procedure.

All participants underwent preoperative ophthalmic evaluation, including Best corrected visual acuity, which was documented using Snellen chart measurements, slit lamp examination, and baseline OCT scans. Spectral-domain optical coherence tomography imaging was performed preoperatively to establish baseline macular thickness parameters, defined as the distance between the inner limiting membrane and the retinal pigment epithelium within the central 1-

[Citation Ullah, A., Jan, S., Orakzai, B.K. (2025). Oct-based analysis of macular thickness changes after uncomplicated phacoemulsification in a tertiary care hospital. *Pak. J. Inten. Care Med. 5(2), **2025**: 196*. doi: https://doi.org/10.54112/pjicm.v5i02.196]

millimeter zone of the Early Treatment Diabetic Retinopathy Study grid.

Surgical procedures were performed by an experienced surgeon using phacoemulsification techniques under either topical or peribulbar anesthesia. The phacoemulsification process involved ultrasonic emulsification of the crystalline lens nucleus, followed by precise intraocular lens implantation into the capsular bag.

Postoperative monitoring included scheduled follow-up examinations at 1, 4, and 8 weeks after surgical intervention. At each visit, patients underwent repeat optical coherence tomography imaging to quantify central macular thickness and a comprehensive ophthalmic examination to document best corrected visual acuity. All data collection was performed using a pre-designed proforma.

Statistical analysis was conducted using SPSS 26. The mean and standard deviation were used for age, CMT, and BCVA. Frequency and percentages were used for gender and comorbidities. We used a paired t-test to assess the mean CMT at different time intervals. Pearson's correlation coefficient was used to determine the relationship between postop CMT at the 8th week and BCVA at the 8th week. To evaluate the association between diabetes and preoperative CMT, we used an Independent t-test. For all statistical tests, P values were considered significant if < 0.05.

RESULTS

Sixty-one patients were included in this study, with a mean age of 59.70 ± 11.78 years (40 to 80 years). The cohort had 35 males (57.4%) and 26 females (42.6%). Regarding comorbidities, 14 patients (23.0%) had a history of diabetes mellitus, while 19 patients (31.1%) were diagnosed with hypertension (Table 1). We observed that diabetic patients had notably higher preoperative mean CMT compared to non-diabetic patients (Table 2).

The mean preoperative CMT was 190.91±6.32 µm. A notable increase was observed at the first postoperative week with the mean CMT rising to 210.81±6.06 µm (p=0.0001) (Table 3).

Table 1: Demographics & comorbidities

Demographics		n	%
Gender	Male	35	57.4%
	Female	26	42.6%
Diabetes	Yes	14	23.0%
	No	47	77.0%
Hypertension	Yes	19	31.1%
	No	42	68.9%

Table 2: Association of diabetes with preop CMT

Diabetes	N	Mean	Std. Deviation	P value
Yes	14	196.7857	4.28196	0.0001
No	47	189.1702	5.78348	

Table 3: Comparison of CMT preoperatively and at 1st week postoperatively

Mean		N	Std. Deviation	P value
CMT preoperatively (um)	190.9180	61	6.32797	0.0001
CMT at 1st week (um)	210.8197	61	6.06220	

The CMT at the 4th week was 225.65±1.06 µm, and by the 8th postoperative week, the mean CMT was 213.86±3.83 µm (p=0.0001) (Table 4). At the final eight-week follow-up, the mean best-corrected visual acuity was excellent at 0.05 ± 0.03 logMAR. A correlation analysis between the final anatomical outcome (CMT) and functional outcome (BCVA) demonstrated a very weak, statistically insignificant negative relationship ($r = -0.06$, $p = 0.61$), indicating that the residual macular thickening had no appreciable impact on the high level of visual acuity achieved (Table 5).

Table 4: Comparison of CMT at 4th week and 8th week postoperatively

Mean		N	Std. Deviation	P value
CMT at 4th week (um)	225.6557	61	1.06278	0.0001
CMT at 8th week (um)	213.8689	61	3.83612	

Table 5: Correlation between CMT at 8th week postoperatively and visual acuity at 8th week postoperatively

Mean		Std. Deviation	N	r	P value
CMT at 8th week (um)	213.8689	3.83612	61	-0.06	0.61
BCVA 8th week (logMAR)	.0464	.03459	61		

DISCUSSION

The demographic profile of our study (mean age of 59.70 years and a male predominance of 57.4%) aligns well with those of similar studies. Shafi et al. reported a mean age of 65.31 years with 58.3% males, while Dad et al. (11, 12 documented a cohort with a mean age of 62.06 years and 57.7% males. This demographic consistency across studies strengthens the comparability of findings. The prevalence of diabetes (23.0%) and hypertension (31.1%) in our patients aligns with the comorbidity profiles frequently reported, such as in the study by Ahmed et al., which identified diabetes as a substantial factor associated with macular thickening (13).

We observed a significant increase in central macular thickness following cataract surgery, consistent with the literature. Our data demonstrated a rise from a preoperative mean of 190.91 µm to 210.81 µm at one week, peaking at 225.65 µm by the fourth week, followed by a decline to 213.86 µm by the eighth week, though still elevated above baseline. This pattern is supported by Devi et al., who observed a nearly identical progression: CMT increased from baseline to a peak at 4 weeks, then began to decline by the 6th week (14). Similarly, Dad et al. documented the maximum thickening at one month postoperatively, with values declining but not returning to baseline by six months (12). These patterns suggest a pathophysiological response to surgical intervention, likely facilitated by inflammatory processes and prostaglandin release, which disrupts the blood-retinal barrier (15).

Notably, our finding that CMT at eight weeks remained elevated above preoperative levels suggests that the macula may take longer to return to preoperative levels after surgical intervention. This observation is supported by the work of Perente et al., who noted persistent changes even at the 6-month follow-up (16).

Perhaps the most clinically significant finding from our study was the dissociation between visual acuity and mean CMT. Despite the increase in CMT visual acuity, patients demonstrated excellent recovery with a mean BCVA of 0.05 logMAR at the eight-week mark. The correlation analysis revealed a negligible, statistically insignificant relationship between CMT and BCVA at eight weeks ($r = -0.06$, $p = 0.61$). This finding strongly supports the concept of "subclinical macular edema," as emphasized by multiple researchers. Dad et al. similarly concluded that increased macular thickness did not associate with visual impairment, noting progressive visual improvement despite anatomical changes (12). Atalay et al. reached a

[Citation Ullah, A., Jan, S., Orakzai, B.K. (2025). Oct-based analysis of macular thickness changes after uncomplicated phacoemulsification in a tertiary care hospital. *Pak. J. Inten. Care Med. 5(2), **2025**: 196*. doi: https://doi.org/10.54112/pjicm.v5i02.196]

similar conclusion, stating that not every increase in CMT necessitates urgent intervention (17).

Our findings suggest that routine postoperative OCT monitoring for all patients undergoing uncomplicated phacoemulsification may be of limited value in the absence of visual symptoms. Instead, resources might be better focused on patients with specific risk factors for clinically significant edema. Our data, in alignment with Ahmed et al., identified diabetes as a notable risk factor for greater macular thickening, as we observed that the pre-op mean CMT was higher in diabetic patients. This association suggests that diabetic patients need vigilant postoperative monitoring or perhaps more aggressive anti-inflammatory prophylaxis.

Several limitations of our study need to be considered. The sample size of 61 patients, while sufficient to detect statistically significant changes, may limit the generalizability of our findings to broader populations. The eight-week follow-up period, though adequate to capture the peak of macular thickening and the initial resolution, does not provide information on the long-term trajectory of CMT normalization. Future research directions should include longitudinal studies with extended follow-up to determine the timeline for complete CMT normalization.

CONCLUSION

In conclusion, our findings showed that uncomplicated phacoemulsification causes a temporary increase in central macular thickness that peaks around 1 month postoperatively and gradually improves by 2 months. This increase in CMT is not correlated with visual acuity.

DECLARATIONS

Data Availability Statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned. (IRB)

Consent for publication

Approved

Funding

Not applicable

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

ASMAT ULLAH (Fellow Vitreoretinal Ophthalmology)
Manuscript drafting, Data collection, Data analysis, Manuscript revisions, and final approval of manuscript.

SANAULLAH JAN (Professor)
Conception of Study, Study Design, Critical input, and Final approval of manuscript.

BILAL KIFAYAT ORAKZAI (Fellow Vitreoretinal Ophthalmology)
Critical input, and Literature review

REFERENCES

1. Cicinelli MV, Buchan JC, Nicholson M, Varadaraj V, Khanna RC. Cataracts. Lancet. 2023;401(10374):377-89. https://doi.org/10.1016/S0140-6736(22)01839-6
2. Chen X, Xu J, Chen X, Yao K. Cataract: advances in surgery and whether surgery remains the only treatment in future. Adv Ophthalmol Pract Res. 2021;1(1):100008. https://doi.org/10.1016/j.aopr.2021.100008
3. Qureshi MH, Steel DH. Retinal detachment following cataract phacoemulsification: a review of the literature. Eye. 2020;34(4):616-31. https://doi.org/10.1038/s41433-019-0575-z
4. Lu Q, Lu Y, Zhu X. Dry eye and phacoemulsification cataract surgery: a systematic review and meta-analysis. Front Med. 2021;8:649030. https://doi.org/10.3389/fmed.2021.649030
5. Fouad YA, Karimaghaei S, Elhusseiny AM, Alagorie AR, Brown AD, Sallam AB. Pseudophakic cystoid macular edema. Curr Opin Ophthalmol. 2025;36(1):62-9. https://doi.org/10.1097/ICU.0000000000001101
6. Hao C, Fan E, Wei Z, Radeen KR, Purohit N, Li K, et al. Elevated inflammatory cytokines persist in the aqueous humor years after cataract surgery. Invest Ophthalmol Vis Sci. 2025;66(4):12. https://doi.org/10.1167/iovs.66.4.12
7. Ferro Desideri L, Arun K, Bernardi E, Sagurski N, Anguita R. Incidence, pathogenesis, risk factors, and treatment of cystoid macula oedema following cataract surgery: a systematic review. Diagnostics. 2025;15(6):667. https://doi.org/10.3390/diagnostics15060667
8. Chu CJ, Johnston RL, Buscombe C, Sallam AB, Mohamed Q, Yang YC, et al. Risk factors and incidence of macular edema after cataract surgery: a database study of 81,984 eyes. Ophthalmology. 2016;123(2):316-23. https://doi.org/10.1016/j.ophtha.2015.10.001
9. Kim SJ, Schoenberger SD, Thorne JE, Ehlers JP, Yeh S, Bakri SJ. Topical nonsteroidal anti-inflammatory drugs and cataract surgery: a report by the American Academy of Ophthalmology. Ophthalmology. 2015;122(11):2159-68. https://doi.org/10.1016/j.ophtha.2015.05.014
10. Samanta A, Kumar P, Machhua S, Rao GS, Pal A. Incidence of cystoid macular oedema in diabetic patients after phacoemulsification and free radical link to its pathogenesis. Br J Ophthalmol. 2014;98:1266-72. https://doi.org/10.1136/bjophthalmol-2013-304438
11. Shafi M, Khan MA, Lodhi Y, Aftab A, Sarfraz MH. Central macular thickness after cataract surgery in patients with diabetes mellitus and without diabetes mellitus. Pak Armed Forces Med J. 2021;71(6):1993-6.
12. Dad M, Tahir MA, Cheema A, Nawaz HN. Change in macular thickness after uncomplicated phacoemulsification surgery using optical coherence tomography in a tertiary care hospital. Pak J Med Sci. 2023;39(5):1488-91. https://doi.org/10.12669/pjms.39.5.4775
13. Ahmed H, Majeed AA, Tareen S, Mengal M, Bibi H, Imam A. Change in central macular thickness after uncomplicated phacoemulsification cataract surgery. Al-Shifa J Ophthalmol. 2025;21(3):160-7.
14. Devi A, Singh VP, Maurya RP, Priyanka. Central macular thickness after uneventful phacoemulsification and MSICS: a prospective comparison. Indian J Clin Exp Ophthalmol. 2024;10(4):639-44.
15. Jaafar AD, Abdulkareem SA, Jaafar MDJ. Macular oedema after uncomplicated phacoemulsification. Afr Vision Eye Health. 2022;81(1):a690. https://doi.org/10.4102/aveh.v81i1.690
16. Perente I, Utine CA, Ozturker C, Cakir M, Kaya V, Eren H, et al. Evaluation of macular changes after uncomplicated phacoemulsification surgery by optical coherence tomography. Curr Eye Res. 2007;32(3):241-7. https://doi.org/10.1080/02713680601160610
17. Atalay K, Kadioglu E, Onder F. Optical coherence tomographic evaluation of macula after uncomplicated phacoemulsification surgery. Glo-Kat. 2016;11:97-9.

[Citation Ullah, A., Jan, S., Orakzai, B.K. (2025). Oct-based analysis of macular thickness changes after uncomplicated phacoemulsification in a tertiary care hospital. *Pak. J. Inten. Care Med. 5(2), **2025**: 196*. doi: https://doi.org/10.54112/pjicm.v5i02.196]