Effect of Femtosecond Lasik for Myopes on Corneal Hysteresis and Tonometry

Thesis

Submitted for Partial Fulfillment of
Master Degree in **Ophthalmology**

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Cairo, Egypt
2019

بسم الله الرحمن الرحيم

وَلَقَدْ آتَيْنَا دَاوُودَ وَسُلَيْمَانَ عِلْمًا وَقَالَا

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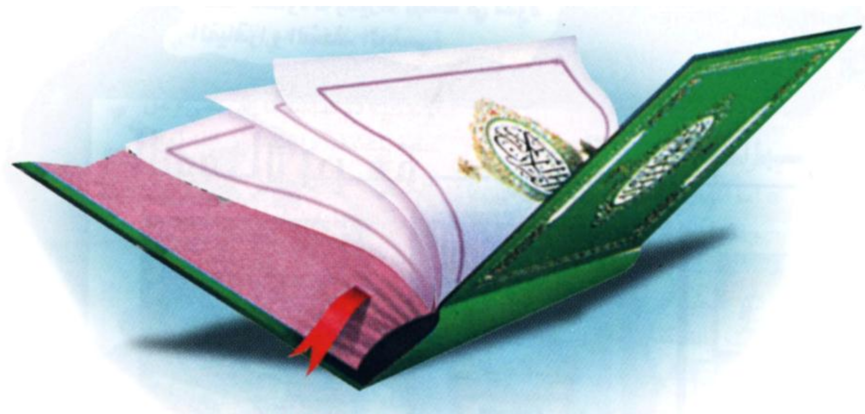

صدق الله العظيم

[سورة: النمل - الآية: ١٥]

Acknowledgments

First and foremost, I feel always indebted to **Allah** the Most Beneficent and Merciful.

*I wish to express my deepest thanks, gratitude and appreciation to **Prof. Dr. Sherif Zaki Mansour**, Professor of Ophthalmology, Faculty of Medicine, Ain Shams University, for his meticulous supervision, kind guidance, valuable instructions and generous help.*

*Special thanks are to **Prof. Dr. Thanaa Helmy Mohamed**, Professor of Ophthalmology, Faculty of Medicine, Ain Shams University, for her sincere efforts, fruitful encouragement.*

*I am deeply thankful to **Dr. Hisham Samy Saad-Eldin**, Lecturer of Ophthalmology, Faculty of Medicine, Ain Shams University, for his great help, outstanding support, active participation and guidance.*

I would like to express my hearty thanks to all my family for their support till this work was completed.

Engy Mahmoud Awadallah

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List of Abbreviations

Abb.	Full term
BSCVA	*Best spectacle corrected visual acuity*
C/D ratio	*Cup / Disc ratio*
CCT	*Central corneal thickness*
CH	*Corneal hysteresis*
CRF	*Corneal resistance factor*
Femto-LASIK	*Femtosecond laser assisted in situ keratomileusis*
FFKC	*Forme fruste keratoconus*
FLEx	*Femtosecond Lenticule Extreaction*
FS	*Femto-Second.*
GAT	*Goldman applanation tonometry*
HOA	*High Order Aberrations*
IOP	*Intraocular pressure*
IOP-CC	*Intraocular pressure cornea compensated*
IOP-G	*Intraocular pressure Goldman equivalent*
KC	*Keratoconus*
LASEK	*Laser assisted sub-epithelial keratectomy*
LASIK	*Laser-assisted in situ keratomileusis*
MRSE	*Manifest Refraction Spherical Equivalent*
ORA	*Ocular Response Analyzer*
PRK	*Photorefractive keratectomy*
SD	*Standard Deviation*
SE	*Spherical Equivalent*
SMILE	*Small Incision Lenticule Extraction.*
UCDVA	*Uncorrected distal visual acuity*

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INTRODUCTION

Near-sightedness, also known as short-sightedness and myopia, is a condition of the eye where light focuses in front of, instead of on, the retina.[1] This causes distant objects to be blurry while close objects appear normal.[1] Other symptoms may include headaches and eye strain.[1] Severe near-sightedness increases the risk of retinal detachment, cataracts, and glaucoma.[2]

The underlying cause is believed to be a combination of genetic and environmental factors.[2] Risk factors include doing work that involves focusing on close objects, greater time spent indoors, and a family history of the condition.[2][3] It is also associated with a high socioeconomic class.[2] The underlying mechanism involves the length of the eyeball growing too long or less commonly the lens being too strong.[1][4] It is a type of refractive error.[1] Diagnosis is by eye examination.[1]

Near-sightedness is the most common eye problem and is estimated to affect 1.5 billion people (22% of the population).[2][5] Rates vary significantly in different areas of the world.[2] Rates among adults are between 15 and 49%.[3][6] Rates are similar in males and females.[6] Among children it affects 1% of rural Nepalese, 4% of South Africans, 12% of Americans, and 37% in some large Chinese cities.[2][3]

LASIK surgery is widely used in the correction of refractive errors and involves the creation of an anterior lamella, followed by stromal photoablation using an excimer laser. (7)

The creation of this lamella is an important step in the surgical procedure and can be performed by two methods: the mechanical microkeratome and the femtosecond (FS) laser microkeratome. (FS) **LASIK: the most modern method of refractive correction exclusively with laser use.** **(7)**

Institute of vision &optics, uses the latest technology for the creation of the surface petal (flap) for LASIK: **the last generation laser iFS Advanced Femtosecond Laser and the newly arrived** Femtosecond Laser 200 Hz Alcon Wavelight. This laser replaces the use of the mechanical microkeratome for the creation of the flap. (8)

One of the advantages of this laser is the precision of the incision with characteristics and dimensions that the surgeon selects, depending on the particular anatomy of each patients' eye. Subsequently the surgeon uses a laser beam to change the curvature of cornea as in the conventional LASIK and to correct the refractive error of the eye. The rehabilitation of the visual acuity is immediate, hence the patients can see clearly after surgery. The procedure lasts a few minutes for each eye and it is conducted under local anesthesia. (8)

Hysteresis is defined as the lag between making a change, such as increasing or decreasing power, and the response or effect of that change. Reichert Ophthalmic Instruments (Depew, N.Y.) has developed the Ocular Response Analyzer (ORA) to measure the biomechanics of the cornea and specifically the corneal hysteresis. The Reichert ORA employs a dynamic bidirectional applanation process to measure Intraocular pressure (IOP) and the cornea's biomechanical properties. [9]

According to Luce, ORA uses a rapid air impulse and an advanced electro-optical system to record two applanation pressure measurements: one while the cornea is moving inward and the other as the cornea returns. Because of its complex viscoelastic structure, the cornea resists the dynamic force of the air pulse, causing a delay in the inward and outward applanation events, resulting in two different pressure values. The average of these two pressure values provides a repeatable Goldmann-correlated IOP measurement. The difference between these two pressures values is corneal hysteresis. The corneal hysteresis measurement indicates the viscous damping in the cornea or the ability of the tissue to absorb and dissipate energy.[9]

The repeatability of the corneal hysteresis provides practitioners an opportunity to quantify the biomechanical nature of the cornea before refractive surgery and thus detect any anomalies. [9] ORA is an instrument designed for tonometry as well as for measurement of corneal biomechanical properties. Several studies have proven the usefulness of the ORA in detecting biomechanical changes related to aging, smoking,[10] and corneal refractive procedures,[11,12] as well as to different pathologic conditions including keratoconus,[13,14] Fuchs dystrophy [15] and diabetes mellitus.[16] Several studies [17,18] have shown that corneal thickness affects the measurement of IOP.

AIM OF THE WORK

- The aim of the present study is to quantify the biomechanical effects of Femtosecond LASIK for myopes using the Ocular Response Analyzer.

- In addition the effect of Femtosecond LASIK treatment on Intra Ocular pressure measurement values will be assesed using (Ocular Response Analyzer) and The Goldmann tonometer (GAT).

REVIEW OF LITERATURE

1. Corneal anatomy

The cornea is a transparent avascular tissue with a smooth, convex surface and concave inner surface, which resembles a small watch-glass. The main function of the cornea is optical; it forms the principal refractive surface, accounting for some 70% (40-45 diopters) of the total refractive power of the eye. Refractive requirements are met by the regular anterior curvature of the cornea and the optically smooth quality of the overlying tear film. Transparency of the corneal stroma is achieved by the regularity and fineness of its collagen fibrils and the closeness and homogeneity of their packing. Water is constantly pumped out of the cornea by its posterior layer, the endothelium. This maintains the optical homogeneity of the corneal layers and prevents swelling and clouding. [19]

The anterior surface of the cornea appears elliptical, being about 11.7 mm wide in the horizontal meridian and 10.6 mm in the vertical meridian in adults. [19]

The posterior surface of the cornea appears circular, about 11.7 mm in diameter. In the optical zone, the radius of curvature of the anterior surface is about 7.8 mm and that of the posterior 6.5 mm, in adult males. The normal cornea is generally prolate, with steeper curvature centrally and relatively flatter peripheral. [20]