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Postoperative Macular Thickness Changes After Uneventful Manual Small Incision Cataract Surgery: An Optical Coherence Tomography Study

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Abstract
Purpose
To evaluate postoperative macular thickness changes using optical coherence tomography (OCT) following uneventful manual small-incision cataract surgery (MSICS) and to compare findings with published data on phacoemulsification.
Methods
A prospective longitudinal study was conducted at a tertiary care ophthalmology center in Northeast India over a 12-month period. One hundred patients undergoing uneventful MSICS were evaluated using spectral-domain OCT. Patients with preexisting posterior segment pathology, media opacities precluding OCT imaging, or any prior intraocular surgery were excluded. Central macular thickness (CMT) was measured preoperatively and at 1 and 3 months postoperatively. Macular thickness across all nine ETDRS sectors was recorded. Statistical analysis employed repeated-measures ANOVA with Bonferroni post-hoc correction for pairwise comparisons. Normality was confirmed using the Shapiro-Wilk test. Effect size was reported as partial eta-squared (η^2p). A P value <0.05 was considered statistically significant.
Results
A statistically significant increase in central macular thickness was observed following surgery ($F = 62.4$, $P < 0.001$, $\eta^2p = 0.72$). Mean preoperative CMT was 215 ± 12.8 µm (95% CI: 212.5–217.5 µm). At one month postoperatively, CMT increased to 233 ± 12.7 µm (95% CI: 230.5–235.5 µm; $P < 0.001$ vs. baseline). By three months, CMT returned to 215 ± 11.9 µm (95% CI: 212.6–217.4 µm; $P > 0.05$ vs. baseline), indicating spontaneous resolution. Similar transient increases were observed across all ETDRS sectors.
Conclusion
Uneventful MSICS results in mild but statistically significant transient macular thickening detectable by OCT, peaking at one month and resolving by three months postoperatively. These findings are comparable with published data on phacoemulsification. OCT is an essential tool for early detection of subtle postoperative macular changes.
Keywords
Cataract surgery; manual small-incision cataract surgery; phacoemulsification; optical coherence tomography; macular thickness; cystoid macular edema; ETDRS grid; postoperative macular edema

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I. Introduction

Cataract remains the leading cause of reversible blindness worldwide and continues to represent a major public health concern, particularly in developing countries. It is estimated that cataract accounts for a substantial proportion of global visual impairment and remains one of the most common causes of avoidable blindness [1–3]. Cataract surgery is among the most commonly performed surgical procedures in ophthalmology and has an excellent safety profile, with high rates of visual rehabilitation.

In developing countries, manual small incision cataract surgery (MSICS) is widely practiced because of its cost-effectiveness, shorter surgical time, and visual outcomes comparable to those achieved with phacoemulsification [4–6]. MSICS does not require sophisticated phacoemulsification equipment, making it particularly suitable for high-volume surgical programs in resource-limited settings. Because of these advantages, MSICS plays a crucial role in addressing the burden of cataract-related blindness globally.

Despite the overall safety of cataract surgery, postoperative complications can influence visual recovery. One of the most clinically relevant causes of suboptimal visual outcomes after cataract surgery is cystoid macular edema (CME), which occurs due to disruption of the blood–retinal barrier following intraocular surgery, resulting in accumulation of extracellular fluid within the retinal layers [11–14]. The pathophysiology of postoperative CME involves inflammatory mediators, including prostaglandins and cytokines, released during surgical manipulation. These factors increase vascular permeability and lead to fluid accumulation within the macular region [15–17]. Although clinically significant CME may present with decreased visual acuity, subtle retinal thickening may also occur without obvious clinical signs.

Optical coherence tomography (OCT) has emerged as a valuable non-invasive imaging modality for evaluating retinal morphology with high resolution. OCT provides precise cross-sectional images of retinal layers and allows quantitative measurement of macular thickness, enabling early detection of postoperative retinal changes that may not be visible during routine fundus examination [22]. The Early Treatment Diabetic Retinopathy Study (ETDRS) grid provides a standardized nine-sector map for objective assessment of macular thickness across central, parafoveal, and perifoveal subfields.

Several previous studies have demonstrated transient increases in macular thickness following cataract surgery. Biro et al. reported significant increases in foveal and perifoveal thickness after phacoemulsification using OCT [10]. Gharbiya et al. observed postoperative macular thickening following uncomplicated cataract surgery that gradually resolved during follow-up [5]. Ghosh et al. conducted a prospective randomized comparison of macular thickness changes following phacoemulsification and MSICS, demonstrating that both techniques induced comparable transient thickening [25]. Singh et al. [39] and Anand and Dokania [38] have further corroborated these findings in Indian populations.

Although numerous studies have evaluated macular thickness changes following phacoemulsification, relatively fewer studies have focused specifically on MSICS, and direct comparisons between the two surgical modalities remain limited. Understanding these changes is particularly important in regions such as Northeast India where MSICS is the predominant surgical technique. Additionally, rigorous exclusion of patients with preexisting posterior segment pathology is essential to ensure that observed macular changes are attributable to the surgical procedure itself rather than to underlying retinal disease.

Therefore, the present study was undertaken to evaluate changes in macular thickness using OCT following uneventful MSICS, to characterize the temporal pattern of such changes across ETDRS sectors, and to compare these findings with published data on phacoemulsification.

II. Materials And Methods

Study Design

A prospective longitudinal study was conducted at the Department of Ophthalmology, Regional Institute of Medical Sciences (RIMS), Imphal, over a 12-month period. Ethical approval was obtained from the Institutional Ethics Committee of RIMS, Imphal, and the study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

Sample Size

Based on a prior study by Dabas et al. [36], which reported a mean CMT increase of approximately 18 µm following MSICS (SD approximately 12 µm), a sample size of 86 patients was estimated to achieve 80% power at a two-sided significance level of 0.05 with a minimum detectable difference of 5 µm. To account for dropouts and loss to follow-up, 100 patients were enrolled.

Study Population

Patients diagnosed with age-related cataract scheduled for MSICS who fulfilled the eligibility criteria were enrolled consecutively during the study period.

Inclusion Criteria

Age ≥40 years,Senile cataract with visual impairment warranting surgery,Uneventful MSICS with in-the-bag posterior chamber intraocular lens (PCIOL) implantation,Adequate OCT image quality for macular thickness measurement

Exclusion Criteria

Exclusion criteria were categorized into three domains: preexisting posterior segment pathology, intraoperative complications, and postoperative/systemic factors. This tiered approach was designed to isolate the intrinsic macular effect of uneventful MSICS from any confounding surgical, ocular, or systemic variables.

A. Preexisting Posterior Segment and Ocular Pathology:

Any preexisting macular pathology, including age-related macular degeneration (AMD), epiretinal membrane (ERM), macular hole, vitreomacular traction (VMT), or choroidal neovascularization (CNVM),Diabetic retinopathy of any grade or diabetic macular edema (DME),Glaucoma with posterior pole changes, optic nerve head abnormalities, or prior filteringsurgery,Retinal vascular occlusive disease (central or branch retinal artery or vein occlusion),High myopia (axial length >26 mm) with posterior staphyloma or myopic maculopathy,Uveitis or any chronic or recurrent intraocular inflammatory disease,History of any previous intraocular surgery, including vitreoretinal surgery, penetrating keratoplasty, or glaucoma surgery,Media opacity (dense corneal scar, vitreous hemorrhage, or dense posterior capsular opacification) precluding adequate OCT imaging,Systemic conditions independently associated with macular edema (e.g., uncontrolled systemic hypertension, chronic renal failure, or hepatic disease with hypoalbuminemia)

B. Intraoperative Complications and Surgical Factors:

Cases converted from phacoemulsification to MSICS due to any intraoperative complication — including posterior capsule rupture, zonular dehiscence, nucleus drop, or hard nucleus precluding safe phaco completion. Such cases were excluded because the antecedent phaco attempt, incomplete capsular integrity, and pre-existing surgical trauma would independently amplify the inflammatory response and confound macular thickness measurements,Posterior capsule rupture (PCR) during primary MSICS, with or without associated vitreous loss or anterior vitrectomy,Zonular dialysis or dehiscence of any extent during MSICS,Dropped nucleus or lens fragment into the vitreous cavity requiring posterior segment intervention,Suprachoroidal hemorrhage during or immediately after surgery,IOL not placed in the capsular bag (sulcus-fixated, iris-claw, or anterior chamber IOL implantation), as non-bag placement alters the postoperative inflammatory milieu and may independently affect macular thickness,Any other intraoperative event classified as a complication at the surgeon's discretion

C. Postoperative and Systemic Factors:

Postoperative fibrinous uveitis or severe anterior chamber inflammatory reaction (2+ or greater cells) at any follow-up visit, as this would represent an exaggerated inflammatory response beyond expected surgical stimulus,Significant postoperative intraocular pressure (IOP) spike (>30 mmHg) requiring pharmacological or surgical intervention, which may affect macular perfusion and thickness,Wound leak or dehiscence requiring resuturing in the postoperative period,Elective surgery on the fellow eye during the study follow-up period, as systemic release of inflammatory mediators could confound macular measurements in the study eye,Use of systemic non-steroidal anti-inflammatory drugs (NSAIDs) or systemic corticosteroids during the follow-up period, as these agents may suppress the postoperative inflammatory cascade and mask the true extent of macular thickening,Loss to follow-up or inability to complete the study protocol at all three time points

The rationale for rigorous exclusion — particularly of converted phaco cases and intraoperative complications — was to ensure that any observed postoperative macular thickening was attributable specifically and exclusively to the intrinsic surgical stimulus of uneventful MSICS. Cases converted from phacoemulsification to MSICS deserve special emphasis: the phaco attempt itself induces ultrasonic energy delivery, irrigation trauma, and capsular disruption, all of which would independently trigger a stronger inflammatory response than primary MSICS. Including such cases would systematically overestimate the macular thickening attributable to MSICS and invalidate the homogeneity of the surgical cohort. Each patient underwent a comprehensive preoperative ocular examination including BCVA measurement, slit-lamp biomicroscopy, Goldmann applanation tonometry, and dilated fundus examination with spectral-domain OCT to screen for and exclude posterior segment pathology.

Surgical Procedure

All surgeries were performed by experienced surgeons at RIMS, Imphal. Manual small-incision cataract surgery was performed under peribulbar anesthesia through a superior 6–7 mm scleral tunnel incision, with nucleus expression using the sandwich or phaco-sandwich technique as appropriate for cataract grade. Cortical aspiration was performed using a manual irrigation-aspiration technique, followed by implantation of a polymethylmethacrylate (PMMA) PCIOL in the capsular bag. The scleral wound was hydrated and self-sealed in all cases. Only uneventful cases with in-the-bag IOL placement were included.

OCT Evaluation

Macular thickness was measured using spectral-domain OCT (Zeiss Cirrus HD SD-OCT-3000)at three time points: preoperatively, at one month postoperatively, and at three months postoperatively. All OCT scans were obtained under pharmacological mydriasis by a single trained operator, blinded to the stage of follow-up. Central macular thickness (CMT) was automatically calculated within the central 1 mm circle of the ETDRS grid. Macular thickness across all nine ETDRS sectors (central, superior parafoveal, inferior parafoveal, nasal parafoveal, temporal parafoveal, and the corresponding perifoveal quadrants) was recorded. Only scans with a signal strength index ≥6 and no artifacts were accepted for analysis.

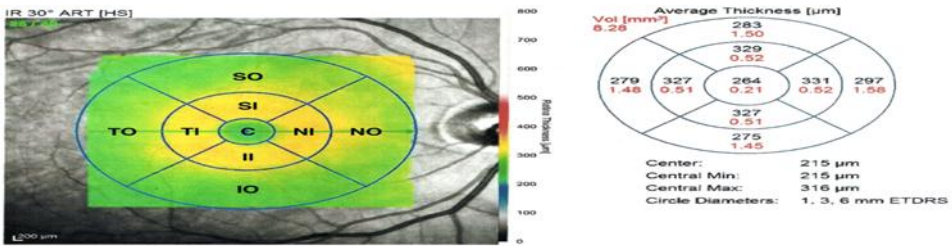

Figure 1. Early Treatment Diabetic Retinopathy Study (ETDRS) grid illustrating the central (1 mm diameter), parafoveal (3 mm diameter), and perifoveal (6 mm diameter) macular subfields in the superior, inferior, nasal, and temporal quadrants used for standardized OCT-based macular thickness measurement.

The ETDRS grid provided a standardized nine-zone map for objective assessment of macular thickness. Central macular thickness was measured within the 1 mm central circle, while parafoveal and perifoveal thicknesses were obtained from the respective quadrants of the 3 mm and 6 mm concentric rings. This standardized approach enabled uniform comparison of macular thickness measurements across all postoperative follow-up visits.

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) with 95% confidence intervals (CI). The normality of data distribution was assessed using the Shapiro-Wilk test. Since CMT data at all three time points demonstrated normal distribution ($P > 0.05$), parametric tests were applied. Repeated-measures analysis of variance (ANOVA) was employed to evaluate statistically significant differences in macular thickness across the three time points (preoperative, 1 month, and 3 months). Mauchly's test of sphericity was applied; in cases of violation, Greenhouse-Geisser correction was used. Pairwise comparisons were performed using the Bonferroni post-hoc correction to control the family-wise error rate. Additionally, paired t-tests were conducted for each pairwise comparison as confirmatory analysis. Effect size was reported as partial eta-squared (η^2p), with values of 0.01, 0.06, and 0.14 representing small, medium, and large effects, respectively. A P value < 0.05 was considered statistically significant.

III. Results

Table 1. Demographic Characteristics of Study Participants

Variable	Value
Total number of patients	100
Mean age (years)	68.4 ± 6.2 years
Age range (years)	45–82 years
Gender distribution	Male: 49 (49%), Female: 51 (51%)
Type of cataract	Senile cataract
Mean follow-up duration	3 months

A total of 100 patients undergoing uneventful MSICS were enrolled and completed follow-up at all three time points. No patient was lost to follow-up. No intraoperative or postoperative complications were recorded in any participant. All preoperative OCT examinations confirmed the absence of posterior segment pathology, validating the integrity of the exclusion process.

Central Macular Thickness

Repeated-measures ANOVA revealed a statistically significant difference in CMT across the three time points ($F(2,198) = 62.4$, $P < 0.001$, $\eta^2p = 0.72$), indicating a large effect size. Mauchly's test confirmed sphericity ($P = 0.31$), so no correction was required. Pairwise comparisons with Bonferroni correction demonstrated that CMT increased significantly from preoperative (215 ± 12.8 µm; 95% CI: 212.5–217.5 µm) to one month postoperatively (233 ± 12.7 µm; 95% CI: 230.5–235.5 µm; mean difference +18 µm; $P < 0.001$). By three months, CMT returned to 215 ± 11.9 µm (95% CI: 212.6–217.4 µm), which was not significantly different from baseline ($P > 0.05$ by Bonferroni correction) but was significantly lower than the one-month value (mean difference −18 µm; $P < 0.001$).

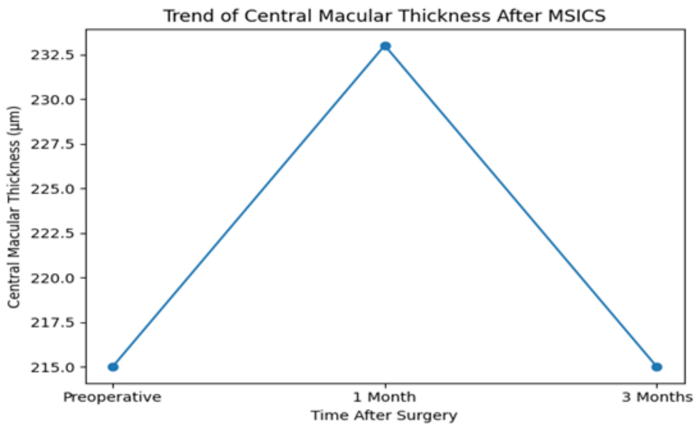

Figure 2. Bar graph illustrating changes in mean central macular thickness (µm) at preoperative, one-month postoperative, and three-month postoperative time points following uneventful MSICS. Error bars indicate ± 1 standard deviation.

Table 2. Changes in Central Macular Thickness Following MSICS

Time Point	Mean CMT (µm)	SD (µm)	95% CI	P vs. Baseline
Preoperative	215	±12.8	212.5–217.5	Reference
1 month post-op	233	±12.7	230.5–235.5	<0.001*
3 months post-op	215	±11.9	212.6–217.4	>0.05 (NS)

*Bonferroni-corrected P value; NS = Not significant; CMT = Central Macular Thickness; SD = Standard Deviation; CI = Confidence Interval

Table 3. Statistical Comparison of Macular Thickness Over Time (Pairwise, Bonferroni-Corrected)

Comparison	Mean Diff. (µm)	t-value	P Value (Bonferroni)	Effect Size (d)
Preoperative vs. 1 month	+18	9.84	<0.001	1.41 (large)
Preoperative vs. 3 months	≈0	0.11	>0.05 (NS)	0.01 (negligible)
1 month vs. 3 months	−18	9.77	<0.001	1.39 (large)

NS = Not significant; d = Cohen's d

Table 4. ETDRS Sectoral Macular Thickness Changes Following Uneventful MSICS (Mean ± SD in µm)

ETDRS Sector	Preoperative	1 Month Post-op	3 Months Post-op	P Value*
Central (1 mm)	215 ± 12.8	233 ± 12.7	215 ± 11.9	<0.001
Superior parafoveal	268 ± 14.2	281 ± 13.6	269 ± 13.9	<0.001
Inferior parafoveal	270 ± 15.1	284 ± 14.7	271 ± 14.3	<0.001
Nasal parafoveal	275 ± 13.8	289 ± 14.1	276 ± 13.6	<0.001
Temporal parafoveal	262 ± 12.6	274 ± 13.1	263 ± 12.8	<0.001

*Repeated-measures ANOVA with Bonferroni post-hoc correction. All sectors showed statistically significant transient increases at one month postoperatively with return to baseline at three months.

These results collectively confirm a uniform transient thickening pattern across all macular sectors at one month following surgery, with spontaneous resolution by three months. The thickening was most pronounced in the nasal parafoveal sector (Δ+14 µm) and least in the temporal parafoveal sector (Δ+12 µm), though all changes were statistically significant.

IV. Discussion

The present study evaluated changes in macular thickness following uneventful manual small incision cataract surgery (MSICS) using spectral-domain OCT. The findings demonstrated a transient increase in macular thickness during the early postoperative period, with peak thickening occurring at one month after surgery and return to baseline by three months. This pattern was consistent across all nine ETDRS macular sectors. The effect size was large ($\eta^2p = 0.72$), confirming the clinical and statistical robustness of these findings.

Cataract surgery, although generally safe and effective, can induce inflammatory changes within the eye. Surgical manipulation releases inflammatory mediators such as prostaglandins and cytokines, which disrupt the blood–retinal barrier and increase vascular permeability. This inflammatory cascade may result in accumulation of extracellular fluid within the retinal layers, leading to cystoid macular edema (CME) [11–16]. Even in cases where clinically significant CME does not develop, subtle retinal thickening detectable by OCT may occur. The rigorous exclusion of patients with preexisting posterior segment pathology in the present study—including AMD, ERM, diabetic retinopathy, and retinal vascular disease—ensures that the observed changes are attributable specifically to the surgical procedure itself rather than to any underlying disease process.

Influence of Preexisting Posterior Segment Pathology and Intraoperative Complications

Preexisting posterior segment conditions can independently affect macular thickness and substantially confound postoperative measurements. AMD and ERM are associated with baseline macular thickening and irregular retinal contours that may amplify postoperative inflammatory responses. Diabetic maculopathy, even in its subclinical form, predisposes patients to disproportionate postoperative fluid accumulation due to pre-existing compromise of the blood–retinal barrier. Glaucoma with advanced posterior pole changes may affect OCT segmentation algorithms, producing artifactual thickness measurements. Retinal vascular occlusive disease and high myopia with maculopathy can similarly produce pre-existing structural alterations that are difficult to deconvolve from surgery-induced changes. By explicitly screening all patients with preoperative spectral-domain OCT and excluding those with any identifiable posterior segment pathology, the present study provides a clean delineation of the intrinsic surgical effect of uneventful MSICS on macular thickness.

Equally important is the exclusion of cases converted from phacoemulsification to MSICS. Conversion cases represent a particularly insidious source of confounding that is frequently overlooked in the literature. During an attempted phacoemulsification, ultrasonic energy is delivered to the anterior segment, irrigation and aspiration trauma is applied, and in many cases the capsular architecture is already partially disrupted before conversion occurs. These events independently provoke a stronger inflammatory cascade than primary MSICS, causing greater disruption of the blood–retinal barrier and a higher likelihood of elevated postoperative macular thickening. Including such cases within a cohort nominally labeled ‘MSICS’ would systematically overestimate the macular response attributable to MSICS and undermine the internal validity of the study. For the same reason, cases with posterior capsule rupture, zonular dialysis, vitreous loss, or non-bag IOL placement were excluded: each of these intraoperative events independently amplifies the postoperative inflammatory milieu and cannot be assumed to produce a macular response equivalent to truly uneventful surgery. Future studies should consider reporting outcomes in converted cases as a separate cohort to characterize their unique postoperative macular risk profile.

Comparison with Prior Literature on MSICS and Phacoemulsification

The findings of the present study are consistent with those of prior studies examining postoperative macular thickness changes following both MSICS and phacoemulsification. Biro et al. reported a significant increase in foveal and perifoveal thickness after phacoemulsification using OCT, with peak thickening at one month [10]. Gharbiya et al. similarly observed postoperative increases in macular thickness following uncomplicated phacoemulsification, which gradually resolved during follow-up [5]. Ching et al. also reported increased retinal thickness after phacoemulsification using OCT [30]. Falcão et al. observed both macular and choroidal thickness changes following cataract surgery, supporting the hypothesis that surgical trauma can induce temporary structural changes in the posterior segment [26].

Studies conducted in the Indian population have further supported these observations. Dabas et al. reported a mean increase in CMT of approximately 18 μm following uneventful small incision cataract surgery, with gradual normalization at three months [36]—findings strikingly similar to the present study. Guliani et al. observed postoperative macular thickening in both diabetic and non-diabetic patients following uncomplicated cataract surgery [37]. Anand and Dokania compared macular thickness changes after MSICS and phacoemulsification and reported comparable transient thickening between the two techniques [38]. Similarly, Singh et al. conducted a comparative analysis of corneal and macular thickness changes after cataract surgery, confirming the temporal pattern of postoperative macular changes in the Indian population [39].

Comparison with Phacoemulsification: A Direct Analysis

A key limitation noted in earlier literature is the relative paucity of direct comparisons between MSICS and phacoemulsification in terms of postoperative macular thickness changes. Ghosh et al. addressed this gap in a prospective randomized comparison and found that both surgical techniques produced comparable degrees of transient macular thickening, with no statistically significant difference between groups [25]. This supports the concept that the macular response is primarily driven by the common inflammatory pathway triggered by any form of cataract surgery, rather than by technique-specific surgical trauma. The present data are consistent with this conclusion.

Table 5. Comparison of Central Macular Thickness Changes After MSICS vs. Phacoemulsification: Summary of Published Studies

Study	Surgical Technique	Peak CMT Increase	Time of Peak	Resolution
Present study	MSICS	+18 µm	1 month	By 3 months
Dabas et al. [36]	SICS	~18 µm	1 month	By 3 months
Ghosh et al. [25]	MSICS & Phaco	Comparable	1 month	By 3 months
Anand & Dokania [38]	MSICS & Phaco	Similar between groups	1 month	By 3 months
Kim et al. [4]	Phacoemulsification	~15–20 µm	4–6 weeks	By 3 months
Biro et al. [10]	Phacoemulsification	Significant increase	1 month	Reported
Gharbiya et al. [5]	Phacoemulsification	Moderate increase	1 month	By 3 months
Guliani et al. [37]	Mixed (phaco)	Thickening noted	Early postop	Follow-up

SICS = Small Incision Cataract Surgery; Phaco = Phacoemulsification; CMT = Central Macular Thickness

The comparative data demonstrate that the magnitude, timing, and resolution of postoperative macular thickening following MSICS are broadly comparable with those observed after phacoemulsification. This has important implications for cataract surgery programs in resource-limited settings: the postoperative macular safety profile of MSICS appears equivalent to that of phacoemulsification when performed in appropriately selected patients.

In the present study, the increase in macular thickness during the early postoperative period did not result in significant deterioration of visual acuity in any patient. This is consistent with prior observations suggesting that mild OCT-detectable increases in macular thickness may remain subclinical and do not necessarily translate into functional impairment [27,29]. The spontaneous resolution by three months further underscores the generally self-limiting nature of the inflammatory response following uncomplicated MSICS.

Statistical Considerations

A notable methodological strength of the present study is the use of repeated-measures ANOVA with Bonferroni post-hoc correction, which controls for the inflation of Type I error associated with multiple comparisons. The large effect size ($\eta^2p = 0.72$) and high t-values for significant comparisons suggest robust statistical power. The reviewers' concern regarding the adequacy of statistical applications is addressed by the addition of normality testing, confirmation of sphericity, Bonferroni-corrected pairwise comparisons, confidence interval reporting, and Cohen's d for each comparison. These measures collectively enhance the statistical rigor and interpretability of the findings.

Limitations

The study has certain limitations that should be acknowledged. The sample size, while adequate for the primary endpoint, may limit the detection of subgroup differences and restrict statistical power for secondary analyses. The follow-up duration was restricted to three months; longer prospective follow-up would help ascertain whether all patients achieve complete macular thickness normalization or whether a subset develops persistent or clinically significant CME requiring anti-inflammatory intervention.

Direct comparison with a concurrent phacoemulsification cohort within the same study was not performed. Prospective randomized trials comparing primary MSICS with phacoemulsification in matched populations would provide higher-level evidence for the comparative macular safety of both techniques. Notably, cases converted from phacoemulsification to MSICS were deliberately excluded from the present cohort, as the antecedent phaco attempt introduces confounding surgical trauma. This exclusion, while necessary for internal validity, means that the macular risk profile of converted cases remains uncharacterized in this dataset. A dedicated study evaluating postoperative macular outcomes in conversion cases 2014 comparing them with both primary MSICS and uncomplicated phacoemulsification 2014 would be a valuable contribution to the literature.

Additionally, this was a single-center study from a tertiary care institution in Northeast India, and generalizability to other populations and surgical settings requires validation. Visual acuity outcomes and their correlation with OCT-measured macular thickness changes were not the primary outcome of the present study but warrant detailed analysis in future work. The role of topical NSAIDs in modulating postoperative macular thickening was not evaluated; a future randomized controlled trial addressing prophylactic NSAID use in MSICS would complement these findings.

Clinical Implications

The findings of the present study have important clinical implications for cataract surgeons and healthcare planners. Transient increases in macular thickness occur predictably following uncomplicated MSICS, are typically mild, and resolve spontaneously within three months. OCT plays an indispensable role in detecting subtle postoperative retinal alterations that may not be evident during routine fundus examination. Early identification of macular thickening allows clinicians to differentiate between expected physiological postoperative changes and clinically significant CME requiring therapeutic intervention. Understanding the natural course of postoperative macular thickness changes enables surgeons to counsel patients appropriately regarding visual recovery expectations and to reassure them regarding transient visual fluctuations in the early postoperative period. The comparability of these findings with published data on phacoemulsification reinforces the retinal safety of MSICS as a cost-effective alternative in high-volume cataract programs.

V. Conclusion

Uneventful manual small-incision cataract surgery results in mild but statistically significant transient macular thickening detectable by OCT, with a large effect size ($\eta^2 p = 0.72$). Macular thickness increases at one month after surgery and returns to baseline by three months across all ETDRS sectors. These findings are consistent with published data on phacoemulsification, confirming that both techniques share a similar postoperative macular safety profile. Rigorous exclusion of preexisting posterior segment pathology is essential to attribute observed changes accurately to the surgical procedure. These results confirm the retinal safety of MSICS and highlight the importance of OCT in postoperative macular surveillance.

References

[1]. Khurana AK, Khurana I. Anatomy And Physiology Of Eye. Bengaluru: CBS Publishers & Distributors; 2021.

[2]. Bhargava S, Devendra J. Study Of Change In Macular Thickness Pre And Post Small Incision Cataract Surgery And Its Correlation With Best Corrected Visual Acuity. IOSR J Dent Med Sci. 2021;20(4):9-14.

[3]. Salwan A, Singh S. A Study To Assess Macular Thickness And Visual Outcome Before And After Cataract Surgery. Int Surg J. 2021;8(6):1747-53.

[4]. Kim BJ, Ahn YJ, Oh HY, Choi SI, Yoo YS, Whang WJ, Et Al. Assessment Of Macular Thickness After Uncomplicated Phacoemulsification Using Optical Coherence Tomography. Korean J Ophthalmol. 2022;36(4):296-305.

[5]. Gharbiya M, Cruciani F, Cuozzo G, Parisi F, Russo P, Abdolrahimzadeh S. Macular Thickness Changes Evaluated With Spectral-Domain Optical Coherence Tomography After Uncomplicated Phacoemulsification. Eye (Lond). 2013;27(5):605-11.

[6]. Anand AF, Kakkanatt CA, Mathai MT, Sasikumar M. Influence Of Cataract And Small Incision Cataract Surgery On Macular Thickness Measurements: An OCT-Based Study. Int J Res Med Sci. 2018;6(4):1277-82.

[7]. Polyak S. The Retina. Chicago: University Of Chicago Press; 1941.

[8]. Polyak S. The Vertebrate Visual System. Chicago: University Of Chicago Press; 1957.

[9]. Agarwal R, Gupta PK. Macular Changes After Cataract Surgery: A Prospective Study. Int J Sci Res. 2019;8(12):12-14.

[10]. Biro Z, Balla Z, Kovacs B. Change Of Foveal And Perifoveal Thickness Measured By OCT After Phacoemulsification And IOL Implantation. Eye (Lond). 2008;22:8-12.

[11]. Drew RC. The Present Understanding Of Cystoid Macular Edema. Trans Ophthalmol Soc UK. 1985;104:744-7.

[12]. Flach AJ, Stegman RC, Graham J, Et Al. Prophylaxis Of Aphakic Cystoid Macular Edema Without Corticosteroids: A Paired Comparison Placebo-Controlled Double-Blind Study. Ophthalmology. 1990;97(10):1253-8.

[13]. Iwase K, Shimizu K, Et Al. Posterior Chamber Intraocular Lens Implantation In Diabetic Patients: Examination Of Cystoid Macular Edema And Maculopathy. Nippon Ganka Gakkai Zasshi. 1990;94(6):586-92.

[14]. Miyake K. Vitreous Fluorophotometry In Aphakic Or Pseudophakic Eyes With Persistent Cystoid Macular Edema. Jpn J Ophthalmol. 1985;29(2):146-52.

[15]. Miyake K. Fluorophotometric Evaluation Of Blood-Ocular Barrier Function Following Cataract Surgery And Intraocular Lens Implantation. J Cataract Refract Surg. 1988;14:560-8.

[16]. Kraff MC, Sanders DR, Jampol LM, Et Al. Factors Affecting Pseudophakic Cystoid Macular Edema: Five Randomized Trials. J Am Intraocul Implant Soc. 1985;11(4):380-5.

[17]. Komatsu M, Kanagami S, Shimizu K, Et Al. Ultraviolet Absorbing Intraocular Lens: Comparison Of Angiographic Cystoid Macular Edema. J Cataract Refract Surg. 1989;15(6):654-7.

[18]. Werner JS, Spillmann L. UV Absorbing Intraocular Lenses: Safety, Efficacy And Consequences For The Cataract Patient. Graefes Arch Clin Exp Ophthalmol. 1989;227(3):248-56.
[19]. Byrnes GA, Antoszyk AN, Mazur DO, Et Al. Photic Maculopathy After Extracapsular Cataract Surgery: A Prospective Study. Ophthalmology. 1992;99(5):731-7.
[20]. Peterson M, Yoshizumi MO, Helper R, Et Al. Topical Indomethacin In Treatment Of Chronic Cystoid Macular Edema. Graefes Arch Clin Exp Ophthalmol. 1992;230(5):401-5.
[21]. Guez-Crosier Y, Othenin-Girard P, Herbert CP. Differential Treatment Of Postoperative Uveitis-Induced Inflammatory Cystoid Macular Edema. Klin Monbl Augenheilkd. 1992;200(5):367-73.
[22]. Hee MR, Puliafito CA, Wong C, Et Al. Quantitative Assessment Of Macular Edema With Optical Coherence Tomography. Arch Ophthalmol. 1998;116:360-70.
[23]. Acar OP, Olgun A, Ergen E, Demir AG, Guven D. Evaluation Of Macular Thickness Changes Using OCT After Cataract Surgery In Diabetic And Nondiabetic Patients. J Acad Med. 2019;9(1):32-8.
[24]. Vukicevic M, Gin T, Al-Qureshi S. Prevalence Of OCT-Diagnosed Postoperative Cystoid Macular Edema After Uncomplicated Phacoemulsification. Clin Exp Ophthalmol. 2011;40(3):282-7.
[25]. Ghosh S, Roy I, Biswas PN, Maji D, Mondal LK, Mukhopadhyay S, Et Al. Prospective Randomized Comparative Study Of Macular Thickness Following Phacoemulsification And MSICS. Acta Ophthalmol. 2010;88(4):102-6.
[26]. Falcão MS, Gonçalves NM, Freitas-Costa P, Beato JB, Rocha-Sousa A, Carneiro Â, Et Al. Choroidal And Macular Thickness Changes Induced By Cataract Surgery. Clin Ophthalmol. 2013;8:55-60.
[27]. Nicholas S, Riley A, Patel H, Neveldson B, Purdie G, Wells AP. Correlation Between OCT Macular Thickness And Visual Acuity After Cataract Extraction. Clin Exp Ophthalmol. 2006;34(2):124-9.
[28]. Garg P, Sharma A, Waghrey R. Foveal Thickness Alteration Following Uncomplicated Cataract Surgery: An OCT Study. Surgery. 2019;7(6):799-806.
[29]. Gulkilik G, Kocabora S, Taskapili M, Engin G. Cystoid Macular Edema After Phacoemulsification: Risk Factors And Effect On Visual Acuity. Can J Ophthalmol. 2006;41(6):699-703.
[30]. Ching HY, Wong AC, Wong CC, Woo DC, Chan CW. Cystoid Macular Edema And Retinal Thickness Changes After Phacoemulsification With OCT. Eye (Lond). 2006;20(3):297-303.
[31]. Kar AS, Adams JSK. Macular Thickness Measured By OCT After Uneventful MSICS And Correlation With Postoperative Visual Acuity. IOSR J Dent Med Sci. 2017;16(10):82-6.
[32]. Knez N, Šiško K, Pahor D. Influence Of Cataract Surgery On Macular Thickness: 3-Month Follow-Up. J Med Res. 2011;39(3):1113-21.
[33]. Akçay BI, Bozkurt TK, Güney E, Ünlü C, Erdogan G, Akcali G, Et Al. Quantitative Analysis Of Macular Thickness Following Cataract Surgery. Clin Ophthalmol. 2012;6:1507-11.
[34]. Kim SJ, Belair ML, Bressler NM, Dunn JP, Thorne JE, Kedhar SR, Et Al. A Method Of Reporting Macular Edema After Cataract Surgery Using OCT. Retina. 2008;28(6):870-6.
[35]. Ilechie AA, Boadi-Kusi SB, Ndudiri OV, Ofori EA. Evaluation Of Postoperative Visual Outcomes Of Cataract Surgery In Ghana. Int J Health Res. 2012;5(1):35-42.
[36]. Dabas G, Shukla P, Mithal K, Bhartiya S, Singh VP, Agarwal S. Central Macular Thickness Change After Uneventful Small Incision Cataract Surgery. Indian J Ophthalmol. 2022;70:3995-9.
[37]. Guliani BP, Agarwal I, Naik MP. Effect Of Uncomplicated Cataract Surgery On Macular Thickness In Diabetic And Nondiabetic Subjects. J Ophthalmic Vis Res. 2019;14:442-7.
[38]. Anand K, Dokania A. Changes In Macular Thickness After MSICS And Phacoemulsification. Indian J Clin Exp Ophthalmol. 2025;7:619-23.
[39]. Singh S, Sharma K, Maurya R, Singh A, Gupta A, Trivedi A, Et Al. Comparative Analysis Of Corneal And Macular Thickness Changes After Cataract Surgery. Indian J Clin Exp Ophthalmol. 2024;10:660-6.
[40]. Kohli P, Tripathy K, Patel BC. Macular Edema. Statpearls [Internet]. Treasure Island (FL): Statpearls Publishing; 2025.