Assessment of dry eye after LASIK with a Femtosecond Laser and a Mechanical Microkeratome

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ABSTRACT

Purpose. Dry eye is the most common complication after LASIK procedure and is associated with corneal denervation. We conducted this study to compare the effect of MK assisted Lasik and Femtolasik on dry eye parameters. **Patients and Methods:** In this prospective, nonrandomized, comparative study, 160 patients with myopia and astigmatism refractive surgery candidates MK assisted lasik and femtolasik were examined, the groups were age and sex matched. Schirmer testing, tear breakup time (TBUT), corneal staining were performed one week pre-operative and at 1 week, 1, 3 and 6 months postoperatively. **Inclusion/exclusion criteria:** Patients older than 18 years with stable refraction, normal ophthalmic examination except for refractive errors planned residual stromal bed thickness more than 300 um. pregnant patients and patients with autoimmune diseases, previous ocular surgery were excluded from the study. **Results:** There was no significant deviation in Schirmer test. There was no significant deviation in cornea staining scores, there was no significant deviation in tear break up time test between the two groups throughout the 6 months post-operative. There was obvious decrease in Schirmer test and TBUT, corneal fluorescein staining post-operative relative to pre-operative values at first week. **Conclusions:** Both FS- and MK-assisted LASIK reduced Schirmer basic test TBUT and increased corneal staining. There was no significant difference in Schirmer test, TBUT, corneal fluorescein staining scores between the two groups.
Key words: Dry eye, LASIK, Femtosecond, Mechanical Microkeratome

INTRODUCTION

Refractive surgery including Laser in situ keratomileusis (LASIK) and femtolasik are the most common performed corneal refractive procedures to correct refractive errors[1]. In MK assisted Lasik, a microblade is used to create the corneal flap before ablation with the laser on corneal stroma in femtolasik, femtosecond laser is used to create the corneal flap before ablation with the laser on corneal stroma[1].

Dry eye is the most common complication encountered after laser refractive surgery with a reported 95% of patients experiencing dryness immediately after surgery. Most patients after LASIK experience gritty sensation, stinging and fluctuation of vision[2].

Many factors contribute to dry eye after laser refractive surgery. There are many theories that suggested the following, LASIK damage the corneal nerve fibers during the creation of the corneal flap, followed by a decrease in corneal sensitivity, blink rate decreases and tear film evaporation increases [3].The higher calculated ablation depth causing more corneal nerve damage and increasing dry eyes post lasik [4]. Reduced goblet cells density during the suction leading to unstable tear film mucin layer. Goblet cell reduction in femtolasik higher than MK assisted lasik due to prolonged suction time[4].

In this study, we use objective parameters to analyze the effects of femtolasik and MK assisted lasik on dry eye.

METHODS

160 patients with myopia and astigmatism of both sexes with mild to moderate myopia were included. The patients' age was 26 ± 5 in Femtolasik group and 27± 7 in MK assisted LASIK group. Spherical equivalent of refraction (-2.50: -7.00) was in femtolasik group and spherical equivalent from (-1.75:-5.00) with astigmatism (-1.00: -3.00) in both groups.

Surgical Procedures

All patients were performed by the same surgeon at a private refractive surgery center between May 2023 and December 2023. All the patients were evaluated at 1-week pre-operative, 1 week and at 1, 3, and 6 months postoperatively.

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The right eye of each patient was enrolled in the study

Morea, M2 (Moria SA, Antony, France) was used in corneal flap creation in MK assisted Lasik group, with parameters of a 110-um flap thickness, 9.0-mm diameter and optical zone of 6.5 mm.

Femtosecond laser (wave light FS 200 femtosecond laser, Alcon) was used for corneal flap creation in femtolasik cases with parameters of flap diameter of 9.0 mm, a flap thickness of 110 um, a hinge angle of 90 degrees, canal width1.7. All patients were instructed to use prednisolone acetate 1% ophthalmic suspension (Pred Forte; Allergan), moxifloxacin hydrochloride 0.5 % ophthalmic solution (vigamox; Alcon Laboratories) four times daily for 1 week and optive fusion UD Allergan Carboxymethylcellulose (INN: Carmellose) sodium 0.5%, Glycerin (INN: Glycerol) 0.9% 4 times daily in the first week then as frequent as needed for the next 3 months post-operative.

Restasis eye drops twice daily (cyclosporine ophthalmic emulsion 0.05%) was used for 3 months. Examinations were performed at 1 week pre-operative, I week and 1, 3, and 6 months post-operative: tear breakup time (TBUT), fluorescein ocular surface staining, Schirmer basic tear secretion test were performed.

Schirmer Basic Tear Secretion Test

Standard Schirmer strip of paper of (35mm x 5mm) was placed at the inferior cul-de-sac for 5 minutes. The length of the wet portion of the strip was measured in millimeters. A score greater then 15 mm in 5 minutes was considered normal

Tear Breakup Time

The TBUT was evaluated 2 minutes after the inferotemporal bulbar conjunctiva was touched with a sodium fluorescein strip. Patients were asked to blink, and the tear film was examined with cobalt blue light of slit lamp. It was measured as the number of seconds between the last complete blink and the first visible disturbance of the precorneal film.

Ocular Surface Staining

Corneal fluorescein staining is used to assess the corneal epithelium viability. After fluroscein instillation in the tear film, the cornea was evaluated under slit lamp with cobalt blue filter. The cornea is divided into 5 zones, central cornea surrounded by the superior, inferior, nasal, and temporal zones. Staining of zones was based on a scale values where 0 is absent and 4 is severe. the cornea is divided into five sections and assigns a value from 0 (absent) to 3 (severe) to each section, based on the amount, size, and confluence of the PEE, for a maximum of 15 point.

Statistical Analysis

All statistical analyses were performed using the commercial predictive analytic Statistical program (Version 14; Dell, Tulsa, OK a *p*-value of less than 0.005 was considered significant statistically

The Kolmogorov–Smirnov test was used to evaluate normal distribution. The chi-square test and Fisher's exact test were used to compare categorical variables. Pearson correlation coefficients (r) were used to evaluate the correlations between continuous variables. Descriptive statistics were calculated as the mean T SD. A value of p G 0.05 was considered statistically significant. The study power was 0.95 when > = 0.05.

RESULTS

Table 1 shows pre-operative characteristics, refraction and keratometry of the patients.Age and sex were parallel between the two group. There was no significant difference in refraction, mean keratometry and stromal ablation depth between the two groups.

Table 1: Preoperative demographic data and pre-operative measurements

		Femtosecond group	Microkeratome group	p
Sample size		80	80	0.82
Age, yr		26 ± 5	27 ± 7	0.65
Sex	Female	45	38	0.48
	Male	35	42	
Spherical equivalent, D		7.0 ± 2.5	5.1 ± 1.75	0.001*
Sphere, D		4.0 ± 2.0	3.0 ± 1.75	0.001*
Astigmatism, D		1.0 ± 0.8	1.0 ± 0.9	0.87
Mean keratometry, D		41.6 ± 5.2	42.0 ± 4.4	0.46
Calculated ablation depth, Km		110 ± 35	90 ± 30	0.005*

*Statistical significance, p G 0.01.

Table 2 shows no significant difference in tear break up time test, schirmer test and fluorescein corneal staining pre-operatively between both groups.

There was significant increase in Schirmer test, TBUT, corneal flurosscein stain results post-operatively in both MK assisted lasik group and femtolasik group

There was no significant difference in Schirmer test, TBUT corneal and fluorescein between both groups at 6 months post-operative.

Table 2: The statistical analyses of pre- and post-LASIK dry eye signs

		Preoperative	1 Wk	1 Mo	3 Mo	6 Mo	p
TBUT's	**FS**	6.2 ± 5.2	7.8 ± 2.7	7.8 ± 2.6	8.8 ± 4.7	9.1 ± 8.6	0.02*
	MK	5.6 ± 5.3	6.3 ± 4.1	6.5 ± 2.5	7.8 ± 4.2	7.5 ± 2.9	
Fluorescein staining scores	**FS**	1.5 ± 1.7	1.8 ± 1.5	1.6 ± 1.5	1.4 ± 1.3	1.3 ± 1.0	0.13
	MK	1.4 ± 1.8	1.9 ± 2.3	1.9 ± 1.6	1.7 ± 1.5	1.6± 1.3	
Schirmer test, mm	**FS**	7.8 ± 4.6	8.8 ± 6.1	8.1 ± 6.2†	8.0 ± 7.0	8.9 ± 7.4‡	0.28
	MK	6.5 ± 5.4	7.1 ± 6.4	7.8 ± 6.5	7.5 ± 5.4	8.2 ± 6.2	

*Statistical significance, p G 0.05.
Within-group analysis of variance was performed with the paired t test.
†Statistical significance, p G 0.05. ‡Statistical significance, p G 0.01.
FS, femtosecond laser; MK, microkeratome; OSDI, Ocular Surface Disease Index; TBUT, tear breakup time.

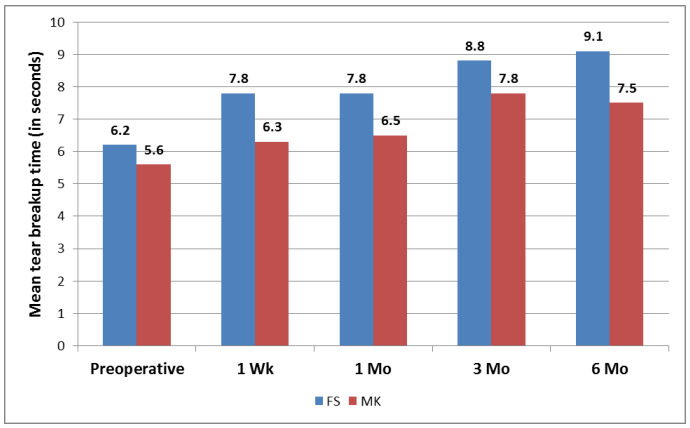

Figure 1: Mean tear breakup time (in seconds) in the femtosecond laser (FS) and microkeratome (MK) groups. p G 0.05 with the repeated-measures analysis of variance.

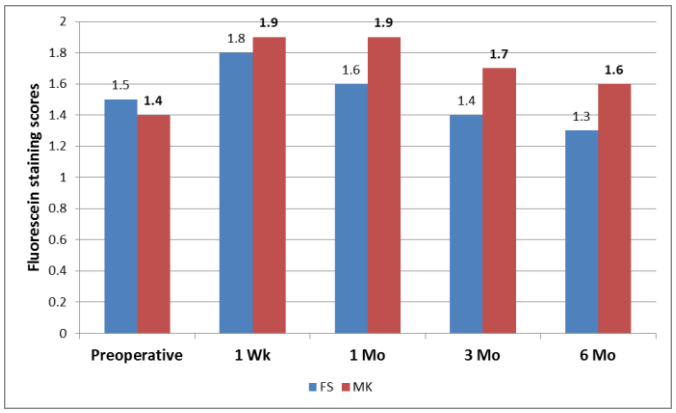

Figure 2: Mean corneal fluorescein staining scores in the femtosecond laser (FS) and microkeratome (MK) groups

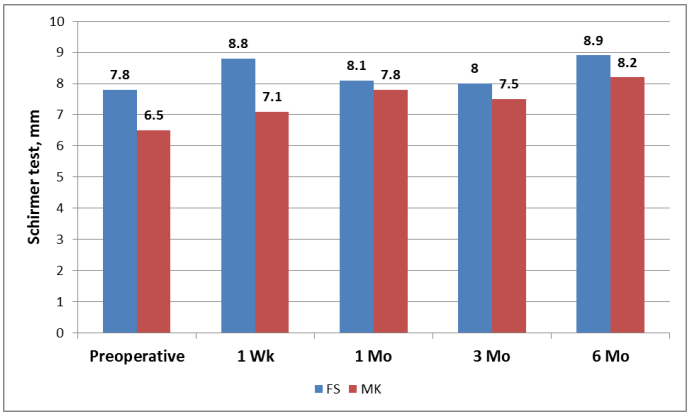

Figure 3: Mean basic Schirmer test values in the femtosecond laser (FS) and microkeratome (MK) groups.

DISCUSSION

Refractive procedures now are very popular in patients with refractive errors. Hence, it is crucial to optimize the results of this elective surgery. One of the most common side effects post lasik is dry eye [1,2]

Many lasik patients complain of symptoms of dry eyes such as visual fluctuations, ocular fatigue, discomfort, stinging, dryness and redness in the early postoperative period; however, these symptoms improve from 1 to 3 months post-operatively[5,6]

Signs of post-operative lasik dry eyes include decrease break up time test, decrease Schirmer test and positive fluorescein corneal staining. Post lasik dry eyes usually increases in the first month post-operative and improves over time, however a small number of patients develop chronic dry eyes more than 6 months post-operative[7]. Pre-operative risk factors for dry eyes post lasik include pre-operative dry eye, high refractive error, deeper ablation depth, thicker corneal flap and female sex.

Mechanisms of post-LASIK dry eye are not clearly understood. Several factors contribute to dry eye post lasik such as corneal denervation during the creation of the corneal flap and decreased corneal sensitivity [7,8]

Also, several studies reported that post lasik dry eyes correlate with the magnitude of refractive error before Lasik and the calculated ablation depth during the procedure.

Corneal flap thickness is an important risk factor for post Lasik dry eyes de Paiva et al. 2006 reported that the risk of dry eye development is related with the degree of preoperative myopia and the calculated depth of laser treatment[4,8]

Salomão et al. 2009 reported lower incidence of post lasik dry eyes with femtolasik but, no correlation was found between flap thickness and calculated ablation depth and the incidence of post lasik dry eyes. Another study reported that Hinge position had no significant effect on post lasik dry eyes. While other studies reported that femtolasik Corneal flap hinge position, hinge angle, and thickness had no effect on post lasik dry eyes [11]

Another meta-analysis reported that significant reduction in postoperative TBUT time occurs with LASIK rather than femtolasik [12,13]

Our study involved 3 diagnostic tests, Schirmer test, TBUT and corneal fluorescein staining. All patients in our study had symptoms of pre-operative dry eyes. In our study, Schirmer test, TBUT and corneal fluorescein staining were significantly higher post-operatively than pre-operatively. There was no significant difference in Schirmer test, TBUT or corneal fluorescein staining between MK assisted Lasik and femtolasik group through 6 months post-operatively.

CONCLUSION

Lasik surgery induced dry eyes signs in both types of laser refractive surgery including MK assisted lasik and femtolasik. And affects vast majority of patients in 6 months post-operative

Schirmer test, TBUT and corneal fluorescein were significantly higher post-operative than pre-operatively there was no significant difference in Schirmer test, TBUT or corneal fluorescein staining between MK assisted Lasik and femtolasik group through 6 months post-operative.

Declarations:
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