POST LASIK DRY EYE

Essay
Submitted for partial fulfillment of Master Degree in Ophthalmology

By
Amira Hamada Ahmed Taha
M.B.,B.Ch.
Faculty of Medicine Mansoura University

Supervised by

Prof. Dr. Hussein Shaker EL-Markaby
Professor of Ophthalmology
Faculty of Medicine
Ain Shams University

Prof. Dr. Tamer Mohamed EL-Raggal
Professor of Ophthalmology
Faculty of Medicine
Ain Shams University

Faculty of Medicine
Ain Shams University
2014

Acknowledgement

All my appreciation, utmost respect to ***Prof. Dr. Hussein Shaker El-Markaby*** Professor of Ophthalmology, Faculty of Medicine, Ain Shams University for his kind supervision and fruitful suggestions.

I also would like to express my special thanks and gratitude *to* ***Prof. Dr. Tamer Mohamed EL-Raggal*** professor of Ophthalmology, Faculty of Medicine, Ain Shams University for his patience, meticulous supervision and unlimited willingness for guiding.

Lastly, I wish to extend my sincere thanks to all my family and colleagues who have continued to support me spiritually and provide valuable advice to guide me to the correct path throughout this study.

Amira Hamada Taha

Contents

List of Abbreviations

BAK	**Benzalkonium chloride**
BCVA	**Best corrected visual acuity**
BUT	**Break up time**
CN V	**Trigeminal cranial nerve**
CN VII	**Facial cranial nerve**
DED	**Dry eye disease**
EGF	**Epidermal growth factor**
ELISA	**Enzyme-linked immunosorbent assay**
HGF	**Hepatocyte growth factor**
IBI	**Inter blink interval**
IL-1a	**Interleukin -1a**
IL-1b	**Interleukin-1b**
IVCM	**In vivo confocal microscopy**
LASIK	**Laser in situ keratomileusis**
LFU	**Lacrimal function unit**
MGD	**Meibomian gland dysfunction**
MMP	**Matrix metalloproteinases**
MUC1-9	**Mucin types**
MUC5AC	**The gel-forming mucin**
NIBUT	**Non-invasive break up time**

NFB	**Nerve fibers bundle**
OCP	**Occular cicatricial pemphigoid**
OPI	**Ocular protection index**
PRK	**Photorefractive keratectomy**
SS	**Sjögren syndrome**
UCVA	**Uncorrected visual acuity**

List of Figures

List of Tables

Introduction

LASIK is nowadays the most commonly performed procedure in refractive surgery and the first choice for the correction of refractive errors in the majority of patients. However, patients subjected to LASIK surgery often report dry eye symptoms postoperatively, and tear fluid abnormalities are frequently described These symptoms are the most common adverse effects of LASIK, causing frustration for both patients and surgeons alike ***(Sugar et al, 2002).***

A definition of dry eye was recently produced by the International Dry Eye WorkShop (DEWS, 2007): "Dry eye is a multifactorial disease of tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface ***(Lemp et al, 2007).***

The incidence of dry eye after LASIK has been estimated to range between 5% and 52% among Caucasian patients, with a higher reported incidence among Asians. It is transitory condition, which typically resolves within 6–9 months after surgery ***(De Paiva et al, 2006).***

Dry eye symptoms include ocular burning, a sensation of sandiness in the eye, blurred vision, photosensitivity and ocular fatigue ***(Salib et al, 2006).***

Clinical signs of dry eye include decreased aqueous tear production, decreased tear volume on the ocular surface, increased rate of tear evaporation and increased tear osmolarity. The patients feel a real

discomfort impairing the quality of vision. There is often a mismatch noted between the severity of signs and symptoms in patients with dry eyes ***(Shoja et al, 2007).***

Dry eye disease has a complex and multifactorial etiology. The ocular surface and the lacrimal gland are a functional unit that work together to maintain the tear film and ocular surface environment . Specifically, there is a complex interaction between the afferent sensory nerves of the ocular surface and the efferent autonomic nerves to the lacrimal gland that modulate both tear composition and secretion. Any factor that disrupts this relationship will lead to tear dysfunction and an increase in the concentration of the tear film (hyperosmolarity) that has been shown to cause inflammation and apoptosis of the epithelium leading to LASIK-induced neurotrophic epitheliopathy (LINE) ***(Solomon et al, 2004).***

There are multiple theories describe how LASIK contributes to the pathophysiology of dry eyes. The main proposed cause is iatrogenic corneal nerve damage. LASIK disrupts both the dense sub-basal nerve plexus and stromal corneal nerves in the creation of the anterior stromal flap and excimer laser ablation of the cornea. Loss of conjunctival goblet cells has also been identified after LASIK, likely due to direct damage from the suction device used during creation of the LASIK flap. Other issues potentially contributing to dry eye symptoms after LASIK include differences in corneal curvature; while normal corneas show prolate profiles (steeper in the center), conventional myopic LASIK produces oblate corneas. These changes in corneal curvature may interfere with even tear distribution. Moreover, patients who seek refractive surgery are often

contact lens intolerant and may have preclinical dry eye before surgery ***(Rodriguez et al, 2007).***

Several preoperative risk factors have been correlated with the development of dry eye after LASIK (female gender, race, preexisting dry eye syndrome)as well as intraoperative (including ablation depth, hinge orientation (superior or nasal), hinge width and flap thickness) ***(Shoja et al, 2007).***

Understanding these risk factors and preoperative identification of patients at risk for severe post-LASIK dry eye is important to optimize surgical outcome. Prior to surgery, LASIK candidates should have a thorough examination, including detailed evaluation of the ocular surface and careful questioning about dry eye symptoms. This can assist the refractive surgeon in selecting effective strategies to optimize the ocular surface prior to surgery, which in turn can result in improved refractive outcomes ***(Suzuki et al, 2010).***

Treatment strategies for dry eye vary widely among ophthalmologists. Lubrication of the ocular surface is a mainstay of treatment of LASIK-induced dry eye prior to and after surgery. Lubrication of the ocular surface with non-preserved artificial tears may improve the corneal microenvironment and lead to a reduction of dry eye symptoms before and after LASIK. Cyclosporine A and punctal plugs may be a helpful addition to augment treatment. Autologous serum drops and gas-permeable scleral contact lenses or goggles, can be used as a last resort for extreme cases ***(Salib et al, 2006).***

Aim of the Work

The aim of this work is to review the causes of post LASIK dry eye and its effect on the quality of life and recent treatment modalities that can increase the satisfaction of both patient and surgeon.

Anatomy of the Cornea

Cornea covers the anterior one-sixth of the total circumference of the globe, whereas the sclera covers the remaining five-sixths. The cornea is a clear, transparent, colorless avascular structure richly supplied with sensory nerve endings. Due to the avascular nature of the cornea, much of its oxygen requirement for metabolic activities comes from atmospheric oxygen dissolved in the tear film. When the eyelids are closed, oxygen can also predominantly enter the tear film from the superficial conjunctival capillaries ***(William et al., 2007).***

The main function of the cornea is optical; it forms the principal refractive surface, accounting for 70% (40-45diopters) of the total refractive power of the eye ***(Charman, 1991).***

Refractive requirements are met by regular anterior curvature of the cornea and optically smooth quality of the overlying tear film. Transparency of the corneal stroma is achieved by 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, endothelium. This maintains the optical homogeneity of the corneal layers and prevents swelling and clouding. The curvature of the cornea is greater than that of the sclera so that a slight external furrow (sulcus sclerae) separate it from the sclera ***(Kaufman et al., 1998).***

The axial thickness of the cornea is 0.50 mm with peripheral thickness of 0.7 mm (figure 1). In front the cornea appears elliptical, being 11.7mm wide in the horizontal meridian and 10.6mm in the vertical. The posterior surface of the cornea appears circular, about

11.7mm in diameter (figure 2). This difference is due to overlap of the sclera and conjunctiva ٧above and below than laterally. The cornea forms part of what is almost a sphere, but it is usually more curved in the vertical than the horizontal meridian, giving rise to astigmatism "with the rule" ***(Coster et al., 2002)***.

Dimensions:

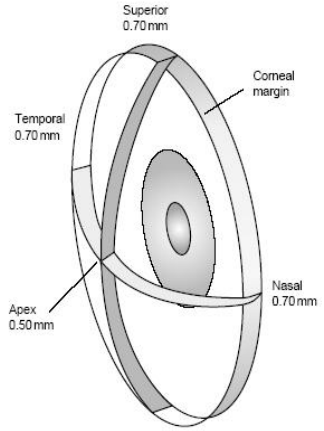

Figure (1)*: The cornea is thicker at the periphery than it is centrally* ***(Coster et al., 2002)***.

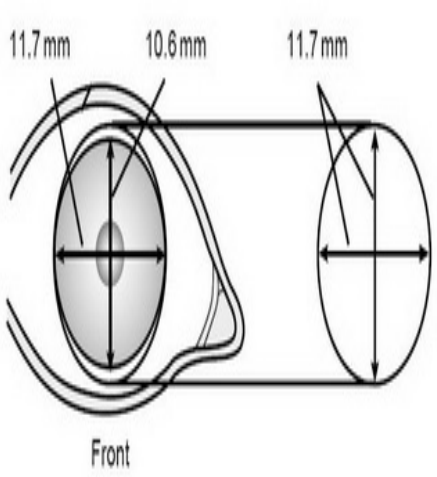

Figure (2): *Dimensions of the normal adult cornea(****Coster et al., 2002)***.

Surface Zones of the Cornea:

The corneal surface can be divided into four anatomical zones (figure 3). The central (optical) zone, the paracentral zone, the peripheral zone and the limbal zone ***(Bores et al., 1993).***

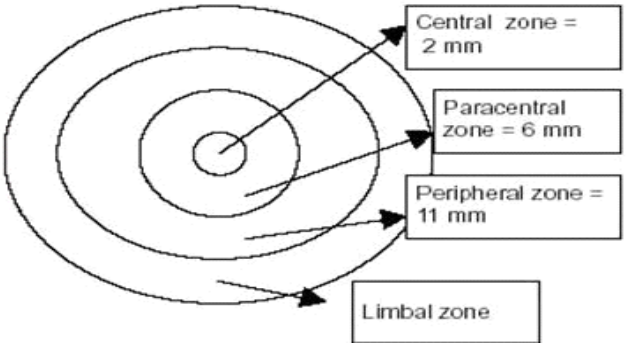

Figure (3): *Surface zones of the cornea* ***(Bores et al., 1993).***

The central Zone of the cornea, is 2-4 mm in diameter overlaid the entrance of the pupil where it represents the most spherical area of the cornea and determines the high-resolution image formation on the fovea hence it is the portion for laser ablation in corneal refractive surgery. Followed by paracentral zone which also called mid, intermediate or mid peripheral zone. It is 6-8 mm in diameter. Peripheral zone called transitional zone, is 7-11 mm in diameter. And limbal zone is 11.5-12 mm in diameter ***(Bores et al., 1993).***

Microscopic Anatomy:

The cornea can be divided into five layers (figure 4): the epithelium, bowman's layer, stroma, Descemet's membrane, and the endothelium. Although the preocular tear film is not part of the cornea, it is intimately associated with the cornea anatomically and functionally ***(Yanoff et al., 2003).***