WAVEFRONT CUSTOMIZED LASIK

Essay

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A°	Angstrom=0.1nanometer
HOA	Higher order aberration
WFG LASIK	Wavefront guided Lasik
LASIK	LASER in situ keratomileusis.
RMS	Root mean square**.**
BCVA	Best corrected visual acuity**.**
UCVA	Uncorrected visual acuity.
PRK	photorefractive keratectomy
FDA	The US food and drug administration
CIPTA	Corneal Interactive Programmed Topographic Ablation
C-CAP	Custom Contoured Ablation Pattern
OPD	optical path difference

AIM OF THE WORK

To review the literature concerning the advantages and disadvantages of wavefront customized Lasik in refractive surgery in comparison to conventional Lasik.

Introduction

The cornea is the major refractive component of the human eye, contributing approximately two thirds of the eye's optical power. The maximum refraction in the eye occurs at the anterior surface of cornea due to its high curvature and due to the large difference between the refractive indices of media on its two sides. (duke, 1970) .

The ideal optical shape of the anterior surface of the cornea is a prolate ellipsoid. Notwithstanding, there are wide variations in shape producing common aberrations such as astigmatism. Deviations from this ideal optical shape provoke significant amounts of asymmetric aberrations that cannot be corrected with traditional spectacles. To know exactly the shape of the corneal surface is important for several reasons: that is, corneal refractive surgery and contact lens design or fitting require accurate modeling of this surface. In both cases, characterization of corneal shape by means of topography is necessary to ensure good optical and visual outcomes after these procedures. (Benjamin and Boyd 2003)

Corneal topography provides the needed data to determine the optical quality of the cornea. Both using Fourier analysis, which allows to quantify the irregularity level of the cornea by dividing its regular and irregular power components, and by means of the Zernike polynomial expansion. , which inform us about the different corneal aberrations which divided into low order aberration (spherical error & astigmitsm) & high order aberration (spherical aberration & coma). (Benjamin and Boyd ,2003)

These low order aberration were treated by spectacles over the last 1000 years. Contact lenses have been an alternative over the last 65 years. Radial keratotomy (RK) and laser in situ keratomileusis (LASIK) offered an alternative which treated spherical and cylindrical aberrations ***(Ronal et al., 2001)***.

Conventional LASIK applies a simple spherocylindrical correction based on the removal of tissue using Munnerlyn's equation ***(Munnertomy et al., 2004)***.

It has been observed that conventional LASIK which treat myopia induces positive spherical aberration dependent on the amount of attempted correction ***(Hollday and Janes,2002)***.

Topography-guided LASIK uses information from both the corneal shape and the spherocylindrical correction to determine the excimer laser ablation profile ***(Knorz and Jendritza, 2000)***.

Wavefront-optimized LASIK is a treatment profile designed to reduce or eliminate the induced spherical aberration of conventional LASIK.The wavefront-optimized treatment is based on a spherocylindrical correction that is adjusted by an internal algorithm to remove additional tissue in the periphery of the ablation zone, thereby creating a more prolate corneal shape ***(El-Danasoury and Bains, 2005)***.

Wavefront-guided (WFG) LASIK, also called custom LASIK, is a variation of the surgery in which the excimer laser is instructed to ablate a sophisticated pattern based on measurements from an aberrometer ***(Munnertomy et al., 2004)***.

Although both wavefront-guided and wavefront-optimized LASIK gave excellent refractive correction results, the former induced less higher-order aberrations and was associated with better contrast sensitivity ***(Prema Padmanablhan et al., 2008)***.

The measurement of central corneal thickness is an important element of the preoperative evaluation for LASIK and even more important for WFG procedures because WFG LASIK tends to remove more stromal tissue than conventional treatments ***(Schallhorn,2008)***

WFG LASIK is safe and effective for the correction of primary myopia or primary myopia and astigmatism and that there is a high level of patient satisfaction. The WFG procedure seems to have similar or better refractive accuracy compared with conventional LASIK. Likewise, there is evidence of improved contrast sensitivity and fewer visual symptoms, such as glare and halos at night, compared with conventional Lasik . No long-term assessment of WFG LASIK was possible because of the relatively short follow-up (12 months or fewer) of most of the studies reviewed ***(Steven, 2008)***.

CHAPTER 1
ANATOMY OF THE CORNEA

The cornea is a clear, transparent, colorless avascular structure richly supplied with sensory nerve endings that generally subserve touch and pain. It covers the anterior one-sixth of the total circumference of the globe (William et al., 2007).

Corneal shape and its surfaces

Normal cornea is a prolate surface, i.e. steeper in the centre than in the periphery. Oblate surface e.g. cornea after Lasik for myopia is flatter in the center than in the periphery.

The anterior corneal surface is aspheric with a central radius of 7.8 mm and a variably less steep peripheral corneal curvature; however, the posterior corneal surface is essentially spherical with a radius of curvature of 6.7 mm. (Fedoral et al., 2006)

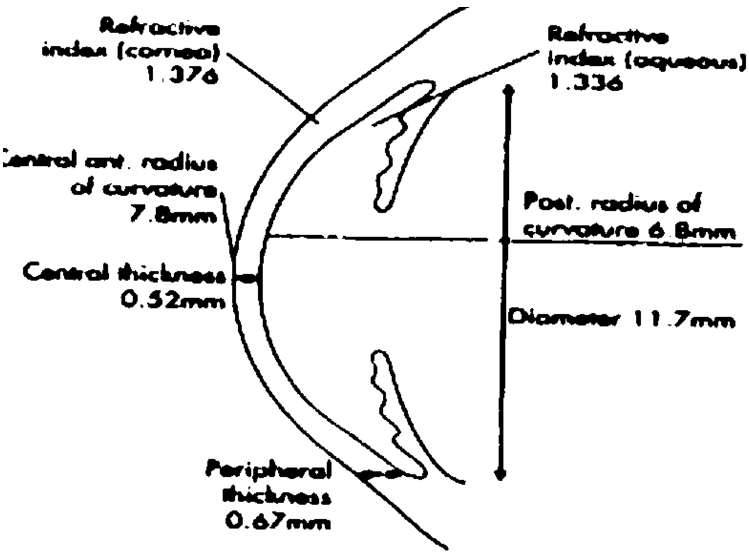

Figure 1: gross anatomy of the cornea. (McGhee, 1997)

Corneal diameter

The external dimensions of the cornea are 11.6 to 12.6 mm horizontally and 10.6 to 11.7 mm vertically. These measurements are approximately 0.1 mm less in females. When viewed from the anterior surface, the cornea is oval (William et al., 2007).

Corneal thickness

The average central corneal thickness is approximately 550 micrometer. The average thickness in temporal, nasal, inferior, and superior quadrants of the cornea was 590, 610, 630, and 640 micrometers respectively. The thinnest site on the entire cornea is located on an average 0.9 mm from the visual axis most commonly in the inferotemporal quadrant. (Fedoral et al., 2006)

Corneal power

Along with the precorneal tear film, the cornea forms the major refracting surface for the eye. The interface between the corneal tear film and the ambient atmosphere provides roughly two-thirds of the refractive power of the human eye. The precorneal tear film is approximately 7 µm thick with a volume of 6.2 ± 2 µL during normal tear production. The average index of refraction of the cornea and tear film taken as a whole is about 1.376. The refractive power for the anterior surface of the cornea is 48.2. The posterior surface of the cornea is bathed with aqueous humor with an optical power -6.2. Therefore, the total optical power of the cornea is 48.2 - 6.2, or approximately 42.0 D, which is about two-thirds of the 60.0 D of total optical power of the human eye. Several surgical procedures have been developed to permanently alter the curvature of the cornea, thereby reducing non pathologic refractive errors. (William et al., 2007).

Corneal zones

Clinically, the cornea is divided into zones that surround fixation line and blend into one another.

A-The central zone: it is 1-2 mm closely fits a spherical surface.

B-The paracentral zone: it is adjacent to the central zone which is a 3-4 mm doughnut with an outer diameter of 7-8 mm. It represents an area of progressive flattening from the centre.

Together, the paracentral and central zones constitute the apical zone as used in contact lens fitting.

C-The peripheral zone: it is adjacent to the paracentral zone is with an outer diameter of approximately 11 mm.

D-The limbus with an outer diameter of approximately 12 mm.

The central and paracentral zones are primarily responsible for the refractive power of the cornea. (Krachmer et al., 1997)

The peripheral zone is also known as the transitional zone as it is the area of greatest flattening and asphericity of the normal cornea.

The limbal zone lies adjacent to the sclera and is the area where the cornea steepens prior to joining the sclera at the limbal sulcus. (Krachmer et al., 1997)

The optical zone is the portion of the cornea that overlies the entrance pupil of the iris. It is physiologically limited to 5.4 mm because of Stiles-Crowford effect.

The corneal apex is the point of maximal curvature typically temporal to the centre of the pupil. The corneal vertex is the centre of the keratoscopic image that does not necessarily correspond to the point of maximal curvature at the corneal apex. (Leibowitz and Warning., 1998)

Microscopic anatomy:

The cornea consists of five layers as shown in figure 2: Epithelium; Bowman's layer; stroma; Descemet's membrane; and endothelium. (Tasman et al., 2007).

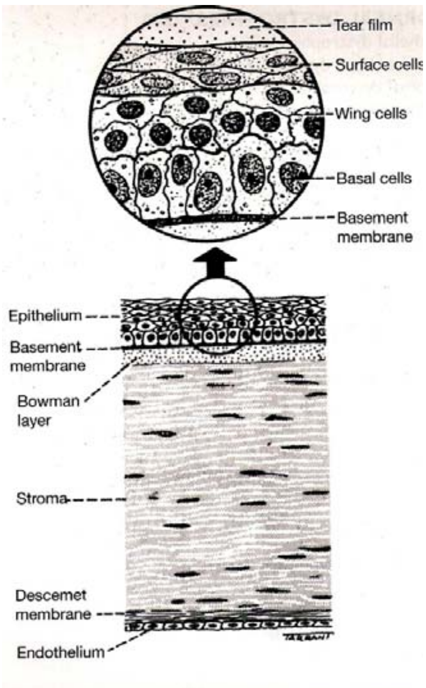

Figure 2: Microscopic anatomy of the human cornea. (Kanski, 2008).