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# Study of tear film status in patients undergoing phacoemulsification surgery

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ABSTRACT

**Background:** The present study was undertaken to study the tear film status preoperatively and post-operatively in patients undergoing phacoemulsification surgery.

**Materials and Methods:** The study was conducted as prospective study on 100 patients undergoing phacoemulsification surgery during the study period of 1 year. Work up for tear film status including Schirmer's test, staining of cornea and conjunctiva with fluorescein dye, TBUT (tear film break up time) was done preoperatively and postoperatively after phacoemulsification.

**Results:** Mean Schirmer's value at preoperative assessment was 27.45±4.95 whereas that at post operative day 7, 15 and 30 was 9.09±2.19, 16.73±5.12 and 24.45±4.05 respectively. Similarly, mean TBUT at preoperative level was 11.11±1.16 which reduced to 6.63±1.57 at day 7, 7.37±1.44 at day 15 and 9.77±0.91 at day 30. Test of significance (ANOVA) showed statistically significant difference in mean Schirmer's and TBUT values at various follow ups post-operatively as compared to baseline ($p<0.01$).

**Conclusion:** Cataract surgery can lead to dry eye due to incision itself as well as due to intra-operative exposure to the microscope light. Thus, artificial tears must be prescribed to improve the quality of life during immediate post-operative period. However, gradually, tear film status improved. We only followed up patients till one month, a long term follow up is recommended to assess the time taken for the tear film to recover to its preoperative status.



## 1. Introduction

Dry eye disease is a multifactorial disease that results due to tear deficiency and over-evaporation and is characterized by ocular discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface.[1–4] Dry eye significantly affects the quality of life of an individual, especially among the elderly population. Moderate to severe dry eye has been associated with impaired ability to perform activities of daily living and it harms work productivity. Also, dry eye hurts mood as well as confidence.[5,6]

The prevalence of dry eye in India has been estimated to range between 18.4% and 40.8%.[7,8] As dry eye is a multifactorial disease, one of the major risk factors for dry eye is ocular procedures such as cataracts or LASIK.[9,10] It has been documented that cataract surgery leads to damage to nerves of the cornea and thus results in impaired sensation which in turn leads to reduced tear production from the lacrimal gland and hence dry eye.[11]

Cataract is the leading cause of reversible blindness among the elderly population. With an increase in the incidence of cataracts, the rate of surgeries for cataracts has increased dramatically. Phacoemulsification is the preferred surgical procedure for cataracts as it requires smaller incisions, and is associated with less post-operative

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astigmatism and early stabilization of refraction.[12] Various factors have been implicated in dry eye disease following phacoemulsification surgery which includes damage of the corneal nerves by incision itself; free radical production due to the use of ultrasound, prolonged exposure to microscope light during surgery along with pre-and post-operative medications.[13] With the above background, the present study was undertaken to study the tear film status preoperatively and post-operatively in patients undergoing phacoemulsification surgery.

## 2. Materials and Methods

After obtaining institutional ethics committee clearance, the present study was conducted as a prospective study in Department of Ophthalmology BMHRC, Bhopal, M.P. 100 patients were included in the study who underwent phacoemulsification surgery during the study period of nearly 1 year i.e., from $1^{st}$ November 2018 to $30^{th}$ October 2019.

### 2.1. Sample size

Sample size was estimated using the formula $N = Z^2 \times P \times (1\text{-}P) \times D / E^2$.

Thus, sample size was estimated to be 55 but a total of 100 patients were included.

### 2.2. Inclusion criteria

Patients presenting in eye OPD for cataract surgery with BCVA- better than perception of light (PL) and projection of light rays present (PR), clear cornea and normal conjunctiva, eyelids and eyelashes.

### 2.3. Exclusion criteria

Patients with dry eye, lid abnormalities like ectropion, entropion, blepharitis or trichiasis and corneal abnormalities were excluded from the study. Patients with history of previous intraocular surgery and those who required suturing after surgery were also excluded.

After obtaining ethical clearance from Institute's ethical committee, all the patients fulfilling inclusion criteria were selected and written consent was obtained from them. Detailed history regarding sociodemographic variables such as age, gender, socioeconomic status was obtained and entered in questionnaire. After obtaining detailed history regarding visual symptoms, co-morbid conditions, and other relevant information, all the patients were subjected to complete ophthalmic evaluation including Visual acuity, torch light and slit lamp examination. Work up for tear film status including Schirmer's test, staining of cornea and conjunctiva with fluorescein dye, TBUT (tear film break up time) was also done during preoperative assessment. All the patients underwent phacoemulsification surgery for cataract extraction under aseptic precautions. All the patients were then evaluated for dry eye post-operatively on day $7^{th}$, $15^{th}$ and $30^{th}$ using Schirmer's, TBUT, staining pattern of cornea and conjunctiva.

### 2.4. Statistical analysis

Data was compiled using MS Excel and analyzed using IBM SPSS software version 20. Categorical data was expressed as frequency and percentage whereas numerical data was expressed as mean and SD. ANOVA test and subgroup analysis was done to assess the mean change in Schirmer's and TBUT values from preoperative period to follow up. P value less than 0.05 was considered statistically significant.

## 3. Results

A total of 100 patients who underwent phacoemulsification surgery were enrolled in our study. Majority of patients who underwent phacoemulsification surgery belonged to 61 to 70 years of age group (53%) followed by 30% patients belonging to 51 to 60 years of age. About 54% cases were females and 61% cases were operated for right eye. (Table 1)

**Table 1:** Distribution of patients according to Baseline variables

| Baseline variables | | Frequency (n=100) | Percent |
|---|---|---|---|
| Age group | ≤50 | 6 | 6.0 |
| | 51-60 | 30 | 30.0 |
| | 61-70 | 53 | 53.0 |
| | >70 | 11 | 11.0 |
| Gender | Male | 46 | 46 |
| | Female | 54 | 54 |
| Eye | Right | 61 | 61 |
| | Left | 39 | 39 |

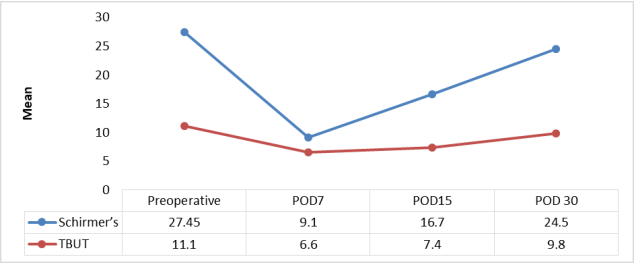


**Figure 1:** Comparison of mean Schirmer's and TBUT values at various follow up

During preoperative period 100% patients had normal Schirmer's test findings whereas at post-operative day 7 and day 15, 86% and 23% cases respectively had moderate dry eye (<10) according to Schirmer's. After one month following surgery, 100% patients had normal Schirmer's test finding. However, 76% patients had normal TBUT

**Table 2:** Distribution of patients according to dry eye and staining pattern

| Dry eye | | Preoperative | Post op day 7 | Post op day 15 | Post op day 30 |
|---|---|---|---|---|---|
| | Normal | 100 (100) | 2 (2) | 77 (77) | 100 (100) |
| Schirmer | ≤10 | 0 (0) | 86 (86) | 23 (23) | 0 (0) |
| | ≤5 | 0 (0) | 12 (12) | 0 (0) | 0 (0) |
| | Normal | 76 (76) | 0 (0) | 0 (0) | 13 (13) |
| TBUT | ≤10 | 24 (24) | 70 (70) | 81 (81) | 87 (87) |
| | ≤5 | 0 (0) | 30 (30) | 19 (19) | 0 (0) |
| | Nil | 100 (100) | 0 (0) | 0 (0) | 76 (76) |
| Staining pattern cornea | Central punctate | 0 (0) | 53 (53) | 0 (0) | 0 (0) |
| | Diffuse punctate | 0 (0) | 47 (47) | 0 (0) | 24 (24) |
| | Reduced | 0 (0) | 0 (0) | 100 (100) | 0 (0) |
| | Nil | 100 (100) | 0 (0) | 44 (44) | 80 (80) |
| Staining pattern conjunctiva | Minimal | 0 (0) | 0 (0) | 35 (35) | 20 (20) |
| | Moderate | 0 (0) | 38 (38) | 0 (0) | 0 (0) |
| | Marked | 0 (0) | 62 (62) | 21 (21) | 0 (0) |

**Table 3:** Subgroup analysis of mean Schirmer's and TBUT values at various follow up

| Timing | Shimmer's | | | TBUT | | |
|---|---|---|---|---|---|---|
| | Mean difference | SE | P value | Mean difference | SE | P value |
| Preoperative vs POD 7 | 18.360* | 0.600 | 0.000 | 4.480* | 0.183 | 0.000 |
| Preoperative vs POD 15 | 10.720* | 0.600 | 0.000 | 3.740* | 0.183 | 0.000 |
| Preoperative vs POD 30 | 3.000* | 0.600 | 0.000 | 1.340* | 0.183 | 0.000 |

preoperatively whereas 30% and 19% cases had severe dry eye according to TBUT at $7^{th}$ and $15^{th}$ postoperative day.

Staining pattern of cornea and conjunctiva was normal in 100% cases during preoperative period whereas that at final follow up 70% and 80% patients respectively had normal staining pattern, respectively. (Table 2)

Mean Schirmer's value at preoperative assessment was 27.45±4.95 whereas that at post-operative day 7, 15 and 30 was 9.09±2.19, 16.73±5.12 and 24.45±4.05, respectively. Similarly, mean TBUT at preoperative level was 11.11±1.16 which reduced to 6.63±1.57 at day 7, 7.37±1.44 at day 15 and 9.77±0.91 at day 30. Test of significance (ANOVA) showed statistically significant difference in mean Schirmer's and TBUT values at various follow ups postoperatively as compared to baseline ($p<0.01$). (Figure 1), (Table 3).

Subgroup analysis was done to assess the mean difference in Schirmers and TBUT values at each follow up as compared to baseline using Tukey HSD. The mean difference in Schirmer's and TBUT values at all follow ups as compared to baseline were significantly highly significant ($p<0.01$).

## 4. Discussion

The present study aimed at assessing the occurrence of dry eye following phacoemulsification surgery or aggravation of the symptoms of dry eye. Literature suggest that tear film status is adversely affected following cataract surgery especially during the early postoperative period.[14,15] The basic pathology associated with dry eye is either deficient production of aqueous humour or excessive evaporation of tears. The dry eye after cataract surgery has been estimated to be short termed. It is difficult to assess the dry eye by a single test, thus, our study included Schirmer's test as well as TBUT to assess the presence of dry eye. Our study observed occurrence of dry eye in all the patients at post operative day 7 and 15 whereas at day 30 Schirmer's test were in normal range in majority of patients but moderate dry eye as observed at $30^{th}$ postoperative day according to TBUT in 87% cases. Similarly, staining patter of both cornea as well as conjunctiva was affected in immediate postoperative period which was improved in majority of cases at post-operative day 30. Hawaiian Eye study in their multicentric study documented that > 60% of eyes had abnormal TBUT, 50% of eyes had central corneal staining and 21.3% of eyes had low Schirmer test results postoperatively after cataract surgery.[16]

Our study documented statistically significant reduction in mean Schirmer's and TBUT values at all the follow up levels when compared to preoperative values. Though at $30^{th}$ postoperative day mean Schirmer's and TBUT values were near preoperative values, but the difference was statistically significant ($p<0.01$).

The findings of present study were supported by findings of Sahu et al, in which mean preoperative Schirmer's and TBUT decreased progressively on day 5 and day

10 postoperatively and then showed a gradual rise at 2 months follow up. However, the difference was statistically significant at all follow up as compared to preoperative values ($p<0.01$).[13]

Similar to present study, Ram et al. observed significant reduction in mean Schirmer's and TBUT values in 25 eyes at various time intervals up to 2 months as compared to preoperative values.[14] Li et al. also documented significant deterioration in both Schirmer's test and TBUT values in 50 eyes, when followed up to 3 months.[9] The findings of Khanal et al supported the finding of present study. They observed deterioration in corneal sensitivity as well as tear physiology immediately during the postoperative period after phacoemulsification whereas the tear functions recovered within 1-month.[16] Our study also observed similar trends i.e., Schirmer's and TBUT values showed improving trend at 30th postoperative day.

The possible pathology associated with dry eye after phacoemulsification could be severing of corneal nerves due to corneal incision which resulted in disruption of corneal - lacrimal gland loop responsible for tear secretion.[17] Also, the reduction of TBUT could be due to surface irregularity at the site of the incision, which may be associated with faster break-up of the tear film, or from a decreased mucin production by the conjunctiva.

## 5. Conclusion

The results of our study to assess dry eye post phacoemulsification showed that cataract surgery may result in dry eye symptoms. This can be attributed to both the incision made during the surgery and the exposure to microscope light during the procedure. Consequently, the prescription of artificial tears is crucial to enhance the quality of life during the immediate postoperative period. However, as time progresses, our study population had an observable improvement in the tear film status. It is important to note that our follow-up period only extended up to one month, and thus, a long-term follow-up is highly recommended to assess the duration required for the tear film to fully recover to its preoperative state.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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