## ORIGINAL RESEARCH

# Comparative evaluation of dry eye syndrome in patients following phacoemulsification and manual small incision cataract surgery

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## ABSTRACT

**Background: Cataract is the major cause of blindness in the developing world. This study aimed at evaluation of tear film stability and tear secretion after phacoemulsification compared with MSICS.**

**Materials and methods: This was a prospective, comparative randomized study that included 100 patients diagnosed with senile cataract. Patients fulfilling the inclusion and exclusion criteria were enrolled and randomized into 2 groups of 50 patients each: Group A who underwent manual small incision cataract surgery (SICS) and Group B who underwent cataract surgery with phacoemulsification technique. Post-operatively follow up was done at 1 week, 1 month and 3 months respectively in both the groups. The patients were subjected to same TBUT, Schirmer's and OSDI scoring at each visit.**

**Results: Comparison between two groups showed non significant tear film and ocular surface indices over period of three months. Both groups showed initial reduction in mean Schirmer's and TBUT at immediate postoperative period ( 1 week) followed by gradual improvement to near baseline at 1 and 3 months postoperative follow up period but still significantly lower than the preoperative values. Both groups showed initial increased in mean OSDI score at 1 week followed by gradual decreased in mean OSDI score at 1 and 3 months postoperative follow up period.**

**Conclusion: Cataract surgery has detrimental effect on tear function in the immediate postoperative period. Effects gradually recover following a month of surgery but do not come to preoperative levels even by 3 months. This holds true for both SICS and phacoemulsification.**

**Keywords: SICS, Phacoemulsification, Dry Eye.**

## INTRODUCTION

According to the international dry eye workshop, Dry eye disease is an abnormality in the quality or quantity of tear film or in tear film dynamics due to any cause, resulting in ocular discomfort, visual disturbance, reduced tear film stability, and potential damage to the ocular surface. [1] The various symptoms observed in dry eye syndrome include dryness, irritation, burning, foreign body sensation, heaviness of the eyelids, redness, excessive lacrimation, ocular pain and fatigue. It may also cause punctate keratitis, persistent epithelial defects, filamentary keratopathy, superior limbic keratoconjunctivitis and diminution of vision. [2]

Intact corneal innervation is binding for normal blinking and tearing reflexes, which in turn is essential to maintain the integrity of the ocular surface. Under normal physiological conditions the sensory nerves in the cornea transmits an afferent signal through the ophthalmic division of the fifth nerve to the brain stem and then, after series of interneurons, the efferent signal is furthur transmitted to the lacrimal gland through parasympathetic and sympathetic nerves which innervate the lacrimal gland and results in tear production and secretion. [3] Any damage to these neuronal circuits interrupts the normal regulation of lacrimal gland function which influences both basal and reflex tear production. This is a major pathogenic pathways in causation of postoperative dry eye in patients undergoing ophthalmic surgeries**.** **[4]**

Cataract surgery is known to modify tear film & ocular surface both qualitatively & quantitatively.[5] Manual small-incision cataract surgery (manual SICS) and phacoemulsification techniques have different characteristics in site and depth of incision. In former, a straight incision is made on the sclera superiorly which penetrates the cornea at the Schwalbe line level, whereas phacoemulsification an incision which is made on clear cornea at the temporal site. [6]

Various factors play an important role in outcome of the patients with or without dry eye that undergo cataract surgery. Most important of these is postoperative corneal desensitization.[7] In SICS there is also big corneoscleral tunnel incision so there occurs denervation of a bigger part of cornea, which is associated with persistent foreign body sensation and irritation and pooling of mucus and debris in the groove.**[8]** On the contrary, in phacoemulsification cataract surgery, the incision size is much smaller. Thereby causing less corneal denervation so higher prevalence and a more severe dry eyes are seen in patients who undergo SICS as compared to those who undergo phacoemulsification surgery.[8]

The aim of this study was to investigate whether cataract surgery by small incision cataract surgery or phacoemulsification technique causes development of dry eye or tear film changes postoperatively in otherwise normal patients and compare the test scores preoperatively and postoperatively. The study also aimed at evaluation of tear film stability and tear secretion after phacoemulsification as compared with small incision cataract surgery (SICS.)

## MATERIALS & METHODS

This comparative study was conducted on 100 patients of cataract who visited Department of Ophthalmology, Government Medical College Patiala after fulfilling the inclusion criteria. A written and informed consent was taken from the patients.

Patients diagnosed with senile cataract of age above 50 years and below 80 years were included. Exclusion criteria were patients who has undergone ocular surgery in the past, patients who wear contact lenses for longer periods, patients who had ocular or extraocular diseases other than cataract that could affect tear film function, such as blepharitis, ocular allergy, thyroid disease, lacrimal system disease or dry eye disorder, diabetes mellitus, collagen vascular disorder and use of any topical or systemic drug in the 3 months period before examination and patients who were on chronic ocular medication.

A detailed history taking was done including age, sex, ocular symptoms, detailed history of diabetes, history of allergy, smoking history, drug intake, joint pain, chemical injury. The presence of any systemic disease, history of ocular surgeries, trauma or contact lens use and ocular medications was noted.

After recording visual acuity with Snellen's chart, Slit lamp examination was performed to check for presence of any anatomical abnormalities that will interfere with normal spread of tear film. Meibomian orifices were examined for pouting, presence of foam, secretion and plugging.

Ocular Surface Disease Index was calculated by asking 12 questions: questions 1–5 refer to ocular pain or visual difficulties; questions 6–9 are about visual functionality in daily life such as reading or driving at night; and questions 10–12 analyze environmental factors such as air conditioning or wind. The number in the box that best represents each answer was circled. The OSDI score was assessed on a scale of 0 to 100, with higher scores representing greater disability. The index demonstrates sensitivity and specificity in distinguishing between normal subjects and patients with dry eye disease.

Schirmer's test was performed with a strip of commercially available pre-sterilized Whatman 41 filter paper measuring 5mm x 35mm without anaesthesia. A value less than 10 mm was taken as dry eye.

Tear break up Time (TBUT) was tested by instilling a 2% fluorescein dye into the inferior conjunctival fornix and measuring the time taken for the appearance of the first randomly distributed dark spot in the pre-corneal tear film under broad beam of cobalt blue light of slit lamp biomicroscope. A value less than 10 seconds was taken as abnormal.

CORNEAL SURFACE FLOURESCEIN STAINING was done by instilling a 2% fluorescein dye into the inferior conjunctival fornix and slit lamp examination was performed to grade the whole corneal surface

Grading Scheme: Corneal staining of area was graded as follows-

1. Grade 0: the cornea showed no punctuate staining.
2. Grade 1: <1/8 of the corneal surface stained.
3. Grade 2: >1/8 to <1/4 of the corneal surface stained.
4. Grade 3: >1/4 to <1/2 of the corneal surface stained.
5. Grade 4: entire corneal surface area stained.

The diagnosed cases of cataract were subjected to various routine investigations. The Patients were divided into 2 groups with Group A comprising of 50 patients who underwent manual small incision cataract surgery (SICS) and Group B comprising of patients who underwent cataract surgery with phacoemulsification technique.

Post-operatively follow up was done at 1 week, 1 month and 3 months respectively in both the groups. The patients were subjected to same TBUT, Schirmer"s, OSDI scoring and corneal surface fluorescein staining at each visit.

## STATISTICAL ANALYSIS

The data was collected from the patients using case report form. The data was entered in excel and analysed using SPSS version 20. Student T test and Wilcoxon signed rank test was used for assessment of level of significance. p-value of less than 0.05 was taken as significant

## RESULTS AND OBSERVATION

The mean age of SICS and phaco groups were 63±8 and 63.6±8 years. Baseline indices of tear film were taken preoperatively according to the standardized techniques.

**Table-1 Postoperative values of tear function tests at 1 week**

| | GROUP-A (SICS) | | | GROUP-B (PHACO) | | |
|---|---|---|---|---|---|---|
| | **PRE-OP** | **1 WEEK POST-OP** | **p-Value** | **PRE-OP** | **1 WEEK POST-OP** | **p-Value** |
| **TBUT** | 13.7 ± 2.45 | 10.76 ± 2.79 | 0.0001 | 13.9 ± 2.04 | 11.2 ± 2.12 | 0.0001 |
| **SCHIRMER'S** | 21.7 ± 3.13 | 16.2 ± 2.65 | 0.0001 | 22 ± 3.49 | 17.2 ± 2.74 | 0.0001 |
| **OSDI SCORE** | 7.12 ± 3.62 | 19.3 ± 7.18 | 0.0001 | 7.79 ± 4.03 | 18.11 ± 5.18 | 0.0001 |

**Table-2 Postoperative values of tear function tests at 1 month**

| | GROUP-A (SICS) | | | GROUP-B (PHACO) | | |
|---|---|---|---|---|---|---|
| | PRE-OP | 1 MONTH POST-OP | p-Value | PRE-OP | 1 MONTH POST-OP | p-Value |
| TBUT | 13.7 ± 2.45 | 11.86 ± 3.18 | 0.0001 | 13.9 ± 2.04 | 11.96 ± 2.33 | 0.0001 |
| SCHIRMER'S | 21.7 ± 3.13 | 18.44 ± 2.86 | 0.0001 | 22 ± 3.49 | 19.4 ± 2.40 | 0.0001 |
| OSDI SCORE | 7.12 ± 3.62 | 14.7 ± 5.04 | 0.0001 | 7.79 ± 4.03 | 13.7 ± 4.90 | 0.0001 |

**Table-3 Postoperative values of tear function tests at 3 months**

| | GROUP-A (SICS) | | | GROUP-B (PHACO) | | |
|---|---|---|---|---|---|---|
| | PRE-OP | 3 MONTHS POST-OP | p-Value | PRE-OP | 3 MONTHS POST-OP | p-Value |
| TBUT | 13.7 ± 2.45 | 12.84 ± 2.82 | 0.0033 | 13.9 ± 2.04 | 12.94 ± 2.19 | 0.0035 |
| SCHIRMER'S | 21.7 ± 3.13 | 20.58 ± 2.99 | 0.0106 | 22 ± 3.49 | 21 ± 2.14 | 0.0181 |
| OSDI SCORE | 7.12 ± 3.62 | 11.6 ± 5.04 | 0.0001 | 7.79 ± 4.03 | 10.8 ± 5.61 | 0.0001 |

In both Group A (SICS) and Group B (PHACO), the patients had significantly lower TBUT and Schirmer's values **(p-Value < 0.05)** 1 week and at 1 month after Cataract surgery as compared to preoperative values and had significantly increased OSDI score **(p-Value < 0.05)** 1 week and at 1 month after surgery as compared to preoperative OSDI score.(Table 1 and 2)

At 3 months, the TBUT and Schirmer's values returned to near baseline (preoperative) values in both Group A (SICS) and Group B (PHACO) but still significantly lower **(p-Value < 0.05)** than the preoperative values whereas the OSDI scores at 3 months postoperatively period started to decrease as compared to the 1 week postoperative period, but are still significantly greater than preoperative or baseline values as shown in Table 3.

**Table-4 TBUT changes over period of 3 months**

| TBUT/ VISITS | GROUP A (SICS) | GROUP B (PHACO) | p-value |
|---|---|---|---|
| Preoperatively | 13.7±2.45 | 13.9±2.04 | 0.6583 |
| 1 Week Post-Op | 10.76±2.79 | 11.2±2.12 | 0.3555 |
| 1 Month Post-Op | 11.86±3.18 | 11.96±2.33 | 0.8580 |
| 3 Months Post-Op | 12.84±2.82 | 12.94±2.19 | 0.8435 |

**Table-5 Schirmer's test changes over period of 3 months**

| Schirmer's/Visits | GROUP-A (SICS) | GROUP-B (PHACO) | p-value |
|---|---|---|---|
| Preoperatively | 21.7±3.13 | 22±3.49 | 0.6518 |
| I Week Post-Op | 16.2±2.65 | 17.2±2.74 | 0.0666 |
| 1 Month Post-Op | 18.44±2.86 | 19.4±2.40 | 0.0721 |
| 3 Months Post-Op | 20.58±2.99 | 21±2.14 | 0.4211 |

**Table-6 OSDI score changes over period of 3 months**

| OSDI Scoring | GROUP A (SICS) | GROUP B (PHACO) | p Value |
|---|---|---|---|
| Preoperatively | 7.12 ± 3.62 | 7.79 ± 4.03 | 0.3840 |

| | | | |
|---|---|---|---|
| 1 Week Post-op | 19.3 ± 7.18 | 18.11 ± 5.18 | 0.3442 |
| 1 Month Post-op | 14.7 ± 5.04 | 13.7 ± 4.90 | 0.3169 |
| 3 Months Post-op | 11.6 ± 5.33 | 10.8 ± 5.61 | 0.4665 |

Comparison between two groups showed non-significant TBUT, Schirmer's and OSDI score changes over period of three months.(Tables 4-6)

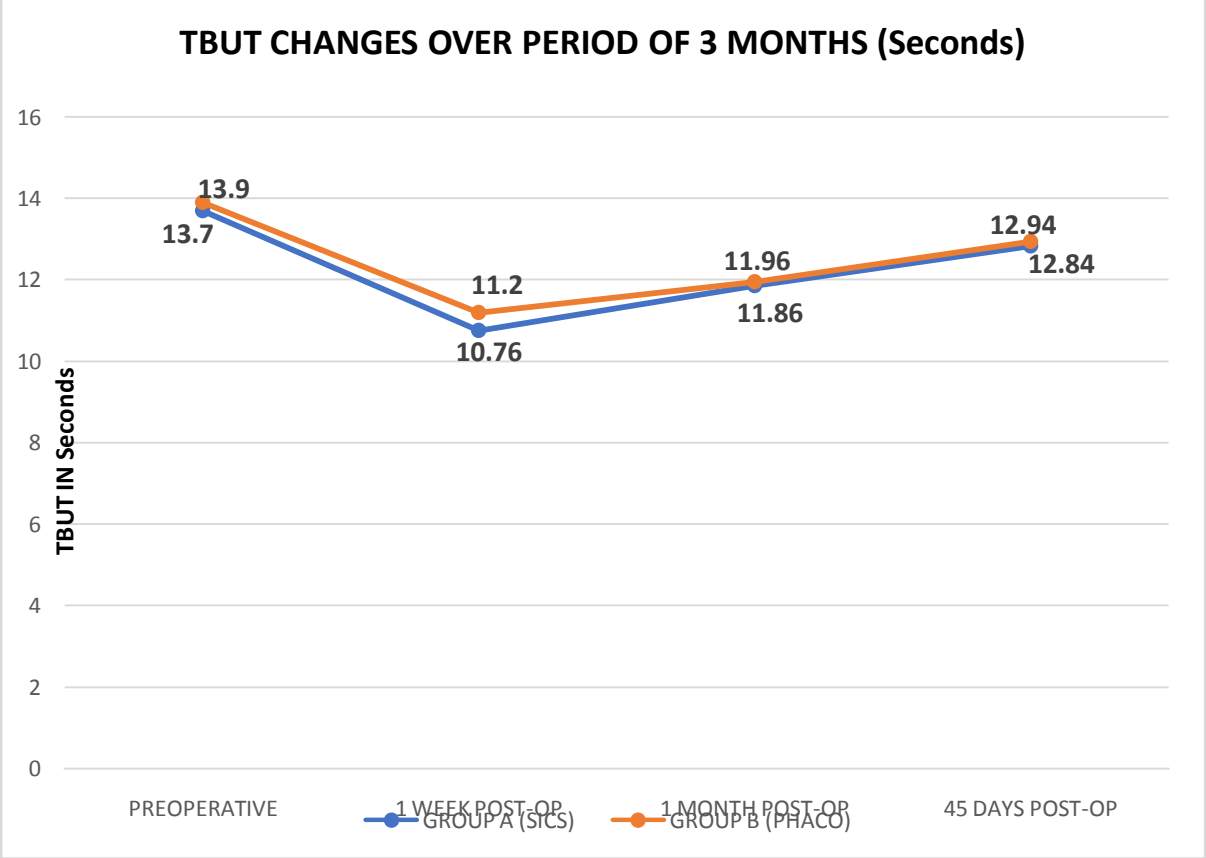


**Figure-1**

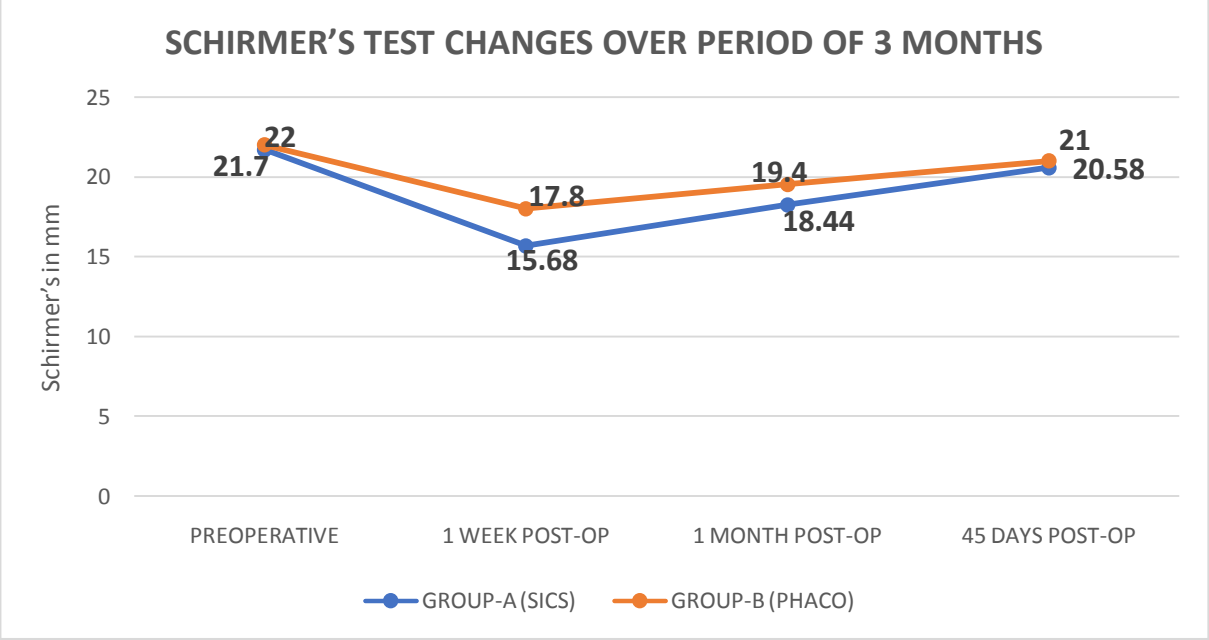


**Figure-2**

Both groups Group A and Group B showed initial reduction in mean TBUT and Schirmer's at immediate postoperative period (1 week) followed by gradual improvement in mean TBUT at 1 and 3 months postoperative follow up period but still significantly lower than the preoperative values.(figure 1,2)

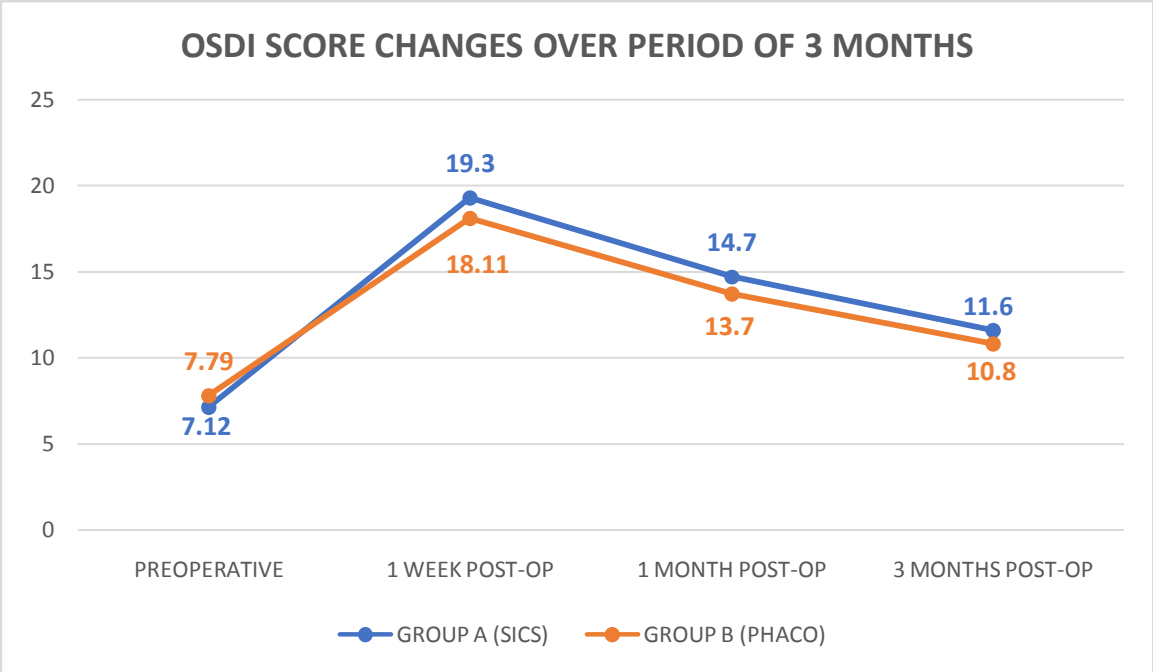


**Figure-3**

Both groups showed initial increased in mean OSDI score at immediate postoperative period (1 week) followed by gradual decreased in mean OSDI score at 1 and 3 months postoperative follow up period , but are still significantly greater than preoperative or baseline values.(figure 3)

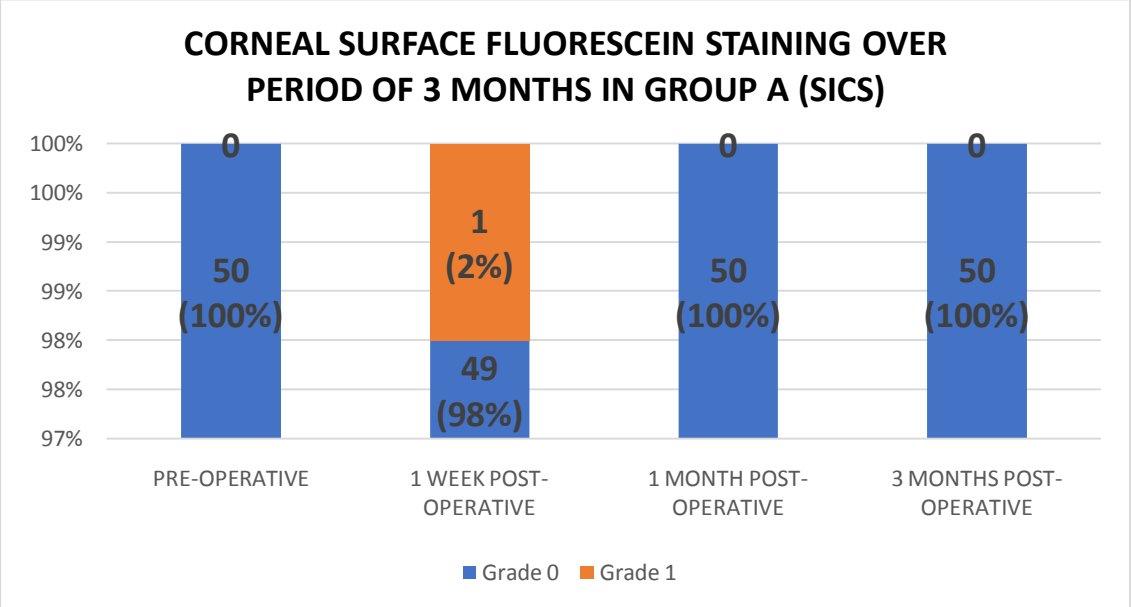


**Figure-4**

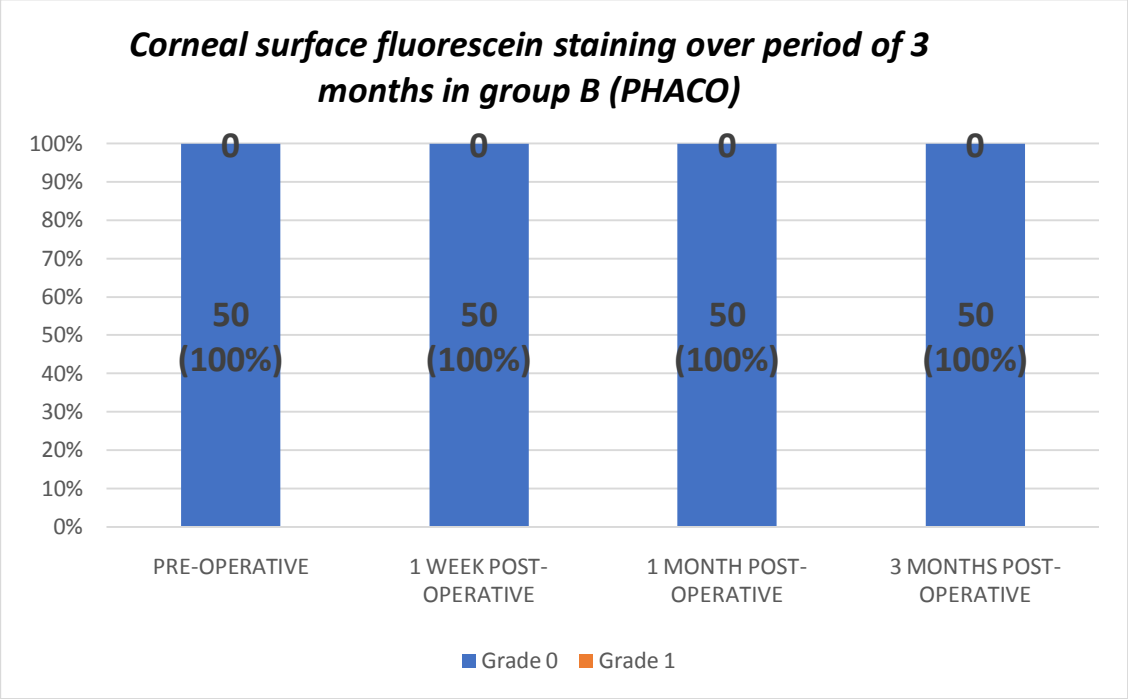


**Figure-5**

In both the groups all patients had Grade 0 staining preoperatively. In Group A (SICS) only one patient (2 percent) showed Grade 1 staining at one week postoperatively while remaining 98 percent showed no staining at any subsequent follow Up.

In Group B (PHACO) no staining was observed in any patient in any follow up.

## DISCUSSION

The tear film-cornea interface is the strongest refracting surface of the eye. Any abnormality in this tear film corneal interface can cause suboptimal visual performance. In this study it is validated that dry eye symptoms and ocular surface damage can occur after the cataract surgery. The development of dry eye after the cataract surgery is a common and unsatisfying experience both for patients as well as the surgeons. [9]

Ocular surface complications were much rarer following phacoemulsification technique. Phacoemulsification has many advantages compared with small incision cataract extraction, including a much smaller incision with less corneal denervation, minimum tear-film surface problems and smaller risk of infections.[10]

Therefore, under the light of above-mentioned data, this present study was undertaken for assessing the tear film functions in an eye with cataract and also comparing it with tear film functions and associated dry eye symptoms after cataract surgery by small incision cataract surgery technique and phacoemulsification technique in the same eye.

In the present study, a total of 100 patients with cataract were examined for tear film functions both preoperatively and postoperatively. Fifty patients were subjected to small incision cataract surgery (Group A) and 50 were subjected to cataract surgery by phacoemulsification technique (Group B).

In present study four objective tests were used for the assessment of tear film changes and tear film secretions following each of small incision cataract surgery and phacoemulsification. These tests were tear film break up time, Schirmer's test, ocular surface disease index scoring (OSDI Scoring) and cornea fluorescein staining test.

**TEAR FILM FUNCTION TESTS**

The mean +/- standard deviation of preoperative tear breakup time (TBUT) in eyes with cataract was 13.7 ± 2.45 seconds among patients who underwent SICS (Group A) which was lowered significantly to 10.76 ± 2.79 seconds (p=0.0001) 1 week after the cataract surgery. In group B the mean ± standard deviation TBUT preoperatively was 13.9 ± 2.04 seconds which was also significantly reduced to 11.2 ± 2.12 seconds 1 week after the cataract surgery by phacoemulsification technique (Table-1). The decrease of Tear Breakup Time was slightly more among patients who underwent cataract surgery by small incision cataract surgery technique (Group A) as comparedto the patients who underwent phacoemulsification cataract surgery (Group- B) but this decrease was statistically insignificant (Table-4).

As concerning tear film breakup time, the present study did not report any significant changes following cataract surgery whether 1 week, 1 month or 3 months between both groups (Table-4). Within each group, at 1 week, 1 month or 3 months postoperatively, our study showed statistically significant deterioration of tear stability proven by TBUT as compared to their preoperative values (Table- 1,2,3). Our results were in concordance with similar studies by Saif MYS et al[11] Sinha M et al[12] which also reported similar results where all dry eye parameters showed worsening after 1 week followed by gradual trend of recovery, which despite of showing initial trend of recovery did not return completely to their preoperative values by the end of 3 months. This can be explained because of the liberation of intense inflammatory mediators which desensitize the corneal sub-epithelial axons which results in tear film disturbance. After that at 4 weeks and 12 weeks gradually there occurs release of nerve growth factors (NGF) which causes nerves to regenerate slowly at par with the healing process, which explains why tear film parameters tend to stabilize to near the baseline value near the 3 months.

When compared between the groups the changes in dry eye parameters were found to be almost similar at any point of follow-up time in both the techniques whether small incision cataract surgery and phacoemulsification (Table-4,5,6).

Contrary to our speculation at the beginning of the study that SICS might result in significant tear film changes as compared to phacoemulsification, our hypothesis did not work here, as in our study no significant difference was found in tear film parameters between the 2 groups. This is in concordance with similar studies by Saif MYS et al[11] Kumari and Lakra[13] which also did not report any significant differences in dry eye parameters following each procedure whether 1 week, 1 month or 3 months between both the groups.

In regard to Schirmer's test, in both the groups A and B it was reduced 1 week following cataract surgery and it returned to near baseline value after 3 months in both the groups (Table-5).

The results of this study suggests that the removal of cataract is associated with worsening of TBUT and Schirmer‟s test values at 1 week butrevert back near the preoperative values near around 3 months. Similar study by Kasetsuwan N et al[14] also showed decreased test scores on immediate postoperative period followed by improvement at 1 month and 3 month postoperative period.

Regarding OSDI scoring, our study showed statistically significant (p value <0.05) increase in OSDI scores (19.3 in Group A and 18.11 in Group B) at 1 week post operative period as compared to the preoperative OSDI score values in both groups (7.12 in Group A and 7.79 in Group B) followed by gradual decrease in OSDI scores at further follow-ups to reach near baseline values at 3 months postoperatively (Table-1,2,3). The results of OSDI were similar to as found in similar studies by Dasgupta and Gupta[15] Ishrat S et al[16] which showed initial worsening or increase of OSDI scores at 1 week postoperative period followed by gradual reduction in OSDI scores when patients were reviewed at 1 month or 3 month postoperative period.

With respect to corneal surface fluorescein staining, majority of our patients had no fluorescein staining at the onset of the study. The staining was seen at the immediate postoperative period at 7 days postoperatively when 1 patient (2 percent) in group A showed grade 1 fluorescein staining. However on further follow-up visits at 1 month or 3 month no corneal staining was observed (Figure 4,5).

Patients can complain of dryness postoperatively at any time starting from immediate first postoperative day, however the highest incidence is on the seventh postoperative day. The signs and symptoms associated with dry eye improve gradually. In addition, no significant difference was observed between SICS and phacoemulsification regarding dry eye parameters contrasting our expectations that SICS might be associated with greater tear film changes and procedures like phacoemulsification would be expected to cause less reduction in corneal sensitivity.

All the dry eye tests conducted on eyes undergoing cataract surgery showed initial deterioration following cataract surgery. The mean values of TBUT, Schirmer‟s showed initial reduction at the 7 days follow-up. Thus cataract surgery affected both tear quantity and tear quality.

The medications used in the preoperative and postoperative period were common to the both groups. Some of these topical eye drops contained preservatives. The steroid drops and other eye drops containing preservatives like benzalkonium chloride are known to cause tear film instability. This may have contributed to the dry eye condition postoperatively.

Thus it is concluded that cataract surgery can cause or aggravate dry eye and affect the dry eye test values in the postoperative period up to 3 months. This holds true for both SICS and phacoemulsification.

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