

Original Research Article

Central macular thickness changes following uncomplicated phacoemulsification surgery

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ABSTRACT

Background: This study aims to evaluate changes in central macular thickness (CMT) following uncomplicated phacoemulsification cataract surgery using spectral-domain optical coherence tomography (SD-OCT).

Methods: A prospective observational study was conducted at the Department of Ophthalmology, GMC Srinagar, from January to July 2024. A total of 134 eyes from patients aged over 40 years with senile cataracts were included. Patients with pre-existing ocular conditions affecting macular thickness were excluded. Baseline and postoperative CMT measurements were recorded on day 1, 1 week, 1 month, and 6 months post-surgery. Statistical analysis was performed using paired t-tests.

Results: The mean preoperative CMT in patients without comorbidities was $248.0 \pm 21.3 \mu\text{m}$. Postoperatively, CMT increased to $249.1 \pm 22.1 \mu\text{m}$ on day 1, $261.6 \pm 32.7 \mu\text{m}$ at 1 week, $266.1 \pm 28.1 \mu\text{m}$ at 1 month, and $252.6 \pm 21.9 \mu\text{m}$ at 6 months. A statistically significant increase in CMT was observed at 1 week and 1 month ($p < 0.005$), followed by a reduction at 6 months. Similar trends were noted in patients with diabetic retinopathy and resolved retinal vein occlusion. No cases of postoperative cystoid macular edema (CME) or loss of best-corrected visual acuity (BCVA) were recorded.

Conclusion: Uncomplicated phacoemulsification leads to a transient increase in CMT, peaking at 1 month and returning toward baseline by 6 months, without affecting visual acuity or causing CME. The findings support the safety of the procedure, even in patients with mild diabetic retinopathy or prior retinal vein occlusion. Further research is recommended to explore long-term macular changes and risk factors for persistent macular thickening.

Keywords: Central macular thickness, Uncomplicated phacoemulsification, Cystoid macular edema

INTRODUCTION

Phacoemulsification is a minimally invasive surgical technique primarily used for the treatment of cataracts. It involves the use of ultrasonic energy to break down the cataractous lens. Due to its safety, precision, and quick recovery time, phacoemulsification combined with intraocular lens (IOL) implantation is presently the preferred method for cataract surgery (CS).¹ Over the course of time, numerous technological advancements have greatly enhanced the diagnosis and management of cataracts and other ophthalmic conditions. The introduction of optical coherence tomography (OCT) has

revolutionized ophthalmology by capturing detailed cross-sectional pictures of the retina, cornea, and other ocular structures using near-infrared light, enabling early and precise diagnosis, monitoring, and management of a wide range of eye conditions.

Pseudophakic cystoid macular edema (CME), also called Irvine-Gass syndrome, remains a significant concern even with the modern advances in CS.² It typically occurs due to inflammation following surgery, leading to leakage of fluid into the macula and the formation of cystoid spaces. This condition is the most ubiquitous cause of suboptimal visual recovery after otherwise uneventful CS.³ It can also

occur inside patients having ocular diseases, counting uveitis, DR, or even after uncomplicated CS.⁴ Diabetes and cataracts are closely linked, as diabetic retinopathy (DR) and cataracts are two of the most ubiquitous eye complications associated with diabetes. Understanding the outcomes and potential complications of CS inside diabetic patients having or not having DR along with severity of DR and glycemic control is critical for effective management and treatment.⁵

Retinal venous occlusion (RVO) exists as the next most ubiquitous RV pathology after DR, with BRVO having three times more risk of incidence than CRVO according to the Beaver Dam Eye Study, especially in patients having hypertension, smoking history, age more than 70 years, or glaucoma.⁶ Pseudophakic CME can frequently develop after phacoemulsification CS inside patients having a history of previous retinal vein occlusion.⁷

The most ubiquitous age group affected with cataract is 60-79 years (senile cataract), closely followed by 40-59 years (presenile cataract). The ubiquity of cataract in the presenile age group has increased significantly in recent studies.⁸

Numerous studies conducted previously to gauge the macular changes after CS showing varying results, some studies report an increase in retinal thickness, while others indicate a decrease.⁹⁻¹¹ This study seeks to assess the bearing of uneventful phacoemulsification on central macular thickness (CMT) utilising optical coherence tomography on local population of Kashmir and enhance our current understanding.

Aim and objective

This work looks to examine the bearing of uncomplicated phacoemulsification on CMT on post-operative day 1, then 1 week, then 1 month, and then 6 months as well as to investigate its relationship with postoperative CME using Spectral Domain OCT. Macular changes were assessed and monitored through the measurement of CMT.

METHODS

A prospective observational investigation was done at Department of Ophthalmology, GMC Srinagar, from 1st Jan 2024 to 31st July 2024. 134 eligible eyes were included. Patients aged more than 40 years with senile cataract were included in study, including patients having comorbidity not involving an increased central macular thickness preoperatively.

Among the 134 patients, 36 patients had diabetic retinopathy not involving macula and 15 patients had old resolved vascular occlusion not involving macula. Patients with active ocular infection, glaucoma, any history of ocular trauma, dense white cataract that precluded OCT imaging were excluded. After taking a thorough history, patients underwent a comprehensive ophthalmologic

examination, along with pre-surgical macular thickness was measured using spectral-domain OCT (Cirrus HD-OCT). All patients underwent phacoemulsification with PCIOL implantation.

Post-operatively, patients were kept on topical steroid and antibiotic on progressively decreasing doses over a six-week period. Post-surgical macular thickness recorded on day 1, then 1 week, then 1 month, and then 6 months. The mean retinal thicknesses at central fovea were documented. Data entry and analysis was done in SPSS22.0. Pre- along with post-surgical CMT were compared utilising paired t-test.

Inclusion criteria

Inclusion criteria include patients with senile cataract, age >40 years, informed consent.

Exclusion criteria

Exclusion criteria include active ocular infection, glaucoma, any history of ocular trauma, a dense white cataract preventing OCT imaging

RESULTS

Out of 134 eyes operated 68 (50.75%) were male and 66(49.25%) female aged 40 years to 82 years old. So, mean age is 62.76±7.71 years (Table 1).

Table 1: Age distribution.

Age range (in years)	Number of patients
40-49	5
50-59	38
60-69	67
70-79	23
80-82	1
Total	134

In patients with no comorbidity, the mean preoperative central foveal thickness (CFT) was 248.0±21.3 µm. The postoperative CFT was 249.1±22.1 µm at day 1st of surgery, 261.6±32.7 µm, 266.1±28.1 µm, 252.6±21.9 µm at 1 week, then 1 month and 6th month after surgery respectively. Significant changes were observed on 1 week, then 1 month and then 6 months (p value <0.005).

In patients with diabetic retinopathy changes with no macular involvement, the mean pre-op CMT value was 252.1±22.4 µm. CMT value was 254.6±24.6 µm, 268.2±29.7 µm, 276.3±33.1 µm, 258.8±32.8 µm on post op day1, 1 week, 1 month and 6 month respectively.

No post CS cystoid macular edema found in any patient. No loss of BCVA was seen in patients despite an increase in macular thickness. No occurrence of CME was seen in patients with comorbidities.

Table 2: Mean retinal CFT.

Mean central foveal retinal thickness (µm)	Pre-op	Day 1	1 week	1 month	6 months
Patients with no comorbidity	248.0±21.3	249.1±22.1	261.6±32.7	266.1±28.1	252.6±21.9
Patients with diabetic retinopathy not involving macula	252.1±22.4	254.6±24.6	268.2±29.7	276.3±33.1	258.8±32.8
Patients with retinal venous occlusion not involving macula	250.4±26.3	251.6±25.8	264.2±31.6	269.7±29.2	253.6±27.8

Table 3: BCVA in LogMAR.

BCVA	Pre op	Day 1	1 week	1 month	6 months
Patients with no comorbidity	0.81±0.36	0.30±0.23	0.21±0.1	0.10±0.07	0.09±0.07
Patients with diabetic retinopathy not involving macula	0.92±0.45	0.35±0.31	0.24±0.1	0.13 ±0.09	0.11±0.09
Patients with retinal venous occlusion not involving macula	0.88±0.36	0.32±0.32	0.25±0.12	0.11±0.07	0.10±0.07

DISCUSSION

This work was conducted to examine the impact of uncomplicated phacoemulsification on CMT and significant difference was observed in the mean CMT after CS, without any loss of BCVA. This work demonstrated a hike in CMT in post operative day 1, then 1 week, then 1 month, and then 6 months. This is alike to the observation reported in study done by Prente et al and Dad et al post operative day 1 macular thickness was similar to pre-operative in all three studies.^{12,13} However, this was in contrast with results from Simion et al and Jagow et al who reported a hike in CMT value from post-operative day 1.^{14,15}

The light-scattering effect caused by lens opacity could be a reason for decrease in optical quality and, consequently, affect the accuracy of pre-operative OCT measurements. Therefore, the first post operative day measurement might more accurately reflect the actual retinal thickness.¹³ These finding were further backed by the investigations done by Dabas et al and Nasreen et al where an increase in post-operative CMT was observed in first week and 1 month which later reduced by 3rd month without any loss of BCVA post-operatively. Similar conclusions were also done by Kemer et al.¹⁶⁻¹⁸

The pathogenesis of CME after CS is primarily driven by inflammatory responses, vascular changes, and disruption of the blood-retina barrier. Surgical trauma to the eye's anterior segment triggers a cascade of inflammatory responses, causing the release of prostaglandins (PGs), cytokines, interleukins, and vascular endothelial growth factors (VEGFs). These mediators increase the permeability of retinal blood vessels, facilitating fluid leakage into the retina, particularly in the macula, resulting in edema. Prolonged surgery can also trigger anterior segment ischemia, which further induces inflammatory responses. The toxicity due to use of intracameral drugs can also lead to inflammation mediated CME.

Complications of CS, such as posterior capsule rupture (PCR), can disrupt the blood-retina barrier (BRB), allowing excess fluid to leak from vessels into the retinal tissue. Increased retinal light exposure from the surgical microscope also contributes to the release of inflammatory factors in the retina.²⁰ Post surgery changes at the vitreoretinal interface, particularly posterior vitreous detachment (PVD), can cause tractional damage, leading to CME. Incidence of CME following CS was reported in less than 7% of patient.²¹⁻²³

Patients with diabetic retinopathy not involving macular area also showed an increased in CMT value post operatively, similar to non-diabetic patients. A meta-analysis done by Liu et al had concluded that CMT increase in post operative 1, 3, 6 months after phacoemulsification is significant in diabetic patient with mild to moderate NDPR, without any loss of BCVA.²⁴ In our study, no incidence of macular oedema or loss of BCVA was observed post-operatively. This was in contrast to earlier studies conducted by Kim et al where loss of BCVA and incidence of CME was reported due to non-involvement of macula.²⁵

Uncontrolled blood sugar levels are a key contributor to the progression of DR following CS.²⁶ Further studies focusing on different diabetic parameters, predisposing factors, and levels of severity with larger sample sizes, are necessary to draw more robust conclusions. The increase in CMT values observed in patients with retinal vein occlusions was significant, but the limited number of patients may potentially compromise the reliability of the data.

An earlier study done in retinal veinous occlusion patients by Cho et al, reported 27% of cases with pseudophakic CME with BCVA worsening in initial 3 postoperative months. In contrast, no incidence of postoperative CME was noted in this work.⁷ A study by Nicolas et al, demonstrated a correlation between BCVA and CMT

increase, however, there was no effect on BCVA with increase in macular thickness in our observation. This finding is supported by other studies.^{15-17, 27,28}

The duration of surgery was not observed in our study, which should be considered in future researches. Ramakrishnan et al and Dabas et al reported that patients who underwent longer duration of surgery exhibited a heightened CMT.^{16,29} Simon et al have shown in their studies that over a longer follow-up period (1 year), a further decrease in CMT values was evident. Difference in operating surgeon is reflected on the CMT value difference (both baseline and change) across different studies and needs to be factored in future studies.¹⁴

CONCLUSION

Uncomplicated phacoemulsification leads to a transient increase in CMT, peaking at 1 month and returning toward baseline by 6 months, without affecting visual acuity or causing CME. The findings support the safety of the procedure, even in patients with mild diabetic retinopathy or prior retinal vein occlusion. Further research is recommended to explore long-term macular changes and risk factors for persistent macular thickening.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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