Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(2), 909 - 913| ISSN:2251-6727

Pre- and Post-Operative Tear Film Assessment in Patients with Age-Related Cataract Undergoing Small Incision Cataract Surgery (SICS)

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(Received: 16 January 2026 Revised: 25 February 2026 Accepted: 17 March 2026)

KEYWORDS
Small Incision Cataract Surgery, Tear Film Stability, Nitbut, Schirmer's Test, Tear Meniscus Height, Age-related Cataract, Dry Eye, Ocular Surface Changes

ABSTRACT:

Background:

One of the major causes of reversible blindness is age-related cataract in the world. Despite the high level of procedure Small Incision Cataract Surgery (SICS) due to its safety and economic efficiency, any postoperative changes in the ocular surface can affect the stability of tears films and patient satisfaction. Measurement of the tear film dynamics after SICS is significant to maximize the surgical outcomes.

Aim:

The purpose was to evaluate and compare the pre and post-operative tear film parameters in the age related cataract patient undergoing SICS.

Methods:

This is a prospective observational study that contained 30 patients (60 eyes) [?]50 years old with uncomplicated SICS. The parameters of tear films analyzed included Non-Invasive Tear Break-Up Time (NITBUT), Schirmer test (without anesthesia), and Tear Meniscus Height (TMH). Assessment was done pre-operative, 2 weeks and 1 month after surgery. Paired t-tests and repeated measures ANOVA were used to conduct statistical analysis and $p<0.05$ was taken to be significant.

Results:

Two weeks after surgery, there were observed minor transient changes in the parameters of the tear film. One month later, NITBUT and Schirmer tests values had statistically significant improvements of the test values at baseline ($p<0.05$). TMH showed negligible changes that were not found to be statistically significant ($p>0.05$). In general, the stability of the tear film, as well as aqueous production, was enhanced in the course of the afteroperative recovery period.

Conclusion:

SICS is related to reversible changes in tear film which are mild. Perioperative tear film evaluation can be used on a regular basis to augment after surgery care and increase patient ease and satisfaction.

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3.Introduction

Cataract is the dominant cause of blindness in the world especially in persons who are above [?]50 years. As per the World Report on Vision, cataract contributes significant share of global impairment of vision particularly in the low- and middle-income countries (WHO, 2023). Recent epidemiology updates state that the aging of the population will bring the prevalence of cataracts to a much higher level in the upcoming decade (GBD 2020 Vision Collaborators, 2021). The most common cause of preventable blindness in India is age-related cataract even though major national efforts to address preventable blindness are reported in the National Programme for Control of Blindness and Visual Impairment (NPCBVI, 2022). The critical determinants of the results of a visual rehabilitation still are accessibility, affordability, and surgical capacity (Murthy et al., 2021).

SICS Intervention: small incision cataract surgery employs a tiny surgical instrument instead of potentially yielding a large implant that could induce complications post-procedure (Breblatt springs et al., 2014).

Small Incision Cataract Surgery Small Incision Cataract Surgery is a self-governing, sutureless, extracapsular surgery that is frequently used in large volume facilities. Modern data show that SICS is as effective as phacoemulsification in terms of providing visual results, especially when it comes to dense cataracts, and it is also cost-effective (Gogate et al., 2020; Venkatesh et al., 2022). It can be used in resource-constrained environments because its learning curve is shorter and it does not require sophisticated infrastructure.

3.3 Tear Film Physiology

Lipid, aqueous, and mucin layers make the tear film, which forms the totality keeping the integrity of the surface and optical clarity of the eye. Non-Invasive Tear Break-Up Time (NITBUT) is used to clinically assess tear stability, as well as volume, Schirmer test and Tear Meniscus Height (TMH). TTAS in perioperative settings is recognized to matter and is highlighted in the TFOS DEWS II update (Craig et al., 2020).

3.4 Rationale of Study

Cataract surgery can cause short-term changes on the surface of the eye because of corneal nerve damage, light toxicity, and medications that have preservatives (Kasetsuwan et al., 2021; Li et al., 2020). Nonetheless, the current evidence regarding the dynamics of tear film after SICS is scarce, which is why special attention should be paid to research.

4. Aim and Objectives

4.1 Aim

To evaluate and compare tear film parameters before and after Small Incision Cataract Surgery (SICS) in patients with age-related cataract.

4.2 Objectives

1. To measure Non-Invasive Tear Break-Up Time (NITBUT) pre-operatively and at defined post-operative intervals following SICS.

2. To assess aqueous tear production using Schirmer's test before surgery and during post-operative follow-up.

3. To evaluate changes in Tear Meniscus Height (TMH) as an indicator of tear volume after SICS.

4. To compare pre- and post-operative tear film parameters statistically in order to determine the significance and clinical relevance of observed variation

5. Materials and Methods

5.1 Study Design

This was a proposed observational study where the researcher wanted to assess the changes in tear film parameters of patients undergoing Small Incision Cataract Surgery (SICS).

5.2 Study Setting

The research was conducted within a tertiary ophthalmology care facility that had sufficient surgical and diagnostic facilities. The participants

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JCHR (2026) 16(2), 909 - 913| ISSN:2251-6727

were informed and gave informed consent before starting the research, and the ethical approval of the institution was obtained.

5.3 Study Population

Thirty patients (60 eyes) aged 50 years and older were recruited to participate by the study, having been diagnosed with age-related cataract and scheduled to undergo uncomplicated SICS.

5.4 Inclusion Criteria

Patients who had no history of dry eye disease and those who had not undergone any intraocular surgery were included.

5.5 Exclusion Criteria

Practitioners who had ocular surface disorders, autoimmune diseases, patients who are wearing contact lenses, and patients who are taking topical ocular drugs at the time were excluded.

5.6 Surgical Technique

Every patient was subjected to a conventional SICS using peribulbar anesthesia. An incision of self-sealing scleral tunnel was made, then the nucleus was delivered and an implantation of an intraocular lens in the posterior chamber was made. The prescription of postoperative medications was made according to the routine.

5.7 Tear Film Assessment

Tear film analysis was conducted at the baseline, 2 weeks and 1 month after surgery. Topcon System (CA-800) was used to measure Non-Invasive Tear Break-Up Time (NITBUT). The aqueous tear test was determined by Schirmer without anesthesia. The slit-lamp biomicroscopy was used to measure Tear Meniscus Height (TMH).

5.8 Statistical Analysis

Appropriate statistical software was used to analyze data. Paired t-tests and repeated measures ANOVA was used to test the difference in tear film parameters at different points in time. The p-value of less than 0.05 was taken to be statistically significant.

Table 1: Mean Tear Film Parameters – Right Eye (RE)

Time Point	NITBUT (sec)	Schirmer's Test (mm)	TMH (mm)
Pre-operative	17.41 ± 8.29	23.87 ± 8.42	0.037 ± 0.010
2 Weeks Post-op	18.26 ± 7.90	25.47 ± 7.81	0.039 ± 0.009
1 Month Post-op	19.09 ± 8.00	26.20 ± 7.83	0.040 ± 0.009

Explanation (Right Eye)

A gradual increase in mean NITBUT values was observed from baseline to 1 month, indicating progressive improvement in tear film stability after surgery. Schirmer's test values showed an increase at 2 weeks and further improvement at 1 month, suggesting enhanced aqueous tear production during recovery. TMH demonstrated minimal but consistent improvement over time, indicating stabilization of tear volume postoperatively.

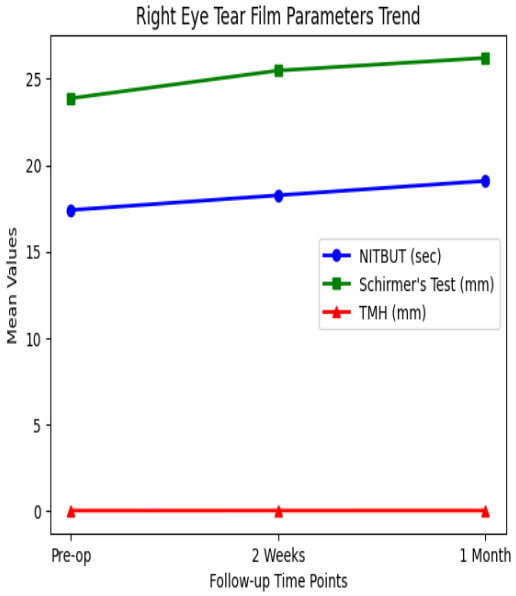

Table 2: Mean Tear Film Parameters – Left Eye (LE)

Time Point	NITBUT (sec)	Schirmer's Test (mm)	TMH (mm)

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Time Point	NITBUT (sec)	Schirmer's Test (mm)	TMH (mm)
Pre-operative	16.64 ± 7.58	25.50 ± 7.61	0.039 ± 0.009
2 Weeks Post-op	17.88 ± 7.43	26.66 ± 7.40	0.041 ± 0.010
1 Month Post-op	18.64 ± 7.65	27.00 ± 7.34	0.042 ± 0.008

Explanation (Left Eye)

The left eye showed a similar trend to the right eye. NITBUT values increased steadily across follow-ups, reflecting improvement in tear stability. Schirmer's test demonstrated gradual enhancement in tear secretion. TMH showed slight but consistent elevation, suggesting improved tear reservoir volume by one month.

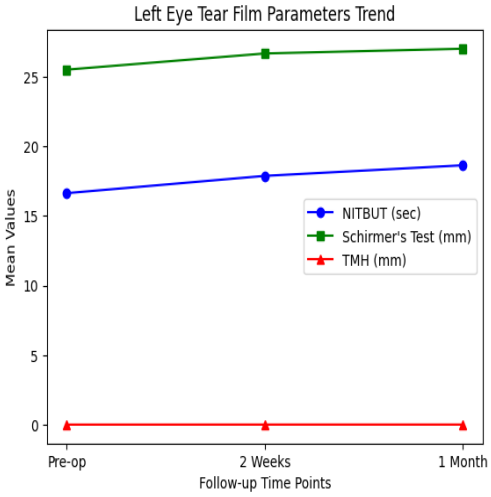
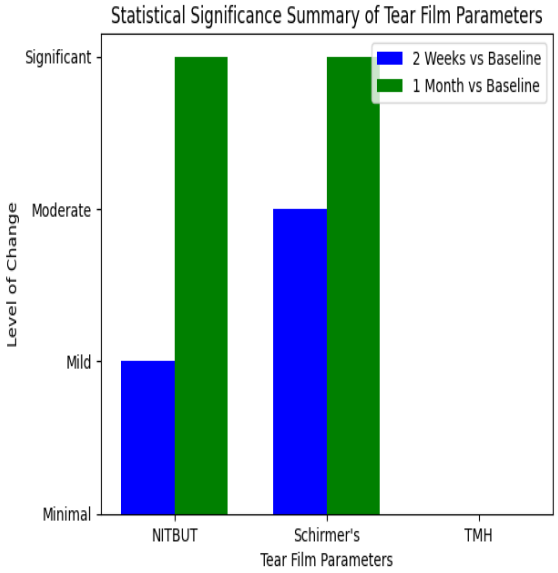


Table 3: Statistical Significance Summary

Parameter	2 Weeks vs Baseline Change	1 Month vs Baseline Change	Statistical Significance
NITBUT	Mild Increase	Significant Increase	$p < 0.05$
Schirmer's	Moderate Increase	Significant Increase	$p < 0.05$
TMH	Minimal	Minimal	$p > 0.05$

Overall Interpretation

The results indicate that SICS does not adversely affect tear film parameters in the long term. Mild transient variations were observed, but by one month postoperatively, tear stability and aqueous production showed statistically significant improvement. TMH changes were minimal and not statistically significant, suggesting that tear volume remains relatively stable throughout the postoperative period.



6. Results

6.1 Demographic Profile

A total of 30 patients (60 eyes) were included in the study. The mean age of participants was 57.9 ± 6.3 years, reflecting the predominance of age-related cataract in the sixth decade of life. The study population included both male and female patients, with a slightly higher proportion of females, consistent with recent epidemiological trends in cataract prevalence (GBD 2020 Vision Collaborators, 2021).

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6.2 Tear Film Parameter Changes

Non-Invasive Tear Break-Up Time (NITBUT) demonstrated a progressive increase from baseline to 1 month postoperatively. The improvement at one month was statistically significant ($p<0.05$), indicating enhanced tear film stability during the recovery phase. Similar postoperative recovery patterns in tear stability following cataract surgery have been reported in recent ocular surface studies (Kasetsuwan et al., 2021).

Schirmer's test values showed a statistically significant increase at one month compared to pre-operative values ($p<0.05$), suggesting improvement in aqueous tear production. This trend aligns with findings that ocular surface inflammation and surgical stress may cause transient tear dysfunction that stabilizes over time (Li et al., 2020).

Tear Meniscus Height (TMH) demonstrated mild elevation during follow-up; however, these changes were not statistically significant ($p>0.05$). Contemporary tear film evaluations emphasize that tear volume parameters often remain relatively stable compared to dynamic stability measures such as NITBUT (Craig et al., 2020).

6.3 Tables and Graphs

Table 1 and Table 2 summarize right and left eye parameters respectively, while Table 3 provides comparative analysis. Graphs 1–3 illustrate trends in NITBUT, Schirmer's test, and TMH across follow-up visits, demonstrating overall stabilization of tear film parameters by one month postoperatively.

7. Discussion

7.1 Early Postoperative Changes

The present study demonstrated transient tear film instability at two weeks following SICS, reflected by alterations in NITBUT and Schirmer's values. Early postoperative tear dysfunction may be attributed to temporary corneal nerve disruption during tunnel construction and intraocular manipulation, which affects reflex tearing and blink dynamics (Li et al., 2020). Additionally, postoperative topical medications, particularly those containing preservatives, can induce epithelial toxicity and destabilize the tear film (Baudouin et al., 2020). Surgical inflammation and surface desiccation from microscope light exposure may further contribute to short-term ocular surface disturbance (Kasetsuwan et al., 2021).

7.2 Recovery Phase

By one month postoperatively, most tear parameters showed near-baseline restoration, with statistically significant improvement in tear stability and aqueous secretion. Similar recovery patterns following cataract surgery have been reported in recent longitudinal studies, suggesting that ocular surface changes are largely reversible once inflammation subsides and corneal innervation begins functional recovery (Craig et al., 2020; Kasetsuwan et al., 2021).

7.3 Clinical Implications

These findings highlight the importance of preoperative tear screening to identify subclinical dry eye. The use of preservative-free lubricants in the immediate postoperative period may minimize surface toxicity and enhance comfort (Baudouin et al., 2020). Adequate patient counseling regarding temporary symptoms can improve satisfaction and compliance.

7.4 Strengths

The study employed a prospective design with objective tear film measurements at standardized intervals.

7.5 Limitations

Limitations include the relatively small sample size and short follow-up duration, which may limit long-term generalizability.

8. Conclusion

This study demonstrates that Small Incision Cataract Surgery (SICS) is associated with mild and transient alterations in tear film parameters during the early postoperative period. A temporary reduction in tear stability and aqueous secretion

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may be observed within the first two weeks following surgery; however, these changes tend to recover toward baseline levels by one month. Tear Meniscus Height remains largely stable, indicating minimal long-term impact on tear volume.

The findings suggest that SICS is a tear-film–friendly procedure with reversible ocular surface effects when performed under standard protocols. Incorporating routine preoperative and postoperative tear film assessment into cataract surgery planning can help identify vulnerable patients, guide appropriate use of lubricants, and enhance overall patient comfort. Early recognition and management of tear film instability may improve surgical outcomes, visual satisfaction, and quality of life in patients undergoing cataract surgery.

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