Original Article

Comparative study of dry eye indices following cataract surgery

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Abstract

Introduction: This study aims to assess dry eye indices following cataract surgery.
Materials and methods: A single center descriptive and comparative study was performed. A total of 100 eyes of 100 cases fulfilling the inclusion criteria from 1st June 2017 to 30th May 2018 were enrolled. Out of 100 eyes, 50 eyes each went through manual small incision cataract surgery (MSICS) and phacoemulsification respectively. For objective analysis : schirmer 1 test(ST-I), tear breakup Time(TBUT) along with lissamine Green Surface Staining(LGSS) was performed on pre-operative day, 1st, 4th and 12th week respectively. Ocular Surface Disease Index (OSDI) was done for subjective analysis on pre-operative day and at 12th week.
Results: The mean age of the patient was 53.66 ± 7.839 years with 34 (68%) being female in a small incision cataract surgery group. In the phacoemulsification group, mean age was 54.72 ± 7.985 years and 32 (64%) were female. On analyzing the objective dry eye indices: ST-I,TBUT and LGSS at 12thweek was 18.80 ± 7.393 mm, 11.30 ± 5.456 seconds and 1.62 ± 1.193 in Small incision cataract surgery group and 27.10 ± 6.326 mm, 16.60 ± 4.699 seconds and 0.38 ± 0.602 in Phacoemulsification group respectively which was statistically significant. ($p< 0.001$).
Conclusion: Regardless of the type of cataract surgery, dry eye disease is unavoidable affecting both tear quality and quantity postoperatively. In our study, phacoemulsification had lesser effect in dry eye indices than small incision cataract surgery.

Key words: Dry eye, Cataract surgery, Lissamine green surface staining, Ocular surface disease index, Schirmer 1 test, Tear breakup time.

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Introduction

Dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and neurosensory abnormalities play etiological roles (Craig J P et al, 2017). The pathogenesis of dry eye are basically abnormalities of the tear film itself, like aqueous tear deficiency, mucin deficiency, lipid abnormalities and lid surfacing abnormalities (Bron A J et al, 2017). Intact corneal innervation is mandatory for normal blinking and tearing reflexes, which in turn is essential for maintaining the integrity of the ocular surface. Under normal physiological conditions, sensory nerves in the cornea transmit an afferent stimulation signal through the ophthalmic division of the trigeminal nerve to the brain stem from the afferent limb of a simple reflex arc and conduct the stimuli back to the central nervous system. The efferent signal is transmitted to the lacrimal gland via secretomotor fibers of facial nerve through the parasympathetic and sympathetic nerves that innervate the gland and drive tear production and secretion (Dartt D A, 2014). Damage to these circuits interrupts the normal regulation of lacrimal gland secretion and influences both basal and stimulated tear production. This is one of the major pathogenic pathways in the induction of postoperative dry eye in patients undergoing ophthalmic surgeries (Garg A et al, 2006). Few literature reported that cataract surgery is associated with the production of oxygen-free radicals, proteolytic enzymes, prostaglandins(Chee S P et al,1999; El-Harazi S M,2001), leukotrienes and inflammatory cytokines which may affect corneal sensitivity, increase inflammation and lead to tear film instability (Cho S, 2009). Khanal S et al. (2008) found disturbance in lipid layer resulting in increased evaporation due to use of preservative (benzalkonium chloride) containing drug postoperatively.The tear film instability might be due incisional site surface irregularity or decrease in mucin production due to goblet cell destruction.(Li XM, 2007)

Materials and methods

This is a hospital based;descriptive and comparative study conducted from1st June 2017 to 30th May 2018 at National Medical College and Teaching Hospital, Birgunj, Nepal. A total of 100 eyes of 100 patients fulfilling the inclusion criteria were included.

Inclusion criteria

- All patients of both genders from 40 to 70 years of age.
- Patients who are willing for surgery by either Manual Small Incision Cataract Surgery (MSICS) or Phacoemulsification.

Exclusion Criteria

- Dry eye syndrome/ keratoconjunctivitis Sicca
- History of previous ocular surgeries
- Systemic disorders like diabetes, hypertension or autoimmune disease
- Patients having any other ocular pathology other than cataract
- History of trauma (Traumatic cataract)
- Patients with established meibomian gland dysfunction
- Patients on any systemic long-term medication
- Irregular follow-up visits
- Patient not willing to participate

Tools and techniques

In this study, out of 100 cases, 50 cases each underwent Manual Small Incision Cataract Surgery (MSICS) and phacoemulsification surgery respectively.

Patient particulars and proper history was taken. Comprehensive ophthalmic examination was done using Carl Zeiss Meditech Slit lamp (Carl Zeiss SL 115, Carl Zeiss Meditech,

Germany), +90D Volk lens (USA) was used after pupil dilation with tropicamide 0.8% and phenylephrine 2.5%.

Mydriasis was achieved by eye drop tropicamide 0.8 % and phenylephrine 2.5 % one hour before surgery. All surgery was done under peribulbar anaesthesia using 5 ml of 2% lidocaine hydrochloride with hyaluronidase enzyme (1500 IU). The surgery was performed by a single surgeon to reduce surgical bias. In SICS, scleral incision of 6-7 mm length was given superiorly with one side port incision and in phacoemulsification corneal incision of 2.5 mm was made at superotemporal, 2 mm side port incision was made 40^0 apart from the main incision in 10 o'clock and 2 o' clock. Polymethylmethacrylate (PMMA) posterior chamber intraocular lens(PCIOL) and foldable acrylic PCIOL was used in SICS and phacoemulsification respectively.

Intraoperatively, the ocular surface was taken care of by providing intermittent saline irrigation and ophthalmic viscoelastic devices. Postoperatively, patient was prescribed combined topical antibiotic: 2^{nd} Generation fluoroquinolone(Ofloxacin hydrochloride 0.3%) and long acting steroid (Dexamethasone 0.1%) in a tapered dosage pattern along with a lubricant (Carboxymethylcellulose 0.5%) for 6 weeks.

For objective analysis of dry eye: Schirmer 1 test (ST-I), Tear break-up time (TBUT) and Lissamine green surface staining (LGSS) were performed a day prior to surgery and at 1, 4 and 12 weeks respectively.

a. Schirmer 1 test (ST-I) was done to assess the aqueous tear production without topical anaesthesia by placing the Schirmer strip, made up of Whatman no. 41 filter paper, with dimensions of 5 mm x 35 mm. The initial 5 mm of the schirmer strip was folded and kept for 5 minutes at the junction of lateral one third and medial two third of lower fornix. The wetting of the strip at the end of 5 minutes was recorded. Values less than 10 mm were considered abnormal.
b. The tear break-up time (TBUT) assessment was done for evaluating lipid components of the tear film. The tear film was stained by applying the fluorescein strip in the lower fornix, and the patient was asked to blink frequently for a few seconds and then asked to stop blinking. TBUT is performed under slit lamp biomicroscopy using cobalt blue filter which measures the time interval for appearance of the first dry spot over the corneal surface after the last complete blink. Average of consecutive three readings with break up time less than 10 sec was considered abnormal.
c. To stain the ocular surface, a lissamine green paper strip was used. Two drops of normal saline was used to moisten the strip, then waited for 15 seconds to dampen it completely before applying it to the lower fornix of conjunctiva. The six areas of the interpalpebral conjunctiva (three areas each of the temporal and nasal conjunctiva) had been independently graded based on a six-point scale (0-5) using the Oxford scheme of ocular surface grading. Score of each area was combined to get the final score (maximum combined score of 30).
d. The subjective evaluation of patients' dry eye symptoms was done on the basis of ocular surface dryness index (OSDI) questionnaire (González M A et al, 2016). This questionnaire included 12 questions for evaluating the symptoms related to dry eye and their effects on vision-related functions, limitations and environmental triggers. Each answer is scored on the basis of symptom frequency using a 5-point scale where 0 indicates no problem and 4 indicate a significant problem. Relevant symptoms were analyzed and severity was inferred.

Data and Statistical Analysis

Interim analysis as well as calculation and tabulation of data were done by statistical software (vendor: SPSS v21, Armonk, NY, USA). Independent sample t test was used for data interpretation and p-value <0.05 was taken as level of significance.

Results

Out of 100 eyes enrolled 50 eyes each went SICS and phacoemulsification surgery.

These dry eye indices were similar in both groups preoperatively, which was statistically insignificant as shown in table 2.

The objective dry eye indices between two groups were statistically significant at 1 week. (Table 3)

The two groups show significant differences for each parameter compared to 4 week. (Table 4)

The two groups showed significant differences for each parameter compared at 12 week. (Table 5)

On observing OSDI questionnaire: out of 74% of cases, 56% had moderate dry eyes and 18% had severe dry eyes in the SICS group. In Phacoemulsification group, only 28% of cases had dry eye, out of which 2% had mild dry eye, 24% had moderate dry eye and 2% had severe dry eye.(Figure 1)

Table 1:Demographic distribution of the participant

Groups	**SICS**	**Phacoemulsification**
Total number of patients	50	50
Male (%)	16 (32%)	18 (36%)
Female (%)	34 (68%)	32 (64%)
Mean age (years)	53.66 ± 7.839	54.72 ± 7.985

Table 2: Pre-operative values of dry eye indices for patient undergoing cataract surgery (n=100)

Dry Eye Indices	**SICS (Mean ± SD)**	**Phacoemulsification (Mean ± SD)**	**P – value**
ST-I (mm)	32.10 ± 3.005	31.94 ± 4.142	>0.005
TBUT (seconds)	20.04 ± 2.020	19.94 ± 2.064	
LGSS	0.16 ± 0.370	0.18 ± 0.18	

Table 3: Values of dry eye indices at 1 week (n=100).

Dry Eye Indices	**SICS (Mean± SD)**	**Phacoemulsification (Mean ±SD)**	**p-value**
ST-I (mm)	21.12 ± 6.448	30.60 ± 5.859	<0.001
TBUT (seconds)	13.88 ± 5.513	18.98 ± 3.750	
LGSS	1.14 ± 0.783	0.34 ± 0.593	

Table 4: Values of objective dry eye indices at 4 weeks (n=100).

Dry Eye Indices	SICS (Mean ± SD)	Phacoemulsification (Mean ± SD)	p-value
ST-I (mm)	19.64 ± 6.691	27.60 ± 5.824	<0.001
TBUT (seconds)	11.90 ± 5.643	17.64 ± 4.462	
LGSS	1.48 ± 0.931	0.40 ± 0.639	

Table 5: Values of objective dry eye indices at 12 weeks surgery (n=100).

Dry Eye Indices	SICS (Mean ± SD)	Phacoemulsification (Mean ± SD)	p-value
ST-I (mm)	18.80 ± 7.393	27.10 ± 6.316	<0.001
TBUT (seconds)	11.30 ± 5.456	16.60 ± 4.699	
LGSS	1.62 ± 1.193	0.38 ± 0.602	

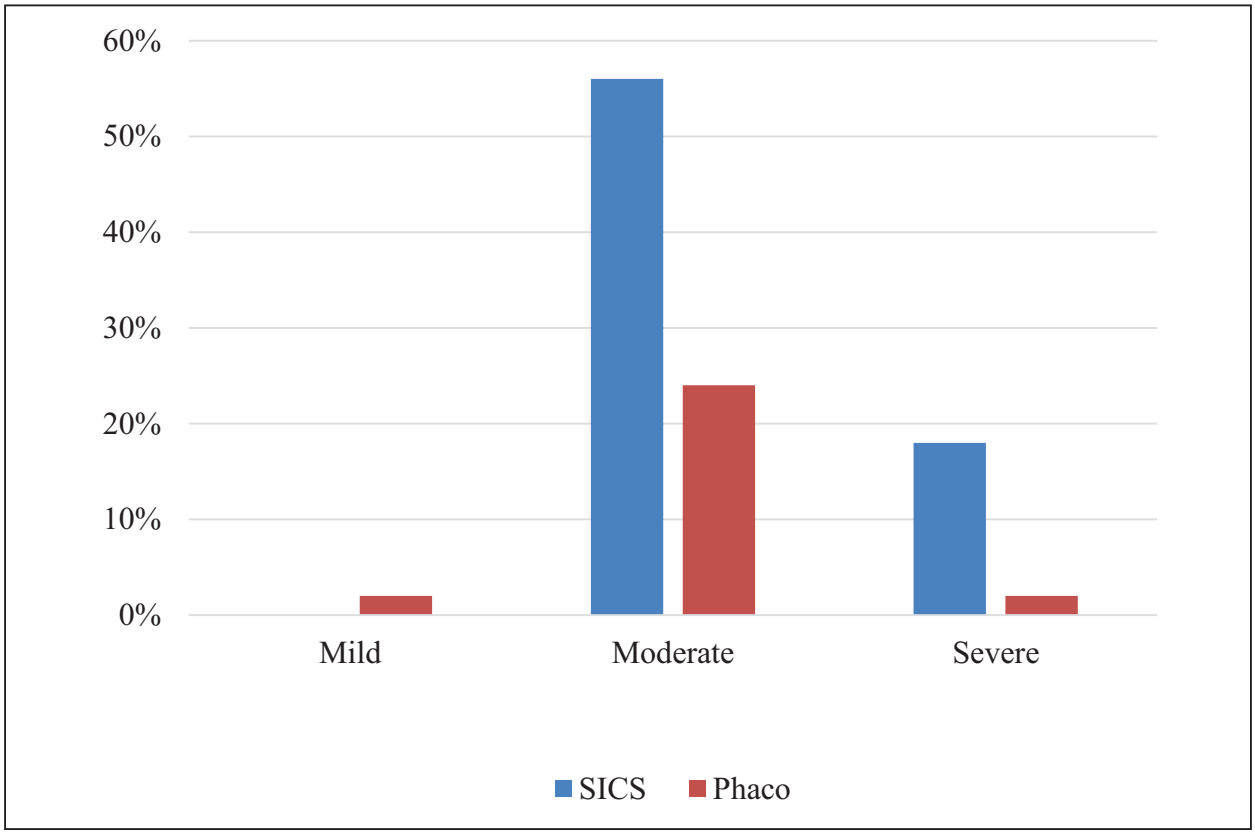

Figure 1: Bar diagram showing comparison of OSDI in two groups.

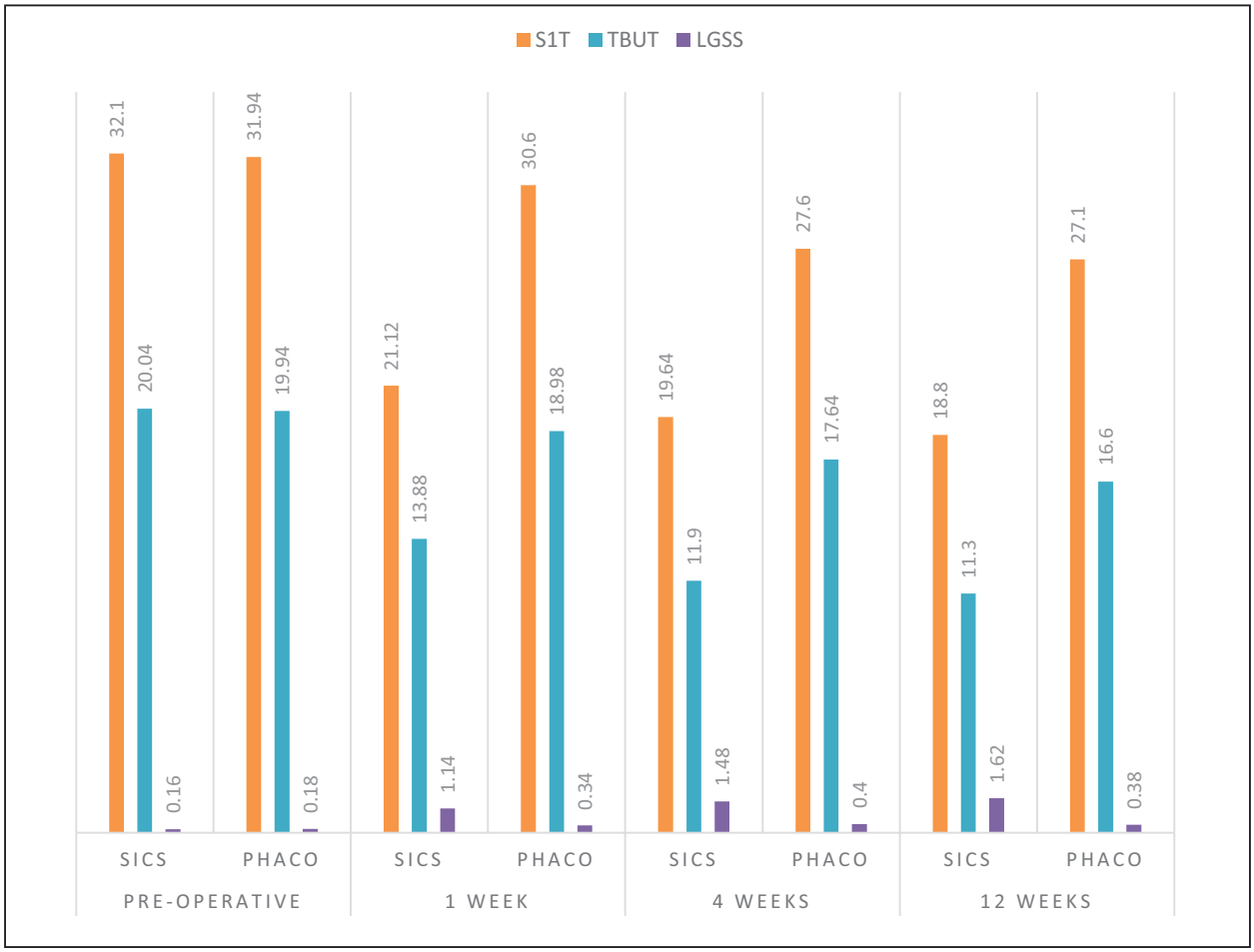

Figure 2: Pre-operative and Post-operative objective values of dry indices in two groups.

Discussion

This study was conducted to assess the dryness of the eyes following manual small incision cataract surgery and phacoemulsification. In the present study, ST-I and TBUT values revealed a declining trend in SICS than in phacoemulsification group at 1, 4 and 12 weeks respectively ($p<0.001$) which was similar to the study done by Cho Y K et al (2009).Li X M et al (2007) reported higher lower tear meniscus height, decreased TBUT and ST-I test and detected squamous metaplasia by impression cytology in patient who underwent phacoemulsification.

In a study conducted by Venugopal K C et al (2012):out of 66.2%, mild grade dry eye was seen in 53.32%, moderate in 26.6% and 20% had severe dry eyes after small incision cataract surgery. Khanal S et al (2008) reported statistically significant changes in tear production, evaporation, lipid layer interferometry and osmolarity along with corneal sensitivity after phacoemulsification.

In contrast, Ram J et al (2002) reported no differences in dry eye before and after phacoemulsification in 23 patients when the TBUT and Schirmer test with anaesthesia were performed which had relatively smaller sample size to comment upon. Srinivasan R et al (2008), Gharaee et al (2009), and Venincasa et al (2013) concluded that modern day cataract surgery has no effect on the ocular surface

and the tear film on a long-term basis. In a study done by Cho Y K (2009) there was no aggravation of dry eye symptoms and signs following use of phaco energy.

Lissamine green ocular surface stain score showed an increasing pattern depicting worsening of dryness post cataract surgery which was significant in SICS than in Phacoemulsification. In case of Phacoemulsification, although there was minimal increase in staining grade, there seems to be a reversal trend with statistically significant values at each period in both the surgeries at 12 weeks. Similar pattern was seen in the study done by Sahu P K et al (2015) where there was a gradual increase in staining score till 1 month then there was a gradual reversal pattern. In a study done by Dasgupta and Gupta (2016) LGSS showed an increasing pattern of staining till the 12th week. Similarly in a randomised controlled trial between surgery with conventional therapy and another group with conventional therapy along with 1% carboxymethyl cellulose sodium (CMC), which was statistically insignificant.(Yao K et al, 2015).

OSDI scoring inferred that in the SICS group: 56% had moderate and 18% had severe dry eye in out of 74 % of total dry eye. In case of Phacoemulsification, 2% had mild dry eye, 24% had moderate whereas only 2% had severe dry eye. Similarly, in a study done by Sinha M et al (2014) there was decrease in OSDI score in follow up period up to 3 months. This indicates that the patient had symptoms of dry eye although there had improved tear function changes. In a study done by Dasgupta and Gupta (2016) there was a similar OSDI score with our study. Sitompul R et al (2008) found a decline in OSDI score on the 14th day in patients who had undergone SICS, but the overall OSDI score improved after Phacoemulsification in follow up visits.

In contrast, Li X M et al (2007) observed statistically insignificant change of overall OSDI score before and after cataract surgery.

Conclusion

This study concluded that cataract surgery causes dry eyes and influences the dry eye indices in the postoperative phase. This is more significant in SICS than in phacoemulsification. OSDI scoring inferred that in SICS 74% had dry eyes in SICS group and 28% in phacoemulsification group.

Limitations

- This study was a single center small group study and had a shorter follow-up period.
- This study was not feasible to incorporate more Dry eye assessment like Tear Osmolarity, Conjunctival impression cytology etc.
- Schirmer 1 test is inaccurate and inevitable due to reflex secretion because of its invasive nature.
- The OSDI questionnaire does not assess more holistic effects of Dry Eye Disease on Quality of Life.

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