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Incidence and Pattern of Dry Eye after Phacoemulsification and Manual Small Incision Cataract Surgery

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Abstract: ***Background: After cataract surgery many patients complain of foreign body sensation, redness, irritation, blurring of vision which are considered as unwanted effects of the surgery. Aim: To evaluate incidence and severity pattern of dry eye after phacoemulsification and manual small incision cataract surgery. Methods: The study consisted of two group of patients – Group 1 underwent phacoemulsification and Group 2 underwent manual small incision cataract surgery (SICS). The dry eye related data was collected preoperatively and at 1 week, 1 month and 3 months postoperatively. Ocular Surface Disease Index Questionnaire, Tear Break -Up Time (TBUT) and Schirmer Test – 1 were used to record the type of dry eye. Results: One hundred eyes of 100 patients, including 38 men and 62 women with the mean age of 60 (±12) years were studied. Dry eyes were found in 42% eyes (p<0.001) of patients at 1 week follow up. 15% and 9% of the eyes were dry at 1 month and 3 months after surgery respectively. There were 34 (53.1%) and 8 (22.2%) dry eyes in SICS and phacoemulsification groups respectively at 1weekpostoperative follow-up which was a statistically significant difference. Majority of eyes (27/42, 64.3%) had mild dryness. There were significant differences in TBUT at 1 week, one month and 3 months postoperatively. At 1 week review, the SICS group had mean TBUT of 10 (±0.55) sec as compared to 13.9 (±0.70) sec in phacoemulsification group (p<0.001). Conclusion: Incidence of dry eye is higher in SICS than Phacoemulsification due to Tear film instability. The clinicians should be conscious about dry eye symptoms and signs in an otherwise healthy eye after cataract surgery.***

Keywords: Dry Eye, Phacoemulsification, Smal Incision Cataract Surgery

1. Introduction

Dry eye syndrome is a multifactorial disease of pre-corneal tear film that results in ocular discomfort, visual disturbance, and tears film instability, with potential damage to the ocular surface.1 Factors that are responsible for development of dry eye after cataract surgeries include prolong use of antibiotic-steroid eye drops, decrease tear film break-up time due to surface irregularity at the site of the incision, decrease mucin production from the conjunctiva secondary to incision placement, decrease corneal sensation due to surgical incision which disrupts the cornea-lacrimal gland loop leading to reduced tear secretion, poor tear film production and stability due to surgically induced ocular inflammation and exposure to light from the operating microscope.[2], [3], [4] The symptoms of dry eye may be temporary but they affect the quality of life of the patient.5 Therefore, a proper counselling is necessary about the evanescent nature of the condition.6

The aims of this study were to identify the incidence of dry eye after cataract surgery and detect the pattern of dry eye after phacoemulsification and manual small incision cataract surgeries.

2. Materials and Methods

This prospective observational study followed the tenets of Helsinki declaration and was approved by Institutional Research and Ethical committee. All the patients enrolled in the study were informed verbally about the procedures. An informed written consent was obtained from each of them.

One hundred patients of senile cataract requiring cataract surgery were selected consecutively. The patients were divided into two study groups - Group 1 cases undergoing manual small incision cataract surgery (SICS) and Group 2 patients undergoing clear corneal phacoemulsification surgery. The dry eye related data was collected preoperatively and at 1 week, 1 month and 3 months postoperatively.

Preoperative dry eye-related data

Tear film function was assessed by Schirmer test-1 (ST-I) and tear film break-up time (TBUT) and the ocular symptoms by Ocular Surface Disease Index (OSDI) score.

1. Schirmer's Test-1

Wetting of the Schirmer's strip ≤10 mm was considered dry eye and these patients were excluded from the study. ST-1 was performed only once.

2. Tear film break-up time

TBUT assessment was done and the readings were analyzed to assess the stability of the pre-corneal tear film - the mucin component of the tear film. The test was repeated three times, and the average was calculated. TBUT <10 sec was indicative of dry eye. The time interval between ST-1 and TBUT was 10 min.

3. Ocular surface disease index

A structured symptom-based survey was conducted to identify patients with symptoms suggestive of dry eyes and these patients were excluded from the study. According to the score of OSDI, which is based upon the response to a questionnaire of 12 questions, subjective symptoms were graded as normal, mild, moderate and severe based on the guidelines of Dry Eye Workshop (DEWS) report.1

Postoperative work-up

The above tests were done on all the patients at 1 week, 1 month and 3 months after the surgery. DEWS grading was used to sub-categorize the severity of dry eye into mild, moderate and severe. We considered the discomfort severity and the frequency of the symptoms, TBUT and ST-1 scores from the classification and the final grading was done by adding the scores of the three tests.

Surgery

Manual SICS with poly methyl methacrylate (PMMA) posterior chamber intraocular lens (PCIOL) implantation was performed with a scleral tunnel incision of 6–8 mm and a side port of 1 mm. Phacoemulsification surgery with foldable PCIOL was done in the other group of patients with a 2.8 mm clear corneal incision and two side ports of 1 mm each. The patients who underwent an uneventful and uncomplicated surgery were only included in the study. The total duration of microscope light exposure as well as time taken to complete the surgery was noted. Moxifloxacin (0.5%) eye drop four times a day was started one day prior to the surgery. Pupillary dilatation was achieved using a combination of phenylephrine (5%) and tropicamide (0.8%) eye drop before the surgery. Postoperatively moxifloxacin eye drop was continued along with prednisolone acetate (1%) eye drop six times a day for one week and then tapered every week over a month.

3. Results

One hundred eyes of 100 patients, including 38 men and 61 (63.5%) women, were enrolled in this study. The mean age was 60 (±12) years with a range of 4. The majority of women (48, 78.7%) were post-menopausal. The occupation of the majority of men was agriculture (20, 64.5%) while most of the women were housewives (32, 52.5%).

Eighty nine per cent of eyes had preoperative best-corrected visual acuity (BCVA) between 1/60 and 6/24. In the enrolled eyes, the preoperative mean TBUT was 15.82 sec (±2.99, range 11–22 sec). The preoperative mean score for the ST-1 was 24.33 mm at five minutes (±5.44, range 15–35 mm).

The cataract surgery was performed using SICS technique in 64 eyes (64%) and phacoemulsification in 36 eyes (36%). The mean duration of surgery was 27.5 min (±10.1, range 10–50 min). The total microscope light exposure time was little longer (mean, 31.1 ± 10.5 min) than the duration of surgery.

The length of incision in the SICS group ranged from 6 to 8 mm (mean, 6.67 ± 0.79 mm) depending on the size of lens nucleus. Similarly, the length of main incision in the phacoemulsification group was 2.8 mm.

There was complete (100%) follow-up at 1 week and at 1 month after the surgeries. However, follow-up was lost in 15 patients (15 eyes, 15%) at 3 months. Among these dropouts, six patients were in the SICS group (9.4%) and nine patients in the phacoemulsification group (25%).

Dry eyes were found in 42% eyes ($p < 0.001$) at 1week follow-up. 15% and 9% of the eyes were dry at 1 month and 3 months after the surgery, respectively (Fig. 1). At 1week postoperative follow-up, there were 34 (53.1%) and 8 (22.2%) dry eyes in the SICS and the phacoemulsification groups, respectively (p value 0.003). Moreover, the severity of the dry eye was more in the SICS group (Table 1).

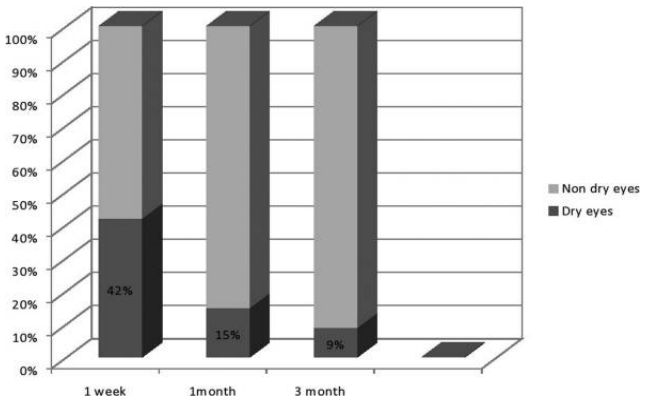

Fig.1: Development of dry eyes at 1 week, 1 month, 3 months postoperatively

Table 1: Prevalence of dry eye at 1 week, 1 month and 3 months postoperatively after cataract surgery

Dry eye	Preoperatively	Postoperatively follow up		
		1 week	1 month	3 months
Absent	100	58(58%)	89(89%)	76(89%)
Mild	Nil	27(27%)	12(12%)	6(7.1%)
Moderate	Nil	11(11%)	3(3%)	3(3.5%)
Severe	Nil	4(4%)	Nil	Nil
Total	100	100	100	85

There were significant differences in the TBUT values at 1 week, at 1 month and at 3 months postoperatively. At 1week review, the SICS group had a mean TBUT of 10.0 ± 0.55 sec as compared to 13.9 ± 0.70 sec in the phacoemulsification group ($p < 0.001$).

The ST-1 did equally well in both the groups at one week – 19.1 ± 0.89 mm and 20.7 ± 0.81 mm in the SICS and phacoemulsification groups, respectively ($p = 0.241$).

Among 42% patients with dry eyes at 1week follow-up, the severity was mild in the majority (27/42, 64.3%). Moderate DEWS score was found in 11 eyes (26.2%) and only four had severe dry eyes at 1 week postoperatively (Fig. 2). A trend towards the decrease in the severity of dry eye was noted on subsequent follow-up visits. None of the patients had severe dry eye at 3 months postoperatively. Out of the nine dry eyes at this visit, 6 (66.7%) had mild and 3 (33.3%) eyes moderate grades of DEWS scores.

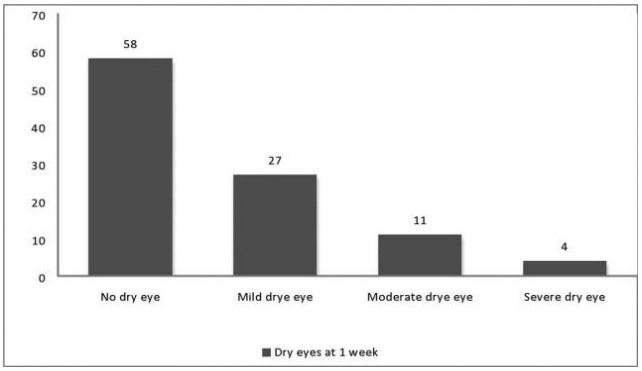

Figure 1: Severity of dry eye at one week postoperatively

There was a significant decrease in the TBUT values in the early postoperative period at one week as compared to preoperative findings (8.7 ± 0.48 sec vs. 15.8 ± 0.31 seconds $p < 0.001$). The significant difference was also noticeable at 1month follow-up (11.2 ± 0.39 seconds vs. 15.8 ± 0.31 seconds $p < 0.001$). However, this difference became non-significant at 3 months as further improvement in TBUT occurred – 4.3 ± 0.37 sec vs. 15.8 ± 0.31 sec $p = 0.089$ (Table 2, Table 3).

Table 2: Tear film break-up time and Schirmer's test results preoperatively and postoperatively after cataract surgery.

Test for Dry eye	Preoperatively values	Postoperatively values		
		1- week	1- month	3 -month
TBUT* (in sec)	15.8±0.31	8.7±0.48 (p<0.001)	11.2±0.39 (P<0.001)	14.3±0.37 (p=0.089)
Schirmer's Test (in mm)	24.5±0.59	15.2±0.64 (p<0.001)	19.7±0.06 (p<0.001)	21.8±0.64 (P<0.001)

Table 3: Tear film break-up time and Schirmer's Test results one week after phacoemulsification and small incision cataract surgery

Surgical procedure	SICS* (n=64)	Phacoemulsification (n=36)	p-value
Dry eyes	53.1%	22.2%	0.003
TBUT^	10.0±0.55	13.9±0.70	<0.001
Schirmer's test (in mm)	19.1±0.89	20.7±0.81	0.241

*Small incision cataract surgery.
^Tear film break-up time.

There was a significant worsening in the TBUT values, ST-1 values and OSDI scores in the immediate postoperative period (Fig. 4, Fig. 5). However, the test values showed a gradual improvement in the dry eye test scores when the patients were reviewed at 1 month and 3 months postoperatively (Fig. 6).

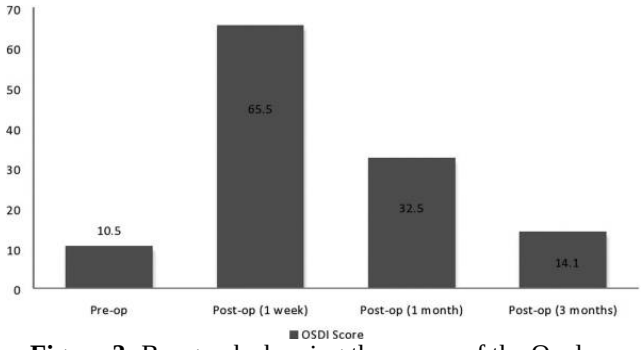

Figure 3: Bar graph showing the scores of the Ocular Severity Disease Index (OSDI) preoperatively and at 1 week, 1 month and 3 months postoperatively.

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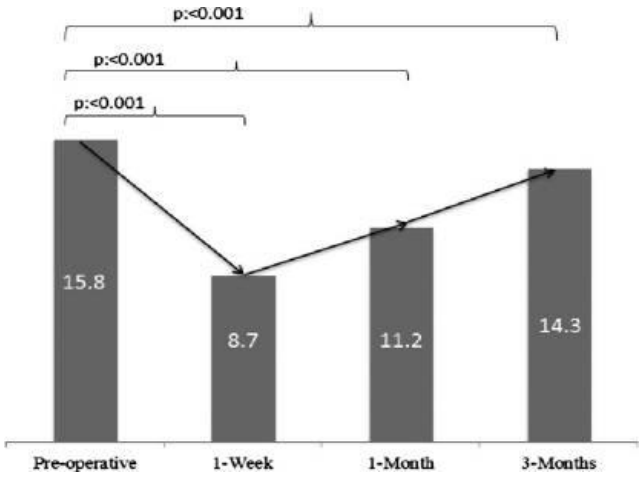

Figure 4: Bar graph showing the mean (in seconds) tears film break-up time (TBUT) Preoperatively and postoperatively

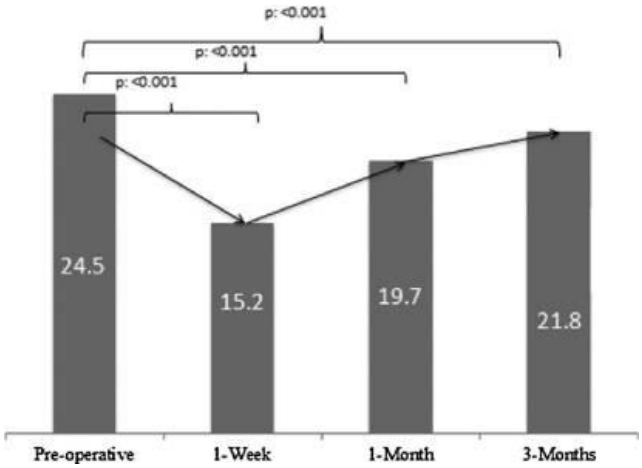

Figure 5: Bar graphs showing the mean (in mm) values of Schirmer's tests preoperatively and postoperatively

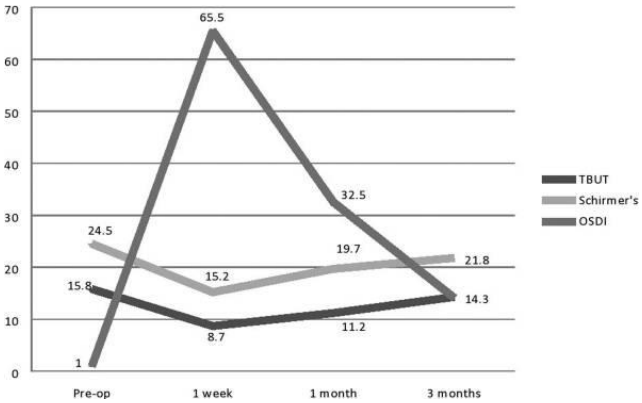

Figure 6: The line diagram showing the significant ($p<0.001$) worsening of TBUT (in seconds)

4. Discussion

The tear film-cornea interface forms the strongest refracting surface of the eye. Any abnormality in the tear film causes suboptimal visual performance. In this prospective study it is validated that dry eye symptoms and ocular surface damage may occur after the cataract surgery. Development of dry eye after the cataract operation can be a common and unsatisfying experience both for patients and surgeons.

Forty two per cent patients developed dry eyes in the early postoperative period in the present study. Although a significant decrease in the test values was found at each postoperative visit, the mean value still remained within the normal range for ST-1 in the current study. Hence, postoperative ocular dryness was diagnosed by the abnormality of TBUT which reflected instability of the tear film as the main reason for dry eyes following cataract surgery.

Oh et al. found a marked decrease in TBUT in the early postoperative period in patients who had undergone phacoemulsification surgery but ST-1 was within normal range.7 In addition, at 1 and 3 months postoperatively, the authors noticed that TBUT and ST-1 values showed improvement, although they still remained lower than the baseline. Other studies have also reported reduced postoperative TBUT and ST-1 scores after phacoemulsification.[4], [8], [9], [10]

Cho and Kim observed the aggravation of dry eye symptoms and diagnostic test results after cataract surgery as compared to preoperative measurements. 3 They concluded that TBUT and the barrier function of the corneal epithelium get affected in the early postoperative period after cataract surgery which is consistent with the present study. Gharaee et al. found no statistically significant difference between the results of preoperative and postoperative ST-1.11 However, similar to our study, TBUT values differed between preoperative and postoperative examinations.

Postoperative dry eye following cataract surgery has been attributed to the abnormality in lipid layer of tear film in some studies. Park et al. have reported abnormal meibomian gland function as the cause of dry eye related to cataract surgery.12 In another study authors have found thinning of lipid layer after cataract surgery.13 These changes in the pre-corneal tear film make it less stable leading to development of dry eye.14

One of the iatrogenic mechanisms responsible for dry eyes post cataract surgery is corneal sensory nerve damage due to the incision. The corneal denervation can result in reduced tear secretion and less blinking. In SICS, with a big corneoscleral tunnel incision, there occurs denervation of a bigger part of cornea, which is associated with persistent foreign body sensation and pooling of mucus and debris within the groove.15 On the contrary, in phacoemulsification cataract surgery, the incision is much smaller. Therefore, there is less corneal denervation. Hence, we observed a higher prevalence and a more severe dry eyes in patients who underwent SICS as compared to those who had undergone phacoemulsification surgery. This is in accordance with other studies where size of incision correlated with severity and duration of dry eye.[7], [15] It is speculated

that phacoemulsification incisions, on the richly innervated horizontal areas of cornea at 3 and 9 o'clock, lead to less tear secretion and resultant neurotropic keratopathy.16 Reduced corneal sensitivity and tear production after cataract surgery has been reported by other authors as well.[16], [17], [18]

Aging and surgical incisions are established culprits of postoperative dry eye. [3], [16], [19], [20], [21] Moreover, preoperative and postoperative use of topical medications like non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids and preservatives in eye drops cause epithelial toxicity and delay the ocular surface healing after cataract surgery.[22], [23], [24], [25], [26] However, drug-induced dry eye worsens with time due to the prolong use of eye drops. It is unlikely that the dry eye in the present study was induced by topical medications, as dry eye tests values improved with time. Li et al. noticed a decrease in the number of goblet cells, with increased squamous metaplasia, due to misuse of eye drops at three months after cataract surgery.4 An association between the use of NSAIDs and ocular dryness is reported in other studies.[27], [28]

We observed a high prevalence of postoperative dryness in females than in males but this difference was not statistically significant. Some previous studies have also reported a female preponderance of condition.[29], [30], [31] Postmenopausal age group is a known risk factor for dry eye disease which can explain the reason for this gender difference.

Mechanical trauma during surgery causes production of chemical inflammatory mediators such as oxygen free radicals, proteolytic enzymes, and cyclooxygenase, on the ocular surface.[32], [33] Furthermore, a longer microscopic exposure time may induce more sever dry eye symptoms due to instability of tear film. Oh et al. observed that the longer the microscopic light exposure time, the more the goblet cell density reduction and the more the development of dry eye.7 Others have also reported microscope light exposure as a contributory factor for dry eye after cataract surgery.[3], [6], [34]

Surgically-induced dry eye in patients with normal ocular surface prior to cataract operation, therefore, may develop due to a number of factors.2 However, the condition is self-limiting and may regain normalcy in 1 to 3 months' time as seen in this study as well as in the previous studies.[8], [16], [17], [35]

Surgical removal of cataract may either aggravate a pre-existing dry eye disease or dryness can develop afresh.[35], [36] The best visual outcome after a successful cataract surgery can be achieved only if the patient has a healthy ocular surface postoperatively.37 In summary, ophthalmic surgeons must be aware of the fact that cataract surgery can induce transient dryness of ocular surface. It can cause annoying symptoms and may prolong the recuperation period after SICS and phacoemulsification surgery.

There are some limitations of this study as with any study. Firstly, the surgeries were not performed by a single surgeon, therefore, the duration of surgery varied between surgeons. However, the technique and instruments used by the operating surgeons were identical. Secondly, the corneal sensitivity was not assessed. Third, a comparison between postoperative dry eye and visual acuity was not done in this study.

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