Comparison of Flap Thickness, Visual Outcomes, and Higher Order Aberrations in Eyes that Underwent LASIK Flap Creation using a Femtosecond Laser Versus a Mechanical Microkeratome

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ABSTRACT

Objective: To compare the predictability of flap thickness, visual and refractive outcomes, and higher order aberrations in eyes that underwent myopic LASIK using either a Technolas femtosecond laser or a Zyoptix XP mechanical microkeratome for flap creation.

Methods: The study involved a total of 44 eyes of 22 patients who underwent LASIK. Flap creation was randomized to using the Technolas femtosecond laser in one eye and Zyoptix XP microkeratome in the contralateral eye. Flap thickness was measured intraoperatively using ultrasonic pachymetry and postoperatively using the Visante AS-OCT. Refractive outcome, visual acuity (VA), higher order aberrations, and contrast sensitivity were compared between the two groups.

Results: Twenty-two patients had LASIK for myopia or myopic astigmatism. Using ultrasonic pachymetry intraoperatively, the mean flap thickness was 134 (±10) um and 124 (±23) um in the femtosecond (FS) and microkeratome (MK) groups respectively. Comparing the deviation of the actual from the intended flap thickness, the FS group had statistically lower standard deviation compared to the MK group (p=0.04). Using the AS-OCT, the mean flap thickness at 3 months postoperatively was 119 (±10.82) um and 123 (±15.77) um in the FS and MK groups respectively. The difference in standard deviation between the two groups did not reach statistical significance (p=0.19). The mean spherical equivalent at 3 months was -0.45D (±0.42) and -0.13D (±0.16) respectively. Eighty-nine percent (89%) of eyes had uncorrected VA of 20/20 or better in both groups. All eyes attained best corrected

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VA of 20/20 or better in both groups. Differences in total higher order aberrations (p=0.09) and contrast sensitivity scores (p=0.47) were not statistically different between the two groups.

Conclusion: Flap thickness predictability was better using the Technolas femtosecond laser compared to the XP microkeratome blade. Visual and refractive outcomes, higher order aberrations, and contrast sensitivity were comparable between the 2 groups.

Keywords: flap thickness, LASIK, femtosecond laser, microkeratome, excimer laser

Laser-in-situ keratomileusis (LASIK) remains the leading choice for the correction of refractive errors because of its high accuracy rate in achieving excellent visual outcomes, good safety record, painlessness, fast visual recovery, and relatively simple surgical technique.

In LASIK surgery, a corneal flap is created, lifted, and after tissue ablation, floated back into place. The creation of the corneal flap is the most critical element in LASIK surgery for several reasons. First, the corneal flap has to be intact and attached at the hinge without any complication. Otherwise, the surgery has to be discontinued. Second, the flap thickness has to be predictable because it is part of the formula to compute if the patient is qualified for LASIK. After estimating the amount of stromal tissue to be removed during ablation, the residual stromal thickness under the flap has to be thick enough to minimize the chance of ectasia. Otherwise, an alternative form of refractive surgery, such as photorefractive keratectomy or implantation of a phakic intraocular lens, should be recommended. Third, the surgical technique has to be simple enough for surgeons to perform the procedure numerous times daily without error. And lastly, from the patient's perspective, the surgical technique has to be acceptable and easy to understand.

Traditionally, LASIK flaps have been created using mechanical microkeratomes. A mechanical microkeratome, such as the Bausch & Lomb Zyoptix XP (Bausch and Lomb, Rochester, NY, USA) is a device wherein a blade oscillates on the underside of the device as it moves forward, cutting a corneal flap. While reliable and easy to use, flap complications such as buttonholes, free caps, and abrasions have been reported.[1]

Femtosecond laser technology has emerged as an alternative device for flap creation. The femtosecond laser uses a YAG laser operating in the infrared wavelength to produce ultra short pulses of energy to create adjacent areas of microcavitation at a specified depth of the cornea.[1] The cavitation or gas bubbles are connected together by blunt dissection creating a separation of corneal tissue, in this case, a corneal flap.

At present, the femtosecond laser machines that are commercially available are Intralase FS (AMO, Abott Laboratories Inc, Illinois, USA), VisuMax (Carl Zeiss Meditec, Germany), Wavelight FS200 (Alcon Laboratories Inc, Texas, USA), Ziemer Femto LDV (Ziemer Group, Switzerland), and Technolas 520F (Technolas Perfect Vision, Munich, Germany). Literature reports have been published on the Intralase and Visumax showing that these femtosecond lasers have better predictability in terms of flap thickness and better visual outcomes than mechanical microkeratomes.[2,3] For the Technolas femtosecond laser, no clinical study has been done to compare its clinical performance to that of a mechanical microkeratome.

The objective of our study was to measure and compare the predictability of flap thickness, visual and refractive outcomes, and higher order aberrations in eyes that underwent LASIK surgery using a femtosecond laser versus a mechanical microkeratome in flap creation.

METHODS

This is a single-center, prospective, randomized, contralateral-eye study comparing two devices used for flap creation during LASIK: the Bausch & Lomb Zyoptix XP microkeratome and the Technolas 520F femtosecond laser. The study protocol was formulated in accordance with the Declaration of Helsinki and approved by the institutional ethics committee. All patients were fully informed of the nature and details of the procedures. The scope of the study, including the risks and benefits involved, were explained. A written informed consent was obtained from all study participants.

All patients underwent full preoperative screening which included history taking, visual-acuity measurements, manifest and cycloplegic refractions, dim-light pupil size determination, slit-lamp examination, intraocular pressure check, ultrasonic pachymetry, Schirmer's test, dilated fundus exam, corneal topography using the Orbscan IIz (Bausch & Lomb, Munich, Germany), undilated and dilated wavefront aberrometry measurements using the Zywave II (Bausch & Lomb, Munich, Germany), and corneal thickness measurements using the Anterior Segment Optical Coherence Tomography (AS-OCT) (Visante, Carl Zeiss Meditec, Germany).

Inclusion criteria were as follows: patients had no prior history of refractive surgery and no contraindications for LASIK; myopia and myopic astigmatism with a spherical equivalent not more than -12D in each eye; high contrast, manifest and best corrected distance acuity of at least 20/25 in both eyes; must be willing to return for scheduled follow-up examinations for up to 3 months after the surgery; and must be willing to have both eyes treated with different flap creation devices.

Exclusion criteria were as follows: when the resulting treatment plan suggested that the residual corneal thickness below the flap was less than 280 μm; patients with irregular astigmatism, forme fruste or diagnosed keratoconus; symptomatic dry eye; corneal pathologies or corneal surface disease; glaucoma or glaucoma suspect; retinal pathologies; previous ocular surgeries; those whose dilated pupil size cannot reach a wavefront diameter of at least 6.0 mm as measured on the Zywave II aberrometer; pregnant or lactating women; and patients with immune related disorders, and/or taking immunomodulating medications.

Monocular visual acuity was tested using the Optec 6500 vision tester (Stereo Optical, Chicago, Illinois, USA). The Snellen-type letter chart in the Optec 6500 was recorded as letter scores and then converted to logarithm of the minimal angle of resolution (logMAR).

To test for contrast sensitivity without glare, best spectacle-distance corrected low contrast visual acuity was measured by the Optec 6500 and recorded as letter scores under mesopic (target luminance of 3cd/m^2) conditions. To test for conditions with glare, side lamps were turned on to simulate night driving conditions and the contrast sensitivity test performed. The last correct answer was recorded, and the contrast sensitivity corresponding to that grating was taken as the contrast sensitivity score for that spatial frequency.

Preoperatively and postoperatively, pachymetry scan protocol was chosen for the assessment of corneal measurements using the AS-OCT (Visante, Carl Zeiss, Germany).

RANDOMIZATION AND SURGICAL PROCEDURE

Prior to the beginning of the study, a computer-generated chart was used to randomize the eyes. In each patient, flap creation was performed with the femtosecond laser (FS) in one eye and the XP microkeratome (MK) in the contralateral eye. All laser treatments were targeted for emmetropia using the personalized-treatment software planner (Technolas Perfect Vision, Munich, Germany). A single surgeon (RTA) performed all the treatments.

In the FS group, the laser was programmed to a flap thickness of 120 μm, a flap hinge width of 6.0 mm, a flap diameter of 8.8 mm with a 110 degree angled side cut. The femtosecond laser energy was 900 μJ and the repetition frequency 80 kHz. For the MK group, the Zyoptix XP microkeratome with a label of 120 μm compression head was used. In steeper corneas (keratometry readings of 43D and above), an 8.5 ring was used whereas in relatively flatter corneas (keratometry readings below 43D), a 9.5 ring was used. The myopic stromal ablation was performed with a Technolas 217P laser with Zyoptix Personalized Aspheric Algorithm (Technolas Perfect Vision, Munich, Germany).

All procedures followed a standard protocol.Ultrasonic pachymetry was done on the central cornea of the first eye (FS eye) before the femtosecond flap was created. After the flap was created, it was not immediately lifted to allow the gas bubbles to dissipate so as not to interfere with iris registration prior to excimer laser treatment. The flap was dissected and lifted and another pachymetry reading taken. Excimer laser treatment was performed, the flap reposited and dried, and eye drops placed.

Surgery then proceeded to the fellow eye (MK eye). Asepsis and antisepsis technique with 10% betadine was applied around the lid and periorbital adnexa, followed by sterile draping of the eye, and

placement of the lid speculum. The fellow eye had ultrasonic pachymetry measurements taken, followed by flap creation using the mechanical microkeratome. The flap was lifted and another ultrasonic pachymetry measurement was performed. Immediately after, the exposed stroma was ablated using the excimer laser. The flap was reposited and eye drops and an eye patch placed after sufficient drying.

Both eyes were checked at the slitlamp for proper alignment before being discharged. Postoperative topical medications were identical for each eye and consisted of Levofloxacin (Oftaquix, Santen Pharmaceutical, Osaka, Japan) 4 times a day and Prednisolone acetate 1% (Pred forte, Allergan, California, USA) every hour for two days then tapered to 4 times a day, and Ketorolac (Acular, Allergan, California, USA) 4 times a day.

To obtain the flap thickness measurement using ultrasonic pachymetry intraoperatively, the stromal bed thickness measurement was subtracted from the total corneal thickness prior to flap cutting. The readings were recorded as the flap thickness (Figure 1). Postoperatively, Visante AS-OCT images were taken to measure flap thickness at specific time points (Figure 2).

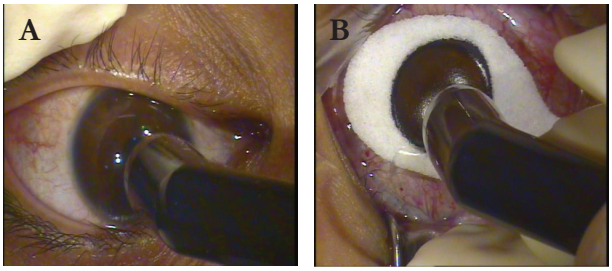

Figure 1. Ultrasonic pachymetry before (A) and after (B) flap cut.

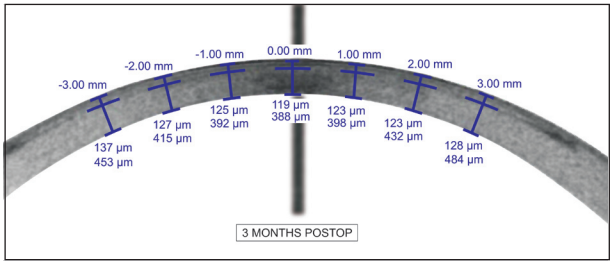

Figure 2. AS-OCT image showing flap thickness at specific time points.

OUTCOME MEASURES

The primary outcome measure was flap thickness. Secondary outcome measures included refractive outcome, visual acuity, contrast sensitivity, and higher order aberrations.

Postoperatively, all patients were examined at 1 hour, 1 day, 1 week, 1 month, and 3 months after the surgery. At each examination, a standard ophthalmologic examination and eye measurements were performed.

STATISTICAL ANALYSIS

Statistical comparisons were performed using the paired two-tailed Student's t-test and the Mann-Whitney U test. A p-value less than or equal to 0.05 were considered statistically significant. Visual acuity was converted to logarithm of the minimal angle of resolution (logMAR) from the decimal notation for analysis. Continuous data were expressed as the mean ± standard deviation.

RESULTS

Forty four (44) eyes of 22 patients with a mean age of 29 years (±6.7, range 18-43 years) were included in the study. In each patient, one eye was assigned to the femtosecond (FS) group and the other eye to the microkeratome (MK) group.

Table 1. Preoperative data.

	FS		MK		p-value
Demographics	(n= 22) 10 males: 12 females Mean age: 29 (±6.7) years				
Mean preop UCVA LogMAR (±SD)	20/200-20/400 0.94 ±0.23		20/200-20/400 0.90 ±0.27		0.21
Mean preop BCVA	20/20		20/20		
Mean preop spherical equivalent (±SD)	-4.11 D (-1.5 to -6.75) ±1.3		-3.9 D (-1.25 to -6.5) ±1.59		
Central Pachymetry	Ultra-sonic	AS-OCT	Ultra-sonic	AS-OCT	
Mean SD	564 um (±27)	546 um (±25)	544 um (±35)	567 um (±27)	

FLAP THICKNESS

Preoperative ultrasonic central pachymetry were 564 ±27 µm (range 526-611) in the FS and 544 ±35 µm (range 515-634) in the MK groups. Using the

Visante AS-OCT, preoperative central pachymetry were 546 ±25 μm (range 507-594) and 567 ±27 μm (range 498-594) respectively (Table 1). The intended flap thickness was 120 μm for both groups.

Using ultrasonic pachymetry intraoperatively, the mean central flap thickness were 134 ±10 μm (range 103-156) and 124 ±23 μm (range 73-155) in the FS and MK groups respectively. Comparing the deviation of the actual from the intended flap thickness, the FS group had statistically significant lower standard deviation than the MK group (p=0.04).

Table 2. AS-OCT flap thickness measurements.

Flap thickness		FS 120 μm	MK 120 μm	p-value
1 hour	Mean SD	120 ±21.52	156 ±31.80	
1 day	Mean SD	112 ±27.20	119 ±19.31	
1 week	Mean SD	115 ±18.41	117 ±16.14	
1 month	Mean SD	116 ±12.06	115 ±20.67	
3 months	Mean Range SD p value (intended vs actual)	119 93-137 ±10.82 p=0.75	123 97-140 ±15.77 p=0.42	p=0.19

Non-contact anterior segment OCT (AS-OCT) readings measuring total corneal and flap thickness were taken at 1 hour, 1 day, 1 week, 1 month, and 3 months after surgery (Table 2). Flaps in the MK group were much thicker compared to those in the FS group 1 hour after surgery. At 1 month postoperatively (n=22), the mean flap thickness were 116 ±12.06 μm and 115 ±20.67 μm in the FS and MK groups respectively. At 3 months (n=17), the mean flap thickness were 119 ±10.82 μm and 123 ±15.47 μm respectively. The difference between intended and actual flap thickness was not significant in both groups (Table 2).

REFRACTIVE OUTCOMES

Preoperatively, the mean sphere was -3.89 ±1.1D, mean cylinder -1.03 ±0.6D, and mean spherical equivalent -4.11 ±1.3D in the FS group. The mean sphere was -3.73 ±1.5D, mean cylinder -0.86 ±0.78D, and mean spherical equivalent -3.9 ±1.5D in the MK group. Refractive outcomes were taken at 1 day, 1 week, 1 month, and 3 months postoperatively.

At 3 months, the mean sphere were -0.23D and 0.07D in the FS and MK groups respectively (p=0.89). The mean cylinder were -0.57D and -0.51D respectively (p=0.63). The mean spherical equivalent were -0.45 ±0.42D and -0.13 ±0.16D respectively. The difference in manifest refractive spherical equivalent (MRSE) was statistically significant between the two groups (p=0.006) with the FS group slightly more myopic (Table 3).

VISUAL RESULTS

The mean preoperative uncorrected distance visual acuity (UDVA) was 20/200 (logMAR 0.9) in both groups. At 1 hour postoperatively, mean UDVA was 20/125 (logMAR 0.8) in the FS and 20/80 (logMAR 0.62) in the MK groups. The difference was statistically significant (p=0.006). From 1 day to 3 months postoperatively, UDVA was 20/20 in both groups (Table 4).

At 3 months, the mean high contrast (HC) UDVA was 20/20 in both groups (p=0.31) and the mean low contrast (LC) UDVA was 20/25 in both groups (p=0.26). The mean HC best-corrected distance visual acuity (BCDVA) was 20/16 in both groups (p=0.57) and the mean LC BCDVA was 20/25 in both groups (p=0.06) (Table 5).

Table 3. Manifest refractive spherical equivalent (MRSE).

	FS	MK	p-value
Preop	-4.08D ±1.30 (-6.75D to -1.5D)	-3.9D ±1.50 (-6.25D to -1.25D)	0.15
1 day (n=22)	-0.3D ±0.38 (-1.12D to -0.25D)	-0.14D ±0.29 (-0.87D to 0.25D)	0.04
1 week (n=22)	-0.28D ±0.41 (-1.50D to -0.375D)	-0.17D ±0.38 (-0.5D to 0.5D)	0.21
1 month (n=22)	-0.18D ±0.49 (-1.62D to 0.5D)	-0.02D ±0.16 (-0.37D to 0.25D)	0.12
3 months (n=17)	-0.45D ±0.42 (-1.37D to 0)	-0.13D ±0.16 (-0.37D to 0.25D)	0.006

Table 4. High contrast uncorrected distance visual acuity (UDVA).

UDVA HC	FS	MK	p-value
1 hour	20/125 (20/25 – 20/200) logMAR 0.9	20/80 (20/20 – 20/200) logMAR 0.62	0.006
1 day	20/20 (20/12.5 – 20/32) logMAR 0.4	20/20 (20/16 – 20/32) logMAR 0.4	1.0
1 week	20/20 (20/12.5 – 20/25) logMAR -0.01	20/20 (20/12.5 – 20/32) logMAR -0.03	0.25
1 month	20/20 (20/12.5 – 20/25) logMAR -0.02	20/20 (20/12.5 – 20/25) logMAR -0.03	0.61
3 months	20/20 (20/12.5 – 20/20) logMAR -0.05	20/20 (20/12.5 – 20/25) logMAR -0.03	0.31

Table 5. High and low contrast visual outcomes 3 months after LASIK.

	FS	MK	p-value
UDVA HC logMAR	20/20 -0.05 ±0.31	20/20 -0.03 ±0.07	0.31
UDVA LC logMAR	20/25 0.18 ±0.14	20/25 0.15 ±0.13	0.26
BCDVA HC logMAR	20/16 -0.07 ±0.06	20/16 -0.07 ±0.05	0.57
BCDVA LC logMAR	20/25 0.13 ±0.11	20/25 0.08 ±0.09	0.06

CONTRAST SENSITIVITY

Preoperatively, contrast sensitivity values were similar between the FS and MK groups in mesopic conditions (p=0.09 Mann-Whitney U test). Comparing them at 3 months, contrast sensitivity with glare (p=0.48) and without glare (p=0.47) were similar.

HIGHER ORDER ABERRATIONS

Preoperatively, the mean spherical aberration (SA) were -0.1 ±0.12 and -0.09 ±0.09 in the FS and MK groups respectively. The mean total higher order aberrations (HOAs) were 0.38 ±0.15 and 0.32 ±0.07 respectively.

At 3 months postoperatively, the measured mean SA were -0.07 ±0.2 in the FS and -0.08 ±0.1 in the MK groups. The mean HOAs were 0.78 ±0.44 and 0.52 ±0.29 respectively. There was no significant difference in SA (p=0.93) and HOAs (p=0.06) between the two groups (Table 6).

Comparing the preoperative to the 3 months postoperative period, there was a significant increase in the SAs in both the FS (p=0.002) and the MK (p=0.007) groups. However, there was no increase in the HOAs (FS p=0.38, MK p=0.18). Comparing both groups in terms of increase in SA (p=1.0) and HOA (p=0.14) preoperatively to postoperatively, there was no difference.

COMPLICATION

One eye suffered a flap buttonhole in the MK-randomized eye. The flap was returned without laser treatment and a bandage contact lens placed. Flap creation and laser ablation was already concluded in the FS-randomized eye prior to the buttonhole. There were no intraoperative complications in the FS-treated eyes.

Table 6. Change in spherical abberation (SA) and total higher-order aberration (HOA).

Aberration	FS	MK	p-value
Preop SA mean (SD)	-0.1 (±0.12)	-0.09 (±0.09)	
3 Months Postop SA mean (SD)	-0.07 (±0.12)	-0.08 (±0.1)	0.93
Mean difference SA mean (SD)	0.02 (±0.17)	0.02 (±0.16)	1.0
Preop HOA mean (SD)	0.38 (±0.15)	0.32 (±0.07)	
3 Months Postop HOA mean (SD)	0.78 (±0.44)	0.52 (±0.29)	0.06
Mean difference HOA mean (SD)	0.38 (±0.44)	0.18 (±0.25)	0.14

DISCUSSION

In LASIK, there are two critical steps in the procedure: flap creation and stromal ablation. In this study, we compared two devices used to create or cut LASIK flaps. The corneal flap and the flap-making device are important for three reasons. First, during preoperative planning, we need to compute for a patient's residual stromal thickness after laser ablation to avoid ectasia. The flap thickness forms part of the equation. A reliable flap maker has to consistently cut a predictable flap thickness with a tight standard deviation or minimal variability. Second, a flap maker has to be considered safe. Ideally, it should consistently create an intact flap during surgery with rare or no complications, such as buttonhole, free cap, or epithelial defects. If a complication occurs, the procedure will be aborted and no stromal ablation performed. Third, even if the flap was intact, the smoothness of the flap or flap bed, or the resulting healing response, can affect visual outcomes because the flap is part of the visual axis.

This prospective study determined if a femtosecond laser is superior to a microkeratome in terms of flap thickness predictability, safety, and visual outcomes.

Several studies have compared femtosecond lasers with mechanical microkeratomes with particular focus on the predictability of flap thickness. Our study was slightly different because it used two devices that measure corneal thickness; namely, ultrasonic pachymetry done intraoperatively and the AS-OCT done at several time points postoperatively.

Using ultrasonic pachymetry, the mean flap thickness created by the MK group was thinner with a central flap thickness of 124 μm compared to 134 μm for the FS group. However, the FS group had a tighter standard deviation (FS 10 μm vs MK 23 μm, p=0.04), suggesting that flap thickness was more reproducible and consistent using the femtosecond laser.

A technical difficulty we encountered when taking measurements using ultrasonic pachymetry was variability in stromal bed hydration. The ultrasonic pachymetry probe would often need to be slightly moistened as it touched the corneal stroma; otherwise, it would not take readings on the dry stromal bed. This hydration, even if minimal, might cause some localized swelling of the central cornea and artificially caused a thicker stromal bed. There might be a tendency to get lower readings of the flap thickness if the stromal bed thickness that was subtracted from the total corneal thickness were erroneously thicker.[4] We recognized this possibility as a source of variability during the planning stage of this study. That was why we added in our study protocol a second measuring device that would not be affected by hydration when taking measurements.

The Visante AS-OCT is a non-invasive imaging technique able to acquire high-resolution images of the anterior cornea. The flap interface, which appears as a dark line parallel to the corneal surface, serves as a reference point from which the flap above and the residual corneal thickness below can be measured. At any time point after surgery, the flap can be measured without touching, wetting, or lifting, removing the variability in flap measuring technique between eyes.

In this study, the Visante AS-OCT was used to measure the FS and MK flaps at 1 hour, 1 day, 1 week, 1 month, and 3 months postoperatively. At 3 months, the mean flap thickness was very close to the intended flap thickness of 120 μm in both flap-making devices (119 μm in the FS and 123 μm in the MK group). The standard deviation was lower in the FS group (±10.8 μm) compared to the MK group (±15.7 μm), but this difference did not reach statistical significance. Patel and associates, in a paired-eye study of 21 patients, also reported no statistically significant difference between the FS (Intralase, 143 ±16 μm) and MK (Hansatome XP microkeratome [Bausch & Lomb], 138 ±22 μm) groups in terms of achieved flap thickness when measured with confocal microscopy 1 month postoperatively.[5]

In contrast, Zhou and colleagues, using an AS-OCT, compared the AMO Intralase FS60 femtosecond laser and the Moria M2 microkeratome and concluded that the accuracy of the femtosecond laser was significantly better than the microkeratome.[6] Several other studies have demonstrated similar results.[7]

In our study, both the ultrasonic pachymeter and AS-OCT showed lower standard deviation in the flap thickness measurements of the FS compared to the MK. Although our AS-OCT results did not reach statistical significance, other published literature supported our findings that flap thickness was more predictable using a femtosecond laser.

One patient was excluded from this study because of an intraoperative complication. The most likely explanation for the buttonhole would be false suction on the conjunctiva without maintaining scleral suction, resulting in an inadequately hardened eyeball that was irregularly compressed as the microkeratome made its forward pass. After visualization of the buttonhole, the flap was immediately returned over the stromal bed without excimer ablation. Because our study was designed to compare the flap thickness created by FS and MK, we excluded this patient from the analysis. Despite having a faint scar, the best-corrected visual acuity returned to 20/20 one month postoperatively. Unfortunate as it may be, this flap complication highlighted the most significant advantage of femtosecond lasers: safety. Even though femtosecond lasers offer more advantages than mechanical microkeratomes, complications have been reported after laser flap creation. Several studies[8,9] found the incidence of diffuse lamellar keratitis (DLK) to be higher in eyes in which the LASIK flap was created with a femtosecond laser than in those in which the flap was created with a mechanical microkeratome.

A study by Moshirfar et al[10] reported that the total complication rates were similar between the FS and MK groups. The FS group had gas breakthrough, opaque bubble layer, transient light sensitivity syndrome, and suction loss leading to incomplete flap. However, the microkeratome group had significantly more epithelial defects intraoperatively. In our study, we did not encounter any complications such as epithelial gas breakthrough, transient light sensitivity, incomplete flap, or diffuse lamellar keratitis in the FS group.

Postoperative visual acuity was similar in both groups. However, the FS group had more myopic

refractive outcomes than the MK group. The probable reason was that we performed this study using the nomograms we had been using for MK-treated eyes. In the future, a relatively simple nomogram adjustment should be made for treatments using FS which would make the refractive outcomes similar to MK-treated eyes. Other studies showed that visual acuity and refraction remained stable and were similar postoperatively in both groups.[11,12,13]

Contrast sensitivity values were similar in both groups preoperatively. We found no statistical difference in the contrast sensitivity with and without glare between the FS and MK groups. This was supported by the similarity in spherical aberration and HOAs we measured. Several studies have also showed similar results.[11-13]

In conclusion, our study showed that predictability in LASIK flap thickness was better when using the Technolas femtosecond laser as compared to the XP microkeratome blade. The occurrence of a buttonhole while using the microkeratome during the course of our study supported the common sentiment that the femtosecond laser was a safer instrument for cutting flaps. Our study results suggested that the type of flap making device did not significantly affect clinical performance in terms of visual acuities, contrast sensitivity, and higher order aberrations. We recommended that nomogram adjustments have to be made in order to obtain similar refractive outcomes using different flap-making devices.

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