بسم الله الرحمن الرحيم

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Comparison between Wavefront Guided and Wavefront Optimized LASIK as regards the Functional Optical Zone

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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List of Abbreviations

Abb.	Full term
APT	*Advanced Personalized Technology*
BCDVA	*Best corrected distance visual acuity*
Cpd	*Cycles per degree*
CTK	*Central toxic keratopathy*
CV LASIK	*CustomVue LASIK*
Cyc/deg	*Cycles per degree*
DLK	*Diffuse Lamellar Keratitis*
EBMD	*Epithelial basement membrane disease*
EKR	*Equivalent K reading*
EOZ	*Effective optical zone*
Epi-LASEK	*Epithelial LASEK*
Epi-LASIK	*Epithelial LASIK*
FLEx	*Femtosecond lenticule extraction*
FOZ	*Functional optical zone*
FOZ_A	*Functional optical zone Axial power method*
FOZ_M	*Functional optical zone Modulation transfer function method*
FOZ_R	*Functional optical zone Root Mean Square error method*
FS-LASIK	*Femtosecond laser in-situ keratomileusis*
GAT	*Goldmann applanation tonometer*
HOAs	*Higher-order aberrations*
HS	*Highly significant*
HSV	*Herpes simplex virus*
HZV	*Herpes zoster virus*
IHD	*Index of height decentration*
IOZ	*Intended optical zone*
ISV	*Index of surface variance*

List of Abbreviations *(Cont...)*

Abb.	Full term
LASEK	*Laser epithelial keratomileusis*
LASIK	*Laser in situ keratomileusis*
LOAs	*Lower order aberrations*
MRSE	*Manifest refraction spherical equivalent*
MTF	*Modulation Transfer Function*
NS	*Non significant*
OZ	*Optical zone*
PRK	*Photorefractive keratectomy*
Q value	*Corneal asphericity*
RGP	*Rigid gas permeable*
RMS	*Root-mean-square*
RMSho	*Root-mean-square of the higher order aberration*
S	*Significant*
SA	*Spherical aberration*
SmILE	*Small incision lenticule extraction*
Sph. Eq.	*Spherical equivalent*
TCRP	*Total corneal refractive power map*
T-PRK	*Transepithelial photorefractive keratectomy*
TZ	*Transition zone*
UDVA	*Uncorrected distance visual acuity*
WFG	*Wavefront-guided*
WFO	*Wavefront-optimized*
WO	*Wavefront-optimized*

ABSTRACT

PURPOSE: To compare between wavefront-guided (WFG) and wavefront-optimized (WFO) LASIK as regards functional optical zone (FOZ) in patients with myopia and myopic astigmatism.

METHODS: This is a prospective, comparative study. One hundred myopic eyes of 50 patients (± astigmatism) were divided into 2 groups according to laser platform; WFO & WFG where femtosecond assisted LASIK was performed. Using Holladay Equivalent K Reading (EKR) report of Pentacam; FOZ was defined as zone centered on pupil center with standard deviation 0.5D around mean EKR. Three months postoperatively differences in FOZ between two ablation patterns were analyzed. Visual acuity, refractive error, corneal asphericity (Q-value) and higher order aberrations root mean square (HOA RMS) error were evaluated.

RESULTS: Mean patients age was 26.64±5.67 years. Preoperative characteristics of eyes in 2 groups were not significantly different (P > 0.05). Intended optical zone (IOZ) was 6mm in both groups. Mean laser ablation depth was greater in the WFG (18 µm per diopter) than in WFO group (16µm per diopter) (P=0.035). After 3 months, FOZ diameters were 4.32±0.94 (71.99 ± 15.68 % of IOZ) for WFO & 4.16±1.13mm (69.33 ± 18.78 % of IOZ) for WFG, with no significant difference between 2 groups (P=0.622). Induced change in corneal asphericity was greater in WFG (P=0.034). Postoperative mean uncorrected distance visual acuity, manifest refraction, HOA showed no significant difference (P >0.05).

CONCLUSION: No significant postoperative difference was found between the WFO and WFG LASIK groups in FOZ size, refractive outcomes, HOA. Whereas, ablation depth and change in corneal asphericity were significantly greater in the WFG group.

Keywords: LASIK, Wavefront guided, Wavefront optimized, Functional optical zone

INTRODUCTION

Laser assisted in situ keratomileusis (LASIK) has been the most popular corneal refractive surgery for myopic correction in the past decade. One of the most interesting technical developments was the emergence of the new ultrashort-pulse lasers (femtosecond) which demonstrated more predictable flap thickness, an insignificant increase in higher-order aberrations (HOAs), better uncorrected visual acuity, and decreased epithelial injury relative to mechanical microkeratomes ***(Montés-Micó et al., 2007 and Lin et al., 2012).***

Conventional excimer laser treatment modalities are designed to address lower-order sphero-cylinder refractive errors changing the shape of the cornea from prolate to a more oblate profile. This led to an increase in the HOAs which can be associated with undesired symptoms such as glare, halos and starbursts and decrease in contrast sensitivity ***(Schallhorn et al., 2008).***

As a result, newer techniques emerged including wavefront-guided (WFG) and wavefront-optimized (WFO) ablations; which take into account the patient's prior HOAs. The WFG ablations are based on preoperative measures of HOAs and can produce a reduction in prior existing HOAs and less induction of new HOAs when compared to conventional treatment. The WFO ablations address variations in the corneal shape when eccentric laser pulses are applied. This decreases

the induction of an oblate profile as well as other HOAs during surgery ***(Kim & Chuck, 2008 and Perez-Straziota et al., 2009).***

Several studies comparing LASIK surgery outcome using different excimer laser platforms have yielded mixed results, several of which have shown no difference between them ***(Yu & Manche, 2014 and He et al., 2014).***

The Pentacam designed on the Schiempflug photography principle is a non-invasive camera, designed to capture images of the anterior segment of the eye and to produce a comprehensive analysis of the cornea and its densitometry, ***(Alzahrani et al., 2017).***

By using Pentacam, it was possible to measure the FOZ (FOZ) of the cornea which is the central cornea with the highest level of optical quality, contrast sensitivity and minimal aberrations. It is measured by using the uniform axial power method, which defines it as the area of the postoperative cornea within a ±0.5D window centered on the mathematical mode ***(Tabernero et al., 2007 and Nepomuceno et al., 2005).***

How closely the results of LASIK surgery using different machines corresponded to the intended correction is not well defined by traditional measures of postoperative refraction and measures of visual acuity. In our study, we are going to compare between 2 different laser platforms (WFG and WFO) by measuring the FOZ after LASIK correction for mild to moderate myopia and myopic astigmatism using the pentacam, which has not been done before.