Evaluation of postlaser in-situ keratomileusis corneal flap and bed thickness using anterior segment optical coherence tomography

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Purpose
Aim of this work is to compare the thickness of the laser in-situ keratomileusis flap created by the mechanical microkeratome Moria M2110 and that created with the mechanical microkeratome Moria M290, using anterior segment optical coherence tomography (OCT) (anterior segment OCT 3D 2000 fluorescein angiography plus).

Design
This is a comparative prospective study.

Patients and methods
In our study, flaps were created using the mechanical Moria M2110 with medlogic plano head (intended flap 110 μm) in 38 eyes, and in the other 43 eyes, the flaps were created using mechanical microkeratome Moria M290. Flap thickness was measured using anterior segment OCT.

Results
In the Moria M2110 with medlogic-10 head created flaps, the mean flap thickness 2 mm nasal to the center, the mean flap thickness 2 mm temporal to the center, and the mean±SD central flap thickness were 135.9±6.4 mm (125–160 mm), 137±9 mm (125–163 mm), and 137.7±10.9 mm (125–164 mm), respectively, in right (OD) and 131.2±9.8 (115–152), 129.2±8.4 (116–152), and 131.2±9.8 (117–154), respectively, in left (OS). In the Moria M290-created flaps, the mean central flap thickness, the mean flap thickness 2 mm nasal to the center, and the mean flap thickness 2 mm temporal to the center were 118.4±11.9 (95–145), 118.5±11.9 (96–144), and 118±11.6 (99–145), respectively, in OD and 115.7±12.3 (99–140), 115.9±11.6 (100–139), and 115.8±11.4 (100–140), respectively, in OS.
The deviation of the created flap thickness from the intended 110 μm was 27.67±10.87 in the M2110 created flap, whereas the deviation from the intended 90 μm thickness in M290 group was 28±11.67 (P=0.722).

Conclusion
Laser in-situ keratomileusis flaps created with the Moria M290 have thinner thickness, and more predictability and more perseverance of bed thickness than those created with the Moria M2110.

Keywords:
anterior segment optical coherence tomography, deviation created, flap thickness, laser in-situ keratomileusis, Moria microkeratome

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Introduction

Myopia is a common refractive error all over the world, and many methods can be used for correction of myopia, either nonsurgical or surgical. Nonsurgical include spectacles and contact lenses and surgical include laser in-situ keratomileusis (LASIK), surface ablation, phakic intraocular lens (IOLs), clear lens extraction (CLE), bioptics, and intracorneal rings (ICRS). Currently, LASIK is the most commonly performed corneal refractive surgery [1].

The most critical step in successful LASIK surgery is the creation of the corneal flap. We used mechanical microkeratomes to form the flap over the past 20 years or with the femtosecond laser [2].

The microkeratomes use shear force traveling across the corneal stroma with an oscillating blade to create a flap [3].

The femtosecond laser uses ultrashort pulses of laser, where plasma is generated and forms cavitational

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bubbles, which coalesce together creating a cleavage plane at a preplanned depth [2].

Anterior segment optical coherence tomography (AS-OCT) can assist in diagnosis and documentation of corneal conditions such as dystrophies and degenerations, as well as assorted inflammatory pathologies. This technology can be used to diagnose and manage corneal infiltrates, ulcers, dellen, or scars [4].

The present study focused on microkeratomes that generate a mechanical cut with applanation. The Moria M2 microkeratome, with a single-use head, is a popular automated microkeratome with a mechanical stop designed for maximum safety that is able to create thin flaps [5].

The present study utilized AS-OCT to perform noncontact comprehensive measurements of corneal flap thickness to assess the accuracy, reproducibility, and uniformity of flaps created by this microkeratome. In addition, postoperative time-dependent changes in flap thickness were evaluated.

Patients and methods

In this prospective, nonrandomized study, patients were consecutively recruited from Minia University. Ethics committe of Minia University approved this study. A written informed consent was obtained from each patient.

This prospective study included 45 patients with myopia (17 men and 28 women, 81 eyes), with a mean age of 27 years.

The patients were divided into two groups:

(1) Group A: it included 38 eyes of 22 patients; in this group, the mechanical microkeratome Moria M2 (Moria M2, 110 with medlogic plano head) was used.
(2) Group B: it included 43 eyes of 23 patients; in this group, the microkeratome Moria M2 (Moria M2, 90 head; Moria Inc., Antony, France) was used.

Inclusion criteria

The following were the inclusion criteria:

(1) Age range from 20 to 50 years.
(2) Clear corneal appearance on slit lamp.
(3) Normal lens, normal IOP, and normal fundus examination result.
(4) Spherical error from −1.50 to −11 D.
(5) Refractive astigmatism of up to −4 D.
(6) Best spectacle corrected vision of 20/25.

Preoperative evaluation

(1) History:
  (a) Systemic:
    (i) Patients were asked about their previous general medical history.
    (ii) Patients were asked about their status regarding pregnancy, breast feeding, or the use of oral contraceptive drugs or the use of hormone replacement therapy.
  (b) Ocular:
    (i) Patients were asked about their ocular history regarding medical and surgical ophthalmic history and the previous use of contact lenses, trauma, and use of eye drops.
    (ii) History of use of eyeglasses and changes in the previous prescriptions in the past year.
(2) Examination:
  (a) Vision: patient's visual acuity was measured and their refraction, both manifest and cycloplegic, was also measured.
  (b) External examination: to assess the eyelids, and orbit depth and possible obstacles for fitting the microkeratome.
  (c) Ocular motility and assessment of phorias and tropias, confrontational visual field test.
  (d) Slit-lamp examination was performed for the following:
    (i) Searching for signs of dry eye and tear film assessment (tear meniscus and breakup time), and detailed examination of the cornea to rule out undiagnosed corneal dystrophies, allergic conjunctivitis, and other pathologies of the conjunctiva and sclera.
    (ii) Pupillary light reaction both direct and consensual reactions and diameters in light and dim situations.
    (iii) Intraocular pressure was measured using Goldmann applanation, to exclude glaucoma.
  (e) Fundus examination: detailed examination to reveal signs of diabetic retinopathy, maculopathy, or optic nerve disease. Examining the periphery to exclude retinal detachment or peripheral retinal lesions, which may increase the risk of retinal detachment.
(3) Investigations

Corneal topography and corneal thickness were measured using a Placido head 20 rings topography, namely, corneal Shin-Nippon CT1000 (Rexxam, Tokyo, Japan) and some cases by using placido disk and scheimpflug camera, namely, Sirius CSO and pentacam.

Methods

Immediate preoperative counseling

Before starting the treatment, the patients were counseled about what to expect during the procedure, that is, sounds and smell and steps that will be taken. Anxious patients were given an oral sedative.

Preoperative medications

Surgery was performed under topical anesthesia. Benoxinate 4% eye drops were instilled three times, 5 min apart. Povidone–iodine 10% was used to prepare the skin. Povidone–iodine 5% drops were applied to the ocular surface, left for 30 s then irrigated. A sterile drape was placed over the skin and eyelashes.

Operative details

The procedure is started first with the corneal surface anesthetized and irrigated with balanced salt solution and the epithelium dried with a cellulose sponge. The cornea was marked with a standard LASIK marker. All procedures were performed first on the right eye, then on the left eye, using the same blade. For the right eye, the incision was made from the temporal and inferior side to the nasal side and, for the left eye, the incision was made from the nasal side to the temporal side.

The M-2 microkeratome (Moria, France) was used to create the flap with either 90-μm head or medlogic plano head. The suction ring was applied. The microkeratome was then placed over the dovetail, and locked into place. The blade was then advanced forward, then backwards, and the suction was released. The microkeratome was removed, and the flap reflected. The stromal ablation was applied. The ablated bed was then dried to remove tissue debris, and then irrigated.

The flap was returned into place, the interface was irrigated again, the flap was repositioned according to the alignment marks, and allowed to dry for 2 min.

Topical antibiotics and steroids were applied.

All cases were operated upon using the Abbott Star S4 IR (Advanced Medical Optics, Lake Bluff, Illinois, USA) excimer laser. All the LASIK flaps were created with the Moria-2 microkeratome using either the 90-μm head or the medlogic plano head.

Postoperative regimen

Steroids and antibiotics were applied for 1 week and then discontinued, and lubricants were used for 3 months.

Postoperative measurements

All eyes were evaluated through AS-OCT 3D OCT-2000 fluorescein angiography plus 1 week postoperatively. The AS-OCT device uses Super luminescence distance diode with wavelength of 840 nm as a light source.

Cross-sectional scans were displayed continuously on the integrated video monitor at a rate of up to 8 frames/s. Images were judged to be of adequate quality based on the following criteria: good demarcation of the anterior and posterior corneal boundaries and absence of artifacts owing to motion or eyelid margins. Each flap thickness was measured at three points (center, midperiphery, and periphery from the vertex of the cornea).

Preoperative values are illustrated in the table as follows:

Group A: M2110 with medlogic plano head

It included 22 patients, with eight males and 14 females. The mean±SD preoperative K1 reading in right (OD) was 43.07±1.14 D (range, 40.7–46.0 D) and K2 reading was 44.51±1.44 D (range, 42.7–47.7 D); the mean±SD preoperative K1 reading in left (OS) was 42.9±1.26 D (range, 40.0–44.6 D) and K2 reading was 44.21±1.05 D (range, 42.7–46.0 D); the mean±SD preoperative corneal thickness in OD was 541.9±26 D (range, 500–586 D) and preoperative corneal thickness in OS was 541.2±21.6 D (range, 505–580 D); the mean±SD spherical error in OD was −5.11±2.17 D (from −1.50 to 10.50 D); the mean±SD cylindrical error in OD was −1.57±0.93 D (from 0 to −3.50 D); the mean±SD spherical error in OS was −3.81±3.02 D (from 0 to −8.0 D); the mean±SD cylindrical error in OS was −1.69±1.1 D (from 0 to −4.0 D) ; the mean±SD uncorrected visual acuity (UCVA) of OD was 0.29±0.147 D; and the mean±SD UCVA of OS was 0.29±0.134 D.

Group B: M290

It included 23 patients, with nine males and 14 females. The mean±SD preoperative K1 reading in OD was 43.06±1.24 D (range, 40.6–45.1 D) and K2 reading was 44.26±1.54 D (range, 41.8 to −47.1 D); the mean±SD preoperative K1 in OS was 43.15±1.48 D (range, 40.3–45.6 D), and K2 reading was 44.27±1.59 D (range, 41.6–47.7 D); the mean±SD preoperative corneal thickness in OD was 535.9±21.4 D (range, 495–574 D) and preoperative corneal thickness in OS was 534.6±19 D (range 500–566 D); the mean±SD spherical error in OD was −5.77±3.6 D (from −0.50 to −11.0 D); the mean±SD cylindrical error in OD was −1.69±1.01 D (from 0 to −4.0 D); the mean±SD spherical error in OS was −5.6±3.29 D (from −1.25 to −11.0 D); the mean±SD cylindrical error in OS was −1.4±0.86 D (from 0 to −3.0 D); the mean±SD UCVA of OD was 0.25±0.140 D; and the mean±SD UCVA of OS was 0.25±0.146 D.

The comparison between the preoperative data of both groups showed difference between the mean K readings by *t* test ($P>0.05$), which was statistically insignificant; between the mean preoperative corneal thickness ($P>0.05$), which was statistically insignificant; between the mean preoperative spherical error ($P>0.05$), which was statistically insignificant; the mean cylindrical error ($P>0.05$), which was statistically insignificant; and the mean preoperative UCVA (0.4), which was statistically insignificant.

Results

Postoperative values are as illustrated in the table.

Group A

The mean±SD central flap thickness in OD was 137.7±10.9 μm (range, 125–164 μm), the mean±SD central flap thickness in OS was 131.2±9.8 μm (range, 117–154 μm), the mean±SD thickness at 2 mm nasal to the center in OD was 135.9±6.4 μm (range, 125–160 μm), the mean±SD thickness at 2 mm nasal to the center in OS was 131.2±9.8 μm (range 115–152 μm), the mean±SD flap thickness at 2 mm temporal to the center in OD was 137±9 μm (range 125–163 μm), the mean±SD flap thickness at 2 mm temporal to the center in OS was 129.2±8.4 μm (range, 116–152 μm), and the mean±SD flap thickness was 134.45±10.35 μm (range, 117–164 μm).

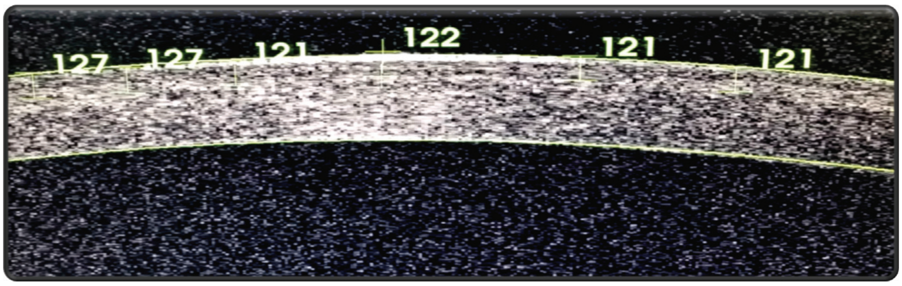
The mean±SD bed thickness in OD was 337.6±34.36 μm (range, 278–400 μm) and the mean±SD bed thickness in OS was 346±28.46 μm (range, 288–390 μm).

The mean±SD postoperative UCVA in OD was 0.66±0.18 (0.4–1.0) and best correfted visual acuitu (BCVA) was 0.66±0.18 (0.7–1), whereas the mean±SD postoperative UCVA in OS was 0.67±0.16 (0.7–1) and BCVA was 0.67±0.16 (0.5–1.0).

Group B

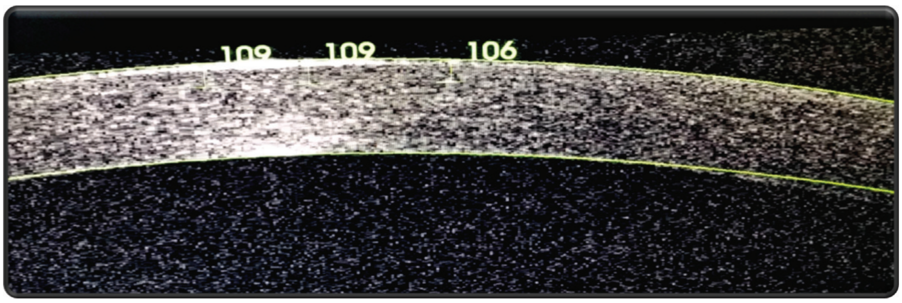
The mean±SD central flap thickness in OD was 118±11.6 μm (range, 99–145 μm), the mean±SD central flap thickness in OS was 115.8±11.4 μm (range, 100–140 μm), the mean±SD thickness at 2 mm nasal to the center in OD was 118.4±11.9 μm (range, 95–145 μm), the mean±SD thickness at 2 mm nasal

Figure 1



Anterior segment optical coherence tomography of flap thickness of M2 110.

Figure 2

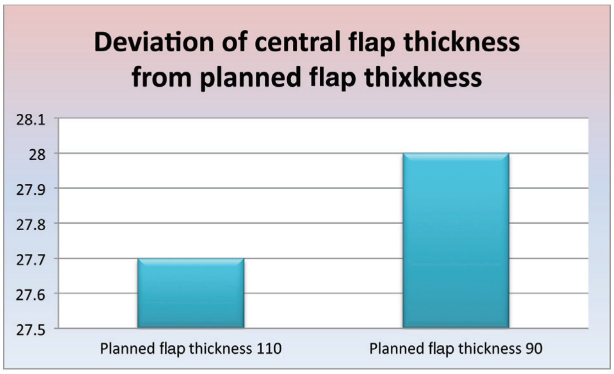


Anterior segment optical coherence tomography of flap thickness of M2 90.

to the center in OS was 115.7±12.3 µm (range, 99–140 µm), the mean±SD flap thickness at 2 mm temporal to the center in OD was 118.5±11.9 µm (range 96–144 µm), the mean±SD flap thickness at 2 mm temporal to the center in OS was 115.9±11.6 µm (range, 100–139 µm), the mean±SD flap thickness was 116.9±11.5 µm (range, 99–145 µm).

The mean±SD bed thickness in OD was 341.7±47.2 µm (range, 276–421 µm) and the mean±SD bed thickness in OS was 346±48 µm (range, 290–430 µm).

Figure 3



A column chart comparing deviation from the intended flap thickness in both groups.

The mean±SD postoperative UCVA in OD was 0.71±0.26 (0.4–1.2) and BCVA was 0.71±0.26 (0.4–1.2), whereas the mean±SD postoperative UCVA in OS was 0.73±0.21 (0.4–1.2) and BCVA was 0.73±0.21 (0.4–1.2).

The deviation of the created flap thickness from the intended 110 µm was 27.67±10.87 µm, with a median of 24, in the M2110 with medlogic-10 head-created flap, whereas the deviation from the intended 90 µm thickness in M290 group was 28±11.67, with a median of 26 (P=0.722) (Figs 1–5, Tables 1 and 2).

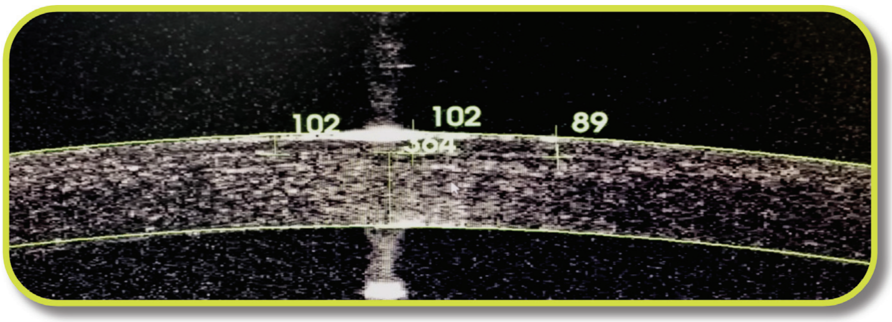
Discussion

LASIK is most popular approach in the world to correct refractive errors. A critical step of LASIK surgery is the creation of the corneal flap. The accuracy of the LASIK flap thickness is a key risk factor for flap complications and ectasia following LASIK [3].

Different ways to create the flap are with a femtosecond laser or mechanical microkeratome.

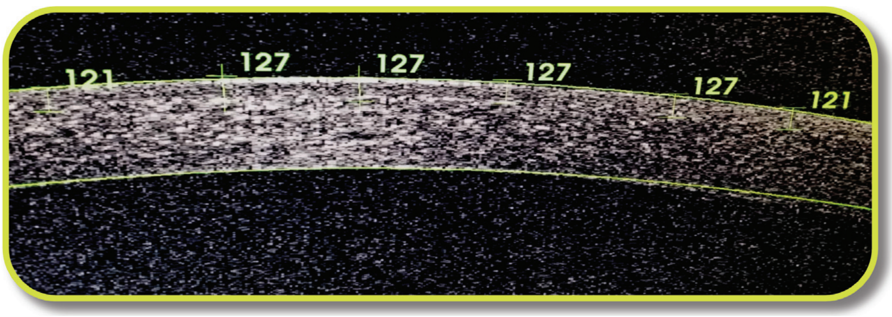
Mechanical microkeratome uses shear force traveling across the corneal stroma with an oscillating blade to

Figure 4



Anterior segment optical coherence tomography of flap thickness of M2 90.

Figure 5



Anterior segment optical coherence tomography of flap thickness of M2 110 with medlogic-10 head.

Table 1 Preoperative characteristics of patients who underwent laser in-situ keratomileusis flap creation with the Moria M2 microkeratome 90 and 110 with medlogic plano head

	M2 110 with medlogic plano [mean±SD (range)]		M2 90 [mean±SD (range)]		*P* value	
	OD	OS	OD	OS	OD	OS
K1 (D)	43.07±1.14 (40.7–46.0)	42.9±1.26 (40.0–44.6)	43.06±1.24 (40.6–45.1)	43.15±1.48D (40.3–45.6)	0.906	0.554
K2 (D)	44.51±1.44 (42.7–47.7)	44.21±1.05 (42.7–46.0)	44.26±1.54 (41.8–47.1)	44.27±1.59 (41.6–47.7)	0.618	0.988
Sphere (D)	−5.11±2.17 (−1.50 to −10.50)	−3.81±3.02 (0 to −8.0)	−5.77±3.6 (−0.50 to −11.0)	−5.6±3.29 (−1.25 to −11.0)	0.466	0.183
Cylinder (D)	−1.57±0.93 (0 to −3.50)	−1.69±1.1 (0 to −4.0)	−1.69±1.01 (0 to −4.0)	−1.4±0.86 (0 to −3.0)	0.253	0.641
CCT (μm)	541.9±26 (500–586)	541.2±21.6 (505 −580)	535.9±21.4 (495–574)	534.6±19 (500–566)	0.477	0.382
UCVA	0.29±0.147	0.29±0.134	0.25±0.140	0.25±0.146	0.406	0.339

OD, right; OS, left; UCVA, uncorrected visual acuity.

Table 2 Postoperative values

	M2 110+medlogic-10 [mean±SD (range)]		M2 90 [mean±SD (range)]		*P* value	
	OD	OS	OD	OS	OD	OS
Central flap thickness (μm)	137.7±10.9 (125–164)	131.2±9.8 (117–154)	118±11.6 (99–145)	115.8±11.4 (100–140)	<0.001*	<0.001*
2 mm nasal to the center (μm)	135.9±6.4 (125–160)	131.2±9.8 (115–152)	118.4±11.9 (95–145)	115.7±12.3 (99–140)	<0.001*	<0.001*
2 mm temporal to the center (μm)	137±9 (125–163)	129.2±8.4 (116–152)	118.5±11.9 (96–144)	115.9±11.6 (100–139)	<0.001*	<0.001*
Bed thickness	337.6 ±34.36 (278–400)	346±28.46 (288–390)	341.7±47.2 (276–421)	346±48 (290–430)	0.528	0.8924
UCVA	0.66±0.18 (0.4–1.0)	0.67±0.16 (0.7–1.0)	0.71±0.26 (0.4–1.2)	0.73±0.21 (0.4–1.2)	0.704	0.576
BCVA	0.66±0.18 (0.4–1.0)	0.67±0.16 (0.7–1.0)	0.71±0.26 (0.4–1.2)	0.73±0.21 (0.4–1.2)	0.704	0.576

BCVA, best correfted visual acuitu; OD, right; OS, left; UCVA, uncorrected visual acuity. *Indicates statistically significant difference.

create a flap (199), whereas femtosecond laser systems use ultrashort pulses of laser and produce corneal tissue cutting using a photodisruption process [3].

The ideal flap is thin (average 100 μm), stable, uniform, central, with no wrinkles and no other complications [3].

Flap thickness and morphology have became the main concern in LASIK surgery, and creating thin flaps is now critical leaving more stromal bed, and decreasing the incidence of post-LASIK ectasia; however, too-thin flaps are more liable for complications such as a free, irregular, incomplete, buttonhole, lacerated flap, or displaced flap. The femtosecond laser helped this new strategy to create thinner flaps with better predictability, and without such complication [6].

However, the flap shape is typically thicker in the periphery and thinner in the center with mechanical microkeratomes. These meniscus-shaped flaps increase the incidence of buttonhole perforation [2].

A deeper peripheral incision cuts more corneal lamellae and nerves while biomechanically destabilizing the cornea compared with a planar flap creation [3].

Different methods can be used to measure the flap thickness: AS-OCT, corneal topography using the scimflug image, and intraoperative ultrasound pachymetry.

In our study, AS-OCT (AS-OCT 3D OCT-2000 fluorescein angiography plus) was used to measure the flap thickness, being a noninvasive, noncontact, easy, and fast approach for measurement, and also a high-resolution image quality is obtained, but the field of image taken is 6 mm, so we could only measure the center and at 2 mm nasal and temporal. In comparison with the other studies, they used the Visante AS-OCT (Carl Zeiss, Meditec), which gives wider field (from limbus to limbus), so they could obtain more measurement points; however, it gives much less resolution.

In our study, the predictability of flap thickness was significantly higher in the Moria M290-created flaps than the M2110 with medlogic plano-created flaps. In the M2 group A, the mean±SD central flap thickness in the right eye was 137.7±10.9 (range, 125–164 μm), the mean±SD thickness at 2 mm nasal to the center was 135.9±6.4 μm (range, 125–160 μm), the mean±SD flap thickness at 2 mm temporal to the center was 137±9 μm (range, 125–163 μm), the mean±SD central flap thickness in left eye was 131.2±9.8 μm (range, 117–154 μm), the mean±SD thickness at 2 mm nasal to the center was 131.2±9.8 μm (range, 115–152 μm), the mean±SD flap thickness at 2 mm temporal to the center was 129.2±8.4 μm (range, 116–152 μm), the mean±SD flap thickness was 134.45±10.35 μm (range, 117–164 μm), and the deviation from the 110 μm intended flap thickness was 27.67±10.87 μm.

The mean±SD bed thickness in right eye was 337.6 ±34.36 μm (range, 278–400 μm) and the mean±SD bed thickness in left eye was 346±28.46 μm (range, 288–390 μm).

However, in the M2 (group B), the mean±SD central flap thickness in right eye was 118±11.6 μm (range, 99–145 μm), the mean±SD thickness at 2 mm nasal to the center was 118.4±11.9 μm (range, 95–145 μm), the mean±SD flap thickness at 2 mm temporal to the center was 118.5±11.9 μm (range, 96–144 μm), the mean±SD central flap thickness in left eye was 115.8±11.4 μm (range, 100–140 μm), the mean±SD thickness at 2 mm nasal to the center was 115.7±12.3 μm (range, 99–140 μm), the mean±SD flap thickness at 2 mm temporal to the center was115.9±11.6 μm (range, 100–139 μm), the mean±SD flap thickness was 116.9 ±11.5 μm (range, 99–145 μm), and the deviation from the 90 μm intended flap thickness was 28±11.67 μm.

The mean±SD bed thickness in right eye was 341.7 ±47.2 μm (range, 276–421 μm) and the mean±SD bed thickness in left eye was 346±48 μm (range, 290–430 μm).

In the study by Aslanides, the M2 single-use head tended to cut a flap thickness of (106±17 μm) than the manufacturer's indications (120 μm), although with a large range (65–152 μm). The M2 90 μm single-use head seems to cut thinner flaps with smaller variability.

The mean±SD flap thickness in the second (left) eye was ~5.5% thinner than in the first (right) eye (103_15 μm compared with 109_18 μm), which is in agreement with other studies. 17,19,20 Although no statistically significant difference (*P*=0.08) was noted between the first (right eye) and second (left eye) cut, and this may change with a larger number of eyes [7].

We did not find any study on Moria M2 110 with medlogic-10 head but found the following studies:

The study by Pietil evaluated flap creation in laser-assisted in-situ keratomileusis, from microkeratome to femtosecond laser. In this study, 300 eyes were treated with the Moria M2 single-use head 90 microkeratome, with the attempted flap thickness of 120 μm. Mean ±SD corneal thickness was 115.4±12.5 μm (range, 73–147 μm). Complications were observed in three (1.0%) eyes. Patient age showed negative correlation with flap thickness. Flap thickness was positively correlated with preoperative corneal thickness. In myopic eyes, flap thickness was not correlated with keratometric power K1, but in hyperopic eyes, increasing flap thickness was associated with flatter keratometric power K1. In clinical practice, single-use heads were easier to use, because they do not need any assembly. The translucent plastic single-use head provided a better observation view for the surgeon on the operated eye than the metallic head. The plastic head also worked more evenly than the metallic head.Moreover, 100 eyes underwent flap creation with the Moria M2 head 130 microkeratome (intended to create 160-μm corneal flap) adjusted with the single-use medlogics calibrated LASIK blade Minus 20 (ML-20 cohort), designed to create a flap of thickness 140 μm. The other 100 eyes were treated with the Moria M2 head 130 microkeratome adjusted with the medlogics calibrated LASIK blade Minus 30 (ML-30 cohort), designed to create a flap of thickness 130 μm. In ML-20-treated right eyes, the mean±SD corneal flap thickness was 129.1±15.6 μm (range, 104–165 μm). In ML-20-treated left eyes, the mean±SD flap thickness 111.5±14.5 μm (range, 78–144 μm). In ML-30-treated right eyes, the mean±SD flap thickness was 127.1±16.6 μm (range, 90–168 μm). In ML-30-treated left eyes, the mean±SD flap thickness was 109.9±16.8 μm (range, 72–149 μm). There was no clinically relevant difference in flap thickness between ML-20 and ML-30. For both cohorts, the difference between the first and second cuts was significant. The first flap was significantly thicker. There were no flap-related complications. Corneal flap thickness in ML-30-treated eyes correlated with corneal thickness, but not in ML-20-treated eyes. Flap thickness did not correlate significantly with age. Flap thickness was associated with keratometric power K1 in ML-30-treated eyes in both myopic and hyperopic eyes but not in myopic ML-20-treated eyes [8].

In another study by Du and colleagues comparing among three types of Moria, that s\is, One Use-Plus SBK, M2 90, or M2 110 head, the difference in mean ±SD flap thickness between right and left eyes was not significant in the SBK group (97.50±11.39 vs. 96.73 ±10.45 μm; P=0.44) but was significant in the M2 90 group (128.03±12.03 vs. 123.40±12.38 μm; P=0.0071) and the M2 110 group (140.53±15.14 vs. 135.23 ±18.03 μm; P=0.0035). The difference from the intended flap thickness (right eyes and left eyes) was 2.50±11.39 and 3.27±10.45 μm, respectively, in the SBK group; −8.03±12.03 and −3.40±12.38 μm, respectively, in the M2 90 group; and −0.53±15.14 and 4.77±18.03 μm, respectively, in the M2 110 group. Flap thickness was positively correlated with baseline CCT in each group, so the SBK head demonstrated the most accurate flap thickness, followed by the M2 90 head and the 110 head [9].

In another study by Pietila and colleagues on corneal flap thickness with the Moria M2 microkeratome and medlogics calibrated LASIK blades, in ML-20-treated right eyes, in which the intended corneal flap thickness was 140 μm, the mean±SD flap thickness was 129.1 ±15.6 μm. In ML-20-treated left eyes, the mean±SD flap thickness was 111.5±14.5 μm. In ML-30-treated right eyes, in which the intended corneal flap thickness was 130 μm, mean±SD flap thickness was 127.1 ±16.6 μm. In ML-30-treated left eyes, the mean±SD flap thickness was 109.9±16.8 μm [10].

Another study by Chen and colleagues compared flaps created using the One Use-Plus microkeratome in 82 eyes (41 patients) and the M2 90-μm microkeratome in 54 eyes (27 patients), using the Visante AS-OCT, at the center and 2 and 3.5 mm from the center, both nasal and temporal, and they found that the central flap thickness was 155.6±14.8, whereas it was dramatically thinner in the One Use-Plus group 114.7±10.1. In the One Use-Plus microkeratome, the flap thickness at 2 mm nasal and temporal was 110.8±11.6 and 111.7 ±9.4, respectively, at 3.5 mm nasal and temporal was 103.6±13 and 118.1±18.6, respectively, whereas in the M2 group, the mean±SD flap thickness at 2 mm nasal and temporal was 155.6±14.8 and 157.9±12.8 respectively, and at 3.5 mm nasal and temporal was 149.1±14.2 and 161.1±12.1, respectively [11].

Another study by Zhang and colleagues, which was a case-control study, 87 patients underwent LASIK in both eyes using Moria II 90 head (52 eyes, 26 cases), 110 head (58 eyes, 29 cases), or 130 head (64 eyes, 32 cases). One week after surgery, AS-OCT was performed four times on each eye to measure flap thickness at 20 points in four meridians. The results were assessed for accuracy, uniformity, and relevant factors [12].

The central thickness of corneal flaps was 119.23±15.65, 140.42±12.26, and 165.92±17.00 μm by Moria II 90, 110, and 130 heads, respectively. The shape of the corneal flaps in the three groups resembled a concave lens, and the central zone was significantly thinner than the paracentral and peripheral zones. The central flap thicknesses were statistically significantly more accurate and regular than the flap in the peripheral zone (F=212.419, P<0.05). The mean±SD difference of right eye (19.58±0.44 μm) was higher than that of the left eye (16.55±0.44 μm). The mean±SD difference of knife in-side (21.30± 0.55 μm) was higher than the knife out-side (14.36± 0.64 μm) (F=25.341, 44.461; P<0.05).

However, in our study, incomplete flaps, buttonholes and other microkeratome-related complications were not observed. The standard deviation was relatively small. Thick flaps can prevent appropriate laser ablation. In the present study, extraordinarily thick flaps, which may significantly reduce the thickness of the stromal tissue available for laser ablation, were created in few cases. Only in a few cases was the thickness of the remaining untouched stromal bed less than 300 μm.

This study evaluates the safety and efficiency of the Moria M2 90-μm single-use head. The M2 90-μm single-use head is a disposable unit made of plastic with several advantages over a conventional reusable microkeratome head. The most important is that a new sterilized head is provided for every patient, which eliminates the need for sterilization by the surgical facility, in turn avoiding possible contamination by microbial pathogens and bacterial endotoxins. Moreover, it requires minimal technical manipulation as the microkeratome blade is preassembled with the disposable head, and being in a special package, it can be mounted without being touched.

The benefits of a thicker stromal bed and the potential technical problems with ultra-thin flaps should be taken into consideration when selecting a microkeratome. In the hands of an experienced surgeon, treatment with the Moria M2 single-use head 90 microkeratome is a safe procedure, as shown in this study, in which no incomplete flaps, buttonholes, or other microkeratome-related complications were found, and finally, the AS-OCT is a subjective method of measurement, which differs from one observer to the other.

Conclusion

LASIK flaps created with the Moria M2 90 have thinner thickness, and more predictability and more perseverance of bed thickness than those created with the Moria M2 110 with medlogic-10 head.

Recommendations

We recommend comparing flaps created with Moria M2 90 head with the Moria One-Plus SBK, and with flaps created with femtosecond laser, and comparing the fore mentioned three groups as flap and bed thickness regarding other items as flap dimensions and regularity.

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Conflicts of interest

There are no conflicts of interest.

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