

Dry Eye Following Cataract Surgery: A Comparative Analysis between Manual SICS Vs Phacoemulsification**Aikya Gadhiya¹, Beena Viramgama², Yash Ajay Kumar Vagadia³, Neel Shriram Bhakare⁴**¹Class 1 Consultant, Government Eye Hospital, Morbi, Gujarat, India²Assistant Professor, JIS Medical College, Howrah, West Bengal, India³3rd Year PG Resident, Krishna Institute of Medical Sciences, Karad, Maharashtra, India⁴3rd Year PG Resident, Krishna Institute of Medical Sciences, Karad, Maharashtra, India

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Abstract:

Background: Dry eye syndrome, a clinical condition marked by insufficient tear secretion or increased tear evaporation, leads to ocular irritation and discomfort. This condition stems from changes in the tear film layer. Post-cataract surgery, numerous patients report sensations of foreign bodies, redness, and dry eye symptoms. The current study aimed to evaluate the frequency of dry eye development following manual small incision cataract surgery (SICS) and phacoemulsification at a teaching hospital.

Materials and Methods: This single-center, prospective observational study included patients aged 45 to 75 years scheduled for elective cataract procedures. Schirmer's test and tear break-up time (TBUT) were used to assess and document dry eye symptoms. A total of 200 eyes from patients were analyzed.

Results: Majority patients were aged 56-65 years and a slight predominance of female participants. The average age of participants was 68.89 ± 6.35 years. A greater proportion of patients underwent SICS (61.50%) compared to phacoemulsification (38.50%). Differences in dry eye incidence between the 1-week and 3-month follow-up, TBUT, and Schirmer's test values were statistically significant ($p < 0.5$). Comparing SICS to phacoemulsification at 1 month, dry eye incidence rates, TBUT, and Schirmer's test measurements also showed significant differences ($p < 0.05$).

Conclusion: Cataract surgeries may induce or exacerbate dry eye symptoms, influencing related test parameters for up to three months post-surgery, with a more pronounced effect observed in phacoemulsification compared to SICS.

Keywords: Cataract surgery, Phacoemulsification, Dry eye, Schirmer's test.

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Introduction

Dry eye disease is a complex, multifactorial condition affecting the tear film and ocular surface, leading to symptoms such as discomfort, visual disturbances, and tear instability, which may cause damage to the ocular surface. This condition is defined by insufficient tear production or excessive tear evaporation, resulting in ocular discomfort, often linked to alterations in the tear film [1].

Phacoemulsification remains the most commonly used method for cataract surgery worldwide. However, manual small incision cataract surgery (SICS) continues to be frequently performed due to its advantages, including lower cost, a smaller learning curve, and a reduced surgical duration. After cataract surgery, many patients report symptoms such as foreign body sensation, irritation, redness, and blurred vision, which are often seen despite a complication-free surgery.

These symptoms tend to be more pronounced in older patients and those with pre-existing ocular surface disorders [2,3]. Aging and surgical incisions are well-recognized factors contributing to postoperative dry eye. Additionally, the preoperative and postoperative use of topical medications, including non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and preservatives found in eye drops, can lead to epithelial toxicity and hinder the healing of the ocular surface following cataract surgery [4-7]. Cataract surgery is the most commonly performed procedure in ophthalmology, and since senile cataracts are the predominant cause of cataract surgery, identifying and managing ocular surface disease is crucial. The present study aims to assess the incidence of dry eye following manual SICS and phacoemulsification at a teaching hospital.

Material and Methods

The present study was a single-center, prospective, observational analysis spanning seven months duration. Patients aged 45 to 75 years scheduled for elective cataract surgery and willing to participate in the study were included.

The exclusion criteria included patients with a history of diabetes, complicated cataracts, previous ocular trauma or surgery, pre-existing dry eye (Schirmer's test result under 10 mm), Sjogren's syndrome, glaucoma, uveitis, lid or nasolacrimal pathway disorders, ocular allergies, pterygium, or any prior ocular surgeries.

The study procedures and goals were explained to each patient in their native language, and written informed consent was obtained. Preoperative evaluations included comprehensive history-taking, a full ocular examination with best-corrected visual acuity, slit-lamp inspection, dilated refraction, fundus examination, cataract grading, intraocular pressure (IOP) measurement via applanation tonometry, and sac syringing.

Slit-lamp examinations were performed to rule out ocular surface disorders. Based on their medical fitness, patients were then scheduled for cataract surgery via either manual small incision cataract surgery (SICS) or phacoemulsification. Standardized postoperative care was provided to all participants.

Dry eye was evaluated using Schirmer's test and the tear break-up time (TBUT) test. Schirmer's test assessed basal and reflex tear production using a 40

× 5 mm Whatman filter paper strip, marked from 0 to 35 mm. Results were categorized as follows: Grade 0 (Normal): >10 mm; Grade 1 (Mild): 5-10 mm; Grade 2 (Moderate): 3-4 mm; Grade 3 (Severe): 0-2 mm

TBUT evaluated tear film stability and meibomian gland dysfunction, with grading based on the time between the last blink and the appearance of a dry spot: Grade 0 (Normal): >10 seconds; Grade 1 (Fair): 6.1-10 seconds; Grade 2 (Moderate): 3.1-6 seconds; Grade 3 (Poor): <3 seconds

Observations were recorded at baseline, then at 1 week, 1 month, and 3 months postoperatively. Data was compiled in Microsoft Excel and analyzed using SPSS version 20.0. For continuous variables, means and standard deviations (SD) were calculated, while ratios and proportions were determined for categorical variables. Statistical significance for differences in proportions among qualitative variables was evaluated using the chi-square test or Fisher's exact test, with a p-value of less than 0.05 considered statistically significant.

Results

Table 1 shows Baseline Data. The study enrolled a total of 200 patients, with 61.5% undergoing Manual SICS and 38.5% undergoing Phacoemulsification. The cohort included 54.5% females and 45.5% males. The majority of participants were in the 56-65 years age group (49.5%). The mean age of participants was 68.89 ± 6.35 years, indicating a predominantly older patient population.

Table 1: Baseline data of study groups

Characteristics	n	%
Type of Cataract Surgery		
Manual SICS	123	61.50
Phacoemulsification	77	38.50
Gender		
Female	109	54.50
Male	91	45.50
Age groups		
46-55 years	31	15.50
56-65 years	99	49.50
66-75 years	70	35.00
Mean age (mean ± SD)	68.89 ± 6.35 years	

Postoperatively, the incidence of dry eye increased significantly. At 1 week follow-up, 36.5% of patients experienced dry eye symptoms.

This decreased at 1 month follow-up to 24.5%, and further decreased to 10.5% at 3 months follow-up (Table 2). Similarly, TBUT significantly decreased from 15.0 ± 0.30 seconds preoperatively to 8.05 ± 1.41 seconds at 1-week follow-up, showing a sharp

reduction post-surgery. At 3 months follow-up, TBUT returned to nearly baseline levels (Table 2). The preoperative value for the Schirmer's test was 22.65 ± 6.12 mm, indicating normal tear production.

Postoperatively, there was a marked reduction. All changes in Schirmer's test were statistically significant ($p < 0.01$).

Table 2: Occurrence of dry eye, TBUT and Schirmer's test results before and after cataract surgery

Parameters	Preoperative	1 week f.up; n (%)	1 month f.up; n (%)	3 months f.up; n (%)	p-value
Dry eyes	-	73 (36.50)	49 (24.50)	21 (10.50)	<0.01
TBUT (seconds)	15.0 ± 0.30	8.05 ± 1.41	12.12 ± 1.29	8.05 ± 1.41	<0.01
Schirmer's test (mm)	22.65 ± 6.12	14.38 ± 6.42	18.86 ± 2.73	21.34 ± 0.68	<0.01

Dry eye symptoms were more common in the Manual SICS group (32.5%) compared to the Phacoemulsification group (14.0%). This difference was statistically significant ($p < 0.01$), suggesting that Manual SICS may contribute to a higher incidence of dry eyes postoperatively (Table 3).

Table 3: Occurrence of dry eye, TBUT and Schirmer's test results in manual SICS vs Phacoemulsification

Parameters	Manual SICS	Phacoemulsification	p-value
Dry eyes	65 (32.50%)	28 (14.00%)	<0.01
TBUT (seconds)	11.21 ± 2.42	7.34 ± 2.05	<0.01
Schirmer's test (mm)	13.97 ± 3.13	11.74 ± 3.98	<0.01

Thus, Dry eye symptoms are frequently observed after cataract surgery, with notable improvement over time, particularly within the first three months. Results from the TBUT and Schirmer's test reveal a temporary decline in tear film stability and tear production following surgery, with a recovery trend seen at three months. Manual SICS is associated with a higher incidence of dry eye symptoms and more pronounced changes in both TBUT and Schirmer's test results compared to Phacoemulsification.

Discussion

Cataract surgery is known to alter both the qualitative and quantitative aspects of the tear film and ocular surface. Manual SICS and phacoemulsification are two techniques that differ in the location and depth of the incision. In manual SICS, a straight incision is made on the sclera superiorly, penetrating the cornea at the level of the Schwalbe line, while in phacoemulsification, the incision is made in the clear cornea at the temporal site. Several factors contribute to the outcomes of cataract surgery in patients with or without dry eye [8]. The causes of dry eye syndrome are multifactorial, including aging, gender, connective tissue disorders, metabolic conditions such as diabetes and hypertension, contact lens use, medications like antihistamines, anticholinergics, antidepressants, oral contraceptives, and eye drops with preservatives, as well as ocular diseases such as blepharitis, chronic conjunctivitis, meibomitis, and pterygium [9,10]. Prabtani RM et al. [11] compared dry eye incidence between phacoemulsification and manual SICS. No significant differences were found in tear film tests (Schirmer's test, TBUT, and TMH) between the groups (Chi-square $P = 0.605, 0.832, 1$). Additionally, the incidence of dry eye was similar in both techniques (Chi-square $P = 0.317$), with a higher incidence in diabetic patients (33.33%). Garg P et al. [12] studied 120 patients with senile

cataracts, with a mean age of 59.25 ± 9.77 years; 60.8% were male. Postoperative Schirmer's test values ranged from 12-35 mm and 8-24 mm at the first and second follow-ups, respectively. The mean TBUT was 13.16 ± 2.45 and 9.64 ± 2.20 seconds at the first and second follow-ups. Lissamine green staining showed grade 3 in 55.8% of patients at the first follow-up and grade 1 in 55.8% at the second follow-up. OSDI values ranged from 1-30 and 10-33, with means of 25.97 ± 5.34 and 11.96 ± 7.47 , respectively, at the first and second follow-ups. Grade 2 dry eye was observed in 89.1% of the phacoemulsification group and 92.2% of the SICS group at the first follow-up ($P < 0.001$), while at the second follow-up, grade 0 dry eye was found in 92.2% of the phacoemulsification group and 82.1% of the SICS group ($P < 0.001$). In a study by Saba Ishrat et al. [13], 96 patients (36.5% men, 63.5% women) with a mean age of 63.1 ± 8.3 years were evaluated. At 1-week post-surgery, 42% of eyes were dry ($P < 0.001$), with 15% and 9% of eyes remaining dry at 1 month and 3 months, respectively. At 1 week, 53.1% of dry eyes were found in the SICS group, and 22.2% in the phacoemulsification group, with a statistically significant difference. The SICS group had a mean TBUT of 10.0 ± 0.55 seconds at 1 week, compared to 13.9 ± 0.70 seconds in the phacoemulsification group ($P < 0.001$). Kumar J et al. [14] conducted a study on 110 eyes of 110 patients before and after manual SICS. The majority of participants were aged between 51 and 60 years (51%). At the 3-month follow-up, 30% of eyes showed lower tear meniscus height (TMH), and 8% had a reduced tear film break-up time (TBUT), with statistically significant results ($P < 0.01$). Significant ocular surface changes, as assessed by Rose Bengal staining, were observed between preoperative and postoperative assessments at 1 week, 1 month, and 3 months ($P < 0.002$). Khadke A et al. [15] assessed 390 patients who underwent cataract surgery, finding a 22.1% incidence of residual dry

eye at 3 months post-surgery (95% CI 17.94 to 26.17). Of these, 31% had mild, 67% had moderate, and 2% had severe dry eye. The incidence was higher in manual SICS compared to phacoemulsification, with a significant association found between dry eye and diminished vision ($P = 0.001$). Gupta M et al. [16] studied 50 eyes of 50 patients who underwent clear corneal phacoemulsification with intraocular lens (IOL) implantation. SIT and FTBUT, as well as conjunctival staining, were at their lowest during the first week ($P < 0.05$), with values approaching baseline by the 12th week ($P < 0.05$). Dry eye was observed in 38% of patients in the 45–55 age group, 50% in the 56–65 age group, and in all patients in the 66–75 age group by the 12th week. This study concluded that phacoemulsification negatively affects tear film stability and tear production postoperatively, with a more pronounced impact in older patients. Phacoemulsification remains the preferred cataract surgery technique due to its speed, safety, and good visual outcomes. However, as with other corneal surgeries, it can disrupt ocular surface and tear function postoperatively [17]. The incidence of dry eye syndrome in cataract surgery patients is influenced by several factors, including the type of procedure, ophthalmic solutions used, intraoperative medications, systemic conditions, exposure to operating microscope light, cumulative dissipated energy (CDE) during the procedure, and time since surgery [18-20].

Conclusion

Cataract surgery, particularly phacoemulsification, has the potential to either induce or exacerbate dry eye symptoms, leading to significant alterations in dry eye test results during the postoperative period, which may persist for up to three months. This effect is more pronounced following phacoemulsification compared to manual SICS. Therefore, a thorough preoperative ophthalmological evaluation for dry eye is essential in patients scheduled for either phacoemulsification or SICS. Early identification and prompt management of any postoperative worsening are crucial to preventing further damage to the ocular surface and avoiding negative impacts on the patient's quality of life and vision due to dry eye syndrome.

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