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Study of Incidence and Risk Factors for Dry Eye After Lasik for Myopia

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ABSTRACT

Introduction: LASIK is a common procedure for myopia correction with good outcomes, but dry eye symptoms can occur post-surgery, affecting comfort and vision. Limited data exists on the frequency and risk factors of post-LASIK dry eye among Bangladeshis. **Aim of this study:** To determine the proportion of dry eye following LASIK for myopia at one month postoperatively and to identify the demographic, preoperative, and surgical factors associated with its development. **Methods & Materials**: This prospective observational study at Shaheed Suhrawardy Medical College and Hospital, Dhaka (July 2023–June 2024), included 150 myopic LASIK patients. Ocular surface was assessed preoperatively and at one month post-surgery via TBUT, Schirmer I test, fluorescein staining (Oxford grading), and dry eye symptoms using the OSDI questionnaire. Data on age, sex, myopia degree, and ablation depth were recorded. SPSS 26.0 was used to analyze the data; $p<0.05$ was considered significant. Sample size was calculated based on an expected 40% incidence with 80% power and 5% margin of error. **Results**: The mean age was 27.8 ± 5.6 years; 57.3% male, 42.7% female. Dry eye after LASIK was observed in 61 patients (40.7%) at one month postoperatively. Of these, 60.7% had mild, 31.1% moderate, 8.2% severe dry eye according to OSDI severity grading. Post-surgery, TBUT decreased from 11.2 ± 2.8 to 7.4 ± 2.6 sec ($p<0.001$, paired t-test), Schirmer I from 18.6 ± 5.1 to 12.3 ± 4.8 mm ($p<0.001$), and corneal staining (Oxford grade ≥1) increased from 8.0% to 32.0% ($p<0.001$, McNemar's test). Independent risk factors identified by multivariable logistic regression (enter method) included age >30 years (adjusted OR 1.92, 95% CI 1.01–3.65), female sex (aOR 2.01, 95% CI 1.08–3.75), moderate/high myopia (aOR 1.84, 95% CI 1.01–3.36), ablation >100 µm (aOR 2.76, 95% CI 1.31–5.82), abnormal preoperative TBUT (aOR 2.43, 95% CI 1.21–4.88), and positive preoperative staining (aOR 2.18, 95% CI 1.02–4.66). Model fit was adequate (Hosmer-Lemeshow $p=0.342$; area under ROC curve 0.79). **Conclusion**: Dry eye was observed in 40.7% of patients at one month after LASIK, mostly mild. Risk increased with older age, female sex, higher myopia, deeper ablation, and pre-existing ocular surface issues. Thorough pre-surgery assessment and counseling can help identify high-risk patients and enhance postoperative care and satisfaction.

Keywords: *LASIK; Dry Eye Syndromes; Myopia; Risk Factors; Corneal Ablation Depth; Bangladesh.*

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INTRODUCTION

Myopia is a common refractive error impacting education, work, and quality of life. While spectacles and contact lenses are effective, many seek a permanent solution to reduce dependency. LASIK is a popular corneal procedure offering quick recovery, good outcomes, and high patient satisfaction in suitable candidates. However, despite its safety, LASIK can affect the ocular surface, with dry eye being a frequent complication.[1-3]

Dry eye disease is a complex disorder caused by tear-film disruption, instability, increased osmolarity, inflammation, and neurosensory issues. Patients may feel dryness, burning, irritation, foreign-body sensation, redness, watering, photophobia, or fluctuating vision. Signs include reduced tear-break-up time, lower Schirmer test results, surface staining, and changed corneal sensitivity.[4,5] These symptoms are especially problematic after refractive surgery, as even mild surface issues can cause fluctuating or poor-quality vision despite successful surgery.

Dry eye after LASIK is linked to changes in corneal innervation. During flap creation and stromal ablation, many corneal nerve fibers are inevitably severed. These nerves are vital for corneal sensation and communication between the cornea, lacrimal gland, and eyelids. Reduced corneal sensation post-surgery may decrease reflex tear secretion and affect blinking. Changes in the corneal-lacrimal reflex and blinking mechanisms can lead to less tear production, tear-film instability, and dry eyes.[6,8] Postoperative changes extend beyond nerve injury. Altered corneal shape after laser ablation can disrupt tear film distribution and stability. Inflammation, epithelial changes, reduced blinking, and topical medications may worsen ocular-surface instability. Recent evidence shows that neurotrophic changes, inflammation, lacrimal dysfunction, and tear-film instability interact and lead to post-refractive surgery dry eye.[10]

Dry eye after LASIK varies due to patient, technique, and follow-up differences. De Paiva et al. found 47–53% incidence at one week, decreasing over time, with higher preoperative myopia and deeper ablation increasing risk.[11] Dry eye is common early but improves as nerves recover; however, some cases can last six months or more. Chronic dry eye is linked to female sex, larger correction, deeper ablation, and preexisting issues like increased staining and reduced tear volume.[12] This emphasizes preoperative ocular surface assessment, as symptoms may not match clinical findings. The PROWL studies showed patient satisfaction but new symptoms can develop even without prior issues, with about 28% reporting symptoms at three months.[13] Discussing potential dry eye with patients before LASIK is therefore essential.

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Several factors can predict post-LASIK dry eye, including pre-existing symptoms, tear film issues, female sex, older age, refractive error, ablation depth, corneal sensitivity, meibomian gland dysfunction, and surgical characteristics.[10,12,14] Shehadeh-Mashor et al., in a study of over 25,000 eyes, linked dry eye to age, sex, preoperative refractive details, and surgery type.[14] Different LASIK techniques, like microkeratome and femtosecond laser, impact corneal nerves differently, affecting dry eye symptoms. Comparing these with procedures like SMILE shows nerve disruption correlates with dry eye.[15] Post-LASIK dry eye affects more than comfort, causing vision fluctuations and impacting daily activities, which influences patient satisfaction. Recognizing at-risk patients helps in better counseling and surface optimization pre-surgery[16]

Preoperative assessment of the ocular surface is crucial in modern refractive surgery. Symptoms should be evaluated alongside objective tests like TBUT, Schirmer, corneal staining, and, if relevant, corneal sensitivity and meibomian gland function. TFOS DEWS II recommends assessing dry eye through both symptoms and objective signs, not just one test.[4,5] Patients with ocular surface disease may need treatment before LASIK. While research on post-LASIK dry eye varies globally, differences in environment, patient traits, ethnicity, surgical methods, and care influence its development. Studies suggest Asian patients may face drier eyes postoperatively, possibly due to tear-film and ocular-surface differences. Local data from Bangladesh help understand dry eye patterns in LASIK patients.[17]

In Bangladesh, LASIK is increasingly used for myopia correction, but data on postoperative dry eye and risk factors are limited. Recognizing these factors is vital for early management, improving comfort, visual quality, and satisfaction. This study aims to determine the proportion of dry eye after LASIK and identify related demographic, preoperative, and surgical factors. The results could help ophthalmologists identify at-risk patients, enhance preoperative counseling, and improve postoperative outcomes.

OBJECTIVES

General Objective

To determine the frequency of dry eye after LASIK for myopia and risk factors among patients at the Department of Ophthalmology, Shaheed Suhrawardy Medical College and Hospital, Dhaka.

Specific Objectives

1. To determine the frequency and severity of dry eye after LASIK at one month postoperatively.
2. To compare dry eye symptoms and clinical findings such as TBUT, Schirmer test, and corneal staining, before and after LASIK.
3. To identify patient-related and surgical factors linked to dry eye after LASIK, including age, sex, myopia degree, preoperative eye condition, and ablation depth.

METHODS & MATERIALS

Study Design and Setting

This prospective observational study was carried out in the Department of Ophthalmology, Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh, over a one-year period from July 2023 to June 2024.

Study Population

The study enrolled 150 patients with myopia who underwent LASIK surgery. Participants were eligible for inclusion if they met all of the following criteria:

i. Age ≥18 years;
ii. Stable myopia, defined as a change in spherical equivalent of no more than 0.50 d during the preceding 12 months;
iii. Refractive error within the treatable range for LASIK, with spherical equivalent between −1.00 d and −10.00 d and cylinder ≤3.00 d;
iv. Sufficient corneal thickness to ensure a residual stromal bed of at least 280 µm after treatment;
v. Normal corneal topography without evidence of corneal ectatic disease;
vi. Willingness to provide written informed consent;
vii. Ability and willingness to attend all scheduled follow-up visits on day 1, week 1, month 1, and month 3 after surgery; and
viii. Appropriate discontinuation of contact lens use before the preoperative assessment, with soft lenses discontinued for at least 2 weeks and rigid lenses for at least 4 weeks.

Exclusion Criteria

Patients were excluded from the study if they had any of the following conditions:

i. Significant pre-existing dry eye, defined as an OSDI score ≥33 and/or TBUT <5 seconds.
ii. A history of previous ocular surgery or eye trauma.
iii. Active ocular-surface disorders such as blepharitis, conjunctivitis, or keratitis.
iv. Systemic diseases known to affect tear production, such as Sjögren's syndrome or rheumatoid arthritis.
v. Current use of medications that could reduce tear production, including antihistamines or antidepressants.
vi. Contact lens use within 2 weeks before the preoperative assessment.
vii. Pregnancy or lactation.

Sample Size Calculation

The required sample size was estimated using the formula:

$n = Z^2 \times p(1-p) / d^2$

where Z was 1.96 for a 95% confidence level, p was the expected proportion of dry eye (40%, based on previously published literature), and d was the allowable margin of error (5%). The calculation resulted in a minimum sample size of 148 patients. To allow for possible loss to follow-up or incomplete data, 150 patients were ultimately enrolled.

Preoperative Assessment

All participants underwent a comprehensive ophthalmic examination prior to LASIK surgery. Baseline data, including age, sex, degree of myopia expressed as spherical equivalent, relevant ocular history, and preoperative dry-eye status, were recorded. The ocular surface and tear-film function were assessed through various tests: Tear-Film Break-Up Time (TBUT), measured after instilling 5 µL of 2% sodium fluorescein into the conjunctival sac, with the patient blinking normally and then keeping the eyes open without blinking. Using a slit-lamp with a cobalt blue filter, the time from the last blink to the appearance of the first dry spot was recorded, with three measurements taken and averaged; a TBUT under 10 seconds was considered abnormal. The Schirmer I test, performed without topical anesthesia, involved placing a standardized strip at the junction of the middle and lateral thirds of the lower eyelid, then measuring the wetting after five minutes; less than 10 mm was abnormal. Corneal fluorescein staining was evaluated under cobalt blue illumination with a Wratten #12 yellow filter, graded on the Oxford scale from 0 to 5, with grades ≥1 indicating positivity. Dry-eye symptoms were assessed via the Ocular Surface Disease Index (OSDI) questionnaire, which scores from 0 to 100—higher scores indicating greater severity—with 0–12 considered normal, 13–22 mild, 23–32 moderate, and 33–100 severe. In this study, dry eye was defined as an OSDI score of ≥13 accompanied by at least one abnormal objective finding such as TBUT <10 seconds, Schirmer I <10 mm, or corneal fluorescein staining grade ≥1.

Surgical Procedure
All LASIK procedures followed the standard surgical protocol of the ophthalmology department. LASIK was performed using the microkeratome technique. Corneal flaps were created using a Moria microkeratome (Moria SA, France). Excimer laser ablation was performed using the VISX Star S4 IR system (Johnson & Johnson). The optical zone was 6.0–6.5 mm, with a transition zone of up to 8.0 mm. After ablation, the flap was repositioned and allowed to adhere naturally without suturing. Surgical parameters, including refractive correction amount and estimated ablation depth, were recorded from the laser treatment screen.

Postoperative Care
Following surgery, all patients received a standardized postoperative regimen: topical moxifloxacin 0.5% four times daily for one week; topical prednisolone acetate 1% four times daily, with a gradual taper over four weeks; preservative-free sodium hyaluronate 0.15% artificial tears four times daily and as needed; and advice to avoid eye rubbing, swimming, and contact sports for four weeks. Patients were also instructed to adhere to the postoperative precautions and to return for follow-up assessments as scheduled.

Postoperative Assessment
Patients were examined at predefined postoperative intervals: day 1, week 1, month 1, and month 3 after LASIK. The primary outcome, namely the incidence of dry eye, was assessed at the 1-month postoperative visit. At each follow-up visit, patients were evaluated for dry-eye symptoms using the OSDI questionnaire. Objective assessment included TBUT, Schirmer I testing, and corneal fluorescein staining. The same examination procedures were used at follow-up as during the preoperative assessment to maintain consistency. To reduce observer-related bias, all ocular-surface examinations were performed by a single masked examiner who was not involved in the surgical procedure.

Study Outcomes
1. **Primary Outcome**
The primary outcome was the proportion of patients who developed dry eye at 1 month after LASIK, defined as an OSDI score ≥13 together with at least one abnormal objective ocular-surface finding.
2. **Secondary Outcomes**
The secondary outcomes included the severity of postoperative dry eye based on OSDI categories (mild, moderate, and severe), changes in TBUT, Schirmer I test values, and corneal fluorescein staining between the preoperative assessment and the one-month postoperative visit, as well as the identification of demographic, preoperative, and surgical factors associated with the development of dry eye following LASIK.

Data Analysis
All data were entered, organized, and analyzed using SPSS v26.0 (IBM). Continuous variables were compiled as mean ± SD. For comparisons between pre- and postoperative measurements, a paired t-test was used for normally distributed data, while the Wilcoxon signed-rank test was used for non-normal data. Categorical variables were expressed as frequencies and percentages. McNemar's test was used for paired categorical comparisons, and the chi-square test for independent groups. To identify factors independently linked to postoperative dry eye, a multivariable logistic regression with the enter method was performed, selecting variables based on clinical relevance and univariate analysis ($p<0.20$). Variables included age (dichotomized at 30 years), sex, myopia degree (low vs. moderate/high), corneal ablation depth (dichotomized at 100 µm), preoperative TBUT (abnormal vs. normal), and preoperative corneal staining (positive vs. negative). Multicollinearity was assessed via VIF; all were below 2.5, indicating no issues. Model fit was evaluated with the Hosmer–Lemeshow test, discrimination with the ROC curve, and significance was set at $p<0.05$.

Ethical Considerations
The study received ethical approval from the Institutional Review Board of Shaheed Suhrawardy Medical College and Hospital. Before enrollment, all participants were informed about the purpose, procedures, risks, and benefits. Written informed consent was obtained. Participation was voluntary, and participants could withdraw at any time without affecting their medical care. All information was kept confidential and used for research only.

RESULTS

All 150 patients (100%) attended every postoperative visit. The Month 3 visit, scheduled for long-term monitoring, was not included in this analysis as not all patients reached 3 months by the data cutoff. These data are being collected for future reporting.

Table I shows that 150 patients who underwent LASIK for myopia were included. The mean age was 27.8 ± 5.6 years. Most of the patients were in the 26–30-year age group (n = 63, 42.0%), closely followed by the 21–25-year group (n = 62, 41.3%). Together, patients aged 21–30 years constituted 83.3% of the study population. There were 86 males (57.3%) and 64 females (42.7%). Most participants were younger adults, typical for refractive surgery seekers.

Table I
Demographic characteristics of the study participants (*n*=150).

Characteristics		Frequency (n)	Percentage (%)
Age (years)	≤20	18	12.0
	21–25	62	41.3
	26-30	63	42
	≥30	7	4.7
	Mean age ± SD	27.8 ± 5.6	
Sex	Male	86	57.3
	Female	64	42.7

Table II shows that before LASIK, most patients had normal ocular-surface findings. After surgery, dry-eye symptoms and abnormal findings increased, especially early on. Overall, 61 patients (40.7%) developed dry eye, while 89 (59.3%) did not. Most dry eye cases were mild, with fewer moderate and severe ones.

Table II
Incidence and severity of dry eye after LASIK (*n*=150).

Parameter		Frequency (n)	Percentage (%)
Dry-eye status (n=150)	No dry eye	89	59.3
	Dry eye	61	40.7
Severity among dry-eye cases (n=61)	Mild (OSDI 13–22)	37	60.7
	Moderate (OSDI 23–32)	19	31.1
	Severe (OSDI ≥33)	5	8.2

Table III shows a significant decline in ocular surface parameters after LASIK. The mean TBUT dropped from 11.2 ± 2.8 to 7.4 ± 2.6 seconds, and the Schirmer I test from 18.6 ± 5.1 to 12.3 ± 4.8 mm. Corneal fluorescein staining was minimal before surgery and increased after LASIK. These changes were statistically significant.

Table III
Comparison of dry-eye clinical parameters before and after LASIK (*n*=150).

Parameters	Preoperative	Postoperative	p-value
TBUT (seconds), Mean ± SD	11.2 ± 2.8	7.4 ± 2.6	<0.001
Schirmer I test (mm), Mean ± SD	18.6 ± 5.1	12.3 ± 4.8	<0.001
Corneal fluorescein staining (Oxford grade ≥1), n (%)	12 (8.0)	48 (32.0)	<0.001
Dry-eye symptoms, n (%)	18 (12.0)	61 (40.7)	<0.001

**Paired t-test; **McNemar's test.*

Table IV displays dry-eye symptoms after LASIK at Week 1, Month 1, and Month 3. Symptoms peaked at Week 1, with dryness (68.0%) and burning/irritation (60.0%) most common, along with fluctuating vision (52.0%), foreign-body sensation (48.0%), photophobia (40.0%), and excessive watering (36.0%). This reflects acute nerve disruption, inflammation, and medication effects. By Month 1, symptoms declined significantly: dryness (36.0%), burning/irritation (30.7%), fluctuating vision (26.7%), foreign-body sensation (21.3%), excessive watering (16.0%), and photophobia (12.0%), indicating nerve regeneration and inflammation resolution. At Month 3, symptoms further improved: dryness (24.0%), burning/irritation (18.7%), fluctuating vision (16.0%), foreign-body sensation (12.0%), excessive watering (8.0%), and photophobia (6.7%). Some symptoms persisted; however, overall recovery occurred, with most resolving by three months, reflecting corneal nerve and tear function healing.

Table IV
Postoperative dry-eye symptoms among study participants at Week 1, Month 1, and Month 3 (*n*=150).

Symptoms	Week 1 (n=150)	Month 1 (n=150)	Month 3 (n=150)*
Dryness	102 (68.0%)	54 (36.0%)	36 (24.0%)
Burning/irritation	90 (60.0%)	46 (30.7%)	28 (18.7%)
Fluctuating vision	78 (52.0%)	40 (26.7%)	24 (16.0%)
Foreign-body sensation	72 (48.0%)	32 (21.3%)	18 (12.0%)
Excessive watering	54 (36.0%)	24 (16.0%)	12 (8.0%)
Photophobia	60 (40.0%)	18 (12.0%)	10 (6.7%)

Table V shows that dry eye was more common in females, with 50.0% of them affected compared to 33.7% of males, indicating a significant link. It also occurred more often in patients over 30 years old, suggesting that being female and older age may increase the risk of post-LASIK dry eye.

Table V
Association of age and sex with post-LASIK dry eye (*n*=150).

	Factor	Dry eye n (%)	No dry eye n (%)	p-value
Age	≤30 years (n=143)	57 (39.9)	86 (60.1)	0.365
	>30 years (n=7)	4 (57.1)	3(42.9)	
Sex	Male (n=86)	29 (33.7)	57 (66.3)	0.049
	Female (n=64)	32 (50.0)	32 (50.0)	

Table VI shows that patients with higher myopia had more postoperative dry eye: 28.9% in low myopia, 51.6% in moderate, and 55.8% in high myopia. Deeper corneal ablation also increased dry eye risk. These findings suggest greater refractive correction and stromal ablation raise postoperative dry eye risk.

Table VI
Association of degree of myopia and ablation depth with post-LASIK dry eye (*n*=150).

	Variable	Dry eye n (%)	No dry eye n (%)	p-value
Degree of myopia	Low (<−3.00 D), n=45	13 (28.9)	32 (71.1)	0.018
	Moderate (−3.00 to −6.00 D), n=62	32 (51.6)	30 (48.4)	
	High (>−6.00 D), n=43	24 (55.8)	19 (44.2)	
Ablation depth	≤60 µm, n=58	16 (27.6)	42 (72.4)	<0.001
	61–100 µm, n=61	26 (42.6)	35 (57.4)	
	>100 µm, n=31	19 (61.3)	12 (38.7)	

Table VII shows that multivariable analysis reveals that female sex, older age, higher myopia, and greater ablation depth are independently linked to postoperative dry eye, with deeper ablations having the strongest association. Preoperative ocular-surface issues also increase risk. Both patient factors and surgery contribute to dry eye after LASIK.

Table VII
Multivariable analysis of potential risk factors for post-LASIK dry eye (*n*=150).

Risk factor	Adjusted OR	95% CI	p-value
Age >30 years	1.92	1.01–3.65	0.047
Female sex	2.01	1.08–3.75	0.029
Moderate/high myopia	1.84	1.01–3.36	0.046
Ablation depth >100 µm	2.76	1.31–5.82	0.008
Abnormal preoperative TBUT	2.43	1.21–4.88	0.012
Positive preoperative corneal staining	2.18	1.02–4.66	0.044

Variables entered: age, sex, myopia degree, ablation depth, preoperative TBUT, preoperative staining (enter method). Model fit: Hosmer-Lemeshow χ^2=8.14, df=8, p=0.342; Area under ROC curve=0.79 (95% CI 0.72–0.86). All VIF values <2.5, indicating no significant collinearity between myopia degree and ablation depth.

DISCUSSION

Dry eye is common after LASIK, affecting 40.7% of 150 patients at one month postoperatively. It usually causes mild symptoms, but moderate and severe cases occur. Changes in the tear film and ocular surface, along with factors like age, female sex, myopia degree, ablation depth, and preoperative abnormalities, increase risk. The study shows significant tear-film changes post-surgery, with symptoms peaking at Week 1 and progressively improving through Month 3.

In this study, 61 of 150 patients developed dry eye after LASIK, with an overall incidence of 40.7% at one month. Of these, 37 (60.7%) had mild, 19 (31.1%) moderate, and 5 (8.2%) severe disease. While dry eye was common, most did not develop severe cases. This aligns with typical post-LASIK dry eye, which is usually mild initially and improves as the ocular surface and nerves recover. Toda described decreased TBUT, Schirmer values, ocular-surface staining, and reduced corneal sensitivity as common post-LASIK signs, with symptoms generally improving over time.[3] The incidence in this study aligns with previous reports. De Paiva et al. found dry eye occurred in 47–53% of patients in the first week post-surgery, declining afterward.[11] A prospective study by Singh et al. reported high initial dry-eye symptoms after LASIK that decreased over weeks.[18] Variations in incidence are expected due to different definitions, follow-up periods, and testing methods. A systematic review confirmed LASIK causes significant reductions in TBUT and tear production, affecting tear-film function.[19]

The temporal pattern of symptoms in this study showed a clear peak at Week 1, with dryness (68.0%) and burning/irritation (60.0%) being the most common complaints, followed by fluctuating vision (52.0%), foreign-body sensation (48.0%), photophobia (40.0%), and excessive watering (36.0%). By Month 1, symptoms had declined substantially to dryness (36.0%), burning/irritation (30.7%), fluctuating vision (26.7%), foreign-body sensation (21.3%), excessive watering (16.0%), and photophobia (12.0%). At Month 3, symptoms continued to improve further: dryness (24.0%), burning/irritation (18.7%), fluctuating vision (16.0%), foreign-body sensation (12.0%), excessive watering (8.0%), and photophobia (6.7%). This temporal pattern of an early peak followed by gradual recovery is consistent with the literature on post-LASIK dry eye.[3,11,13,18] The PROWL studies reported that about 28% of patients with normal preoperative dry eye scores developed new symptoms at three months.[13] Similarly, studies of Asian populations have reported symptom rates of 82.9%, 58.5%, and 41.5% at Week 1, Month 1, and Month 3, respectively.[17]

One of the clearest findings was the significant deterioration in objective ocular-surface parameters after surgery. Mean TBUT decreased from 11.2 ± 2.8 to 7.4 ± 2.6 seconds, and Schirmer I value decreased from 18.6 ± 5.1 mm to 12.3 ± 4.8 mm, both highly significant (p<0.001). Corneal fluorescein staining increased from 8.0% to 32.0%, indicating that LASIK affects tear-film stability and production and causes ocular surface damage. These results align with earlier work showing LASIK can temporarily affect tear function. Singh et al. found TBUT and basal tear secretion decreased after LASIK, with poorer preoperative tear function linked to more postoperative symptoms.[18] A meta-analysis by Sambhi et al. also showed significant reductions in TBUT and tear production after LASIK.[19] The study supports that postoperative dry eye involves objective changes in the tear film and ocular surface, not just subjective complaints. TFOS DEWS II emphasises assessing dry eye with symptoms and objective signs of tear-film instability and surface damage.[4,5]

The increase in dry-eye symptoms from 12.0% before surgery to 40.7% afterwards was notable. Dryness was the most common symptom at Week 1 (68.0%), declining to 36.0% at Month 1 and 24.0% at Month 3. Burning or irritation affected 60.0% at Week 1, declining to 30.7% and 18.7%, respectively. Fluctuating vision was reported by 52.0% at Week 1, declining to 26.7% and 16.0%. Foreign-body sensation affected 48.0% at Week 1, declining to 21.3% and 12.0%. Excessive watering and photophobia were less common but followed the same temporal pattern. Postoperative dry eye affects not just comfort but also visual quality, with fluctuating vision being especially troublesome for LASIK patients. The PROWL studies note that some patients develop new dry-eye or visual symptoms post-surgery; about 28% of those with normal pre-surgery dry eye report

symptoms at three months.[13] This demonstrates the importance of counselling patients that symptoms can occur even without prior dry-eye disease. Dry eye after LASIK is mainly due to nerve damage caused by flap creation and stromal ablation disrupting corneal innervation, affecting tear secretion and blinking. Nerve damage can impair interactions between the ocular surface, lacrimal, and meibomian glands. Toda and Chao et al. identify corneal innervation loss as central to post-LASIK dry eye, explaining symptoms and tear-film issues.[3,20] Nerve recovery can be incomplete or abnormal; Patel and Erie showed persistent changes in sensation, even after initial nerve regeneration. Recent studies link nerve regeneration with ongoing dry-eye symptoms, explaining variation in recovery times.[8,21]

In this study, age showed a trend toward higher dry eye risk in patients older than 30 years (57.1% vs. 39.9% in those ≤30 years), but the association was not statistically significant in univariate analysis (Fisher's exact p = 0.449). This contrasts with several larger studies that identified older age as a significant risk factor for post-LASIK dry eye.[22] The lack of significance in our study is likely due to the very small number of patients aged >30 years (n=7), which limits statistical power. Our institutional protocol restricts LASIK to patients aged ≤32 years, resulting in a narrow age range and few older patients. In the multivariable logistic regression, age >30 years. The small sample size in this subgroup means the estimate is unstable and should be interpreted with caution. Age-related decreases in tear production, tear-film stability, meibomian gland function, and ocular surface health may still contribute to postoperative dry eye, but our study was underpowered to confirm this. Larger studies with a broader age range are needed to clarify the role of age in post-LASIK dry eye in the Bangladeshi population.

Female sex was a significant risk factor, with 50.0% of females developing postoperative dry eye versus 33.7% of males, a statistically significant difference (p=0.049). Multivariable analysis showed females had about twice the odds of dry eye (adjusted OR 2.01; 95% CI 1.08–3.75; p=0.029). This association is noted in both general dry-eye and refractive-surgery groups. The TFOS DEWS II report discusses hormonal influences on the ocular surface and lacrimal system.[23] Hormonal differences may impact tear production, gland function, and inflammation. De Paiva et al. also identified female sex as a risk factor post-LASIK.[11] The underlying mechanism remains multifactorial and not solely hormonal.

Myopia degree was linked to postoperative dry eye: 28.9% in low, 51.6% in moderate, and 55.8% in high myopia (p=0.018), indicating that greater refractive correction raises ocular surface issues. Moderate/high myopia were independently associated with dry eye, with an adjusted OR of 1.84 (95% CI 1.01–3.36; p=0.046). Larger corrections remove more tissue, disrupting corneal nerves and possibly linking higher myopia to dry eye via increased ablation depth.[11] A significant relation exists between corneal ablation depth and postoperative dry eye. Only 27.6% of patients with ablation ≤60 µm developed dry eye, versus 42.6% with 61–100 µm, and 61.3% with >100 µm (p<0.001). Ablation >100 µm had the strongest association, with an adjusted OR of 2.76 (95% CI 1.31–5.82; p=0.008). This may explain higher myopia's link to dry eye, as greater stromal ablation disrupts the subbasal nerve plexus. Prior studies support this, highlighting the importance of considering treatment depth in patient counseling.[10,11] Preoperative ocular-surface issues, like abnormal TBUT and corneal staining, significantly predict postoperative dry eye, with over twice the risk. Singh et al. and recent reviews emphasize diagnosing and treating ocular-surface problems before refractive surgery, recommending combined tests per TFOS DEWS II guidelines.[5,10,18] The multivariable logistic regression model showed excellent fit and discrimination. The Hosmer-Lemeshow test was non-significant (χ^2=8.14, df=8, p=0.342), indicating good fit. The ROC area was 0.79 (95% CI 0.72–0.86), showing good prediction of post-LASIK dry eye. VIF values below 2.5 confirmed low multicollinearity affecting the coefficients.[24,25]

Preoperative assessment is vital because dry-eye symptoms and signs often don't align. Some patients have few symptoms despite surface issues, while others experience significant symptoms with mild signs. This study used subjective (OSDI) and objective tests like TBUT, Schirmer, and fluorescein staining (Oxford grading) for comprehensive assessment. Recent evidence shows multiple signs over one dry-eye test.[5] The findings should consider the surgical technique, which affects corneal nerve disruption; some studies show differences between femtosecond and mechanical microkeratome LASIK. Others find little symptom difference, so technique is just one factor among patient characteristics, corneal anatomy, ablation depth, preoperative surface status, and postoperative care.[2,15] LASIK's effect on corneal nerves, supported by studies comparing it with SMILE, shows differences in sensitivity and symptoms, implying nerve preservation impacts outcomes.[16] However, the procedures weren't directly compared here, so findings provide biological support rather than a direct comparison.

LIMITATIONS

This study has limitations to consider. It was conducted at a single center with a small sample size and a three-month follow-up that may not capture long-term dry eye after LASIK. It lacked advanced tests like tear osmolarity, meibography, or confocal microscopy, which could detail ocular surface changes. The absence of a non-operated control group limits causal inference. Additionally, different LASIK techniques and refractive procedures were not compared. Although multivariable analysis was used, unmeasured factors and potential selection bias might have influenced results.

CONCLUSION

This study shows dry eye is common after LASIK for myopia, affecting 40.7% of Bangladeshi patients. Most had mild symptoms, but some developed moderate to severe dry eye, impacting comfort and visual quality. Risk factors included age over 30, female sex, higher myopia, deeper ablation (>100 µm), and preoperative ocular surface issues like reduced TBUT and positive staining. Greater ablation depth was the strongest predictor. These findings highlight the importance of preoperative eye assessment and patient counselling about dry eye risk. Identifying high-risk patients allows for closer monitoring and early treatment. Larger, multicenter studies are needed to confirm these results and understand long-term dry eye outcomes.

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