RESEARCH PAPER

Assessment of Tear Film Changes Before and After Small Incision Cataract Surgery in Patients with Age-Related Cataract

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ABSTRACT

Background: Cataract surgery is one of the most commonly performed ophthalmic procedures for visual rehabilitation. However, it may lead to alterations in tear film function, resulting in postoperative dry eye symptoms. Small Incision Cataract Surgery (SICS), widely practiced in developing countries, requires evaluation for its impact on tear film stability.

Aim: To assess pre- and postoperative tear film changes in patients with age-related cataract undergoing Small Incision Cataract Surgery.

Methods: This prospective observational study was conducted on 75 patients with age-related cataract at Meenakshi Medical College over a period of one year. Tear film assessment was performed preoperatively and postoperatively on Day 1, 1 week, and 4 weeks using Schirmer's test, Tear Film Break-Up Time (TBUT), and fluorescein corneal staining. Statistical analysis was carried out using paired t-test, with $p < 0.05$ considered significant.

Results: There was a significant reduction in Schirmer's test values and TBUT in the immediate postoperative period (Day 1 and 1 week) ($p < 0.001$), indicating decreased tear secretion and tear film instability. Fluorescein staining scores increased postoperatively, suggesting ocular surface disturbance. However, gradual improvement was observed by 4 weeks, with tear film parameters approaching preoperative values and no statistically significant difference.

Conclusion: Small Incision Cataract Surgery is associated with transient tear film dysfunction, which is most pronounced in the early postoperative period and gradually resolves within 4 weeks. Preoperative screening and appropriate postoperative management of tear film disturbances are essential to enhance patient comfort and surgical outcomes.

Keywords: Age-related cataract, Small Incision Cataract Surgery (SICS), Tear film, Dry eye, Schirmer's test, Tear Film Break-Up Time (TBUT), Fluorescein staining

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Introduction

Age-related cataract remains the leading cause of reversible blindness worldwide, particularly in developing countries where access to timely surgical intervention may be limited (1). Cataract extraction plays a critical role in reducing visual impairment and improving quality of life among the elderly population (2). Among the various surgical techniques, Small Incision Cataract Surgery (SICS) has gained widespread acceptance due to its cost-effectiveness, shorter surgical time, and favorable visual outcomes, especially in resource-constrained settings (3).

While the primary goal of cataract surgery is visual rehabilitation, increasing attention has been directed toward ocular surface and tear film alterations following surgery (4). The tear film is essential for maintaining corneal transparency, ocular comfort, and optimal visual quality (5). Disruption of tear film homeostasis can lead to dry eye symptoms, which may negatively affect postoperative satisfaction despite good visual acuity outcomes (6).

Several factors associated with cataract surgery contribute to tear film instability. These include corneal nerve damage caused by surgical incision, exposure to operating microscope light, use of topical medications containing preservatives, and postoperative inflammation (7,8). Although SICS involves a relatively larger incision compared to phacoemulsification, its specific effects on tear film dynamics have not been extensively studied (9), highlighting the need for further evaluation.

Additionally, pre-existing subclinical dry eye may be exacerbated following cataract surgery, making preoperative tear film assessment equally important (10). Evaluating changes in tear film parameters both before and after surgery can aid in early diagnosis and management of postoperative dry eye, thereby improving patient comfort and surgical outcomes (11). This study aims to assess the pre- and postoperative tear film changes in patients with age-related cataract undergoing Small Incision Cataract Surgery. By comparing tear film parameters, the study seeks to better understand the impact of SICS on ocular surface health and emphasize the importance of routine tear film evaluation in cataract management.

Materials and Methods

This prospective observational study was conducted in the Department of Ophthalmology at Meenakshi Medical College hospital & Research Institute over a period of one year, after obtaining approval from the Institutional Ethics Committee. The study adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

A total of 75 patients diagnosed with age-related cataract and scheduled for Small Incision Cataract Surgery (SICS) were included in the study. Patients were recruited consecutively based on predefined inclusion and exclusion criteria. Patients aged 50 years and above with age-related cataract who were willing to provide informed consent and undergoing uncomplicated SICS were included in the study. Patients with pre-existing ocular surface disorders such as dry eye or blepharitis (12), history of previous ocular surgery or trauma, use of topical medications affecting the tear film such as lubricants or antiglaucoma drugs (13), contact lens wearers, and those with systemic diseases affecting tear secretion such as Sjögren's syndrome or uncontrolled diabetes mellitus (14) were excluded.

All patients underwent a comprehensive preoperative ophthalmic evaluation including best corrected visual acuity (BCVA), slit-lamp biomicroscopy, intraocular pressure measurement, and fundus examination. Tear film evaluation was performed using Schirmer's test without anesthesia, where values less than 10 mm in 5 minutes were considered indicative of dry eye (15), tear film break-up time (TBUT), with values less than 10 seconds considered abnormal (16), and fluorescein corneal staining, which was assessed and graded using standard grading systems (17).

All patients underwent manual Small Incision Cataract Surgery (SICS) under aseptic precautions. A self-sealing scleral tunnel incision was made, followed by capsulotomy, nucleus delivery, cortical aspiration, and implantation of a posterior chamber intraocular lens (PCIOL). All surgeries were performed by experienced surgeons using a standardized technique. Postoperative treatment included topical antibiotics and corticosteroids in tapering doses.

Postoperatively, patients were followed up on Day 1, 1 week, and 4 weeks. At each follow-up visit, BCVA, slit-lamp examination, and tear film parameters including Schirmer's test, TBUT, and fluorescein staining were assessed.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Quantitative variables were expressed as mean ± standard deviation, and qualitative variables as percentages. Paired *t*-test was used to compare preoperative and postoperative values. A *p*-value <0.05 was considered statistically significant.

Results

A total of 75 patients with age-related cataract who underwent Small Incision Cataract Surgery (SICS) were included in the study. The mean age of the study population was 64.8 ± 7.2 years, with 42 (56%) males and 33 (44%) females.

Table 1: Demographic Distribution

Variable	Number (n=75)	Percentage (%)
Age 50–60 years	18	24%
Age 61–70 years	37	49.3%
Age >70 years	20	26.7%
Male	42	56%
Female	33	44%

The majority of patients belonged to the 61–70 years age group (49.3%), indicating that cataract prevalence increases with age. There was a slight male predominance (56%) in the study population.

Table 2: Comparison of Schirmer's Test Values

Time Point	Mean ± SD (mm)	p-value
Preoperative	18.6 ± 4.2	—

Time Point	Mean ± SD (mm)	p-value
Day 1	12.3 ± 3.8	<0.001
1 Week	14.8 ± 3.5	<0.001
4 Weeks	17.2 ± 3.9	0.08

There was a significant reduction in Schirmer's test values on postoperative Day 1 and at 1 week compared to preoperative values ($p < 0.001$), indicating decreased tear secretion following surgery. By 4 weeks, values improved and were not significantly different from baseline ($p = 0.08$), suggesting recovery of tear production.

Table 3: Comparison of TBUT Values

Time Point	Mean ± SD (seconds)	p-value
Preoperative	13.5 ± 2.8	—
Day 1	8.2 ± 2.5	<0.001
1 Week	10.4 ± 2.3	<0.001
4 Weeks	12.6 ± 2.6	0.06

TBUT values showed a statistically significant reduction in the early postoperative period (Day 1 and 1 week; $p < 0.001$), indicating tear film instability. At 4 weeks, TBUT values approached preoperative levels and were not statistically significant ($p = 0.06$), suggesting restoration of tear film stability.

Table 4: Fluorescein Staining Scores

Time Point	No Staining (%)	Mild (%)	Moderate (%)
Preoperative	60%	30%	10%
Day 1	28%	44%	28%
1 Week	40%	42%	18%
4 Weeks	55%	35%	10%

Fluorescein staining increased significantly in the immediate postoperative period, with a higher proportion of patients showing moderate staining on Day 1, indicating ocular surface damage. Gradual improvement was observed over time, with staining patterns returning close to baseline by 4 weeks.

Table 5: Incidence of Dry Eye

Time Point	Dry Eye Present (%)
Preoperative	12%
Day 1	48%
1 Week	32%
4 Weeks	16%

The incidence of dry eye increased markedly in the immediate postoperative period, peaking at 48% on Day 1. This gradually decreased over time, reaching near preoperative levels (16%) by 4 weeks, indicating that postoperative dry eye following SICS is transient.

Discussion

Cataract surgery, while primarily aimed at visual rehabilitation, has been shown to influence the ocular surface and tear film dynamics. In the present study, a significant reduction in tear film parameters was observed in the early postoperative period following Small Incision Cataract Surgery (SICS), with gradual recovery over time.

In our study, Schirmer's test and TBUT values showed a statistically significant decrease on postoperative Day 1 and at 1 week, indicating reduced tear secretion and tear film instability. These findings are consistent with the study by Kasetsuwan N et al. (18), who reported that cataract surgery induces transient dry eye due to disruption of corneal nerves and postoperative inflammation. The reduction in tear secretion observed in our study may be attributed to decreased corneal sensitivity following surgical incision.

Similarly, Li XM et al. (19) demonstrated that tear film instability and dry eye symptoms are common after cataract surgery, particularly in the early postoperative period. Their findings support our observation of a significant decrease in TBUT values immediately after surgery.

The increase in fluorescein staining scores in the early postoperative period in our study indicates ocular surface damage, which gradually improved by 4 weeks. This is in agreement with Cho YK et al. (20), who reported that ocular surface staining increases after cataract surgery due to epithelial disruption and inflammatory response, but shows recovery with time.

The incidence of dry eye in our study peaked on postoperative Day 1 and decreased progressively by 4 weeks. This transient nature of postoperative dry eye has also been reported by Sahu PK et al. (21), who observed that most patients experience temporary tear film disturbances that resolve within a few weeks after surgery.

Furthermore, our findings are supported by Ram J et al. (22), who emphasized that surgical factors such as incision size, light exposure, and use of topical medications contribute to postoperative tear film dysfunction, although these changes are usually reversible.

By the end of 4 weeks in our study, tear film parameters approached preoperative values, and the differences were not statistically significant. This suggests that although SICS causes temporary alterations in tear film

physiology, the ocular surface has the ability to recover over time.

Conclusion

Small Incision Cataract Surgery (SICS) is associated with a significant but transient alteration in tear film function. The present study demonstrated a marked reduction in Schirmer's test values and Tear Film Break-Up Time (TBUT), along with increased ocular surface staining in the immediate postoperative period, indicating tear film instability and dry eye changes. However, gradual recovery of tear film parameters was observed over time, with values approaching preoperative levels by 4 weeks. These findings suggest that postoperative dry eye following SICS is temporary and self-limiting. Nevertheless, preoperative evaluation of tear film status and early postoperative management are essential to minimize patient discomfort and improve overall surgical outcomes. Routine tear film assessment should be considered as an integral part of cataract surgery care

Conflict of Interest: The authors declare that there is no conflict of interest.

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