Original article:

Comparative assessment of tear function and ocular surface following cataract surgery employing manual SICS and phacoemulsification techniques

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Abstract

Context: Ophthalmic surgeries involving cornea are known to disrupt tear function & alter ocular surface. Cataract surgery is the most frequently performed ophthalmic surgery with consistent visual outcomes. Quality of results are affected by dry eye symptoms leading to a renewed interest in postsurgical evaluation of tear function & ocular surface.

Purpose: To compare postsurgical parameters of tear function & ocular surface homogeneity following cataract surgery with the twin techniques of 'Manual SICS' & phacoemulsification.

Settings & Design: A prospective randomised study on cases operated for cataract at Rohilkhand Medical College, Bareilly during the study period of April 2014 to March 2015 and subjected to tear function & ocular surface evaluation.

Methods: 84 cases of cataract surgery randomly assorted into 2 groups (42 each), based on the mode of surgery; Manual small incision cataract extraction & clear corneal phacoemulsification. Patients were evaluated for tear function parameters that included tear meniscus height(TMH), Schirmer test I (ST-1) without local anaesthetic and Fluorescein tear breakup time(TBUT). Ocular surface evaluated using corneal fluorescein staining as per oxford scheme.Measurements were taken preoperatively and at intervals of 7,15, 30,60 & 90 days.

Statistical analysis was done using students paired t test.

Results: Preoperative values for Schirmer's test I, tear meniscus height, Fluorescein tear breakup time, &fluorescein ocular surface staining were significantly reduced ($p<0.05$) at day-7, day-15& day-30 for both groups as compared to preoperative levels. Tear film & ocular surface indices tended to return to preoperative values after day 30 with a slower recovery noted for SICS group. Inter group comparisons highlighted a greater change in the measured indices for SICS group as compared to phaco, at day 7, 15& 30. Tear film parameters and ocular surface staining were comparable in the SICS & Phaco group at day 60 & 90; $p=0.473$ & 0.538 respectively.

Conclusion: Cataract surgery has a detrimental effect on tear function & ocular surface in the immediate postoperative period producing a dry eye. Effects gradually recover following a month of surgery but do not come to preoperative levels even by 3 months. Changes produced in tear function & ocular surface by SICS & Phacoemulsification surgeries are comparable although the phacoemulsification cases fare better in the immediate postoperative period.

Key words: Dry eye, Phacoemulsification, Small incision cataract surgery

Introduction

A smooth ocular surface & lacrimal film are essential for the formation of clear image, as they constitute the first refractive medium. Minor variations in ocular surface or changes in tear film have direct repercussions on quality of vision. Cataract surgery is known to alter tear film & ocular surface both qualitatively & quantitatively.[1] Conventional cataract surgery by virtue of its large incision is known to denervate cornea producing corneal desensitization and break the lacrimal functional unit.[2] The

subjective effect is production of dry eye with multiple symptoms of congestion, watering, grittiness, tiredness and transient blurring of vision.[3] Hence despite a seemingly good visual outcome as recorded on Snellens, the overall patient satisfaction is wanting.

Manual small incision cataract surgery & phacoemulsification have currently become the preferred modes of cataract surgeries. A reduction in incision size & operating time have brought earlier visual rehabilitation with reduced symptoms and astigmatism. However dry eye conditions remain a common accompaniment of these otherwiseuneventful surgeries. Studies have highlighted a temporary or even permanent derangement of tear function & ocular surface following both Manual SICS & phacoemulsification procedures.[,4,5,6,7] Comparative studies for these procedures, evaluating tear function & ocular surface integrity using acceptable functional indices are lacking. Present study has been designed to critically evaluate the unwanted side effect of dry eye production following both these common surgical procedures & ascertain the superiority of one against other.

Materials and Methods

This was a prospective randomized observational cohort study planned for patients undergoing surgery for age related cataract at Rohilkhand Medical college & hospital, Bareilly, a tertiary centre for eye care. Prior clearance for the study was taken from Institutional Ethical committee & an informed consent taken from all the participants of this study. Patients were randomly assorted into two groups based on the mode of surgery undertaken, SICS or Phacoemulsification.

Inclusion criteria comprised of;

i) Cases with age related cataract
ii) Age group 40 years & above

Exclusion criteria consisted of the following;

i) Pre-existing dry eye or ocular surface disorder
ii) Pre-existing chronic topical medication
iii) Diabetes
iv) History of previous ocular surgery
v) Patients with co-existing ophthalmic conditions like ocular allergies, pterygia, blepharitis or viral keratitis

The study was done on 84 consecutive patients of age related cataract that were randomly assigned to 2 cohort groups of 42 each subjected to cataract surgery by either SICS or phacoemulsifiction techniques. A standard postoperative regimen of Moxifloxacin, 0.5% & Prednisolone acetate 1% given 4 times daily for 1 monthwas followed. Out of the selected patients, 8 were lost for follow up & were not considered for study. 39 patients in SICS group & 37 patients in Phaco group completed the study.

Evaluated parameters included Tear meniscus height which was determined on Slit lamp using a graduated slit beam.

Schirmer's test I values were recorded on 5×35 mm standard Schirmer test strips of no.41 whatmann filter paper. The strip was inserted over the lower lid margin midway between the middle and outer third & avoiding the cornea. Eye was kept open & upwardly fixated with allowance for blinking. No anaesthetic agent was used.

Measurements were taken after 5 minutes. Fluorescein tear breakup time (TBUT) was determined using a fluorescein impregnated paper moistened with normal saline. The strip was placed in theinferior fornix avoiding contact with ocular surface & patient asked to stare following few blinks to distribute the stain.

Appearance of first fluorescein discontinuity in the centre ofcornea was observed on a slit lamp with diffuse illumination & 10 X magnification,

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employing cobalt blue filter. Time interval for appearance of dry spot, measured using a digital timer and average of 3 consecutive readings considered for analysis.

Corneal staining with fluorescein was evaluated using a slit lamp with diffuse illumination, a cobalt blue filter & a 16 X magnification. The upper eye lid was lifted to grade the whole cornea within 2 minutes & following 30 seconds of fluorescein strip application.

The Oxford scheme of grading of stain was used, based on a six point scale ; (0,1,2,3,4,5), with a maximum possible grade of 5.

All the tear film indices were measured for the operated (test eye) & other eye (control eye) at regular intervals of day 7, 15, 30, 60 & 90.

Statistical analysis was done for all numerical indices employing student's paired t test.

P- values less than 0.05 were considered statistically significant.

Results

The Mean ages&SD of SICS & Phaco groups were 56.32 ± 7.85 and 55.53 ± 7.93 years respectively; (P = 0.2473).Male : female ratios for the two groups were equally matched; (21:18 in SICS group & 19:18 in phacoemulsification group).

Baseline indices of tear film & ocular surface were taken preoperatively according to the standardized techniques. All evaluated preoperative indices for SICS & Phacoemulsification groups were comparable, (p > 0.05); Refer Table-1.

Table 1: Preoperative values of tear function & Ocular surface Indices

	Tear meniscus height (TMH) (mm) (Mean± SD)	Schirmer's Test – I (ST-I) (mm) (Mean ± SD)	Tear breakup time (TBUT) (seconds) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.59 ± 0.16	23.21 ± 2.13	12.32 ± 2.45	1 (0 to 2)
Phaco	0.58 ± 0.17	22.64 ± 2.17	12.21 ± 2.96	1 (0 to 2)

Postoperative deterioration was noticed for all the conducted tests during subsequent visits. Mean Tear meniscus height (TMH) as recorded for SICS group was 0.28 ± 0.081, on day 7, 0.24 ± 0.128 on day 15 and 0.20 ± 0.137, on day 30 showing a declining trend. Corresponding TMH values for Phaco group were 0.32 ± 0.071, 0.28± 0.094 & 0.27 ± 0.173 on day 7, 15& 30 respectively. This deterioration from preoperative values was statistically significant (p< 0.05). TMH record of subsequent visits highlighted a reversal of declining trend with values of 0.29 ± 0.095 & 0.33 ± 0.117 for SICS group and 0.31 ± 0.072 & 0.34 ± 0.132 for phaco group at day 60 & 90 respectively. The final TMH values were significantly less than preoperative values even after 3 months for both SICS & Phaco group. The values were however comparable with each other for both evaluated groups at day 60 &90; (p=0.613 & 0.741 respectively).

Schirmer's test values echoed similar pattern with declining figures of22.32 ± 2.24, 19.31±1.86, 16.63 ± 1.74, 14.06 ±1.86 for SICS group at day 7,15,30 & 60 respectively. Schirmer's values reversed after second month with figures of 17.98 ± 1.75 at day 90 which were never the less significantly less than preoperative values. A comparative account of Schirmer's test values for phacoemulsification group formed a similar pattern (Refer tables 2-6) but showed an earlier

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reversal following 1 month with least values of 14.86± 1.66 recorded at day 30.

Fluorescein tear breakup time values revealed significant reductions for both groups at days 7,15 & 30 (refer tables 2-6). TBUT values tended to plateau thereafter with a faster reversal noted for phacoemulsification group and a gradual reversal for SICS group of patients at day 60 & 90.

Corneal staining scores differed significantly from baseline values in the immediate postoperative period of one month in both the groups. Corneal staining pattern differed in SICS group but not phacoemulsification group at day 60. Staining scores were however not significantly different from preoperative levels at day 90, for SICS as well as phacoemulsification group suggesting a quiescent surface.

Table - 2: Postoperative values of tear function & ocular surface indices at Day – 7

	Tear meniscus height (TMH) (Mean± SD)	Schirmer's Test – I (ST-I) (Mean ± SD)	Tear breakup time (TBUT) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.28 ± 0.081	22.32 ± 2.24	10.53 ± 2.48	3 (2 to 4)
Phaco	0.32 ± 0.071	22.14 ± 2.03	10.96 ± 3.02	3 (2 to 4)

Table - 3: Postoperative values of tear function & ocular surface indices at Day – 15

	Tear meniscus height (TMH) (mm) (Mean± SD)	Schirmer's Test – I (ST-I) (mm) (Mean ± SD)	Tear breakup time (TBUT) (seconds) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.24 ±0.128	19.31 ± 1.86	9.13 ± 1.75	3 (2 to 4)
Phaco	0.28 ± 0.094	19.43 ± 1.88	9. 67 ± 1.69	2 (1 to 3)

Table - 4: Postoperative values of tear function & ocular surface indices at Day – 30

	Tear meniscus height (TMH) (mm) (Mean± SD)	Schirmer's Test – I (ST-I) (mm) (Mean ± SD)	Tear breakup time (TBUT) (seconds) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.20 ± 0.137	16.63 ± 1.74	7.86 ± 1.76	3 (2 to 4)
Phaco	0.27 ± 0.173	14.86 ± 1.66	8.12 ± 2.08	2 (0 to 3)

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Table - 5: Postoperative values of tear function & ocular surface indices at Day – 60

	Tear meniscus height (TMH) (mm) (Mean± SD)	Schirmer's Test – I (ST-I) (mm) (Mean ± SD)	Tear breakup time (TBUT) (seconds) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.29 ± 0.095	14.06 ± 1.86	7.93 ± 2.12	2 (1 to 3)
Phaco	0.31 ± 0.072	16.29 ± 1.79	8.46 ± 1.91	1 (0 to 2)

Table – 6: Postoperative values of tear function & ocular surface indices at Day – 90

	Tear meniscus height (TMH) (mm) (Mean± SD)	Schirmer's Test – I (ST-I) (mm) (Mean ± SD)	Tear breakup time (TBUT) (seconds) (Mean ± SD)	Corneal stain grade (oxford-scheme) (Mean ± SD)
SICS	0.33 ± 0.117	17.98 ±1.75	8.34 ± 1.37	1 (0 to 3)
Phaco	0.34 ± 0.132	18.31 ± 1.93	10.02 ±1.67	1 (0 to 2)

Figure – 1

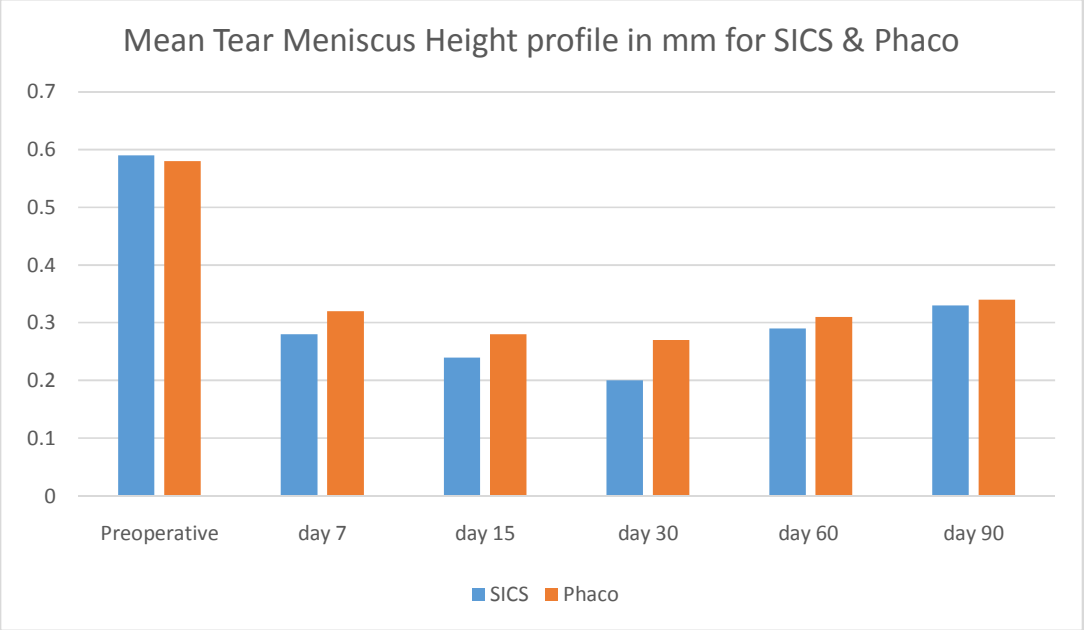


Figure - 2

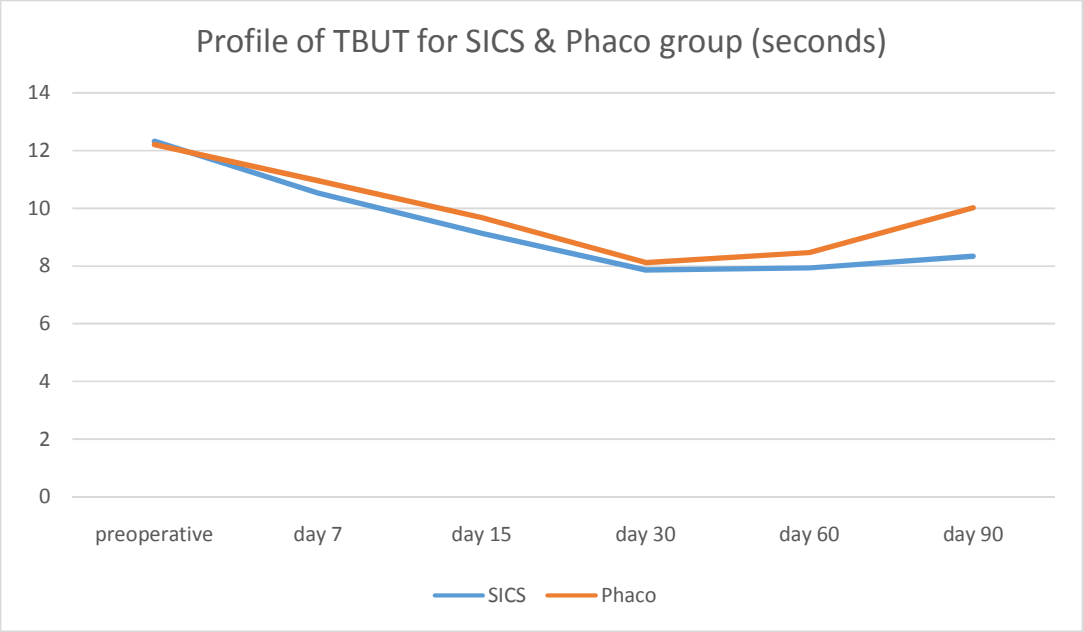


Figure - 3

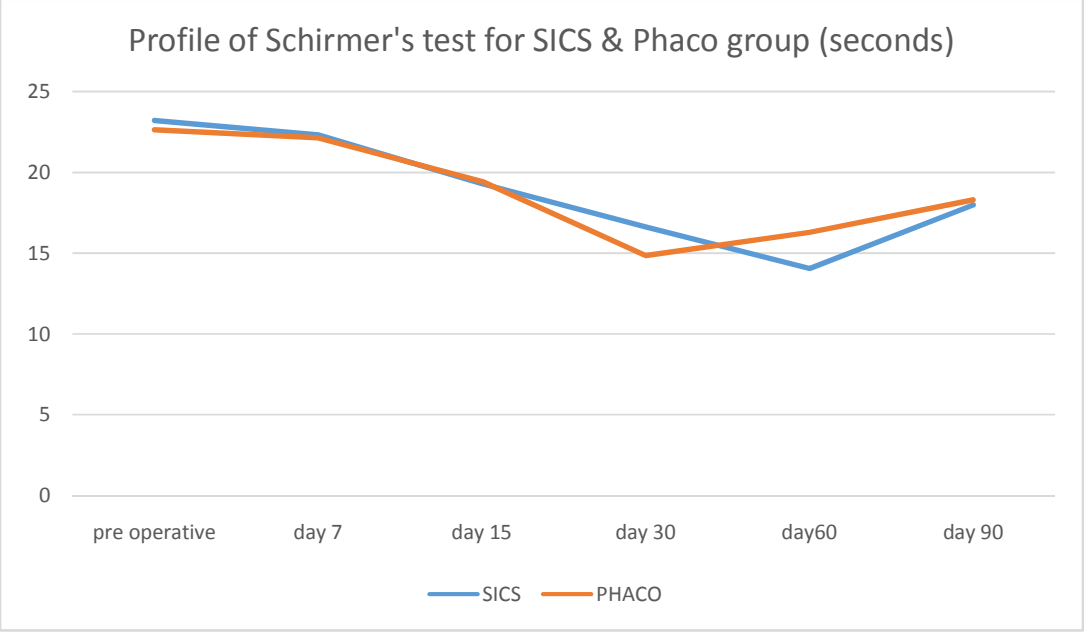
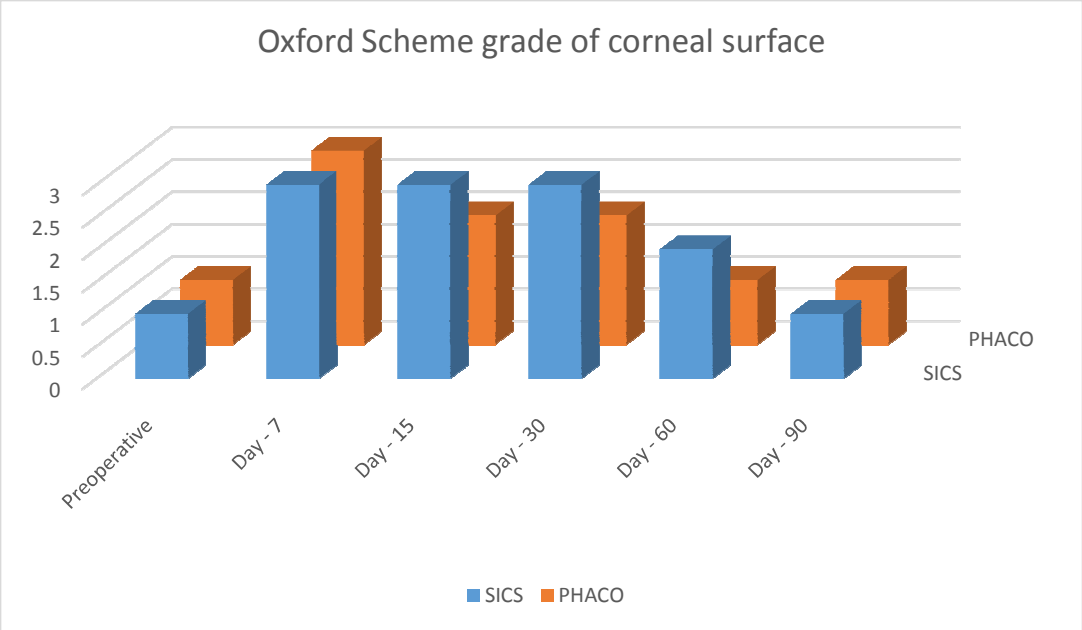


Figure - 4



Discussion:

A smooth & stable tear film is essential for the refractive function of cornea apart from according protection to the corneal & conjunctival epithelium. Cataract surgery as also other corneal surgeries like LASIK, is known to disrupt the fragile ocular surface and alter the tear film qualitatively as well as quantitatively.[8,9] A myriad of etiological factors are proposed to explain the postsurgical dry eye status ranging from reduced corneal ,sensibility, limbal stem cell & goblet cell loss, inflammation, tissue oedema, preservative toxicity, reduced blink reflex and even microscopic light.[10,11,14]With an already reported prevalence of 11 to 33% in studied normal populations, the added quantum of surgically induced dry eye seriously compromises the quality of life.[15,16] This is especially so because both cataract and dry eye are age related conditions and tend to complement each other. Evaluation of dry eye is difficult since there is no gold standard test to quantify its status. Questionnaire based approach like OSDI values despite being useful in routine clinical situations have gross subjectivity. Hence various diagnostic tools with different sensitivities & specificities are used in conjunction to achieve consensus on dry eye status.

Currently, Manual small incision cataract surgery and phacoemulsification are the two preferred modes of cataract surgeries as also the most frequently performed ocular surgeries. Their respective roles in alteration of tear function as also the ocular surface on a comparative basis have not been well studied.The present study using objective clinical parameters of tear function addresses the problem of tear film evaluation for both techniques in a quantifiable manner.

Various studies have reported aggravation of dry eye symptoms after cataract surgery.[2,5,6,7]Ram et al (2002) had highlighted serious dry eye features likefilamentary keratopathy, persistent epithelial defects, infective keratitis & stromal keratolysis following conventional extracapsular cataract extraction.[1] This was understandable on account

of denervation of a large section of cornea following incision as also the surface irregularity produced by the sutures. Phacoemulsification technique on account of smaller incision size, early wound stabilization and less postoperative inflammation was believed to be less infringing on the normal tear film and ocular surface. Chao et al (2013) validated this view in their study on 49 patients without dry eye, none of whom developed dry eye disease following phacoemulsification surgery.[6]They reported temporary reduction in physiological tear levels, seen one week post surgery gradually returning to normal baseline levels by third month. A similar study in China, observedimmediate development of dry eye measured at day 1 & 2 with rapid return of tear functionparameters to base line values within a month.[7]The study reported return of Schirmer's test values by day 7, (p=0.831), height of tear meniscus at 14 days, (p= 1.000) and tear breakup time, fluorescein staining scores& grades of tear film pattern at 30 days,(p >0.05) postoperatively. On a slightly dissenting note studies by Sinha et al noted marked deterioration in all the measured tear film indices that continued for the observation period of 3 months.[4,] The values were however lowest at 1 month. Khanal et al[13] investigating on 18 patients of phacoemulsification for changes in corneal sensitivity & tear physiology reported immediate postsurgical deterioration. They noticed a trend towards recovery within 1 month for tear functions and 3 months for corneal sensitivity.]Our study noted a falling pattern of TMH, TBUT & ST-I values that showed a rapid postoperative decline at day 7, 15 & 30 following phacoemulsification surgery which seemed to plateau thereafter, with a gradual recovery noted at day 60 & 90; (Refer fig 1to 3). Corneal staining changes were however less marked from day 15, in the phacoemulsification group even though the scores after 1 week were significantly greater than the baseline,(p<0.001).The observation concurs with similar findings by Chao et al, who underscored the fact of near normalization of ocular surface after an initial disturbance of a week to fortnight.[6]

Studies evaluating tear film & ocular surface indices after SICS, are few and less objective. In the rural belt of South India, a descriptive, cross-sectional study by Venugopal et al, sited a high incidence of 66.2% dry eyes following manual small incision cataract surgery with corneo-scleral tunnel.[12] The incidence was reported higher in the late postoperative period of 6 weeks to 2 years. No statistically significant gender based or surgical site based difference was reported in this study. In a recent study comparing dry eye indices that included Impression cytology scores, clinical profile of dry eye status was compared, following SICS & phacoemulsification cataract surgeries.[4] The evaluated parameters of TMH, SIT & TBUT were comparable for both groups at all periods of 7,30 & 90 days postoperative. However the third monthpostoperative Impression cytology count of mucin cells was significantly less at 143.16 ±63.043 for SICS group when compared to 184.436 ± 59.904 for phacoemulsification group. This finding of a higher ocular surface disruption in SICS cases as reflected by poorer impression cytology counts goes well with the observation of our study, where we noticed poorer oxford staining scores for cornea at least in the initial postoperative weeks ; (refer table 2,3 & fig-4).

As Diabetes has been observed as a risk factor.[20] in derangement of postsurgical tear physiology weexcluded all diabetics from our study. We also excluded pre-existing dry eyes to give objectivity to our results unlike few other studies where dry eyes were counted. Evaluation of similar parameters in other eye as control added objectivity to our results.

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Conclusion

The study categorically reveals that tear function & ocular surface are affected by cataract surgery by both SICS & Phacoemulsification techniques producing a dry eye in normal patients. Tear function parameters as also the ocular surface reverse to normal state after a declining trend for a month. This reversal is more rapid in phacoemulsification cases even though the final states at 3 months are comparable. Preoperative levels of tear function & ocular surface are not completely reached even following 3 months of surgery.

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