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Flap Thickness Measurement Using the Amadeus Microkeratome

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Abstract. To evaluate the predictability of flap thickness measurement with the 160 micron head of the Amadeus microkeratome and its complications. A retrospective study of 100 eyes underwent LASIK where the flap was created with the 160 microns head of the Amadeus microkeratome. The flap measurement was done by applying the ultrasonic pachymeter on the center of the cornea before and after the cut, the difference was considered the flap thickness. The mean flap thickness for the right eye was 167 ± 16 for the right eye, 154 ± 19 for the left eye. The flap thickness had a highly significant positive correlation (Pearson correlation) with the corneal thickness while no correlation was found with the spherical equivalent, keratometer readings and flap diameter. The second cut was found to be thinner than the first cut. The 160 microns head usually give within the range of this reading, but not less. The second cut is usually thinner. This data will help the user of the microkeratome to estimate the residual bed thickness to avoid post LASIK ablation complications.

Keywords: LASIK, Flap, Microkeratome, Amadeus.

Introduction

Laser-assisted in situ keratomileusis (LASIK) has become a standard procedure in refractive surgery and offers many advantages over

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photorefractive keratotomy[1-2]. However, the creation of a corneal flap was associated with a number of intraoperative complications (button hole, free cap, thin flap) or postoperative complications like flap striae, epithelial in growth[2]. This depends on the microkeratome and the different corneal parameters[3-5]. The Amadeus microkeratome flap measurements and its complications in a series of patients with myopia who had LASIK were evaluated.

Subjects and Method

A retrospective evaluation of 100 eyes was conducted for patients who underwent LASIK for myopia during year 2009 (cases where done in Dr. Erfan and Bagedo General Hospital and Eye Care Center in Jeddah, KSA). An exclusion criterion includes cornea with active or recurrent disease, corneal opacities, keratoconus and any local eye disease or systemic diseases that contraindicates refractive surgery.

All patients had a complete ophthalmological examination including cycloplegic refraction, corneal pachymetry, and corneal topography. The mean keratometric power of the 3 mm central cornea indicating the spherical equivalent power of the cornea within the 3 mm pupil zone was considered. Corneal thickness was determined as the mean of five measurements obtained from the center of the cornea by DGH pachymeter (DGH Technology, Inc, Exton, PA USA).

After obtaining informed consent and full procedure instructions, the patients had LASIK. All LASIK procedures were performed after an application of topical anesthesia (Benoxinate minims). The microkeratome handle was applied over the cornea with cent ration guided by the entrance pupil. The handle incorporate the motor and the suction ring as one assembled unit applied over the cornea. The manufacturer guidelines was followed for the 8.5 ring diameter of 8000/m blade oscillation, 2.5 mm/sec traverse speed and hinge width according to the keratometric readings (less than 42.25 width 1.0 mm, 42.5-45 width 0.8 and more than 45 widths 0.6 mm). Suction was applied till the unit indicated that a proper suction was achieved verified by applanation tonometer (65 mmHg). A single-use new blade was always used for both eyes, and the right eye was done first. Using the 160 mm plate, the motor was advanced and a nasal hinged lamellar flap was created. The ultrasonic pachymetry was applied on the center of the

cornea before flap creation and after flap creation on the central stromal bed on a dry surface. The differences between the two readings were considered the flap thickness. The length of the flap hinge and the maximum horizontal diameter was measured using a surgical caliper. Ablation was performed by the Allegretto wave light laser. The stromal bed was washed by balanced salt solution (BSS, Alcon Lab., Fort Worth, TX USA).

The flap was folded back in position, painted by a wet sponge to assure proper repositioning and was left to dry for two minutes. Eye protection was achieved by a transparent hard shield. Patients received Tobramycin, Dexamethasone Eye Drops, Ofloxacin 0.3% eye drops and preservative free tear natural for 15 days.

Patients were followed after one week, one month and three months for flap complications, refraction, visual acuity and pachymetry.

Results

The study included 100 eyes of 50 myopic patients. The average age of the patient was 23 years old (range from 19 to 42 years). The mean spherical equivalent for the right eye was 4.6 + 1.8 diopter (D) and for the left eye was 4.8 + 1.8 D. The mean keratometer reading for the right eye was 42.6 + 1.3 D in the flattest axis and 44.2 + 1.5 D in the steepest axis; for the left eye it was 41.9 + 1.6 D in the flattest axis and 43.9 + 1.8 D in the steepest axis. The mean corneal thickness for the right eye was 545.8 + 41 m and 544 + 40 m for the left eye. The mean flap diameter was 8.4 + 7 mm for the right eye and 8.4 + 6 mm for the left eye. The flap thickness measurement for the right eye was 167 + 16 m and 154 + 19 m for the left eye. Flap thickness had a highly significant positive correlation with corneal thickness (Right eye $r = 0.389$ $p = 0.005$, Left eye $r = 0.47$, $p = 0.001$).

A stepwise multiple regression formula was done to determine the joint contribution of the significant variables to flap thickness and corneal thickness was identified as the only specific predictor (Pearson correlation). There was no correlation with the spherical equivalent, keratometric reading and flap diameter (Table 1).

The microkeratome cut of the second eye gives usually a thinner flap in most of the cases.

Table 1. Correlation between flap thickness and different variables.

Variable	Pre-spherical Equivalent	Keratometry	Corneal Thickness	Flap Diameter
Flap Thickness				
r	0.316	0.073	**0.389***	0.128
p	0.206	0.612	**0.005**	0.375

Stepwise regression formula:
*Pearson correlation: * Correlation is significant at the 0.01 p level (2 – tailed)*

Discussion

An ideal microkeratome would consistently produce a corneal flap of desired thickness. Most surgeons use the microkeratome labeling and the laser ablation depth to preserve the standard 250 um of residual corneal tissue. The reproducibility of a determined flap thickness allows the surgeon to manipulate the parameter of the laser (optical zone, refraction) to be always in the safe residual corneal tissue.

This study, evaluates the 160 um head of the Amadeus microkeratome in relation to the corneal thickness, refraction, keratometric reading and flap diameter. The recommendations of the manufacture to fix the speed of oscillation, motor advancement speed, hinge diameter and suction power according to the keratometric reading was followed.

In this study, the positive correlation with the flap thickness was the corneal thickness (right eye: $r = 0.389$, $p = 0.005$, left eye: $r = 0.47$, $p = 0.001$). The other variables have shown poor colorations.

In other studies, using the Amadeus microkeratome was found that the only factor that significantly correlated with flap thickness was the flat keratometric value in the first eye. This correlation was low ($r = 0.15$) and did not find a statistically significant correlation with the corneal thickness, and it was explained that the control vacuum setting was used in an attempt to reduce flap thickness[6-7].

On the other hand, Yi and Joo using the SCMD® microkeratome noted a statistically significant positive correlation between flap thickness and corneal thickness ($r = 0.833$, $p = 0.001$)[8].

In a study using the Hansatome microkeratome it was found that a weak positive correlation between preoperative pachymetry and flap thickness. The reason for this may be related to the fact that thicker

cornea is more compressible than thinner cornea as shown experimental in rabbit[9].

There was a significant change between the second cut of the second eye, using the same blade. This was observed in multiple studies. This difference was attributed to the change in the sharpness of the blade. Several studies have shown that the blade edge sharpness deteriorated after multiple passes[10-12]. Another possibility is that salt crystal from the dried balance salt solution (BSS) may have affected the microkeratome performance on the second eye[11].

In this study, there was no flap complications attributed to the use of the microkeratome. The single piece design of the Amadeus microkeratome was easy to use, especially in eyes with narrow palpebral fissure. The flap diameter was sufficient to perform all ablation. The Amadeus microkeratome created a reproducible flap, the thickness was within the range of the reading 160 m head + 16 sd for the right eye and + 19 sd for the left eye. The surgeon has a good visibility of the corneal flap while performing the surgery, with the ability to abort the procedure in suspecting a complication. Flap thickness variation in LASIK plays an important role, mainly with high correction and thin cornea, because the residual corneal thickness is a crucial factor in preventing corneal ectasia[12-14]. Thicker cornea is prone to produce thicker flap with the Amadeus 160 m head, knowing your microkeratome performance with a specific head will guide the surgeon for a better postoperative results.

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قياس سمك رقعة القرنية بواسطة جهاز الأماديوي القاطع للقرنية

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المستخلص. الغرض من الدراسة تقييم مدى التنبؤ لسمك رقعة القرنية بواسطة القاطع للقرنية أماديوي بالرأس ١٦٠ ميكرون. بدراسة بأثر رجعي ل ١٠٠ عين، تم إجراء عملية الليزك، وتم رفع رقعة القرنية بجهاز الميكروكيراتوم نوع أماديوس بواسطة الرأس ١٦٠ ميكرون، وتم قياس سمك القرنية بالموجات فوق الصوتية قبل وبعد الرفع. متوسط سمك القرنية للعين اليمنى ١٦±١٦٧، و١٩±١٥٤ للعين اليسرى. وجه العلاقة الإحصائية بين سمك الرقعة وسمك القرنية أن سمك الرقعة أرقّ في العين الثانية دائمًا. الرأس ١٦٠ ميكرون عادة تقطع في حدود هذه القراءة، وليس أقل ولكن دائماً القطع الثاني يكون أرقّ.